



DProf thesis

Sustainable urban waste management through the lens of service users

Oluwadipe, S.O.

Full bibliographic citation: Oluwadipe, S.O. 2023. Sustainable urban waste management through the lens of service users. DProf thesis Middlesex University

Year: 2023

Publisher: Middlesex University Research Repository

Available online: <https://repository.mdx.ac.uk/item/1w4qy7>

Middlesex University Research Repository makes the University's research available electronically.

Copyright and moral rights to this work are retained by the author and/or other copyright owners unless otherwise stated. The work is supplied on the understanding that any use for commercial gain is strictly forbidden. A copy may be downloaded for personal, non-commercial, research or study without prior permission and without charge.

Works, including theses and research projects, may not be reproduced in any format or medium, or extensive quotations taken from them, or their content changed in any way, without first obtaining permission in writing from the copyright holder(s). They may not be sold or exploited commercially in any format or medium without the prior written permission of the copyright holder(s).

Full bibliographic details must be given when referring to, or quoting from full items including the author's name, the title of the work, publication details where relevant

(place, publisher, date), pagination, and for theses or dissertations the awarding institution, the degree type awarded, and the date of the award.

If you believe that any material held in the repository infringes copyright law, please contact the Repository Team at Middlesex University via the following email address: repository@mdx.ac.uk

The item will be removed from the repository while any claim is being investigated.

See also repository copyright: re-use policy: <https://libguides.mdx.ac.uk/repository>

**Sustainable Urban Waste
Management Through the Lens of
Service Users**

Saeed Olaniyi Oluwadipe

M00661269

Department of Natural Sciences
Faculty of Science and Technology

September 2023

A project submitted to Middlesex
University in partial fulfilment of the
requirements for the degree of
Doctor of Professional Studies

ACKNOWLEDGEMENTS

Firstly, I thank almighty Allah for his infinity wisdom and mercy in allowing me to complete this project. I thank my family (Dad, Mum, Ismail, Basirat, Mariam, Rasidat, Yusuf, Yassin, Morenike, Arike, Saidah, and Abdul Akeem) for their support and patience especially my wife Bola. My thanks to my superb supervisors, Professor Diane Purchase, Professor Hemda Garelick, Dr Simon McCarthy, and Dr Huw Jones for their relentless support, patience, and guidance in completing the research.

My thanks also go to all friends and work colleagues who have supported me through this academic journey not to mention my line manager Sean Dwyer and John Curnow-Baker who made this project possible in helping with the funding grant from the Westminster City Council (WCC) and colleagues in WCC Highways Planning Team for their support.

I also want to specifically thank all my work colleagues in Westminster City Council and the Recycling Team who helped in the data collection. Final thanks to Loy Phillips, Mahbuba Khan and Brendon Harper for their valuable time and input.

Glossary

BBC	British Broadcasting Corporation
BSDA	British Soft Drinks Association
CIWM	Chartered Institute of Waste Management
DEFRA	Department for Environment, Food and Rural Affairs
DRS	Deposit Return Scheme
ERB	Environmentally Responsible Behaviour
EU	European Union
GLA	Greater London Authority
ISWA	International Solid Waste Association
LWARB	London Waste and Recycling Board
MBT	Mechanical Biological Treatment
MRC	Micro Recycling Centres
MWMS	Municipal Waste Management Strategy
PET	Polyethylene Terephthalate
SCT	Social Cognitive Theory
SISDS	Small Islands Developing States
UK	United Kingdom
UNEP	United Nations Environment Programme
WCC	Westminster City Council
WFD	Waste Framework Directive
WRAP	Waste and Resources Action Programme

Abstract

The Westminster City Council (London, UK) recycling rate has been fluctuating between 19% and 25% over a ten-year period from 2011 to 2021, which is below the 50% threshold target for household waste set by the UK government. This research aimed to investigate the issues surrounding the low recycling rate to inform the design and implementation of an effective waste management policy. The key research questions are: what are the barriers to achieving a high recycling rate in the City of Westminster and how can these barriers be removed? The research used mixed methods to collect data through residents' online surveys, residents' interviews, and council staff interviews. The quantitative analysis revealed that age, education, and type of residence have an impact on the survey respondents' recycling activities. While the results of the merged qualitative analysis of the residents' interviews and the staff interviews indicate that the following factors are affecting the council recycling rate: physical factors, communication, public engagement, human factors, service constraints, and policy constraints. Findings from the research allowed a sustainable recycling indicator (simplified model) to emerge as a functional tool to increase the council recycling rate. It is concluded that despite positive human behaviours, most of the residents surveyed or interviewed continued to face situational barriers bordering on physical factors and the level of recycling service provided by the council has affected the council recycling rate. The sustainable recycling indicator provides opportunities for the council and other urban local authorities to increase their recycling rate. Suggestions to improve the recycling rate were categorised into three groups under the local waste planning policy, recycling service, and national waste legislation. These recommendations are mainly centred on improving the council recycling service and implementing new local planning policies to increase recycling storage capacities in new and refurbished developments.

Keywords: Household Recycling, Recycling Barriers, Sustainable Waste Indicator, Behaviours, Deposit Return Scheme

CONTENTS	Page
Acknowledgements.....	ii
Glossary.....	iii
Abstract.....	iv
CHAPTER 1 INTRODUCTION	1
1.1 Background and Context.....	1
1.1.1 Westminster City Profile.....	2
1.1.2 Westminster City Council Recycling History.....	3
1.1.3 Westminster City Council Recycling Service.....	6
1.1.4 Research Aims and Objectives.....	8
1.2 Project Outline and Quick Overview.....	9
1.3 Academic Contribution of the Research.....	12
1.4 Impact of the Research to the Local Community.....	13
1.5 Professional Significance of the Research.....	14
CHAPTER 2 SYSTEMATIC LITERATURE REVIEW.....	17
2.1 Introduction.....	17
2.2 Methods.....	17
2.3 Theoretical and Conceptual Framework.....	18
2.3.1 Environmental Determinism Theory.....	18
2.3.2 Behavioural Change Theory.....	19
2.3.3 Nudge Theory.....	19
2.3.4 Proposed Conceptual Framework for the Research.....	20
2.4 Literature Review Results and Discussion.....	21
2.4.1 UK Recycling Rate.....	21

2.4.2 Barriers to Recycling.....	22
2.4.3 Physical Barriers.....	24
2.4.4 Socio- Economic Barriers.....	26
2.4.5 Human Behaviours.....	28
2.4.6 Policy Constraints.....	32
2.4.7 Effective Communication/ Public Engagement.....	36
2.4.8 Service Constraints.....	38
2.4.9 Literature Review Conclusion.....	39
CHAPTER 3 RESEARCH METHODOLOGY.....	40
3.1 Introduction.....	40
3.2 Research Design.....	41
3.2.1 Participants - Brief Introduction.....	42
3.2.2 Pilot Stage- Brief Introduction.....	42
3.3 Data Phases.....	43
3.3.1 Residents' In-depth Interviews (Phase 1) - Sampling Strategy	44
3.3.2 Residents' Self-completion Questionnaire (Phase 2) - Sampling Strategy.....	49
3.3.3 Council Staff In-depth Interviews (Phase 3) – Sampling Strategy.....	52
3.4 Methods of Analysis -Thematic Analysis (Residents and Staff In-Depth Interviews).....	55
3.4.1 Data Management and Storage	56
3.4.2 Data Transcription and Familiarisation.....	56
3.4.3 Descriptive Coding.....	57
3.4.4 Final Themes Generation.....	59
3.4.5 Results Extract from NVivo 20.....	61

3.5 Methods of Analysis - Quantitative Analysis (Self-completion Questionnaire).....	61
3.5.1 Sample Representativeness (Self-completion Questionnaire).....	62
3.6 Ethical Consideration.....	63
CHAPTER 4 RESULTS AND DISCUSSION – PHASE 1 DATA.....	66
4.1 Thematic Analysis- Phase 1 Data.....	66
4.2 Final Emergent Themes.....	70
4.2.1 Human Factors Theme.....	70
4.2.2 Physical Factors Theme.....	75
4.2.3 Communication and Public Engagement Theme.....	81
4.2.4 Incentives Theme.....	86
4.2.5 Service Constraints Theme.....	89
4.2.6 Policy Constraints Theme.....	94
CHAPTER 5 RESULTS AND DISCUSSION – PHASE 2 DATA.....	98
5.1 Quantitative Analysis – Results and Discussion (Phase 2 Data).....	98
5.2 Recycling Behaviour.....	100
5.3 Recycling Enabling Factors.....	103
5.4 Commitment.....	109
5.5 Bin Colour and Labels.....	112
5.6 Recycling Bag Accessibility.....	117
5.7 Collection Frequency.....	122
5.8 Food Waste Collection.....	126
5.9 Communication Methods.....	131
5.10 Communication Effect.....	136

5.11 Recycling Events.....	140
5.12 Micro Recycling Centres Proximity.....	145
5.13 Future Waste Legislation.....	153
CHAPTER 6 RESULTS AND DISCUSSION – PHASE 3 DATA.....	158
6.1 Thematic Analysis- Phase 3 Data.....	158
6.2 Final Central Themes.....	161
6.2.1 Barriers.....	162
6.2.2 Communication.....	172
6.2.3 Engagement.....	178
6.2.4 Food Waste.....	184
6.2.5 Micro Recycling Facilities.....	188
6.2.6 Recycling Bags.....	192
6.2.7 Service.....	195
6.2.8 Legislation.....	200
CHAPTER 7 TRIANGULATION AND GENERAL DISCUSSION.....	204
7.1 Introduction.....	204
7.1.1 Quick Overview of Phase 1 Results.....	204
7.1.2 Quick Overview of Phase 2 Results.....	204
7.1.3 Quick Overview of Phase 3 Results.....	205
7.2 Triangulation of the 3 Phases Results.....	205
7.3 General Discussion.....	208
7.3.1 Human Factors.....	208
7.3.2 Physical Factors.....	209
7.3.3 Communication and Engagement.....	213

7.3.4 Service Constraints.....	215
7.3.5 Policy Constraints.....	218
7.4 PDCR Model (Policy, Drivers, Change and Recycling).....	224
7.4.1 Policy and Regulation.....	224
7.4.2 Drivers (Service and Infrastructure)	226
7.4.3 Change (Perception and Behaviour)	227
7.4.4 Recycling Rate.....	227
7.5 Sustainable Recycling Indicator.....	228
7.5.1 Sustainable Recycling Indicators Categories.....	229
7.6 Use and Application of the Sustainable Recycling Indicator.....	235
7.7 Data Limitations.....	238
7.8 Research Limitations.....	239
7.9 Academic Contribution of the Research.....	240
7.10 Research Evaluation and Positionality.....	241
7.11 Reflection on Research Process.....	241
CHAPTER 8 RECOMMENDATIONS, FUTURE RESEARCH, AND CONCLUSION.....	243
8.1 Recommendations.....	243
8.1.1 Local Waste Planning Policy Recommendations.....	243
8.1.2 Recycling Service Recommendations.....	245
8.1.3 National Waste Legislation Recommendations.....	249
8.2 Ease of Implementation.....	250
8.3 Future Research.....	257
8.4 Conclusion.....	258
9 REFERENCES.....	260

10 APPENDICES.....	291
--------------------	-----

List of Appendices

Appendix A1: Paper 1.....	291
Appendix A2: Papers Citations.....	292
Appendix B- Pilot In-depth Interview Guide- Residents.....	306
Appendix C-Main In-Depth Interview Guide Residents.....	309
Appendix D - Pilot Self-Completed Questionnaire (Residents).....	311
Appendix E- Main Self-Completed Questionnaire (Residents).....	313
Appendix F- Council Staff In-Depth Interview Guide.....	343
Appendix G- Some Transcripts Residents and Codebook In-Depth Interviews.....	347
Appendix H- Some Transcripts and Codebook Council Staff In-Depth Interviews.....	368
Appendix I- Residents Self-Completed Questionnaire Data.....	402
Appendix J - Sample Representativeness.....	412
Appendix K - Participation Information Sheet (PIS).....	418
Appendix L- Template for the Participant Consent Form.....	427
Appendix M - Westminster Approval To Access Data.....	429
Appendix N - Uni Ethics Approval.....	430
Appendix O- Participants Comparison Analysis.....	432
Appendix P - The Adjusted Data Phase 2.....	436
Appendix Q- Variables with Non-Significant Relationships.....	454
Appendix R- Variables with Significant Relationships not presented in main the report.....	486
Appendix S- Council Recycling Communication Plan.....	498

Appendix T - Council Engagement Activities.....	499
Appendix U – The Current Interventions being Researched by the Council Innovation Team.....	500
Appendix V - The Council Recycling and Waste Storage Requirements for Developments Implementing the Research Recommendations on the Council Local Waste Policy.....	504

List of Tables

Table 1.1: Westminster recycling rate over 10-year period from 2011 to 2021.....	4
Table 1.2: Existing waste indicators used in the waste management industry to monitor circularity of recycled materials and references.....	13
Table 2.1: Types of recycling barriers derived from different literature sources and the comments section indicating opposite views.....	23
Table 3.1: Participants profiles for both the pilot and main residents’ in-depth interviews (Phase 1).....	47
Table 3.2: Participants counts for each of the 20 Westminster administration area for the resident’s self-completion questionnaire (Phase 2).....	51
Table 3.3: Participants profiles and background for the council staff in-depth interviews (Phase 3).....	53
Table 3.4 showing how the codes were assigned to the initial themes.....	59
Table 3.5 demonstrating how the initial themes were assigned to the final themes.....	60
Table 4.1: Coded texts allocated to initial themes for the residents’ in-depth interviews during the thematic analysis (Phase 1 data).....	67
Table 4.2: initial themes grouped under the final themes during thematic analysis of the residents’ in-depth interviews (Phase 1 data).....	70
Table 5.1: Details of the explanatory variables with significant and non-significant relationship with the corresponding responsive variables.....	99

Table 5.2: The result of the cross tabulation of the education variable and recycling behaviour variable in the borough of Westminster.....	101
Table 5.3: The result of the cross tabulation of the age variable with bin labelling and colours variable in the borough of Westminster.....	114
Table 5.4: The result of the cross tabulation of the education variable with bin labelling and colours variable in the borough of Westminster.....	115
Table 5.5: The result of the cross tabulation of type of residence variable and the recycling bag variable in the borough of Westminster.....	121
Table 5.6: The result of the cross tabulation of type of residence variable and the collection frequency variable in the borough of Westminster.....	124
Table 5.7: The result of the cross tabulation of age variable and the food waste collection variable in the borough of Westminster.....	128
Table 5.8: The result of the cross tabulation of internal storage variable and the food waste collection variable in the borough of Westminster.....	129
Table 5.9: The result of the cross tab of education variable and effectiveness of communication variable in the borough of Westminster.....	138
Table 5.10: The result of the cross tabulation of age variable and recycling events attendance variable in the borough of Westminster.....	142
Table 5.11: The result of the cross tabulation of type of residence variable and micro recycling centres (MRC) proximity variable in the borough of Westminster.....	148
Table 5.12: The result of the cross tabulation of ward areas variable and micro recycling centres (MRC) proximity variable in the borough of Westminster.....	150
Table 5.13: The result of the cross tabulation of age variable and desired waste legislation change variable in the borough of Westminster.....	155
Table 6.1: Coded texts allocated to initial themes for the staff in-depth interviews during the thematic analysis (Phase 3 data).....	159

Table 6.2: Initial themes grouped under the final themes during thematic analysis of the staff in-depth interviews (Phase 3 data).....	161
Table 7.1: The result of the chi-square tests (quantitative analysis) showing the significant and non-significant relationships between the explanatory variables and the response variables for data collected in phase 2.....	205
Table 7.2: The triangulation process of merging the results from the 3 phases of the research into 5 central barriers.....	207
Table 7.3: Physical barriers stated by participants in each phase and the various sections where they are located.....	210
Table 7.4: Policy constraints stated by the participants in each phase and the various sections where they are located.....	219
Table 7.5: Definition of availability and effectiveness of each enabling factors within the sustainable recycling indicator.....	232
Table 8.1: Impact rating and ease of implementation of the recommendations arising from the research results.....	251

List of Figures

Figure 1.1a: Map of Westminster showing twenty administrative wards before 5 th May 2022 (Map produced by the Westminster City Council GIS Team)...	2
Figure 1.1b: Map of Westminster showing eighteen administrative wards effective from May 2022 (Map produced by the Westminster City Council GIS Team).....	3
Figure 1.2: Westminster recycling rate compared to the average recycling rate data for all London Boroughs, and England from 2011 to 2021 (Source: London DataStore, 2022).....	5
Figure 1.3: Recycling rate comparison data between two inner London councils and two outer London councils from 2011 to 2021 (Source: London DataStore, 2022)	6
Figure 1.4: Thesis structure indicating the 9 chapters and its components.....	10

Figure 1.5: Elements of the professional doctorate programme showing different modules undertaken.....	14
Figure 2.1: Research conceptual framework model indicating 4 stages of reviewing the council current recycling rate and the developments of the required interventions to increase the recycling rate.....	20
Figure 2.2: The annual recycling rate of the 4 UK devolved administrations and the UK average recycling rate from 2015 to 2020.....	22
Figure 2.3: The theory of planned behaviour based on Ajzen (1991) showing how perceived behavioural control influences attitude towards the behaviour.....	29
Figure 2.4. The social cognitive theory (SCT) based on Phipps et al. (2013) showing factors that contributes to behavioural outcomes.....	31
Figure 3.1: Research design showing integrated strategy and analytical approach to address research problems.....	41
Figure 3.2: Data phases showing 3 stages of data collection and the different time periods of data collection.....	43
Figure 3.3: Thematic analysis stages showing steps taken in analysing data obtained in Phases 1 and 3.....	55
Figure 3.4: Ethical issues faced during the research and mitigations to resolve ethical issues.....	64
Figure 4.1: The 11 initial themes that emerged during thematic analysis of the residents' in-depth interviews (Phase 1 data).....	66
Figure 4.2: The six final themes that emerged during thematic analysis of the residents' in-depth interviews (Phase 1 data).....	69
Figure 4.3: Thematic mind map indicating the 3 sub-themes under the human factors theme.....	71
Figure 4.4: Thematic mind map indicating the 4 sub-themes under the physical factors theme.....	76

Figure 4.5: Thematic mind map indicating the 4 sub-themes under the communication and engagement theme.....	82
Figure 4.6: Thematic mind map indicating the 3 sub-themes under the incentive theme.....	86
Figure 4.7: Thematic mind map indicating the 3 sub-themes under the service constraint's theme.....	90
Figure 4.8: Thematic mind map indicating the 3 sub-themes under the policy constraints theme.....	94
Figure 5.1: The proportion of the respondents who engage in recycling activity and those who do not participate in recycling activity.....	100
Figure 5.2: The proportion of the respondents influenced by recycling enabling factors to carry out recycling activities.....	104
Figure 5.3: The result of the cross tabulation of the age variable and the recycling enabling factors variable in the borough of Westminster.....	105
Figure 5.4: The result of the cross tab of the type of residence variable and the recycling enabling factors variable in the borough of Westminster.....	107
Figure 5.5: The proportion of the respondents based on their commitments to recycling activity.....	109
Figure 5.6: The result of the cross tab of the education variable and commitments to recycling variable in the borough of Westminster.....	110
Figure 5.7: The proportion of the respondents' responses to bin labelling and colours question.....	113
Figure 5.8: The proportion of the respondents on how they access the council free recycling bags.....	119
Figure 5.9: The proportion of the respondent's preference to recycling and rubbish collection frequency.....	123
Figure 5.10: The proportion of the respondent's preference to food waste collection service and availability of food waste storage.....	127

Figure 5.11: The proportion of the respondent's response to different medium of recycling communication received.....	132
Figure 5.12: The result of the cross tabulation of age variable and medium of communication variable in the borough of Westminster.....	134
Figure 5.13: The proportion of the respondent's response to the effectiveness of communication received.....	137
Figure 5.14: The proportion of the respondent's attendance to recycling events in the borough of Westminster.....	141
Figure 5.15: An example of a recycling advert placed on the Westminster reporter magazine.....	144
Figure 5.16: An example of an MRC image in Westminster shown to the respondents during completion of the self-completed questionnaire.....	146
Figure 5.17: The proportion of the respondent's proximity to the micro recycling centres distributions in the borough of Westminster.....	147
Figure 5.18: Map of the micro recycling centre's locations and distributions in the borough of Westminster (Source: produced by the researcher using the council internal GIS system).....	151
Figure 5.19: The proportion of the respondents preference to desired change in waste legislation in the borough of Westminster.....	154
Figure 6.1: The 15 initial themes that emerged during thematic analysis of the staff in-depth interviews (Phase 3 data).....	158
Figure 6.2: The 8 final themes that emerged during thematic analysis of the staff in-depth interviews (Phase 3 data).....	160
Figure 6.3: Thematic mind map indicating the different sub-themes under the barriers theme.....	163
Figure 6.4: Thematic mind map indicating the 3 sub-themes under the Communication theme.....	173

Figure 6.5: Thematic mind map indicating the different sub-themes under the Engagement theme.....	179
Figure 6.6: Thematic mind map indicating the different sub-themes under the food waste theme.....	185
Figure 6.7: Thematic mind map indicating the different sub-themes under the micro recycling centres theme.....	189
Figure 6.8: Thematic mind map indicating the different sub-themes under the recycling bags theme.....	192
Figure 6.9: Thematic mind map indicating the different sub-themes under the Service theme.....	196
Figure 6.10: Thematic mind map indicating the different sub-themes under the legislation theme.....	200
Figure 7.1: The descriptive data on mixed recycling behaviour (phase 2) without any statistical test indicating the number of respondents and their recycling behaviour across the age groups.....	217
Figure 7.2: The summary of the 4 main barriers identified in the research resulting from merging the results of the 3 data phases and the various interventions to mitigate the barriers.....	222
Figure 7.3: The PDCR model showing the workflow of connecting interventions steps required from policy design to changing householders behaviour in achieving high recycling rate.....	225
Figure 7.4: Composite sustainable recycling indicator designed based on this study findings which can be used as monitoring strategy to achieve high recycling rate.....	229
Figure 7.5: Simplified sustainable recycling indicator to be used in conjunction with the flow chart shown in figure as a functional tool to increase recycling rate.....	235

Figure 7.6: An example of Westminster Council current rating on the simplified SRI after initial assessment showing the first step of using the model as a functional tool to increase recycling rate	236
Figure 7.7: Sustainable Recycling Indicator (SRI) flow chart process to increase recycling rate using enabling factors (EF).....	237
Figure 8.1: Delivery of recommendations in relation to ease of implementation and impact showing A to H are easy to implement but are of low impacts, while I to T are also easy to implement and are of medium impacts, and U to AE are of high impacts but are difficult to implement.....	255
Figure 8.2: Ease of implementation and impact of each of the 30 recommendations bubble chart.....	256

List of Boxes

Box 1: Summary of the issues and interventions required from the result of the cross tabulation between education and recycling behaviour variables in the borough of Westminster.....	102
Box 2: Summary of the issues and interventions required from the result of the age and residence type cross tabulations with recycling enabling factors variable in the borough of Westminster.....	108
Box 3: Summary of the issues and interventions required from the result of the cross tabulation between education and recycling commitment variables in the borough of Westminster.....	112
Box 4: Summary of the issues and interventions required from the result of the age and education cross tabulations with bin labelling and colours variable in the borough of Westminster.....	117
Box 5: Summary of the issues and interventions required from the result of the cross tabulation between type of residence and recycling bag variables in the borough of Westminster.....	122
Box 6: Summary of the issues and interventions required from the result of the cross tabulation between type of residence and collection frequency variables in the borough of Westminster.....	126

Box 7: Summary of the issues and interventions required from the result of the age, internal space, external space variables with food waste collection variable cross tabulation in the borough of Westminster.....	130
Box 8: Summary of the issues and interventions required from the result of the cross tabulation between age and medium of communication variables in the borough of Westminster.....	136
Box 9: Summary of the issues and interventions required from the result of the age and education variables with effectiveness of communication variable cross tabulation in the borough of Westminster.....	140
Box 10: Summary of the issues and interventions required from the result of the cross tabulation between age and recycling events attendance variables in the borough of Westminster.....	145
Box 11: Summary of the issues and interventions required from the result of the type of residence and ward areas variables with MRC proximity variable cross tabulation in the borough of Westminster.....	152
Box 12: Summary of the issues and interventions required from the result of the cross tabulation between age and desired waste legislation change variables in the borough of Westminster.....	157

Chapter 1 INTRODUCTION

1.1 Background and Context

I am a Chartered Environmentalist and a Chartered Waste Manager with 11 years of experience in the Environmental Regulation and Waste sector within different local authority settings. Currently, I am the Waste Project Coordinator for Westminster City Council in reviewing and assessing waste management strategies for large scale developments within the borough.

This research project is designed out of the need to address the City of Westminster's low recycling rate. It aims to allow the design and implementation of an effective waste management policy. The research involved studying the social experiences of the residents and the council recycling staff to identify issues and barriers to achieving a high recycling rate.

The essence of the research is to use the views of the service users (i.e., the residents) to shape or re-mould the waste planning policy in the way the council provides waste services and infrastructure, and to re-align these services towards the behavioural attitude of the users. These views will be used to plan and develop key interventions and changes that will positively impact the recycling rate and reduce contamination levels.

1.1.1 Westminster City Profile

The City of Westminster is one of 32 London boroughs that share local government powers with the Greater London Authority (GLA). The city is designated as an Inner London Borough with a very diverse resident population of 255,000 in 2018. (Westminster City Council, 2018). The latest population figure from the Office for National Statistics (ONS) indicates a population of 204,236 in 2021, which is about a 6% decrease within the two-year period (ONS, 2021).

The borough originally had 20 wards (Figure 1.1a) between 2002 and 4th May 2022 during the period of research data collection.



Figure 1.1a: Map of Westminster showing twenty administrative wards before 5th May 2022 (Map produced by the Westminster City Council GIS Team).

Effective from 5th May 2022, the borough is now divided into 18 wards (Figure 1.1b) with different levels of deprivation across the wards. The local areas are among the most and least deprived areas in the UK. In Westminster, 67% of the 204,236 residents are in employment and 6% have no educational qualification (Westminster City Council, 2022).

There are 94,815 residential properties in Westminster, of which 44% are privately rented properties, 28% are owned or shared ownership, and 28% are socially rented. In terms of accommodation types, 70% of these housing stocks are flatted properties, 26% are houses which are either detached, semi-detached or terraced, and the remaining other accommodations are 4% (ONS, 2021). About 46% of Westminster residents are satisfied with the on-street recycling collection and 35% are satisfied with door-to-door recycling collection according to a 2017 survey (Westminster City Council, 2018).

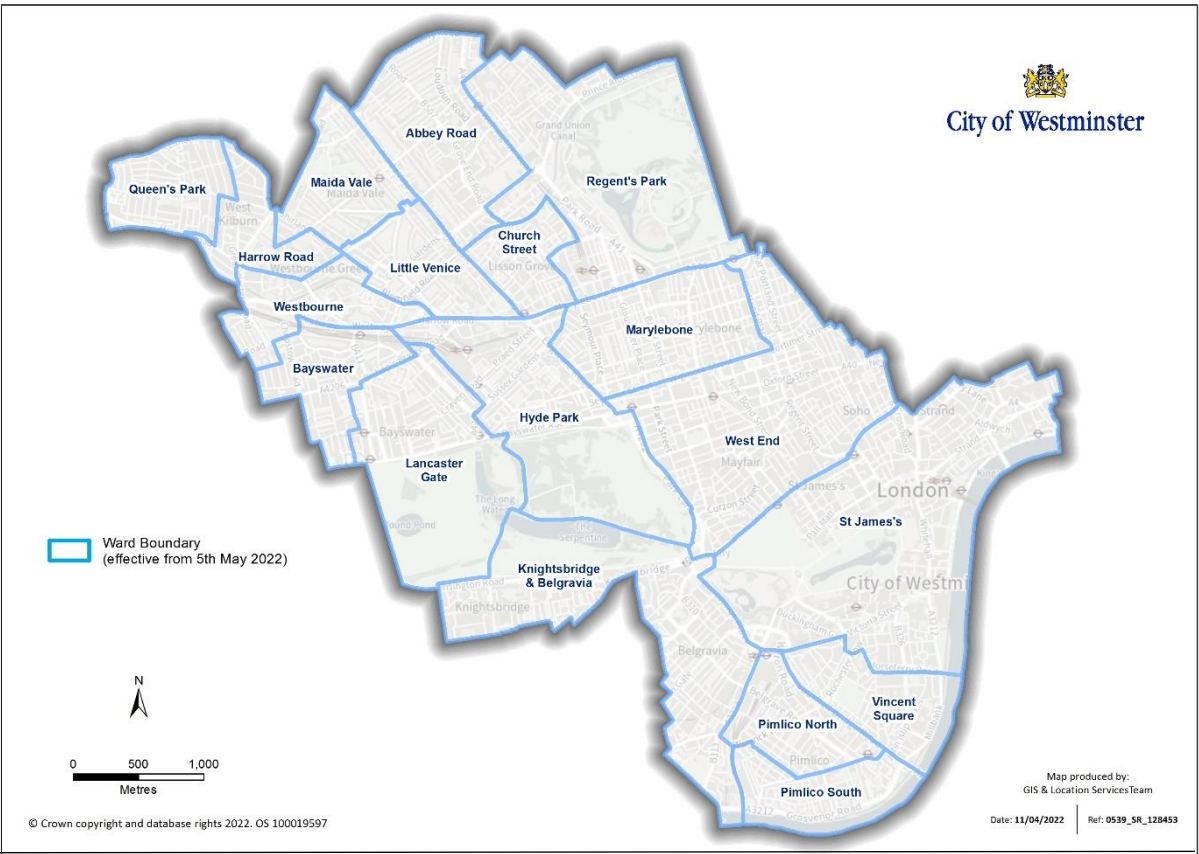


Figure 1.1b: Map of Westminster showing eighteen administrative wards effective from May 2022 (Map produced by the Westminster City Council GIS Team).

In 2016, 18% of the resident population of 247,614 were classified as children while working age residents (18-64 years) constitute 70% of the population. The remaining 12% of the population were older people from 65 years and above. In addition to the English language, the top five non-UK languages are Arabic, French, Spanish, Italian and Portuguese (Westminster City Council, 2022).

In terms of economy, Westminster has estimated 768,000 local jobs and 52,000 businesses. Westminster's contribution to the UK national economy is estimated at £72 billion (Westminster City Council, 2022).

1.1.2 Westminster City Council Recycling History

The borough produces about 107,333 tonnes of municipal waste in the year 2020/21 (Defra, 2022). The local authority has been struggling to meet the original annual recycling target of 50% by 2020 set by the national government. The current target is to achieve a 65% recycling rate by 2035.

The Westminster City Council (WCC) recycling rate ranged between 17% to 25% between 2011 and 2021. It started at 25% in the year 2011/12 and then dropped down to 17% in the year 2016/17 (Table 1.1).

Table 1.1: Westminster Recycling Rate over 10-year period from 2011 to 2021
(Source: London DataStore, 2022).

Year	Recycling Rate
2020/21- Post Pandemic Rate	24%
2019/20 - Pre-Pandemic Rate	20%
2018/19	22%
2017/18	19%
2016/17	17%
2015/16	17%
2014/15	19%
2013/14	21%
2012/13	22%
2011/12	25%

The Westminster recycling rate before and after the pandemic shows a 4% increase, but the specific reasons for this increase are not known (because the increase was only evident after the completion of data collection). Literature sources (Tchetchik et al, 2021; Ebner and Lacovidou, 2021; Sarmiento et al, 2022; Mahyari et al, 2022) suggested that the increase in recycling rate observed in many places may be due to stay-at-home regulation, which allowed more time to engage in recycling activities.

The Westminster data was compared to the average of all the London boroughs and the whole of England over the same 10-year period, and the result indicates poor performance of Westminster compared to the increase in recycling rate for all London boroughs and England peaking at 33% and 43% respectively. (Figure 1.2).

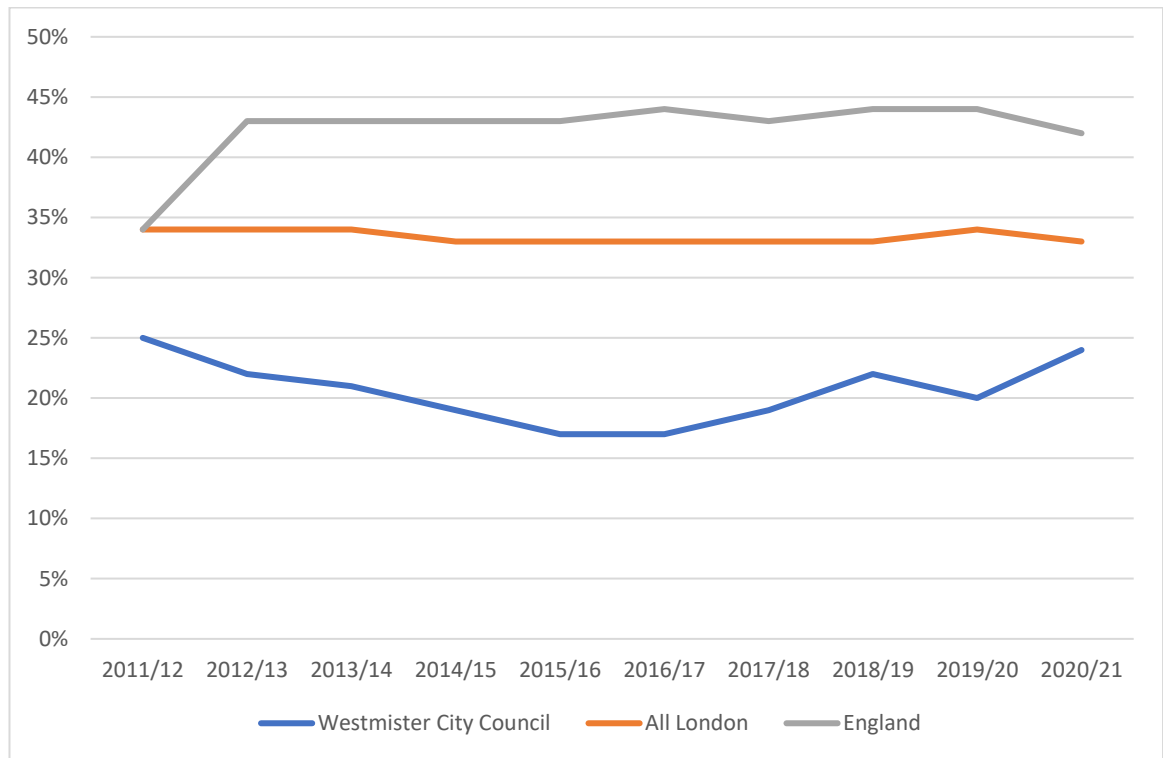


Figure 1.2: Westminster Recycling Rate Compared to the Average Recycling Rate Data for All London Boroughs, and England from 2011 to 2021 (Source: London DataStore, 2022).

It should be noted that Westminster (WCC) is an Inner London Borough characterised by densely built areas with high-rise flatted properties. Therefore, further recycling rate data comparisons were made between two Inner London Boroughs (WCC and Royal Borough of Kensington and Chelsea, RBKC) and two Outer Boroughs (Richmond and Bromley) characterised by less densely populated areas with single occupancy houses. The data comparison (Figure 1.3) revealed two interesting facts:

- The two Inner London Councils indicate an almost comparable level in recycling behaviour in contrast to the two Outer London Councils that exhibit a similar opposite levels in recycling behaviour.

- The two Inner London Councils have low recycling rates compared to the two outer London Councils that have high recycling rates.

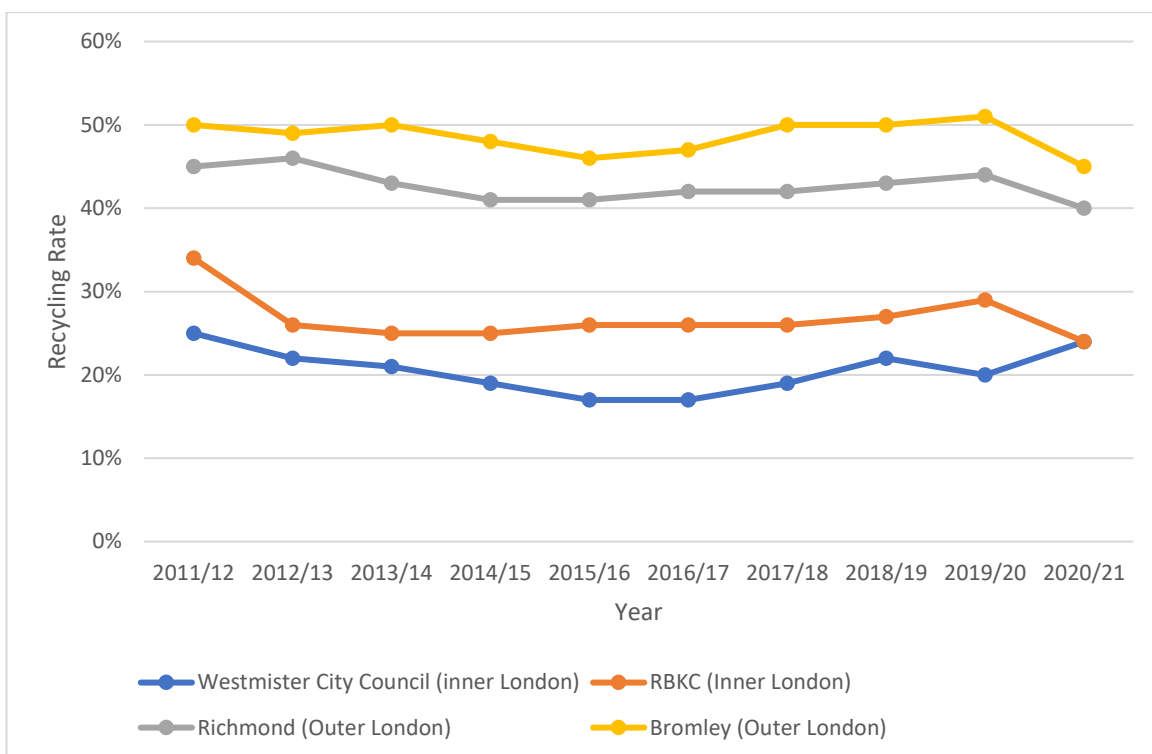


Figure 1.3: Recycling Rate Comparison Data Between Two Inner London Councils and Two Outer London Councils from 2011 to 2021 (Source: London DataStore, 2022).

1.1.3 Westminster City Council Recycling Service

The Westminster recycling service is designed to cope with the physical constraints of the Westminster location and its building infrastructures. Due to a lack of space and logistic issues, recyclable materials are collected as mixed recycling. The components of mixed recycling are paper, cardboard, plastics, tins, and glass. The mixed recyclable materials are collected by Veolia (a private waste contractor contracted by the council) and then sent to the Integrated Waste Management Facility in Southwark, London for recovery and processing.

The processed materials are used locally or exported for further reprocessing to be used as raw materials for new products. For collected materials reprocessed locally, plastics are recycled in Dagenham, glass is turned into insulation wool in Merseyside, and paper and cardboard are recycled in Kent.

The council operates different collection regimes for mixed recycling depending on the area and the availability of waste infrastructure. The three main types of collection currently employed are bin collections, bag collections and doorstep collections. Bin collection is the most popular in flatted properties where communal recycling bins are collected. This method of collection is also common with houses that have enough space to store bins.

Bag collections are also popular in old, flatted properties or new flatted properties with less than 10 units. Bag collections are used in terraced houses with no frontal spaces for bins. The doorstep collections use black boxes (44L) as a medium of collection. This mode of collection is more common in houses with no spaces for bins. A small fraction of flatted properties also uses this service.

The mixed recycling collection frequency depends on the area. Most properties in areas of central London that attract high footfalls of tourists such as the West End, Mayfair, and Soho have between twice weekly to daily collection of mixed recycling. These areas are known as central Westminster. The other segment of Westminster known as outer Westminster has a weekly collection of mixed recycling.

It is important to note that rubbish and recycling are collected on different days currently, but with the introduction of separate food waste collection in early 2022, the council is planning to introduce a one-day collection for the three main streams of waste (rubbish, mixed recycling, and food waste). This means that the three waste streams will be collected weekly on the same day with three different refuse vehicles. The reason for this is mainly for ease of service use and to avoid confusion between collection days.

In addition to the collection of mixed recycling from household properties, there are micro recycling centres (MRC) which are scattered all over the borough and located on the pavements. The council also runs one mobile recycling unit outside the Warwick Avenue underground, London.

1.1.4 Research Aim and Questions

This research aims to understand the barriers (faced by the residents) and challenges (faced by the council) in achieving a high recycling rate. The result of the research will then be used to develop a new strategy and policy approach to urban waste management based on information obtained from service users.

Two main broad questions will be explored:

- What are the barriers to a high-level rate of recycling?
- What can be done to overcome such barriers?

Further questions to be explored are outlined below:

- Why do residents of Westminster not recycle?
- Are the barriers related to residents' demographic (age and level of education), infrastructure (type of residence and recycling facilities) or does it have to do with the nature of the transient population?
- What do the users understand the term "Recycling" to mean?
- What are the factors that could greatly influence public behavioural attitudes to waste management?
- Could motivation and incentives play a key role in improving the recycling rate?
- How do we resolve issues around elevated levels of contamination of recyclable materials?

The following research objectives are configured to provide solutions to the research questions.

- To investigate reasons why residents are struggling to achieve a high recycling rate. This objective will be achieved through residents' interviews and self-completed questionnaires.
- To identify the prerequisites needed to ensure appropriate provision of infrastructure for more sustainable and integrated management of waste. This objective will be achieved through council staff interviews and residents' self-completed questionnaires.

- To make strategic recommendations to the local authority for effective and sustainable waste infrastructure based on evidence from the research. This objective will be achieved through council staff interviews and residents' self-completed questionnaires.
- To develop a new strategy and policy approach to urban waste management based on information obtained from service users to increase the Westminster recycling rate. This objective will be achieved through council staff interviews and residents' self-completed questionnaires.

1.2 Project Outline and Quick Overview

The project report has been detailed as indicated in figure 1.4 which shows the quick overview of the thesis structure and its components.

Chapter 1: Introduction

Provides the context and background to the project to explain the justification for the research. It details the Westminster City Profile and the recycling rate history between 2011 and 2021. The City of Westminster's recycling rate was compared to other inner and outer boroughs within GLA and England. The chapter also introduces the council recycling service, details the research aims and objectives, the significance, and the contributions of the research.

Chapter 2: Literature Review

Gives an extensive literature review of the topic starting with situating the research within a human behavioural theoretical framework. The literature review also discussed the barriers affecting recycling rates in urban areas in the UK. The literature review concluded that multidimensional interventions are required to mitigate issues affecting the UK's low recycling rate or output.



Figure 1.4: Quick overview of the thesis structure indicating the 8 chapters and its components.

Chapter 3: Research Methodology

This includes research methods, approach, and project design to achieve the aims and objectives of the research. Mixed methods (both quantitative and qualitative methods) were used to gather and analyse data. It details how data was collected through interviews, surveys, and the subsequent data analysis using thematic and quantitative analysis. The chapter also includes ethical considerations and procedures, and how project participants were approached and sampled.

Chapter 4: Results and Discussion - Phase 1 Data

Research findings are presented which include results from the analysis and discussion of residents' in-depth interviews (phase 1 data) in providing meaningful data on local recycling barriers faced by the 12 participants.

Chapter 5: Results and Discussion - Phase 2 Data

Research findings are presented which include results from the analysis and discussion of residents' self-completed questionnaire (phase 2 data) in providing meaningful data on local recycling barriers faced by the 417 participants.

Chapter 6: Results and Discussion - Phase 3 Data

Research findings are presented which include results from the analysis and discussion of council staff in-depth interviews (phase 3 data) in providing meaningful data on service constraints encountered by the council recycling team.

Chapter 7: Triangulation and Discussion

Discusses the finding of the research which corresponds to existing knowledge about barriers to recycling but with a dynamic local perspective or narratives of the issues based on local factors. A PDCR (Policy and Regulation, Drivers, Change and Recycling) model and a sustainable recycling indicator (SRI) are put forward as mechanisms to effect change and to improve the council recycling rate.

Chapter 8: Recommendation, Future Research, and Conclusion

Provides relevant interventions and solutions to mitigate the barriers to recycling based on the result of the research and to achieve the project objectives.

Recommendations are based on what resources are available to facilitate meaningful intervention that will increase the recycling rate and reduce the level of contamination. The chapter also indicates possible two areas where future research on increasing the recycling rate can be based. It also provides a summary of research problems, implications of the research, and key findings that will be used to develop interventions to increase residents' participation in recycling activities, thereby increasing the borough recycling rate.

1.3 Academic Contribution of the Research

Although numerous studies have been conducted on recycling barriers, they are related to other geographical locations (different to Westminster City) and in general context. Currently, there is no localised extensive study or extensive research that specifically dealt with recycling barriers in the City of Westminster, which is representative of high density urban areas and multi-occupancy living. This has resulted in the design of a sustainable recycling indicator (SRI) specifically for household recycling. The SRI developed can be applied for use by other local authorities through iterating the enabling factors that are relevant to their peculiar situations.

Furthermore, all the existing waste indicators (circular economy indicators, resource efficiency indicators, and end-of-life recycling input rate) are dealing with processes, raw materials flow, overall efficiency rate, treatment, and end-of-life efficiency rate for recyclable waste (Table 1.2). These indicators are not suitable for measurement and monitoring of the progress and performance of household recycling rates that relate to human behaviour and household recycling service.

Table 1.2: Existing Waste Indicators Used in the Waste Management Industry to Monitor Circularity of Recycled Materials and References.

Existing Waste Indicators	Acronyms	Purpose	References
Circular Economy Indicators	CEI	Used to monitor and evaluate waste generation to monitor performance towards a circular economy. Used for all types of waste that can be recycled and recovered.	(De Pascale et. al., 2021)
Resource Efficiency Indicators	REI	Used to monitor and evaluate waste generation to monitor performance towards circularity. Used for all types of waste that are recycled or recovered.	(Moraga et. al., 2022)
End-of-Life Recycling Input Rate	EOL-RIR	Used to track the improvement of materials towards circularity. Used mainly for metals.	(Espinoza, 2021)

Finally, one paper related to the research (Appendix A1) has been published in journals providing the opportunity to disseminate knowledge that could be beneficial to other current or future research on recycling barriers.

1.4 Impact of the Research on the Local Community

Waste management is a sensitive issue in the UK, especially if any policy shift may result in negative outcomes for the immediate community or the environment. However, it is expected that the research outcomes would bring about a positive impact on the local community in line with the council's clean street policy and protection of the environment.

The positive impact of increasing recycling the borough recycling rate will consequently contribute to the overall strategy of reducing the effects of climate change. Furthermore, the sustainable recycling indicator designed (one of the key outcomes of the research), has the potential to improve waste management practices across the UK and therefore benefit the wider community.

1.5 Professional Significance of the Research

I aspire to become an expert in the field of waste management. One of the drivers for achieving this objective is this research study on how to achieve sustainable urban waste management. The completion of this research will equip me with leadership skills, which will facilitate my dissemination plan in taking lead in the transformation and change, which will occur because of the project. It will also help in updating my professional skills and knowledge within the waste management industry.

Overall Learning from the DProf Modules

As part of the Doctorate programme, I undertook the following modules (figure 1.5) to achieve the requirements of the programme. The key learning and knowledge gained from each module are detailed are detailed below.



Figure 1.5: Elements of the Professional Doctorate Programme Showing Different Modules Undertaken.

Review of Learning IPL 4013: This module provided me with the opportunity to reflect on previous learning and how it provides a strong foundation for the proposed research. It enables critical analysis of my situatedness, epistemology and ontology to the project. One key learning that I have gained from this module is that it has equipped me with reflective ability. This has helped in applying the concept of reflexivity throughout the project. Additionally, I have now imbibed the trait of doing a formal self-appraisal continuously.

RAL Claim 1 IPL 4040: This module enabled me to highlight some shortcomings in previous projects which is an important learning outcome that will prevent such shortcomings in any future projects. This is learning from experience. I am now able to draw from my professional experience to design new interventions to achieve sustainable outcomes for the environment. More importantly, the module enables me to identify transferable waste management professional skills that can be applied to my research project.

RAL Claim 2 IPL 4060: One important learning outcome from this module, is that it has allowed me to identify research capabilities gained from the previous project that can be applied in the proposed research. Building on these research skills has contributed to the completion of the project. Also, these acquired research skills would be applied in future research and professional practices.

Planning a practitioner research & development programme IPL 4016: This module is particularly important in putting into focus the whole programme and allows effective planning and design of the research to make it a success. The learning outcome gained from this module is that it has equipped me with planning and organisation skills that are vital in conducting project research and delivery of work projects.

Explorations in Leadership IPL 5001: In this module, I have gained leadership skills that will facilitate my dissemination plan in taking lead in the transformation and change that will occur because of the project. Also, it has helped to identify gaps and areas of further improvement in my professional experience that relates to leadership within the waste management industry. I have learnt how to use ethical leadership qualities, trust, and policy to achieve organisational sustainability.

Research Project IPL 5320: The learning products from this module will be used to improve the followings:

- The existing recycling service the council is providing to Westminster residents
- Improve the provision of the waste infrastructure in developments
- Increase the borough of Westminster's recycling rate and reduce contamination of recyclable materials.

Chapter 2 Systematic Literature Review

2.1 Introduction

The literature review chapter provides an overview of the literature on waste and recycling which includes the conceptual framework for the research and barriers to recycling. The review also focuses on the history of the UK recycling rate to provide a contextual setting of the recycling challenges. Furthermore, the review is grouped under sections to ensure a robust approach is undertaken in reviewing the body of literature.

2.2 Methods

This review was conducted using several databases and keywords to yield relevant literature that applies to the title of the review. Databases such as Science Direct, SAGE journals, Google Scholar, and the Web of Science were used to search for relevant literature. There was also limited use of Google to search for other information that was not available in the databases cited above. The key terms and search words used include recycling, household recycling, household waste, deposit return scheme, recycling incentive scheme, recycling schemes in Europe, barriers to recycling, recycling behaviours, waste regulation in the UK, and recycling schemes case studies.

Over one hundred pieces of literature including abstracts and full papers sources were reviewed. This literature was then grouped into various categories depending on the main theme of the literature.

A systematic approach was then employed to categorise the search results into the year when the article or literature was published, how relevant the literature is to the research and if the database is a recognised database for waste management. The main literature reviewed was from 2017 to 2021 to ensure that up-to-date information and trends in the waste management industry were adequately covered.

Of the fifty of these studies reviewed, thirty were within the years 2010 to 2016, fifteen sources were between the years 2000 to 2009 and five works of literature were from sources before the year 2000. In addition, secondary waste flow data were obtained from the UK government websites to interrogate relevant waste data that was used in this review.

2.3 Theoretical and Conceptual Framework

A theoretical framework is an important aspect of any research, and it serves as a master plan in which the research is situated or embedded (Grant and Osanloo, 2014). The proposed research bordered on service users' behaviour and perception of recycling. Therefore, an understanding of the human behavioural theoretical framework will enable the formulation of a conceptual framework for the research. The essence of the initial theoretical and conceptual framework analysis is to appreciate all relevant theories to the research, which will aid the subsequent adoption of theory or theories that are most relevant and suitable.

There are numerous behavioural theories that may be relevant to the study. Maxwell (2004) advised that the key guiding factor in selecting a theory or theories is that the theory must agree or reflect the purpose and questions of the research. The following three theories outlined below with brief explanations are applicable to the research.

2.3.1 Environmental Determinism Theory

This theory stipulates that human activities are dictated to or influenced by the prevailing physical environment (Lewthwaite, 1966), and may influence human behaviour or cultural norms. For example, a migrant living in Westminster City from a country with no developed waste and recycling management system may find it difficult to adjust to a unique way of managing waste or recycling in the urban environment. In this scenario, a lot of factors may be at play in the unfamiliar environment such as language barrier or imbibed cultural norm from the old environment. The Environmental Determinism Theory will help underpin the research to delineate to what extent the environment influences service users in disposing of their recyclable materials.

2.3.2 Behavioural Change Theory

In Behavioural Change Theory, there is a belief that education and knowledge can create awareness about an issue which in turn modifies people's attitude towards a desired outcome. Behavioural change is an important intervention technique (Michie and Johnston, 2012) that can be used to achieve positive outcomes.

Studies on Behavioural Change have resulted in many theories on the subject. According to Michie et al (2005), it is a complicated process to select or determine which of these theories suits individual research programs due to overlapping constructs that exist between the numerous behavioural change theories. The Behavioural Change Theory encompasses other theories such as the theory of environmentally responsible behaviour (ERB), the theory of planned behaviour and the reasoned action theory.

The above theories have the fundamental principles that communication, education, and knowledge coupled with good intention and rational thought can change people's attitudes which ultimately will change their behaviour or how they behave. The application of behavioural change theories in the research may help determine if the council's current community engagement programmes with service users are effective or need to be improved to achieve the desired outcome.

2.3.3 Nudge Theory

Nudging is “By knowing how people think, we can make it easier for them to choose what is best for them, their families and society” (Thaler and Sunstein, 2008). Generally, there is a discord between the environmental policy and regulation set at the national level and the behaviours of the end users of products affected by the relevant environmental policy (Gellard, et al, 2019).

Nudge theory combines the three crucial elements (behavioural science, political theory, and behavioural economics) to allow effective intervention. This means that council policy can shift from penalising mode to motivational mode by harmonising waste policy, service, and predicted service users' behaviours to achieve positive outcomes.

One of the objectives of the research is to explore using the nudging approach or the use of incentives to motivate service users to modify or change their perceived behaviours towards recycling. It is therefore important to examine how the concept can be used to nudge service users to change their perception or behaviour towards recycling.

2.3.4 Proposed Conceptual Framework for the Research

The above theoretical frameworks have been used as a foundation to construct an initial conceptual model (Figure 2.1) for the research. This is to indicate possible interventions that can be applied to resolve research problems. It is expected that combining council waste policy with communication, improved waste infrastructure, improved service and economic incentives will fulfil project intentions.

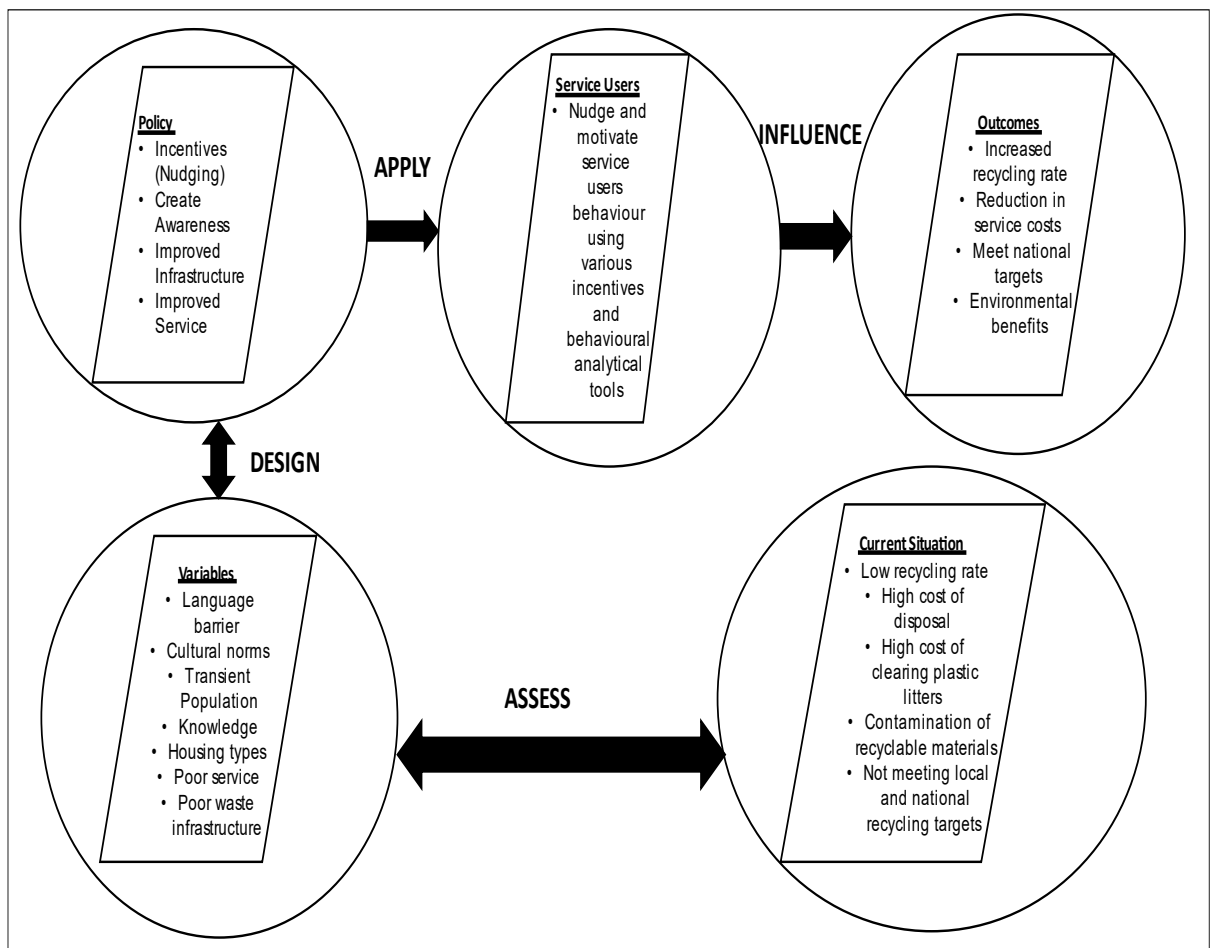


Figure 2.1: Research Conceptual Framework Model indicating 4 stages of reviewing the council's current recycling rate and the developments of the required interventions to increase the recycling rate.

2.4 Literature Review Results and Discussion

2.4.1 Uk Recycling Rate

In 2008, the European Union (EU) Waste Framework Directive (WFD) 2008/98/EC set a recycling target of 50% for member states by 2020 (European Commission, 2020). The Waste (England and Wales) Regulations 2011 thereafter transposed the EU Waste Framework Directive (WFD) (2008/98/EC) into law in England and Wales.

The UK government has taken over the control of Environmental Policy from the EU after Brexit and has put in place an ambitious Resource and Waste Strategy to forge a circular economy for England. The Resource and Waste Strategy for England 2018 set a new recycling target of 65% of municipal waste to be achieved by 2035 (Local Government Association, 2018).

The local authorities' recycling rates are derived from the statutory waste returns submitted by all local authorities on a financial year basis. Details of how the recycling rates are calculated are provided in Appendix A1 (The second and third paragraphs of the Introduction).

According to the latest waste flow data, the UK generated around twenty-seven million tonnes of household waste and the recycling rate was at 44% in 2020 (Defra, 2022b). Household waste is collected by 408 local authorities in England, Wales, Scotland, and Northern Ireland.

Overall, the UK recycling rate fluctuates between 44% and 46% and has consistently struggled to meet even the lower annual recycling target of 50% of household waste set previously under the EU WFD. The challenges faced by the UK local authorities in meeting the statutory recycling target are discussed in the next sections. Figure 2.2 indicates the recycling rates for each devolved administration. The total tonnage of waste generated in each devolved administration over a five-year period (2015 to 2020) and the lowest and the highest recycling rates of local authorities in England are provided in Tables 1 and 2 in Appendix A1.

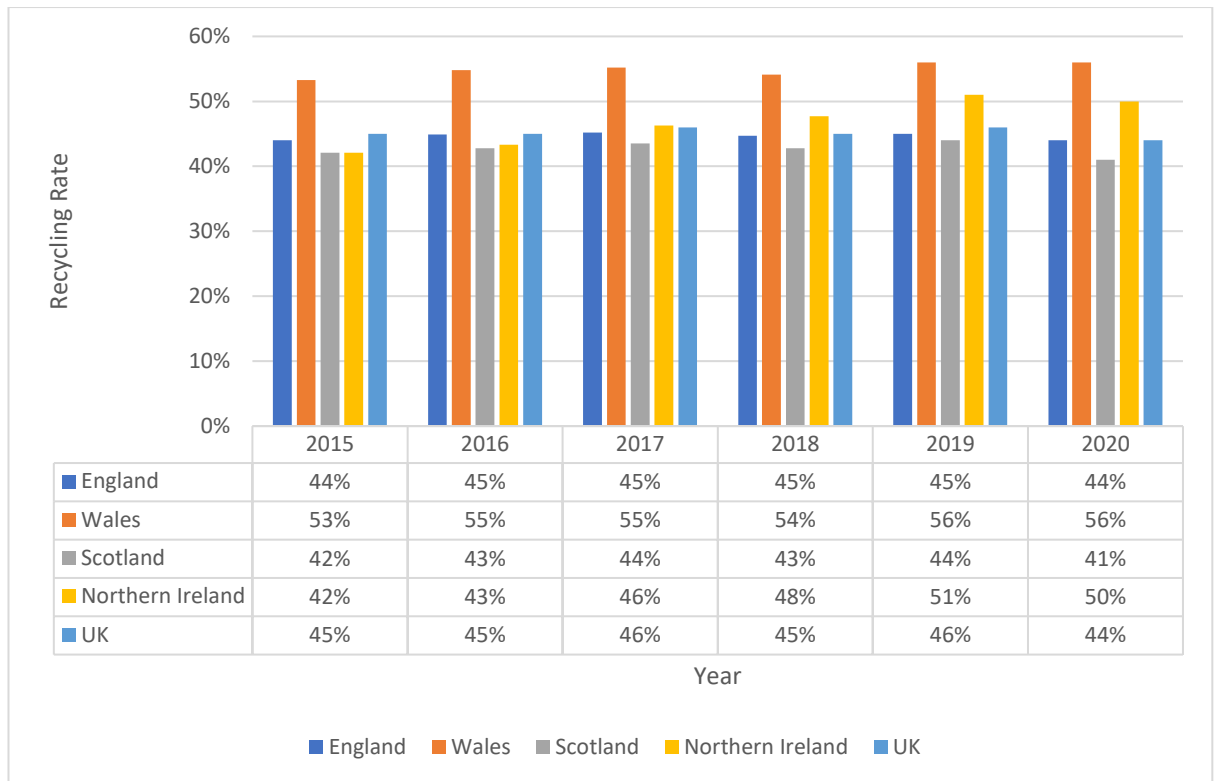


Figure 2.2: The annual recycling rate of the 4 UK devolved administrations and the UK average recycling rate from 2015 to 2020.

2.4.2 Barriers to Recycling

The recycling issue is overly complex and multifactorial. A range of factors or barriers have been attributed to the causes why the target was unattainable. These phenomena could either be localised and region-specific, commonly identified in most of the regions, or the results of combined effects of localised and general factors.

A critical evaluation of these different barriers will enhance our understanding of the challenges and focus on resources to tackle some of the common factors. Six categories of recycling barriers derived from literature sources based on different studies and research into recycling barriers were identified (Table 2.1).

Table 2.1: Types of recycling barriers derived from different literature sources and the comments section indicating opposite views.

Barriers Group	Literature Sources	Comments
Physical Barriers	Letelier et al., 2021; Jatau & Binbol, 2020; Li et al., 2020a; Yakob et al., 2020; Díaz-Meneses and Vilkaite-Vaitone, 2020; Du Toit and Wagner, 2020; Rodríguez and Camilli, 2018; Yukalang et al, 2017; WRAP, 2014a; Timlett and Williams, 2011; Jesson and Stone, 2009; Barr and Gilg, 2005; Ando and Gosselin, 2005; Liu and Sibley, 2004	Li et al. (2020a), state that distance to the recycling facility is not a barrier.
Socio-Economic Barriers	Zhou et al., 2021; Mofid-Nakhaee et al., 2020; Du Toit and Wagner, 2020; Knickmeyer, 2020; Tsalis, et al., 2018; Seng, et al., 2018; Vieira & Matheus, 2018; Önder, 2018; Rodríguez and Camilli, 2018; Yukalang et al, 2017; Dai et al., 2017; Bertoldo and Castro 2016; Becker, 2014; Colesca et al 2014; Yau, 2012; Prestin and Pearce, 2010; Timlett and Williams, 2009; Vicente and Reis, 2008; Jenkins et al., 2003	Önder (2018), assert that income levels do not have a significant impact on the recycling rate. Dai et al.(2017) concluded that the age factor has no substantial effect on recycling behaviours.
Human Behaviours	Jatau and Binbol, 2020; Rousta et al., 2020; Li et al., 2020a; Schill et al., 2020; Sung et al., 2019; Peng et al, 2018; Price, 2018; Moss, 2018; Eichler, 2017; ILM, 2017; Watts, 2017; Schill et al., 2016; Schumaker, 2016; Czajkowski et al., 2015; Taberero, 2015; Keighren, 2015; Phipps et al., 2013; Timlett and Williams, 2011; Fishbein and Ajzen, 2011; Thaler and Sunstein, 2008; Knussen and Yule, 2008; Michie, 2005; Eagly and Chaiken 2005; Tonglet et al., 2004; Ajzen, 1991; Bandura, 1986; Ajzen, 1985	Rousta et al. (2020) concluded that human behavioural factors are the major elements that either enable or function as barriers to conducting recycling activities.
Policy Constraints	Li and Wang, 2021; Ferronato et al., 2021; Sewak et al., 2021; Ayçin and Kayapinar Kaya, 2021; Li et al. (2020b); DEFRA, 2020a; DEFRA, 2019; Ogiri et al., 2019; Wiesmeth et al., 2018; Smith and Bolton, 2018; HM Treasury, 2018; Yukalang et al, 2017; Alfaia et al., 2017; Pollans, 2017; Kirakozian, 2016; Green Alliance, 2014; WRAP, 2014b; ; Cole et al., 2014; DEFRA, 2012; Halvorsen, 2012; European Parliament, 2011; Klockner and Oppedal., 2011; Abbott et al., 2011; Costa et al., 2010; Defra, 2006; Jordan et al., 2003	Li et al. (2020b); Halvorsen (2012), concluded that incentives, fines, and penalties have a weak influence on recycling habit.
Communication/Public Engagement	Sewak et al., 2021; Mofid-Nakhaee et al., 2020; Drimili et al., 2020; Lee, 2020; Jump, 2020; Lee and Krieger, 2020; Al Mamun et al., 2018; Glad, 2018; Satapathy, 2017; Yukalang et al., 2017; WRAP, 2016b; Byrne and O'Regan, 2014; Miafodzyeva and Brandt, 2013; De Feo and De Gisi, 2010; Iyer and Kashyap, 2007; Mee and Clewes 2004; Mee et al., 2004; McDonald and Oates, 2003; Chan,1998	Mofid-Nakhaee et al, (2020) indicate that public education facilitates positive influence in improving recycling quality in comparison to municipalities that do not engage in recycling public awareness.
Service/Collection	Jatau & Binbol, 2020; Tsalis et al., 2018; Yukalang et al, 2017; Shearer et al., 2017; Bernstad et al., 2016; WRAP, 2016a; WRAP, 2016c; Sealey and Smith, 2014; Timlett and Williams, 2011; Entwistle, 1998	Timlett and Williams (2011), state that recycling service is one of the major factors affecting the recycling rate.

Barriers to recycling result from a wide range of factors which could be social, physical, lack of effective community engagement, human, economic, and policy constraints. Interestingly, these same factors could also be used as an intervention to implement an effective recycling system. It should be noted that all these factors are closely interwoven, and any intervention to increase the recycling rate must address all the relevant factors.

Timlett and Williams (2011) recognised three important key factors: infrastructure, service, and behaviour, known as the ISB model that can be used to maximise recycling rates through a better understanding of the situation and context for users' behaviours. Studies undertaken by Yukalang et al. (2017), Jatau and Binbol (2020) and Du Toit and Wagner (2020) confirmed this position. It was further suggested that meaningful intervention is only possible when we understand the behaviour of the end-users of products and then, to achieve a successful recycling regime, align recycling services to fit the end users' behaviours (Timlett and Williams 2011).

2.4.3 Physical Barriers

Among the top three factors of the ISB model, infrastructure is the most important in increasing the recycling rate (Yakob et al., 2020; Du Toit and Wagner, 2020; Letelier et al., 2021), especially in high-density urban areas. Waste infrastructure includes the type of building, allowable internal or external storage space for waste, type of bin infrastructure, proximity to storage or recycling centres, and waste collection vehicle accessibility to collect waste (Timlett and Williams, 2011).

Source segregation, another key element in achieving a high recycling rate, is wholly dependent on infrastructure. Therefore, recycling schemes with no opportunity for source segregation to occur are bound to fail (WRAP, 2008; Turner, et al., 2015). The ISB model did affirm this position. In their research findings, Timlett and William (2011) indicated that 'Infrastructure' with a 'high convenience factor' influenced 'Service' to capture recyclables, which in turn initiated or triggered more positive action in resident 'Behaviour' than 'Infrastructure' with a 'low convenience factor' that restricted 'Service' to capturing recyclables.

One of the problems relating to recycling infrastructure is the non-involvement of the public in the design of the recycling infrastructure. De Feo and De Gisi (2010) suggest that recycling rates could be increased by consulting the householders in the design of waste storage infrastructure in new developments. This is justified, as the householders will use these infrastructures.

Some studies (Jatau, 2020; Yukalang et al., 2017; WRAP, 2014a; Mee et al., 2004) have found that the common barrier to recycling is lack of space, distance to a recycling facility, inadequate infrastructure, and lack of internal storage space.

In terms of distance to recycling facilities, Li et al. (2020a) argued that proximity to recycling infrastructure is not a barrier to recycling practice. Their study of recycling habits in a community with similar characteristics and common factors (except for distance), found that an increased distance of 360m to the recycling facility only has a 3% negative variation to when the distance of the recycling facility was at 80m to the households.

The distance of measurement from the households was between 80m to 360m to the recycling facility. This assertion contrasts with the findings of Yakob et al. (2020) and Letelier et al. (2021), both studies identified an increased distance to a recycling facility as a barrier, as residents with high travel distance to recycling infrastructure were less responsive to recycling activities compared to residents with low travel distance to recycling infrastructure. However, it is important to note that Yakob et al. (2020) study was conducted in a community that has different prevailing factors and situations different from the study of Li, et al. (2020a), which was carried out in a community with the same factors and prevailing situations. This variance in conditions may explain the difference in the outcome of both studies.

Housing type also plays a crucial situational factor in influencing recycling intentions (Díaz-Meneses and Vilkaite-Vaitone, 2020). A resident's intention to recycle may be obstructed by a lack of storage space, both internally and externally, to store recyclable materials. This fact was corroborated by Du Toit and Wagner (2020), their study found that there are more recycling activities in houses compared to apartments due to the availability of storage spaces in houses and the lack of spaces in flatted properties.

Since most buildings in the urban areas are high-rise flatted properties, in contrast to the rural areas where houses are predominant, this could be the reason most of the local authorities with high recycling rates are located outside dense urban environments as evidenced in Table 3.

In the City of Westminster, 70% of the residential housing stock are flatted properties and 30% are houses (ONS, 2021), which indicates that the infrastructure and the types of buildings may be contributing factors to the borough's low recycling rate. It is therefore of paramount importance that future new developments should incorporate effective waste management structures to effectively capture recyclable materials and increase recycling output.

2.4.4 Socio-Economic Barriers

Socio-economic barriers will include population transiency, level of income, level of education, age, knowledge, and awareness of environmental harm that influences human behaviour. The list is not exhaustive as the characteristics of socio-economic barriers also include factors such as homeownership, employment status, political beliefs, and presence of children in the household (Yau, 2012; Becker, 2014; Knickmeyer, 2020; Vicente and Reis, 2008).

Studies have revealed that the level of education and age do affect or influence recycling outputs (Tsalis et al., 2018; Jenkins et al., 2003; Colesca et al., 2014). However, Dai et al. (2017) in their study, although agreed that age is an influencing factor for recycling behaviour, argued that the level of education has no substantial effect on the waste behaviours of the two groups of residents and students surveyed for recycling activities.

Residents with medium or elevated level (college or tertiary education) education are much more aware of the environmental benefits of recycling (Seng et al., 2018; Prestin and Pearce, 2010) or can easily understand recycling communications better, therefore are able to respond positively to recycling campaigns or initiatives. Residents with a low level of education (no education or primary education) may not be able to understand the environmental benefits and therefore recycling response from this group may be low or negative coupled with other factors.

Timlett and Williams (2009) identified the impact of the transient population as one of the main factors affecting recycling behaviours in urban environments.

Portsmouth City was used as a case study in the research. The study results indicate that recycling programs in high-density housing areas associated with less transient and deprived populations are more likely to succeed than in areas with high transient and deprived populations.

However, a cautionary approach must be considered to avoid applying one recycling system to fit all localities (Knickmeyer, 2020), as individual and households' environmental behaviours vary significantly from one locality to another (Klockner and Oppedal, 2011).

Economic factors also play a leading role in affecting recycling rates. Residents in areas of deprived households may not allocate time to or focus on recycling activities because they are more preoccupied with meeting essential needs deemed more important than recycling (Knickmeyer, 2020; Smith and Bolton, 2018).

A negative relationship has been found to exist between income levels and recycling rates (Önder, 2018). Seng et al. (2018), on the other hand, state that the level of income is related to the level of education and therefore greatly influences the resident's awareness of recycling knowledge thus resulting in positive recycling actions.

This relational factor is corroborated by the study conducted by Vieira and Matheus (2018). The level of income also affects the affordability of the type of housing (Jenkins et al., 2003). Predominantly, people on low income may only afford flatted properties which results in low output of recycling rates. In contrast, high- or medium-income residents can afford houses that accommodate effective recycling infrastructure, thereby facilitating high output recycling rate.

2.4.5 Human Behaviours

Different theories have been expounded to explain human behaviours and attitudes and how they influence response or action in a certain manner. Some researchers (Lewthwaite, 1966; Michie et al., 2005; Thaler and Sunstein, 2008) have worked on theories of human behaviours such as Environmental Determinism Theory, Behavioural Change Theory, and the Nudge Theory, respectively.

The Environmental Determinism Theory is based on the idea that the physical environment has an impact on the behaviour of people living within a specified geographical location or climatic conditions (Lewthwaite, 1966). The theory has been criticised widely and rejected because of its use in justifying racial differences and imperialism (Keighren, 2015).

However, the Environmental Determinism Theory could be applied and adapted to suit certain perspectives through the application of local variables. In the recycling context, if the natural physical environment is replaced with a manufactured environment (building type and type of recycling infrastructure) and the socio-cultural environment (custom, education, and level of income), these replacement environments will play a role in determining individual decision-making processes (Rodríguez and Camilli, 2018), and ultimately influence their recycling behaviour.

Defra (2006) suggested an approach of adopting strategies and policies based on a behavioural change model to influence recycling habits. This is a key shift in policy governance to move away from enforcement to the nudging approach. There are many behavioural change models and we have reviewed two major concepts: the theory of planned behaviour and the social cognitive theory.

The theory of planned behaviour was proposed by Ajzen (1985) which describes intention as the basis of any behaviour in conjunction with other motivational factors. The more secure the intention, the higher the performance of the action (Ajzen, 1991). In this model (Figure 2.3), the motivational factors are attitude, subjective norm, and perceived control. Attitude can be defined as hidden or concealed inclination response to physical and nonphysical objects, the response could be negative or positive depending on the nature of the inclination (Fishbein and Ajzen, 2011).

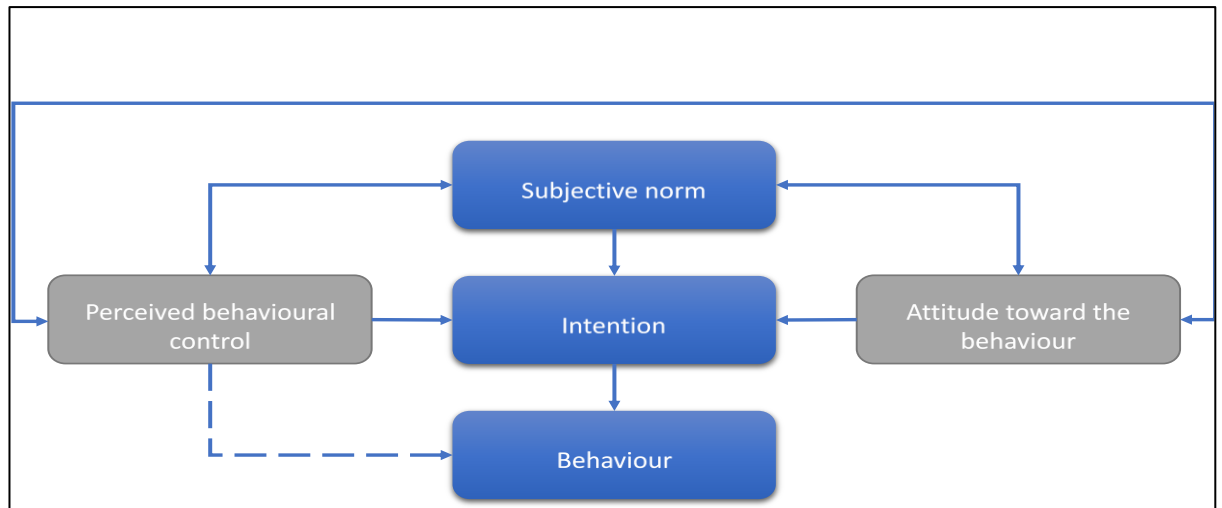


Figure 2.3: The theory of planned behaviour based on Ajzen (1991) showing how perceived behavioural control influences attitude towards the behaviour.

Eagly and Chaiken (2005), define attitude as a speculative or theoretical configuration of the mind. Norms are societal obligations that could be formal or informal standards or rules. Norms could also be described as social pressure influencing individuals to act in a certain way. The stronger the influence, the more likely the action will be performed in the manner described by society (Fishbein and Ajzen, 2011). Recycling studies (Byrne and O'Regan, 2014; Knickmeyer, 2020; Timlett and Williams, 2009) have shown that norms or acceptable behaviours could be localised based on the prevailing narratives in the area or peer pressure influence. A good example is “my neighbourhood recycles so I recycle” or “my neighbourhood does not recycle so I do not recycle.”

Perceived control refers to the ability to act and the self-confidence to project a successful outcome. This ability may include skills, awareness, and other resources that may well include enabling and disabling factors to perform the required action (Fishbein and Ajzen, 2011). In the recycling behaviour context, a positive attitude coupled with positive societal norms and the ability to act (including enabling environment and positive intention) will result in positive recycling habits and an increase in recycling outputs (Sung et al., 2019).

In contrast, a negative attitude from the start of thought to act or not will lead to negative recycling behaviour. However, there will be other barriers or factors that may interact with the process and result in different behaviours. Roustae et al. (2020) reached the same conclusion in their study that human behavioural factors are major elements that either enable or function as barriers to conducting recycling activities.

As an illustration, an individual may have a good attitude coupled with a positive disposition to societal norms and good intentions but lack the ability to perform the required actions (e.g., the lack of recycling infrastructure or resources to enable recycling), such individual will have no choice but to dispose of the recyclable materials as rubbish. Here the good intentions and attitudes were obstructed by external factors beyond the individual's control.

The Social Cognitive Theory (SCT) proposed that learning (Figure 2.4) takes place in a social setting influenced by the dynamic interplay between the personal, behaviour, and environment (Bandura, 1986). In this scenario, the three factors are interconnected rather than isolated in creating an outcome. There is a need to emphasise that the "environment" in social cognitive theory includes both the "physical and socio-cultural environment" different from the solely "physical environment" in the environmental determinism theory. SCT is particularly useful in understanding the dynamics and complexity underlying different elements of sustainable consumption behaviours to ease relevant interventions (Phipps et al., 2013), which can also be applied to understanding individual or communal recycling behaviour and the prevailing situations. Extensive works (Bertoldo and Castro, 2016; Czajkowski et al., 2015; Kirakozian, 2016; Peng et al., 2018; Knussen and Yule, 2008; Cerda and Cerda, 2018; Tabernero et al., 2015) have been conducted to link SCT to recycling behaviours.

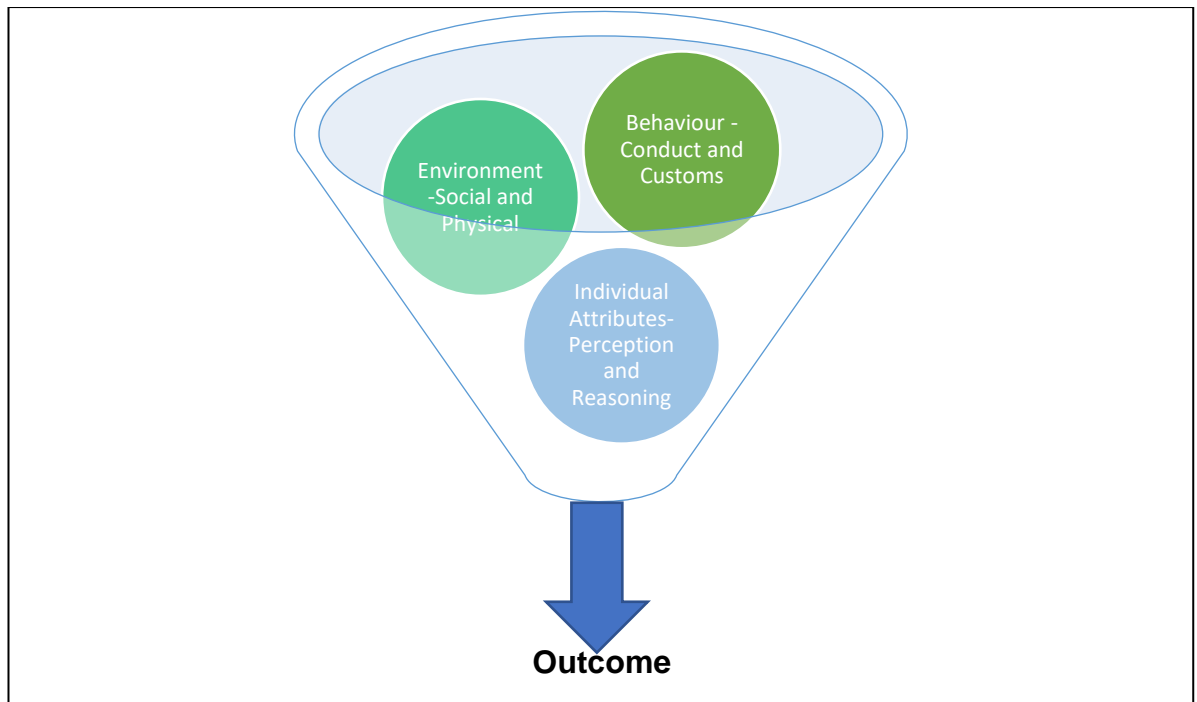


Figure 2.4. The Social Cognitive Theory (SCT) based on Phipps et al. (2013) showing factors that contributes to behavioural outcomes.

Schill et al. (2020) used SCT to research children’s recycling behaviour by exposing the children to different recycling settings. The results show that the level of recycling participation and compliance depends on each child’s family setting, the position of the recycling point, and family interaction influence. Here, the personal (knowledge), the environment (school or home), and the behaviour (past experiences) are at play in influencing different outcomes in different settings.

Schill and Deirdre (2016) also found that selected interventions can be used to ease recycling habits. Similarly, shown recycling behaviours are based on attitudes which in turn are influenced by adequate recycling awareness, accessible recycling infrastructure, and not being constrained by situational factors (Tonglet et al., 2004).

Research conducted by the Institute of Leadership and Management (ILM, 2017) in 2017 shows that the younger generation (20 - 38 years) also known as millennials, will constitute 50% of the UK workforce by 2020. It is therefore important to focus on this group to characterise their consumer behaviours.

Price (2018) detailed five characteristics of millennials with regard to the circular economy. Among these characteristics is the spending power of this age category

as a prolific consumer group, which will start greater demand for products and services specially tailored to their style and taste. Their high preference for online shopping has increased the flow of packaging waste which has necessitated the need to promote recycling education among the younger generation.

Surveys conducted in the UK have shown different recycling behaviours for millennials. A poll of 3,000 respondents conducted in 2017 found that 49% of 16-34 year olds always recycle compared to 70% of the age group 35-54 years that always recycle. The highest barrier to recycling cited by the younger population surveyed was the ambiguity in figuring out what materials can be recycled (Eichler, 2017).

A similar survey conducted by the waste company Veolia found that 71% of the age range 18-24 years have the opinion that the greatest responsibility to recycle lies with the local authorities compared to 58% of over 55 years that share the same opinion (Watts, 2017). Another survey shows that 78% of the age range 25-34 years are in the habit of recycling compared to 94% of people over the age of 55 years (Moss, 2018).

These surveys indicate that the younger generation is recycling less than the older generation. Therefore, the younger generation must be educated about the benefits of recycling which is vital in embedding a circular economy in modern society. Especially, considering that the younger generation is the future generation that will benefit most from the preservation of the environment.

2.4.6 Policy Constraints

Many studies have found policy constraints and limitations as one of the barriers to achieving a high recycling rate in the UK even though the same policies are geared towards this objective. Li and Wang (2021) surmised that recycling schemes can only be successful when policy or decision-making tools are aligned with citizen or public behaviour. Although the UK has one of the more ambitious waste strategies to translate waste and resource management into a circular economy, these strategies lacked a robust process or system in place to achieve their goals. Jordan et al. (2003) echoed the same concern that desired policy goals do not always harmonise with stakeholders' capabilities to implement the required policy ambitions.

Most waste policy interventions are devoid of co-production in terms of understanding the user's needs and situations and involving them in formulating strategies to resolve household recycling issues (Sewak et al., 2021; Alfaia et al., 2017). The Non-involvement of citizens in formulating waste policies and strategies has resulted in public distrust in government waste policies, and thus a barrier to the effective implementation of such policies (Drimili et al., 2020; Pollans, 2017).

Most of the citizens doubt whether the materials collected are genuinely recycled, many believe the materials are burned to generate electricity just like the rubbish collected. Hence, question the need to separate recyclable waste from non-recyclable waste.

Consultations carried out by Defra in 2012 on red tape bureaucracy with a specific theme on environmental regulation, reported that stakeholders in the waste industry raise a concern about the complexity and inconsistency of 257 regulatory instruments within the UK environmental legislation framework (Defra, 2012). Such complexity, inconsistency, and ambiguity are obstacles to delivering policy goals (Ayçin and Kayapinar Kaya, 2021).

One of the shortcomings of waste policies and strategies in the UK is the non-recognition of adequate waste infrastructure and system to ensure source segregations of quality recyclable high-value materials for further processing into new products without recourse to virgin materials (Green Alliance, 2014). Policies are mainly directed to manufacturers, superstores, local authorities, and waste companies but not to the householders who are primarily the producer of the waste. Defra (2019) found that householders' compliance is fundamental to increasing the recycling rate. This then suggests that, at the national level, there is a gap in waste policies that may aim for an integrated approach to waste management in the UK.

The issue of non-direct charging of householders for waste generated meant that local authorities rely on council tax and national government grants to run effective waste and recycling schemes. With recent national government cutbacks on funds available to local authorities, it is natural that most councils will give much

credence to waste management from an economic viability approach rather than to meet national recycling targets (Entwistle, 1998).

Users of recycling receptacles are often confused about which material to deposit in relevant receptacles. This is because a wide range of different receptacles with distinct colours and labels are provided by the local authorities (Jesson and Stone, 2009). This situation and confusion are even more compounded if householders moved from one local authority area to another with receptacles provided in distinct colours and labels.

Lack of uniformed collection system for waste in the UK is as a result of UK waste policy deficiency. (Defra, 2019). Schumaker (2016) suggested that one label is used for each material and adopted everywhere.

Although it has been found that harmonising the collection system across the board may also create other problems (Knickmeyer, 2020); for example, the housing types and environmental behaviour vary in different local authority areas. Therefore, it has been argued that recycling schemes must be tailored or modelled in line with local characteristics (Klockner and Oppedal, 2011).

The economic intervention or policy instrument to resolve the recycling problem is of two facets, the positive incentive gain (deposit return schemes, vouchers, and card points) and the negative incentive gain (fines and tax) that can be used to stimulate recycling habits in households. Mofid-Nakhaee et al. (2020) suggested that giving financial incentives to residents could promote effective recycling activities. Similarly, Zhou et al. (2021) applied the use of financial incentives to the residents where the residents see their recyclable materials as resources that they could trade with the waste collection companies for financial gain. This approach increased the recyclable waste collection by 229% in the surveyed community.

A comparison of the impact of financial penalties on the recycling rate worldwide conducted by Halvorsen (2012) found that the introduction of economic penalties resulted in negative effects. The introduction of penalties or 'pay as you throw' may increase incidents of waste fly-tipping or dumping in public places to avoid paying for waste disposal.

In contrast, Ogiri et al. (2019) in their study of using a deterrence approach to nudge citizens to conduct recycling activities found that the introduction of negative incentives in form of fines and sanctions was a substantial factor in increasing residents' participation in recycling activities.

Similarly, the plastic bag tax introduced in the UK has cut down the rate of plastic bag usage; the latest data published by Defra data show an 85% to 95% reduction in the use of plastic bags, in the UK, between 2018 and 2020 (DEFRA, 2020a).

In Europe, the EU Packaging Directive (94/62/EC) was the driver behind the introduction of a deposit return scheme (DRS) for empty drink bottles and containers. The scheme has been largely successful in increasing the recycling rates of the EU member states with a mandatory deposit return scheme (European Parliament, 2011).

The European Parliament's (2011) briefing paper on a review of DRS in some European countries found that there was between 82% to 98% return rate of bottles and cans. Denmark DRS was successful in achieving an 84% recycling rate through the implementation of a mandatory DRS for drinks containers. Other EU member states, such as Germany and Estonia, also achieved a high recycling rate and return because of DRS implementation (European Parliament, 2011). It can therefore be concluded that any financial penalties or incentives to increase recycling needs to be selective and targeted to certain recyclable materials to achieve effective implementation.

It is noteworthy that the UK is currently drafting contingency plans to implement the DRS in England (Circular, 2020). Scotland has already passed legislation to implement the scheme from July 2022 before which relevant infrastructure will be in place for the take-back scheme (Zero Waste Scotland, 2020). The scheme is also under consideration in Wales and Northern Ireland (BSDA, 2020). In introducing the DRS in the UK, Wiesmeth et al. (2018) cautioned that the scheme could only be effective if there are policy regulations that require mandatory rather than voluntary or informal deposits; in addition, such DRS must be managed, checked, and enforced by the government.

As a result of both past and current UK waste policies, the household recycling rate has increased (Abbott et al., 2011) from zero to the current 45% rate and a shift in public behaviour and attitude toward recycling was seen. However, more work needs to be done on waste legislation to ensure future policies are formulated through stakeholders' collaborations in aligning shared objectives to achieve effective implementation (Norris, 2019).

2.4.7 Effective Communication and Public Engagement

Recycling information and knowledge available to householders have been identified as one of the barriers to achieve a high recycling rate (Byrne and O'Regan, 2014; Miafodzyeva and Brandt, 2013; Lee, 2020). In terms of communication and resident engagement, the barriers may range from a lack of public education or awareness of the benefit of recycling (Satapathy, 2017) to the use of the language of instruction.

Eco literacy and environmental awareness play a significant role in influencing positive recycling activities of a low-income community surveyed (Al Mamun et al., 2018). This research suggested that intense public engagement can be strategically planned to target such communities to increase recycling output. Glad (2018) highlighted that the language of communication could be seen as discriminative if users or citizens within the community cannot all understand the language of communication. Therefore, the non-native English-speaking section of the community is formally excluded from recycling activities.

In the UK, due to the absence of a national statutory regime, there are a variety of recycling regimes in operation. Therefore, many local authorities have taken advantage of this autonomy to introduce relevant recycling schemes and collection systems to meet their national target of 50% (Cole et al., 2014) and specific local needs, such as housing types (Muhle et al., 2010) and prevailing demographic variation.

Some examples are illustrated below. Bexley Council, a borough in the Greater London Area, introduced a recycling scheme in 2011, branded "London Green Points" to nudge and engage residents to increase their recycling behaviour. Under the scheme, residents are awarded accumulated green points every time they recycle to obtain vouchers from the local authority which can be used at local

retailers. Bexley Council achieved a 54.1% recycling rate in the 2018/19 fiscal year (London Data Store, 2019), which is 4% above the national target; the green point scheme has been identified as a factor in achieving this success (Jump, 2020).

The Waste and Resources Action Programme (WRAP) designed a new communication strategy for Barrow Borough Council to implement a new recycling scheme in 2008. The council wants to introduce a separate collection for cardboard and plastic and replace the existing 240L bin with a 120L bin for weekly collection (Wrap, 2016a). As a result of the new scheme implementation, the council achieved an increase in recycling from 22% in 2007/08 to 36% in 2009/10 (WRAP, 2016a).

Newcastle-under-Lyme Borough Council introduced two-phased plans to implement a new kerbside service and a fortnightly waste collection accompanied by separate weekly food waste collections. To achieve the scheme objectives, the council formed a partnership with WRAP to help improve the council's communication strategy and resident engagement approach. The scheme achieved a savings of £500,000 in the year 2010/11 and the recycling rate increased from 27% to 50% (WRAP, 2016b).

Coventry City Council introduced a new larger mixed recycling 240L bin collection and reduced smaller bins for residual waste. WRAP helped the council to design a communication strategy to increase resident participation and the recycling rate. After the scheme was implemented, the Council made a saving of £1m and a 6% increase in the recycling rate (WRAP, 2016c).

These four UK local authorities' examples provide an insight into how different local authorities manage their recycling schemes differently as suggested by Klockner and Oppedal (2011). It also shows that the majority of the UK local authorities are focussing more on communication campaigns (WRAP, 2014b) rather than conducting in-depth studies and analyses to determine recycling behaviours. The only exception to this trend was Bexley's Green Point scheme which focuses on behavioural change through practical residents' involvement.

In summary, communication has been identified as a crucial factor in influencing recycling, either positively through an efficient recycling communication system, or negatively through a lack of awareness and recycling information (WRAP, 2014b;

McDonald and Oates, 2003). Other factors such as resident behaviours, situations, infrastructure, and space also play important roles in influencing recycling rate or output (Timlett and Williams, 2011).

Communication strategies employed by most local authorities in dealing with public recycling behaviour still depend on traditional approaches (Sewak et al., 2021), and therefore, there is a need to shift to contemporary methods of communication and residents' engagement to capture a wider audience, especially the younger generation. As clear from the review, effective communication strategy plays a significant role (Lee and Krieger, 2020; Chan, 1998; Mee and Clewes 2004) in creating awareness about the UK local authorities' recycling programmes.

Local authorities could also embark on programmes such as residents' site tours of the recycling facilities for residents, so they can become familiar with what eventually happens to the materials collected from their households. This will dispel the recycling myth and doubts that all the materials collected are burned and there is no need to conduct source segregation. Public engagement through effective communication and organising awareness programmes could nudge residents and householders to actively participate in recycling activities and ultimately result in a higher recycling rate.

2.4.8 Service Constraints

The recycling services provided to the residents by the local authorities can create conditions that are either favourable or unfavourable to the recycling activities (Timlett & Williams, 2011; Yukalang et al., 2017). Similarly, Tsalis et al. (2018) surmised that effective recycling services are a key factor in enabling a high recycling rate. This assertion was elucidated through their study where bespoke recycling services were tailored to the specific needs of different communities.

This barrier seems to be localised in certain areas and it is situational depending on local factors such as inadequate spaces to offer additional waste streams collection (e.g., food waste), or to hold or store many recyclable materials for seven days prior to the weekly collection service. Jatau and Binbol (2020) found that collection frequency is a factor that can increase the recycling rate in urban areas' flatted developments. Where storage space is scarce, and residents rely on

increased recycling collection frequency to keep up the recycling activities, otherwise these recycling materials will be lost to rubbish collection.

Less than half of councils in England (160 out of the 326) do not offer food waste collection (ITV, 2020). However, separate collection of household food waste can increase the recycling rate through a reduction in the volume of residual waste (Sealey and Smith, 2014; Shearer et al., 2017; Bernstad et al., 2016). Therefore, local authorities with low recycling rates could benefit greatly from the introduction of borough-wide household food waste collection which can increase the borough recycling rate by at least 25%. However, there are challenges to food waste collection such as existing infrastructure may not be capable to support its separate collection and how food waste will be stored in flatted properties before its collection to prevent odour and rodent infestations.

2.4.9 Literature Review Conclusion

In conclusion, it is a challenging task to generalise the barriers to household recycling and one general approach would not resolve all these barriers due to specific localised conditions, prevailing situations, and difficulty in predicting human behaviours.

Nevertheless, the comprehensive literature review found that the following barriers are essential to recycling in the UK: waste policy constraints, lack of effective communication /public engagement, physical barriers, service constraints, human factors, and socio-economic barriers. These factors are interrelated and interdependent in most cases, when one factor is ineffective it could result in a domino effect affecting the whole recycling system. The three most impactful barriers are: physical factors, effective communication/public engagement, and the influence of the prevailing waste policy on service constraints. These three main factors, therefore, need more conscientious effort in addressing the UK's low recycling rate.

Chapter 3 Research Methodology

3.1 Introduction

There are different paradigms that can be applied in exploring and understanding the social world's problems. Two main leading paradigms are positivism and interpretivism, although other paradigms do exist in the research world (Grix, 2010).

In positivist research, the positivist tends to understand and explain the world phenomenon using theory as a means to project realities (Danermark et al., 2002). However, data obtained through this paradigm research are numerical and therefore more applicable to quantitative analysis (Pollard, 2002).

Interpretivism sometimes labelled as the opposite of positivism is more concerned with detailed understanding of human experiences and the reality of research participants and the researcher's experiences (Cresswell, 2003) as the theory may not be adequate to explain the complexity of human behaviours (Grix, 2010). Data obtained through this paradigm are more applicable to qualitative analysis (Mackenzie and Knipe, 2006).

One of the benefits of interpretivism as noted by Thanh and Thanh (2015), is the flexibility and fluid approach to participant reality in giving details about their own peculiar experiences. Therefore, interpretivist research is versatile in unearthing hidden issues from the research participants cascading into rich experiences of the social phenomenon under study (Wahyuni, 2012).

On the other hand, Jones (2011) argued that the positivism paradigm enables and provides solutions to critical issues through the acquisition of quality and substantial data that can unveil trends and remove ambiguity. He noted further that the paradigm makes use of highly cumulative data, and the emphasis is more on the objectivity of the data. Therefore, this research used a mixed-method approach to achieve project outcomes by harnessing both paradigms' strengths that provided a detailed analysis of the resident population's behaviour towards recycling.

3.2 Research Design

The research was a mixed method (Figure 3.1) looking at the ontology of the social experiences and understanding of the public behaviours towards waste management. Lewin (2011) pointed out the benefit of combining both qualitative and quantitative analysis as harnessing the strength of both methods to achieve project outcomes.

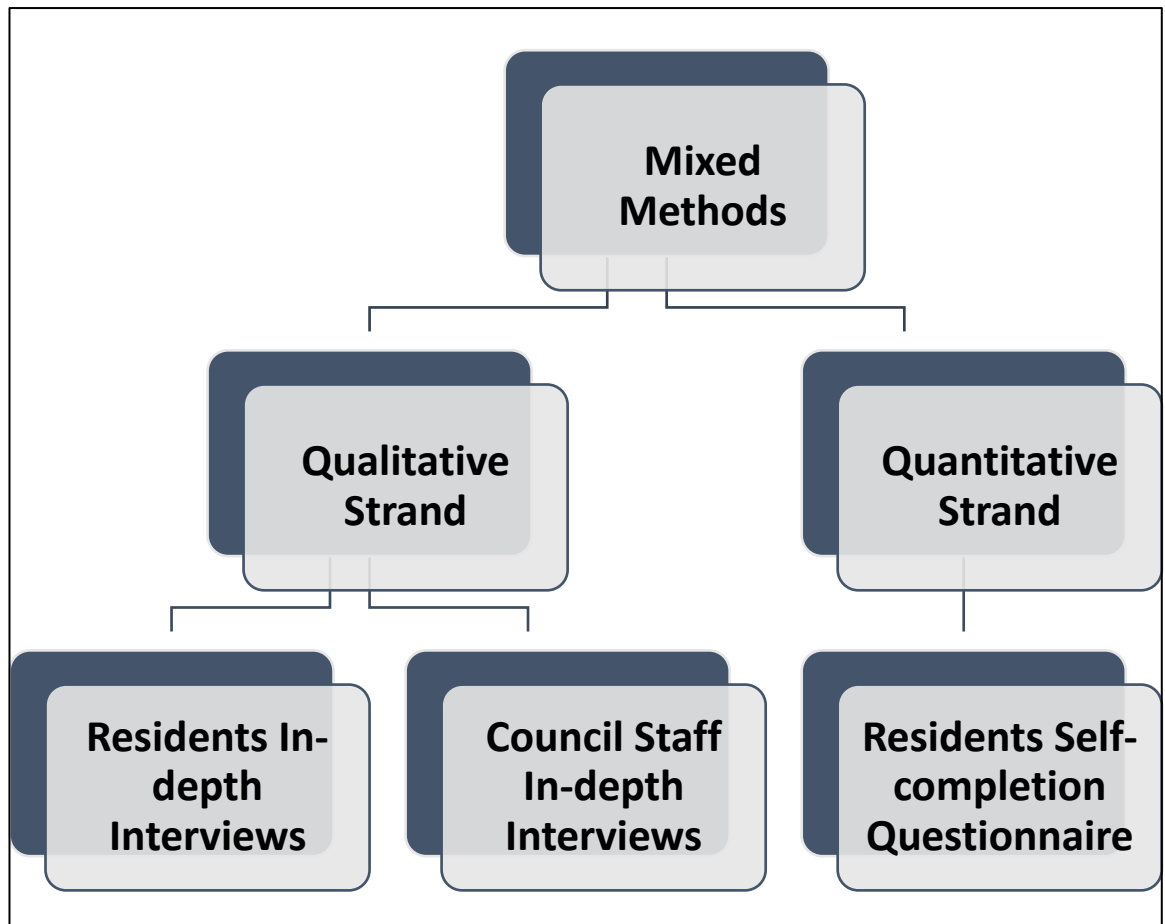


Figure 3.1: Research design showing integrated strategy and analytical approach to address research problems.

In utilising a qualitative approach as part of the mixed method, data were collected through resident in-depth interviews and staff interviews focusing on behavioural attitudes to waste. While residents' questionnaires form part of the quantitative data that was collected as a strand of the mixed method. Qualitative data obtained from the research were analysed using thematic analysis and the questionnaire data were analysed using quantitative analysis.

3.2.1 Participants - Brief Introduction

All adults (male and female) aged 18 years and above who are residents living within the Borough of Westminster were approached for the research as the research questions emanate from households within the borough. The participants were recruited through emails, letters, and adverts on the council's social media and website directed to the residents living in Westminster. The term "resident" is any person that currently lives in Westminster City no matter how long they have resided in the borough.

The advert canvassing for both the in-depth interviews and self-completion questionnaire participants made it clear that only the residents living in the City of Westminster are needed for the research. The inclusion of the ward question (which ward do you live in?) in both the resident interviews and self-completed questionnaires ensured that the residents of the City of Westminster are the only participants that took part in the research.

The residents' interviews have 12 participants, and the self-completion questionnaires was completed by 417 respondents. Also, 3 Westminster Council staff were interviewed from two different departments because of their involvement with the council recycling program. The small number of staff interviews is due to a lack of staff availability to be interviewed.

3.2.2 Pilot Stage- Brief Introduction

Pilot investigations are preliminary studies that provide vital hints to prepare the design of the full-scale study or better indicate any potential issues that can be resolved before embarking on the main study (Edwin and Hundley, 2002).

Similarly, Brooks et. al. (2016) states that pilot studies offer useful insights in terms of validating research questions and identifying gaps in research design.

Furthermore, a pilot study could be used as a "testing ground" to determine the suitability of a research method through the collection of pilot data from two different approaches (Cataldi, 2018).

The essence of the pilot phase was to collect preliminary data to test the approach and to find any flaws or mistakes in the approach before launching the main data collection. This approach also provided a short synopsis of what was expected from the main data.

Pilot resident interviews and self-completion questionnaires were conducted for the residents before the main interviews and the survey was conducted. A pilot in-depth interview was not conducted for the staff interviews due to a lack of staff to interview.

3.3 Data Phases

The research applied a sequential mixed design to collect data. In sequential mixed design, data gathered from one phase is linked to another phase (Driscoll et al., 2007). In using this design in my research, the first phase of data gathering involved the collection of the residents' qualitative data. The resulting qualitative data from the first phase was then analysed and used to design the survey questionnaires to collect the second phase data, which is the resident survey. The final third phase of data collection was the staff interviews, where data collected from the earlier two phases were used as an interview guide.

The goal here is to link one phase (Figure 3.2) to the next phase to identify if all the research participants are facing similar issues in carrying out recycling activities and to determine if the recycling service constraints are linked to the barriers faced by the residents.

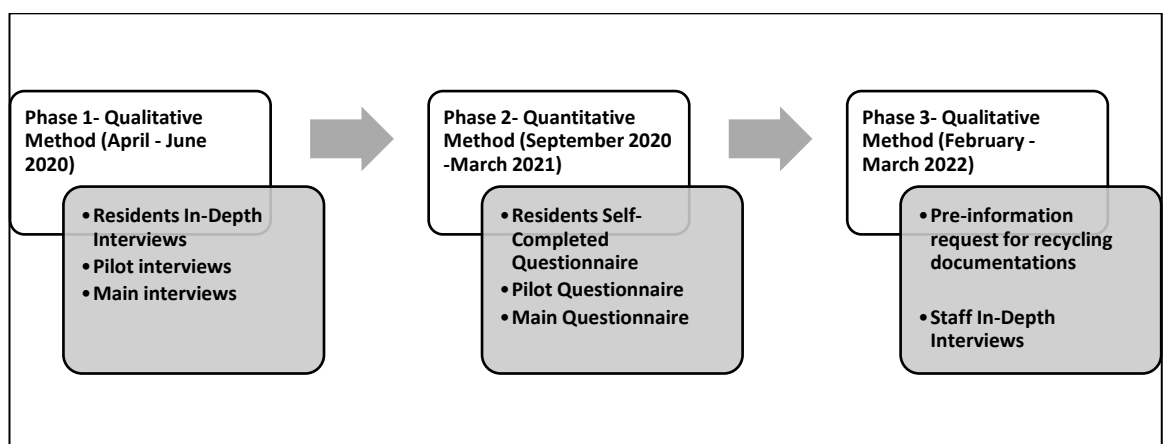


Figure 3.2: Data phases showing 3 stages of data collection and the different time periods of data collection.

Bentahar and Cameron (2015) and Larkin, et al (2014), also affirmed the benefit of sequential research strategy in their research, in which exploration occurs within the framework of analysis, which then allows investigators to have in-depth understanding of the complexity of the phenomenon under study. The results from the data acquired from the three phases were triangulated to develop a sustainable recycling indicator to monitor the recycling rate and to set achievable recycling targets. This approach allows the application of different paradigms to the same research aim in providing new perspectives at each sequential phase.

Data were collected from all twenty wards (administrative areas) within the City of Westminster. It was originally thought that secondary waste data exists for each ward with regards to recycling rate, which would have allowed the determination of wards with low or high recycling rates to be compared. Then the research would focus on the wards with low recycling rates to identify recycling barriers but this waste data at the ward level does not exist. In the absence of existing baseline data, it was decided to sample all the wards as sampling a few wards means that issues in other wards not sampled may be overlooked.

3.3.1 Residents In-depth Interviews (Phase 1) - Sampling Strategy

Phase 1 data collection adopted volunteer sampling approach which is one of the four sampling methods identified by Gill (2020). Residents volunteers living in Westminster City were sought to participate in the research. However, two main criteria for choosing the volunteered participants are that they currently live in Westminster and that they reflect the borough housing types in order to achieve objectives of the research outcomes. Other criteria were that the volunteered participants reflects the socio-economic and demographic characteristics of Westminster in terms of employment, level of education and tenure of residency.

The decision to adopt this sampling method is due Covid 2019 Pandemic movement restriction and the difficulties in recruiting participants for recycling research. The residents' interview participants were recruited using the Westminster City Council social media platform by placing adverts on the social media page.

Additionally, emails were sent to recruit resident participants in the research by using the council residents' database. The communication outreach resulted in only twelve residents showing interest in being interviewed. The initial target for the number of resident interviews was 10 but 12 residents participated in the interview. The reason for the target few numbers of 10 resident interviews was to generate questions and ideas on likely recycling issues that can be asked from the larger number of respondents in phase 2. This approach ensured that the recycling issues were generated organically by the participants with minimal influence of the researcher.

Residents Pilot In-depth Interviews

Two pilot interviews were undertaken. Based on the reactions and responses from the two participants, some of the interview questions were changed. The questions changed or removed from the main interviews are outlined below. Appendix B shows the pilot in-depth interview guide.

- The two piloted participants were reluctant to provide their ages. So, the age question was taken out of the interview questions but was included in the self-completion questionnaire. This decision was taken because the self-completion questionnaire will be anonymous, and respondents may feel comfortable sharing their age through an anonymous source.
- The question "what do you understand by recycling" was changed to "what do you understand by mixed recycling." The participants confused clothes and shoes recycling which are not collected by the council with the usual mixed recycling (plastic, cardboard, glass, and tins) collected by the council. Recycling is a broader term which is not the focus of this research. Mixed recycling is more apt and suitable for household recyclable materials collected by the council and within the confines of the research aims and goals.
- During the first pilot interview, I was trying to answer my question before the participant could respond. I made a note of this and planned to avoid such a situation in the next interviews.

- I added a new question to the main interviews as it occurs to me during the pilot interviews that I have not included the direct question to enquire about recycling barriers. In the main interviews, I then included this question “what are the barriers encountered personally by the participants that may affect their ability to recycle.”

Residents In-depth Main Interviews

A total of twelve resident interviews were undertaken including the two pilot interviews. The interview participants came from varied backgrounds (Table 3.1) such as a librarian, retired personnel (Senior Citizens), project manager, self-employed, full-time housewife and Independent Living Assessor. Nine out of the twelve participants live in flatted properties and the remaining three participants reside in houses.

The participants are located in 8 wards out of the then council’s 20 wards (now redrawn to 18 wards). The educational background varies from no formal education to the master’s degree level. These varied characteristics of the participants described above reflect the Westminster general profiles (detailed in chapter 1.1.1) in terms of percentage of residents in employment, type of properties, and level of education. This ensured that achieved samples represent all possible views that could be collected.

Each of the twelve interviews was reviewed individually to fully understand the participant experience and perspectives taking into consideration their background and any prevailing situational factors. There is no strict or rigid rule in conducting an interview (Englander, 2012). However, two ways of conducting an interview can be identified; face-to-face interview and a self-completion interview where participants can provide their answers in written form (Giorgi, 2009).

Giorgi’s description of the types of interviews did not include the foreseeable trend in technological advancement that now makes it possible to conduct online face-to-face interviews.

Table 3.1: Participant's profiles for both the pilot and main residents' in-depth interviews (Phase 1).

Participant Number	Years of Residency in Westminster	Property Type	Educational Qualification	Profession
P1 (Pilot Interview)	13 years	Flatted Property	Master's Degree	Librarian
P2 (Pilot Interview)	30 years	Flatted Property	Master's Degree	Apprentice
P3	36 Years	Flatted Property	No Formal Education	Retired Personnel
P4	3 Years	Flatted Property	Master's Degree	Project Manager
P5	4 months	Flatted Property	Vocational	Executive Assistant
P6	24 Years	Flatted Property	Diploma	Self-Employed
P7	28 Years	Flatted Property	Diploma	Self-Employed
P8	10 Years	Flatted Property	High School	Homemaker
P9	3 Years	Flatted Property	Bachelor's Degree	Public Servant
P10	5 Years	House	Bachelor's Degree	Project Officer
P11	25 Years	House	Bachelor's Degree	Public Servant
P12	5 Years	House	Bachelor's Degree	Independent Living Assessor

Due to the lockdown restriction and the COVID-19 crisis, physical face-to-face interviews were not feasible and phone interviews were conducted for the residents' interviews by using mobile phones. The option to use an online face-face medium was considered but not used due to possible technical connection issues that may arise during the interviews. Additionally, some of the participants may not have access to the same software as the researcher which would have facilitated its use.

King et. al. (2018) cited building rapport with the participant as a recipe to facilitate the participant's comfort in opening up on issues. Additionally, Rowley (2012) highlighted some important factors in conducting a successful interview. The two factors are clarity in the questions being asked and engaging the interviewee during the interview. These factors were applied by ensuring that the questions are not compounded but open and leading questions to engage the interviewees to elaborate more on their experiences.

The main in-depth interviews consist of 22 semi-structured questions (Appendix C). The interview lasted between 30 minutes to 45 minutes for all twelve participants. This was determined through time recorded on the dictaphone. The interviews were only conducted after the Participant Information Sheet (PIS) and consent form was sent to all the participants and the completed consent form seeking their consent was received by the researcher through email.

It is important to note that all other forms of media were considered such as using zoom and skype but were not used because participants may not feel comfortable with their faces being recorded. Also, there are issues in using these kinds of media due to problems with internet connection such as lack of reliable internet connections in some areas and some participants may not have access to these types of media. Therefore, this option was not offered to the participants.

3.3.2 Residents Self-completion Questionnaire (Phase 2)- Sampling Strategy

A self-selection sampling was used to collect data in phase 2, which provided an opportunity for every resident of Westminster that wanted to take part in the survey. The advantage of self-selection sampling. This sampling approach has the potential to yield good data because it attracts people who have strong opinions about issues relating to recycling. Why one of the disadvantages of the sampling method is the introduction of biases on the part of the participants (Sharma, 2017). Issues around biases were mitigated through triangulation of the three phases dataset. This approach was selected to ensure that all possible residents in Westminster can be sampled due to difficulties in getting people to complete surveys.

The survey was conducted online, and the Westminster residents were recruited through emails, newsletters, the council's monthly magazine called the Reporter and text messages. Also, the council's external website, Facebook page and the app Nextdoor (a social media) were used to give awareness about the survey and to implore them to complete the survey.

Qualtrics software platform was used to design and conduct the survey. The survey was designed to be anonymous so that respondents can be confident in completing the survey and also to satisfy research ethics requirements.

Additionally, the age profiles used in the data collection and analysis (Phase 2) were different from the normal age profiles used for general sampling purposes. This approach was undertaken to reflect the age profiles normally used to collect statistical data in the borough, in order to comply with the Westminster funding requirements.

Residents Pilot Self-Completion Questionnaire

The pilot survey resulted in nine respondents completing the survey online. The pilot survey consisted of thirty-seven questions. Three respondents out of the nine respondents that completed the pilot survey provided the following additional comments:

- That the survey questions are too many and may put people off from completing the survey.

- That the survey should include questions on disability, elderly, and conflict of household opinions regarding recycling.
- That the first few questions were too personal (age, education) and not related to reasons why people engage in recycling.

Reflecting on the suggestions made by the three respondents, I reduced the thirty-seven questions to thirty questions, questions on disability issues and conflicting household opinions were included but the age and education questions were retained because they are crucial factors in monitoring trends in recycling behaviours.

The rationale for removing some questions and merging some questions was noted within the questions that were removed and marked in pink colour. Some of the questions that were retained but revised were marked in yellow colour as shown in Appendix D. Appendix D contained the questions asked in the pilot survey.

Residents Main Self-completion Questionnaire

A total of 417 respondents completed the main online survey, all living within the various wards of Westminster Borough. Table 3.2 shows the ward distribution of the participants. A data size of about 150 samples was initially envisaged due to the public attitude to surveys. The larger size data collected from the survey could be attributed to the increased environmental awareness among the members of the public.

Wright (2005) summarised three benefits of conducting online surveys which are quick access to the target group, time saving and reduced costs. This research capitalises on these three benefits of collecting data through this medium. One of the disadvantages of conducting a self-completion online questionnaire is that detailed information about the participants is unknown apart from the general characteristic used to target the group (Huffman, 2006), therefore some of the responses may be overstated. This issue was mitigated by triangulating data from the three sources before possible interventions were suggested.

Table 3.2: Participants counts for each of the 20 Westminster administration areas (wards) for the resident's self-completion questionnaire (Phase 2).

Ward Area	Percentage	Participant Count
Abbey Road	2%	10
Bayswater	8%	34
Bryanston and Dorset Square	6%	25
Church Street	4%	16
Churchill	2%	10
Harrow Road	3%	14
Hyde Park	8%	32
Knightsbridge and Belgravia	3%	14
Lancaster Gate	1%	4
Little Venice	4%	18
Maida Vale	9%	35
Marylebone High Street	8%	32
Queens Park	8%	32
Regents Park	4%	18
St James	4%	16
Tachbrook	3%	11
Vincent Square	6%	24
Warwick	4%	18
West End	10%	42
Westbourne	3%	12
Total	100%	417

The main questionnaire consists of thirty questions (Appendix E) which were divided into nine sections based on the resulting seven major final themes from the interviews which are outlined below:

Block 1 – Questions 1 to 5 (Demographics)

Block 2 – Questions 6 to 11, and Question 15 (Personal Inclination to Recycling - Planned Behaviour)

Block 3 – Question 12 (Barriers to recycling)

Block 4 – Questions 13 and 14 (Incentives and motivation)

Block 5 – Questions 16 to 21 (Infrastructure)

Block 6 – Questions 22 to 24, and Question 29 (Council Recycling Service)

Block 7 – Questions 25 to 28 (Communication)

Block 8 – Question 30 (Council Waste Policy and Government Legislation)

3.3.3 Council Staff In-depth Interviews (Phase 3) - Sampling Strategy

The staff interviews were conducted to gain a better understanding of the barriers affecting the borough's recycling rate from the council staff perspective. This will provide further insights into the issue under investigation. But more importantly, shed light on different areas not revealed in the resident's interviews. The same interview principles utilised in the residents' in-depth interviews were applied in the Council staff's in-depth interviews.

However, purposive sampling method was used to select the participants in this phase. Gill (2020) described purposive sampling as a selective sampling where participants who are involved in the issues being investigated are directly targeted. This was the main reason for choosing the staff participants that were interviewed because they were involved in the council recycling service.

Four Westminster Council staff were originally chosen to be interviewed from three different departments, because of their involvement with the council recycling program. The three departments were the recycling team (2 interviewees), the council corporate communication team (1 interviewee), and the council research team (1 interviewee).

However, the staff to be interviewed from the corporate communication team was no longer an employee of the council. Interview requests were extended to other members of the council’s corporate communication team to see if they were part of the recycling communication initiatives, but the request was turned down because they were not involved in the recycling program. Eventually, three staff from two different departments were interviewed. Table 3.3 shows the profiles of the three staff that were interviewed.

Table 3.3: Participant’s profiles and background for the council staff in-depth interviews (Phase 3).

CP1 is the council waste and recycling manager that manages the team that coordinated the borough waste management operation. He has been in the team for more than 18 years. He also manages the council waste collection contractor and consults with them on a daily basis.
CP2 is the council recycling officer appointed to manage the council recycling communication, events, and engagement duties. CP2 has been in the post for more than 5 years.
CP3 is the council research and innovation team manager that manages the council’s overall strategy and intelligence functions through gathering of data to help the council make informed decisions. CP3 team has collaborated with the recycling team on many recycling projects. CP3 has been in the post for more than 13 years.

The interview process was carefully designed to ensure that all issues arising from the resident data and the pre-information obtained from the council staff were synthesised to form the basis of the interview guide. The entire process of conducting the three staff interviews was iterative, by updating and revising the interview guides after each interview to provide further insights into the issues around recycling participation.

Before the interviews were conducted, relevant literature, earlier interviews, and the survey analysis were reviewed to obtain an in-depth understanding of the prevailing recycling issues. I also requested for documentation relating to communication strategies from the recycling team. The responses obtained provided the opportunity to streamline the interview guides to target areas of inefficiency. Green and Thorogood (2018) argued that such documentation can be used as control documents to make further improvements. Appendix F shows the general templates used for the staff interviews.

The three interviews were conducted online using Microsoft teams as a medium of engagement. This option of conducting the staff interviews online was utilised because the researcher and staff interviewed have access to the same software being employed by the same council. The interviews were recorded using the recording function within the Microsoft team's application. Each interview lasted approximately 50 minutes. At the start of each interview, I provided the participants with the general outline of the interview. Responses were clarified for further insights or on issues that were not clear from the PIS and the consent form.

Questions were also asked at the end of each interview about other staff that could provide more information about the research. Interview for the CP1 was conducted first, followed by the interview for CP3 and the interview for CP2 was conducted last. CP1 views and responses were used to revise the interview guide for CP3. Subsequently, CP1 and CP3 views and responses were used to revise the interview guide for CP2.

Also, I ensured that the proposed questions are simple, short, and consist of more open questions (using what and how). The closed questions are prompted by further questions. The number of closed questions was reduced to a small number. This is to allow the participants to share more of their experiences, as closed questions will restrict the participant from answering the questions. The research participant information sheet and the participant consent form were sent to all three participants. The consent form was completed, signed, and returned by the three participants.

3.4 Methods of Analysis - Thematic Analysis (Residents and Staff In-Depth Interviews)

Thematic analysis was employed to interpret data obtained from the interviews (residents and council staff). Thematic analysis (TA) can be a daunting task, due to the lack of adequate literature on the process of performing a dependable TA (Nowell et al., 2017). One of the benefits of TA as highlighted by Braun and Clarke (2006), is its ability to assess different participants' views and theming out variances and comparisons to generate unexpected findings.

TA flexibility may lead to a lack of a consistent approach to data analysis (Holloway & Todres, 2003). However, Javadi and Koroush (2016), argued that subjecting data to rigorous thematic analysis will strengthen the validity of the enquiry and mitigate any incoherency.

These benefits of TA as outlined by Braun and Clarke (2006) are in line with the research aims to identify unknown underlying issues that may be affecting the council's low recycling rate. The thematic analysis process of the interviews was conducted in stages as indicated in figure 3.3.

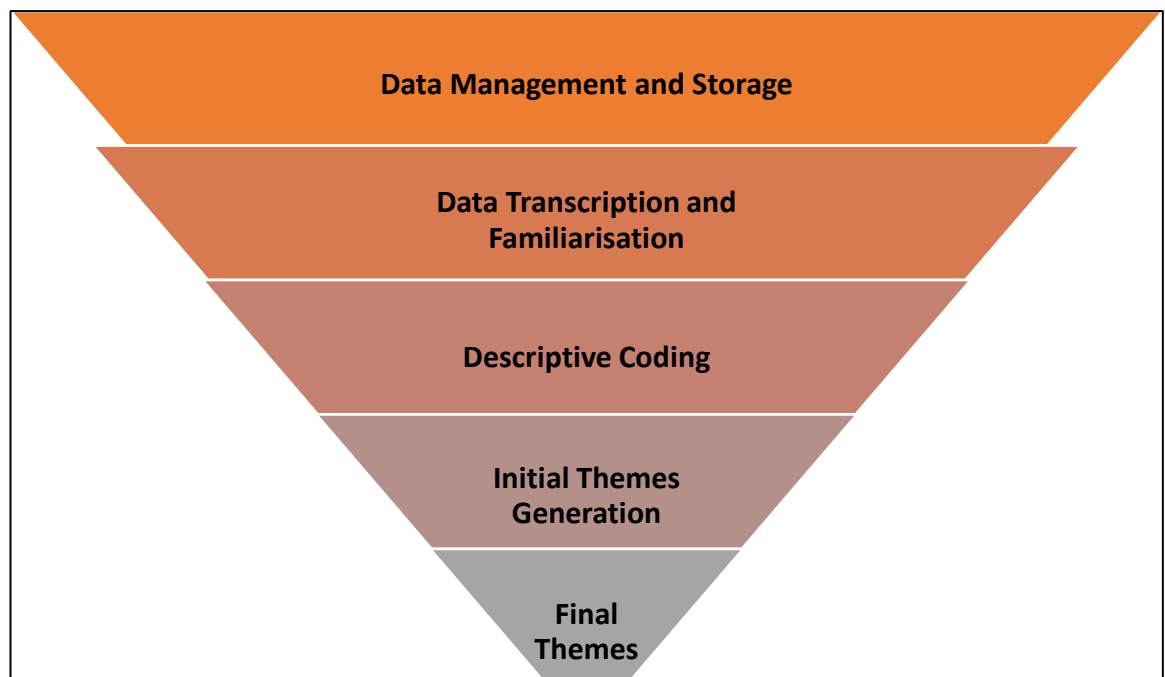


Figure 3.3: Thematic analysis stages showing steps taken in analysing data obtained in Phases 1 and 3.

3.4.1 Data Management and Storage

The residents' in-depth interviews (12) were conducted by putting on the mobile phone speaker and a dictaphone was used to record the interview. The interview lasted between 30 minutes to 45 minutes for all twelve participants. This was determined through time recorded on the dictaphone.

The staff in-depth interviews (3) were conducted online using Microsoft Teams as a medium of engagement. The interviews were recorded using the recording function within the Microsoft team's application. Each interview lasted approximately 50 minutes as indicated by the software timing function.

Each of the interview (both residents and staff) were stored straight after it was conducted and saved in two separate folders under a central database. One folder was used for the residents interviews data and the other was used for the staff interviews data. A serial number in sequence was used as a file title for each participant in the two separate folders. This approach to data management enabled the interviews to be transcribed effectively without mixing up the participants' data.

3.4.2 Data Transcription and Familiarisation

In this second stage of data analysis, the interviews were transcribed word for word to ensure accurate data capture from all the participants. Each of the interview (both residents and staff) were transcribed straight after it was conducted. It took almost a week to transcribe each interview because the interviews were transcribed manually by the researcher without any software assistance. This allows the researcher to be more familiar with the issues and comments raised by the participants.

Notes were also made during the transcription to highlight important issues raised by the participants. Such notes laid the groundwork for initial thoughts on potential codes that could be used on NVivo for subsequent data analysis. To ensure the researcher is well grounded in the comments made by the participants, the transcript notes of each interview were read and re-read to become familiar with their contents and by listening again to the recorded interviews. This robust approach ensured that high quality data was generated from the transcription.

The transcribed interviews were then transferred to NVivo 20 (Release 1.0) for detailed rigorous analysis and interpretation. It is important to emphasise that the whole research (literature reviews, data collection, data analysis/interpretation, and report writing) was done only by the researcher without the assistance of a research assistant.

3.4.3 Descriptive Coding

The next stage is the descriptive coding phase where codes were assigned to important phrases on NVivo 20 using the inductive approach as a guiding principle. In conducting the TA, an inductive approach to the analysis was used to allow the data to generate the themes. This approach ensured that the coding and the themes were data-driven and highly influenced by the contents of the interview data (Caulfield, 2022).

It is important to emphasise that the analysis was conducted by the researcher while NVivo 20 was only used as a data organisation tool to aid effective analysis of the in-depth interviews. The decision to code ideas within each text was taken in piecemeal stages to ensure all important phrases were rigorously coded. This was achieved by adding new codes onto NVivo 20 as the texts were reviewed.

Furthermore, the process of coding the data was not a one-time process for each interview rather it was a continuous process of iterative throughout the research stages based on suggestions by Vaismoradi et al (2016). This robust approach allowed a condensed synopsis of issues occurring in the data. Additionally, this approach mitigates concerns raised by Robson (2002) about the researcher's biasness in conducting thematic analysis.

A codebook was then generated for each interview phase. Appendix G shows some of the transcript notes and the codebook for the resident in-depth interviews and Appendix H indicates transcript notes and the codebook for the council staff in-depth interviews.

3.4.4 Initial Themes Generation

The initial themes stage consists of assigning codes to initial emerging themes on NVivo 20. This was achieved by combining several similar codes to a theme depending on the relativity or connectivity of the codes. As an illustration, codes such as internal and external storage, chutes, recycling bins and storage capacity were themed under Infrastructure. Therefore, initial themes were generated by collating all the codes to identify emerging patterns. Further theme development was framed upon Vaismoradi et al (2016) proposition on thematic analysis stages which are formation, refinement, and finalisation. The formation process was utilised in the initial theme stage, while the refinement and finalisation process was utilised in the final theme stage.

During the formation of the themes, the codes generated were classified, labelled and then compared to each other to discern any differences or similarities. This process allowed initial themes to emerge through further definitions and descriptions. These descriptions were based mainly on similarities criteria or common trends among the codes. This process was used to assign each code to emerge themes as shown in Table 3.4.

Table 3.4 showing how the codes were assigned to the initial themes.

Codes	Initial Themes
A1	Initial Theme 1
B1	
C1	
D1	
A2	Initial Theme 2
B2	
C2	
D2	
A3	Initial Theme 3
B3	
C3	
D3	

3.4.4 Final Themes Generation

During the final themes stage, the reviewed initial themes were further streamlined on NVivo 20 to obtain the final theme to form a title that reflects the general subjects.

The refinement and finalisation process as earlier suggested by Vaismoradi et al (2016) was used to relate the themes to established categories or classifications to develop a succinct and clear narrative. As stated earlier, the refinement of the codes and themes was a constant process throughout the research.

The criteria used to join the initial themes under a broader theme is based on their relation and connection to the broader term. It is important to emphasise that the key criteria in determining the final themes were looking for issues or factors that are central to a particular theme which then allows the overarching themes to emerge. Table 3.5 indicates how the initial themes were assigned to the final themes.

Table 3.5 demonstrating how the initial themes were assigned to the final themes.

Codes	Final Themes
A1	Final Theme A
A2	
A3	
A4	
B1	Final Theme B
B2	
B3	
B4	
C1	Final Theme C
C2	
C3	
C4	
D1	Final Theme D
D2	
D3	
D4	

For example, food waste collection, collection frequency and council recycling service were identified separately as themes in the initial descriptive coding stage but were all grouped under council recycling service, because “council recycling service” is a broader term and encompasses the food waste collection and the collection frequency.

3.4.5 Results Extract from NVivo 20

Functions within NVivo 20 were used to help organise the resulting information from the thematic analysis carried out. The word frequency function was used to determine the most frequent words within the dataset. Meaningful interpretation could not be made from the result of the word frequency run on NVivo. However, the thematic mind maps, codebook, and comparison analysis functions proved very useful in the report presented in chapters 3, 4, and 6. The diagrams and information gathered using these functions were extracted from NVivo, which allowed graphical representations of the analysis results.

3.5 Methods of Analysis - Quantitative Analysis (Self-completion Questionnaire)

The survey data collected was analysed using the Pearson's chi-square test of independence. Chi-square is a statistical test that is used to determine a significant relationship between two or more categorical variables (Shih and Fay, 2017). Also, it can determine if variables in a population do not have strong association, which can aid in concluding that such variables are independent (Nihan, 2020).

Chi-square test for hypothesis tests about whether the sample collected is as expected. The chi-square test is used to contrast the observed values in the data to the expected values that you would perceive if the assumptions were true (Hess and Hess, 2017).

- The null hypothesis H_0 states that the 2 variables are independent (meaning that the value of one variable does not explain the value of the other variable)
- The alternative hypothesis H_1 states that the 2 variables are dependent (meaning that the value of one variable assist in the prediction of the other variable)

The assumption of the chi-square is that data is obtained independently from the population, and each cell must have at least 5 cases in 80% of the cells and no cell should have less than 1, and a p -value less than 0.05 will indicate statistical significance (McHugh, 2013).

The test is nonparametric and not suitable for parametric data (Rana and Singhal, 2015). The benefits of chi-square include the test's flexibility, robustness, and ease of application while the test drawbacks include non-sensitivity to a small sample size below 50 and issues with analysis for 20 or more data categories (McHugh, 2013). The limitation of the test does not apply to this survey as the sample size was more than 50 and the data categories were less than 20.

Oakshott (2017), in comparing the benefits of data collection methods asserts that the accuracy of any survey data depends on its size, the larger the data, the more precise the result. This is because large samples enhance data stability by reducing variance and providing greater opportunities for statistical analysis and sub-sample analysis. The sample size (N=417) obtained from this survey was large enough to enable data analysis.

The chi-square was used for the survey analysis due to the categorical data nature of the survey. The survey was primarily based on the recycling behaviours of Westminster residents and to investigate if any of the factors affecting recycling participation are related or independent. The chi-square provided the best fit analysis to achieve these objectives based on its strengths and weaknesses elucidated above.

Therefore, in order to examine significant relationships between demographic variables (age, education, residence type, and administration area) and recycling factors (such as behaviour, habit, communication, engagement, recycling facilities), we used a chi-square independence test after verifying its assumptions (the sample consisted of independent observations, and the count in each cell was larger than 5). A critical value of 0.05 was used for statistical significance for all tests carried out.

3.5.1 Sample Representativeness (Self-completion Questionnaire)

The demographic data within the self-completion questionnaire was compared to the existing secondary baseline demographic data to decide if the sample population was representative of all the residents living in the borough of Westminster. This approach ensured that the sample data was close to the true population.

A purposeful quota sampling (selective sampling) approach was not undertaken in this survey simply because the data required to fulfil research aims need to be objective in seeking views from all possible residents of Westminster. The questionnaire data is shown in Appendix I.

Three demographic data were collected as part of the survey, which are age, the highest level of education obtained and type of housing. These three data were compared to the existing secondary baseline data obtained from the London Datastore (2015) which is derived from the Office for National Statistics (ONS) for data collected in 2011. The full report of the census 2021 was not available at the time of publishing this thesis. The detailed process of demographic data adjustment to suit the true population is available in Appendix J.

3.6 Ethical Consideration

Ethical consideration can be defined as code of conduct and values employed in research designs to ensure research integrity and prevention of harm to the participants (Bhandari, 2022). Bhandari (2022) identified six ethical issues that could arise when conducting research. However, only five of these ethical issues apply to this research, which are research integrity, voluntary involvement, informed consent, confidentiality, and biasness. Ryen (2004), also identified informed consent as one of the ethical issues to be considered in research, to ensure that research participants are informed of their withdrawal rights and the nature of the research. Issues relating to voluntary participation and informed consent were mitigated using information contained within the participant's information sheet (PIS) to ensure that all participants are aware of their voluntary participation and have the right to withdraw from the research at any point in time. Figure 3.4 shows the different ethical issues faced during the research and the mitigation for each issue.

The participant's consent was obtained, signed, and documented. Appendices K and L show the participant information sheets (PIS) and the template of the consent form that were distributed to the participants, respectively. The link to the PIS was included in the survey and the first page of the questionnaire (Appendix I) requested their consent before they completed the questionnaire.

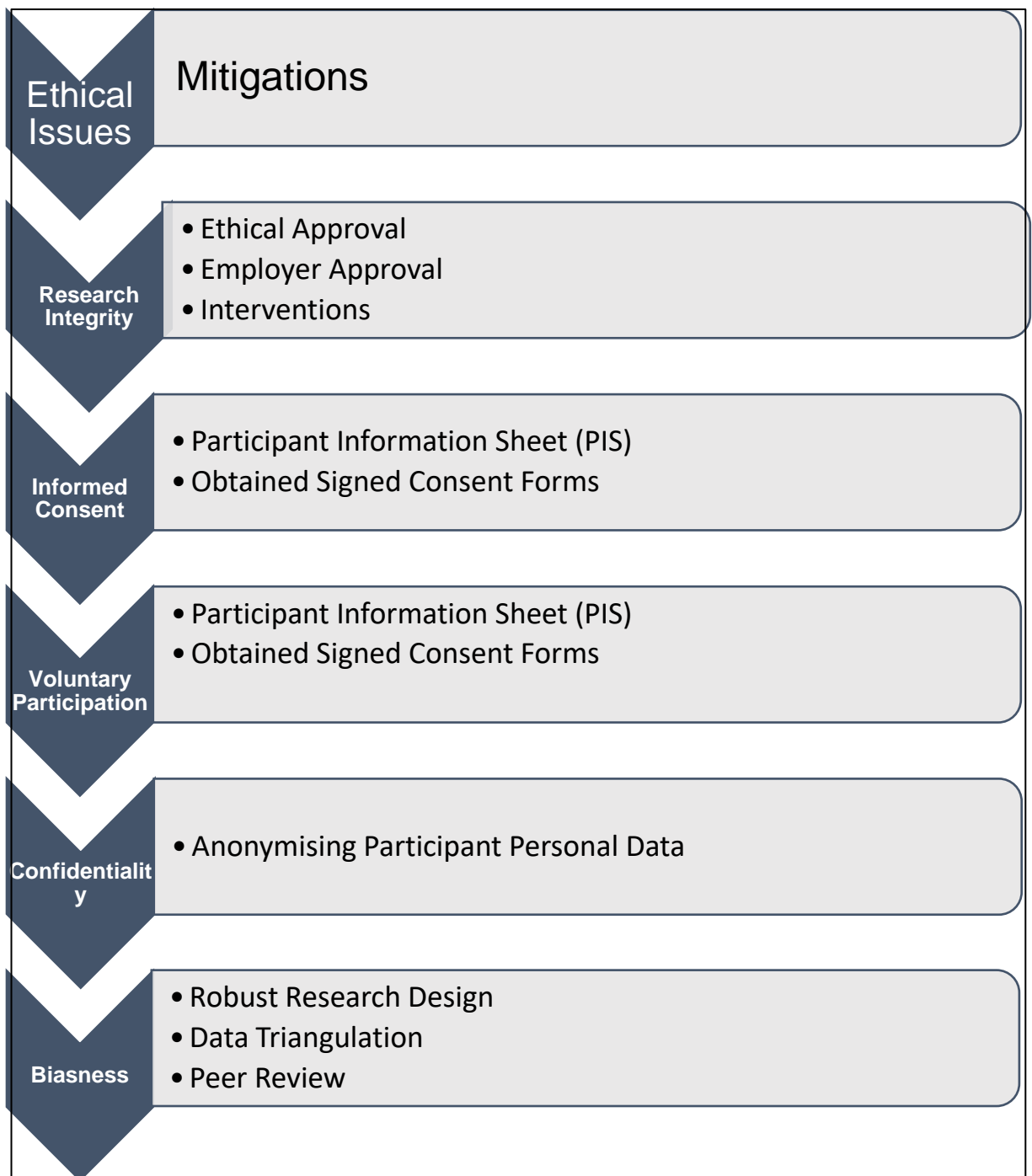


Figure 3.4: Ethical issues faced during the research and mitigations to resolve ethical issues.

There are ethical issues relating to personal data with regards to research interventions using CCTV and personalised digital cards to monitor the use of the micro recycling centres and the communal bin stores in high rises. It needs to be stressed that their uses are only proposed for deterrence (CCTV) and collecting waste data (personalised digital card) from different households to provide better services and management of the waste facilities.

It is not proposed that these technologies are used for imposing fines or levies on the residents. These intervention issues will be mitigated by recommending that the council and developers should inform the residents of their uses and seek their consents within the tenancy agreements.

Ethical consideration relating to confidentiality was mitigated by anonymising the participant's personal data within the in-depth interviews. The self-completion questionnaire was designed to collect non-personal data so that the participants could be identified.

The research results were analysed thoroughly to remove any bias and to ensure the correct interpretation of the data obtained. Pannucci and Wilkins (2010) asserted that biases can occur at any stage of research from design to presentation of results.

Pannucci and Wilkins (2010) suggested that biases at the design stage can be mitigated by randomising pilot participants and keeping to minimum the exclusion factors in order to closely align the study and the population under study. The pilot studies undertaken were framed on the basis of this suggestion to avoid researcher biases toward selective groups within the residents of Westminster.

Smith and Noble (2014), summarised how biases could be mitigated throughout the research process, by following a robust approach to constantly compare participant's accounts, data triangulation and peer review of the results. The data obtained from the research were subjected to this rigorous approach to validate data.

Finally, access to council data, resources and materials was obtained from my employer (Appendix M) and ethical approval was obtained from the University ethics committee (Appendix N).

Chapter 4 Results and Discussion – Phase 1 Data

4.1 Thematic Analysis- Phase 1 Data

The methods and process of developing codes and themes for the residents' qualitative data have been described in detail in Section 3.4.1. The 10 initial themes that emerged from this process are shown in Figure 4.1. Table 4.1 shows the different codes assigned to the initial themes.

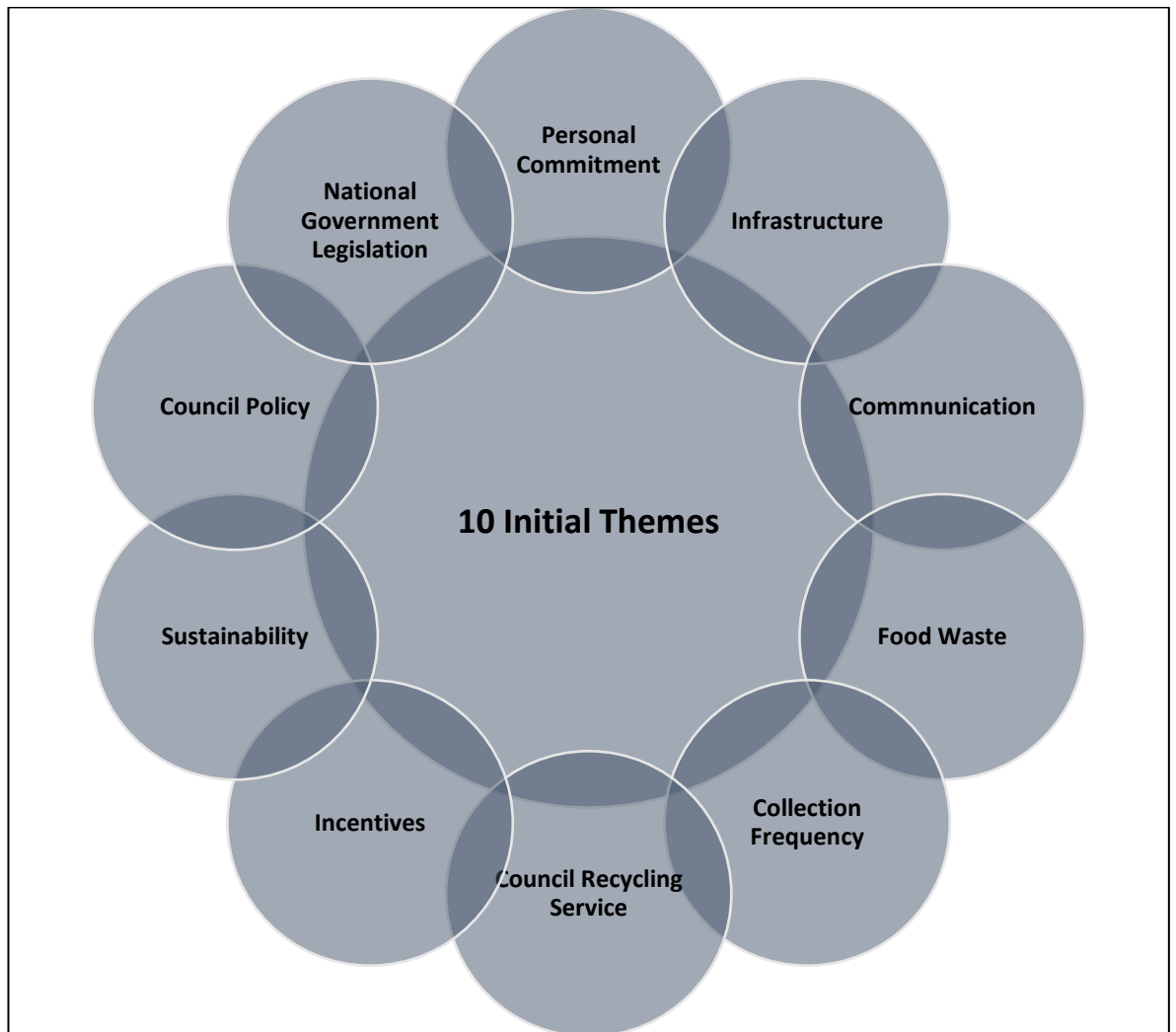


Figure 4.1: The 11 initial themes that emerged during the thematic analysis of the residents' in-depth interviews (Phase 1 data).

Table 4.1: Coded texts allocated to initial themes for the resident's in-depth interviews during the thematic analysis (Phase 1 data).

Initial Themes	Examples of Coded Texts to the Initial Themes
Infrastructure	Space constraints, lack of internal space available to allow source segregation, lack of external space availability for a refuse store, inadequate number of recycling bins, lack of external recycling bins, proximity of recycling bins location, easy to recycle in houses- individual bins, difficult to recycle in blocks of flats- communal bins, and use of chutes causes blockages.
Personal Commitment and choice	Recycling habit, neighbour and peer influence, moral obligation, enthusiastic about recycling, keen recycler, hates waste, and looking forward to food waste collection (eagerness to participate in food waste collection service).
Communication	Lack of public engagement, lack of recycling awareness, ineffective communication, inconsistent communication with residents, and language of communication do not reflect resident diversity.
Food Waste	No collection for food waste, desire for food waste collection, food waste collection will reduce the amount of waste in the rubbish bin, food waste collection will increase recycling rate, not happy with non-collection of food waste, urgently require food waste service, and low public engagement on the food waste trial.
Collection Frequency	Reduced waste collection frequency will push residents to dump waste, reduced waste collection frequency will not increase recycling, reduced rubbish collection will cause more problems, I am opposed to reduced rubbish collection because it will lead to waste fly tipping, reduced waste collection will force people to separate rubbish and recycle, maintain current rubbish collection and increase recycling collection, reduce refuse collection and increase recycling collection, reduced rubbish collection frequency will work in some ward and not work in other ward, and current collection service for waste and recycling is very reliable.

Initial Themes	Examples of Coded Texts to the Initial Themes
Council Recycling Service	Problems in accessing recycling bags from the council, new residents that have difficulty to access council recycling service, over spilling of recycling bins occur most in Christmas periods because of no increase in recycling collection, friendly and helpful waste collection team, particularly valuable experience with recycling service, and priority given to rubbish collection more than the recycling collection.
Motivation/Incentive	Acknowledgement of the current incentive schemes in some wards known as community reward, lack of incentives schemes in some wards, Introduce local competition to increase recycling rate, incentives will be popular if linked to localised employment or something visible in the local community, Introduce incentives to all wards, deposit return schemes (DRS) will only benefit residents on low income, deposit return schemes (DRS) will not work in some affluent areas of Westminster, and use fines for non-recyclers.
Sustainability	Protection of the environment, recycling to protect future generations, recycling to protect the planet, and recycling help preserve wildlife and improve human lives.
Distrust in council waste policy	Residents' doubts about recycling destination, transparency on end use of recycling may increase motivation, more clarity on recycling destination, recycling is a myth. distrust the council on recycling policy, where does the recycling end up, and what is the point of recycling.
National Government Legislation	Inconsistent recycling regimes, different recycling regimes across different boroughs, ban manufacturers from producing goods and packaging that are not recyclable, legislate on unnecessary packaging, hold landlord responsible to force them include recycling terms in contracts, recycling regimes should be consistent throughout the country, compulsory landlords to provide recycling storage in their properties, take hard stance and zero tolerance against non-recycling.

The initial ten themes were critically reviewed to look for similarities and to group them into broader terms that reflect the general subjects which then results into the final seven themes. Figure 4.2 indicates the 6 final themes while Table 4.2 displays how the 10 initial themes were merged to achieve the 6 final themes.



Figure 4.2: The 6 final themes that emerged during thematic analysis of the residents' in-depth interviews (Phase 1 data).

Table 4.2: Initial themes grouped under the final themes during thematic analysis of the residents' in-depth interviews (Phase 1 data).

Final Themes	Initial Themes Grouped under Final Themes
Human Factors	Personal Commitments, Sustainability and Choice
Physical Factors	Infrastructure
Communication and Public Engagement	Communication and Public Engagement
Incentives	Incentives
Service Constraints	Food Waste, Collection Frequency and Council Recycling Service
Policy Constraints	Distrust in Council Policy and National Government Legislation

4.2 Final Emergent Themes

Each of the final themes will be discussed below in detail and relating it to the main research objective of “What are the barriers in achieving high recycling rate” and possible interventions to mitigate these issues. Relevant interventions are briefly discussed in this chapter as a detailed discussion on intervention is presented in Chapter 8. Also, only a few quotes from the participants were used in this chapter, more detailed quotes are available in Appendix G

Braun and Clarke (2006) advised that the presentation of the thematic analysis report be succinct, comprehensible, rational, and stimulating by synthesising issues across the themes to provide a thought-provoking presentation. In addition, arguments from literature could be used to support the findings of the results. The analysis of the results and subsequent discussion were framed upon Braun and Clarke (2006) suggestions.

4.2.1 Human Factors Theme

This theme comprises three sub-themes as indicated in the thematic mind map shown in Figure 4.3. The human factor's theme explained the participant's tendency and consciousness that underpin or drive the action that influences the

recycling behaviour or habit. This consequently impacts the recycling output either positively or negatively. The result as explained below shows that the human factor has a positive impact on the participants influencing their recycling habit.

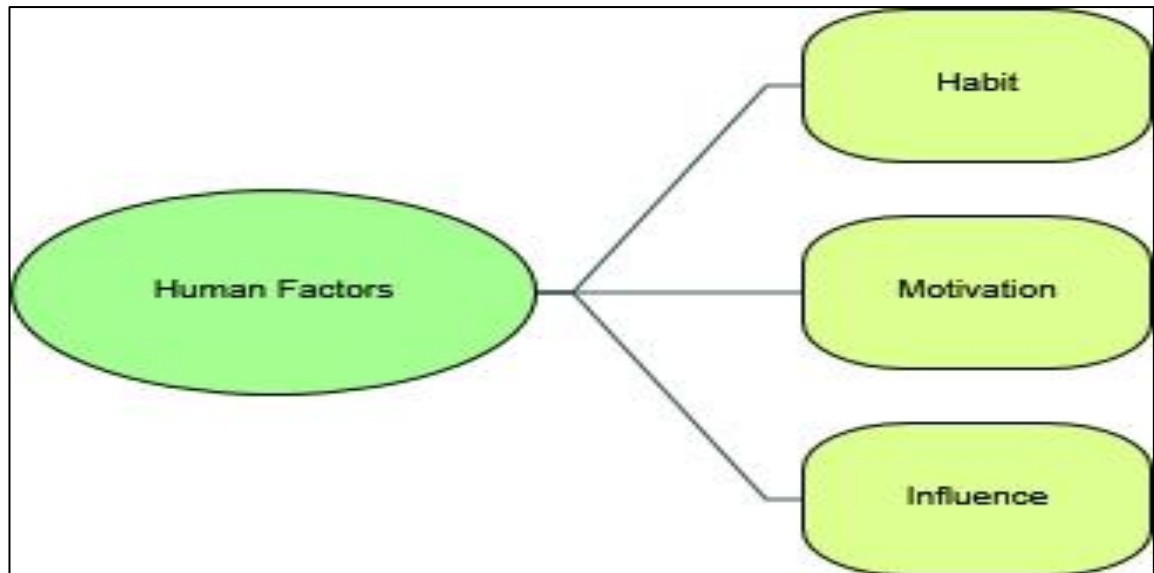


Figure 4.3: Thematic mind map indicating the 3 sub-themes under the human factors theme.

Oluwadipe et. al., (2021) identified human behaviour as one of the factors affecting recycling participation where motivation and habit play vital roles in influencing behaviours. Sung et al., (2019) also highlighted that behavioural attitude may have a negative or positive effect on recycling activities.

The sub-themes discussed under this theme indicate that the participant's behaviours have positive effects on recycling activities but issues from other themes (such as physical factors and service constraints) are contributors to their inability to recycle effectively.

Habit: This sub-theme reveals some of the participant's zeal, passion, consistency, commitment, habit, and tenacity towards recycling activities. It indicates consistency in recycling activities and therefore will enable a steady supply of recyclable materials to increase the recycling rate. All the participants (with the exception of P3 and P7) are consistent with their recycling habits although with varied degrees of passion and consistency.

In terms of varied degrees of consistency, P5 and P10 implement a constant recycling action in checking the material label to confirm if it can be recycled to avoid placing the material in the wrong bin. P4, P6, P9, P11, and P12 also stated that they are very consistent in their habit in recycling their waste.

While P2 is eager to participate in recycling activities, but they are trying to familiarise themselves with recycling activities to be confident about recycling properly. But more importantly, looking forward to participating in the future food waste collection service currently being planned by the council. However, some other participants like P7 and P8 even though they engage in recycling activities are struggling to keep up with their recycling habits due to busy work schedules.

Only two participants (P3 and P7) are not fully committed to recycling activities. Interestingly, the reason for P3 inconsistent recycling habit is a different reason why P3 is not a committed recycler even though both have been residents of the borough for more than 25 years and live in flatted properties.

“We would like to recycle. There is no recycling in this block as there is no external bin for recycling.” (P3)

“I am not consistent with my recycling; I only recycle when I can. I am remarkably busy and do not have time to sort the recycling out and may end up in the rubbish bin.” (P7)

The P3 non-commitment to recycling activities is due to a lack of recycling storage facilities and would have been committed if storage facilities were available.

Whereas P7 inconsistency with recycling activity is due to a lack of time. It is important to note that P7 is self-employed which may be a contributing factor. However, P6 who is also self-employed is a committed recycler.

It is therefore evident that all the participants exhibit varied characteristics within this sub-theme. However, this is expected as human behaviours vary from one person to another. Phipps et al. (2013) used social cognitive theory (SCT) to explain the variance in human behaviours where the action is influenced by varied situational factors and the dynamism of the human mind. A detailed explanation of this theory was provided in the literature review.

The statements above, therefore, reveal that in these instances, the barrier to recycling is both human and lack of storage infrastructure, and it is evident that these factors are interrelated and require holistic interventions to resolve these issues. The provision of an adequate storage facility will resolve the issue with residents that have a similar situation as P3. While residents with P7 situations could be incentivised to participate in recycling activities.

Motivation: This sub-theme describes what motivates the participants to be committed to recycling activities. Awareness of environmental benefits, moral principles, and protection of the ecosystem are the motivating factors propelling the participants to engage in recycling activities. Even P7 (who seldom recycles) acknowledges that he sometimes carries out recycling activities because it is good for the environment.

Resident awareness of recycling benefits and schemes in place is particularly important in increasing recycling output. This assertion has been proved in the studies carried out by Lee (2020) and Byrne & O'Regan (2014), where awareness of recycling benefits has been identified as a factor that increases recycling participation.

Since the council collects the recyclable materials as co-mingled giving rise to the term "mixed recycling." One of the questions then was to ask respondents if they know what the term means. All the respondents are familiar with mixed recycling, and they were able to articulate its meaning.

P2 provided a statement that summarises the views of all other participants. P2 relates that they are influenced and motivated to engage in recycling activities due to the blue planet documentary effect and the understanding of the environmental impact of waste mismanagement. P2 has a master's degree qualification which is also a contributing factor. A factor that is applicable to most of the resident participants interviewed.

"All of the above. moral principle, blue planet effect or environmental harm and benefit. Definitely. Can I just say I do not like waste? It does annoy me. I make use of unwanted materials for other things to use. We all must do it, not just one person" (P2).

Interventions that will be proposed in the communication and public engagement theme should increase residents recycling participation.

Influence: This sub-theme captures intra-household influence and inter-household influence on recycling habits and behaviour. It also details how some participants are taking responsibility or ownership of resolving recycling problems by contacting the council on behalf of other residents or influencing other household members to carry out recycling activities.

P4 and P11 shared their experiences of how they have influenced a member of their household to inculcate recycling habits so that the efforts of the influencer in recycling materials are not wasted but complemented by the other household member. This intra-household influence is an important factor that the council should research more in identifying the key recycling influencer in each household to nurture other household member's recycling habits.

"I make sure my girlfriend does as well. We should be influencing people to do the right thing and not push them in the wrong direction." (P4)

"Even my 14 years old, when she was two, I used to encourage her to put things in the recycling bin. She is 14 years old now and that is how long we have been recycling". (P11)

Although both P4 and P11 are graduates, P4 lives in a flatted property while P11 lives in a house. In another sphere of influence, P1, P2 and P5 exhibited self-responsibility in taking measures to help other residents recycle their waste effectively. These participants are so enthusiastic about recycling and will go to the extent of aiding other residents to effectively recycle such as putting up recycling leaflets in the communal areas.

One good example provided by P2 was calling the council to come and collect bins that are full. The impact of this single action of P2 will prevent the loss of mixed recycling as being disposed of as rubbish. P5 will challenge other residents when misusing the communal recycling bins. These three participants (P1, P2, and P5) live in flatted properties where communal bins are utilised. A detailed comparison of participants with shared characteristics (building type) is available in

Appendix O which explored both the commonality and differential barriers to recycling.

P1, P2, P4, P5, and P11 can be categorised as “environmental champions” based on their actions. Plank (2011) defines environmental champions as volunteers who raise environmental consciousness and foster a culture of responsibility within their community. The council already has a recycling champion network and residents like P1, P2, P4, P5, and P11 could be utilised to make meaningful contributions to increase recycling participation in their local areas.

In terms of perceived negative influence, the perceived norm of neighbours was also evident with P8. P8 only recycles intermittently, it is likely that their inconsistent recycling habit is influenced by inter-household’s influence arising from the neighbours. Norms could be described as a social pressure influencing individuals to act in a certain way. The stronger the influence, the more likely the action will be performed in the manner described by society (Fishbein and Ajzen, 2011)

“But I know that I do not see many of my neighbours carrying out recycling because I rarely see the recycling bags at the bin storage area.” (P8)

P8 is a homemaker by profession and holds a high school qualification. This may be a contributing factor. Although, other factors may also be influencing this habit or perception. The provision of eco-literacy and awareness could mitigate the perceived negative norms.

4.2.2 Physical Factors Theme

The physical factor’s theme detailed infrastructural barriers faced by the participants in carrying out effective recycling activities. There are sub-themes as indicated in Figure 4.4 thematic mind map. Adequate waste storage facilities have to be aligned with positive human behaviour, good recycling service and effective communication/engagement to enable effective recycling participation.

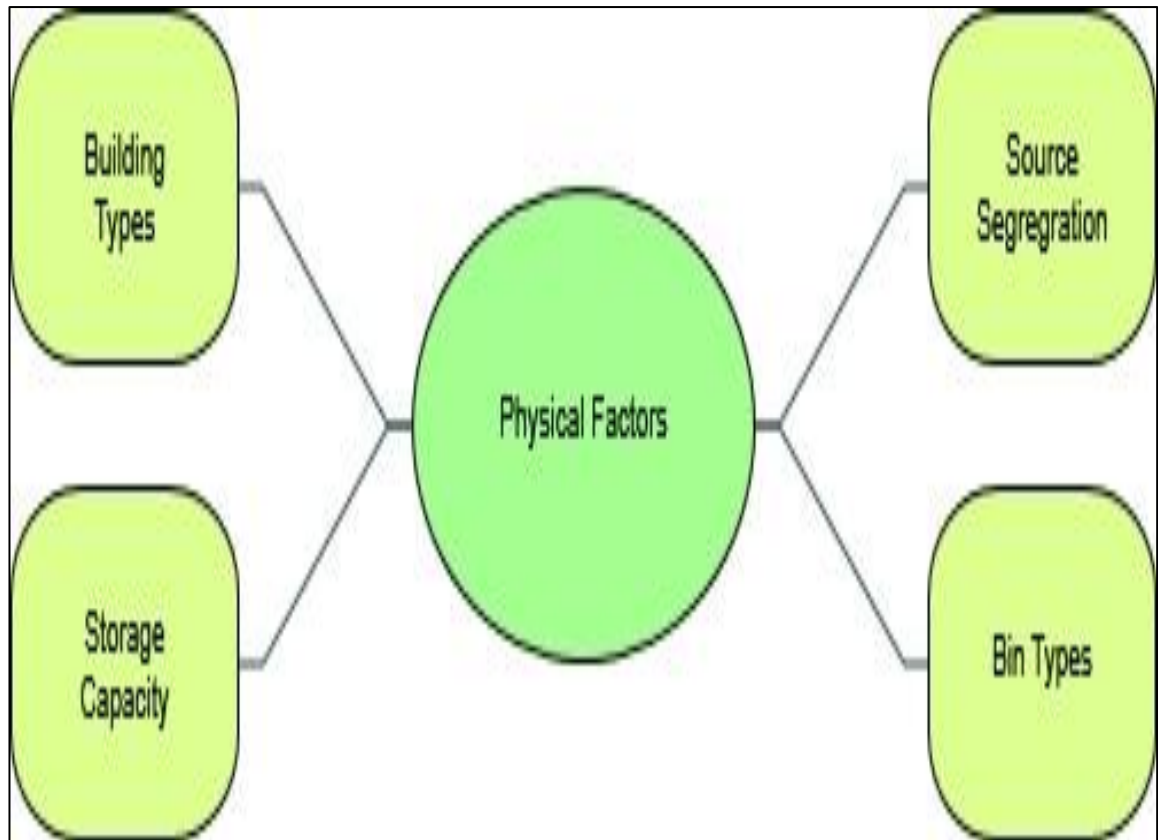


Figure 4.4: Thematic mind map indicating the 4 sub-themes under the physical factors theme.

Building Types: This sub-theme revealed building types as enabling factors for effective recycling or as a barrier to recycling activities, which in turn is related to accessibility issues to storage facilities. Timlett and Williams, (2011) study highlighted building type as a crucial factor in enabling high recycling output and concluded that recycling outputs from houses are higher than flatted properties due to structural design. The research findings agree with Timlett and Williams, (2011) assertion. This fact was also corroborated by the study carried out by Du Toit and Wagner (2020).

Out of the participants that mentioned this sub-theme, P11 and P12 lives in a house and the other remaining participants (P2, P4, P5, P6, P7) live in blocks of flats. Therefore, there are different impacts of building types on recycling activities.

P4, P6, and P7 are of the opinion that the prevalence of high-rise buildings (blocks of flats) in the City of Westminster posed a barrier to achieving effective recycling activities in contrast to houses that provide the opportunity to carry out recycling activities. In their experiences, limited spaces, and the use of communal bin

storage in high rises are the main issues. They lamented that the use of communal bin facilities lacks responsibility from the users and discourages residents that want to recycle properly.

Interestingly, P5 in their experience do not see living in high-rise buildings as a barrier to recycling but acknowledged that implementing a recycling incentive scheme in buildings with communal recycling storage may be a daunting task in determining which residents are recycling and which residents are not recycling.

“There are no barriers for me at all to recycle by living in a high-rise building. Even if we have to take the recyclable materials to the ground floor bins in the absence of a chute, I do not see that as a barrier. But I do not know how recycling incentive schemes will operate in tower blocks” (P5).

P11 and P12 stated that living in a house has provided them with the opportunity in terms of adequate space and easy accessibility to conduct effective recycling activities. They went further to state that they do not think residents living in high rises would have such accessibility. As an intervention increased public engagement, frequent collection of mixed recycling, and the use of suitable incentives could be applied to residents to increase recycling output. A detailed comparison of participants with varied characteristics (building type) is available in Appendix O which explored both the commonality and differential barriers to recycling.

Source Segregation: Source segregation refers to the sorting of waste at source to separate recyclable materials from rubbish to achieve two benefits. One is to capture the recyclable materials at source to provide an instant opportunity for them to be recycled. Secondly, to avoid contamination with rubbish and therefore ensure that high-quality materials are captured for further reprocessing. A study carried out by Christensen and Matsufuji (2011) highlighted the second benefit of why source separation is highly important. But Bernstad (2014) argued that enabling infrastructure (space and different waste stream bins availability) are major considerations to facilitate this process.

A commonly held belief of the flatted participants was that source separation of waste into rubbish and recycling can be conducted internally (kitchen) but those

participants (P3 and P6) living in flatted properties are having difficulties in conducting source separation. This is due to varied factors of internal space availability and availability of the council free recycling bag. P3 stated that inaccessibility to the council free recycling bag and lack of space for a separate recycling bin is hampering their effort to sort out waste at source. P6 reiterated the same concern about space availability.

*“There is no internal space to separate recycling and rubbish so as not to contaminate the recycling. This means I do not have separate bins for recycling”
(P6).*

The reason for this variance is that P3 and P6 might be living in old, flatted properties where there is no under-kitchen counter divided storage for different waste streams. This small facility is now available in newly built flatted properties as a planning requirement. Another issue was the availability of the free recycling bags as not all residents are aware of how to request them.

Participants living in houses can conduct source segregation but with different degrees of ease. P11 although faces internal space challenges but can still perform source separation by using the front garden since they live in a house.

“We have a separate bag for rubbish and a separate bag for recycling in the kitchen, although it can be quite congested. What we do is as soon as the rubbish bag is full, we take it outside to the rubbish bin, and for recycling we put the recycling black box outside in the front garden. Because we do not have enough space inside the kitchen” (P11)

In a separate twist, P7 has a similar issue to Participant 11. Even though they live in different types of buildings. P7 also has a problem with internal space but has one bin for rubbish and then uses a bag for recycling in the kitchen as there is not enough space for a second bin. Interestingly both solved the problem using different available means at their disposal.

This disparity in the result shows that flatted properties and some houses are having the same problems regarding lack of space. This negates the general assumptions that all houses have more storage space than high rises. This

assumption was also proved wrong in the later result from the self-completed questionnaire that came from a larger number of participants.

Storage Capacity: Storage capacity refers to adequate recycling bins available both internally and externally and it is highly dependent on space availability. Lack of adequate capacity to store different waste streams could result in rubbish and recyclable materials being stored together in the same bin and ultimately reduce the overall recycling output collected by the council.

The majority of the participants living in flats and houses have adequate internal storage capacity for mixed recycling. However, participants (such as P2, P3, P8, and P9) living in flatted properties lack adequate external storage capacity. In some cases, there is no external recycling facility in high rises as confirmed by P3.

“We have enough external storage capacity for rubbish but none for recycling even though there is space available externally to store the recycling bins, we therefore need storage capacity to recycle plastics and some other recyclable materials that are left in the rubbish bins” (P3).

Conversely, participants (P10, P11, and P12) living in houses have adequate external storage capacity. Different factors account for the reasons why both groups (Houses and High Rise) have adequate or lack external adequate storage facilities.

Participants (such as P12) living in houses have enough external space for waste storage due to the structural design that allows garden frontage, and they only have the exclusive opportunity to use this storage with no pressure on the storage from other users.

“We have enough external storage for segregated rubbish and recycling. it is just about, and it works because we have our own external bins to ourselves, and we are the only one using it as I live in a house” (P12).

This is not the case with high-rise buildings that lack individual garden frontage for the occupiers. Additionally, occupiers of flatted properties rely on communal bin storage with pressure on the facility from co-tenants as stated by P8.

“Since the external recycling bins are small, it fills up very quickly. So, most of the time when I want to use the recycling bins they are already filled up and I just leave my recycling near the bins on the floor. Sometimes, the external bin storage area is full and with bins overflowing that it is difficult to differentiate which bin is for recycling and which bin is for rubbish” (P8).

The lack of adequate storage capacity for mixed recycling in high rises is one of the issues affecting the low recycling rate. Since flatted properties constitute 70% of the housing stock in the borough.

Three interventions are proposed. Firstly, it is recommended that the existing flatted properties in the borough are surveyed to determine if spaces are available to provide more mixed recycling bins. Secondly, design for new developments should ensure that high rises have adequate external facilities for mixed recycling. Thirdly, frequent collection of mixed recycling in those areas with non-adequate external storage capacity will alleviate the issues recounted by P8.

Bin Types: This sub-theme captures the participants’ experiences relating to the type of bins (rubbish and mixed recycling) available externally, frequency of collection of the bin types and use of the bins.

All the participants have rubbish bins and recycling bins available externally but P3 and P9 that live in flatted properties, do not have external recycling bins at all. These are old properties built before the introduction of the waste planning policy that requires external storage. Occupiers of such properties rely on the council’s free recycling bag to recycle.

“We do not have any external storage facility for recycling. Although there is no further space at the block for an extra bin. The property owner could have rededicated one of the rubbish bins to be used for recycling. But the property owner cannot be bothered. But generally, all the residents in my street put their recycling in the council recycling bag and then leave it on the street for collection” (P9).

The frequency of collection is another issue with the bin types. The participants lamented that the council collects rubbish bins more than recycling bins which does not facilitate recycling activity. Rubbish bins are collected between 3 times a

week or daily depending on the area while recycling bins are collected once or twice a week depending on the area. The disproportionate collection of the different waste streams is affecting the low recycling output.

In terms of how the external recycling bins are used, P8 noted that some of the residents in their block do not bother to separate their waste and then dump rubbish bags into the recycling bins thereby causing contamination of the recyclable materials.

However, P4 mentioned that the design of the recycling bins made them difficult to use because of the small hole aperture to use to put the recycling bags through. It must be noted that the small hole aperture in the recycling bins is designed to prevent bags full of recycling to be pushed through; rather it is expected that residents should place the individual recyclable item through the hole one by one. This approach will prevent the blockage of the small aperture.

Studies carried out by Jatau (2020) and Yukalang et al. (2017) also found that inadequate infrastructure is a limiting factor to effective recycling. Therefore, one of the major issues about the external recycling bins is the non-availability of these bins and infrequent collection with the growing pressure and demand to recycle, which then acts as a barrier to achieving effective recycling. To facilitate a high recycling rate and to meet the 65% recycling target by 2035, it is essential to put in place the interventions proposed in the storage capacity sub-theme.

4.2.3 Communication and public engagement Theme

This theme accounts for the participants' views on how effective the council's communication and engagement and issues relating to it. Effective communication and public engagement are enabling factors that provide an avenue for the council to promote the recycling schemes and more importantly to engage the residents in finding solutions to recycling barriers. Therefore, a lack of effective communication and public engagement would be a barrier and adversely impact recycling output (Lee and Krieger, 2020). The theme would be discussed in detail through the sub-themes indicated in Figure 4.5.

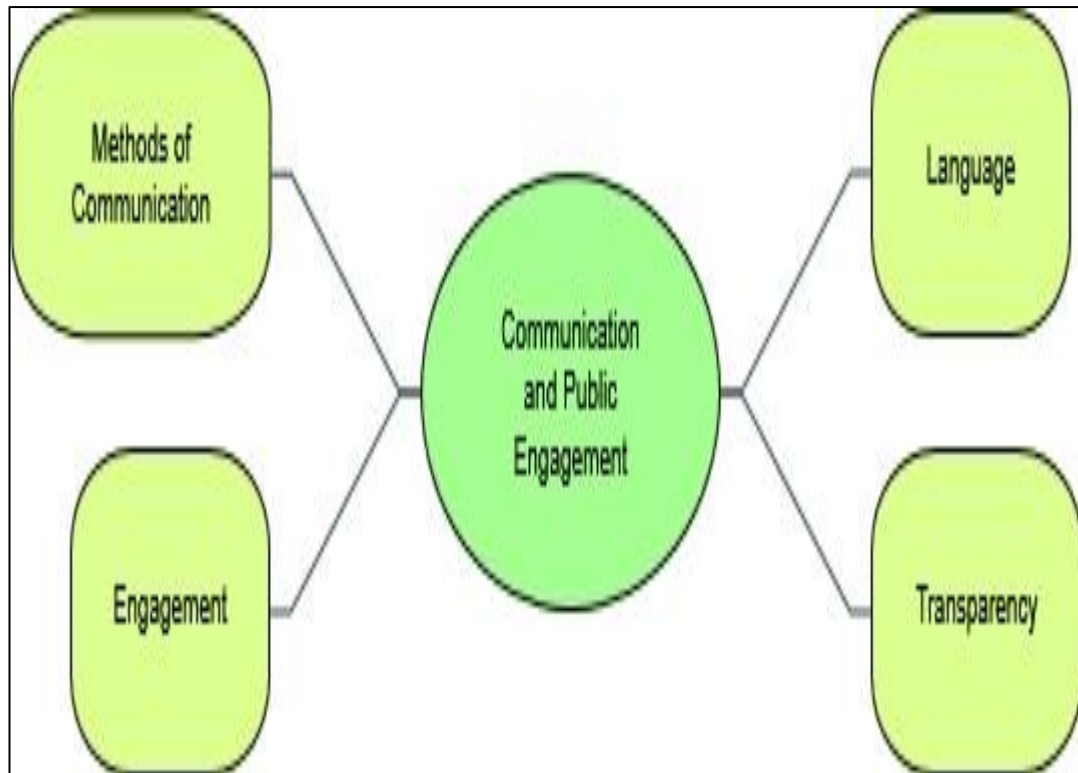


Figure 4.5: Thematic mind map indicating the 4 sub-themes under the communication and engagement theme.

Methods of Communication: The responses from the participants that have received one or other form of communication indicates that the council is employing different types of communication modes to get the recycling messages or information to the residents. The different type of communication method used by the council includes the use of leaflets, regular newsletter, emails, periodical magazines, letters and through door knocking exercise.

All the participants have received one form of communication except for P9. The response from P9, who has lived in the borough for 3 years, was compared to P4 (who lived in the borough for 3 years) and P5 (who lived in the borough for 4 months), to see if the residency duration could be a factor why P9 has not received any recycling information. But P4 and P5 commented to have received a leaflet about recycling when they first moved in and thereafter have been receiving the council magazine that contains recycling information.

The council tax team may not have updated the recycling team on the arrival of P9 in the new flat and therefore was missed during the dispatch of recycling information to new residents. This shows that the council recycling team database

is not robust enough to capture new entrants to the borough. This issue also came out of the data acquired from the resident's self-completion questionnaire, which will be presented in the general discussion (data triangulation).

Additionally, P10 and P11 queried why the council that wants to reduce waste is using paper-based methods to disseminate information. Thereby resulting in the generation of more waste. These participants said that they will prefer an electronic-based method of communication to cut out paper waste. Both P10 and P11 live in houses. While P7 prefers electronic communication, newsletters and magazines forms of communication are more popular with participants living in flatted properties.

“Also, I find it very ironic that we want to reduce waste but sending paper leaflets out creates more waste. Perhaps the use of electronic means such as text messages, electronic newsletters, knocking on the doors, talking to people and emails will cut out paper waste.” (P11)

P11 and P2 surmised that door knocking exercise is the most effective means of communicating recycling activities. Both participants described their door-knocking exercise as a positive experience.

The council could adopt both methods of communication (electronic and paper) and send out information based on the preferred method chosen by the residents, and then finally back it up with periodic door-knocking exercises to stimulate the residents as suggested by P11 and P2.

Language: This sub-theme described the use of the language of expression and clarity of information contained in the communication they received or saw. P5 and P11 gave the impression that language barriers within the council recycling communication strategy can create obstacles for residents that cannot understand English and therefore could impact their ability to recycle effectively. Glad (2018) asserted that language may create a barrier to effective communication to focus groups if the language of instruction does not reflect the diversity within the group.

It is important to emphasise P5 is from a white background while P11 is from an ethnic minority background to understand their perspective with regard to the use of language. P5 concern is more on the choice of words used in the recycling

communication rather than the language itself. Where the choice of words should be very simple, clear, and concise to convey an effective understanding to recycle properly.

“As long as the methods are effective across languages, there is no reason why people cannot do it or recycle properly.” (P5)

Whereas P11 although can understand English and has a bachelor’s degree is drawing from their cultural background experience to suggest that language may be a barrier for other residents that cannot understand the English language.

“You may leave a leaflet through the door but unless English is their first language, or can they speak and read English otherwise they might think it is junk and bin the leaflet. Although the leaflet is in English, there are some small print in English asking people who cannot understand English to call a number for interpretation. I doubt it if anybody will ever ring the number because they cannot understand the instruction in English in the first instance”! (P11).

This issue also emerged from the council staff’s in-depth interviews and will be discussed in detail during data triangulation.

Engagement: The engagement sub-theme relates to forms of engagement experienced or the type of engagement they want the council to implement. Some of the participants, although praising the council’s efforts in organising recycling engagement sessions in libraries across the borough, still think that the council is not fully engaging the residents about the benefits of recycling and the status of the council recycling rate. These views came from participants living in both houses and flats.

P2, P5 and P11 were shocked and surprised about the council’s low recycling rate as they were not aware. They thought the recycling scheme was going well in the borough because their recyclable materials were always collected promptly. This shows a lack of proper engagement activities to update residents. Making the residents aware of the low recycling rate can motivate them to do better.

“I am surprised to hear that we have a low recycling rate as a borough, very disappointed and very shocked” (P5).

P11 was more enthusiastic on the issue of the council's active engagement with residents because they could relate to their personal experiences that makes them good recyclers. Throughout the themes and sub-themes P11 singled out to be a "Star Recycler" in terms of passion and commitment to recycling, influencing members of their household to recycle and going the extra mile to create space in the front garden for mixed recycling storage.

More importantly, P11 experience recounted below indicates the importance of resident engagement to increase recycling output.

"I think it was in 2006, we had this gentleman from the recycling team coming into the library to talk about recycling. He brought some beautiful things with him such as a pen made from plastic recycling, a can made from yoghurt pot. And I remember he gave us lots of these things to encourage us to recycle. That was the reason I started recycling a long time ago in 2006. Since then, we have been recycling everything" (P11).

In summary, the participants suggested campaigns targeting school kids, who can easily influence their parents, organising educational workshops in workplaces across the borough, use of local groups or faith groups to get the message across hard-to-reach people and use of Nextdoor (a social networking website) to ignite healthy debate within neighbourhoods to address issues of critical importance to the local community.

Transparency: P1, P2, P5, and P11 made references to the issue of transparency as residents are not aware of what happened to the recyclable materials collected. They commented that the council need to be more transparent on the end destination of the recyclable materials collected.

The participants passionately believed that this information would clear up the myth and misconception that the materials collected are not recycled but dumped in another country or burned. Such misconception does not encourage residents to sort out the recyclable materials for recycling because they perceive it as a waste of time.

“We need more information on what happens to the recyclable materials collected. These are not clear, okay I am recycling, but what happens to my recyclable materials collected. Where are these recycling stuffs going”? (P1)

“There is this question other people are asking about where does all this recycling goes? I think the council should be able to work on this. We need to communicate to people what happens to the recycling.” (P5)

Public engagement through effective communication could motivate householders to actively participate in recycling activities in achieving a higher recycling rate (Oluwadipe et. al., 2021).

4.2.4 Incentives Theme

This main theme consists of the sub-themes indicated in Figure 4.6. The theme centres around what kind of incentive schemes will motivate respondents to engage more in recycling activities. Should the residents be rewarded for recycling, or should they be penalised for not recycling, or should a middle course approach be taken through the implementation of deposit return schemes where the residents are either rewarded or penalised by choice?

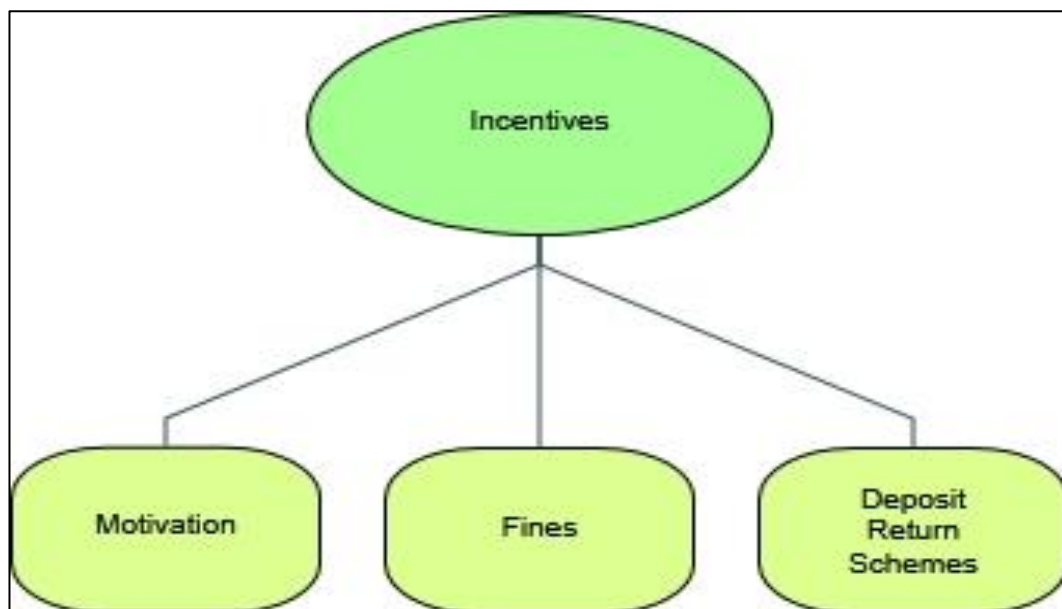


Figure 4.6: Thematic mind map indicating the 3 sub-themes under the incentive theme.

Studies on the use of incentives to increase recycling participation has resulted in different outcomes. Zhou et al. (2021) application of financial reward (positive

incentive) to increase participation resulted in increased recycling output. While Halvorsen (2012) study on the application of economic penalties to recycling activities resulted in the negative effects of waste fly-tipping in public places. This theme explored all these possibilities briefly based on the participants' accounts.

Motivation: In this sub-theme, all the participants support that the council should use positive incentive schemes to motivate the residents. The general feeling is that the residents are not motivated enough to make an extra effort in recycling their waste.

Even though other infrastructure barriers may be at play in making recycling activities possible. The current incentive schemes organised by the council are only targeted to some estates within the borough and the participants want these schemes to be rolled out across all the wards in the borough.

However, P4 and P6 support the incentive system but doubt if any incentives will work if there is no active engagement with residents or infrastructure that will support effective recycling activities.

“Yes, incentives will motivate people, but the most important thing is to facilitate how people can recycle and to communicate this effectively to people. And actively engage local people and encourage people to recycle” (P6).

The majority of the participants favour financial rewards in terms of cashback, reduction in council tax and vouchers even though they are in employment and are middle incomers. This result supports Zhou et al. (2021) assertion about the financial reward impact on recycling participation.

Fines: P8 and P10 discussed the sub-theme fines. The two participants supported the introduction of fines as a negative incentive (in addition to supporting positive incentives) to deter residents from throwing recyclable materials in the rubbish bins and vice versa. Although, P10 thinks this approach may be draconian in nature but necessary to force residents to do the right thing.

“I think that the council instead of reducing the pick-up should levy fines on the households who do not dispose their waste responsibly. That is the way I see it. Probably very draconian, I think everyone is a mature adult and if you act as a child, you should be treated as a child. Punitive measures to me are a source of income to the council and act more as a deterrent to me.” (P10).

“If people are not recycling, may be introduction of fines will force residents to recycle more.” (P8).

Based on the profile of P8 who lives in a flatted property, is unemployed and sometimes recycles. It is surprising that an individual with no employment and sometimes recycle will support fines and penalties for not recycling. While it is more understandable while P10 will support penalties because they always recycle and want all residents to recycle as well.

This data did not reveal whether negative incentives will work in Westminster but ruminating on Halvorsen (2012) study result, it will be difficult to identify which of the residents in flatted properties are not recycling for levies to be served on them. Additionally, it may increase waste dumping on public highways for householders that may want to evade enforcement.

Deposit return scheme: Only P10 referred to the sub-theme deposit return scheme (DRS) in detail. Other Participants (P1 and P5) just wondered how DRS will work especially for residents living in high rises.

P10 relating their experience when living in New York where a system like DRS is in place recounted that the DRS will not work across all levels of income. They commented that DRS will work effectively for householders with low incomes who will make all efforts to return the empty container to cash their deposit. But for the affluent such deposit are a meagre amount that can be disregarded.

“I grew up in New York City. Here is how that goes, When they are done with the container, they go into the supermarket with five bottles and might get a quarter, 25 cents. Nobody does that. The only people in New York that will do that are people that are struggling, people that are homeless, people that are indigent, people that are on low fixed income, a lot of elderly people who need extra money. People living in Westminster, all drive in Bentley, they all drive in Mercedes. One bedroom apartment in my neighbourhood goes for 2 million dollars (Pound?). These people would not be collecting tin, cans, and bottles to get a few pennies off the supermarkets. These people do not even go to supermarket, they send their housekeepers to the supermarket. I do not think that kind of incentives will work in Westminster” (P10).

There are other challenges apart from the one stated above by P10. There are questions on the availability, accessibility of the DRS machines, and how the scheme will be managed. Despite these challenges, experiences from other European countries that have implemented the DRS are positive and it is driving those countries recycling rates up to about 70% on the average (European Parliament, 2011).

The UK government is currently proposing to introduce the deposit return scheme (DRS) in England and Wales from 2024 to target drink containers. It is envisaged that the deposit paid by the end user at the time of purchase of the beverage will incentivize the end user to return the empty container to collect their deposit back. There is a good prospect that the scheme will increase the recycling rate of the local authorities in the UK following the successful implementation in some EU countries.

4.2.5 Service Constraints Theme

This theme consists of the sub-themes as indicated in Figure 4.7. It detailed the participant’s experience with the council’s recycling and collection service. More importantly, how these services affect their abilities in conducting recycling activities.

Tsalis et. al. (2018) argued that recycling services can only be effective if tailored to the different needs of the local community. Tsalis et. al. (2018) argument applies to Westminster in terms of building types because houses will have different servicing needs from flatted properties. But there are challenges with this approach when logistic and operational factors are considered. This theme also emerges from data collected from self-completion questionnaires and staff in-depth interviews which will be discussed in detail in chapter 7.

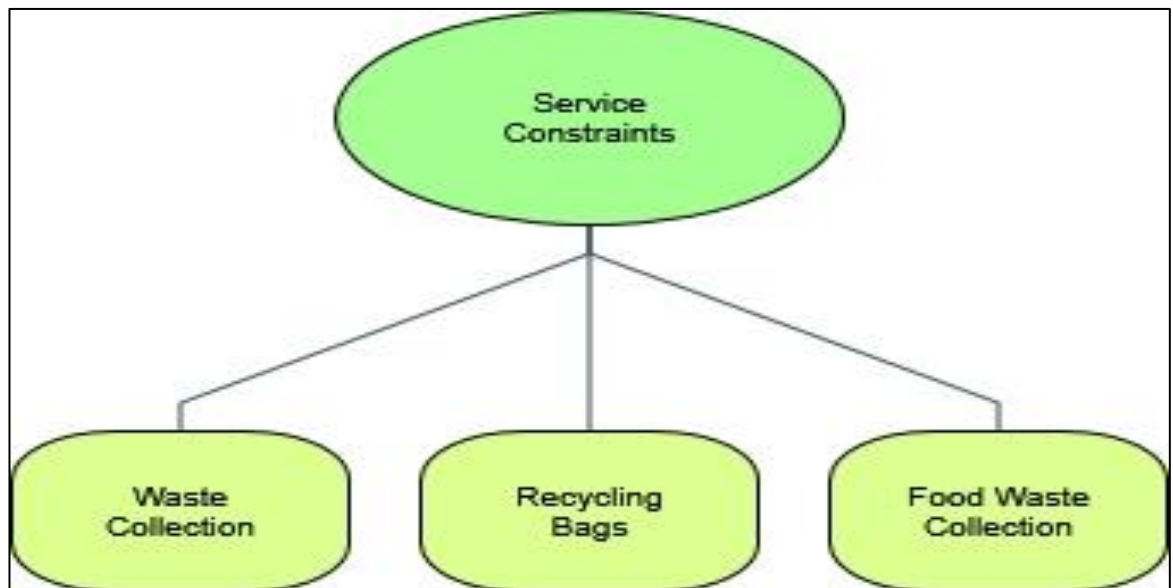


Figure 4.7: Thematic mind map indicating the 3 sub-themes under the service constraint's theme.

Waste Collection: This sub-theme reveals the disparity between the frequency collection of rubbish and recycling. The council collects rubbish more frequently than recycling. This collection mode practised by the borough does not offer incentives for residents to separate their waste, especially in a city experiencing acute shortages of both internal and external storage facilities for recyclable materials.

The council is collecting rubbish more frequently due to the location of the borough and its status as a tourist destination area. Therefore, there is pressure on the council to make the streets clean and clear of rubbish for tourists.

The sub-theme is also closely related to the physical factors theme where lack of adequate storage facility has a knock-on effect on the collection frequency. Interestingly, all the participants (P1, P4, P7, P8, and P9) that mentioned this sub-

theme live in high rises where external storage facilities are inadequate. This shows that participants living in houses are not impacted by the collection frequencies due to the availability of adequate external storage spaces.

P9 queried the council's efforts at recycling schemes and wondered whether the council was really committed to increasing recycling rate. It appears that the council is giving the residents the wrong impression not to recycle when recycling is collected once a week and rubbish is collected daily.

“I think personally, recycling is a low priority for the council, and they give high priority to refuse collection. For me, they should balance it out. But residents can put rubbish out every time on the streets and it gets taken away very quickly. You throw a bag away on the street and it is taken away straightaway by the council. I think the council should spend more on recycling and reduce frequent collection of waste” (P9).

These participants (P1, P4, P7, P8, and P9) were then asked, “what is their view with regards to reduction in rubbish collection and increased recycling collection to cope with a large volume of mixed recycling”?

P7 is most concerned about the recycling collection during festive periods when large amounts of recyclable gift packaging is generated and the storage cannot cope with these amounts of packaging, but it seems the council still operates at a normal level during Christmas. This results in the overflowing of the recycling bins and ultimately most recyclable materials end up in the rubbish bins since they are collected daily. P7 then suggested that mixed recycling collection should be increased during festive periods to cope with increased demand.

The consensus among the participants that discussed this sub-theme was that the current level of rubbish collection frequency should remain while the frequency of collection for mixed recycling should increase. P8 and P9 were the only dissenting voices and of the opinion that reducing the rubbish collection frequency will compel the residents to recycle more.

Recycling Bags: In this sub-theme, the respondents relate their experiences regarding access to the council's free recycling bags. The council provides free recycling bags to residents that do not have external storage facilities to store the

recyclable materials for bin collection. However, there are issues with accessibility to these recycling bags because the distribution outlets are minimal and not widely known by the residents.

Currently, the recycling bags can be requested from the library, online from the council website, by phone, from the waste collection operatives during collection rounds and by email. More importantly, the recent crisis of covid-19 pandemic has compounded the accessibility to recycling bags. Lack of easy accessibility to the free recycling bag could be a barrier to recycling activities as residents may end up throwing the recyclable waste materials in the rubbish bins.

The majority of the participants both living in houses and high rises were affected by this issue with the exception of P10 who lives in a house. P10 does not have any issues at all in requesting and receiving the free recycling bags from the council.

“I went on the Westminster website to request a recycling bin; it is like a black bin and some bags. Anytime, I request the bags and they just deliver it. Even if I went to the drivers picking up the recycling and I ask, they give it to me” (P10).

The other participants such as P12 and P6 may not be aware of these two avenues cited by P10. P12 was unable to get the bags from libraries as usual due to covid-19 pandemic. Furthermore, P12 wants the council to implement a recycling system without bag use.

“Another barrier is the COVID 19 with regards to the recycling bags. Due to the pandemic, I am not able to get the plastic bag for recycling from the library. Or is there any other way of recycling without using these bags” (P12).

“There should be other ways to constantly distribute the recycling bags” (P6).

This sub-theme also appears in phases 2 and 3. Therefore, relevant interventions will be presented at the triangulation stage.

Food Waste Collection: This sub-theme detailed the participant’s experiences regarding the non-collection of food waste. At the time of data collection (Phases 1 and 2), the council was not collecting food waste. The success of the food waste trial conducted in 2019 has enabled the council to start collecting food waste in

early 2022. Half of the participants (P1, P2, P4, P5, P9, and P12) are not happy that the council is not collecting food waste currently and are expecting it to be rolled out in the future. P12 is the only house participant that mentioned food waste.

“Being able to recycle food skins like vegetables skins and food waste would even be better, that means my normal bin would be very empty because most things that are in there are food waste. That would be good. Yes, I will make space for it but then because I want to do it. But then people who are not interested may be challenged to find space for food waste storage” (P2).

“We would like to have food waste recycling because we know other boroughs do collect food waste.” (P12)

“Another thing is that we do not have food waste collection, which is a substantial chunk of waste that can be recycled or recovered which goes into rubbish bins.” (P4)

The participants mentioned two important points relating to food waste. Firstly, that introduction of food waste collection will reduce the quantity of waste materials in the rubbish bins and by reasoning that will elevate the council recycling rate. Since the bulk contents in the rubbish bins are mainly food waste.

Secondly, the allocation of extra storage space to accommodate food waste collection may be problematic for some residents that are already challenged with shortages of storage spaces both internal and external. It is also important to note that some of the participants are ready to make space for food waste storage.

This question was explored further in phase 2 data to see if the larger participants would have storage issues with regard to food waste collection.

The reason for the other participants not mentioning food waste was that food waste was not part of the direct question. The other participants only mentioned food waste collection when asked what barriers they face in carrying out recycling activities. Studies carried out by Shearer et al. (2017) and Bernstad et al. (2016) concluded that household food waste collection can increase the recycling rate. Therefore, the commencement of the council food waste collection will uplift the council recycling rate.

4.2.6 Policy Constraints Theme

This theme consists of the sub-themes indicated in Figure 4.8 thematic mind map for policy constraints. The theme is concerned with the participants' views of the current and future UK waste legislation and its impact on recycling participation. Sewak et al. 2021 highlighted that waste policy formulation is not aligned with users' needs in resolving behavioural recycling issues, which makes such policies or legislations to be ineffective. The users in this situation are the householders that generate parts of the municipal waste.

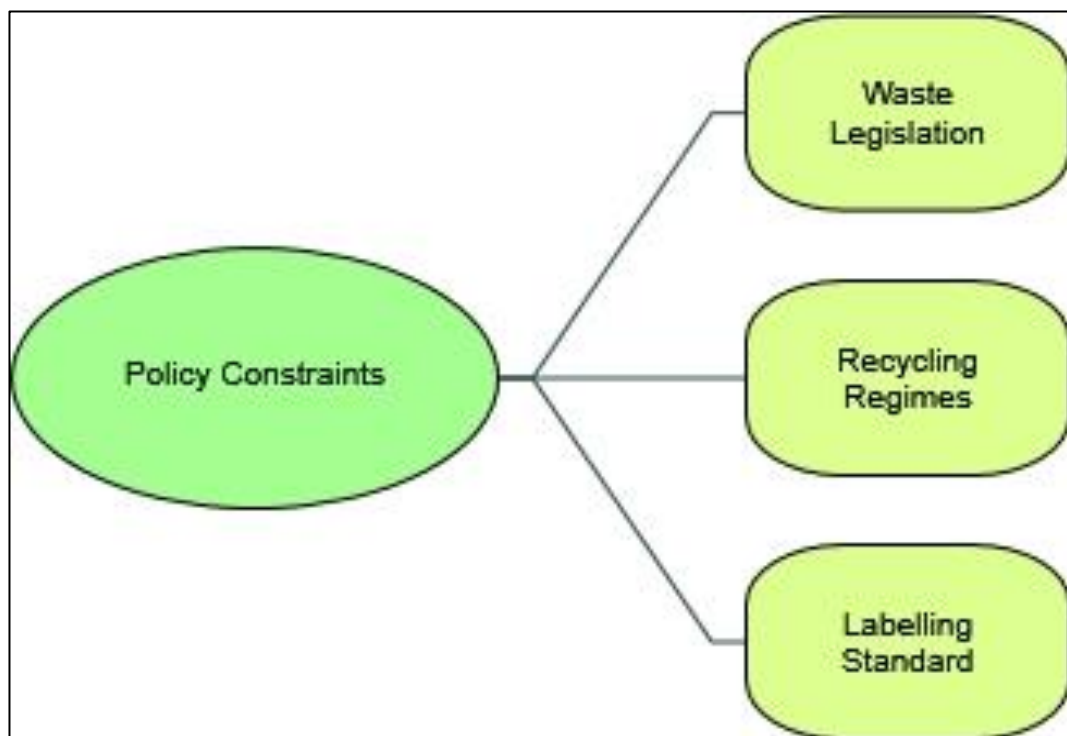


Figure 4.8: Thematic mind map indicating the 3 sub-themes under the policy constraints theme.

Waste Legislation: This sub-theme focuses on the lack of waste legislation to mandate local authorities to collect ward-by-ward area waste data, mandatory recycling for householders and banning of non-recyclable plastics. P4, P7, P9, P10, P11, and P12 discussed this sub-theme. These participants have already been identified as star recyclers (except P7) and that is why they are more passionate to talk about all issues regarding recycling than others. P7 only discussed this sub-theme to cite it as a barrier to recycle properly.

P11 suggested that the council should make available recycling rates based on the ward level to ensure efforts are concentrated on wards with a low recycling rate.

“It would be useful for the council to break down the recycling rate by wards to identify which wards are recycling and the wards not recycling. This will allow the council to adopt strategies targeted towards the wards not recycling enough.”

(P11)

Currently, recycling rate is not available at the ward level throughout the country because there is no requirement within the waste legislation for this data to be available at the ward level but rather recycling data from each borough is collected as one single entity data for each borough.

The simple reason for collecting recycling data this way is the practicability of collecting waste ward by ward basis, for operational costs reason waste is collected street by street basis. Geographically, one street may fall within two or three wards thereby making recycling data available on the ward level a difficult and costly endeavour for local authorities struggling with reduced funding from the national government.

P9 and P10 suggested a mandatory recycling rule for all property owners and property owners. P10 thinks that waste legislation should introduce fines to householders that refuse to recycle or recycle properly to enforce mandatory recycling. Currently, it is not compulsory for householders to recycle their waste, but it is compulsory that local authorities provide recycling services to their residents.

However, some local authorities are making it compulsory for their residents to use the waste receptacles or bins appropriately. In addition, P9 wants the councils to compel property owners to install relevant recycling infrastructure in their properties to facilitate recycling activities.

P10 also proposed that the council should work with manufacturers to eliminate or ban packaging materials that are not recyclable. I did advise the participant that this suggestion is outside the remit of the council and that such a policy could only be implemented by the national government.

“I will say that manufacturers of goods should be encouraged not to use materials that are not recyclable. When I buy bananas, they are in plastic bags that cannot be recycled. What is the point in that, I do not understand? Maybe Westminster can engage with manufacturers and supermarkets and say there is no need to put a bunch of bananas in a plastic bag. There is no need for that” (P10).

However, it should be noted that the government in October 2020 banned some specific single-use plastics such as plastic straws and a proposed tax on other single-use plastics will be introduced in the future. This approach is short of the total ban suggested by the participant.

Recycling Regimes: P4 commented on the different recycling regimes that operate throughout the UK and their specific impact on Westminster borough due to its character as a seat of government and the presence of tourist attraction locations. P4 then went further to suggest consistency in bin colours and labels for different waste streams and the same classification of materials collected.

“It is different for different councils with different rules and schemes. People moving in and out of Westminster. People do not stay long. They have come from somewhere, where there are different recycling rules. So, recycling consistency within various councils in London and the country is one. Above all, the recycling regime in terms of colours, material collected, and labels should be consistent across the country” (P4).

Labelling Standard: P7 and P12 demanded clarity in the packaging labelling which is currently ambiguous and confusing to many participants. They surmised that it is exceedingly difficult to ascertain if some packaging is recyclable or not due to two reasons.

Firstly, they have received conflicting advice from different councils about the recyclability of some packaging materials. Secondly, the labelling on the packaging material is not very explicit or there is no direction on the labels whether the materials are recyclable or not.

“I think the information could be clearer on the labels of what can be recycled and what cannot be recycled, which would be helpful. You know there are four of us including the children. If something is clear, it is extremely easy and simple to tutor small children than when it is quite confusing.” (P12)

“Sometimes, I am not sure whether a packaging is recyclable or not. When I am not sure I just put it in the rubbish bag. I do not have the time to search for information.” (P7)

Based on the participants' experience with packaging labels, unclear labelling of packaging materials is a barrier to achieving a high rate of recycling, as P7 has declared dumping packaging materials in the rubbish bin if the packaging labels are not clear enough.

Jesson and Stone (2009) identified different recycling regimes and labelling issues as limitations to effective recycling where householders are confused about labelling format and recycling scheme if they are new residents in the borough. However, uniform recycling schemes can also cause issues as boroughs differ in characteristics that will require bespoke systems. To explore this further, a question was dedicated to packaging labelling in the data collected in phase 2 to seek views about this issue from larger respondents.

In general, the analysis of the data collected in phase 1 indicated that the participants face similar and simultaneously differential recycling barriers.

Therefore, any possible interventions must be holistic and robust to capture both the commonality and the differential factors that exist among the participants to increase recycling participation in the borough. Interventions for this theme are outlined in Section 8.1.3.

Chapter 5 Results and Discussion - Phase 2 Data

This chapter details the results and discussions of the residents' self-completion questionnaire which was collected during phase 2 data gathering.

5.1 Quantitative Analysis – Results and Discussion (Phase 2 Data)

In enabling data analysis and understanding the recycling views and behaviours across the different demographic factors, the data obtained were grouped into explanatory variables and responsive variables which are tabulated in Table 5.1.

The data were then subjected to statistical analysis using chi-square to find significant relationships between the variables. Prior to statistical testing, survey data were modified using the baseline demographic data to ensure data representation of the true population as detailed in Appendix J.

The four explanatory variables used are age, level of education, type of residence and ward level. Table 5.1 indicates how the groups were compared using the explanatory variables to show the different variations of the responsive variables.

Pearson's chi-Square test was used to find any significant relationship between the variables for the resident's survey data. The analysis was carried out on SPSS software (Statistical Package for the Social Sciences). The resulting probability value (p -value) was then used to establish an association between the variables.

The different p -values indicated below show different types of interpretations that were inferred.

When $p \leq 0.05$ (There is significant relationship between the variables)

When $p > 0.05$ (There is no significant relationship between the variables)

The results of the chi-square (χ^2) will be reported in this format:

χ^2 (degrees of freedom (df), n = sample size) = chi-square statistic value, p -value.

Only variables that show meaningful relationships were reported in this section. A detailed analysis of variables with non-significant relationships is available in Appendix Q.

Table 5.1: Details of the explanatory variables with a significant and non-significant relationship with the corresponding responsive variables.

Explanatory Variables with Non-Significant Relationship with Responsive Variables	Explanatory Variables with Significant Relationship with Responsive Variables	Responsive Variables
Age, Residence, Ward Area Type,	Education	Q10 Recycling Behaviour
Education, Ward Area	Age	Q13 Enabling Factors
Age, Ward Area	Education, Residence Type	Q15 Commitment
Age, Education	Residence Type, Ward Area	Q19 Micro Recycling Centre Proximity
Residence Type, Ward Area	Age, Education	Q21 Bins Colour and Labels
Age, Education	Residence Type, Ward Area	Q22 Recycling Bags
Age, Education, Ward Area	Residence Type	Q23 Collection Frequency
Education, Residence Type, Ward Area	Age	Q24 Food Waste Collection
Education, Residence Type, Ward Area	Age	Q25 Communication Type
Residence Type, Ward Area	Age, Education	Q26 Communication Effect
Education, Residence Type, Ward Area	Age	Q27 Recycling Events
Education, Residence Type	Age	Q30 Future Waste Legislation

More importantly, it should be noted that adjusted data (baseline data) for age and education were calculated in addition to the raw survey data. Also, comparing the adjusted data and raw self-completion questionnaire data indicates that there is no significant difference between both data statistically as shown in Appendix J. Therefore, the raw questionnaire data was used for interpretations and discussions. The adjusted data are detailed in Appendix P.

It is also important to note that this data is predominantly a survey of respondents that always recycle and as such, not much emphasis is placed on non-recycling activities due to the low participation of residents in the non-recycling group. The interpretation and analysis were mainly focussed on the recycling barriers encountered by the respondents to build a profile of their recycling behaviours and different characteristics.

5.2 Recycling Behaviour

The explanatory variables of age, level of education, type of residence and ward level were assessed with the variation of recycling habits across the participant range. Only the level of education shows a meaningful relationship with the participant's recycling behaviour.

The question was asked (single answer), how often do you recycle these items (plastic tubs, food and drink cans, glass bottles, paper, cartons, and cardboard)? Figure 5.1 indicates that 91% of the respondent's state that they always recycle. while 2% of the participants do not carry out any recycling activity.

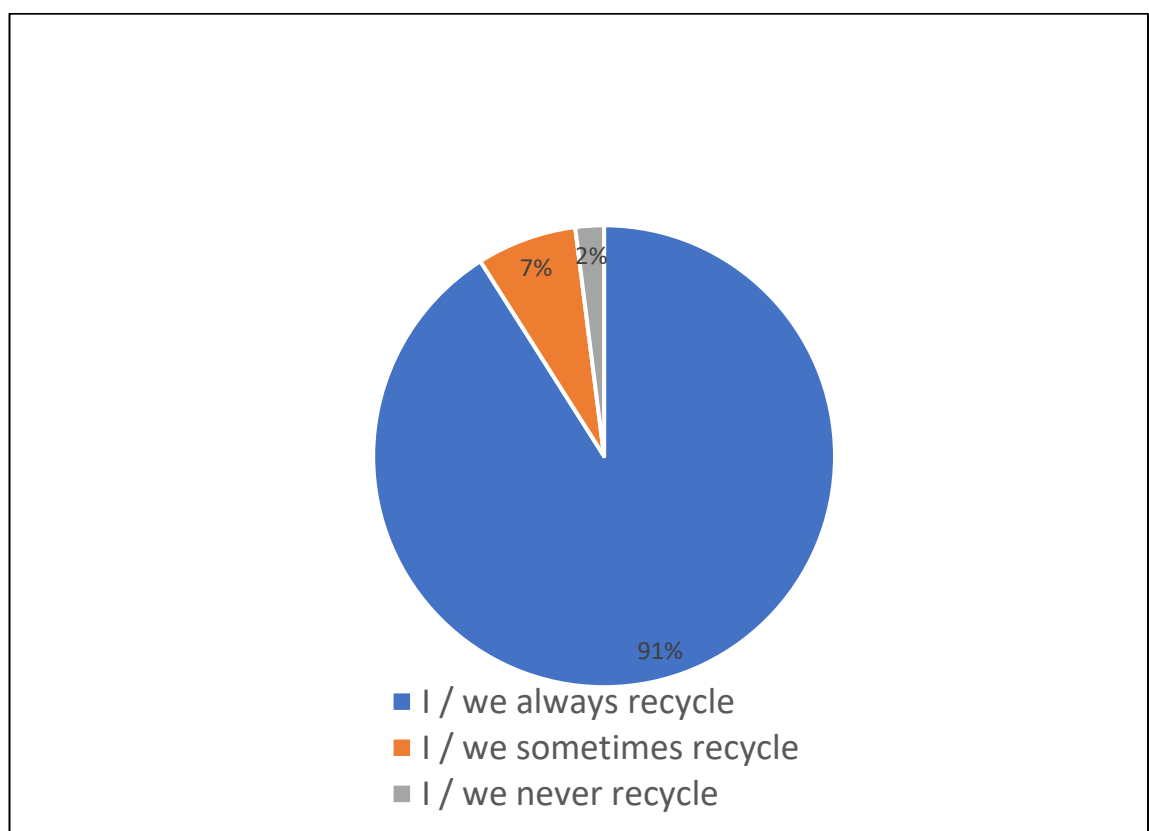


Figure 5.1: The proportion of the respondents who engage in recycling activity and those who do not participate in recycling activity.

Education and Recycling Behaviour: A chi-square test of independence was performed to examine the relationship between the level of education and the behavioural inclination to carry out recycling activities. The relationship between these variables was significant, χ^2 (df=10, n=417) = 66.0, p -value = 0.01. The result shows that residents with higher qualifications are more likely to participate in recycling activities.

In analysing data from Table 5.2, high recycling participation was observed across all levels of education. Also, the level of education increases with the proportion of recycling behaviour.

Respondents with post-graduate degree qualifications have the highest proportion (93%), and respondents with secondary school qualifications have the highest part (20%) of respondents that never recycle, compared to other levels of education.

This may be due to reasons such as increased exposure to environmental awareness by respondents with higher qualifications as they progressed through their study. Vice versa, respondents with lower educational qualifications may have limited exposure to environmental awareness.

Table 5.2: The result of the cross-tabulation of the education variable and recycling behaviour variable in the borough of Westminster.

How often do you recycle?	Recycling Behaviour			
Education	Always recycle	Sometimes recycle	Never recycle	Total Percentages
Secondary school	80%	0%	20%	100%
Higher or further education	92%	6%	2%	100%
College or university	90%	8%	2%	100%
Post-graduate degree	93%	7%	0%	100%
Number of Respondents	417			
Chi-Square Tests (p -value)	0.01			

It can therefore be deduced from the chi-square tests, that level of education is a factor that influences recycling behaviour in this survey, as the recycling participation increases with the increase in the level of education. The result also validates data collected in phase 1 where the majority of the participants that

exhibit high recycling behaviour are university graduates and lower recycling activities were observed more with participants with lower educational qualifications.

In summary (Box 1), tests analysis conducted for education, age, ward level, and type of residence indicates that only education has a direct influence on the respondent's recycling behaviour.

Recycling Behaviour

Determinant Variables




- Education

Issues

- The highest percentage of the respondents that always recycle have the highest qualification (Postgraduate Degree-93%)
- The respondents with the lowest qualification (Secondary School Qualification-80%) have the lowest percentage in the category that always recycle.

Causes/Impacts

- Less exposure to environmental awareness for respondents with lower educational qualifications.
- High exposure to environmental awareness for respondents with higher educational qualifications.

Intervention

- Early intervention or introduction of recycling subjects in primary and secondary schools is fundamental, in levelling environmental education across the levels of qualification.
- The need for national curriculum on waste and recycling topics to be taught as a complete subject rather than taught under general subject.

Box 1: Summary of the issues and interventions required from the result of the cross tabulation between education and recycling behaviour variables in the borough of Westminster.

The result indicates that 98% of the respondents always or sometimes recycle. Also, 88% of the respondents have a university degree (Appendix I) which positively impacts their recycling behaviour as evidenced in the result. Studies conducted by Seng et al. (2018); Vieira and Matheus (2018), also confirm that the level of education is a factor that affects recycling behaviour, where elevated level of literacy skills will facilitate an effective understanding of recycling communication or information.

Therefore, relevant intervention would need to address the qualification gap by focusing more on strategies that would enable residents with lower qualifications to actively participate in recycling activities. To balance the recycling behaviours in

the borough, early intervention or introduction of recycling subjects in primary and secondary is fundamental, in levelling environmental education across the levels of qualification.

5.3 Recycling Enabling Factors

The explanatory variables of age and type of residence were assessed against recycling enabling factors. Both variables indicate a significant relationship with the enabling factors. The question was asked (multiple answers), which of the following would encourage you to recycle these items more (plastic tubs, food and drink cans, glass bottles, paper, cartons, and cardboard)? This question was designed to capture the recycling barriers encountered by the respondents that always recycle. The phrase “would encourage” is another way of asking if there are any barriers to recycling.

Most of the respondents (20%) did state that clear and consistent labels on packaging will make it easy for them to recycle materials that are recyclable while mandatory recycling is not very popular among the respondents (Figure 5.2). This data reveals two important findings. Firstly, it shows that one enabling factor or intervention would not be enough to facilitate effective participation in recycling activity. Secondly, it shows the range of current barriers faced by the respondents in carrying out recycling activities.

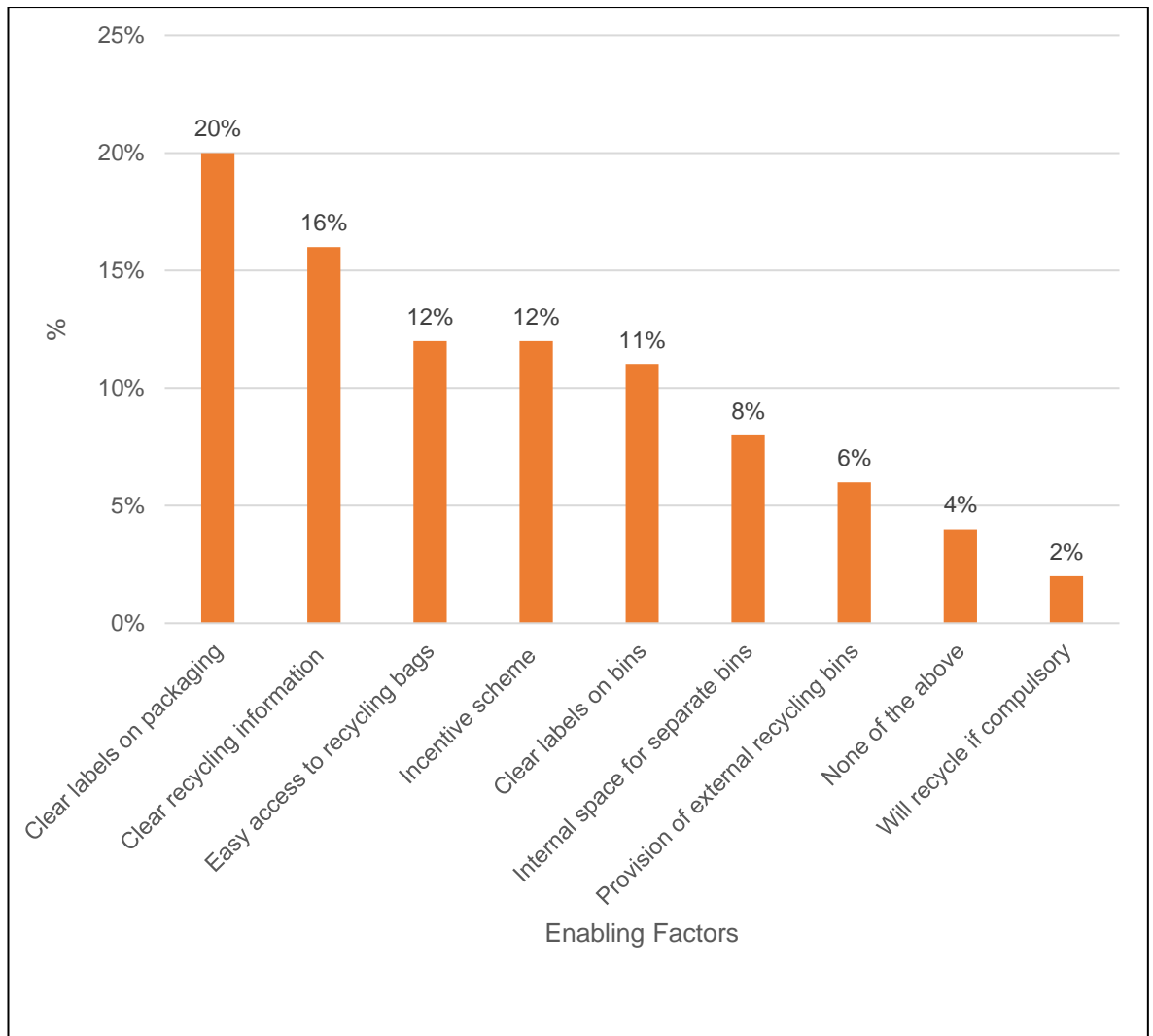


Figure 5.2: The proportion of the respondents influenced by recycling enabling factors to carry out recycling activities.

Age and Recycling Enabling Factors: The chi-square independence test between age and recycling enabling factors indicated that the age proportions differed significantly in their preferences for different enabling factors, χ^2 (df=33, n=417) = 63.56, p -value = 0.00. This means that different age groups showed different inclinations as to what factors will facilitate their recycling activities.

Figure 5.3 indicates that the younger generation (22-38 years - 65%) and (39-45 years - 71%) age groups, feel strongly about clear labelling on packages in enabling recycling activities than the older generation (46-54 years - 62%) and (over 55 years - 62%) age groups. While the older generations (over 46 years) are less motivated by incentives to carry out recycling activities than the younger generation (22-45 years).

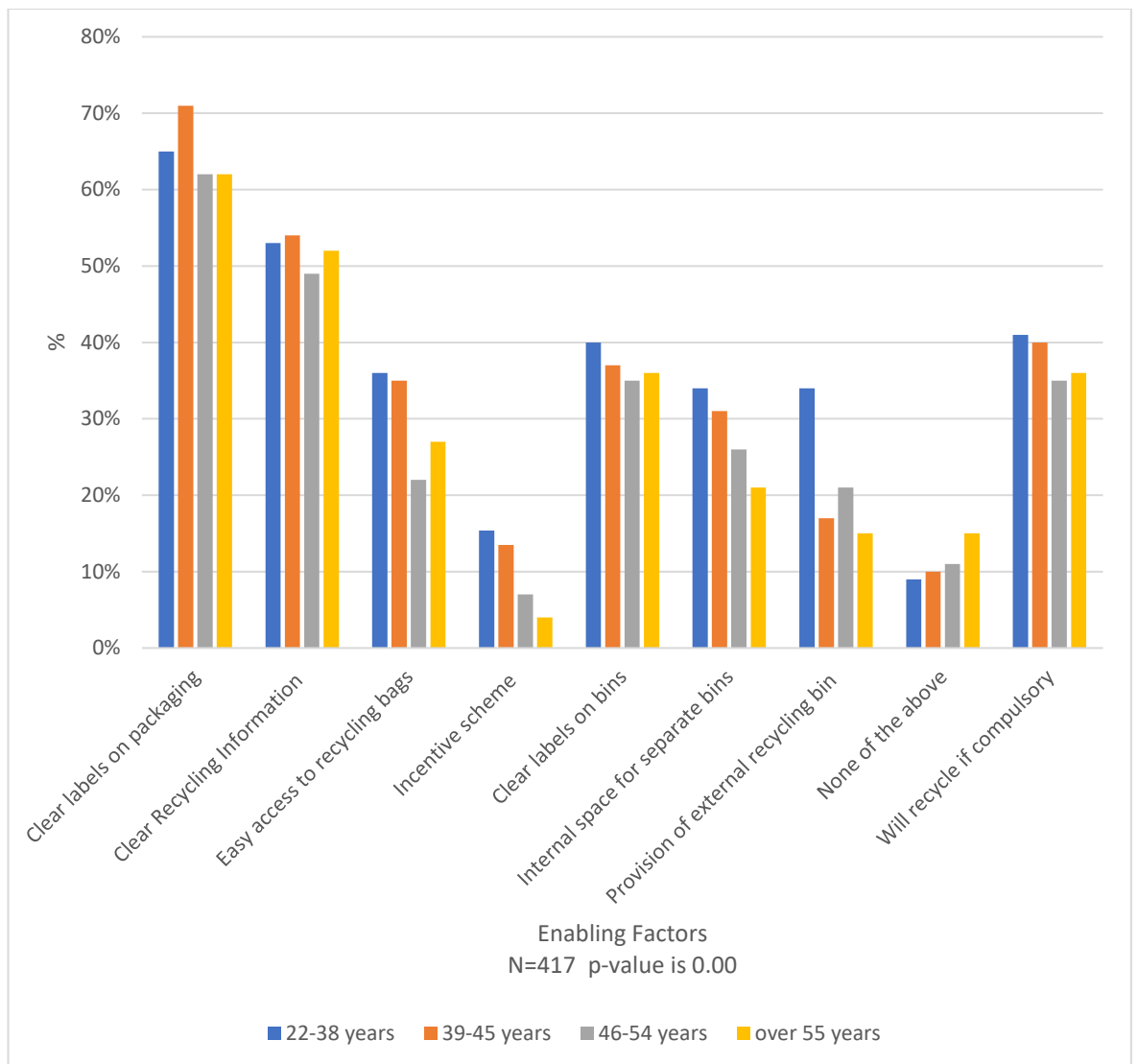


Figure 5.3: The result of the cross tabulation of the age variable and the recycling enabling factors variable in the borough of Westminster.

Interestingly, the over 55 years age group have the highest response to the option that none of the enabling factors will encourage them to recycle. The descriptive data of the questionnaire (question 10), indicates that the millennials (22-38 years) recycle less than the older generation (39 to over 55 years). Du Toit and Wagner (2020) in their study found that the older the participants surveyed, the more likely they participate in recycling activities. But these recycling enabling factors show a different result, why? The reason why the older generation is not incentivised by incentive schemes or not encouraged by the enabling factors is that they are already motivated, face fewer barriers, and do not need incentives to recycle.

But the younger generation face these barriers (disguised as enabling factors) more and therefore will require more enabling factors to participate in recycling activities as shown by the chi-square test.

Also, the most popular enabling factors are clarity on packaging labels and clear recycling information. Participants in phase 1 data collection (policy constraints theme) also identified non-clarity of packaging labels as a barrier to recycling activity. It is therefore important that future waste legislation should focus more on standardising the packaging labelling to provide more clarity to the users.

Type of Residence and Recycling Enabling Factors: A chi-square test of independence performed showed that there was a significant association between type of residence and recycling enabling factors where χ^2 (df=44, n=417) = 61.73, p -value = 0.04. This indicates that participants living in different residence types show varied disposition to recycling enabling factors.

Clear labels on packaging as indicated in Figure 5.4 is a high-priority area for all the residence types (except for houses with sharers) although with different degrees of inclination. Easy access to free recycling bags is more of an issue with participants living in houses with sharers having the highest percentage of 45%.

Preference for incentive schemes continues to be a low priority as seen with age explanatory variable. Where participants living in houses displayed the lowest inclination to this enabling factor than participants living in flats.

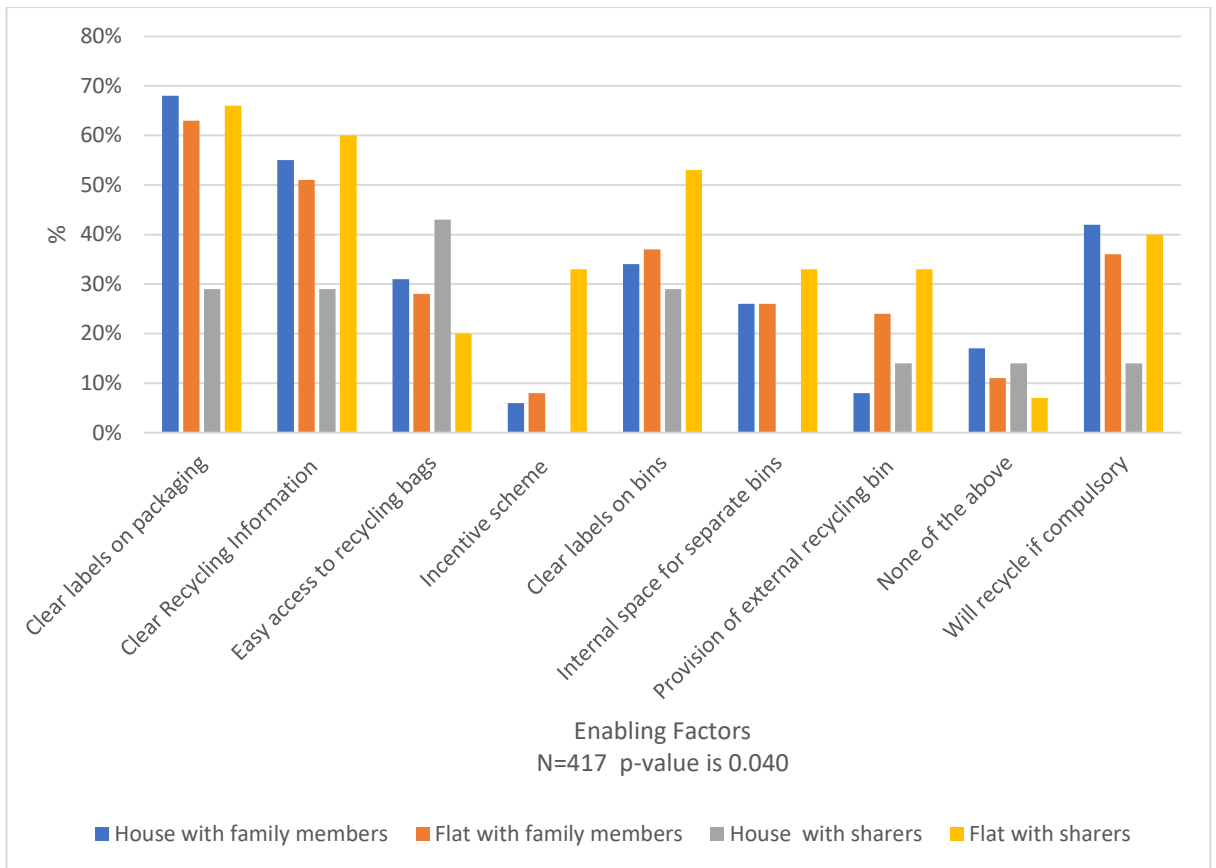


Figure 5.4: The result of the cross tabulation of the type of residence variable and the recycling enabling factors variable in the borough of Westminster.

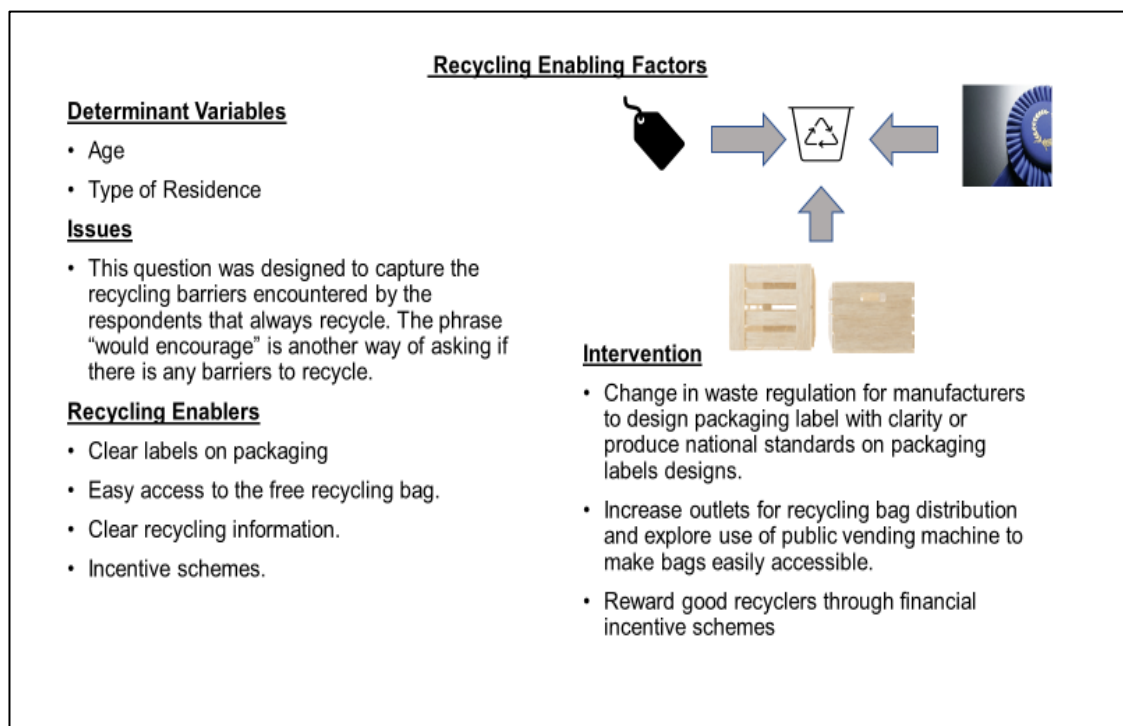
In summary (Box 2), tests analysis carried out for age and type of residence against recycling enabling factors indicates that enabling factors are influenced by age and type of residence. Across the various age groups and residence types, there is a consensus that more clarity is needed for the recycling information on the packaging label. This enabling factor has the highest percentages across the age groups than other enabling factors.

More importantly, this data corroborates another survey conducted in the UK, which states that the highest barrier to recycling for the younger population was the ambiguity in deciding what materials can be recycled (Eichler, 2017). The result from phase 2 data indicates that higher percentages of the 22-38 years (65%) and 39-45 years (72%) want the recycling labelling on packaging to be clearer. This enabling factor has the highest percentage for these age groups than other enabling factors.

The type of residence and age results indicate a low affinity to incentive schemes among the respondents. Question 14 responses about what type of incentive the most preferred, the results again indicate a low inclination to incentives, as 60% of the respondents (Appendix I) did not choose any incentives, while the remaining 40% opted for financial incentives. Interestingly, participants in phase 1 data also have a high affinity towards financial incentive schemes.

Mitigating these issues will require the use of simple graphics, or colour-coded icons with text to enable users, easily decide the recyclability of packaging materials. This will also require a change in the waste legislature to make this labelling standard, a uniform standard across the country. Although participants' disposition to incentives is low, financial rewards could still be employed to increase recycling participation.

The council should also explore the possibility of increasing outlets for recycling bag distribution using public vending machines to make bags easily accessible. The introduction of incentive schemes across the borough would also enable more resident participation in recycling activities.



Box 2: Summary of the issues and interventions required from the result of the age and residence type cross-tabulations with recycling enabling factors variable in the borough of Westminster.

5.4 Commitment

The explanatory variables of age and level of education were evaluated against commitments to recycling activities. Only the level of education indicates a significant relationship with a commitment to recycling activities.

The question was asked (single answer), If you put a piece of rubbish or recycling in the wrong bin by mistake, do you try to remove it and place it in the correct bin?

The question was to determine the following:

- How far can the residents go in preventing cross-contamination of recycling and rubbish?
- How committed are the residents to doing the right thing?
- How conscious are the residents of conducting recycling activity?

Figure 5.5 shows the percentages of commitment based on the participant's level of education. The data result indicates that most of the sample population will try to avoid cross-contamination of rubbish and recycling. It also shows that the majority of the sample population are committed recyclers and are conscious of their recycling habits. Additionally, it shows that 6% of the sampled population cannot participate in recycling activities due to non-availability of recycling bins.

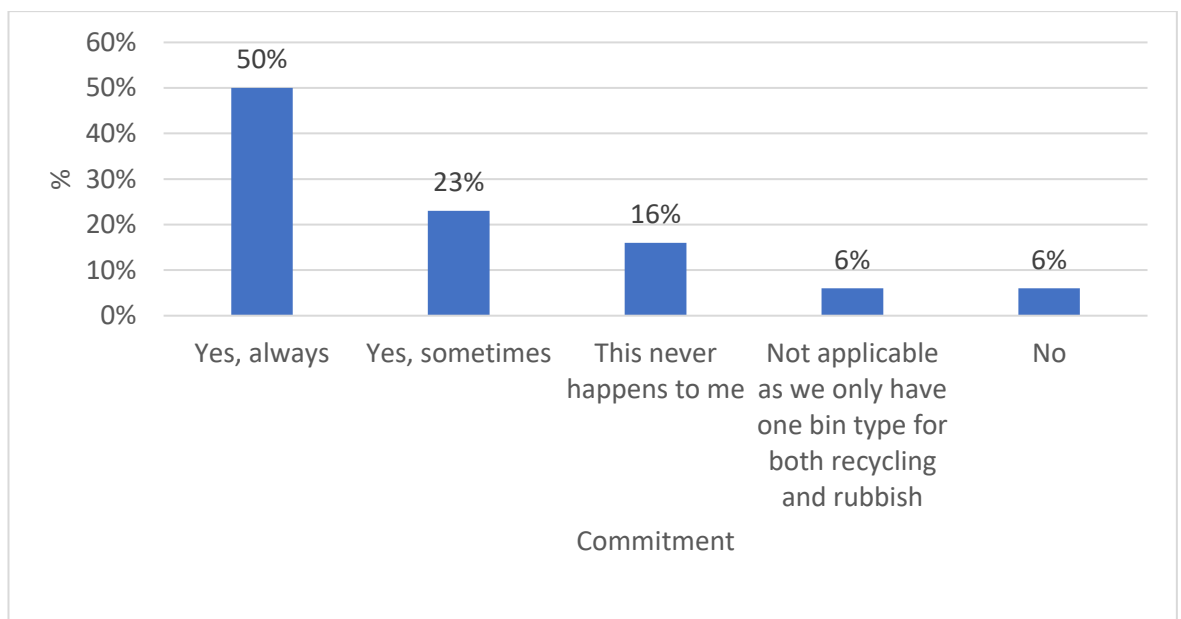


Figure 5.5: The proportion of the respondents based on their commitment to recycling activity.

Education and Commitment: The chi-square independence test (figure 5.6) shows that the level of qualifications differed significantly from recycling commitment, χ^2 (df=20, n=417) = 50.36, p -value = 0.00. This means that participants with different levels of qualifications showed different behaviour regarding commitment to recycling activity. The result indicated in figure 5.6 shows that participants with college and postgraduate qualifications are more committed recyclers than the other two lower levels of education by always correcting their recycling mistakes.

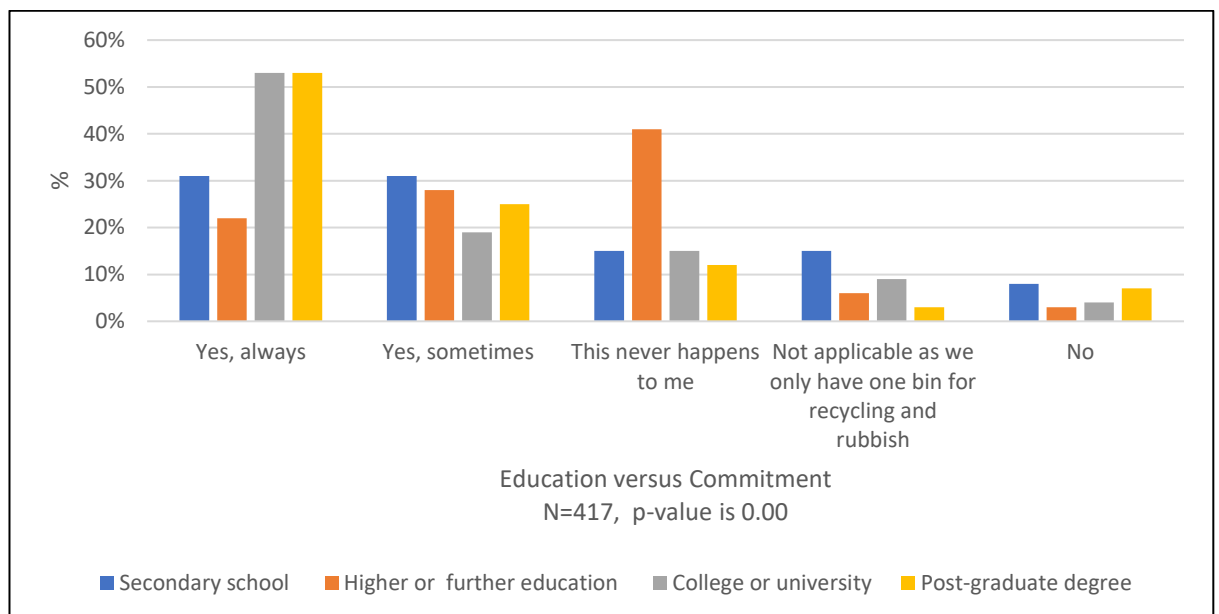


Figure 5.6: The result of the cross-tabulation of the education variable and commitments to recycling activity variable in the borough of Westminster.

Interestingly, the percentage of non-committed recyclers is almost the same and higher for participants with secondary school (8%) and post-graduate degree qualifications (7%) than for other levels of qualifications. The expectation was that participants with postgraduate qualifications would be less than other levels of qualifications (in this group) because of their awareness of environmental benefits.

One possible explanation is that people generally regard bins to be dirty and therefore, a barrier to removing the wrong waste material placed in the bin. However, due to the very low percentage of non-committed recyclers within the postgraduate qualification group, the impact of such influence is negligible compared to the impact of committed recyclers being influenced by a higher level of qualification.

Another interesting behaviour is exhibited within the higher or further education group. This group has the lowest percentage (22%) in correcting their recycling mistakes but has the highest percentage (41%) of never committing a recycling mistake. As expected, participants with secondary school qualification show the lowest commitment out of all the levels of qualification.

This shows again that commitments to recycling activities increase with the level of education. The higher commitment from respondents with higher qualifications could be from the awareness of the environmental benefits of recycling, which may not be available to respondents with lower educational qualifications.

The result shows that recycling awareness programmes would need to be designed to focus more on residents with lower educational qualifications. This result also corroborates data from phase 1 where participants with higher educational qualification show high passion and commitment to recycling activities.

The result of this analysis also corroborates Hu & He (2022) and Meng et. al. (2019) findings on household disposal practices where a higher level of education is an enabling positive factor for recycling participation.

In summary (Box 3), test analysis shows that age has no significant relationship to recycling commitment, but education is a factor that influences commitment to recycling activities. Respondents with higher qualifications show higher commitment to recycling activities than the respondents with lower qualifications.

Recycling Commitment

Determinant Variables

- Education

Issues

- 53% of respondents with college or university qualification and post graduate qualification shows higher commitment in always correcting their recycling mistakes.
- Between 21% to 31% of respondents with other lower qualification shows low commitment in rectifying their recycling mistakes.

Causes/Impacts

- Environmental awareness of recycling benefits may be responsible for high commitments to recycling for respondents with higher qualifications.
- Lack of commitment to recycling activities could affect recycling rate to fluctuate year in and year out.



Intervention

- Early intervention or introduction of recycling subjects in primary and secondary schools is fundamental, in levelling environmental education across the levels of qualification.
- The need for national curriculum on waste and recycling topics to be taught as a complete subject rather than taught under general subject.

Box 3: Summary of the issues and interventions required from the result of the cross-tabulation between education and recycling commitment variables in the borough of Westminster.

5.5 Bin Colour and Labels

The explanatory variables of age and level of education were assessed against respondents' views on bin labels and colour. Both variables show a significant relationship with bin labelling and colours.

The question was asked (single answer), Westminster City Council uses black bins for both recycling and rubbish, which are labelled mixed recycling and rubbish, what do you think of this? The question was asked to follow up on the bin labelling issues that emerged during phase 1 data under the policy constraints theme. This is to determine if the same colour used for recycling and rubbish is also a barrier to recycling for the larger sampled population.

The information displayed in Figure 5.7 indicates the percentages for the different perceptions to bin labelling and colours. This trend will be used to discuss the influence of age and education variables in the sections below.

Additionally, the data provided details on the type of storage systems which indicates a lack of proper storage systems in some of the participant's households. Although 32% of the participants can segregate waste into two streams of rubbish and mixed recycling, they lack proper bin infrastructure which can result in low recycling output.

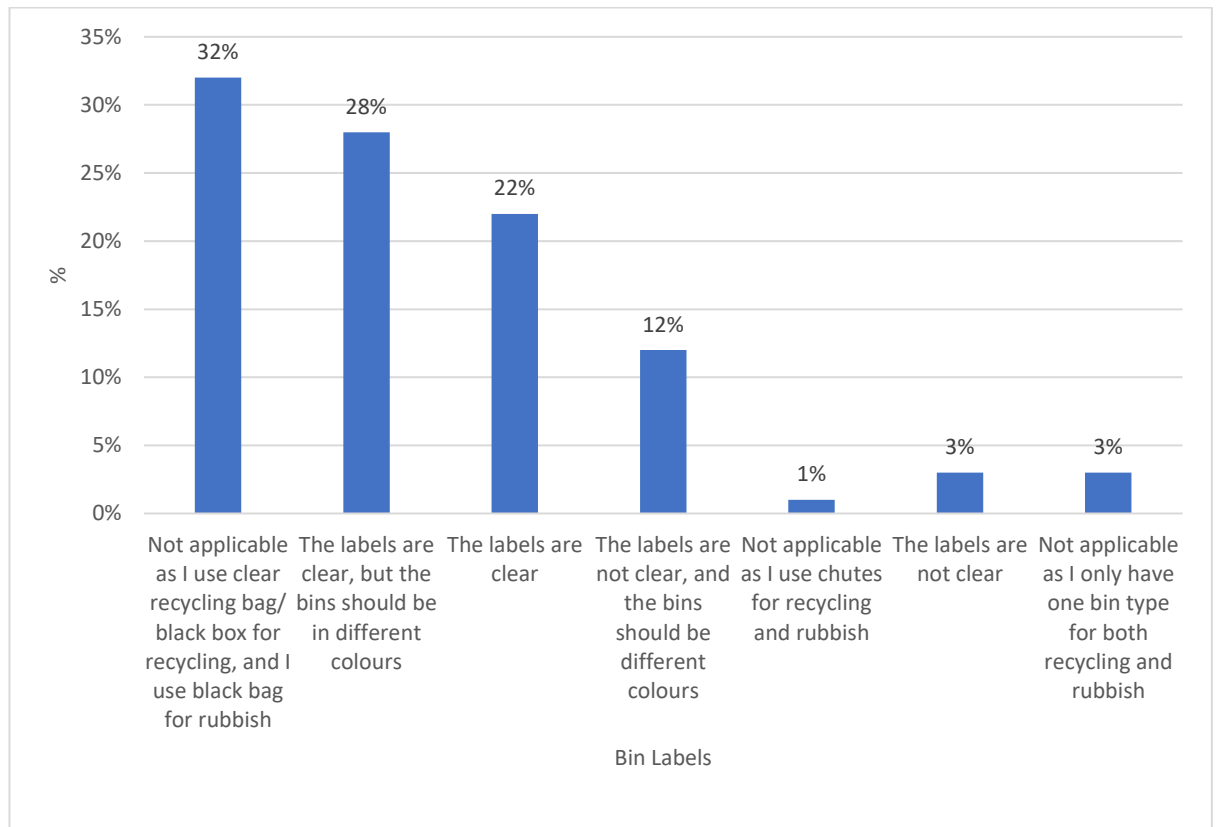


Figure 5.7: The proportion of the respondents' responses to bin labelling and colours question.

In general, the data indicate that 50% out of the participants (65%) that use external bins stated that the labels are very clear. While 40% of this 65% prefer different bin colours for different waste streams.

Age and Bin Labelling and Colours: A chi-square test of independence was performed to examine the relationship between age and bin labelling format. The relationship between these variables was significant, χ^2 (df=18, n=417) = 37.66, p -value = 0.00. This means that the age groups indicate different perceptions of the bin labelling format.

In terms of clear labelling information on the bins (Table 5.3), 30% of the over 55 years age group believes the bin labelling is clear in contrast to 23% of the age group 22-38 years that disagree with this opinion.

Similarly, the total proportion of 22-38 years (55%) that prefer distinct colours for bins is higher than the total proportion of those over 55 years (34%) that have the same notion. This is surprising, as you will expect those over 55 years with failing eyesight to have issues with bin label clarity and colours. These comparisons indicate that bin labelling format and the colour is a limiting barrier to participating in recycling activity for the younger generation (22-38 years).

Table 5.3: The result of the cross-tabulation of the age variable with bin labelling and colours variable in the borough of Westminster.

Age	Not applicable as I use clear recycling bag/black box for recycling, and I use black bag for rubbish	The labels are clear, but the bins should be in different colours	The labels are clear	The labels are not clear, and the bins should be in different colours	Not applicable as I use chutes for recycling and rubbish	The labels are not clear	Not applicable as I only have one bin type for recycling and rubbish	Total Percentages
22-38 years	29%	32%	11%	23%	2%	2%	1%	100%
39-45 years	39%	27%	18%	8%	0%	2%	6%	100%
46-54 years	37%	24%	18%	12%	1%	6%	2%	100%
over 55 years	30%	27%	30%	7%	1%	2%	3%	100%
Number of Respondents								417
Chi-Square Tests (<i>p</i> -value)								0.004

The result also indicates that there is popular support for the bins to be in different colours to prevent contamination issues. Since the chi-square test has established a strong link between the respondents' ages and their views about the bin infrastructure. The council must consider having different bin colours for different waste streams. This will facilitate easy identification of relevant disposal bins for the required storage for the younger generation.

Education and Bin Labelling and Colours: The chi-square independence test (table 5.4) performed indicates that levels of education differed significantly between different bin labelling formats, χ^2 (df=30, n=417) = 102.13, p -value = 0.00. It can be inferred that participants with different levels of qualification showed different perceptions of the bin labelling format and colour.

Table 5.4: The result of the cross tabulation of the education variable with bin labelling and colours variable in the borough of Westminster.

Education	Not applicable as I use clear recycling bag/black box for recycling, and I use black bag for rubbish	The labels are clear, but the bins should be in different colours	The labels are clear	The labels are not clear, and the bins should be in different colours	Not applicable as I use chutes for recycling and rubbish	The labels are not clear	Not applicable as I only have one bin type for recycling and rubbish	Total Percentages
Secondary school	38%	8%	23%	15%	8%	0%	8%	100%
Higher or further education	22%	34%	19%	16%	0%	3%	6%	100%
College or university	33%	29%	21%	10%	1%	2%	4%	100%
Post-graduate degree	32%	27%	23%	13%	1%	3%	1%	100%
Number of Respondents								417
Chi-Square Tests (p -value)								0.00

In terms of clear bin labelling, the total proportion of secondary school leavers that believes the labelling is clear is 31% and lesser than the total proportion of participants with post-graduate qualification (50%). The same trend is observed with the preference for distinct bin colours for different waste streams. It is thus evidently clear that the labelling format is complex and more easily understood by university graduates than secondary school leavers.

This again, indicates a strong link between the level of education and the bin labelling standard, and popular support across the educational levels for the bins to be in different colours. This may suggest that the choice of words used in the information on bin labels may be too technical and therefore, not easy for the respondents with the lowest levels of education to understand. Hence, a lack of

clarity about bin labels and colours would cause confusion among residents in placing items in the wrong bin, thereby causing contamination and loss of the mixed recycling stream.

In summary (Box 4), test analysis for age and education indicate a significant relationship with respondents' views on bin labelling and colour. Generally, respondents in each age group and level of education state that the labels on the bins are clear but it would be much easier if the different waste streams bins are in a different colour. This barrier relating to age has already been discussed (in line with Eichler, 2017 study) under the recycling enabling factors (section 5.3). Similarly, the impact of education has already been discussed in Section 5.4 (in relation to Meng et. al., 2019 study) where an elevated level of literacy skills will facilitate an effective understanding of recycling information.

Therefore, it is highly imperative to review the current bin labelling format to allow easy participation of the residents with a low level of education in recycling activities. More importantly, the local authority should consider having different bin colours for the different waste streams. In addition, the choice of words and graphics on the label should be remarkably simple, large, and bold to aid easy identification for all the age groups.

Bin Labelling and Colours

Determinant Variables



- Age
- Education

Issues

- 23% of the respondents in the age group 22-38 years are of the opinion that the labels are not clear. This age group have the highest percentage response to this category than other age groups.
- Respondents with secondary school qualification (15%) and higher education qualification (16%), have the highest percentages of respondents that believed that the bin labels are not clear, and that the bins should be in different colours.

Causes/Impacts

- Choice of words used in the information on bin labels may be too technical and not easy for the respondents with the lowest levels of education to comprehend.
- Lack of clarity regarding bin labels and colours would cause confusion in placing the wrong items in the wrong bin, thereby causing contamination and loss of mixed recycling stream.

Intervention

- It is highly imperative to review the bin labelling format to allow easy participation of the residents with low level of education in recycling activities.
- Choice of words and graphics on the label should be very simple, large and bold to aid easy identification.
- The local authority should consider having different bin colour for the different waste stream.

Box 4: Summary of the issues and interventions required from the result of the age and education cross-tabulations with bin labelling and colour variable in the borough of Westminster.

5.6 Recycling Bag Accessibility

The explanatory variables of residence type and ward level were evaluated against the accessibility to the council's free recycling bags, both variables indicate significant relationships. However, the ward level analysis is not presented (but available in Appendix R) because no valuable information could be derived from the data. Also, ward level is not an important factor that affects the availability of the recycling bags but rather depends on the service provided by the council.

The question was asked (multiple answers), what methods have you used to request recycling bags from the council? The question was asked because data from phase 1 under the service constraints theme indicate that the participants were having problems with recycling bag accessibility. This will allow further exploration of what is causing this accessibility issue.

Figure 5.8 shows the percentage distribution of the responses to recycling bag accessibility. The main three ways of accessing the bags are through electronic requests (35%), from the libraries (21%), and telephone requests (9%) while the

less popular avenues are the mobile recycling centre, from community events, and from the recycling collection crews.

These other avenues are less popular because responses from recycling events (discussed in section 5.11) indicate that the sampled residents are not aware of these events. Furthermore, the council only has one mobile recycling centre in Warwick Avenue which may be far for other residents living in other administrative areas.

While also, only a few residents may be at home when the recycling is collected and therefore had no opportunity to request recycling bags from the collection crew. Finally, only 9% of the respondents are not aware of how to request the bags from the council. These responses explained above will be used to analyse and discuss the distribution among the types of residence sampled.

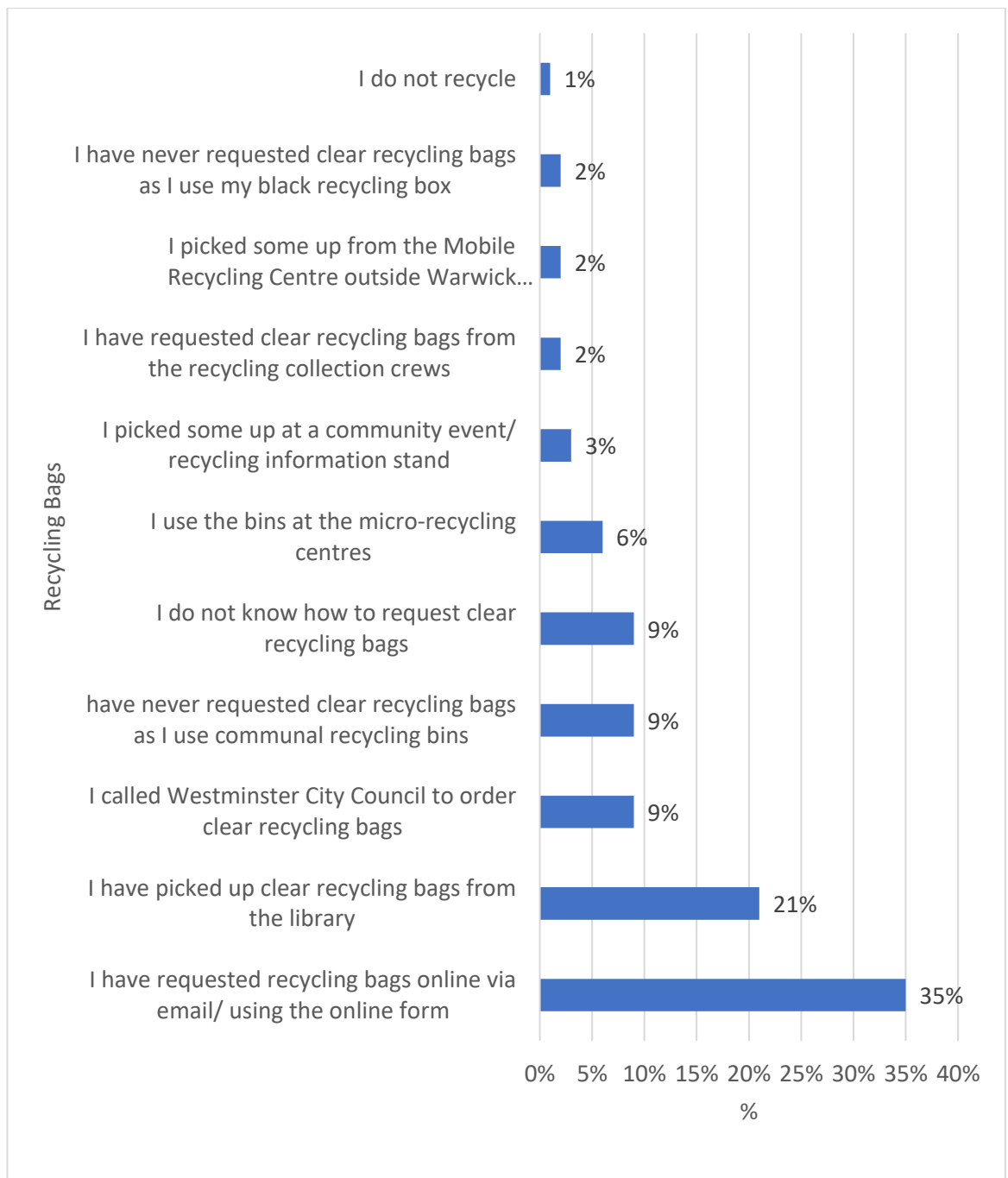


Figure 5.8: The proportion of the respondents on how they access the council's free recycling bags.

Type of Residence and Recycling Bags: A chi-square test of independence conducted for these two variables showed that there was a significant association between type of residence and recycling bag accessibility, χ^2 (df=44, n=417) = 92.66, p -value = 0.00. This signifies that accessibility to the recycling bags varies according to the residence type.

Table 5.5 shows the percentage distribution among the residence types. The data indicates that online requests for recycling bags are most popular with respondents living in houses having the highest demand and lower demand is associated with participants living in flatted properties. The same trend is observed with telephone and library requests.

In contrast, respondents living in flatted properties have the highest percentage (15%) of residents who are not aware of avenues to request recycling bags than the participants living in houses (5%). This data indicates the followings:

- It indicates that respondents in houses are using recycling bags more than respondents in flats. These will be houses with no frontal gardens to accommodate external bins or houses not located on accessible streets for bin collections, and there is high awareness among the participants of the house on how to access the council recycling bag.
- Use of recycling bags is also common in high rises where external communal bins are not available, but they have the highest accessibility issues to recycling bags than their houses counterpart.
- Suggests that the non-availability or inaccessibility of the recycling bag can create a fundamental barrier to achieving a high recycling rate, as most of the respondents depend on this medium to recycle their mixed recyclable materials.

Table 5.5: The result of the cross tabulation of the type of residence variable and the recycling bag variable in the borough of Westminster.

Type of Residence	Do not recycle	Only use recycling box	Mobile recycling centre	Recycling collection crews	Community events	Use bins in micro-recycling centres	Don't know how to request bag	Only use communal recycling bins	Telephone	Library	Online
House with family members	0%	4%	3%	1%	2%	2%	5%	3%	17%	34%	67%
Flat with family members	1%	3%	3%	3%	4%	11%	15%	16%	11%	29%	41%
House with sharers	0%	0%	0%	14%	14%	0%	0%	0%	0%	14%	86%
Flat with sharers	0%	0%	0%	0%	13%	0%	0%	0%	13%	7%	40%
N	417										
Chi-Square Tests (p-value)	0.00										


The council should review the current practice of the use of recycling bags, especially in flatted properties and consider the use of external communal bins. This consideration will largely depend on the availability of space for external storage facilities. However, the council should review the current practice of using the recycling bag, especially in flatted properties as this practice is not sustainable. The study carried out by Workentin et al. (2022) on the use of recycling bags in Canada, shows that the environmental and economic impacts of using plastic bags cannot be justified.

In summary (Box 5), tests analysis has indicated a significant relationship between residence type and ward level with the recycling bag accessibility. The majority of the respondents (72%) as seen in figure 5.8 rely on the council's free recycling bags to recycle their waste. This roughly matches the 80% of the respondents that lack external storage facilities for recycling. Also, a high dependency on recycling bags is seen in both houses and flats.

High dependency on recycling bags is caused by the lack of external storage facilities in the properties. Furthermore, the lack of easy accessibility to the bags is resulting in the loss of the mixed recycling stream to the residual waste stream.

Consequently, this would affect the council’s annual recycling rate to decrease or to be stagnant.

Therefore, in addition to the existing distribution outlets, the council should consider setting up recycling bag vending machines in strategic ward-level locations. The use of such vending machines can be controlled and monitored by access cards given to registered residents. Also, in large estates, the use of the concierge facility could be used to distribute the bags.

<u>Recycling Bag</u>	
<p><u>Determinant Variables</u></p> <ul style="list-style-type: none"> • Type of Residence <p><u>Issues</u></p> <ul style="list-style-type: none"> • 72% of the respondents rely on the council free recycling bag to recycle their waste. • High dependency on recycling bags is observed in both houses and flats. But higher in houses as shown in table 3 <p><u>Causes/Impacts</u></p> <ul style="list-style-type: none"> • High dependency on recycling bag is caused by lack of external storage facilities in the properties. • Lack of easy accessibility to the bags is resulting in the loss of mixed recycling stream to the rubbish stream. • Consequently, would impact the council annual recycling rate to decrease or stagnant. 	
	<p><u>Intervention</u></p> <ul style="list-style-type: none"> • In addition to the existing distribution outlets, the council may consider establishing recycling bag vending machines in strategic ward level locations. The use of such vending machine can be controlled and monitored by access cards given to registered residents. • In large estates, use the concierge facility to distribute the bags. • Ultimately, the council should review the current practise of using the recycling bag especially in flatted properties as this practise is not sustainable.

Box 5: Summary of the issues and interventions required from the result of the cross-tabulation between type of residence and recycling bag variables in the borough of Westminster.

5.7 Collection Frequency

The explanatory variables of age and residence type were evaluated against the respondents’ views on the current collection frequency for rubbish and mixed recycling. Meaningful relationship was only established for residence types. Currently, the council collects rubbish much more frequently than mixed recycling.

The respondents were asked (single answer), “If the council collected the rubbish less often, do you think this could encourage more residents to recycle?” The question was asked to explore the expectation of the council collection frequency

from the larger sampled population which participants in phase 1 data have identified as an issue. It will therefore help to determine if a reduction in the rubbish collection frequency will force residents to maximise the use of recycling bins. This will result in a reduction in the volume of rubbish bins and an increase in the volume of mixed recycling bins.

The data shown in Figure 5.9 suggest that more of the sampled population will prefer the current collection frequency for rubbish to be maintained and increase the collection frequency for recyclable materials. As a reduction in rubbish collection frequency will increase fly-tipping incidents. Only a very small segment of the respondents (6%) believed that a reduction in rubbish collection will encourage residents to recycle more.

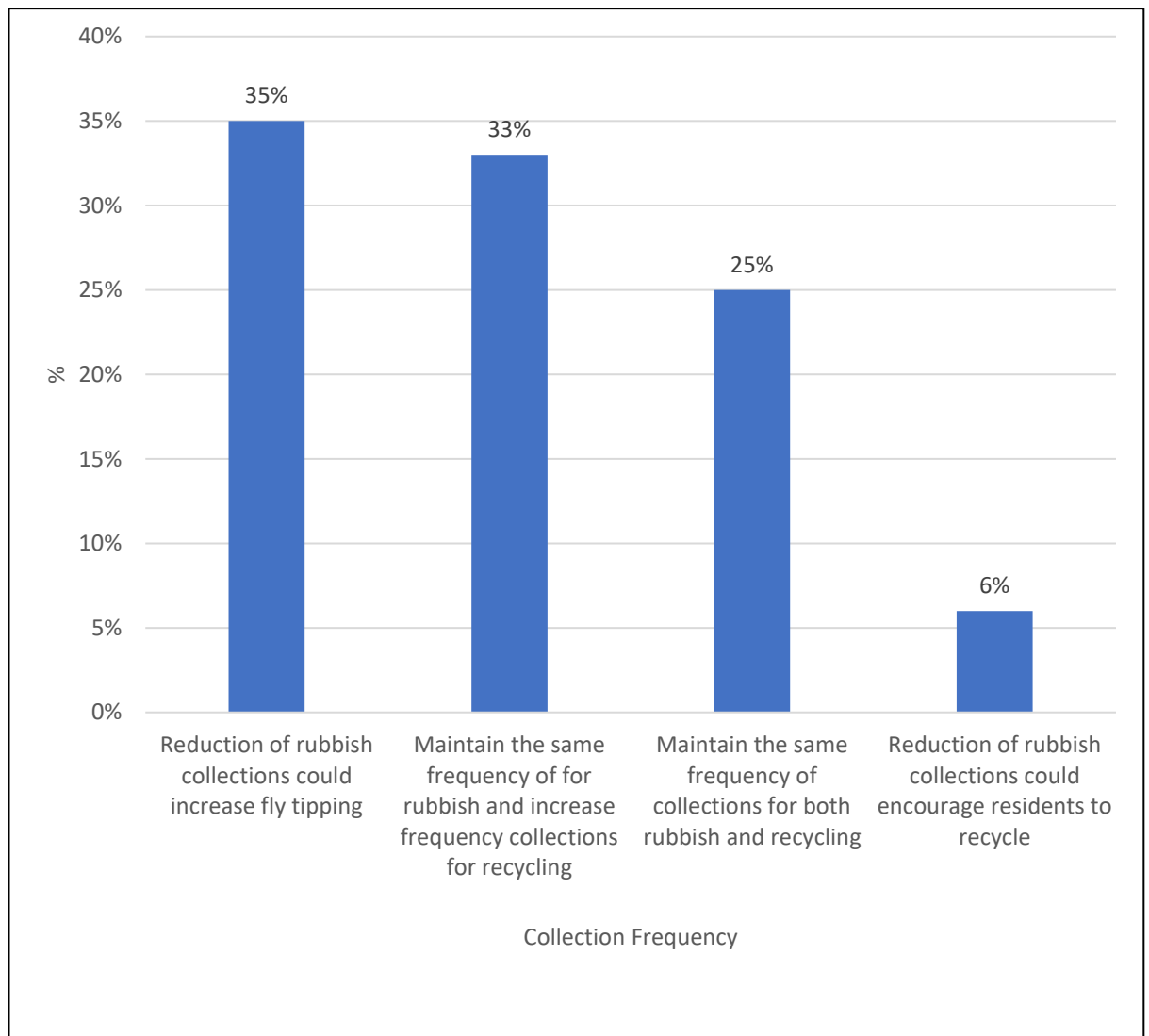


Figure 5.9: The proportion of the respondents' preference for recycling and rubbish collection frequency.

Type of Residence and Collection Frequency: The chi-square independence test showed that type of residence varies significantly between the different views of collection frequency, χ^2 (df=9, n=417) = 21.02, p -value = 0.01. This means that the views on collection frequency are influenced by residence type.

Table 5.6 indicates that the most prevalent view for respondents living in houses (37%) and flats (35%) with family members is that the reduction in rubbish collection could increase fly-tipping incidents. While for the respondents living in houses (71%) and flats (33%) with sharers, their main concern is that the council should maintain the current collection level for rubbish and increase that of the mixed recycling.

Table 5.6: The result of the cross-tabulation of the type of residence variable and the collection frequency variable in the borough of Westminster.

Type of Residence	Reduction of rubbish collections could increase fly tipping	Maintain the same frequency of for rubbish and increase frequency collections for recycling	Maintain the same frequency of collections for both rubbish and recycling	Reduction of rubbish collections could encourage residents to recycle	Total Percentages
House with family members	37%	31%	27%	5%	100%
Flat with family members	35%	33%	26%	6%	100%
House with sharers	29%	71%	0%	0%	100%
Flat with sharers	27%	33%	27%	13%	100%
Number of Respondents					417
Chi-Square Tests (p -value)					0.013

The reason for this split in the prevalent views among the types of households could be because of the properties housing the respondent with family members are owned, and thus their main concern is that fly tipping would destroy the social amenity of their area.

Households with sharers may be renting the properties or part of the transient resident population and therefore, are less concerned about fly-tipping. Rather, they are bothered about the accumulation of mixed recyclable materials within their properties and will prefer an increase in the collection frequency for mixed recycling, to make more space within their residences.

Therefore, an increase in collection frequency for mixed recycling will give an opportunity to maximise recycling output (Jatau et al., 2020 and Tsalis et al., 2018), especially in properties that lack external storage facilities.

In summary (Box 6), the type of residence data indicates less support for the view that reduction in the rubbish collection would encourage residents to recycle more. Also, support to maintain the current rubbish collection frequency and increase the recycling collection frequency is popular among all the residence types.

This data also matches the preference of participants in phase 1 data, in which they prefer the council to maintain the current frequency collection of rubbish and increase the recycling collection frequency, especially during festive periods.

Collection Frequency

Determinant Variables


- Type of Residence

Issues

- Would reduction of rubbish collection frequency encourage residents to recycle more? **No (84%)**
- Would reduction of rubbish collection frequency increase fly tipping? **Yes (35%)**
- Should the council maintain the current frequency for rubbish collection and increase the frequency collection for mixed recycling? **Yes (33%)**

Causes/Impacts

- Lack of adequate internal and external storage facilities resulting waste dumping and cross contamination
- Inadequate collection frequency for mixed recycling
- Loss of high-quality recyclable materials



Intervention

- Increase mixed recycling collection frequency to the same level for rubbish collection.
- Use local planning policy to ensure new developments have adequate internal and external storage space.
- Increase installation of Micro Recycling Centres to provide wider coverage of the borough.

Box 6: Summary of the issues and interventions required from the result of the cross tabulation between type of residence and collection frequency variables in the borough of Westminster.

In order to mitigate these circumstances, the council should therefore review its current collection frequency pattern with a view to increasing the frequency of recycling collection. This will facilitate the recycling activities of residents that lack adequate external storage facilities in all types of residences. It would also ensure the maximum capture rate of these materials from the residents. In addition, new residential properties should be required to provide adequate storage space (both internal and external) to avoid overspilling and contamination issues through planning permission conditions.

5.8 Food Waste Collection

The explanatory variables of age, internal storage and external storage were assessed against the respondents' views on the proposed food waste collection. All three variables indicate a meaningful relationship with food waste collection. However, only variables of age and internal storage are presented below while the analysis for external storage is available in Appendix R. This is because the external storage result is similar to the internal storage result.

The question was asked (single answer), If the council introduced a city-wide food waste collection service, how would this service affect you?

At the time of data collection for phase 2, the council was yet to begin food waste collection. The council has now rolled out (early 2022) the food waste collection service and data collected in phase 3 will shed light on the challenges of this new service.

The majority of the respondents (74%) are ready to segregate food waste for separate collection if the council starts collecting residential food waste. However, 30% of this group do not have enough storage space to accommodate food waste collection.

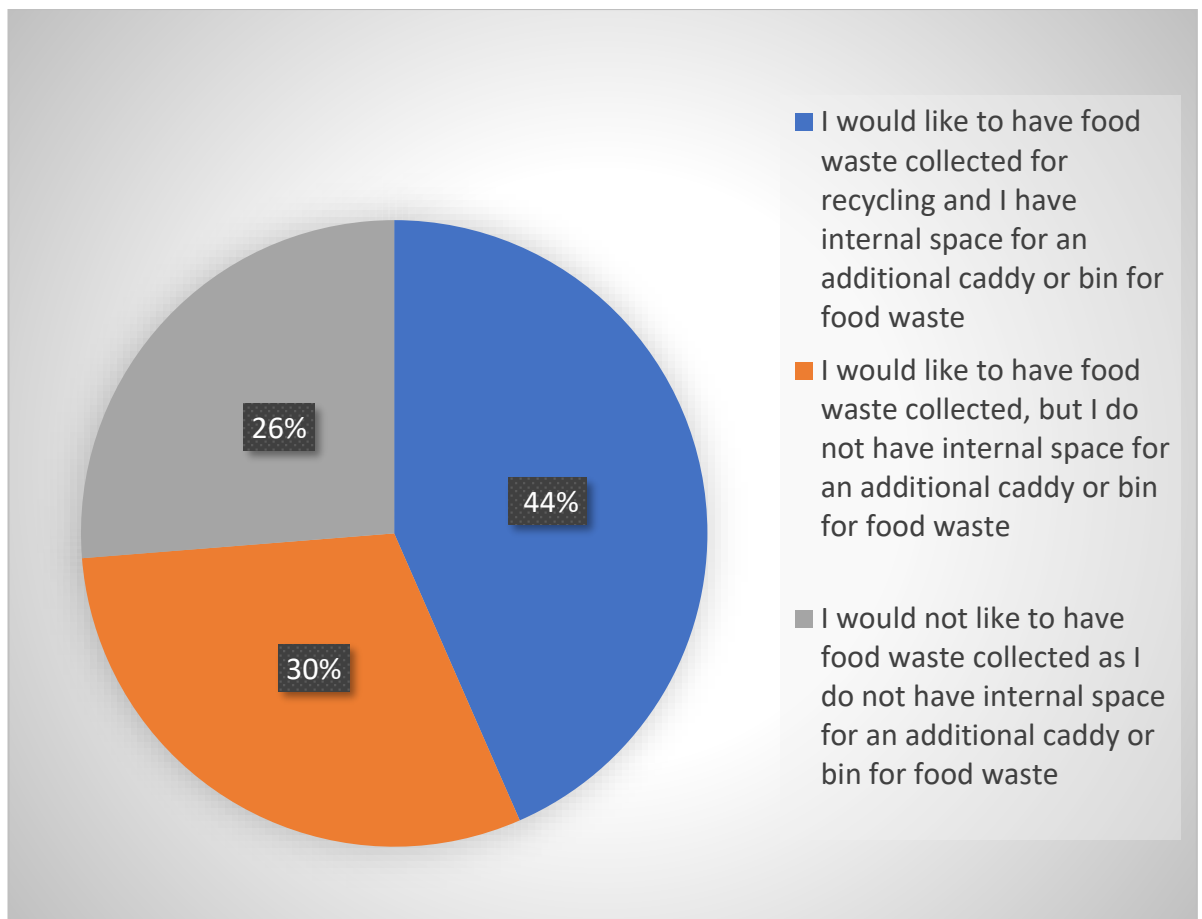


Figure 5.10: The proportion of the respondents' preference for food waste collection service and availability of food waste storage.

This 30% of the sampled population prefer food waste collection but the lack of internal infrastructure presents a barrier for these residents to be able to do so in the future, perhaps provision of an external food waste bin (if possible) may at least facilitate half of this group to recycle food waste.

The remaining 26% that would not like food waste collection cite lack of internal space to store food waste as the main barrier. Also, possibly half of this group could be influenced to change their mind if there is the availability of external storage for food waste. Also, in phase 1 data collection, half of the participants (P1, P2, P4, P5, P9, and P12) indicates a high preference for food waste collection. As food waste can be counted against the recycling waste flow data, the commencement of food waste service could increase the council recycling rate by another 20% since this service is very popular among the participants in this research.

Age and Food Waste Collection: A chi-square test of independence showed that there was a significant association between age and food waste collection, χ^2 (df=6, n=417) = 29.53, p -value = 0.00. This can be interpreted that the age groups differed significantly in their preference for food waste collection.

Table 5.7 indicates that the younger generation (22-38 years) shows higher preference (56%) for food waste to be collected than the older generations. But the older generation (over 55 years) have less storage capacity issues to store food waste than the younger generations. Though there may be higher preference for food waste in the younger generations, they faced higher barriers in participating in food waste service.

Table 5.7: The result of the cross tabulation of age variable and the food waste collection variable in the borough of Westminster.

Age	Want food waste collection and have additional storage space	Want food waste collection but no additional storage space	Do not want food waste collection and no storage space	Total Percentages
22-38 years	56%	33%	11%	100%
39-45 years	46%	39%	15%	100%
46-54 years	43%	34%	23%	100%
over 55 years	37%	26%	37%	100%
Number of Respondents				417
Chi Square Tests - p -value				0.000

Additionally, the over 55 years age group have the highest preference for non-food waste collection service and lack storage capacity to accommodate food waste. It may be that the overriding concern for the lack of interest is due to the lack of storage space. Therefore, the council will need to innovate ways to mitigate the lack of storage both internally and externally to achieve maximum participation of the residents in its food waste collection service.

Internal Storage and Food Waste Collection: A chi-square test of independence was performed to examine the relationship between internal storage and food waste collection. The relationship between these variables was significant, χ^2 (df=8, n=417) = 22.10, p -value = 0.00. This means that the preference for food waste collection is influenced by internal storage availability.

Table 5.8 shows that the availability of internal storage space is an extraordinarily strong factor influencing the respondents' preference for food waste collection. Most of the respondents with adequate internal space (48% and 60%) have the highest preference for food waste collection to be introduced, while the respondents struggling with space have the highest preference for food waste collection not to be introduced (32%) due to lack of internal space. This result corroborates the result from the age and food waste collection analysis that lack of storage space is a barrier to the food waste collection service.



Table 5.8: The result of the cross-tabulation of the internal storage variable and the food waste collection variable in the borough of Westminster.

Internal Space	Want food waste collection and have additional storage space	Want food waste collection but no additional storage space	Do not want food waste collection and no storage space	Total Percentages
Space with two separate storages	48%	27%	25%	100%
Space but one storage for both rubbish and recycling	60%	20%	20%	100%
No Space, only one bin for both rubbish and recycling	19%	49%	32%	100%
Number of Respondents				417
Chi Square Tests - p-value				0

Also, the result of the external storage (Appendix R) shows that 32% of the respondents lack additional external storage space to accommodate food waste. Since, the availability of internal and external space is strongly linked to interest in the food waste collection service, any intervention must focus primarily on addressing this issue before the introduction of the service.

In summary (Box 7), test analysis has shown a strong relationship between internal space, external space, and age variation with interest in food waste collection. Demand for food waste collection is immensely popular across age groups, as 74% of the respondents are interested in the service.

Food Waste Collection

<p><u>Determinant Variables</u></p> <ul style="list-style-type: none"> • Age • Internal Space • External Space <p><u>Issues</u></p> <ul style="list-style-type: none"> • High demand for food waste collection (74%). • 56% of the respondents lack appropriate storage space in their properties to cater for food waste. <p><u>Causes</u></p> <ul style="list-style-type: none"> • Lack of external storage facilities. • Lack of adequate external storage facilities. • Lack of internal storage spaces. • Lack of adequate internal spaces. 	<div style="display: flex; justify-content: space-around;">   </div> <p><u>Intervention</u></p> <ul style="list-style-type: none"> • Daily mobile food waste collection service. • Call in service request for food waste pick up. • Use the planning regime to ensure new residential developments have adequate internal and external storage space. • Food waste collection at the Micro Recycling Centres. • Free food waste bin distribution to residents to facilitate food waste collection. • Small compact and portable food waste bins for internal storage.
--	--

Box 7: Summary of the issues and interventions required from the result of the age, internal space, external space variables with food waste collection variable cross-tabulation in the borough of Westminster.

However, storage issues arising from the lack of internal and external spaces would be an obstacle for 56% of the respondents, in taking part in the food waste collection service. Shearer et. al., (2017) stated the importance of separate food waste collection in increasing the recycling rate of local boroughs but stressed that interventions to facilitate such service must be effective to achieve sustainable outcomes.

Wei et. al., (2017) also concur with Shearer et. al., (2017) summation but went further to identify odour as a major environmental challenge to food waste collection.

Mitigating measures such as the provision of food waste collection at the micro recycling centres, commissioning of a daily mobile food waste collection service, or call-in service to request food waste pick up, are part of the possible interventions for households that lack external space or adequate space to site a storage facility.

Free food waste bins can be distributed to households that have external space to store food waste, to facilitate food waste recycling. Bins for internal use food waste storage should be small and portable to cope with the lack of adequate internal space.

Strategically, there is a need to use the development planning regime to its maximum capability to ensure adequate waste storage facilities are provided in new developments.

5.9 Communication Methods

The explanatory variables of age and level of education were assessed against the type of communication received. Relationship was only established for age. The question was asked (multiple answers), what council communications have you seen or received about mixed recycling?

Figure 5.11 shows the percentage distribution of communication received by the respondents.

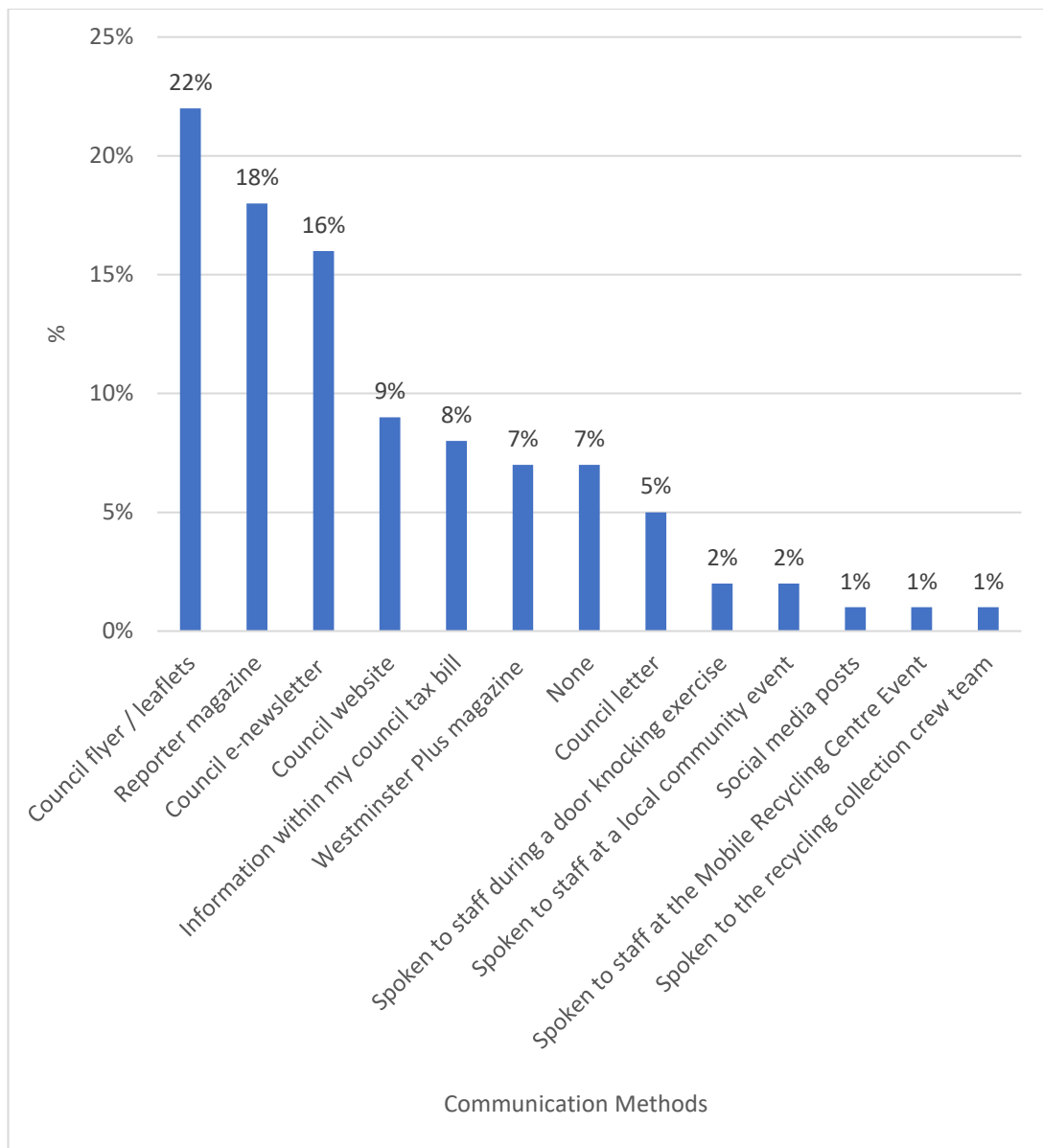


Figure 5.11: The proportion of the respondents' response to different mediums of recycling communication received.

The data indicates that the council is sending recycling information through a wide range of medium and numerous channels, which is reaching most of the respondents (93%).

Although the most common communication channel is through other electronic media, it shows that social media (1%) is highly underutilised as evidenced from Figure 5.11. The age analysis below will indicate the impact of social media on the younger generation. However, more work may need to be carried out to make other forms of communication effective. Judging from the responses, only 7% of the sampled population have not come across any recycling information.

Age and Communication Methods: A chi-square test of independence showed that there was a significant association between age and communication methods employed by the council, χ^2 (df=39, n=417) = 125.40, p -value = 0.00. This means that the different age groups have received different forms of recycling communication.

Figure 5.12 indicates an interesting and surprising trend, where the older generation has received more communication through electronic media (e-newsletter and council website with exception of social media) than the younger generation (22-38 years). This negates the expectation that the younger generation should have received more of this communication type.

However, the younger generation (22-45 years) has received more communication from social media than the older generation (over 46 years) even though the percentages of respondents that have received this form of communication are very small.

Furthermore, the millennial group (22-38 years) have the highest proportion (31%) of respondents that have not received any form of recycling communication from the council, and they form the largest population in the borough. Considering that the use of social media only makes up 1% of the types of communication methods received, the council will need to reinforce the use of social media to create recycling awareness among the millennials. This medium is the most efficient way to target and reach the 22-38 years age group.

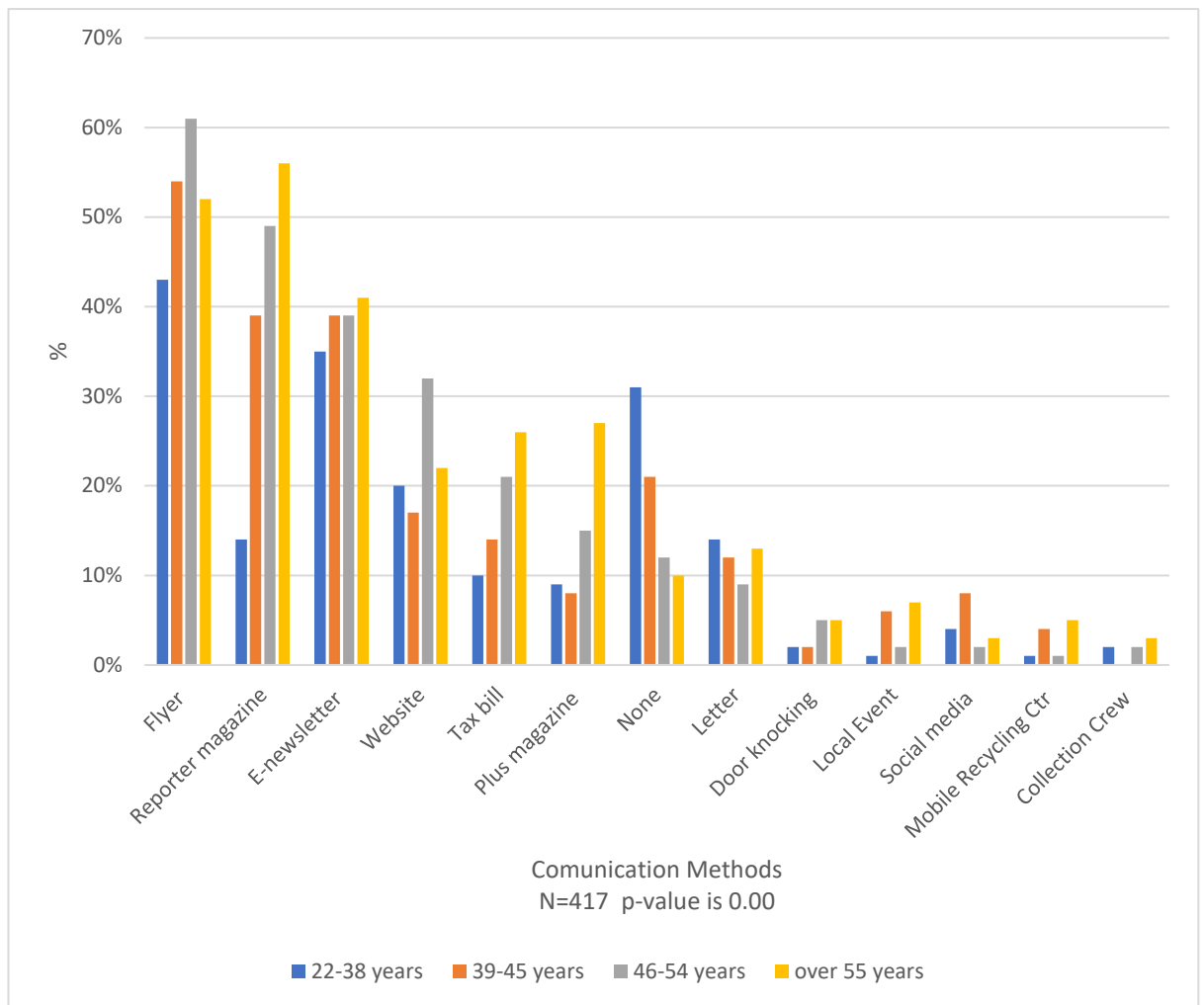


Figure 5.12: The result of the cross-tabulation of the age variable and medium of communication variable in the borough of Westminster.

Local community events and mobile recycling centres seem to be popular media for the older generations. However, considering the low percentages, these media are underutilised by the council. The council could target the older generations more for these events, especially the senior citizens that have more time to give for recycling activities. To increase attendance at these functions, the council could ask current attendees to invite their resident peers or friends to the programme, and then reward them with a discount voucher as a nudging tool.

In general, the data shows that the older generations are receiving more recycling information than the millennials. This could be attributed to the simple reason that social media platforms are not fully utilised to attract the younger generations.

It seems the council is not utilising its communication medium adequately to mobilise residents to recycling events or the residents are missing these events information on the communication received. Mee and Clewes (2004), and Mofid-Nakhaee et al., (2020) all agreed that effective communication and public engagement play a vital role in facilitating recycling activities.

Therefore, to reach more residents across all age groups. The council could formulate communication strategies that can allocate more resources to social media platforms, local community events, mobile recycling centres and door-to-door knocking exercises.


The following recommendations are proposed to resolve these problems. In addition to the council's existing popular media for communicating recycling messages, the council can make use of role models (movie stars, popular singers, footballers, and cartoon characters- for children) in recycling adverts on Tik Tok, Snapchat, Instagram, and Facebook.

It will be appropriate for the millennials to see Justin Bieber (for example) on Tik Tok acting and conveying a recycling message on social platforms. This will present a powerful message that can influence the millennials to recycle. This same recycling advert displaying the role models can also be made available on the council refuse collection vehicles, as electronic rolling boards as the vehicles move around to collect rubbish and mixed recycling. The electronic rolling board adverts can also be mounted on the giant bins available at the micro recycling centres.

The contemporary seismic shift of conducting most meetings online is many opportunities that need to be explored. Online recycling forums can be set up on the ward level on the "Nextdoor" app. The social network app is mainly set up for neighbourhoods, where you can get local tips and share information that would be of benefit to the local community. The app is designed perfectly so that only residents that live in the area can join the neighbourhood forum.

In summary (Summary Box 8), tests analysis carried out for age against forms of communication received shows that age has a significant relationship with forms of communication. The analysis indicates that the council is not reaching many of the millennials that constitute the highest population in the borough. Rather, the

traditional communication approach mainly employed by the council only attracts the older generation. The use of social media platforms that can attract the younger generation is highly under-utilised.

<u>Communication Methods</u>	
<p><u>Determinant Variables</u></p> <ul style="list-style-type: none"> • Age <p><u>Issues</u></p> <ul style="list-style-type: none"> • 31% of the 22-38 years age group have not received any recycling communication compared to other age groups. • Poor attendance of residents at recycling events, although over 55 years age group shows higher attendance (12%) than other age groups. <p><u>Causes</u></p> <ul style="list-style-type: none"> • Social media avenues that can attract the 22-38 years, that constitute the highest borough population is highly under-utilised. • Poor publicity given to the recycling events and use of media that are not popular to the residents. • No incentives to drive residents' participation towards recycling events. 	 <p><u>Intervention</u></p> <ul style="list-style-type: none"> • Use popular social networks such as Tik Tok, Instagram and Snapchat to reach the younger generation. • Use popular role models (actors, footballers, singers) to disseminate recycling message. • Transform the recycling event strategy, by using online public forum to organise recycling events and use the same medium to broadcast recycling message. • Use incentives such as discount vouchers as a nudging tool to increase the senior citizens participation in recycling activities. • Employ a communication and marketing strategist to manage the council recycling communication strategy.

Box 8: Summary of the issues and interventions required from the result of the cross-tabulation between age and medium of communication variables in the borough of Westminster.

5.10 Communication Effect

The explanatory variables of age and level of education were evaluated against the effect of communication received. Both variables show significant relationships. However, only level of education analysis with communication effect is presented while the variable of age analysis is presented in Appendix R. This is because age variation with communication methods is already presented in Section 5.10 and influence of level of education will be more appropriate to describe the effectiveness of the communication received.

The question was asked (single answer), what do you think of the communications you saw/received?

Figure 5.13 shows the percentage distribution of the communication effectiveness where the majority of the respondents agreed that the communication received was useful and clear.

This result (Figure 5.13) shows that out of the 93% of the respondents that have received information (Figure 5.11), only 70% find the information useful and clear. This data then suggests that recycling communication is effective, and it is reaching most of the residents.

However, the words usage (technical jargon) and the language used is a barrier to some minority groups or respondents with lower educational qualifications. This assumption will be tested in the level of education variation with communication effectiveness.

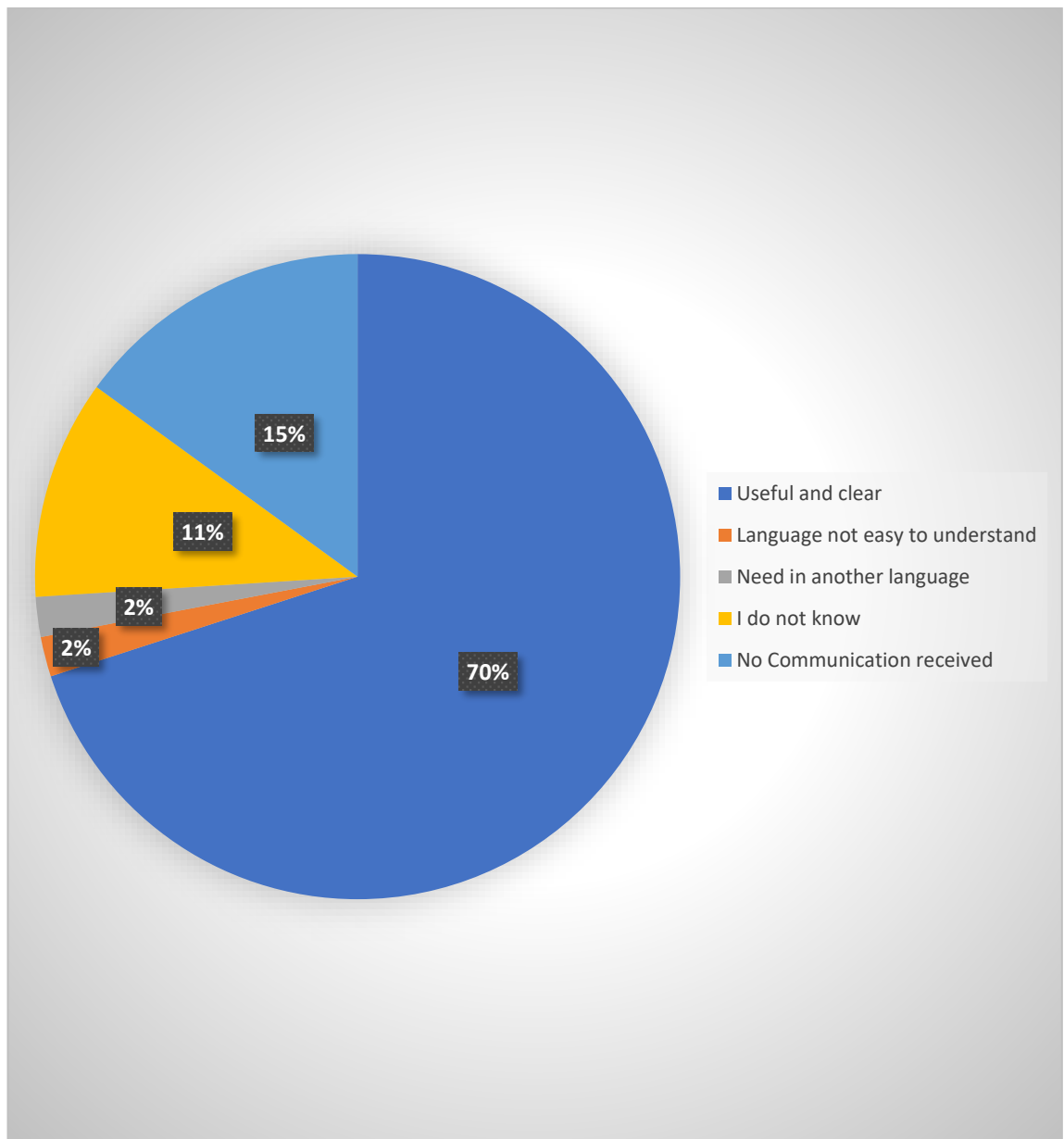


Figure 5.13: The proportion of the respondents' response to the effectiveness of communication received.

Education and Communication Effect: A chi-square test of independence showed (Table 5.9) that there was a significant association between the level of education and communication effect, χ^2 (df=12, n=417) = 33.43, p -value = 0.00. This means that the effectiveness of communication received varies with different levels of education.

Interestingly, the assumption made above regarding respondents with lower qualification having issues understanding complex recycling communication was false. But rather (as seen in Table 5.9), none of the respondents with the lowest educational qualification have issues with the level of grammar or technical jargon used in the recycling communication. Surprisingly, only respondents with higher qualifications (further education-6% and post-graduate degree-3%) are having issues understanding the recycling information.

In general, respondents with higher qualifications find the recycling communication useful and clear than the respondents with lower qualifications. This suggests that levels of education play an important role in understanding recycling information.

Table 5.9: The result of the cross-tabulation of education variable and effectiveness of communication variable in the borough of Westminster.

Education	Useful and clear	Language not easy to understand	Need in another language	I do not know	No Communication	Total Percentages
Secondary school	53%	0%	0%	16%	31%	100%
Higher or further education	66%	6%	2%	19%	7%	100%
College or university	74%	0%	0%	12%	16%	100%
Post-graduate degree	70%	3%	0%	10%	17%	100%
Number of Respondents						417
Chi-Square Tests (p -value)						0.001

A small percentage (2%) of the respondents with further education qualifications prefers the language of communication to be in another language. The City of Westminster profile (WCC, 2022) identified the top five non-UK languages spoken in the borough as Arabic, French, Spanish, Italian and Portuguese.

The 2011 population statistic also identified 62% of the Westminster population to be from a white background (City Population, 2021). Therefore, the remaining 38% are from Asian, Black, Arab, and other ethnic groups. Even though the percentage of the respondents that want the recycling information in another language is small, it may be worth it that the recycling information is also provided in the top five non-UK languages spoken in the borough to reach the wider population in the borough.

Furthermore, data obtained from phase 1 (under the communication and public engagement theme) indicate similar concerns as raised by P5 and P11. They stress that language barrier and choice of words within the council recycling information can create obstacles in understanding the information and therefore could impact the residents' ability to recycle effectively.


More concerning is that few respondents were unable to rate the effectiveness of the communication received. In this category, respondents with secondary school qualifications (15%) and further education qualifications (19%) have the highest percentages. This indicates that some respondents with lower qualifications may be finding it hard to understand the recycling information issued. A study carried out by Okonta and Mohlalifi (2020) also correlates the level of education to recycling source segregation where higher-level education has a positive impact on recycling behaviour.

Since the chi-square has proved a link between levels of qualification and the effect of communication, it may be prudent that the council review its recycling communication strategy to ensure that the recycling information is inclusive and accessible to all residents.

In summary (Box 9), the analysis of the test has shown that age and education have a significant relationship with the effectiveness of recycling communication. Most of the respondents (70%) across the age groups and educational levels agree that the council's current communication is clear and useful.

The council can increase the effectiveness of recycling communication by reviewing its current communication strategy to affect the wider community. These should include using appropriate simple layman terms and wordings, ensuring the information is clear, concise, coherent, and it is suitable for all residents irrespective of their age and educational level.

Communication Effect

<p><u>Determinant Variables</u></p> <ul style="list-style-type: none"> • Age • Education <p><u>Issues</u></p> <ul style="list-style-type: none"> • 14% of the respondents believes that the recycling communication received is not clear. • 12% are unable to rate the effectiveness of the communication received. Respondents with lower educational qualification are majority in this category. <p><u>Causes</u></p> <ul style="list-style-type: none"> • Uses of technical jargons. • Language not easy to understand. • Recycling information conveyed through language some very few respondents cannot understand. 		<p><u>Intervention</u></p> <ul style="list-style-type: none"> • The council should review its recycling communication strategy to ensure that the recycling information is inclusive and accessible to all residents. • Use appropriate simple lay man terms and wordings in recycling information. • The information used in communication should be clear, concise, and coherent and suitable for all. • The council should also consider making the recycling information available in Arabic and Bengali languages to cater for the ethnic minority residents.
---	--	---

Box 9: Summary of the issues and interventions required from the result of the age and education variables with the effectiveness of communication variable cross-tabulation in the borough of Westminster.

5.11 Recycling Events

The explanatory variables of age and ward level were assessed against attendance at recycling events to gauge public engagement concerning recycling activities. Only age indicates a significant relationship with attendance at recycling events.

The participants were asked (single answer), have you ever attended an event in Westminster about recycling including workshops, library recycling information stands or workshops or the mobile recycling centre (MRC)? The question was asked to further explore if non-awareness of recycling events was also prominent

among the larger participants as some participants in phase 1 were not aware of these recycling events.

Figure 5.14 shows the different percentages of responses against recycling event attendance. This data indicates about 15% of the sample population is aware of the various council public engagement events and 81% not aware of these engagements. This data contrasts the 93% of the respondents that have received one communication or the other from the council.

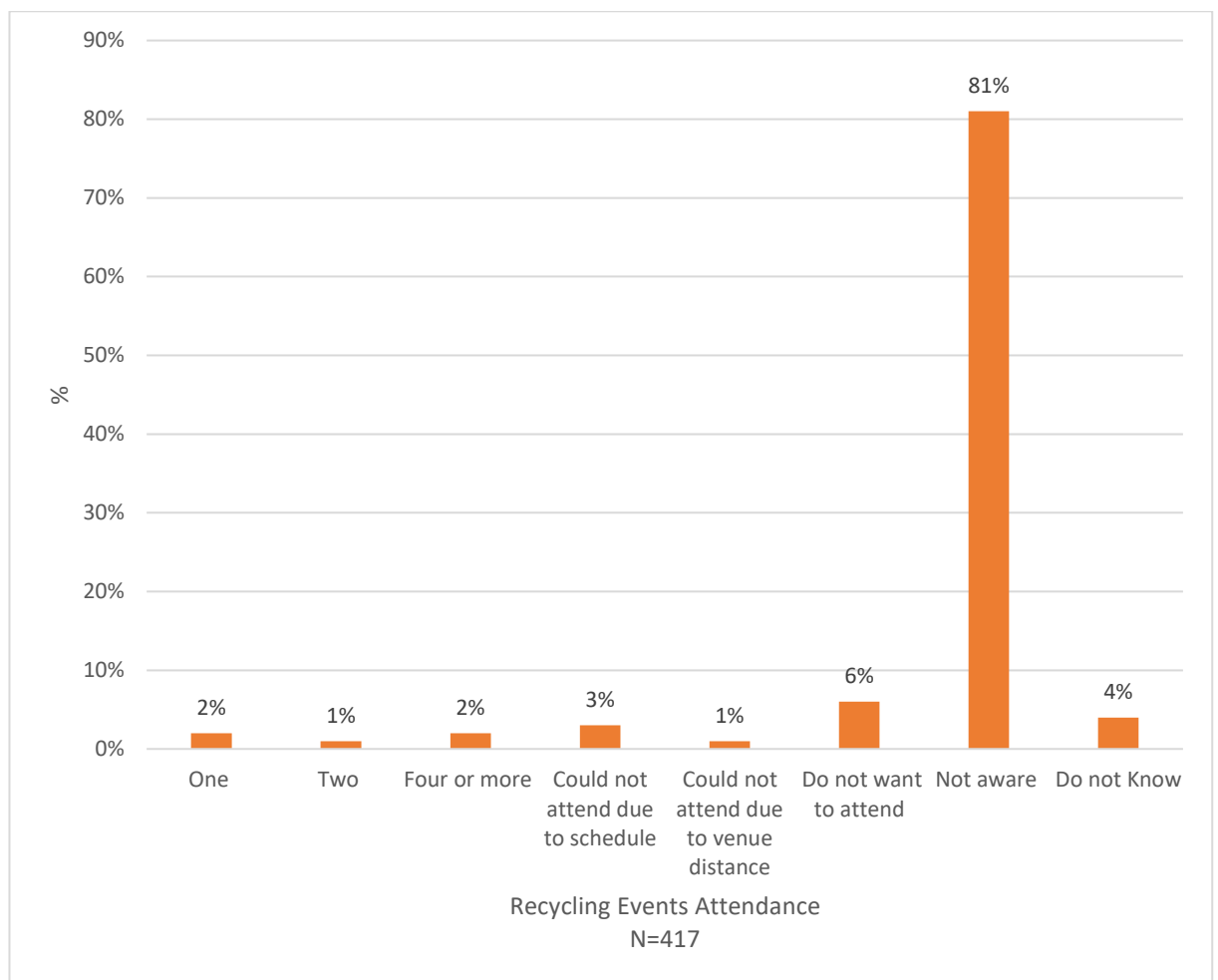


Figure 5.14: The proportion of the respondents' attendance at recycling events in the borough of Westminster.

This shows that the council is not using communication media to propagate and disseminate information about these public events. The communication offered by the council in this regard is not effective to mobilise residents to the recycling local events.

Busy schedules and distance to these local events are some of the barriers cited by some respondents. The frequent organisation of these local events and rotation of the events ward by ward on a street basis should overcome this barrier and will ensure more resident participation in recycling activities.

Age and Recycling Events: The chi-square independence test showed that the age proportions differed significantly between different responses to recycling events attendance, χ^2 (df=21, n=417) = 31.02, p -value = 0.00. This means that each age group showed a different disposition to recycling events attendance.

Table 5.10 indicates that most of the respondents across all the age groups are not aware of the council recycling events, even though this majority always recycle their waste. It could be inferred that, if the council is struggling to engage the respondents that always recycle, then it will be more difficult to engage residents that do not recycle.

Table 5.10: The result of the cross-tabulation of the age variable and recycling events attendance variable in the borough of Westminster.

Age	One	Two	Four or more	Could not attend due to a schedule	Could not attend due to the venue distance	Do not want to attend	Not aware	Do not Know	Total Percentages
22-38 years	1%	0%	2%	0%	0%	5%	87%	5%	100%
39-45 years	7%	2%	4%	11%	0%	7%	67%	2%	100%
46-54 years	3%	1%	1%	1%	3%	9%	80%	1%	100%
over 55 years	2%	0%	2%	2%	0%	5%	84%	5%	100%
Number of Respondents	417								
Chi-Square Tests - p -value	0.002								

Barriers such as venue distance and busy schedules are much more pronounced in the older population (39 years and above). This disparity may be due to the older population being preoccupied with work or personal matters, while the younger population are still much more agile and have time to pursue other interests such as recycling activities.

There is also a category of respondents that are aware of the events but choose not to attend due to a lack of appetite for such events. Most of these respondents are in the age group 46-54 years (9%). The reason for low attendance at recycling events across the age groups is the inadequate exposure given to these events.

The council should overhaul its public engagement strategies or conduct more research on how to actively engage the residents. The council may perhaps explore holding the recycling events online to make it much easier for the residents to participate in such forums. Oluwadipe et. al., (2021) suggested that intense public engagement can be strategically planned to target specific groups (for example, using age characteristics) or areas (with low recycling output) to increase recycling participation.

Among the popular means of communication received (section 5.9) by the respondents is the Westminster Reporter Magazine. Earlier issues of the magazine were reviewed and all of them have the same recycling information which is devoid of publicity for recycling events. Figure 5.15 shows the recycling page from the latest issue.

Recycle... it's easy!
Our disposable recycling bags are now clear!

NEW!

Please only put the following in your mixed recycling bags:

mixed paper & card	plastic bottles, pots, tubs & trays	mixed glass bottles & jars	food tins & drink cans	cartons

no black bags
 no garden waste
 no polystyrene

Why are the bags now clear?
To help our recycling crews spot when the wrong thing is put in.

Why is it important to recycle correctly?
Putting the wrong thing in the recycling costs much more to manage.

Can I still use my recycling box and blue bags?
Yes, our recycling crews will continue to empty your recycling boxes and collect your blue bags.

How do I get recycling bags?

- Order online: westminster.gov.uk/recycling-bags
- Pick-up a pack from:
 - your local library
 - the mobile recycling centre westminster.gov.uk/mobile-recycling-centre
- Ask your porter or caretaker.

How do I use them?

- Live in a house or in a small block of flats?**
 - Check your collection day and time via: westminster.gov.uk/recycling
 - Leave your bags in clear view for our crews to collect.
- Live in a block of flats?**
 - Take your recycling bags to your building's large black recycling bins.
 - Ask your porter or caretaker for details.
- Live on an estate?**
 - Use your reusable recycling bags.
 - Ask your housing manager about how to recycle on your estate.

For further information, visit: westminster.gov.uk/recycling

Westminster recycles City of Westminster RECYCLING

Figure 5.15: An example of a recycling advert placed in the Westminster reporter magazine.

In summary (Box 10), to resolve the issue of inadequate exposure. The council should aggressively use social media platforms (for example, the Nextdoor app and Facebook) and the existing media platforms to constantly publicise these recycling events. It is important to note that these public events are key in updating the residents about various recycling services within the borough. It is also an avenue for the residents to raise issues that prevent them from recycling.

Recycling Events

Determinant Variables


- Age

Issues

- 81% of the respondents are not aware of the council recycling events.
- The events is mainly attracting the 39-45 age group. The group have 28% of the event awareness than the remaining age groups.

Causes

- Inadequate publicity for the events.
- Use of social media not intensely applied for publicity.
- Some respondents could not attend the events due to venue distance and busy schedules.



Intervention

- The council should aggressively use the social media platforms (for examples, Nextdoor app and Facebook) and the existing media platforms to constantly publicise these recycling events.
- Use S106 planning instrument to obligate developers to form tenants recycling forum in large residential estate to increase resident participation in recycling activities.
- Adopt two-way strategy of organising both online and face to face recycling events.
- Make recorded online sessions available for residents that missed both the online (live) and face to face sessions.

Box 10: Summary of the issues and interventions required from the result of the cross-tabulation between age and recycling events attendance variables in the borough of Westminster.

The issues relating to venue distance and busy schedules could be resolved, by adopting a two-way strategy of organising both online and face-to-face recycling events. This will ensure that the needs of both the younger and older generations are catered for. The online sessions can also be recorded and made available to residents, who have missed both the online and face-to-face sessions.

5.12 Micro Recycling Centres Proximity

The explanatory variable of the type of residence, ward level, age, and level of education was evaluated against proximity to micro recycling centres (MRC). Only residence type and ward level show a significant relationship when tested for MRC proximity.

The question was asked (single answer), micro-recycling centres (like the one in figure 5.16) are provided for residents to recycle unwanted materials including textiles and shoes, small electrical appliances, books and more. Do you have an on-street micro-recycling centre close to your home? The question was asked to determine how accessible the MRC are to the respondents. High accessibility of

the MRC can alleviate the lack of recycling storage facilities as emerged in the physical factor theme in phase 1 results.



Figure 5.16: An example of an MRC image in Westminster shown to the respondents during completion of the self-completed questionnaire.

Figure 5.17 shows that 65% of the respondents have access to a nearby MRC, but only 53% of the respondents use the MRCs. Which then meant that a total of 47% of the respondents do not use the micro recycling centres. The 12% of the respondents that are aware of a close-by MRC site but do not use it, may not be bothered because the council are already offering recycling collection from their homes. It could be inferred from the data that the MRCs are readily accessible since more than half of the respondents have an MRC close to their residence.

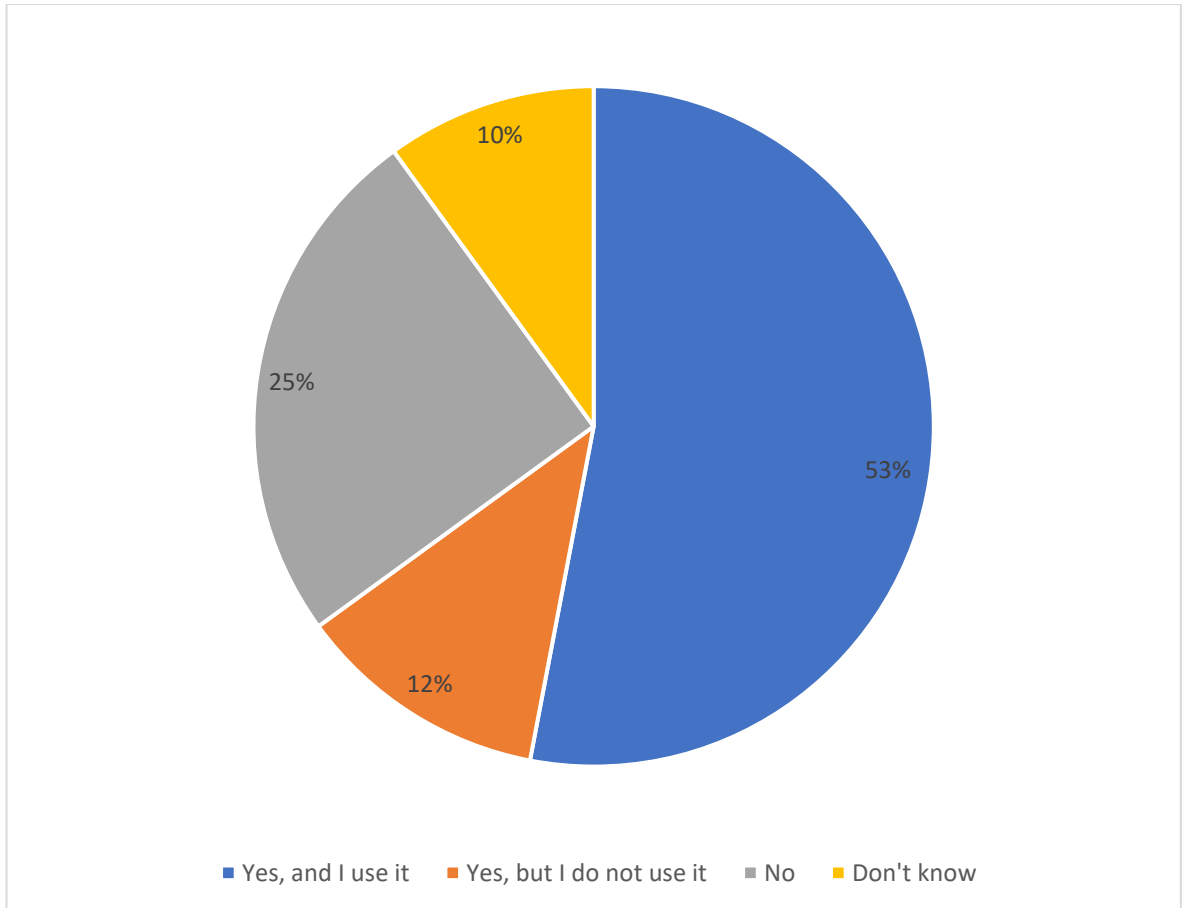


Figure 5.17: The proportion of the respondents' proximity to the micro recycling centres distributions in the borough of Westminster.

Type of Residence and MRC Proximity: A chi-square test of independence was performed to examine the relationship between the type of residence and MRC usage. The relationship between these variables was significant, χ^2 (df=12, n=417) = 16.45, p -value = 0.04. This means that all the respondents living in distinct types of residences showed different preferences in the usage of the readily available MRCs.

The result displayed in Table 5.11 indicates almost the same usage between inhabitants of houses and flatted properties with houses (with sharers) having the highest usage of the MRC (59%).

Table 5.11: The result of the cross tabulation of the type of residence variable and micro recycling centres (MRC) proximity variable in the borough of Westminster.

Type of Residence	Yes, and I use it	Yes, but I do not use it	No	Do not know	Total Percentages
House with family members	49%	12%	25%	14%	100%
Flat with family members	55%	15%	22%	8%	100%
House with sharers	59%	6%	25%	10%	100%
Flat with sharers	52%	13%	25%	10%	100%
Number of Respondents	417				
Chi-Square Tests - p -value	0.044				

However, in terms of properties close to a nearby MRC with no usage, respondents living in flatted properties have a higher percentage of non-usage than respondents living in houses. Also, respondents living in flats with family members are more affected by the non-availability of MRC in their areas than other types of residence. The following can be gathered from the analysis above.

- Houses with sharers have the highest usage of MRC because sharers buy their individual shopping which will generate more waste than houses with a family that will have one family shopping. Therefore, there is more tendency to use the MRC instead of waiting for the weekly recycling collection.
- The trend explained above is not seen in flatted properties simply because the majority of the flatted properties have communal bins where there is no responsibility on the users to keep the communal areas clean and tidy. In other words, the availability of communal bin storage gives little appetite to use the MRC for the occupiers of flatted properties. Hence, a higher

percentage of nearby MRC with no user is found with respondents living in flatted properties.

- That almost half or more than half of the respondents across each type of residence have a close-by MRC facility, which may indicate that the MRCs are well distributed and popular, and easily accessible by occupants from different types of residences.

The findings detailed above agree with Letelier et al. (2021) and Li et al. (2020) studies on recycling infrastructure proximity. Letelier et al. (2021) study shows higher participation of residents in recycling activities when the distance to recycling infrastructure was decreased. Li et al. (2020), argued that this factor (distance to recycling infrastructure) is not a major barrier as shown in their study.

The conclusion on this result in line with previous studies (cited above) is that residences' close proximity to recycling infrastructure enables occupiers to engage in recycling activities but it is not a major barrier, because non-usage of a known nearby recycling facility is observed with some respondents.

However, there is also a high number of respondents in all types of residence that do not have a close-by MRC or do not know if there is one. The council will need to embark on campaigns to create awareness about the location of these sites. Also, there is a need to consider increasing the number of MRC sites to ensure total coverage of the borough. This will alleviate issues with the lack of external storage facilities in old properties.

Ward Areas and MRC Proximity: The chi-square independence test showed that different ward areas differed significantly between different usage of the MRC, χ^2 (df=57, n=417) = 117.23, p -value = 0.00. This means that respondents in different ward areas showed different behaviour regarding the use of a nearby MRC.

This result shown in Table 5.12 was correlated to the distribution map (Figure 5.18) of the total 160 MRCs available in the ward areas to determine the validity of responses provided by the respondents. More emphasis is placed on responses for usage, non-availability of a nearby MRC and non-awareness of the existence of the MRC locations.

Table 5.12: The result of the cross-tabulation of ward areas variable and micro recycling centres (MRC) proximity variable in the borough of Westminster.

Ward Areas	Yes, and I use it	Yes, but I do not use it	No	Do not know	Total Percentages
Abbey Road	70%	20%	10%	0%	100%
Bayswater	76%	12%	6%	6%	100%
Bryanston and Dorset Square	64%	12%	20%	4%	100%
Church Street	44%	31%	19%	6%	100%
Churchill	50%	10%	30%	10%	100%
Harrow Road	43%	14%	29%	14%	100%
Hyde Park	40%	13%	41%	6%	100%
Knightsbridge and Belgravia	36%	0%	28%	36%	100%
Lancaster Gate	75%	25%	0%	0%	100%
Little Venice	78%	17%	5%	0%	100%
Maida Vale	51%	23%	9%	17%	100%
Marylebone High Street	79%	9%	9%	3%	100%
Queen's Park	48%	7%	32%	13%	100%
Regent's Park	50%	22%	28%	0%	100%
St James's	38%	6%	37%	19%	100%
Tachbrook	64%	0%	27%	9%	100%
Vincent Square	67%	13%	12%	8%	100%
Warwick	50%	6%	33%	11%	100%
West End	14%	6%	59%	21%	100%
Westbourne	58%	17%	17%	8%	100%
Number of Respondents					417
Chi-Square Tests - <i>p</i> -value					0.000

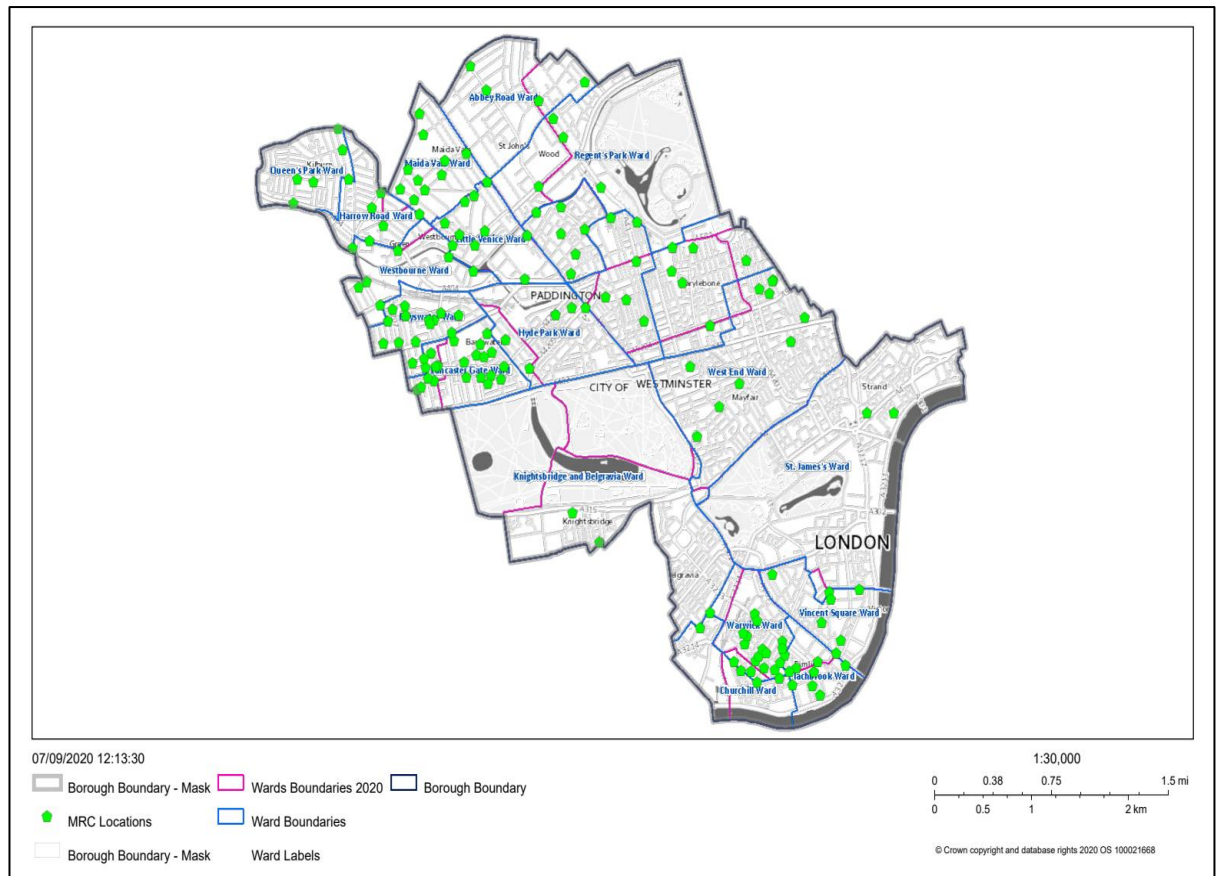


Figure 5.18: Map of the micro recycling centre's locations and distributions in the borough of Westminster (Source: produced by the researcher using the council's internal GIS system).

Table 5.12 shows Hyde Park (41%) and West End (59%) indicate the highest percentages for MRC non-availability when cross-checked with the distribution map (figure 5.18). It was revealed that Hyde Park and West End have seven and nine MRCs respectively, but these MRCs are distributed sparsely over the two large ward areas. The sparse distribution will mean that the MRCs are far from some residential properties. Residents in these properties will not be aware of such facilities.

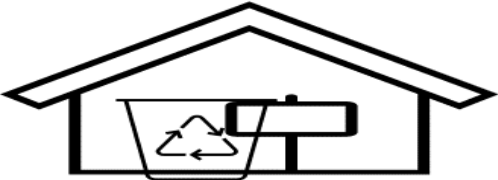
In contrast, Lancaster Gate shows a high usage (75%) of the MRCs but 0% responses to MRC non-availability and non-awareness of the existence of the MRC. But when cross checked with figure 5.18, Lancaster Gate has twenty-one MRCs clustered within a small ward area. Therefore, the responses from Lancaster Gate respondents are not surprising because they have an adequate and evenly distributed MRCs to cover the whole ward area.

Also, the effects of Li et al. (2020) study are more pronounced in this ward where 25% of the respondents even though having knowledge of the nearby MRCs but never used them.

In general, this data provides useful information on how the MRC sites are used in different wards by the respondents. Therefore, to increase the use and accessibility of the MRCs, the following are recommended.

- The council will need to engage more with residents' wards that have close-by MRCs, but the usage is low.
- The need to install more MRCs in ward areas (after detailed correlation with the council data on locations of MRC) that the respondents have claimed there is no close by MRC site.
- More awareness campaigns in ward areas with the highest response that the respondents are not aware of any close by MRC.

In summary (Box 11), tests analysis for the type of residence and ward level with MRC proximity indicates significant relationships exist. More than half of the respondents in each type of residence have an MRC close to them and used them for recycling deposits, which means both flats and houses have a similar percentage of usage.

<u>MRC Proximity</u>	
<p><u>Determinant Variables</u></p> <ul style="list-style-type: none"> • Type of Residence • Ward Level <p><u>Issues</u></p> <ul style="list-style-type: none"> • 25% of the respondents do not have an MRC close to their residence. • 10% of the respondents do know if they have a close by MRC. • MRC is not adequately installed in some wards. <p><u>Causes/Impacts</u></p> <ul style="list-style-type: none"> • Loss of mixed recycling to rubbish collection if residents do not have external recycling storage. • Lack of adequate MRC may result in waste dumping in public spaces. • The reason for lack of adequate MRC in wards like West End is due to lack of open space on the public highway to site this infrastructure. 	 <p><u>Intervention</u></p> <ul style="list-style-type: none"> • The problem of space to site the MRC could be addressed in large proposed residential builds, where the MRC can be integrated into the design of the developments. • Use of constant mobile recycling centres to address the shortage of the permanent sited MRC. The mobile recycling centres should use electric vehicles to eliminate air pollution from fossil fuel vehicles. • Increase installation of Micro Recycling Centres to provide wider coverage of the borough.

Box 11: Summary of the issues and interventions required from the result of the type of residence and ward areas variables with MRC proximity variable cross-tabulation in the borough of Westminster.

The reason for the lack of adequate MRC in wards like West End is due to the lack of open space on the public highway to site this infrastructure. Most of the pavements in central London are narrow and mainly preserved for pedestrian movement due to the high footfall of commuters, visitors, and tourists that frequent these areas.

The problem of space to site the MRC could be addressed in large proposed residential builds, where the MRC can be integrated into the design of the developments. Also, the use of constant mobile recycling centres should be explored to address the shortage of permanently sited MRC. The mobile recycling centres should use electric vehicles to cut air pollution from fossil fuel vehicles.

5.13 Future Waste Legislation

The explanatory variables of age, education and type of residence were tested against respondents' views on future waste legislation. Only age indicates a significant relationship.

The question was asked (multiple answers), which of the following proposals do you think should be addressed by future national legislation to increase recycling?

Figure 5.19 indicates the percentages of responses to future waste legislation. The most popular proposals are legislation to ban manufacturers from producing packaging/ products and to address the non-uniformity of different recycling regimes across the country. This will enable the implementation of one recycling system (in terms of the same types of containers/ same colour of containers/ same materials going into the mixed recycling bin) that is consistent throughout the country.

The least popular proposal is to hold landlords responsible for mixed recycling generated within their properties.

This data indicates the sampled population's support for change in waste legislation that will improve the recycling rate. This suggests that some respondents see the non-uniformity of the recycling regime and lack of adequate recycling storage facilities as barriers to achieving effective recycling.

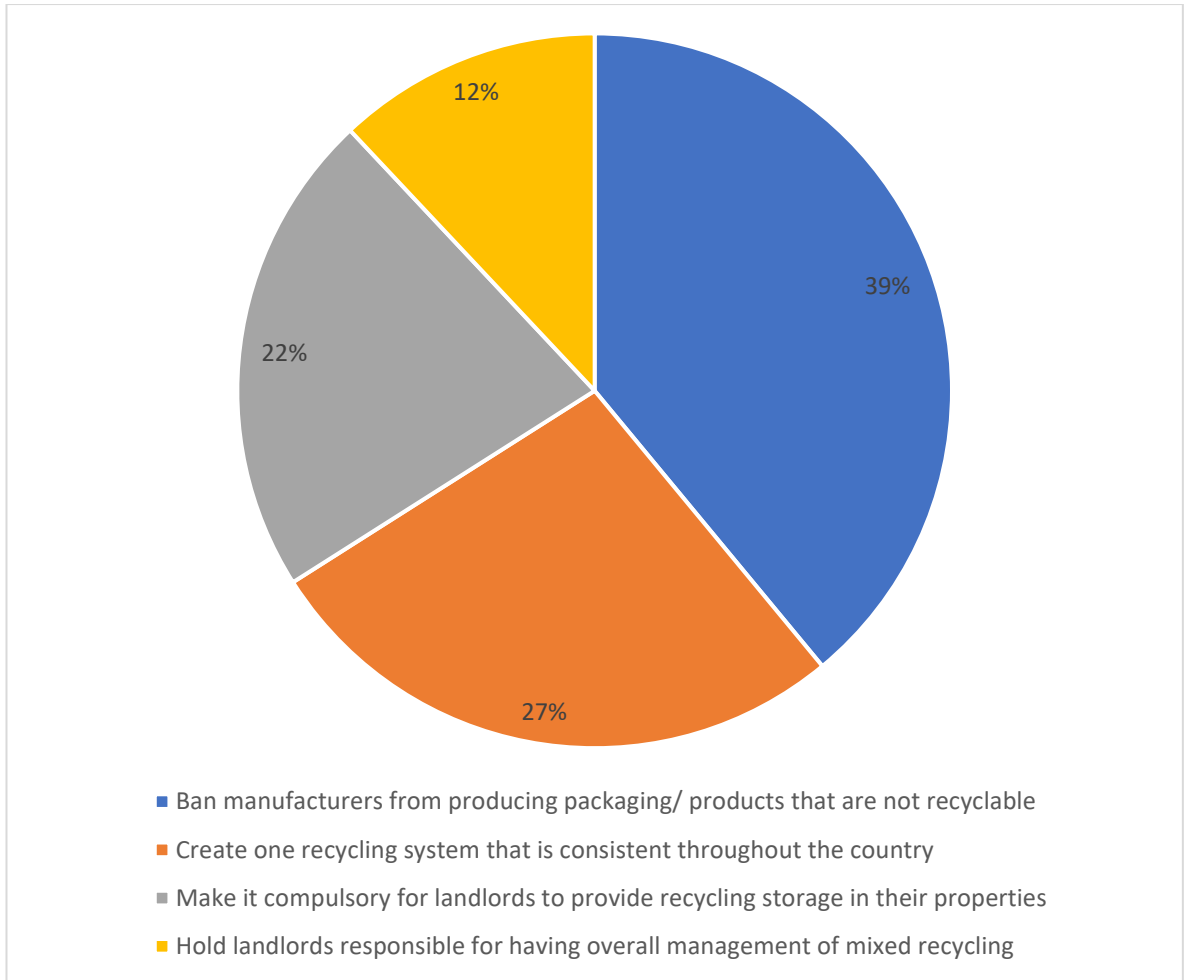


Figure 5.19: The proportion of the respondents' preference to the desired change in waste legislation in the borough of Westminster.

Age and Waste Legislation: The chi-square independence test showed that the age groups differed significantly in their preference for waste legislation change, χ^2 (df=12, n=417) = 23.54, p -value = 0.02. This means that respondents in different age groups showed a different preference for new waste legislation.

Table 5.13 indicates that the younger generations are more in support of various changes to future waste legislation than the older generations. This data is consistent with other results already explained previously in section 5.3 about the eagerness and zeal of the younger generation to effect changes in recycling activities with regard to packaging labelling standards, preference for food waste collection and incentives.

Table 5.13: The result of the cross-tabulation of the age variable and desired waste legislation change variable in the borough of Westminster.

Age	Ban non-recyclable packaging	Uniform recycling system	Compulsory landlords to provide recycling storage	Hold landlords responsible for mixed recycling management
22-38 years	89%	62%	67%	31%
39-45 years	94%	62%	50%	37%
46-54 years	90%	57%	40%	21%
over 55 years	85%	61%	45%	27%
Number of Respondents	417			
Chi-square Tests (<i>p</i> -value)	0.023			

It can therefore be inferred that the younger generation requires motivations, incentives, and legislative framework nudging to stimulate their participation in recycling activities. While the older generations are already motivated and do not need such nudging to participate in recycling activities. There are many factors influencing this behaviour in the older generations. These include maturity, higher educational qualifications, and more experience in recycling activities (due to longer participation). In general, this data provided additional insights into barriers faced by the respondents and the benefits of changes to the existing waste legislation, which are outlined below.

It shows that the majority of the respondents across the age groups are in support of the zero waste and circular economy approaches (banning of non-recyclable packaging and mandatory external recycling facility in residential properties) to significantly reduce rubbish and support the continuous re-use of materials as much as possible. In reality, less rubbish generation will ultimately result in less collection of rubbish, and consequently, increase mixed recycling collection frequency to support the circular economy.

Secondly, high support for the national uniform recycling system indicates that the majority of the respondents are confused about the non-uniformity of the UK recycling system, when moving to another borough or if they have a second home, or sometimes live with other relatives in a different borough. This could affect the recycling rate of the affected boroughs if these residents in question are not familiar with the new borough recycling system.

Burgess et. al., (2021) cited the lack of UK national coordination for recycling collection is creating confusion within the population, because a plastic waste material that is acceptable by one local authority for recycling is rejected by another local authority, and therefore collected as rubbish.

Therefore, implementing these proposals in future waste legislation would provide an opportunity to capture a high rate of recyclable materials to support the circular economy and conserve virgin raw materials.

This issue also emerged in phase 1 data under the policy constraint's theme where these participants (P4, P7, P9, P10, P11, and P12) supported a uniform national recycling regime and made recycling storage provision in properties a mandatory requirement for landlords.

In summary (Box 12), test analysis indicates age as a factor that influences the respondents' views on waste legislation. More importantly, the data also suggest that there is support for changes in future waste legislation across all age groups, to increase the recycling rate.

It is recognised that this intervention is outside the remit of the local authority. However, the council could mount pressure on the national government with support from other local authorities to implement these proposed changes.

Summary of Waste Legislation

Determinant Variables

- Age

Issues

- 39% of the respondents want future waste legislation to include ban on non-recyclable packaging.
- 27% of the respondents want the new legislation to address non-uniformity of the UK recycling regimes.
- 22% of the respondents want the waste legislation to require mandatory external recycling facilities in residential buildings.

Causes/Impacts

- Non-uniformity of the local authorities recycling regimes is causing confusion and a barrier to increase recycling rate.
- Lack of external storage for recycling results in low capture rate for recyclable materials.



Intervention

- Implementing these proposals in future waste legislation, would provide opportunity to capture high rate of recyclable materials to support the circular economy and conserve the virgin raw materials.
- The council could mount pressure on the national government with the support from other local authorities to implement these proposed changes.
- Waste legislation to accelerate the use of sustainable materials for packaging. Incentives should be applied to nudge the manufacturers of goods. This is fundamental to zero waste and circular economy implementation.

Box 12: Summary of the issues and interventions required from the result of the cross-tabulation between age and desired waste legislation change variables in the borough of Westminster.

Chapter 6 Results and Discussion – Phase 3 Data

6.1 Thematic Analysis- Phase 3 Data

The methods and process of developing codes and themes for the staff qualitative data have been described in detail in Section 3.4.1. The 15 initial themes that emerged from this process are shown in Figure 6.1 while Table 6.1 shows the different codes coded to the initial themes.



Figure 6.1: The 15 initial themes that emerged during the thematic analysis of the staff in-depth interviews (Phase 3 data).

Table 6.1: Coded texts allocated to initial themes for the staff in-depth interviews during the thematic analysis (Phase 3 data).

Initial 15 Themes	Examples of Codes coded to the Initial Themes
Legislation	Fines, Residential, Businesses, Political Agenda and Enforcement
Properties	Age and Refurbishment
Economy	Consumption, Waste Reduction and Online Shopping
Contamination	Types, Levels, Sampling, Sites, Bin Labels and Records
Incentives	Effectiveness, Challenges, Focus, Participation Level and Process
Recycling Rate	Methodology, Comparison, Incentives and Calculation
Collaboration	Collaboration
Micro Recycling Facility	Maintenance, Servicing, Collection, Misuse, Bin Design, Bin Labels and Monitoring
Recycling Bags	Quantity, Alternative, Misuse, Advantages, Disadvantages, Order, Delivery, Time Frame, and Information
Food Waste	Storage, Constraints, Feedbacks, Implementation, Trial, and Impact
Recycling Collection	Frequency and Constraints
Research	Collaboration, Sustainability, Demographics, Innovation, Behavioural Insights and Challenges
Barriers	Infrastructure, Space, Costs, Recycling Regimes, Transient Population, Misconceptions, Constraints, Language, Location, Diverse Residents, Buildings, Data and Behaviours
Engagement	Workshops, Recycling Champions, Role Model, Events, Attendance, Challenges, Feedbacks, Letters, Communication, Website, Monitoring, Objectives, Strategies, New Residents, social media, Newsletter, Door Knocking and Outreach
Service	Inclusion, Mitigations, Assisted Service, Exclusion, Challenges, Recycling Regimes and Pandemic.

The initial 15 themes were critically reviewed to search for resemblances and to cluster them together under a main theme that reflects the general subjects. This then results in the final 8 themes. Figure 4.2 indicates the 8 final themes while Table 4.2 displays how the 15 initial themes were merged to achieve the 8 final themes.



Figure 6.2: The 8 final themes that emerged during the thematic analysis of the staff in-depth interviews (Phase 3 data).

Table 6.2: Initial themes grouped under the final themes during the thematic analysis of the staff in-depth interviews (Phase 3 data).

Final 8 Themes	Initial Themes Grouped under Final Themes
Barriers	Properties and Contamination
Communication	Emerged as a new theme to distinguish from the Engagement theme
Engagement	Incentives
Food Waste	Food Waste
Legislation	Legislation
Micro Recycling Facility	Micro Recycling Facility
Recycling Bags	Recycling Bags
Service	Recycling Collection

6.2 Final Central Themes

Initially, the final themes were 9, with “Collaboration” making the additional ninth theme. However, the collaboration theme is not a barrier or service constraint to recycling activities but rather an intervention to resolve recycling issues. So, it is hugely different from other themes. Therefore, it was decided to remove it as a central theme and a brief discussion on collaboration will be presented before the detailed discussion of the 8 central themes.

Collaboration focuses on the partnership between the council recycling team and the council innovation team. It also explains why the innovation team (CP3) was interviewed, and the efforts being made by the recycling team to resolve issues related to recycling participation. This provides a powerful front to the residents and indicates a unity of purpose among the council's different departments.

The recycling team are using the innovation team's expertise to carry out studies on behavioural change, and how it could be applied to influence the residents towards positive recycling behaviours. This approach matches Zhang et al. (2021) assertion of a circular economy. Zhang et al. (2021) highlighted that a circular

economy cannot be attained without undertaking behavioural insight that will shed light on peoples' environmental behaviour, and how best to influence or nudge them to recycle properly.

The 8 emerging central themes were discussed below in detail by relating them to the main research objective of "what are the barriers to achieving a high recycling rate." Each central theme will be defined as an introduction to give the context of the themes.

Also, the importance, issues, and impacts of the themes were discussed followed by relevant interventions to mitigate or resolve the issues. Additionally, these final themes were correlated briefly with the data collected in phases 1 and 2 if relevant, while detailed triangulation of the three data phases will be presented in chapter 7.

6.2.1 Barriers

The barriers theme centred around the barriers to achieving a high recycling rate from the perspectives of the council staff involved in the recycling program. This theme is the most important of all the central themes because it collates all the key issues affecting the household's recycling participation. Figure 6.3 indicates the thematic mind map of the issues coded under barriers.

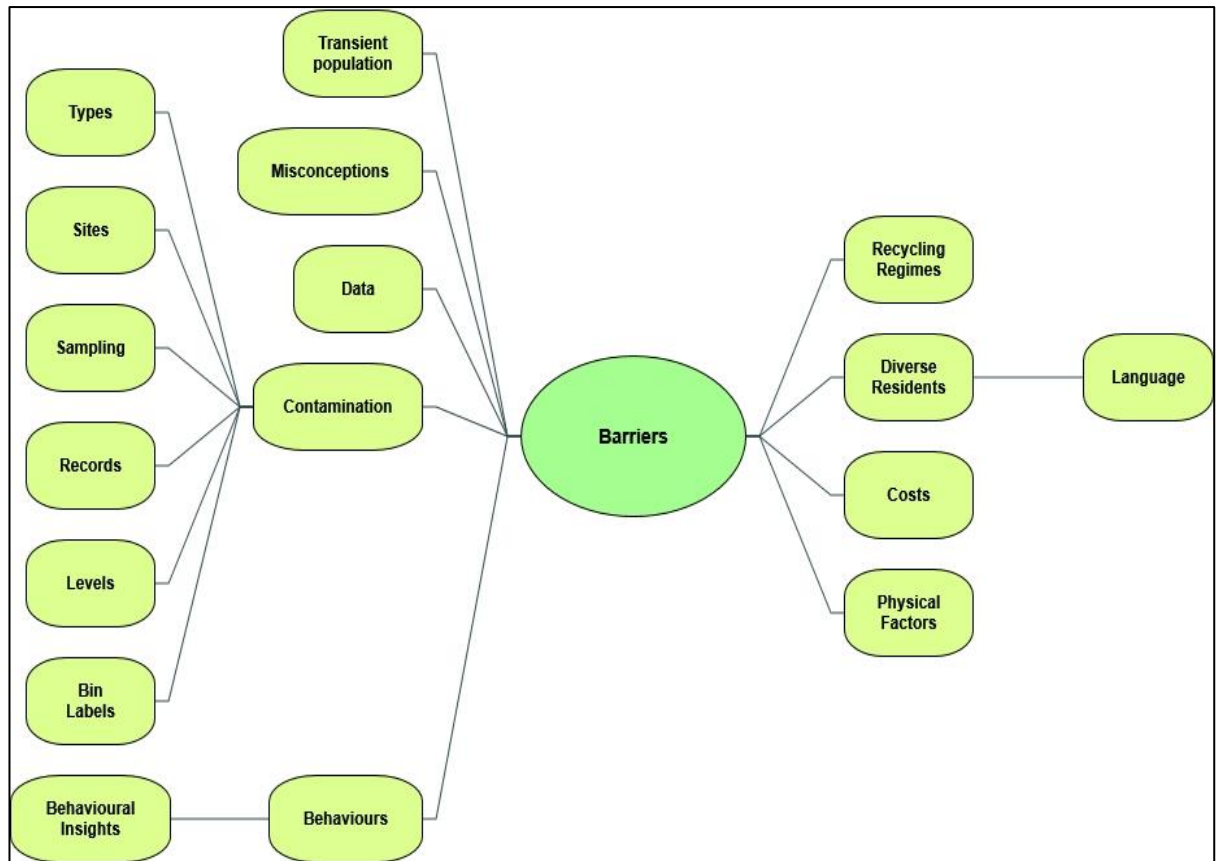


Figure 6.3: Thematic mind map indicating the different sub-themes under the barriers theme.

Transient Population: Different studies have revealed the transient population as one of the factors affecting recycling output. Timlett and Williams (2009), found the issue of the transient population as one of the major factors affecting recycling output in Portsmouth. University students and new build residents were identified as key transient populations. The City of Westminster has similar urban characteristics to Portsmouth.

However, the key transient population in Westminster are tourist visitors and the residents that move constantly in and out of the borough. Studies (Robertson and Walkington, 2009; Jatau and Binbol, 2020) conducted accurately match the results of the transient population impact on recycling activities in Westminster. CP2 put the percentage of this transient population in Westminster to be about 30% of the residents.

The new residents moving into Westminster would not have the immediate full knowledge and understanding of the borough's existing recycling program. This is an impact or barrier that will reduce the new residents' participation in recycling

activities if the service varies greatly from their previous borough. As an intervention, CP2 stated that the Westminster council is already targeting new residents through the council tax database to communicate with these new residents.

However, additional intervention is required to manage the incoming resident's engagement, especially for new build and refurbished properties. The council should also use the current planning regime to include clauses and conditions within the planning agreements to initiate contact. The clause or condition should obligate property owners and house owners to include the council recycling information within the tenant's information packs.

Recycling Regimes: This factor represents the different recycling regimes that are operated by different local authorities in the UK. The factor is also closely related to the transient population factor. In the sense that residents moving across two boroughs may find the recycling services confusing if the two boroughs have different recycling programs. CP3 summarised the effect of this factor using both personal and work experiences.

“The problem is, as I said before, I am sure you will have found it in your research as well is that recycling varies so much between different boroughs, and it is really confusing that you can genuinely want to do the right thing. And I mean both of us were overconfident in what we thought in our ability to recycle in Westminster. And you know most people are wanting to be right, and to get it right. You know I live in Southwark, and we have different coloured bins, and you go to the neighbouring borough and the bin means something different. You can recycle bags there, you cannot do that here, and it is just so easy to make a mistake” (CP3- Innovation Team Manager).

In phase 1 data, P4 cited similar concerns on differential recycling regime as having the same effect as described by CP3. In phase 2 data, 27% of the respondents want future waste legislation to address the non-uniformity of the recycling service provided by local authorities. Interestingly, the views of the residents are aligned with the council staff on this barrier, which allows critical evaluation on the council side to design services that will reduce the effects of this barrier.

Different recycling regimes stemmed from the need to provide localised recycling services. Therefore, harmonising the services into a uniform regime may have detrimental effects in other areas (Knickmeyer, 2020; Oluwadipe et al., 2021). The report published by Wrap (2014), further strengthens the need for customised recycling services to tackle the different localised barriers faced by that local authority. The interventions proposed for the transient population factor would ensure that the impact of different recycling regimes is managed to maximise recycling output from new residents.

Misconceptions: Misconceptions about the council recycling service are a barrier to achieving a high recycling rate. Some of the residents interviewed and surveyed also acknowledged this issue as a factor. Phase 2 data indicates that 89% of the residents surveyed are not aware of what happened to the materials collected. The root cause of this misconception is the resident's doubt of the council waste policy as commented by CP2.

Reports in the news probably contribute to the resident's doubts about the materials collected. Franklin-Wallis (2019), reported in the Guardian Newspaper about the widespread practice of some local authorities sending collected recyclable plastics to foreign countries. These exported materials are ultimately abandoned in open dumps or burned. In 2020, the story of forty-two plastic containers returned to the UK from Malaysia was a piece of national news about the lack of adequate care or process in ensuring materials collected are recycled properly (BBC, 2020).

Although the council already organises periodic advertised visits to recycling plants for residents. More could be done for residents, who are not able to attend the recycling sites by making a short virtual video clip of the recycling process. This is to dispel doubts about the end use of the materials collected. The video clip can then be made available on the council website, the council corporate Facebook page, and the recycling service Facebook page and sent to the resident's email addresses.

Data: Lack of existing adequate household recycling data in terms of wards or geographical variation was cited as a barrier by CP2 and CP3 towards improving recycling service. CP3 lamented the research team's frustration in measuring the change in behaviours due to the lack of localised data. Data availability would have allowed better simulations and analysis to identify areas or wards with the greatest problems.

“Another thing that I thought of, is the way that the data is collected currently. So, the recycling tonnage includes both residential and commercial. It is not easy to measure change in residence behaviours or you know in a particular group. It is hard to disassociate between businesses and residents, and there is no standard method of measuring” (CP3- Innovation Team Manager).

The need to automate the recycling collection service using geographical coordinates becomes increasingly important. This can be done in two ways. One by using onboarding gadgets mounted on collection vehicles. This can automatically record the geographical coordinate and weight of the residential commingled recyclable bins collected.

The second option, which is the best option, is to install smart sensors in all residential recycling bins. Data such as the geographical coordinates and weight can then be downloaded from the sensors just before collection. Data obtained from these sources will provide insights into each ward's pattern of recycling behaviour.

However, the complexity and the term of the council collection contract with a third-party provider may not make this happen in the short term. Participant CP3 noted the issue of the collection contract as a constraint to improving the current service.

Lacovidou et al. (2019), cited local authorities' long-term contracts for waste collection services as an obstacle to adopting contemporary technological advancements that will improve recycling services. This is because changes to the collection contract mid-term may generate much higher costs (due to penalties) that may outweigh the benefit of adopting modern technology.

Behaviours: This factor relates to residents' behaviour towards recycling activities. All three staff participants are concerned that this is one of the main barriers they faced when designing improvements to the recycling service. Lack of care and laziness in putting the right materials into relevant bins are the behavioural attitudes experienced by the residents. CP1 (Recycling Manager) states:

“Laziness..... People are just inherently lazy. And I can see that with any just recycling bin, they are just prepared to open the lid and chuck whatever they got inside whether the cardboard contains polystyrene or wood or whatever. People are not going to break the bit of the cardboard down before placing it in the bin.”

However, CP1's statement above indicates that the residents may not be finding it easy to recycle, and that is why they are exhibiting these characteristics. WRAP (2014) established the following reasons for residents' behavioural attitude to recycling, which are busy schedules with no time to allocate for recycling, lack of household routine and a simple mistake of forgetfulness. Although busy schedules and forgetfulness emerge as a barrier to recycling in phases 1 and 2 data, it is a minor barrier as only 3% of the respondents in phase 2 data cited this factor as a barrier. While only 6% of the respondents will never correct their recycling mistake if they make one.

So, the questions are, how can we make recycling easy for the residents, and how can we nudge or influence the residents to do the right thing? CP3, an expert in behavioural insight, thinks that this is a tough challenge, due to the diverse resident base living in Westminster. Also, with Westminster having a transient population of 30%, how do you design a long-term behavioural change program when you constantly have residents moving in and out of the Borough very quickly? These are the challenges.

It is noticeably clear from the data obtained that some residents' behaviours are contributing to the contamination of the recycling receptacles, which in turn is stagnating the recycling rate of the borough. Designated interventions as suggested by Schill and Deirdre (2016), could be used to target different demographic areas by designing specific intervention programs to target the areas with high contamination rates.

The council is already addressing this issue through research into residents recycling behavioural insights studies. The complexity of human behaviour means that predictions and proposed solutions must evolve constantly to match the changing human behaviour. This is where the challenge lies in trying to understand behaviours as confirmed by CP3. The behavioural insight research is still ongoing, and it will make sense to wait for its outcome, which will enable suitable interventions to be put in place.

Physical Factors: The participants mentioned two factors under the physical factors that influence recycling activities. The factors are the borough location and the building's structure. The borough's location within central London has been cited by the participants as a barrier to implementing an effective recycling service. Westminster is one of the densest boroughs in London with an extremely high urban density of 12,564/km² (City Population, 2020). It is characterised by old buildings and old infrastructures such as narrow roads and pavements. All these factors bear heavily on the abilities of the residents to recycle properly and for the council to provide an efficient recycling service.

The impact of the location barrier is that it limits the kind of service that can be provided, how recycling is collected, the kind of infrastructure to put in place, where to locate the infrastructure, the frequency of collection, and the type of vehicle used for collection. These are the constraints faced by the council recycling service as recounted by the two participants CP1 and CP2.

“You know, another thing that we will not be able to resolve is how we are going to deal with all our historic properties, most of them are listed and a substantial number of them cannot be easily modified to modern waste management. So, there are lots of barriers from the residential point of view. We have a very mixed housing stock” (CP1- Recycling Manager).

Deficient waste infrastructure is typical of service constraints in high-density urban areas (Conke, 2018; Ho, 2018). This could be a result of a high density of buildings and a lack of space to site relevant waste facilities. Various studies (Yukalang et al., 2017; Oluwadipe et al., 2021) have found that types of buildings and their structural characteristics impact recycling output. These studies' findings match the constraints experienced in Westminster. The lack of adequate internal

and external storage spaces for source segregation and common use of communal recycling facilities are influencing low recycling participation.

Solutions to these structural problems for the existing built areas will need strategies that are streamlined to mitigate these barriers. As an intervention, a mobile recycling facility mounted on specialist vehicles can be deployed to areas that have the highest density of population and historical properties. The vehicles will need to be powered by renewable sources in order not to create other environmental impacts. New build planning policies will need to be reviewed to resolve issues surrounding structural barriers such as narrow roads, and lack of private and public spaces for recycling facilities.

Diverse Residents: Westminster is a central borough in London, which is densely populated by residents with diverse backgrounds and languages. The variety of the different audiences in Westminster results in issues with language barriers. Participant CP2 stated the other languages spoken by residents apart from the English Language.

“It depends on the area. I must check. Sorry, but from memory it is like we have Portuguese, Bengali, Arabic, and I think that there are two others” (CP2- Recycling Officer).

Literature reference indicates that the top five languages (after the English Language) spoken by state school students in Westminster are Arabic, French, Spanish, Italian and Portuguese (Westminster, 2022). This wide spectrum of resident base presents a recycling service constraint.

Studies conducted (Timlett and Williams, 2009; Bernstad, 2014) cited language as a barrier for different ethnic groups in grasping the full requirements of recycling information, if the information is not available in their first language.

The views gathered from the council staff participants indicate that the council does not automatically translate all recycling communication but only on request. This itself is a barrier because not all non-English speaking residents will have time to request such service. Participant CP2 cited two reasons why translation is only conducted on request. Firstly, the council officials cannot verify the accuracy of the translated information to be sure of the correct transmission of the message.

The second reason is that printing the translated recycling communication in bulk would result in waste. Also, the materials will be out of date when new recycling information is available. However, results from phases 1 and 2 indicate this barrier as a minor issue as only 2% of the respondents required recycling information in another language different from English.

Currently, as mitigation to this barrier, the council does make use of language apps when conducting the door-to-door knocking exercise. In addition, the pamphlets given out by the knocker have some basic information in the top five languages if there are problems with using or understanding the language app.

In addition to these current mitigation measures, the council could make all the recycling information available in the top five languages (apart from the English Language) in electronic format to prevent wastage of printed materials. This format can then be made available on the council website and social media pages, which can then be easily updated when required. In terms of the accuracy of the translated information, the council should use professional and accredited translation services to mitigate the accuracy concern. Furthermore, studies conducted by WRAP (2018) in different urban areas of the UK, recommend the use of pictorial information in recycling information as a measure against language barriers.

Costs: CP1 mentioned costs briefly as a barrier to providing effective recycling service to the residents. Local authorities in the country are cutting service costs to deal with the national government's decreased funding and financial constraints. Waste and recycling services are not immune to these financial difficulties.

Conke (2018), mentioned cost as a service barrier in implementing an effective recycling service. This is because local authorities in the UK are subsidising waste collection rather than directly charging the residents. He went further to identify this issue as a political rather than a technical constraint. The funding pressures on local authorities meant that they are only targeting “valuable” recyclable materials for collection. This ultimately results in the “non-valuable” recyclable materials being discarded as residual waste (WRAP, 2014).

The study by Bacot et al. (2002) also indicates that most local authorities are offering commercial waste collection (from businesses), alongside residential

collection to augment waste collection income. This can be a problem when deciding the exact tonnage collected from the residential properties for statutory data reporting. Two of the participants (CP1 and CP3) confirmed this as an issue in collecting accurate household recycling data to improve the Westminster City Council recycling rate.

Contamination: The contamination code refers to the barrier faced when the recycling bins are contaminated. Such bins are disposed of as residual waste and therefore, impact the council recycling rate. The staff participants discussed the issues around the distinct types of contamination, the levels of contamination, the bin labels, periodical sampling, and records of the public recycling facilities where contamination is common.

“So, we do not record it for individual sites. So, if a site (MRC) is contaminated and the recycling crew cannot collect what is in the bin. The bin (contaminated recycling bin) will be obviously left behind. And a call will be raised for the bin (contaminated recycling bin) to be collected as a general waste instead” (CP1- Recycling Manager).

Food waste and unrecyclable plastics are the greatest sources of contamination and concern in the mixed recycling bins. This data is obtained by sampling the bins that are sent to the materials recycling facility (MRF).

Occasionally, clothes, shoes and small electrical items are found in the mixed recycling bins. Participant CP1 emphasised these three items mentioned above are not problematic when present in the mixed recycling bins, because they are easier to be separated at the sorting facility. The level of contamination for electricals, clothes, and shoes is under 1%. While the level of food waste and unrecyclable plastic is between 2%-3%.

Although the percentage of the contamination of concern (food waste and unrecyclable plastic) is exceedingly small, the wetness of food waste would have damaged the quality of the cardboard and paper, and therefore render it useless for reprocessing. Data released by the Department for Environment Food and Rural (Defra, 2014), shows that food waste and residual waste were responsible for rejecting 226,770 tonnes of contaminated recyclables collected in England in 2013.

Based on the data obtained from phases 1, 2, and council staff council, there are two evident factors why the mixed recycling bins are contaminated by contaminants of concern. The first factor was the non-collection of food waste (at the time of collecting data). The second factor is the non-collection of plastic that the council has deemed not to be valuable in the economic sense. This issue can be linked back to the type of collection contract with the council waste collection contractor. CP1 refers to this category of plastic as “unrecyclable plastic”. The plastic in this category is single-use plastics such as tubs, pots, films, and wrappers.

According to Hopewell et al. (2009), advancement in recycling technology has made it possible to re-process these types of single-use plastic. Therefore, the term “unrecyclable plastic” is incorrect, and the term “non-valuable plastic” is more appropriate for this range of plastics. Horodytska et al. (2018) argued that the low economical value and operational difficulties are reasons why these single-use plastics are neglected for recycling.

Rajendran et al. (2012) elucidated that these operational difficulties are based on the loss of the intrinsic physical properties, decreased molecularly, and loss of rigidity of this single-use plastic.

As an intervention, the current food waste collection roll-out scheme that is gradually expanding will hopefully remove or reduce food waste as a contaminant in the mixed recycling bins. The issue of “non-valuable plastic” can be resolved in two ways. Either to have these plastics removed from the mixed recycling stream at the sorting facility or to increase the range of the mixed recycling materials collected to include this type of plastic.

6.2.2 Communication

The communication theme focuses on strategies and the medium of communication. The theme also details how the council uses this powerful tool to communicate and inform the residents about the recycling service. This theme is also the second crucial factor after the barriers theme because the theme is almost connected to all other themes. Before the interviews, documentation relating to communication objectives, engagement strategies and youth

engagement strategies was requested. Figure 6.4 indicates the thematic mind map of the issues coded under communication.

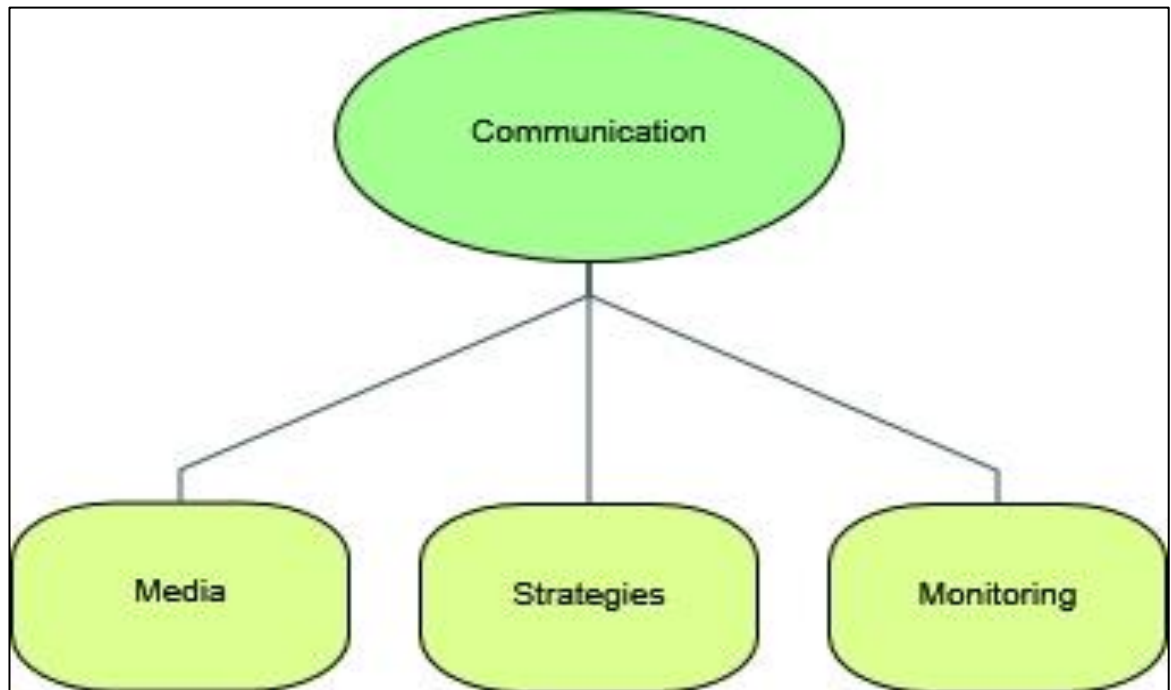


Figure 6.4: Thematic mind map indicating the 3 sub-themes under the Communication theme.

Strategies: The strategies code contains issues around the council's communication strategies, what are the communication strategies and how are the strategies implemented. The request for the council recycling communication strategies indicates that the council does not have a specific or detailed written communication strategy. The responses below from CP2 confirmed this assertion.

Response: *“Recycling communication plan attached. The council does not have a specific written recycling strategy but relies on ReLondon communication assets produced for all London boroughs. Be That Person Campaign Toolkit - 'Be that person' campaign communications assets - ReLondon which was launched in December 2021” (CP2-Recycling Officer).*

The council recycling plan (see Appendix S) only shows the dates of annual planned events. The response also shows that the council is relying on ReLondon communication resources for London boroughs. ReLondon is an organisation set up by the London Mayor to improve waste management in London.

For the request for documentation on the council's current recycling communication strategy, which is specifically focused on the younger generation. The response below was obtained from Participant CP2.

Response: "For children due to staffing constraints this is not something we focus on. However, if a request comes in from a school, we will deliver an activity (reading a recycling story book 'Munch and his Funny Tummy' or give a presentation depending on the key stage). Very few of these requests over the past 18 months due to schools not wanting visitors on their premises. Additionally, a portion of Westminster students are not Westminster residents- therefore not a priority area. 18-34 year olds- ReLondon have completed a report. Report - Motivating young Londoners to recycle - ReLondon. The council does not have their own specific documentation" (CP2-Recycling Officer).

For the request for documentation relating to a resolute communication expert that manages recycling communication. The response below was obtained.

Response: "CP2, coordinate the recycling operational communication and engagement collaborating with the council Corporate Communication Team, along with various contractors. The recycling team does not have a wholly resolute recycling communication expert" (CP2 -Recycling Officer).

For the request for documentation detailing an external organisation managing the council recycling communication.

Response: "Such a document does not exist. The council engagement contractors do not manage our recycling communication; they provide a service that feeds into our comms and engagement plan" (CP2 - Recycling Officer).

The responses above show a lack of adequate resources to manage the council's recycling communication which can affect residents' participation in recycling activities. This is because a lack of detailed written communication indicates a lack of preparedness. Lack of budget resources has been cited as a contributing factor

to the lack of an effective communication strategy. Kaplowitz et al. (2009) stated that decisions on the communication strategy approach depend on funds available for recycling programs.

As an intervention, there is a need for the recycling department to create a resolute “recycling behavioural unit” that will consist of a recycling officer, a behavioural analyst, and a communication expert. Additionally, the unit should draft detailed written communication strategies that are localised to suit the situational factors in Westminster. Relying on a general communication strategy provided by an external organisation, may not be adequate to mitigate localised issues. This recommendation will require adequate funding for its objectives to be attained.

Media: The Media code consists of various channels that the recycling service uses to communicate recycling messages. Such media are the council website, social media (Facebook), letters, newsletters, and door-knocking exercises. The recycling team use both the council’s corporate social media channels (Facebook and Twitter) and the recycling team Facebook called ‘Westminster Recycles.’ The corporate Twitter account has larger followers than the corporate Facebook account as recalled by CP3.

“Okay. So, for social media engagement for Facebook, we have 5,892 followers, and for Twitter we have 29,500. And yes certainly, Twitter more than Facebook, has good reach as well. They quite often do pay social as well” (CP3- Innovation Team Manager).

The Westminster Recycle Facebook page has an extremely low following of about 500 followers. CP2 was asked if there is any drive to increase followers on Westminster Recycle Facebook. CP2 commented that this is not a priority, as it is a common trend for all local authorities’ Facebook pages to have a low following. The reasons for that are further explained below.

“No immediate plans. Because it is quite niche in terms of the residents that would have followed or have that level of interest. It is fine. It is remarkably similar to other local authorities that have a specific recycling social media page. But we will continue to put information out there for residents that have that interest, and again it might increase again once the recycling champion scheme is sort of refreshed and re-launched, but I would not say it is a top priority” (CP2 -Recycling Officer).

Although, social media are being used to promote recycling messages (videos) and to pass any recycling information such as changes in collection times. The low number of following means that the messages are not reaching the wider resident population.

CP3 agrees that more could be done to use social media to engage the residents, especially the younger generation. However, the council is trying to strike the balance in order not to bore the residents with too much information. Also, CP3 said that the use of role models to influence the residents is significant.

The use of an electronic newsletter is another medium of communication employed by the council. The council has two main newsletters (The Reporter and the Westminster Plus) which also carry recycling messages on how to recycle properly. This medium has a better reach than social media.

“Yeah, but it is an e-newsletter though, the Westminster. So, I think it goes out..... The click rate is around between 30% and 40%. And the usual..... last week, the city average successful deliveries over the last year has been 110,000. So, it does have good reach, my Westminster newsletter” (CP2 -Recycling Officer).

The door-knocking exercise is also conducted by the recycling service to have face-to-face interaction with the residents. Other channels of communication used are council tax packs and letters.

The result of this phase 3 data indicates that the recycling team is utilising all possible means of communication. However, are these means effectively utilised? Phase 2 data also indicates that 93% of the respondents stated that they have received one form of communication or the other from the recycling service.

This indicates that the communication channels being used are effective because it is reaching a large percentage of the respondents.

There may be other underlying issues if the survey data is further scrutinised. For example, the issue of digital exclusion is a factor that could affect the propagation of recycling information as some residents will not have access to electronic devices. Thereby being digitally excluded from recycling communication. Phase 2 data shows that only 51% of the respondents have received recycling information from electronic sources, while 42% of the respondents have received recycling information from non-electronic sources.

CP3 mentioned that the innovation team have mapped out digitally exclusion areas in Westminster. This map could be used to strategize how recycling messages are communicated in Westminster. The use of non-electronic media could be concentrated more in areas that are digitally excluded. However, CP2 argued that the current communication channels are adequate to mitigate issues surrounding the digital exclusion, where recycling letters are sent to all residents using the council tax database.

Nevertheless, the digital exclusion map can still be used to review and plan communication strategies for these areas. It is not enough to rely on the assumption that the postal letters will be adequate to mitigate this issue.

Monitoring: The monitoring code covers how the recycling team monitor the use of online recycling communication by the residents, call centres data, and new residents to Westminster. It also includes feedback about the recycling service.

Since the council have a high transient population of 30% as identified earlier, it is a good practice that the council is monitoring the new residents coming into the borough. CP2 described how the new entrants to the borough are monitored and then provided recycling information, to make them aware of the council recycling program.

“So, as I said before, it could be that we get more container orders. That is a big one. We monitor website hits. If needed and if we really want to be specific, we can look at call centres figures. The recycle team managed the food waste in the email inbox. So, we get direct customer service interactions with residents. So, we

know if residents have received things and how they have reacted to things, because people are very quick to complain obviously, or quicker to question, or query what is going to happen, when are they going to collect the bins. How is it going to work and how are they going to be affected” (CP2 -Recycling Officer)

As a general intervention for the Communication theme. The following are recommended. In addition to the personalised messages, the contents of the recycling communication can be designed to promote recycling as a community activity or a social norm. This is to cultivate a community sense of belonging that “if everybody is recycling, I want to recycle as well.”

This assertion is evident from a recycling survey carried out by WRAP (2021). The results of the survey conducted in 2021 indicated that the respondents that perceive recycling as a social norm, recycle more materials than the respondents that do not perceive recycling as a social norm. Hence, the study recommends the use of plural pronouns in key recycling messages such as “Together we recycle” or “Britain recycles.”

The result of a similar study conducted by Geislar (2017) indicates that norm communication increases recycling participation which ultimately leads to a high recycling rate. This is to reinforce in the mind of the people that recycling is a norm and serve as an encouragement to do the right thing.

6.2.3 Engagement

The engagement theme focuses on events, workshops, outreach, use of incentives, and a recycling champion network. This theme is also a critical factor because of its close connection to communication, the barriers, and the service theme. Before the interviews, documentation relating to engagement strategies was requested. Below is the response received from CP2.

Response: “We can supply a list of engagement activities over the past 12 months if useful? To note this time frame is not reflective of the usual amount of engagement we would undertake in a normal year due to covid and staffing issues. Our waste collection contractor mainly attends these events or activities on behalf of WCC due to staffing levels. Engagement list attached” (CP2 -Recycling Officer).

The engagement activities list is shown in the appendix as appendix T. Figure 6.5 indicates the thematic mind map of the issues coded under engagement.

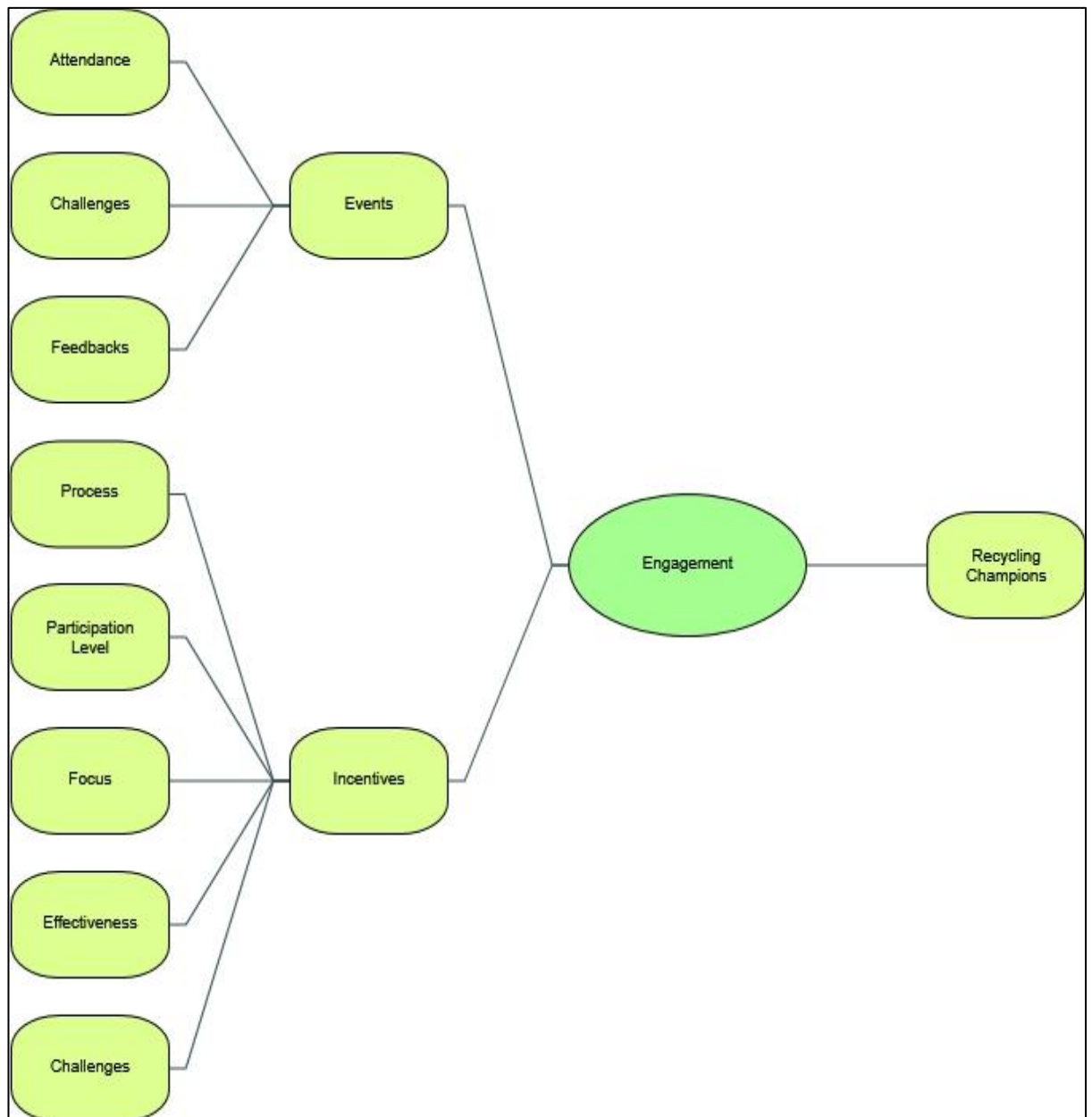


Figure 6.5: Thematic mind map indicating the different sub-themes under the Engagement theme.

Events: The events code details how the engagement workshops, events and outreach were conducted. Before the COVID-19 pandemic, most of the workshops were physical attendance with less focus on online workshops. CP2 stated that the pandemic brought about a seismic shift of focusing more on online workshops. So, all the workshops were conducted online due to COVID-19 restrictions.

The result of a Local Government Association (2020) survey indicates that residents in the UK were very satisfied with the way they were engaged during the pandemic by their local authorities. The respondents in this survey perceive the engagement with their local councils to be positive and appropriate. This is a result of the shift to virtual resources to engage the residents. CP3 commented that people are now keen to attend hybrid workshops (physical and online) due to busy schedules or venue distance.

The attendance at the council recycling events is extremely low but then CP2 believes this is typical for all local authorities. More importantly, COVID-19 restrictions have also affected attendance levels.

“So, it is always hard, and this is just not in Westminster, this is everywhere to get a good turnout at a recycling event. I can check, however the numbers we have now would not be reflective of the normal years. Every event we do, we keep a record of how many residents we engaged with but again it is hard to say how things are going to play out in the next year and how reflective the past two years have been again because of covid are not regular attenders’ levels” (CP2 - Recycling Officer).

There are many pertinent factors contributing to this low attendance (before the COVID-19 pandemic). The result from phase 2 data indicates these factors to be busy schedules (3%), venue distance (1%) and lack of events awareness (85%) are the factors responsible for the low attendance. Only 5% of the respondents have attended one recycling event or the other. The remaining 6% were aware of the events but not interested in attending.

CP2 was asked, how are the recycling events advertised. The response was that these events were advertised on social media. This may be the factor largely responsible for the low attendance because we know from the communication theme that the recycling team social media have a low following. Willman (2015) investigated the most efficient ways of passing across recycling information or communication. The result from Willman's (2015) study indicates that door to door deliverance of recycling communication has the greatest impact on increasing the recycling rate. As an intervention, it would be helpful if the recycling events are advertised through the delivery of door-to-door mailing. More importantly, the

events should be advertised on all of the council communication media and also continue to hold hybrid events. This is to give the residents more choices to attend the events.

CP2 also outlined other challenges faced by the recycling team in organising events. Among these challenges are severe weather if the event is outdoor, and the risk of high attendance of neighbouring residents if the events are held close to the border of Camden and Kensington boroughs. The other challenges are issues associated with using online technology, which is detailed below.

“And then also we had repair week, which took place at a different point in time, whenever it was last year or the year before. It was a repair event which would always take place in person because it was covered, we had to run it online. Which had its own sort of complications because the people who do the repair workshops might be very skilled at repair, but it might not necessarily be....It is a learning process for anybody trying to run a webinar to make sure that obviously the camera is on the actual selling, so they can see what is happening so that it is useful for the people attending” (CP2 -Recycling Officer).

It is recommended that presenters at the repair workshops are supported, to gain training on how to effectively use online technology as a tool, to enhance the deliveries of the workshops.

These recycling events are also reviewed based on the feedback provided by the attendees. Comments on complaints and issues relating to recycling activities are collated for further action and resolution.

“So, after any event we monitor how many people we engage with, lots of leaflets were given out, what sort of questions were raised, and any sort of further actions. So, if a resident came along and complained about something, was curious about something, or whatever they wanted. We will act on what has been raised at that event. Yes. So, it could be service issues saying that the bins at this location are always overflowing. It could be an information issue. For example, they could be saying that this information on the webpage that we need, is not there. It could be a complaint relating to something recently..... that they were happy with food waste recycling but have not received their containers as they should have done” (CP2 -Recycling Officer).

Evidence from the interviews indicates that feedbacks are not documented after being actioned. There should be a process to document feedback and the actions taken. This documentation will serve as a baseline data to review the recycling service for future improvements.

Recycling Champions: The council also operates a network of recycling champions. This group consists of residents that are enthusiastic about recycling and help the council to propagate recycling activities. The group also features recycling videos and coordinates visits to recycling centres. CP2 believed that the recycling champions are more role model citizens that will have more impact than using famous people as recycling influencers.

“So, the recycling champions were obviously an immense help with that, they have been kind of put-on board and helped in sporadic ways recently. But hopefully that scheme will be re-energise shortly, re-launched, and will have more sort of forward plan with engagement for the next 12 months. What we did on corporate communication last year was to use recycling champions in videos. And I thought that was good because they are keen about recycling obviously, and they are Westminster residents. So, they made videos for us for Christmas, they dressed up in Christmas outfits like Santa outfits and stuff like that and talked about the Christmas tree recycling or what should be recycled during Christmas. I think that resonates better than sort of public influences but that is my personal perspective”
(CP2 -Recycling Officer).

It is not known what influence the recycling champion network had on the borough recycling output as data collected in phases 1 and 2 did not reveal any impact of the network.

Incentives: The incentives code details the council's activities in nudging the residents to make the right decision through rewards and incentives. The incentive scheme is only focused on some selected estates (flatted properties) that have low recycling output. The low recycling output in high-rise buildings is caused by two factors.

The first factor is related to the type of building, and the second factor relates to the use of a communal bin facility, where there is no individual responsibility (Oluwadipe et al., 2021). CP2 lamented that it is very difficult to get good recycling from communal bins.

Therefore, the incentive scheme that was designed to increase recycling participation in high rises was inadequate and cumbersome because it is not easy to find out individual participation, as this is not monitored or measured. CP2 explained the process and how it works.

“You just recycle in your normal way. The only differences are that we will monitor the recycling levels of the bins. We monitor how much the approximate recycling is coming out of that estate. They do not have to opt into it. You do not really do anything. You just conduct recycling in your normal way. We just give communications, and try to encourage people to recycle, because of the incentive that your estate will win something. You will then help suggest and vote if you live in the estate, and it is for the community benefit. You can do what you want really with the money. So, it could be so for activities for the elderly residents on these estates, they could do a visit or something, we would put money towards that. That could be towards pantomime for children, it could be for energy efficient light bulbs, it could be for trees, it could be for a table tennis table for the youth club”
(CP2 -Recycling Officer).

Since the scheme participation is not monitored and there is no data on levels of individual participation. It will be difficult to review and improve the scheme. Other challenges cited by CP2 about the scheme include difficulties in identifying a resident representative to collect the prize and difficulties in getting residents to vote for the charity that will receive the cash donation.

These challenges bring into question the effectiveness of the incentive scheme to increase the council recycling rate. Result from phase 2 data shows that 88% of the respondents are not motivated by the incentive scheme to recycle but are influenced by other factors. The remaining 12% are motivated by an incentive scheme to recycle.

This result is contrary to previous studies (Mofid-Nakhaee et al., 2020; Zhou et al., 2021), which have indicated that incentives have a significant impact on the recycling rate. The disparity in the results may be due to localised factors, as Mofid-Nakhaee et al., 2020; Zhou et al., 2021 studies were conducted in Iran and China, respectively.

The solutions to the challenges faced by the incentive scheme can only be resolved when digital DRS technology is available in the UK. This will allow residents to participate in the scheme to have an individual digital account, and they can use the digital app on their mobile phone to scan materials before being placed in the bin. Preferably, they may just use any nearby DRS collecting machine to achieve the same purpose.

6.2.4 Food Waste

The food waste theme detailed the trial and the implementation of the food waste collection service. It should be noted that there was no food waste collection service before the commencement of this research. Food waste is being treated as a separate theme from the service theme because it is a new service and needs to be analysed separately for better clarity.

This theme is also particularly important because it has the potential to increase the council rate by a further 22% as evidenced in the resident's survey. This is consonant with Ladele et al. (2021) study, which indicates that separate food waste collection has a positive impact on the recycling rate. Figure 6.6 indicates the thematic mind map of the issues coded under food waste.

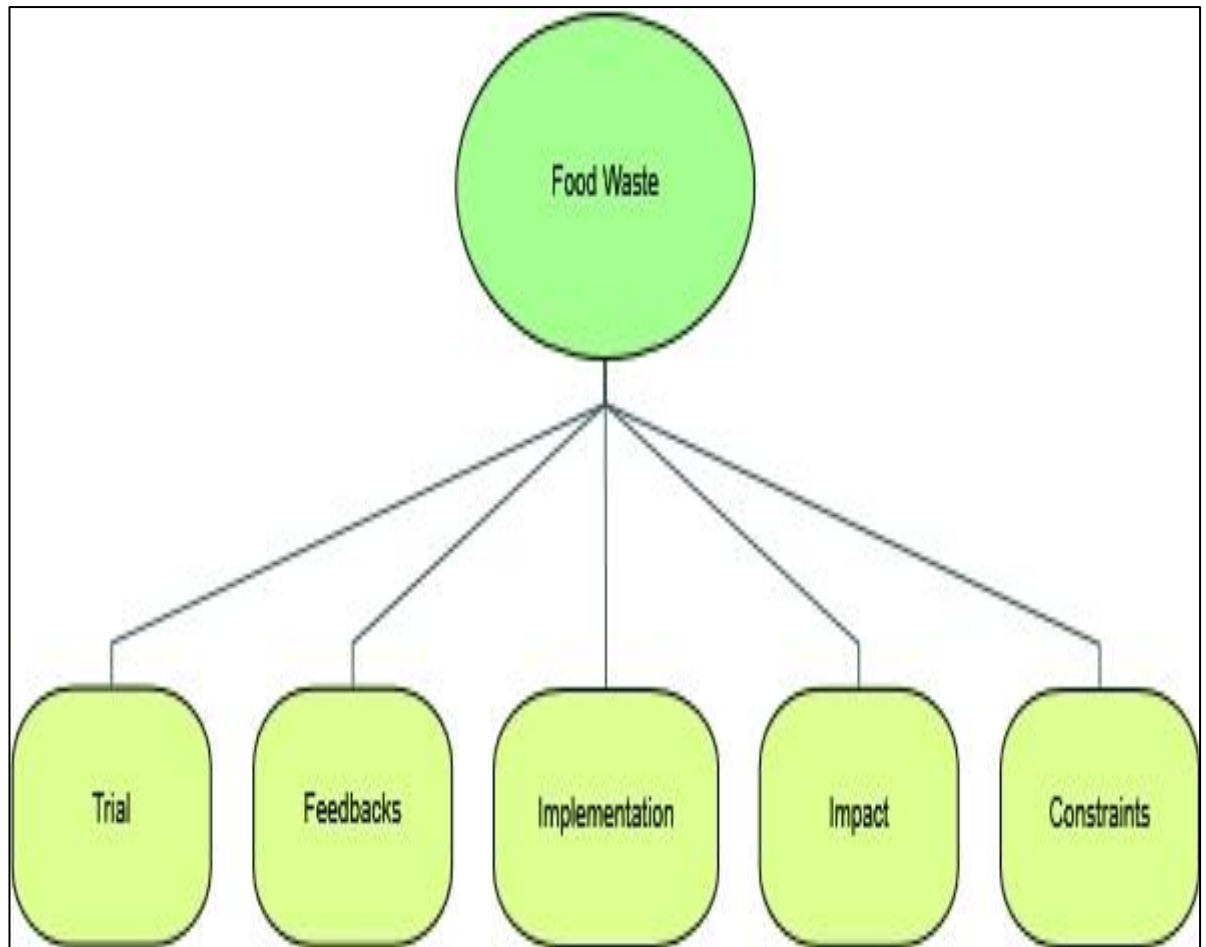


Figure 6.6: Thematic mind map indicating the different sub-themes under the food waste theme.

Trial: The council conducted a food waste trial collection before its implementation. The trial was to determine the feasibility of introducing the service to gather evidence on logistics, constraints, and challenges. The result of a food waste trial conducted by Roe et al., 2022 shows that such trials can provide insights into food waste management issues, which will allow tailored interventions before the final implementation of the food waste policy. The trial was run within different types of housing to evaluate the different logistics that will be required for the varied housing stocks.

“Yes, the trial was run in autumn 2019 until the end of February. So, we had an enjoyable time with the trial. It won a waste performance award. It went well. I must check the figures but on top of my head it was like six hundred tonnes over that period. But it was an effective way to assess how to roll out a service with very various and varied housing stock. So, we did it in residential kerbside streets. Fifteen houses in north Westminster, we did it in about five housing estates with communal waste bins, and we ran it in about fifteen or maybe twenty mansion private blocks of flats. I think as we are expanding obviously the trial was only seven thousand households. So, relatively small” (CP2 -Recycling Officer).

Feedbacks: Feedback from the residents indicates that the trial was well received, positive. The results of the data in phases 1 and 2 supported the introduction of food waste service as 74% of the respondents (phase 2) want food waste to be collected from their properties. The remaining 26% would not like food waste collection mainly due to lack of storage infrastructure. This group could be influenced to change their mind if appropriate storage infrastructure is in place. Therefore, implementing the food waste service can significantly increase the council recycling rate.

Implementation: The food waste collection service is now permanent and has been rolled out in phases with plans to cover the whole of the borough by the end of the year 2022. Also, free food waste caddy (23L) is made available for residents to store food waste inside their properties. This will encourage the residents to participate in the service, especially those that lack a storage facility.

“We are rolling it now as we speak. So, we are planning to cover the whole of the city by the end of the year. We are now rolling out the residential food waste collection through a phased approach” (CP1 -Recycling Manager).

Constraints: However, there are some constraints facing the food waste service. The constraints are lack of storage and difficulties in collecting food waste in some properties. The council is trying to resolve the problem using government grants to conduct further studies. CP1 outlined the constraints below.

“So, that is to develop a collection method to collect food waste. For example, some flats in Soho above shops that cannot have caddies have a communal doorway that cannot accommodate anything. So it is that type of properties sort of in the City, Soho, Covent Garden, in parts of Marylebone, parts of Mayfair, there are quite a few residential properties that we have got no way yet to collect from them. And funding will probably go towards developing a collection system that can accommodate those properties. I understand in some areas we might want to rely on elements of accommodating food waste in the public realm. However, we want to keep that to a minimum. Because using the public realm for waste is not where we want to be ” (CP1 -Recycling Manager).

Respondents in phase 2 data pointed out the storage issue for food waste, as 56% of the respondents said that they lack storage for food waste if the service is implemented. It is good to know that the council is aware of this issue and efforts are underway to resolve the problem. However, it is recommended that the existing MRC facilities are updated to collect food waste along with other waste materials.

Impact: Although there is a great interest from the residents to introduce the service, some residents have raised amenity issues relating to food waste storage. Such as odour and an increase in rodent infestation. Qamaruz-Zaman and Milke (2012) in a study on food waste odour cited offensive odour as a factor that prevents residents' participation in food waste service. Qamaruz-Zaman and Milke (2012) went further to suggest that the cause of the odour may arise from two reasons. Which are the food waste type and the manner of storing the waste within the properties. Oh et al. (2022) found a close relationship between a lack of proper food waste management and an increase in rodents' infestation in estates where the study was conducted. Unsecured bins, damaged bins with holes, bins overflow, and infrequent collection frequency were the main factors contributing to this rodent infestation. However, CP1 and CP2 downplayed the impact. They surmised that neighbouring councils have implemented food waste collection with no issues of rodent infestation and smell. They argued that the free food waste caddy is lockable and secured to mitigate these concerns.

“It is a bit of a super flux comment. In general, that food waste will now be in a residual waste. So, with regards to smell, if waste is collected frequently, it does not leave the smell issue. Also, with regards to access to rodents, I will say it is more secure because the food waste is in a more lockable bin that rodents cannot get access to it. But when you put your food waste in the black sack and leave it in your front garden, it is much easier for rodents to get access to. So, I think in that respect food waste collection improves rodent control because it is in a lockable container. The containers in all the estate are encased as well. So, there is no easy access to rodents. The current open chamberlain bins are accessible to rats, even euro bins are accessible to rats if the lids are open. I used food waste bin here in my flat, I have to say that my residual bin does not smell because my residual bin tends to smell when food waste is thrown into it” (CP1 -Recycling Manager).

It is recommended that the principles of the waste hierarchy are applied to the management of food waste. The council's current food waste management only focuses on food waste recycling. Efforts should also be directed to food waste prevention campaigns to ensure an integrated approach system to food waste management. Roe et al., 2022 argued that food waste management interventions should include influencing residents' consumer behaviours in areas of food purchase and planning. The odour and vermin threats can be mitigated through residents' training on how to manage food waste storage within their properties. Also, an easy guide on how to use, clean and maintain the food waste caddy should be printed on the caddy.

6.2.5 Micro Recycling Facilities

The micro recycling centres (MRC) theme detailed the use of the MRCs, their maintenance and design. The MRC sites are in the public realm spread over the borough. The MRCs network is a solution to the lack of space in Westminster to locate the larger recycling centres that are common in the outer London boroughs and county councils. Mixed recyclable materials from households such as paper, cardboard, plastics, aluminium cans, and glass can be deposited at these sites.

Other materials like small electrical items, books, shoes, and clothes are also collected at the sites. Figure 6.7 indicates the thematic mind map of the issues coded under micro recycling centres.

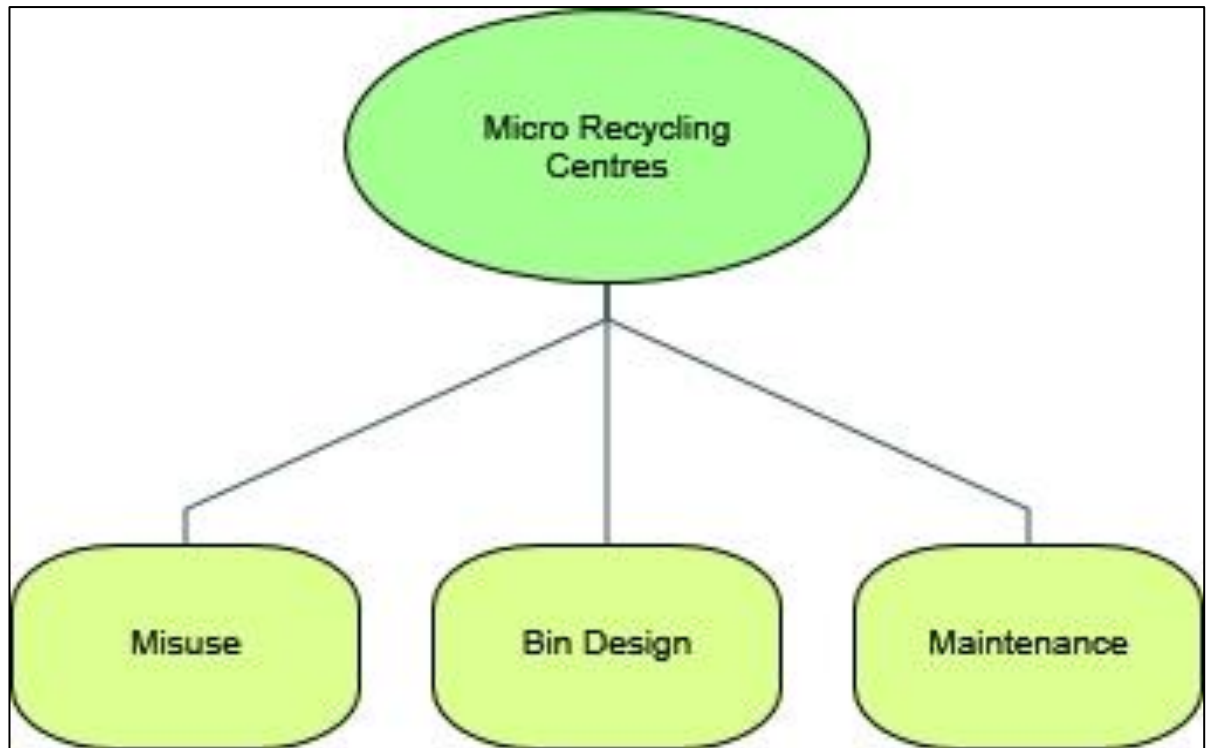


Figure 6.7: Thematic mind map indicating the different sub-themes under the micro recycling centre's theme.

Misuse: The sites are prone to misuse due to a lot of factors as explained by CP2.

“And something that was identified was that people when they are using the on-street paper and cardboard or mixed recycling bins, they do not often fold the boxes before they put them in the bins, which leads to bins being full when they are not full. Just because the un-collapsed box takes up more space. So, it is just a way of trying to encourage residents to flatten their box before putting them in the bin. Because obviously this would lead to overflowing bins, and then people just leave waste around the bins. So, resulting in fly tipping another detrimental behaviour” (CP2 -Recycling Officer).

Lyas et al. (2005) study identified similar issues with the London Borough of Havering kerbside recycling service. Lyas et al. (2005) asserted that misunderstanding about the use of the service is one of the main factors responsible for the misuse.

Another factor is the use of the sites by commercial and business units. This group is expected to pay for their recycling and waste to be disposed of, but rather look to avoid paying for waste disposal and therefore dump their waste at the MRCs.

“But I would say it is because they are not bins in enclosed areas, they are not bins in the flat, there is a lot of uncontrolled behaviour with anything that is on the public footpath. So, you can have abuse by businesses, any commercial waste people should not use those bins but can use those bins. So, it is not an environment that you can easily manage to make sure it is scientific. There are still uncontrollable factors involved if you get what I am saying” (CP2 -Recycling Officer).

It is recommended that the use of CCTV is introduced at all the micro recycling centres to deter antisocial behaviours. The use of notice boards advising users that they are being watched and recorded will reduce incidents of misuse but will not eliminate this concern.

Bin Design: The way the bins at the MRCs are designed and labelled is also an enabling factor to promote effective use of the sites. Currently, improvement work is being trialled in some sites with new clearer labels on the bins as detailed by CP2.

“So, the current stage of the project is that the team has done the baselining, there are new lids on the bins which are slightly wider to help fit in the cardboard boxes inside. And there is sort of clearer messaging on the bins, and then I think there are nine trial sites or bins with the lids, and with stickers which I have to check, and then some control sites as well. And then, these are just paper and cardboard bins; they are not mixed recycling bins for the on-street paper cardboard bins. And then shortly the residents that are local to the micro cycling centre sites that have the new lids and stickers on them will receive letters to remind them, and how to spell colour boxes essentially” (CP2 -Recycling Officer).

As the improvement project is still ongoing, it is difficult to know what the impact of the re-designing will be. Also, it should be noted that the result of phase 2 indicates that 11% of the respondents are influenced by the labelling format to recycle properly. While 15% stated that the bin labelling format is not clear, and they want improvement on the labelling formats and colours.

However, participants in phase 1 data only have issues with packaging materials labelling rather than bin labelling.

Oluwadipe et al. (2021) stated that the non-involvement of the public in the design of the recycling facilities is affecting the way it is being used. De Feo and De Gisi (2010), recommend that residents' involvement in the design of the recycling infrastructure could increase the recycling rate. This is because the infrastructure will be used by the residents and capturing their experience will enable the effective use of the facility.

Maintenance: The code details the cleaning and servicing of the bins. Before the interview, a request for information and documentation was sent to the recycling team. The request asked for a documentation schedule on how frequent the MRC sites are emptied, cleaned, and maintained. CP1 responded with the information below.

Council's Response

- Some MRCs are collected daily, and some sites are collected twice a day.
- Scheduled cleaning, replacement, and maintenance of the bins and other infrastructure of the sites are done twice yearly.
- Replacing damage and vandalism at MRC sites is done on a continuous ongoing basis and whenever reported.
- Cleaning of the site (sweeping, flushing) is done daily in most cases.
- Fly tipping around the sites is removed on a continuous ongoing basis.
- There is no documentation to provide.

The response indicates that there is no detailed strategy or robust regimes to maintain the sites. It is therefore recommended that the maintenance regime is detailed and documented to ensure the MRC sites are serving their purpose. The documentation should be reviewed periodically and updated when necessary.

6.2.6 Recycling Bags

The recycling bag theme detailed the use of the bags for storage, collection, ordering of the bag, and issues related to their use of the bag. The recycling bag is being treated as a separate theme from the service theme because it is a principal factor contributing to the council's low recycling rate. This is because the phase 2 result shows that 63% of the respondents use recycling bags for collection. Figure 6.8 indicates the thematic mind map of the issues coded under the recycling bag.

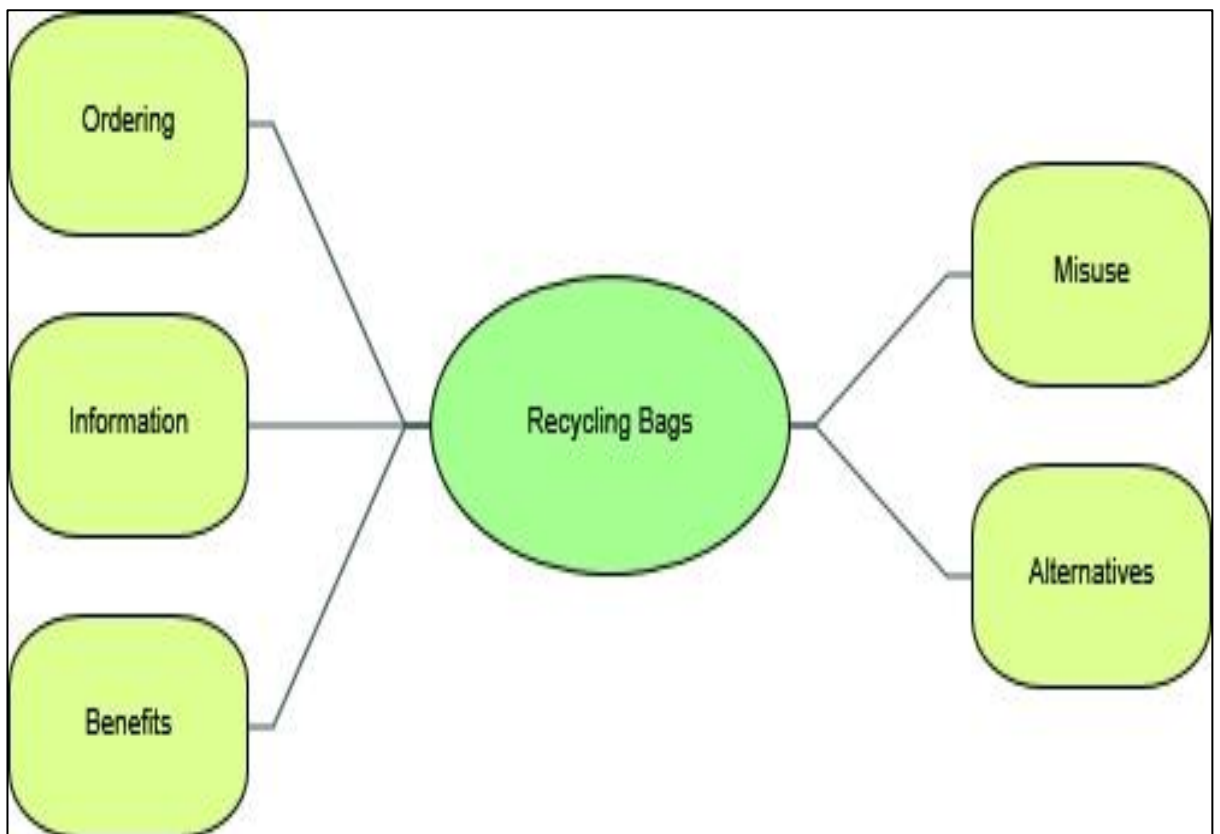


Figure 6.8: Thematic mind map indicating the different sub-themes under the recycling bags theme.

Ordering: This code entails the process of ordering the bags, the delivery timeframe, the type of properties that use the bags and the quantity of bags sent out at any given time. The bags are delivered within a period of 10 days after being ordered by the residents. There are many ways (by telephone, council website request, email request, and at libraries) available to order the bags as explained by CP1.

However, despite the number of means to access the bags, a few residents are having problems accessing the bags. Participants in phase 1 data (P6 and P12)

were having issues accessing the bags but with different degrees of inability. Inaccessibility to the bags is an ongoing issue for P6 while P12 only have accessibility issues during the COVID-19 pandemic.

Also, respondents (9%) in phase 2 data stated that they are not aware of the means to access the bags, and 4% of the respondents cite the lack of easy accessibility to the bags as a barrier to recycling.

CP1 was asked, how will the council differentiate between residents sending the bags proactively without the residents ordering the bags. The response provided shows that bags are proactively sent to residents based on their type of property.

“So, it is not all the residents. There is a caveat to that. So, it is kerbside properties and mansion blocks that are on the kerbside doorstep service. So, the bags are not sent.....the disposable transparent plastic bags are not sent to the estates for example, because they are on a blue bag service. And if a mansion block is on a blue bag service, they have a communal bin and they have a blue bag and they empty the bag out all the time into the bins. They would not have a proactive delivery but everybody else does. I think it is one or two clear packs delivered twice a year” (CP1 -Recycling Manager).

So, the 9% of the respondents (phase 2 data) having issues with the bags may be residing in mansion blocks with no communal recycling bins, therefore, this group will not have bags being proactively delivered to them. The result from phase 2 data corroborates this assertion as 85% of the respondents that have issues with bag accessibility reside in flatted properties.

Information: This code represents how the information about the recycling bags is communicated to the residents. This is also critical to determine if there is a gap in the communication that is sent out to the residents. The comments from CP1 and CP2 provided further insight.

“All the information is available online. You know, we do regular outreach, we do door knocking where we knock on everybody’s door at various times as well to avoid people being away. So, there is a wealth of information in there. Some point you must sort of be realistic, what more do you want us to do. All the information is available. If I live somewhere and I do not know how to recycle. The first place I

will go is to my local authority website. What is more that is expected to communicate and make it clear how they can get the bags? And we repeat the process 3 months down the line because someone has moved on again” (CP1 - Recycling Manager).

The above comments indicate that most of this information on recycling bags is mainly available online, but if we take into consideration the issue of digital exclusion, there will be some residents that would not be able to access this resource or information. Therefore, it is recommended that the recycling communication delivered through letters and printed newsletters should contain special information on how to access the free recycling bag.

Alternatives: The issues coded under this code discuss other alternative outlets to access the recycling bags. This is important in the case of emergency needs when online or telephone orders will not resolve short-term supply issues. CP1 outlined the two-backup system in place to deal with an emergency need.

“Then they can also get to the library to pick them up if they really want them. And furthermore, if they are using the on-street MRC bins, they do not need the recycling bag. They can put the mixed recycling in the MRC bins, loose as well” (CP1 -Recycling Manager).

However, there is a critical point to note here. In circumstances where there is no nearby library or MRC, there will be an urgent need for a recycling bag. There is a high probability that residents in such situations will dump the materials in the residual bin instead of waiting for 10 days for the bags to arrive. A quick fix to this issue may include storing extra bags in the concierge estate office for emergency use.

Benefits: This code deals with the benefits of using the bag system in Westminster. CP1 argued that the character and the design of Westminster mean that the use of bags is the only viable option to collect recycling in some areas. It is important to note that Westminster is not the only local authority using recycling bags for collection. A study conducted by Robinson and Read (2005), noted that the use of recycling bags is one of the means of recycling collection in the London borough of Royal Borough of Kensington and Chelsea.

“The main reason why we have recycling bags is that the only way we can collect recycling from a lot of properties. These properties cannot have wheelie bins, they cannot have big euro bins, etc. So, there is no way for us to collect recycling otherwise. We have some areas in Westminster where they are using boxes and crates, these are far from ideal because the contents often spill out. At least in a bag, it is held, and it is more user friendly. Regardless, we will still need to have that waste contained somehow. Most properties in Westminster just cannot accommodate bins or wheelie bins system that are in use elsewhere to hold waste. So, for us it is unavoidable” (CP1 -Recycling Manager).

However, there are some disadvantages of using bags for the collection system. One is that the system is not sustainable because the bags are single-use plastics. CP1 agreed with this assertion. Workentin et al. (2022) conducted an extensive study on the use of recycling bags in Canada, and the result of the study shows that the environmental and economic impacts of using the bags cannot be justified.

The other disadvantage is that the bags are misused and used for lining residual bins instead of lining the mixed recycling bins. Lyas et al. (2005) observed the same behaviour of recycling bag misuse in the household recycling study carried out in the London borough of Havering. Although CP1 concurred that the bags are misused for rubbish and garden waste, they are confident that this misuse is not widespread in Westminster.

As a recommendation, the council should explore the possibility of using bags that are not made from plastics. These bags should be durable and washable for continuous re-use. The bag could be owned by the council and rented out to the residents for a token affordable fee. A pair of such bags should be given out to the residents. So that when one is being washed, the other bag is in operation for use. This will eliminate the issue of single-use plastic and misuse of the bags for residual waste.

6.2.7 Service

The service theme detailed the recycling regimes, frequency of collection, aided service for the physically challenged residents, challenges, and mitigations to these challenges. The result from phase 2 data shows that 73% of the

respondents are generally happy with the recycling service that the council is providing. Figure 6.9 indicates the thematic mind map of the issues coded under service.

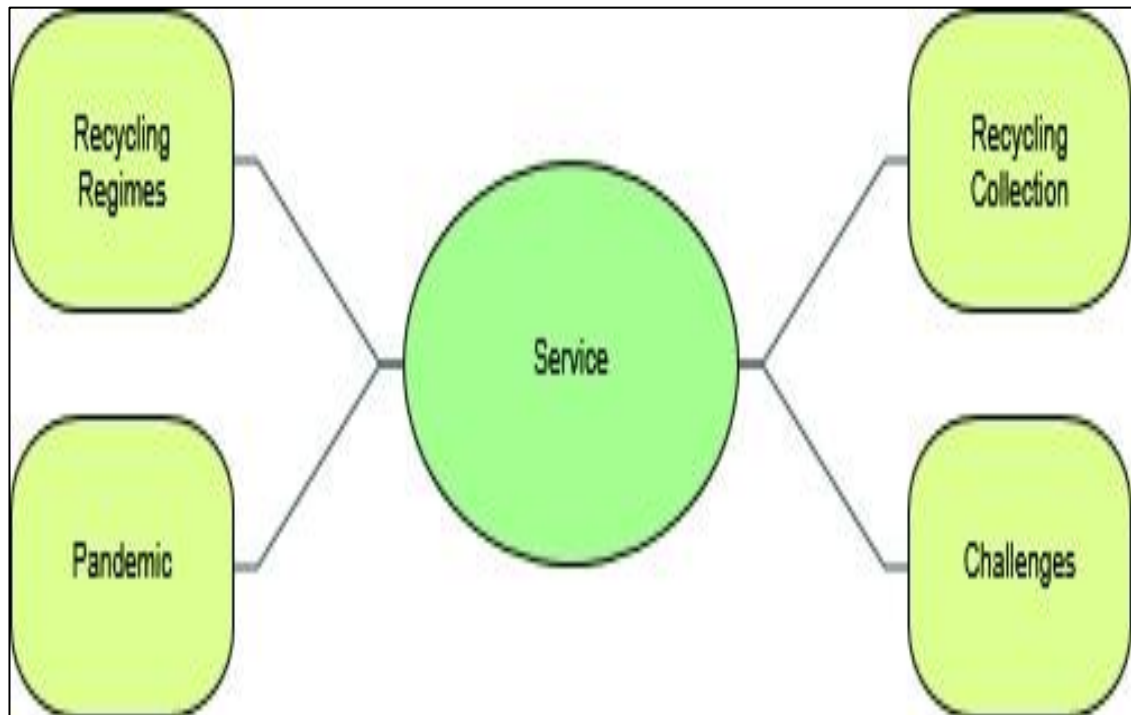


Figure 6.9: Thematic mind map indicating the different sub-themes under the Service theme.

Recycling Regimes: The recycling regimes code details the influence and the impact of the neighbouring boroughs' recycling service on Westminster. Studies (Jesson and Stone, 2009; Schumaker, 2016; DEFRA, 2019) have revealed the impact of different recycling regimes on recycling output. Since different councils operate different recycling programmes to suit their local needs, this non-uniformity in service creates confusion for the residents, especially the transient population.

All the participants (CP1, CP2, and CP3) agree that different recycling regimes of the neighbouring boroughs have an impact on the Westminster recycling service. This barrier has been discussed extensively in phase 1 result (under the policy constraints theme) and phase 2 result (future waste legislation). It is interesting to note that the council staff recognise and agree with the residents (respondents) that this issue is a barrier to recycling activities.

“Different boroughs have different recycling methods. And the other thing is the visitors. We have huge influx of visitors to Westminster every day. So, they will all have different recycling processes in their borough. And trying to get them recycle better as well” (CP3 – Innovation Team Manager).

The confusion is more about the disparity in the materials collected for recycling. As mentioned earlier under the “barriers theme” due to financial constraints some councils are prioritising the collection of economically valuable plastics over other plastics. Whereas some local authorities are collecting all plastics.

Recycling Collection: This code explains the council frequency of collection for different waste materials. Currently, the council operates different collection frequencies for different areas depending on their sensitive locations.

The different collection types are daily, once a week, twice a week and three times a week, of all the four types of collection frequency. The most main type of collection for residential properties is a weekly collection for recycling and daily collection for residual waste.

Results from phases 1 and 2 data shows that the resident participants are not happy with the daily collection of rubbish and weekly collection of recyclable materials. Because they think this kind of collection frequency is anti-recycling. They prefer the council to maintain the current rubbish collection frequency but to increase the collection frequency for mixed recycling.

CP1 defended the current collection frequency compared to other local authorities and they are confident that things will improve with the new proposed collection frequency.

“So, you need to bear in mind as well that in most local authority areas in the UK, their recycling collection is fortnight. In Westminster, the minimum is once a week which is already more. Now as we roll out food waste collection across Westminster, we will be moving to a one-day collection scheme where refuse, recycling and food waste are collected on a single day” (CP1- Recycling Manager).

After the interview with CP1, it was asked again if this proposed collection frequency will mean that some areas prone to large waste generation will still be subjected to this new collection frequency. CP1 confirmed that such areas will still get more collection frequency due to their localised factors.

The critical point about the proposed collection frequency is that higher storage capacity must be allocated to recycling and food waste storage. So that they do not end up in the residual bin. If this point is taken into consideration, the one-day collection scheme will work perfectly because the residents will be constrained in effectively managing the use of the three different bins. Additionally, the council also offers assisted recycling services to physically challenged residents, which is a scheme to ensure equal participation in recycling activities.

It is also important to emphasise the argument of Mattsson et al. (2003) concerning recycling collection schemes. Mattsson et al. (2003) argued that any recycling collection scheme that takes into consideration the situational needs of the local community, will facilitate an efficient collection system. Therefore, the proposed collection frequency must be checked at the initial stage to ensure it is fulfilling the needs of the local community and if not, a thorough review is required to satisfy this crucial requirement.

Challenges: There are a lot of challenges facing the recycling service in terms of collection. Due to the character of the central areas in Westminster where flats are found on top of retail units, it is practically difficult to separate the commercial collection from the residential collection.

This kind of collection practice is affecting the data collection for residential properties with regard to reporting the council recycling rate. CP2 commented on this issue.

“Even if you do, that all depends on the rounds, and what makes the most efficient sense for the vehicles. Because a lot of the area are mixed, so someone in the West End, you got residential with commercial so does not make sense particularly to have separate rounds. You must collect it together otherwise it is an inefficient use of vehicle movements. So, also you got on-street bins as well. So, it is kind of altogether. It does not make logistical emissions, vehicle efficiency crew sense to separate the streams” (CP1- Recycling Manager).

There is impending waste legislation to resolve this issue, which will be discussed in detail in Section 8.1.3.

Pandemic: This code explores the impact of the pandemic on the recycling service and how the recycling service was adjusted to cope with the pandemic. However, Different participants have different perspectives on the pandemic impact and effect. All the residents interviewed strongly believe that the pandemic has an impact on the recycling service. Notably, the difficulty in accessing the recycling bags. The recycling team interviewed (CP1 and CP2) have a uniquely different perspective. CP1 disagreed that the pandemic has affected the recycling service.

“I cannot say it has affected us very much in Westminster. Yes, there is no impact on services. We have run the service throughout the pandemic. And we collected whatever that must be collected. I do not agree with the notion that it was difficult to access the bags. We have delivered the recycling bags throughout the pandemic. Just because they could not pick up the bags at the libraries, we were still delivering them” (CP1- Recycling Manager).

CP2 agreed that the pandemic has affected the recycling service, but only in the areas of events and engagement activities.

“In terms of face-to-face engagement obviously because of COVID has not happened often. Whereas for the past two years because of personnel changes and then Covid, it has been exceedingly difficult to plan face to face engagement” (CP2- Recycling Officer).

It is recommended that the recycling team have a resilience emergency plan for the recycling service to cope with issues about bag accessibility, collections, and events. This plan will need to be reviewed in periodical updates to ensure that the council can cope with future pandemic events.

Studies (Tchetchik et al., 2021; Ebner and Lacovidou, 2021; Sarmiento et al., 2022; Mahyari et al., 2022) on the pandemic effect of recycling, indicates another impact apart from the engagement activities. The other impacts as enumerated by the studies are the increase in the recycling rate and less residual waste generation.

The increase in the recycling rate is due to the availability of time to engage in recycling activities, which is also due to stay-at-home regulations. While the less waste generation is due to the low shopping activities by the consumers because people are saving for the unknown future. These studies also highlighted that the use of single-use plastic has increased considerably due to the mitigation to control infection.

These other impacts outlined above were not revealed in the interview and survey data collected for the research. However, the comparison of the Westminster recycling rate before and after the pandemic shows a 4% increase. The rate was 20% in the pre-pandemic annual result for the year 2019/20 and 24% post-pandemic for the year 2020/21 (London DataStore, 2022). Therefore, Participant CP1 may be right in saying that the pandemic has not affected the recycling service negatively.

6.2.8 Legislation

The legislation theme detailed the political motivations, economy, enforcement and how the recycling rate is calculated. Figure 6.10 indicates the thematic mind map of the issues coded under the legislation.

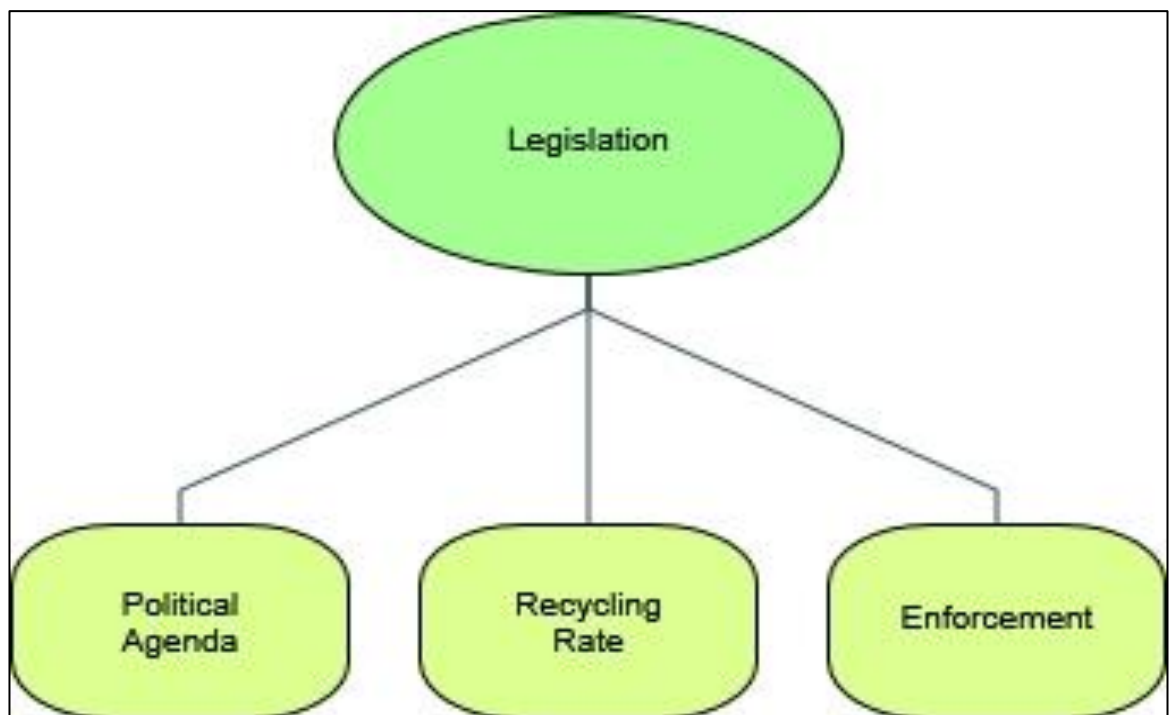


Figure 6.10: Thematic mind map indicating the different sub-themes under the legislation theme.

Political Agenda: Issues coded under political agenda described the lack of political motivation to push stringent legislation that will increase the recycling of each borough and ultimately will increase the UK national recycling rate. Oluwadipe et al. (2021) identify policy constraints as a barrier to recycling activities. The latest data from the Department for Environment, Food & Rural Affairs (Defra) shows that the UK recycling rate is 43.6% for the year 20/21 (Defra, 2022). CP1 lamented the lack of political will to make recycling a mandatory activity for householders to achieve a higher rate.

“I cannot see that legislation coming in, probably not in my lifetime. There is no political appetite to push it that far. You know waste production is still not high on the political agenda. And no one really knows how we can really push the reduction of waste” (CP1- Recycling Manager).

Historically, some powers within the waste legislation allowed the local authorities to force residents to recycle their waste, but such powers were removed from the legislation.

“And that was done on political grounds because a lot of the powers that the local authorities had on forcing residents and the people that manage their waste to recycle was taken out of the legislation. The political desire is still there to have a light touch approach on residents and the properties they live in around recycling” (CP1- Recycling Manager).

CP1 believes the main reason for this lack of political will is because of the economy. Waste reduction will translate to consumers buying fewer products which will have an impact on the economy. The national government will need to look beyond the economy and put strategies in place to turn waste into resources to achieve a truly circular economy.

Recycling Rate: Issues coded under this code relates to the method employed to calculate the recycling rate. Local authorities are required to submit annual waste data (WasteDataFlow, 2021) to monitor the Circular Economy Package target of a 65% recycling rate by 2035 (DEFRA, 2020b). The method of calculating the recycling rate has been branded unfair CP1 because it does not consider the geographical location and urban character of some boroughs.

Thereby, giving rural boroughs more opportunity to have a high recycling rate than the urban boroughs.

“You need to have a look at what is the methodology for recycling rate. And what is being compared to what. You compare the recycling rate for example between Westminster and an outer London borough, what you should realise is that those the outer London boroughs recycling rate is half made up of garden waste which they have collected for composting. We do not have that in Westminster. So, you know comparing our rate to Bexley is not fair because Bexley has so much garden waste. When you look on the dry materials that we collect, our recycling rate is sort of in the middle, it is not the lowest, there are boroughs that collected far less dry recycling than we do. So, to say that our recycling rate is not high, I think it is just that we do not have garden waste in there, but if you look at how much dry recycling materials that we collected, we are sort of an average performer” (CP1- Recycling Manager).

The response above could be interpreted that the current method of calculation is not exactly accurate to capture the reality on the ground. Because basing the recycling rate on weight calculation as highlighted by CP1 means that boroughs with no garden waste will have less waste tonnage.

According to CP1, the UK methodology of calculating the recycling rate is quite different to how other countries are calculating their recycling rate. CP1 argued that the mixed recycling percentage should have been calculated as a segregation rate to provide a true picture of recycling output.

“Internationally, the recycling rate is calculated in a unique way. How we calculate it in the UK, or in England at least, is that the materials collected minus anything that cannot go into the recycling process like rejects or residues. Now, in some other places in the world, it is simply recorded as what is collected in the trucks. So, you can collect trucks full of bricks (demolition and construction waste), and it will count towards recycling or their recycling rate. Now, a more correct description of such... would have to be segregation rate rather than recycling rate. It is often you know.... International recycling rate often compared to some other places, it might also include construction and demolition waste, or part of the commercial waste stream” (CP1- Recycling Manager).

It is recommended that local authorities in the UK should form a pressure group to prevail on the national government to review the current methodology for calculating the recycling rate. So, the method of calculation reflects the practical reality of recycling activities.

Enforcement: The code details the inadequacy of the current legislation to enforce non-compliance with MRC use. Fines and penalties cannot be an issue for contamination of the recycling bins because there is no legislative backing. CP1 thinks that such power would have helped in increasing recycling output of the borough.

“We cannot issue a fine if we find a glass bottle in the residual bin. We just do not have that option. But in other places in the world, they have got more draconian measures, and if there is a recycling found in a general waste bin, the property owner will get fined for it. Yes, yes, the only way you could do that is by holding the managing agent, or the property owner or the estate manager responsible for the format the waste comes out to be collected. So, you will act against the property owner for not being in control of all the internal waste segregation. Even in the Environment Bill that is in effect now, there is no legislation, there is no clause that enables us to do so. There are clauses that we can force businesses to recycle including the managing agent of those businesses that manage their waste. But that is not replicated for the residential element” (CP1- Recycling Manager).

CP1 also lamented that the use of CCTV is not useful in many situations of waste crimes but is only useful when a waste crime is committed with the use of a vehicle. But not useful if the offender committed the crime on foot. Illegal dumping of waste is the crime referred to, in this situation. The current work on behavioural insight by the council should also focus on this issue. This is to understand the situational factors influencing the illegal dumping of waste.

Chapter 7 Triangulation and General Discussion

7.1 Introduction

This chapter details the triangulation of the results from the three data phases (Figure 3.2) and a quick overview to prelude the integration of results from the data phases. The overall discussion was then based on the consequent analysis and deduction from both quantitative and qualitative (mixed method) analysis carried out in the research.

7.1.1 Quick Overview of Phase 1 Results

The thematic analysis of phase 1 data (as detailed in Chapter 4) leads to the 6 final emergent themes which are human factors, physical factors, communication/public engagement, incentives, service constraints and policy constraints. These emerged 6 themes constitute the barriers for the participants to engage in recycling activities.

7.1.2 Quick Overview of Phase 2 Results

The result of chi-square tests (quantitative analysis as detailed in Chapter 5) using 4 explanatory variables (age, education, type of residence, and ward area) against various response 12 variables, resulted in both significant and non-significant relationships as shown in Table 7.1. The resulting significant relationships from the chi-square test revealed the distinct barriers (in the form of the responsive variables) affecting recycling activities in Westminster.

Table 7.1: The result of the chi-square tests (quantitative analysis) showing the significant and non-significant relationships between the explanatory variables and the response variables for data collected in phase 2.

Explanatory Variables	Response Variables											
	1	2	3	4	5	6	7	8	9	10	11	12
Age		■		■			■	■	■	■		■
Level of Education	■		■	■					■			
Residence Type		■			■	■					■	
Ward Area					■						■	

1= Recycling Behaviour, 2= Recycling Enabling Factors, 3= Commitment, 4= Bin Labelling and Colours, 5= Recycling Bag Accessibility, 6= Collection Frequency, 7= Food Waste Collection, 8= Communication Methods, 9= Communication Effect, 10= Recycling Events, 11= Micro Recycling Centres Proximity, 12= Future Waste Legislation. N=417

Significant Relationship
 Non-Significant Relationship

7.1.3 Quick Overview of Phase 3 Results

The thematic analysis of phase 3 data (as detailed in chapter 6) leads to the 8 final central themes which are barriers, communication, engagement, food waste, micro recycling facilities, recycling bags, service, and legislation. In this result, all 8 themes emerged as barriers for the participants to engage in recycling activities.

7.2 Triangulation of the 3 Phases Results

Since data were collected in three phases with different methods and sets of participants. It is important to triangulate the data from these three sources to enable a comprehensive understanding of the research.

Flick (2018) defined triangulation as a methodological strategy of converging data from different methods in order to validate and strengthen the research outcomes. The benefit of triangulation is already outlined in its definition above. Morgan (2019) argued further that triangulation boosts research integrity and reliability by reducing biases of any of the methods utilised.

Therefore, triangulating the 3 data phases helps identify the common recycling barriers to both the residents and council staff participants. Additionally, triangulation also helped in presenting a balanced view between the residents and council staff participants where they have provided different views on the same barriers.

Noble and Heale (2019) state that triangulation is time-consuming, especially when dealing with a large volume of complex data arising from mixed methods. This weakness of triangulation will ensure rigorous analysis and interpretation in approaching the triangulated dataset in piecemeal stages. The steps taken during the process of triangulation were outlined below.

Initially, the emerged barriers (results) in each phase were outlined separately. Thereafter, the results in each phase are then merged into 5 groups based on the commonality and similarities of the result titles as indicated in Table 7.2.

As an illustration, the human factors main theme resulted from collating all human factors topics in phases 1, 2 and 3 for effective triangulation of issues under this main theme. This same process was utilised for the remaining 4 main themes.

Table 7.2: The triangulation process of merging the results from the 3 phases of the research into 5 central barriers.

Phase 1 Results (section 7.1.1)	Phase 2 Results (section 7.1.2)	Phase 3 Results (section 7.1.3)	Converged Results for the 3 Phases into 5 Central Barriers	Components of the Converged Results
Human Factors	Recycling Behaviours	Barriers	Human Factors	Human factors, recycling behaviours, commitment, and barriers (human behaviour, transient population)
Physical factors	Commitment	Communication	Physical Factors	Physical factors, recycling enabling factors, bin labelling and colours, micro recycling centres proximity, micro recycling facilities, barriers (physical barriers such as property types and infrastructure)
Communication / Public Engagement	Recycling Enabling Factors	Engagement	Communication and Engagement	Communication, public engagement, and incentives
Incentives	Bin labelling and colours	Food Waste	Service Constraints	Service constraints, recycling bag accessibility, collection frequency, and food waste
Service Constraints	Recycling Bag Accessibility	Micro Recycling Facilities	Policy Constraints	Policy constraints, future waste legislation, and legislation
Policy Constraints	Collection Frequency	Recycling Bags		
	Food Waste Collection	Service		
	Communication Methods	Legislation		
	Communication Effect			
	Recycling Events			
	Micro Recycling Centres Proximity			
Future Waste Legislation				

The 5 main converged barriers were then used for general discussion to compare the commonalities and disagreements among the 3 datasets.

7.3 General Discussion

The process of triangulation described in the above section resulted in merging the 3 phases' results together to generate 5 central themes resulting from the research study which are discussed below.

7.3.1 Human Factors

Results from phase 1 (Section 4.2.1) and phase 2 indicate that human factors (habit, zeal, passion, and commitment to recycling activities) have a positive impact on the resident participants in influencing their recycling habits. All the participants in phase 1 are consistent with their recycling habits with the exception of P3 and P7 who are not committed recyclers due to busy schedules (P7) and the non-availability recycling storage facility (P3).

The same trend is observed in phase 2 where 91% of the respondents always recycle (Figure 5.1) and 66% (Figure 5.5) of the respondents are consistent with this recycling habit. A higher level of education was the motivating factor for these two recycling behaviours as 88% of the respondents (Appendix I, Q3) have a university degree, which positively impacts their recycling behaviour. This was evidenced by the significant relationships established from the chi-square tests (Table 5.2 and Figure 5.6).

Westminster statistics published in 2022 indicate that 6% of the borough residents have no educational qualification (Westminster City Council, 2022), this means that 94% of the resident population is educated within all levels of education. Studies conducted by Seng et al. (2018); Vieira and Matheus (2018), confirm that the level of education is a factor that affects recycling behaviour. In which a high level of literacy skills will facilitate an effective understanding of recycling information, this assertion was evident in the research results detailed above.

The council staff participants in phase 3 (Section 6.2.1) have a different view of the residents' recycling behaviour. CP1 described the residents as inherently lazy and lacking care in putting the right materials into relevant bins which are causing contamination. The cause of contamination is not mainly caused by laziness but the result of the 30% transient population who are not familiar with a new recycling regime (Section 6.2.1), lack of adequate recycling bins in some properties, the design of the bin infrastructure which does not allow easy recycling activity (Section 4.2.2), infrequent collection of mixed recycling (Section 5.7), and inaccessibility to recycling bags (Section 4.2.5) are the co-factors causing contamination issues.

Díaz-Meneses and Vilkaite-Vaitone (2020) in exploring the transient population recycling barrier between the subjective barrier (human behaviour) and the objective barriers (service constraints and infrastructure) also found that some people may decline to carry out recycling activities due to its discomfort and incumbrance even though they want to recycle. This situation could be improved by providing good collection services and convenient waste infrastructure.

It can be concluded from the correlation of the 3 phases' results on human factors, that human behaviour is not identified as a major barrier to recycling activities in Westminster, but the minor behavioural issues encountered are cross related to the infrequent collection of mixed recycling (service constraint) and the way the MRC bins are designed (infrastructure).

7.3.2 Physical Factors

The physical barriers mentioned by all the participants include property types, bins design, proximity to micro recycling centres (MRC), inadequate or lack of external storage capacity for mixed recycling, inadequate internal storage space to effect source segregation, and the borough's structural characteristics (old buildings and narrow roads). Table 7.3 indicates the instances where physical barriers in each data phase.

Table 7.3: Physical barriers stated by participants in each phase and the various sections where they are located.

Phase 1 Data (section 4.2.2)	Phase 2 Data	Phase 3 Data
Building types	Residence type (sections 5.3, 5.6, 5.7, and 5.12)	old buildings and old infrastructures (section 6.2.1 and figure 6.3)
Inadequate storage capacities	Lack of internal storage space to affect source segregation (sections 5.3 and 5.8)	Micro recycling facilities (section 6.2.5)
Lack of internal storage space to affect source segregation	Inadequate external storage capacity (sections 5.3 and 5.8)	
Lack of recycling bins	Bin colours and labels (section 5.5)	
	Micro recycling centres proximity (section 5.12)	

The resident participants commented on the physical factors as limitations to engage in effective recycling activity, while the council staff participants mainly focused on physical factors as a service constraint where external recycling storage facilities cannot be provided in most of the borough's old residential buildings. In addition, the borough's narrow roads are hampering the effective collection of waste and recyclable materials in some areas.

In phase 1 data (Table 7.3), the participants commented that the use of communal bins in high-rise buildings constitutes a barrier to effective recycling participation. This is because the use of communal bins lacks individual responsibility as found in houses that have individual bin storage.

Furthermore, houses tend to have more storage space both internally and externally than flats in high rises to provide adequate storage for mixed recycling. Phase 2 data (Figure 5.4) shows that the chi-square test established a significant relationship between residence types and recycling enabling factors. Figure 5.4 also indicates that flatted properties in high rises require adequate internal and external storage (for mixed recycling) than houses as enabling factors to participate in recycling activities. This outcome agrees with earlier studies by Díaz-Meneses and Vilkaite-Vaitone (2020); Timlett and Williams (2011); WRAP (2014a) that has established that housing type is a crucial factor that influences recycling activity.

However, Figure 5.4 also shows that some houses are lacking both internal and external storage spaces. As a critical note to the earlier studies on residence type's impact on recycling behaviours, the impact on recycling behaviours is influenced more by the availability of internal and external space for source segregation than the residence types. It could be argued that both houses and flats when devoid of space to enable source segregation would result in low recycling output. Therefore, the main focus should be more on space availability than residence types.

The design and use of the micro recycling centres (MRC) also feature as a barrier in phase 2 and phase 3 data (Table 7.3). The use of MRC was only mentioned by P2 in phase 1 data (Appendix G) when the recycling bins located at their residence are full.

In phase 2 data, the result of the chi-square test (Table 5.12) between MRC proximity and its distribution in the ward areas indicates a significant relationship. The respondents' ward areas from Table 5.12 were cross-checked with the location map for MRC distribution in the borough, which indicated a very low number (1 MRC per 1500 head) of MRC in ward areas with higher percentages of respondents that are not aware of any MRC in their neighbourhoods.

While high usage of MRC is more pronounced among the respondents that have a high concentration of recycling facilities in their neighbourhoods (1 MRC per 500 head). Inadequacy of MRCs in some ward areas will be a barrier to residents living in such areas if the facilities are far from their residences, as 22% of the respondents were not aware of the MRC existence in their area (Figure 5.17). Findings from previous studies by Letelier et al. (2021) and Li et al. (2020) on proximity to waste infrastructure in relation to this result (Table 5.12) have already been detailed in Section 5.12.

In phase 3 data (Section 6.2.5), the council staff participants acknowledge that the current design of the MRC bins is not enabling their proper use. Therefore, the recycling team is working with the council innovation team to re-design the bins for effective use and ease.

This acknowledgement is important as the current bin labelling and colouring format (section 5.5) is causing more issues for the younger generation (22-38 years) than the older generations (39 to over 55 years) as shown in Table 5.3. This finding disagrees with Dai et. al. (2017) study where they concluded that age has no substantial effect on recycling behaviours.

In addition, Table 5.4 indicates that respondents with lower educational qualifications have more difficulties than respondents with higher educational qualifications in distinguishing the bins for different waste streams. This is because one colour is used for both rubbish and recycling bins (but with a label to identify the bin type). Previous studies on education's influence on recycling activities had already been cited in Section 7.3.1. Data from the 3 phases have shown that physical factors are one of the major barriers affecting the borough's low recycling rate. Relevant interventions are proposed in Chapter 8.

7.3.3 Communication and Engagement

Lack of effective communication and public engagement featured prominently in the 3 data phases as one of the major barriers to effective recycling participation in the borough of Westminster.

Most of the resident participants in phases 1 (Section 4.2.3) and 2 (Sections 5.9 & 5.10) agreed to have received at least one type of recycling communication. Only P9 has never received any recycling communication in phase 1 data, while 7% of the respondents in phase 2 data have also received no recycling information from the council (Figure 5.11).

This corresponds to the council staff participants' statements (phase 3 data, Section 6.2.2) that they are proactively mailing recycling information (flyers, leaflets, letters, and magazines) to residents using the council tax database.

Although the council is communicating with the majority of the residents as evidenced above the reach is lop-sided by reaching the older generations more than the younger generation. This was evidenced in the result of the chi-square test between age and methods of communication in phase 2 data (Figure 5.12).

The social media that could attract the younger generation only reached 1% of the respondents (figure 5.12). This shows that social media is highly underutilised. CP2 in phase 3 data (Section 6.2.2) concurred that the recycling team's Facebook page only has 500 followers out of the 204,236-resident population (Section 1.1.1), which is less than 1% of the resident population.

The main underlying issue is the lack of overall strategic communication plans and specific engagement strategies focusing on the residents especially the younger generation (22-38 years). CP2 response to documentation requests that are specifically focused on the younger generation affirms this position.

"Additionally, a portion of Westminster students are not Westminster residents- therefore not a priority area. ReLondon has completed a report on 18-34-year-olds, about motivating young Londoners to recycle. We use this report; the council does not have their own specific documentation" (CP2-Recycling Officer).

Knickmeyer (2020) suggestion on recycling communication strategy could be used to attract the younger generation. Knickmeyer (2020) recommended that customised communication would be effective in targeting a specific audience to address some specific issues. Social media could be utilised effectively in this regard to engage the younger generation.

In terms of understanding the recycling communication received, resident participants in phase 1 (Section 4.2.3) did not raise many issues with comprehending the recycling information with the exception of P11 who suggested that the recycling information should be in the top 5 languages spoken in the borough to reflect the diversity of the residents. In phase 2 data (Section 5.10), the degree of recycling information comprehension was influenced by the level of education. This is evident from the result of the chi-square test (Table 5.9) where the percentages of the respondents with a higher educational qualification is higher than the percentages of respondents with a lower educational qualification in understanding the recycling information. Thus, there is a need to simplify the recycling information to make it easy for all residents with various levels of education to understand. In addition, as suggested by Meneses (2006), recycling information could utilise multiple learning models to accommodate various educational needs among the target audience.

Accounts of effective engagement were narrated in phase 1 data (Section 4.2.3), especially by P11 who became an active and passionate recycler through attendance of one recycling event. But the results from the larger sampled population in phase 2 data (Figure 5.14) show that only 5% of the respondents attended recycling events before the pandemic and 85% are not aware of these events.

This shows a disparity between 93% of the respondents that have received recycling communication and 85% of the same sampled population who are not aware of the council recycling events. A quick check of the council copy of the recycling communication (Figure 5.15) shows no advertisements about recycling events but only simple information on how to recycle.

In general, results from the 3 data phases indicate that a lack of effective communication and engagement strategy on the part of the council is creating a barrier to the residents in terms of age and level of education differences among the residents. Also, the council is not fully utilising the existing communication channels to promote recycling events that will encourage more resident participation in recycling activities. Oluwadipe et al. (2021) stated the urgent need for local authorities to shift from wholly traditional communication approaches to varied contemporary methods of communication to increase recycling participation among the diverse residents' base.

7.3.4 Service Constraints

The service constraints from the 3 data phases include infrequent collection of mixed recycling, recycling bags accessibility issues, non-collection of some plastic materials based on the different recycling regimes, and lack of food waste collection service (prior to the commencement of food waste service in 2022).

Resident's participants in phases 1 and 2 data cited all the service constraints mentioned above as barriers to effective recycling. In phase 1 (Section 4.2.5), the resident participants stated that the infrequent collection of mixed recycling is causing mixed recycling to be placed in the rubbish bins, because the rubbish bins are collected more frequently than the mixed recycling bins. Therefore, causing the loss of considerable volume of recyclable materials, which could account for the borough low recycling rate. An increase in recycling collection frequency for residents in such a situation would cut the loss of recyclable materials to rubbish collection (Jatau et al., 2020; Tsalis et al., 2018).

Phase 1 (Section 4.2.5) participants also commented on the difficulties in accessing the council recycling bag during the COVID-19 pandemic for some participants and outside the pandemic for some. They also showed great interest to recycle food waste but could not, because the food waste service was not available then.

In phase 2, 33% (Figure 5.9) of the respondents want the council to increase the collection frequency for mixed recycling which indicates the infrequent collection of mixed recycling is an issue. Furthermore, 12% (Figure 5.2) of the respondents stated that easy access to recycling bags will enable them to recycle effectively, while 9% (figure 5.8) of the respondents do not know how to request recycling bags from the council.

In terms of impact on types of residence, the chi-square test result (Table 5.5) established a significant relationship between the type of residence and recycling bag accessibility, where high rises have the highest percentage of respondents having accessibility issues to recycling bags than houses.

This is important considering that 75% of the respondents live in high rises which are close to 70% of the housing stocks that are high-rises in Westminster (Appendix J). Still, in phase 2, 70% of the resident participants would like to participate in the food waste service, but 44% of this group do not have enough storage space to accommodate the service (Figure 5.10). This result corroborated the phase 1 resident participants desire for food waste service.

In terms of age distribution (Table 5.7), the desire for food waste service is higher for the younger generation (56%) than the older generation (37%). This chi-square test result (Table 5.7) showed a significant relationship between age and food waste collection contrast with different conclusions on studies relating to age influence on recycling behaviour. Du Toit and Wagner (2020) study concluded that the older generation is more likely to participate in recycling activities than the younger generation. While Dai et al. (2017) in their study, concluded that age has no substantial effect on recycling behaviours.

The difference in research outcomes on recycling behaviours is stemmed from the complexity of human behaviour which is determined or affected by other different underlying factors which may or may not be localised (Klockner and Oppedal, 2011).

This is because the study by Du Toit and Wagner (2020) focuses on mixed recycling in general while this chi-square test result only tested for food waste recycling. The older generations in this study may dislike food waste service due to other factors such as odour and rodents, which may not bother the younger generation. However, the descriptive data on mixed recycling behaviour (phase 2) without any statistical test (Figure 7.1) indicates that the millennials (22-38 years) recycle less than the older generation (over 55 years). This meant that 84% of the millennials sampled always recycle compares to 93% of the sampled older generation that always recycles. Therefore, agreeing with Du Toit and Wagner (2020) study.

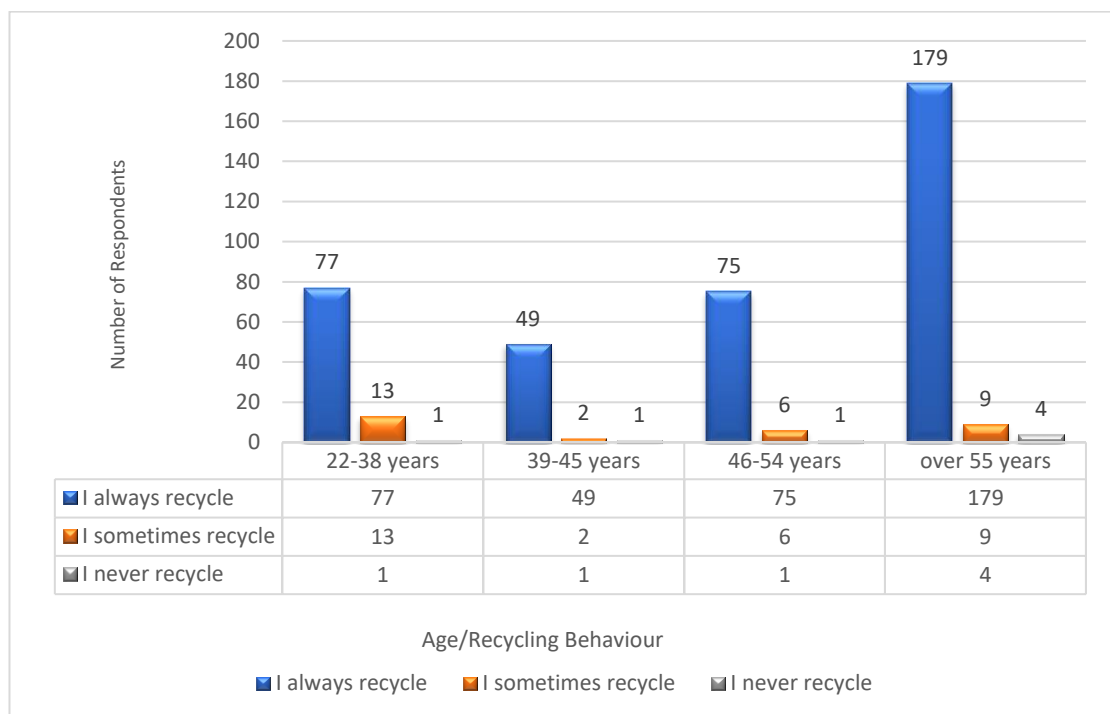


Figure 7.1: The descriptive data on mixed recycling behaviour (phase 2) without any statistical test indicating the number of respondents and their recycling behaviour across the age groups.

The staff participants in phase 3 data (Section 6.2.7) differ and argued that food waste service is now available, that there are a variety of ways of requesting the recycling bags (through email, council website, telephone, and libraries), and that the council collection frequency compared to other local authorities is better. Therefore, they do not consider these three issues to be barriers to recycling activities in Westminster. But they do agree that the different recycling regimes operated in different boroughs are a service constraint. This is because the 30% transient population of Westminster may not be conversant with the borough recycling scheme which may cause issues when carrying out recycling activities.

In general results from the 3 data phases indicate service constraints as a barrier to recycling activities even though staff participants in phase 3 data disagree with some service constraints. The current implementation of the food waste service in the borough has the potential to increase the council recycling rate.

Since the council depends on the residents to carry out effective recycling activities, it is paramount that the council listen to the residents on issues relating to recycling bag accessibility and infrequent mixed recycling collection to further boost the borough recycling rate.

7.3.5 Policy Constraints

The policy constraints identified in the three data phases are more aligned with the national waste legislation than the council's local policy on waste management. These constraints are indicated in Table 7.4. Table 7.4 should be referred to, throughout this section for reference.

Table 7.4: Policy constraints stated by the participants in each phase and the various sections where they are located.

Policy Constraints	Phase 1 Data (Residents Participants)	Phase 2 Data (Residents Participants)	Phase 3 Data (Council Staff Participants)
Labelling format for packaging materials	Section 4.2.6	Section 5.2	
Banning packaging materials that are not recyclable	Section 4.2.6	Section 5.13	
Non-uniformity of recycling regimes across the country in terms of recyclable materials collected and bin design	Section 4.2.6	Section 5.13	Section 6.2.8
Legislation to hold landlords responsible for mixed recycling in their properties and Make recycling compulsory for householders	Section 4.2.6	Section 5.13	Section 6.2.8
Method of calculating recycling rate for local authorities			Section 6.2.8
Political Agenda			Section 6.2.8
Waste Enforcement			Section 6.2.8

The labelling format of packaging materials was identified as a barrier in phase 1, which agrees with the Bening et. al. (2021) study who cited inadequate labelling framework for packaging materials as a barrier to recycling activities. Bening et. al. (2021) further stressed that consumers of packaged goods are confused by the ambiguous labelling information to determine whether a packaging material is recyclable or not.

Non-uniformity of recycling regimes across the country in terms of recyclable materials collected and bin design is a consistent policy constraint across the 3 data phases. Both the residents and council staff participants agreed on this barrier. While banning non-recyclable packaging materials was more common with the resident participants in phases 1 and 2.

Phase 2 data (Figure 5.19) indicates that 39% of the respondents want the government to ban non-recyclable packaging materials and 27% of the respondents want the government to legislate on a national uniform recycling system to eliminate confusion created by the current non-uniform system.

Resident participants in phase 1 and staff participants in phase 3 agreed on making recycling compulsory for householders, while resident participants (22% - Figure 5.19) in phase 2 prefer legislation that will make it compulsory for landlords to provide recycling storage in their properties. Such legislation will ensure adequate storage capacities are provided both internally and externally for mixed recycling and eliminate the loss of mixed recycling to rubbish collection.

Phase 3 council staff participants emphasise on lack of political will to legislate tough waste legislation that will increase recycling because it may have a detrimental impact on the economy and therefore, deprive the local authorities of the much-needed powers to carry out enforcement actions against non-recyclers. Bartl (2014) agreed with this assertion and argued that the waste reduction initiatives negates economic interests of various interested parties such as the government, investors, and producers. This creates a dilemma that can only be resolved through strong political will.

More importantly, they also lamented the method of calculating the annual recycling rate that provided an unfair advantage to boroughs in rural areas over the urban boroughs. The impact of the current method of calculating the recycling rate is that it is hiding the true picture of the recycling rate and therefore not reliable as recounted by the staff participants in phase 3.

In general, results from the three phases have identified waste legislation constraints as one of the major barriers to recycling activities in Westminster. As suggested by Li and Wang (2021), future waste legislation formulation must be aligned with public behaviours and perceptions to achieve high public participation in recycling activities. It is noted that this intervention is beyond the remit of Westminster borough, but the borough can form a pressure group with other local authorities to lobby the central government for these changes to waste legislation.

The discussions detailed above on the 5 converged themes (human factors, physical factors, communication and engagement, service constraints, and policy constraints) indicate 4 major barriers (physical factors, communication and engagement, service constraints, and policy constraints). These 4 main factors are making up recycling barriers towards achieving a high recycling rate in Westminster. Figure 7.2 indicates the four main barriers and their relevant interventions.

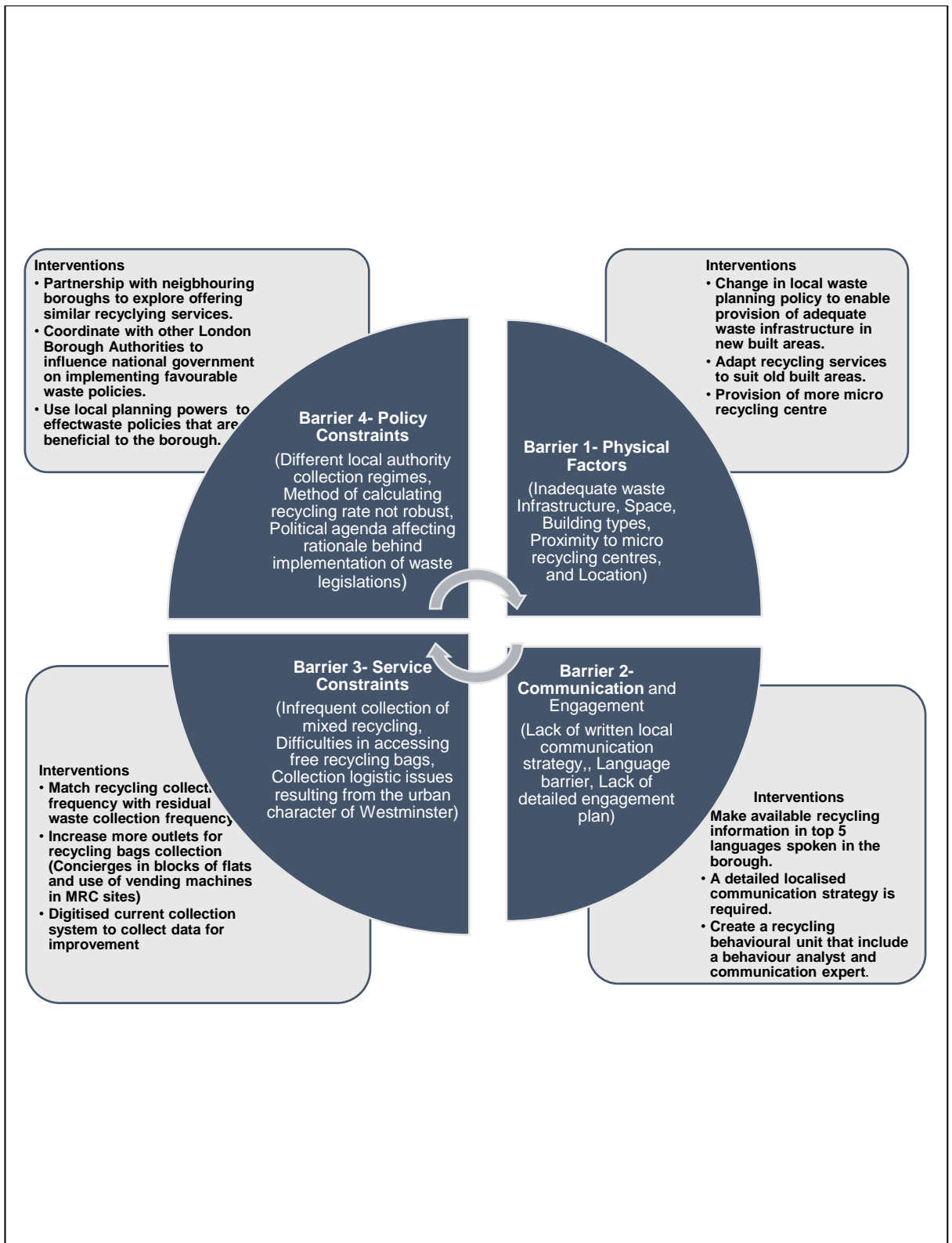


Figure 7.2: The summary of the 4 main barriers identified in the research resulting from merging the results of the 3 data phases and the various interventions to mitigate the barriers.

In summary, the results from the 3 data phases agree with Oluwadipe et al. (2021) study that waste policy constraints, lack of effective communication, and physical factors are the most important factors affecting the recycling rate in the UK.

Furthermore, the results from this research also pinpoint service constraints as one of the additional major barriers. It can then be argued that service constraints being one of the main barriers in Westminster is due to the localised effects such as the transient population, types of buildings, and narrow roads.

Spoann, et al. (2018) suggested that the quality of recycling services can be improved through infrastructure redesign, skilled workforce, and adapting equipment (in this case refuse collection vehicles) to deliver positive outcomes. Whiteman et al. (2021) share the same view in their categorisation of development bands (DBs) for sustainable waste management. They suggested within DB3 that standards of collections need to be prioritised to reinforce physical infrastructure to ensure local and national capacity building.

With regard to policy constraints, Whiteman et al. (2021) highlighted that current national waste policies in many countries are based on using fiscal instruments and obligations on local authorities to manage waste disposal, which has not made effective gains. They suggested that using policy to make a mandatory change in technical specifications would be more effective than using fiscal instruments and obligations. This recommendation is relevant to resolve the issues within infrastructural barriers and service constraints.

In terms of physical factors, the result agrees with many studies (Strydom, 2018; Nunkoo, et al., 2021; Timlett and Williams, 2009; Timlett and Williams, 2011) that have indicated physical factors as a main barrier or one of the main barriers in achieving effective recycling participations. The physical barriers identified by this research include inadequate waste infrastructure, lack of space for storage, building types, and proximity to micro recycling centres.

Communication and engagement barriers identified in Westminster include lack of written local communication strategy, language barrier, and lack of detailed engagement plan. Studies carried out by Satapathy (2017) and Lee (2020) identified a lack of effective communication and public engagement as a factor affecting recycling activities. Satapathy (2017) specifically identifies language barrier as a factor that can prevent awareness about recycling service. While Lee (2020) emphasises the importance of public engagement as a recipe to achieve zero waste economy through knowledge building and awareness of the public.

7.4 PDCR Model (Policy and Regulation, Drivers, Change and Recycling)

Findings from the research allow a PDCR (Policy and Regulation, Drivers, Change and Recycling) model (Figure 7.3) and a sustainable recycling indicator (Figure 7.4) to emerge, in dealing with the council's stagnant recycling rate, which is common with the most urban areas with a high density of flatted properties. This PDCR model (developed by the researcher) is built upon the ISB (Infrastructure Service Behaviour) model developed by Timlett and Williams (2011).

It is important to view the ISB model as the segmented part of the whole intervention process to improve the recycling rate. Infrastructure, service, and behaviour are not sufficient factors to increase the recycling rate but rather, they are part of the process to increase recycling output.

The PDCR model, on the other hand, gives a comprehensive approach starting from the policy and regulation, as the first tier of intervention to the ultimate result or product of a high recycling rate.

7.4.1 Policy and Regulation

For waste policy and regulation to be effective, there is a need to recognise all the stakeholders involved in recycling, their collective impacts, and obligate each stakeholder with some specific connecting duties to facilitate an effective recycling regime. The following four main stakeholders are identified, the regulators (Defra, Environment Agency, and the local authorities), goods and product manufacturers, the landowners (developers and landlords), and the end-users (householders).

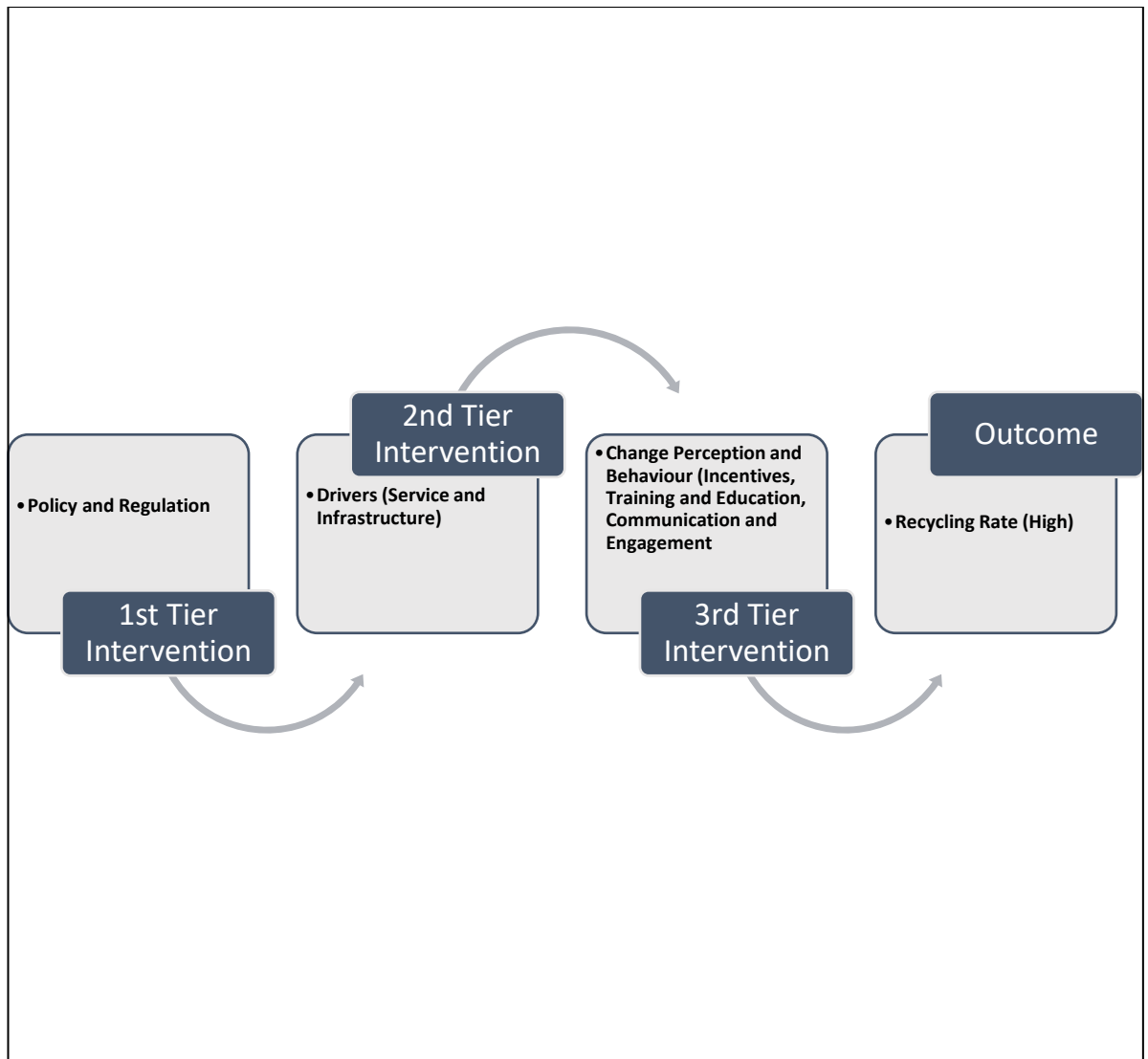


Figure 7.3: The PDCR model showing the workflow of connecting intervention steps required from policy design to changing householder’s behaviour in achieving a high recycling rate.

The missing link between the current waste regulation and the proposed framework is that the waste duty of care (Section 75 of the Environmental Protection Act, 1990) obligates householders to some general waste duties of care. None of these duties includes a requirement to segregate recyclable materials from rubbish or to recycle their waste. There is a need to include this requirement within the Environmental Protection Act.

In order to increase recycling output from households, the national government should consider this radical approach and make householders solely responsible for their waste disposal through direct charging of waste disposal or positive incentives (e.g., council tax discount). The direct charging model should be based on paying no charge for mixed recycling and food waste and a charge for rubbish disposal based on volume, in order to nudge the householders to recycle more of their waste. This approach worked in the case of the plastic bags charge that has cut its use drastically (HM Treasury, 2018) because of the direct economic impact on individual households.

The second missing link is that there is no requirement for developers and property owners in the current waste legislation to provide adequate internal and external storage facilities to facilitate recycling activities. There is a need for the integration for both development planning regulation and waste regulation to address the gap in waste infrastructure in residential buildings. In addition, the proposed framework should also consider banning non-recyclable packaging materials to accelerate the implementation of a zero-waste economy.

7.4.2 Drivers (Service and Infrastructure)

One of the functions of waste regulation is to place duties on local authorities to put in place services and relevant infrastructure to support a circular economy. A uniform national recycling regime would avoid confusion for transient residents in terms of bin labelling formats and colours for different waste streams.

Provisions of adequate recycling centres, collection of food waste, increased frequent collection for mixed recycling, readily available recycling bags, clear labelling information on bins, and distinct colours for receptacles storing different waste streams are the enabling factors that will make it easy for residents to recycle.

The Deposit Return Schemes (DRS) in the EU member states are good case studies. Legislation on DRS in some of these countries requires mandatory deposit return for drinks containers, and the policy was backed with adequate DRS collecting machines installed widely all over these countries. Thus, making it easy

for consumers to access and use, consequently resulting in a high return rate and recycling rate (European Parliament, 2011).

7.4.3 Change (Perception and Behaviour)

The next process or intervention within the PDCR is then to engage the public through effective communication, awareness programmes, public engagement, and the use of incentives. Since human behaviour is a continuously changing phenomenon, there is a need for local authorities to adjust communication styles, and approaches to suit the changing population. The use of contemporary communication media is therefore highly recommended to target the younger generation, to initiate their interest in recycling activities. This recommendation echoes Meneses' (2006) suggestion that recycling communication needs to be designed to target different audience groups.

We live in a world where the majority are influenced by role models in sports, acting, and internet influencers. Local authorities should capitalise on such inclinations to nudge the residents towards positive recycling behaviours.

The research also shows that the use of incentives is not very much popular with the respondents (that always recycle) but popular with respondents that sometimes or never recycle. This result is similar to Li et al. (2021) findings that consumers with environmental awareness of recycling benefits are not motivated by financial incentives, but consumers that lack this environmental awareness are motivated financially to recycle. Therefore, financial incentives or other incentives can be used for the minority of the Westminster population that are induced by incentive schemes.

7.4.4 Recycling Rate

A high increase in recycling output can only be achieved (as indicated in the triangulation results, section 7.2), when an effective waste policy can enable efficient service, and require waste infrastructure to be in place, to facilitate effective recycling activities. In addition, a well-formulated communication and public engagement strategy would influence the residents to recycle, which then provides an opportunity to achieve a high recycling rate.













7.5 Sustainable Recycling Indicator

A composite sustainable recycling indicator (Figure 5.3) was devised based on the research results from the 3 phases. The sustainable recycling indicator (SRI) developed from this research is a novelty idea in relation to household recycling output within the waste management industry. The existing waste indicators which are detailed in section 1.3 are not applicable to monitor the yearly household recycling rate to improve recycling performance and output.

Wang et. al., 2017 and Fontana et. al., 2020 argued that although a novelty idea would have been drawn from the experiences of existing ideas, what determines its novelty is the combination of new knowledge to design the new idea. The use of indicators generally is an existing idea, but the new knowledge arising from this study (triangulated results) has been used to design an SRI (new idea) that is applicable to monitoring household recycling rates.

The SRI is very important in contributing to new knowledge and providing a solution to urban local authorities struggling with their low recycling output. It provides a strategy for monitoring the recycling enabling factors and a course of action to make effective or available any enabling factors that are a barrier to recycling activities. In terms of impact, the implementation of the SRI would facilitate easy recycling activities (to increase residents' participation) that will consequently lead to a high recycling rate for the borough.

In developing the composite sustainable recycling indicator (SRI), the proposed interventions for the various barriers (identified from the research data) were used as enabling factors to classify the recycling rate into three main groups: low, medium, and high.

Categories	Recycling Rate	Enabling Factors (EF)											
													
		Residents Peculiar Situations	Education and Environmental Awareness	Clear Packaging Labelling	Clear Bin Labelling and Colour	Internal Source Segregation	External Recycling Facility	Recycling Bag Accessibility	Separate Food Waste Collection	Public Recycling Centres Proximity	Recycling Collection Frequency	Communication	Public Engagement
A	High	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	
B	High	Green	Green	Yellow	Yellow	Green	Green	Green	Green	Yellow	Green	Green	
C	Medium	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	
D	Medium	Yellow	Yellow	Yellow	Yellow	Green	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	
E	Medium	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Green	Yellow	Yellow	
F	Medium	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Green	Yellow	Yellow	
G	Medium	Green	Green	Green	Green	Green	Green	Green	Yellow	Yellow	Yellow	Yellow	
H	Low	Red	Red	Red	Red	Green	Green	Green	Green	Green	Red	Red	
I	Low	Green	Green	Yellow	Yellow	Green	Red	Yellow	Red	Yellow	Red	Yellow	
J	Low	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	

Recycling Rate Key	
Rate	Percentage
Low	≤39%
Medium	40% - 59%
High	≥60%
Enabling Factors Key	
Not Available/Effective - Red	
Less Available/Effective - Yellow	
Available/Effective - Green	

Figure 7.4: Composite sustainable recycling indicator (SRI) designed based on this study’s findings displaying variety of enabling factors required to increase recycling rate.

7.5.1 Sustainable Recycling Indicators Categories

The SRI enabling factors are defined as available, somehow available, or not available depending on their availability or effectiveness in facilitating recycling output. The different outputs are then categorised into ten divisions from A to J.

The categories were developed using the results of the research to pinpoint areas or factors affecting the council low recycling rate. In essence, the categories are a stepwise strategy towards achieving a high recycling rate.

Basically, if all the enabling factors are green then the recycling output will be high (Category A) and if all the enabling factors are yellow then the recycling rate will be medium (Category C). Similarly, if all the enabling factors are red, the recycling

output will be low (Category J). These are the three basic categories. Additionally, there are other different category variations depending on the different availability of the enabling factors and the actual recycling rate within the spectrum.

The recycling rate is ranged to include different variations of the recycling outputs of high, medium, and low.

Category A

Category A has a high recycling rate because all of the enabling factors are green, which makes them available and effective. The recycling rate will be at high percentages $\geq 60\%$.

Category B

Category B has a high recycling rate but not all the enabling factors are available green, which makes three enabling factors to be somehow available or effective. The recycling rate will still be in the range $\geq 60\%$.

Category C

Category C has a medium recycling rate where all the enabling factors are yellow, which makes them to be somehow available or less effective. The recycling rate will be in the range of 40% to 59%.

Category D

Category D has a medium recycling rate where most of the enabling factors are yellow which makes them to be somehow available or less effective. Only five enabling factors are green. The recycling rate will be in the range of 40% to 59%.

Category E

Category E has a medium recycling rate where most of the enabling factors are yellow which makes them to be somehow available or less effective. Only three enabling factors are green. The recycling rate will be in the range of 40% to 59%.

Category F

Category F has a medium recycling rate where half of the enabling factors are yellow, and the other half is green. The recycling rate will be in the range of $\leq 40\%$ to 59%.

Category G

Category G has a medium recycling rate where more than half of the enabling factors are green, and the remaining are yellow. Although similar to category F, the enabling factors that are green in category F are yellow in Category G and vice versa. The recycling rate will be in the range of 40% to 59%.

Category H

Category H has a low recycling rate where the two important enabling factors are red, and the remaining enabling factors are green. The recycling rate of this category will be $\leq 39\%$.

Category I

Category I has a low recycling rate where the enabling factors are a combination of green, red, and yellow. The recycling rate will be $\leq 39\%$.

Category J

Category J has a low recycling rate where all the enabling factors are red, and this category has the lowest recycling output. The recycling rate will be $\leq 39\%$.

As an example, the Westminster City Council is in Category I on the composite sustainable recycling indicator. The composite sustainable recycling indicator is based on the results from this study research and literature reviews. This is based on the council's current recycling rate of 24% (2020/21) and the respondents' responses.

Initially, as a course of action, the council would need to try to achieve category G before moving to category B or A. Therefore, an initial target of around 45% needs to be set for the next 10 years. This recommendation is in line with the council waste strategy, which aims to increase the recycling rate to 35% by 2020, 40% by 2025, and 45% by 2031.

Table 7.5 below indicates the definition of the availability and the effectiveness of the enabling factors. This can be used as a reference table to allocate the category in the indicator against recycling output or rate. The essence of the SRI is to help determine the current situations with regard to barriers faced and then use it to plan improvement to achieve a high recycling rate in phases.

Table 7.5: Definition of availability and effectiveness of each enabling factor within the sustainable recycling indicator.

Definition of Availability and Effectiveness of Enabling Factors	Available/Effective	Somehow Available/Less Effective	Not Available/Not Effective
Residents Peculiar Situations	This refers to residents' motivation and attitude to recycling. If the resident is highly motivated and exhibits a positive attitude to recycling. This enabling factor is available and effective	If the residents are not highly motivated but nudged slightly by incentives to conduct recycling, or they exhibit a lukewarm attitude towards recycling activities This enabling factor is less effective	If the residents are not motivated at all to recycle and display negative attitude to recycling activities, the enabling factor is not available
Education and Environmental Awareness	This enabling factor is effective or available if most of the residents are highly educated or have high degree of environmental awareness	This enabling factor is somehow available if most of the residents have lower educational qualifications or have low degree of environmental benefits of recycling	This enabling factor is not available if most of the residents have no educational qualifications or no awareness of environmental benefits of recycling
Clear Packaging labelling	This enabling factor is effective if the recycling information on the packaging labels are noticeably clear with no ambiguity	This enabling factor is less effective if the packaging labels although may contain recycling information, the information is not enough to make a right decision	This enabling factor is not available if the packaging label contains no recycling information
Clear Bin Labelling and Colour	This enabling factor is effective if the recycling information on the bin labels are noticeably clear and legible with no ambiguity and different waste streams bins have distinct colours	This enabling factor is less effective if the bin labels are clear but not legible and the bins for different waste streams have the same colours	This enabling factor is not available if the bin labels are not clear, not legible and the bins are in the same colour








Definition of Availability and Effectiveness of Enabling Factors	Available/Effective	Somehow Available/Less Effective	Not Available/Not Effective
Internal Source Segregation	This enabling factor is available if there are adequate internal space to allow two or more separate storage of segregated waste streams	This factor is somehow available if there are no adequate internal space for two bins, but residents still manage to store recycling in a makeshift recycling bag and have bin for rubbish	This factor is not available if there is no adequate internal space, and residents only have one bin for both recycling and rubbish
External Recycling Facility	This enabling factor is available if there are adequate external space to allow two or more separate storage of segregated waste streams	This factor is somehow available if there are no adequate external space for two bins, but residents still manage to leave full recycling bag on the pavement for collection and have external bin for rubbish	This factor is not available if there is no adequate external space, and residents only have one bin for both recycling and rubbish
Recycling Bag Accessibility	This enabling factor is available if the recycling bags are easily accessible when needed with no waiting time for recycling bag to arrive	This factor is somehow available if the recycling bags are not easily accessible and there is a waiting time for the bags to arrive	This factor is not available, if the residents are not aware of how to access the recycling bag and requests for bags are not completed within the agreed waiting time
Separate Food Waste Collection	This enabling factor is available if there is a food waste collection service and there is storage space to store food waste	This enabling factor is somehow available if there is a food waste collection service but there is no storage space to store food waste	This enabling factor is not available if there is no food waste collection service and there is no storage space to store food waste
Public Recycling Centres Proximity	This enabling factor is available if the public recycling centres are widely available in all the wards and easily accessible for resident's use	This enabling factor is somehow available if the public recycling centres are not widely available in all the wards, and it is not easily accessible for resident's use	This enabling factor is not available if there are no public recycling centres for resident uses

Definition of Availability and Effectiveness of Enabling Factors	Available/Effective	Somehow Available/Less Effective	Not Available/Not Effective
Recycling Collection Frequency	This enabling factor is available, if the mixed recycling materials are collected more than twice a week	This enabling factor is somehow available if the mixed recycling materials are collected twice a week and rubbish is collected up to four times a week	This enabling factor is not available if the mixed recycling materials are collected once in a week and rubbish is collected more than twice a week
Communication	This enabling factor is effective, if social media are used heavily in addition to the traditional communication methods to communicate recycling information to the residents	This enabling factor is less effective if social media are under- utilised. But the traditional communication methods are used heavily to communicate recycling information to the residents	This enabling factor is not effective, if social media are not used at all. And efforts are only concentrated on the traditional communication methods
Public Engagement	This enabling factor is effective, if the public engagement activities are very popular with residents coupled with high attendance. Also, if the public forums are organised online in addition to physical attendance at organised events.	This enabling factor is less effective if the public engagement activities are not well-publicised resulting in low attendance. Also, if the public forums are not organised online in addition to physical attendance at organised events.	This enabling factor is not effective, if the public engagement activities are not extremely popular with residents. Also, if the public forums are not organised online in addition to physical attendance at organised events.

7.6 Use and Application of the Sustainable Recycling Indicator

The composite SRI in Figure 7.4 detailed all possible scenarios (10 categories) of recycling rate that emerged from the research results. However, the composite SRI cannot be applied for local authority use because some of the enabling factors are not within their powers to legislate. Additionally, the composite SRI is too complex to use, as some of the categories may not be applicable to all or some of the local authorities.

Therefore, a simplified SRI indicated in figure 7.5 shows the 3 basic categories that can be applied to increase the recycling rate. The simplified SRI is highly flexible, streamlined, and adaptable, where the enabling factors can be substituted or added to suit local needs.








Categories	Recycling Rate	Enabling Factors (EF)						
								
		Education and Environmental Awareness	Clear Bin Labelling and Colour	Adequate Internal Storage to Segregate Waste into three Streams	Adequate External Recycling Storage outside properties	Recycling Bag Accessibility	Public Recycling Centres Proximity	Increased Frequency for Recycling Collection
A	High							
B	Medium							
C	Low							

Recycling Rate Key	
Rate	Percentage
Low	≤39%
Medium	40% - 59%
High	≥60%
Enabling Factors Key	
Not Available/Effective - Red	
Less Available/Effective - Yellow	
Available/Effective - Green	

Figure 7.5: Simplified sustainable recycling indicator (SRI) to be used in conjunction with the flow chart shown in figure as a functional tool to increase recycling rate.

In adopting the simplified SRI for use, local authorities will need to follow the steps detailed below. Initially, local authorities should first assess their current situations.

Also, new enabling factors can be added or substituted to ensure a bespoke model that suits the local authorities' needs or situations. In addition, the current recycling rate of the local authority should be compared to the recycling rate key within the SRI. This is to determine if they fall within B (medium) or C (low) categories. For example, the current assessment of the enabling factors and the recycling rate of Westminster City Council on the simplified SRI is shown in Figure 7.6 as a guide.

Categories	Recycling Rate	Enabling Factors (EF)						
								
		Education and Environmental Awareness	Clear Bin Labelling and Colour	Adequate Internal Storage to Segregate Waste into three Streams	Adequate External Recycling Storage outside properties	Recycling Bag Accessibility	Public Recycling Centres Proximity	Increased Frequency for Recycling Collection
C	Low (24%)	Green	Red	Green	Red	Yellow	Yellow	Red

Recycling Rate Key	
Rate	Percentage
Low	≤39%
Medium	40% - 59%
High	≥60%
Enabling Factors Key	
Not Available/Effective - Red	
Less Available/Effective - Yellow	
Available/Effective - Green	

Figure 7.6: An example of Westminster Council current rating on the simplified SRI after initial assessment showing the first step of using the model as a functional tool to increase recycling rate.

After the current assessment has been carried out on the simplified SRI, the local authority can then use the flow chart (Figure 7.7) to plan further interventions to make green, any enabling factor that is red or yellow. The flow chart in Figure 7.7 shows the detailed process of how to use the simplified SRI, as a functional tool in setting meaningful targets to increase any local authority recycling rate.

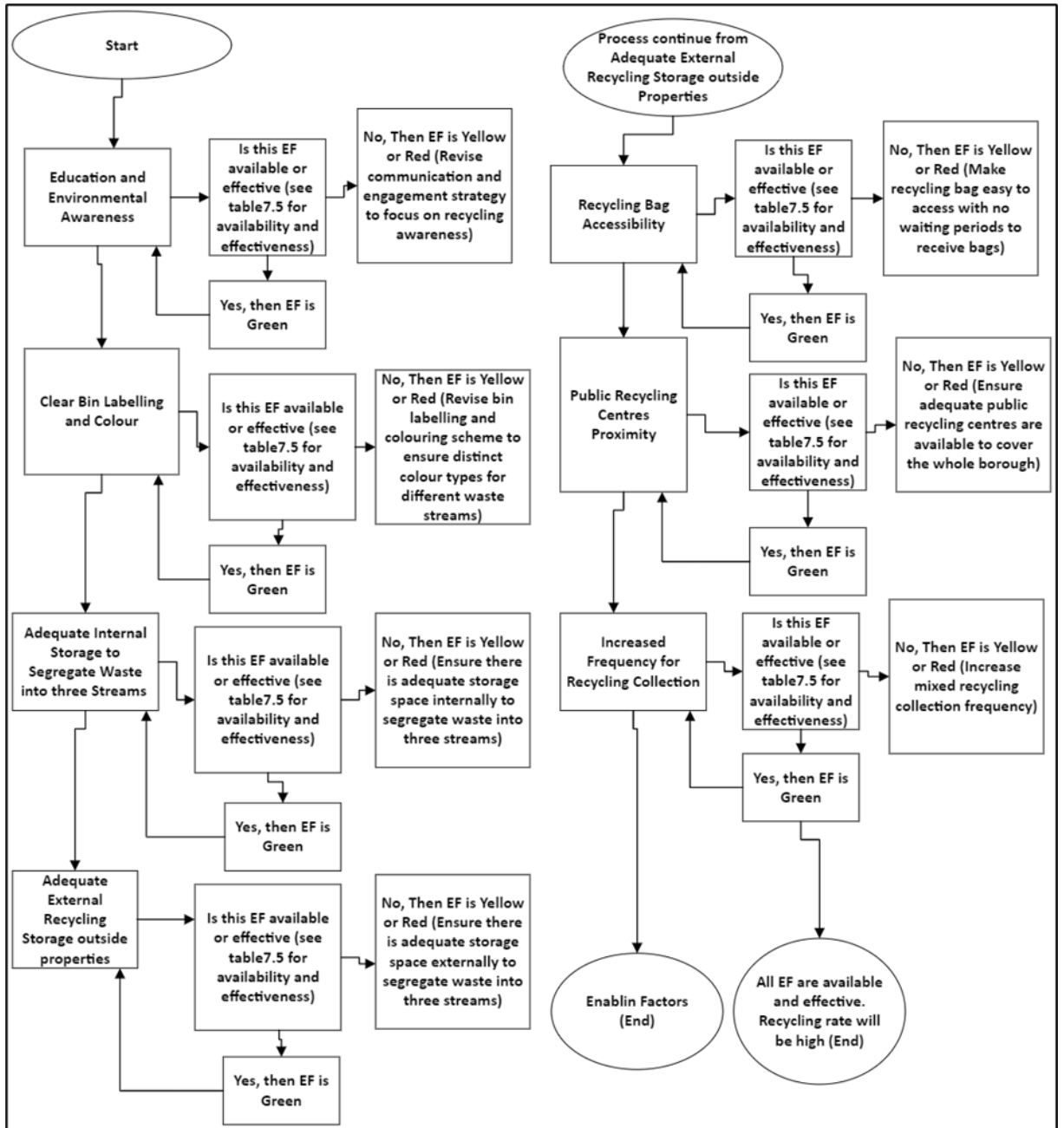


Figure 7.7: Sustainable Recycling Indicator (SRI) flow chart process to increase recycling rate using enabling factors (EF).

7.7 Data Limitation

The Coronavirus Pandemic of 2019 greatly influenced resource limitations on how data was collected. One of such limitations was the inability to conduct face-to-face interviews rather telephone and online media were used. Face-to-face interviews would have provided more individualised touch and more engagement with the participants. In addition, the self-completed questionnaire data collected was more biased toward certain age groups and levels of education. This anomaly was corrected by adjusting the data to the true population using the baseline data from the UK population census data.

Type of residence data collected from the self-completed questionnaire did not include data on other types of accommodations such as boat houses and hostels. The baseline data was revised to exclude these other types of accommodation. The research data only considered houses and flatted properties that were the main form of habitation.

In modifying the self-completed questionnaire data, primary school education was excluded for analysis purposes because the response percentages were less than 1%. Also, in the ONS data, the 'No Qualification,' apprenticeship and 'Other Qualification' percentages were excluded because they were not sampled. The survey data also relied on the baseline census data taken in 2011 because the latest census carried out in 2020 was yet to be published at the time of authoring this report.

The data collected from the residents' participants were limited in scope in terms of recycling behaviour. Most of the participants exhibited good recycling behaviour while there is a small number of participants that do not recycle. More numbers of residents that do not recycle would have provided more insight into the barriers faced by this group. Therefore, the behavioural attitudes of non-recyclers were not captured in this research.

However, it can be argued that if the active recyclers are facing situational barriers to recycle effectively, then the non-recyclers would even be facing more difficulties to participate in recycling activities. The emerged barriers facing the active recyclers can, therefore, be used as a profile to improve recycling services offered to the residents.

Phase 1 results were used to design the self-completed questionnaire (phase 2 data). It could then be argued that any result generated from phase 1 will reflect the results of phase 2. Also, all the barriers revealed in phase 1 results matched the barriers identified in phase 2. However, the analysis of phase 2 data provides more information about the distribution of age, types of residence and level of education with regard to the participants' recycling behaviours. Data from phase 3 mitigated the limitation identified above by giving different perspectives from the council staff managing the recycling service. Therefore, meaningful triangulation was affected by converging the results from the 3 phases.

Finally, the number of staff interviewed was small. This was due to limited resources and the availability of time and staff to conduct more interviews. Interviewing more staff would have provided more information about how the teams involved in recycling service interact and collaborate with each other in the delivery of the recycling service.

7.8 Research Limitation

There were some research limitations due to time constraints and restrictions during the Coronavirus pandemic. This meant that the planned observation of recycling collection rounds with the collection crew was not feasible. This would have allowed observations of the state of recycling bins in both houses and high rises to obtain first-hand information.

Additionally, the site observations of the micro recycling centres (MRCs) carried out were not rigorous due to time constraints during the Coronavirus pandemic. Furthermore, such data would not have reflected the usual usage of the MRC (outside the pandemic) due to staying at home regulations. Therefore, a decision was made not to use the MRCs observations data.

The council staff interviewed in phase 3 were known to me because we work in the same council. Financial constraints meant that an assistant researcher could not be hired to conduct phase 3 interviews to make the interviewees more comfortable with providing more information.

7.9 Academic Contribution of the Research

The research has provided significant information relating to local recycling barriers to the existing body of literature in this area. More importantly, a sustainable recycling (SRI) indicator has been developed which can evolve into a standard sustainable recycling indicator used worldwide. Till date, there is no such indicator in place to systematically advance an increase in the recycling rate and the SRI developed can be used as a benchmark for future SRI developments. Thus, this research has open ways for further research in this regard.

One paper (Appendix A1) has been published in journals about the research to disseminate knowledge that could be beneficial to other current or future research on recycling barriers. The first paper (Appendix A1) has already been cited by 11 published papers (Appendix A2) on an international level (in the UK, EU, Indonesia, and Kazakhstan) within one year of publication. Thus, making substantial academic contributions in sustainable management of household waste. Work is going on to publish the second paper that will detail the research results and recommendations.

Additionally, the research has contributed to the waste policy decision-making process in the EU. One of the papers that cited the first research paper was a technical report written by researchers (Cristóbal et. al., 2022) from the European Commission's Joint Research Centre (JRC). The technical report was an evidenced-based scientific report to support the European Union policy process in future waste legislation. It could then be argued that the research findings have supported the regional future waste policy process in Europe.

The rigour with which the research was conducted in terms of the use of mixed methods, consistency in the methods used, accurate representation of the population studied and the triangulation of results from 3 different data phases has established confidence in the findings. These findings have challenged the current thinking that recycling barriers are always general in any given area, but rather additional localised factors can also be limitations to recycling activities.

7.10 Research Evaluation and Positionality

Research evaluation provides useful insights into how the research was carried out in terms of using a robust methodology, process and means of achieving accurate data and research outcomes. It details the reflexivity of the researcher in weighing actions to moderate or eliminate biases towards the project. Additionally, it is a transparent medium for detailed research data limitations that will be useful for readers when making judgements on research outcomes.

In terms of positionality to the research, I will consider myself as an outsider with regard to the residents' participants and the recycling services rendered by the recycling team. However, I am an insider researcher with insights into how waste policy relates to the provisions of storage facilities in buildings in the local waste management policy.

Therefore, my current role as a waste project officer is an interface role between policy design and the operational side of policy implementation. This means I am well-positioned to identify issues in waste policy design that may affect its implementation or the operational phase. This has provided a unique opportunity to influence changes that will increase the council's recycling rate. My positionality in this regard has facilitated outcomes that will make this objective possible.

7.11 Reflection on Research Process

The idea of reflexivity is for the researcher to acknowledge the impact of his own influence and external influences on the work setting. In other words, reflexivity is a self-appraisal method of your consciousness and relationship to others to determine the research implications of your work. (Costley et al., 2010).

It can be deduced from Costley et al. (2010) definition that reflexivity is the ability of a researcher to look inwards and subject their thoughts and intentions to critical evaluation of any biased tendency or inclination that will impact or influence the research outcomes.

Some may even argue that the researcher is already biased from the onset in choosing a particular topic to research, which may be true to a certain extent. We research a topic because we feel strongly and enthusiastic about our ideas and what benefits it will bring to society. However, a researcher cannot lose oversight of the objectivity aspect of qualitative research. It is at this tipping point that reflexivity plays a vital role in moderating any biased attitude towards the project.

In summary, the reflexivity process was applied throughout my research to help avoid personal bias and help manage any impact of external influence on project intentions and outcomes. I was able to achieve this by keeping a research diary that noted my thoughts and actions, and applying lessons learnt from previous phases to new phases of the research. For example, lessons learnt from residents' interviews were applied in the staff interviews to ensure high data validity.

In terms of bias elimination, the principle of objectivity was applied rigorously in the selection of the participants and the data representation method was applied to the survey data to ensure data validity and representation.

Chapter 8 Recommendations, Future Research, and Conclusion

8.1 Recommendations

The analysis of the research data has resulted in recommendations that are grouped into local waste planning policy recommendations, recycling service recommendations, and national waste legislation recommendations.

8.1.1 Local Waste Planning Policy Recommendations

The local waste planning policy recommendations will be implemented by the planning waste unit led by the researcher using the council waste storage policy document as an instrument of implementation. The local waste planning policy recommendations will address issues related to storage facilities in developments.

Additionally, the use of planning obligations (S106) agreements will also be utilised in this policy document. Section 106 of the Town and Country Planning Act 1990 allows local planning authorities to enter into planning obligations agreements with landowners and developers as part of the granting of planning permissions for new developments. These obligations are legally binding and called section 106 agreements.

The local waste planning policy recommendations are outlined as follows:

- The local waste planning policy (council waste storage policy document) should be reviewed by the waste planning unit and revised to facilitate the provision of adequate waste storage infrastructure in developments.
- Use planning conditions to secure adequate internal and external waste storage space in permitted developments.
- The waste planning unit should use planning obligations to obligate developers to form tenants' recycling forums in high-rise properties when permitting these developments. This will provide the council with an effective network of recycling forums to facilitate effective recycling participation and engagement.
- Also, the waste planning unit should obligate landlords and house owners to include the council recycling information within the tenant's information packs for new tenants in new major developments.

- Similarly, complex major or large-scale developments should be required to employ a full-time or part-time waste management operative to coordinate and manage effectively waste generated from the developments. This will ensure excellent quality recyclable materials are captured and high recyclable output.
- S106 agreement should be used to obligate developers of complex major or large-scale developments to submit an annual waste report showing steps taken to increase recycling output and how the waste generated has been managed effectively to achieve a minimum of 70% recycling rate for residential developments.
- Developers and landowners of residential properties should be obligated to make use of tenancy agreements as a useful tool to obligate tenants to recycle properly. Clauses in the tenancy agreements can include obligations on tenants to ensure that the recycling bins are used correctly. More importantly, induction on how to use the bin store effectively should be conducted for new occupiers. This approach will result in better management of the bin store and prevent contamination of recyclable materials.

Effective Management of Communal Bin Stores

Bin stores in residential developments could be designed better to aid good human behaviours such as nudging the residents to put materials in correct bins. Developers and landowners will be recommended to use modern technologies such as CCTV and digital fob to achieve this purpose. Since all new builds now have CCTV in bin stores and digital fobs for residents to access bin stores. So, the approach is not new, but these two tools can be adapted to monitor the use of the bin store where a unique digital fob is given to each resident to access the communal bin store.

The unique digital fob should be able to record the date and time each resident is using the bin store. These data can be compared to the CCTV data to identify residents who are misusing the bin store. A gentle reminder to such residents and occupants of their signed obligation (tenancy agreement) will influence them to use the bins better in the future. The benefits of this proposal are:

- The system will ensure better bin store management in preventing dumping around the bins and identify any issues that residents may be facing in using the bin stores effectively. Developers can then proactively resolve those issues before they become problematic.
- The approach will provide data on how different types of units (1 bed, 2 beds, 3 beds) or different uses in mixed developments are generating waste in terms of usage frequency. This data can then be compared and used to plan for the number of bins required in future developments or even used to design a standard for storage capacity in developments.
- The data could be used to identify and reward residents that recycle properly.
- The approach will increase the greater responsibility of flatted property residents in using communal bin storage. A problem currently identified with communal bin storage.

8.1.2 Recycling Service Recommendations

The recycling service recommendations will be passed to the council recycling team for implementation. The recycling service recommendations will address issues related to service, communication, and engagement barriers. It should be noted that the council has now implemented a food waste collection service thereby mitigating the lack of food waste collection barrier.

Service Recommendations

- The recycling team should use the concierge services in flatted properties to distribute recycling bags for emergency uses is recommended. This will ensure constant availability of the bags while waiting for the online orders to arrive.
- The recycling team should provide a simple guide on how to use, clean and maintain the food waste caddy. This guide should be printed on the caddy. This will resolve issues with odour and rodents.

- The recycling team should document the Micro Recycling Centres (MRCs) maintenance regime and service. This document should be reviewed periodically to ensure the MRCs are maintained and serviced regularly.
- The council should use and deploy mobile recycling centres (using electric vehicles) in areas that have MRC shortages.
- The recycling team should use different bin colours for different waste streams. This will avoid confusion in using the bins.
- It is also recommended that the council should design a resilience emergency plan for recycling services to cope with future natural disasters and pandemics.
- The council should increase the range of plastic types collected. Increasing the range of plastics collected will increase the volume of recyclable materials and decrease rubbish volume. This will contribute to the increase in the council's recycling rate.
- The council should increase the installation of more micro recycling centres in the borough, especially in wards that lack these facilities using new developments as a vehicle.
- The recycling team should use spaces in the micro recycling centres to provide collection for food waste in areas where door-to-door food waste collection is difficult or challenging.
- The council should investigate the use of recycling bags made from paper (easy to recycle) or plaid woven plastic (that can be washed and re-use) to replace the current plastic recycling bags. This approach will eliminate the use of single-use plastic.

- There is a need for the council to automate the recycling collection service using geographical coordinates. This can be done in two ways. One by using onboarding gadgets mounted on collection vehicles. This can automatically record the geographical coordinates and the weight of the residential commingled recyclable bins collected. The second possibility, which is the best option, is to install smart sensors in all residential recycling bins. Data such as the geographical coordinates and weight can then be downloaded from the sensors just before collection. Data obtained from these sources will provide insights into each ward's area pattern of recycling behaviour.

Communication Recommendations

- The council should implement a review of the contents within recycling information to ensure that all residents regardless of their educational background can effectively understand the information.
- The council should ensure that the choice of words and graphics on bin labels are simple and easy to understand. The labels should be large and bold to aid in the easy identification of bin types.
- Recycling information should be made available in electronic format for the top five languages spoken in the borough to cater for diverse resident groups in the borough.
- The council should set up a process for documenting feedback on recycling issues to serve as baseline data for future reviews and changes.
- The recycling team should use a digital exclusion map for Westminster to concentrate on areas that are digitally excluded and use non-electronic communication.

Engagement Recommendations

- The council should focus more on the younger generation by using incentives and social media to increase their participation in recycling activities.
- In addition, recycling videos featuring popular role models should be used on social media to influence the younger generation.
- The recycling team should organise regular resident site visits to the council recycling processing facilities. This approach will dispel the myths about the collected recyclable materials destination.
- In addition, the recycling team should design short video clips of what happened to the recyclable materials collected and make them go viral on social media platforms.
- The council should create a recycling behavioural unit that will consist of a recycling officer, a behavioural analyst, and a communication expert. This unit can then map out communication and engagement strategies that will increase recycling participation among the residents of Westminster.
- IT training should be provided in-house (on delivering webinars and online events) by the council for staff and external consultants delivering presentations at recycling events.

Additionally, the council innovation team (in liaison with the recycling team) is currently working on some interventions to mitigate recycling barriers. These interventions are detailed in Appendix U.

8.1.3 National Waste Legislation Recommendations

The national waste legislation recommendations outlined below will address issues and barriers arising from waste legislation constraints. Since waste legislation is not legislated by the local authorities in the UK, the recommendations will need to be implemented by the national government through the Department for Environment, Food & Rural Affairs (Defra). The recommendations are:

- The need for a national curriculum on environmental study topics to be taught as a complete subject rather than taught under general subjects for all levels of education. Westminster City Council can lead other local authorities in this regard to influence the department of education to make this happen.
- A review of the national waste legislation by the Department for Environment, Food & Rural Affairs (Defra) to effect proper labelling for all packaging products. This will avoid confusion regarding whether a material can be recycled or not.
- Revision to the national waste legislation by Defra to unify bin labelling format and colours for all local authorities in the UK. This will promote bin labelling consistency across the UK.
- Defra should review the current method for calculating the recycling rate in the UK. So, the method of calculation reflects the practical reality of recycling activities, and it is consistent with the calculation methodology used worldwide.

It is important to note that Defra is proposing a series of changes to the current waste legislation, which resolves most of the waste policy constraints identified in this study. Defra has carried out consultations on these proposals with the waste management stakeholders (manufacturers, local authorities, waste management companies, and the public). The past consultations on proposed future waste legislations are quoted below from the Defra website (Defra, 2023):

Extended Producer Responsibility (EPR) for Packaging

The proposed EPR regulation is to motivate producers and manufacturers of products to design packaging materials that are easy to recycle. Additionally, the producers of these products will be obligated to pay the full net cost of managing the packaging waste materials.

Introducing a Deposit Return Scheme (DRS) in England, Wales, and Northern Ireland

The proposed DRS legislation is intended to increase the capture rate for drink containers and reduce plastic litter. It is envisaged that scheme introduction will increase the UK recycling rate.

Consistency in Household and Business Recycling in England

The proposed regulation is aimed at achieving a consistent recycling scheme (household and businesses) for local authorities in England. The proposed recycling scheme uniformity will eliminate confusion resulting from different recycling regimes that currently exist in England.

Introduction of mandatory digital waste tracking

The proposed introduction of a central digital waste tracking will ensure accurate waste data are recorded when waste is collected from households and businesses. This approach will enable local authorities to accurately delineate waste from households from the waste collected from businesses. More importantly, waste data will be available geographically to determine waste generated in each local government administrative area.

8.2 Ease of Implementation

To aid the effective implementation of the recommended actions, the proposed interventions were reviewed together with the impact of the actions and their ease of implementation (Table 8.1). All the recommendations including the local waste planning policy recommendations, recycling service recommendations, and national waste legislation recommendations totalled 30 in number. Alphabets (from A to AE) were allocated to each recommendation as shown in Table 8.1 to allow graphical display in Figures 8.1 and 8.2.

Table 8.1: Impact rating and ease of implementation of the recommendations arising from the research results.

Recommendations	Recommendations	Impact	Ease of Implementation
Review of the contents within recycling information to ensure all residents regardless of their educational qualifications can effectively understand the information.	A	4	1
Use the concierge services in flatted properties to distribute recycling bags for emergency uses.	B	1	5
Choice of words and graphics on bin labels should be quite simple. Large and bold to aid easy identification of bin type.	C	2	4
Make recycling information available in electronic format for the top five languages spoken in the borough.	D	3	6
IT training (on delivering webinars and online events) for staff and external consultants delivering presentations at recycling events.	E	8	8
A process set up for documenting feedback to serve as baseline data for future reviews and changes.	F	6	2
Easy guide on how to use, clean and maintain the food waste caddy should be printed on the caddy.	G	5	7
MRCs maintenance regime and servicing should be documented and reviewed periodically.	H	7	3
Special focus on the younger generation and use of incentives to increase participation in recycling activities.	I	16	15
Design and implement waste planning policy to facilitate adequate waste storage infrastructure in developments.	J	9	12

Recommendations	Recommendations	Impact	Ease of Implementation
Use mobile recycling centres (Use electric vehicles) in areas that have MRC shortages.	K	14	18
Use of different bin colours for different waste streams.	L	13	16
Use contemporary social media to reach the younger generation through videos featuring popular role models.	M	17	14
Use local planning instruments to obligate developers to form tenants recycling forums in major developments.	N	11	19
Obligate property owners and house owners to include the council recycling information within the tenant's information packs for new tenants for major developments.	O	12	20
Organise constant residents site visits to the council recycling processing facilities.	P	18	11
Design short video clips of what happened to the materials collected and make it go viral on social media platforms.	Q	19	13
Creation of a recycling behavioural unit that will consist of a recycling officer, a behavioural analyst, and a communication expert.	R	10	17
Use of digital exclusion map to concentrate and use of non-electronic communication in areas that are digitally excluded.	S	15	9
Resilience emergency plan for recycling service to cope with future natural disaster and pandemics	T	20	10

Recommendations	Recommendations	Impact	Ease of Implementation
The need for a national curriculum on waste and recycling topics to be taught as a complete subject rather than taught under general subjects for all levels of education.	U	28	27
A review of the national waste legislation to effect appropriate packaging labelling for products.	V	29	29
Revision to waste legislation to unify bin labelling format and colours.	W	30	28
Increase the range of plastic types collected.	X	26	24
Increase installation of more micro recycling centres.	Y	25	23
Use spaces in the micro recycling centres to provide collection for food waste in areas that door to door collection is difficult.	Z	21	22
Investigate the use of recycling bags made from paper (easy to recycle) or plaid woven plastic (that can be washed and re-use) to replace the current plastic recycling bags.	AB	22	21
The need to automate the recycling collection service using geographical coordinates becomes increasingly important. This can be done in two ways. One by using onboarding gadgets mounted on collection vehicles. This can automatically record the geographical coordinate and the weight of the residential commingled recyclable bins collected.	AC	23	26

Recommendations	Recommendations	Impact	Ease of Implementation
The second option, which is the best option, is to install smart sensors in all residential recycling bins. Data such as the geographical coordinates and weight can then be downloaded from the sensors just before collection. Data obtained from these sources will provide insights into each ward's pattern of recycling behaviour.	AD	24	25
Review the current methodology for calculating the recycling rate by the national government. So, the method of calculation reflects the practical reality of recycling activities.	AE	27	30

The impact criterion shows how important is the recommendation to achieve a high recycling rate. Since the recommendations are 30 in total, each recommendation is rated on a scale of 1 to 30. In this scale 1 has the lowest impact and 30 has the highest impact.

The ease of Implementation criterion details how easy it is to implement each recommendation. This factor uses the means of delivery, limitation to influence, different entities required to implement the recommendation, time, and efforts. In summary, this factor indicates how easy or hard to implement each recommendation. Each recommendation is rated on a scale of 1 to 30. In the rating, 1 being the easiest to implement and 30 being the hardest to implement.

Figures 8.1 and 8.2 below, indicate the delivery of recommendations in relation to ease of implementation and impact, showing A to H are easy to implement but are of low impact, while I to T are also easy to implement and are of medium impact, and U to AE are of high impacts but are difficult to implement.

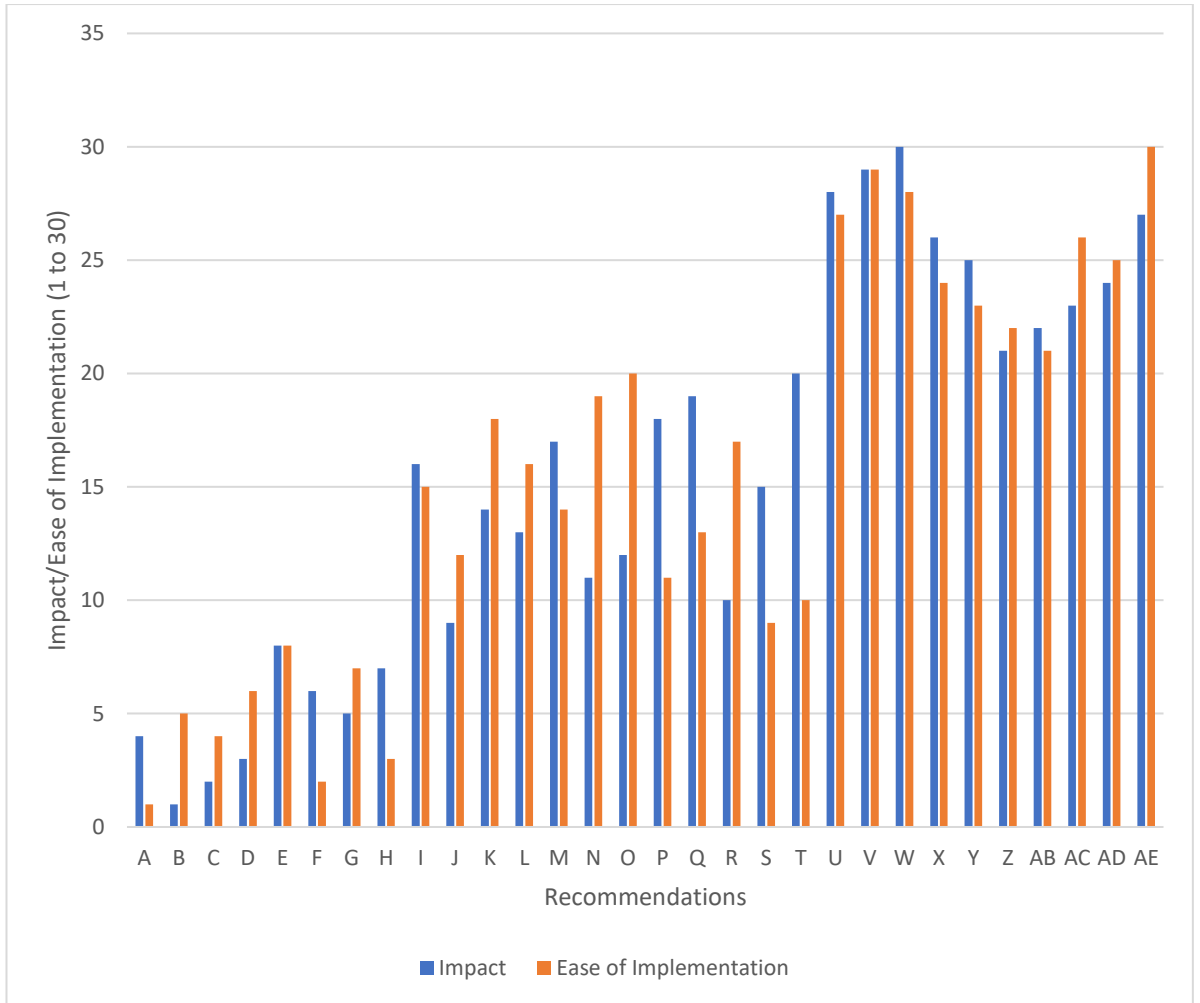


Figure 8.1: Delivery of recommendations in relation to ease of implementation and impact showing A to H are easy to implement but are of low impacts, while I to T are also easy to implement and are of medium impacts, and U to AE are of high impacts but are difficult to implement.

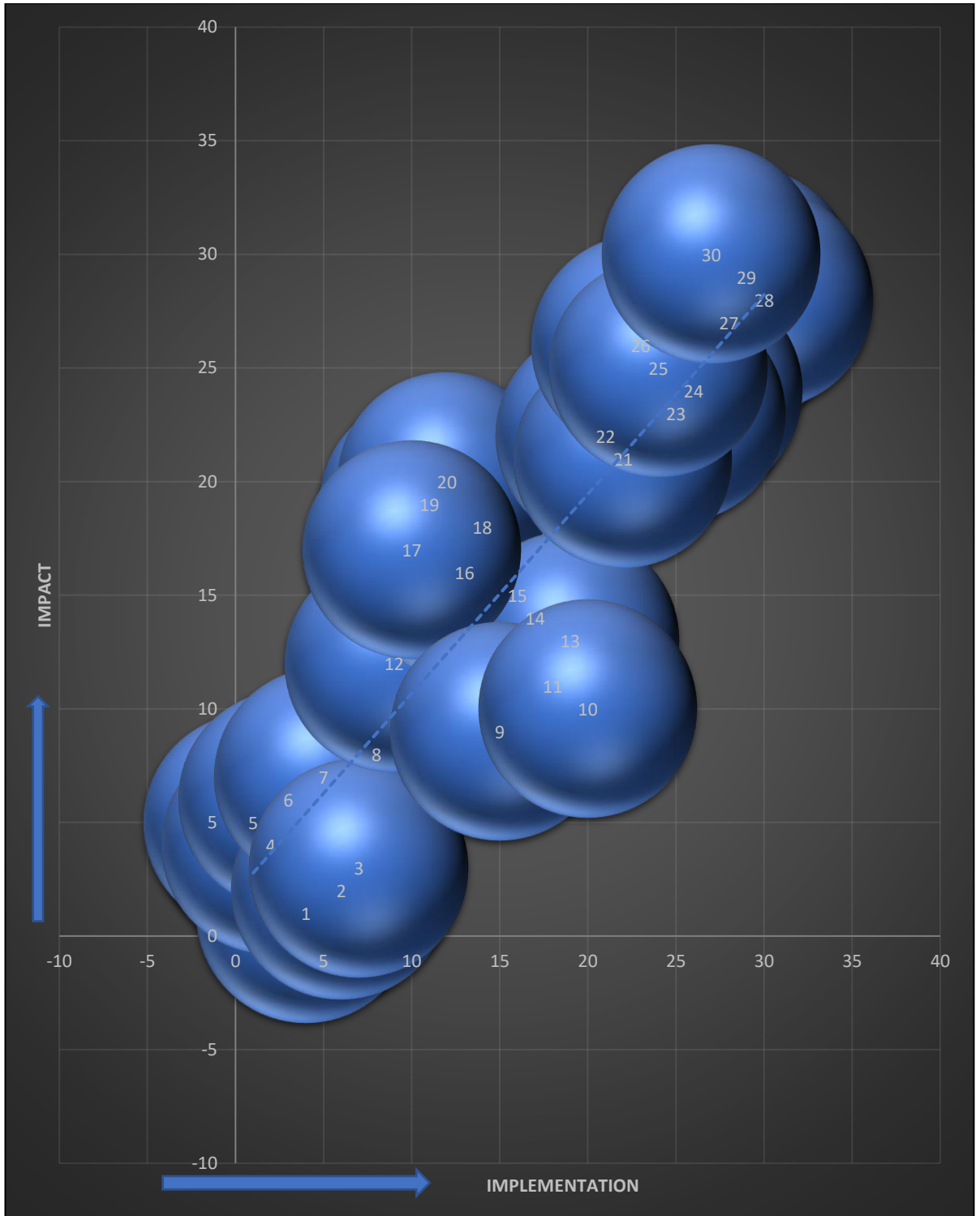


Figure 8.2: Ease of implementation and impact rating for each recommendations bubble chart.

8.3 Future Research

Future research could address all the limitations to data and the research identified in Sections 7.6 and 7.7. My research has provided data on local recycling behaviour in Westminster which can be used as foundation data to research further on the four main barriers identified. Since this research is based mainly on the barriers faced by residents that engage in recycling activities, further research could focus on the barriers faced by residents that do not participate in recycling activities. The result of such research could then be used to refine the sustainable recycling indicator and to make it more standardised and adaptable for wider use.

Furthermore, the future availability of the new census data could be used to evaluate and determine any variance in recycling behaviour between the local population data of 2011 and the local population data of 2021.

Future research could also derive data from a focus group that includes Westminster residents, the local recycling champions, the council recycling team representatives, and the council waste contractor representatives. This will provide an integrated approach to solving the recycling barriers experienced in Westminster.

Additionally, future observation data can be collected from observing the use of communal recycling bins in flatted properties and the observations of the recycling collection rounds. These observations could provide useful data on patterns of behaviour or attitude toward recycling activities when the new collection regime of one-day collection is implemented.

8.4 Conclusion

The aim of this research is to understand the barriers (faced by the residents) and challenges (faced by the council) in achieving a high recycling rate. The research results are used to develop a new strategy and policy approach to urban waste management based on information obtained from service users.

The research results have suggested that despite positive socio-demographic factors and positive human behaviours, most respondents are still facing situational barriers mainly based on physical factors, policy constraints, communication and engagement, and recycling service constraints, which are affecting the council recycling rate.

In terms of physical factors, the barriers faced are lack of adequate internal and external storage to allow source segregation of waste, lack of adequate MRC in some wards, and non-availability of recycling bins in some dwellings.

The main challenges concerning the recycling service provided by the council relate to the infrequent collection of recyclable materials, non-collection of residential food waste, and residents' difficulties in accessing the free recycling bags provided by the council.

Policy constraint issues relate to confusion arising from different collection regimes in different local authorities, lack of effective national waste policy and the method around recycling rate calculation. Communication and engagement barriers arise from the council's dependence on a regional general communication strategy with no localised strategy to suit the needs of the borough.

These recycling barriers identified can be mitigated by using the sustainable recycling indicator (SRI) designed as a functional tool to enable effective resident recycling activities. The sustainable recycling indicator contains elements of interventions that can be used to target the four main recycling barriers that exist in Westminster to increase the borough's recycling output to achieve a high recycling rate.

The research has also achieved its objectives in identifying the enabling factors required in providing sustainable and integrated management of waste in Westminster. Additionally, evidence from the research has allowed strategic recommendations to the council recycling team in providing efficient recycling service. This will facilitate resident recycling participation and increase the borough's recycling output.

Finally, results from the research have allowed the development of a waste planning policy in ensuring that new and refurbished developments in Westminster have adequate internal and external recycling storage facilities to accommodate mixed recycling materials, and the use of planning obligations and legal instruments to facilitate residents' participation in recycling activities.

This new waste planning strategy developed has been incorporated into the revision of the council recycling and waste storage requirements for developments (waste planning policy document). This document is a waste storage guidance requirement for developers and landowners to follow when applying for planning permission for new and refurbished developments. This revised waste policy document is available in Appendix V.

9 References

- Abbott, A., Nandeibam, S. and O'Shea, L. (2011) 'Explaining the variation in household recycling rates across the UK', *Ecological Economics*, 70(11), pp. 2214-2223. [https://doi: 10.1016/j.ecolecon.2011.06.028](https://doi.org/10.1016/j.ecolecon.2011.06.028).
- Ajzen, I. (1985) From intentions to actions: A theory of planned behavior. In J. Kuhl & J. Beckmann (Eds.), *Action-control: From cognition to behavior* (pp. 11-39). Heidelberg: Springer.
- Ajzen, I. (1991) The theory of planned behavior, *Organizational Behavior and Human Decision Processes*, (50)2, pp. 179-211.
- Alexander, C., Smaje, C., Timlett, R. and Williams, I.(2009) '[Improving social technologies for recycling](#)' *Proceedings of the Institution of Civil Engineers - Waste and Resource Management* 2009 (162)1, pp.15-28
- Alfaia, R. G. de S. M., Costa, A. M. and Campos, J. C. (2017) 'Municipal solid waste in Brazil: A review', *Waste Management & Research*, 35(12), pp. 1195–1209. [https://doi: 10.1177/0734242X17735375](https://doi.org/10.1177/0734242X17735375).
- Al Mamun, A., Mohiuddin, M. A., Ghazali B., Thurasamy, R., Fazal, S.A. (2018) 'Recycling Intention and Behavior among Low-Income Households' *Sustainability* 10, no. 7: 2407. <https://doi.org/10.3390/su10072407>
- Amsbary, J.H. and Powell, L., (2018) *Interviewing in a changing world: Situations and contexts*. Routledge.
- Ando, A.W. and Gosselin, A.Y. (2005) 'Recycling in multifamily dwellings: Does convenience matter?', *Economic Inquiry*, vol. 43, no. 2, pp. 426-438. <https://doi.org/10.1093/ei/cbi029>
- Ayçin, E. and Kayapinar Kaya, S. (2021) 'Towards the circular economy: Analysis of barriers to implementation of Turkey's zero waste management using the fuzzy DEMATEL method', *Waste Management & Research*. [https://doi: 10.1177/0734242X20988781](https://doi.org/10.1177/0734242X20988781).

- Bacot, H., McCoy, B. and Plagman-Galvin, J. (2002) 'Municipal Commercial Recycling: Barriers to Success', *The American Review of Public Administration*, 32(2), pp. 145–165. [https://doi: 10.1177/02774002032002002](https://doi.org/10.1177/02774002032002002)
- Bandura, A. (1986) *Social foundations of thought and action: A social cognitive theory*. Prentice Hall, Englewood Cliffs, NJ
- Barr, A. and Gilg, A. (2005) Conceptualising and analysing household attitudes and actions to a growing environmental problem: development and application of a framework to guide local waste policy. *Applied Geography*, 25 , pp. 226-247.
- Bartl, A. (2014) Moving from recycling to waste prevention: A review of barriers and enables. *Waste Management & Research*, 32(9_suppl), pp.3-18.
- Batllell, M., Hanf, K., (2008) 'The fairness of PAYT systems: Some guidelines for decision-makers'. *Waste Management*. 28, 2760–2766. <https://doi.org/10.1016/j.wasman.2008.02.031>.
- BBC (2020) Malaysia returns 42 containers of 'illegal' plastic waste to UK. Available at: [Malaysia returns 42 containers of 'illegal' plastic waste to UK - BBC News](#) (Accessed 17 April 2022).
- Becker, N. (2014) *Increasing high recycling rates. IIIIEE Master's thesis*. Lund University. Available at: https://scholar.google.com/scholar_lookup?title=Increasing%20High%20Recycling%20Rates%2C%20SocioDemographics%20as%20an%20Additional%20Layer%20of%20Information%20to%20Improve%20Waste%20Management&publication_year=2014&author=N.%20Becker. (Accessed 26 November 2020).
- Bening, C.R., Pruess, J.T. and Blum, N.U. (2021) Towards a circular plastics economy: Interacting barriers and contested solutions for flexible packaging recycling. *Journal of Cleaner Production*, 302, p.126966.
- Bentahar, O. and Cameron, R. (2015) Design and Implementation of a Mixed Method Research Study in Project Management. *Electronic Journal of Business Research Methods*. 13(1), pp. 3-15. Available at: <https://search-proquest-com.ezproxy.mdx.ac.uk/docview/1759174670/31D0C31F569D41CFPQ/12?accountid=12441> (Accessed 22 March 2019).

- Bernstad, A. (2014) 'Household food waste separation behavior and the importance of convenience', *Waste Management*, (34)7, pp. 1317-1323. <https://doi.org/10.1016/j.wasman.2014.03.013>.
- Bernstad Saraiva, A., Davidsson, Å and Bissmont, M. (2016) 'Lifecycle assessment of a system for food waste disposers to tank – A full-scale system evaluation', *Waste management (Elmsford); Waste Management*. 54, pp.169-177. <https://doi.org/10.1016/j.wasman.2016.04.036>.
- Bertoldo, R. and Castro, P. (2016) 'The outer influence inside us: Exploring the relation between social and personal norms', *Resources, Conservation and Recycling*, 112, pp. 45-53. <https://doi.org/10.1016/j.resconrec.2016.03.020>.
- Bhandari, P. (2022) Ethical Considerations in Research: Types & Examples. Available at: <https://www.scribbr.co.uk/research-methods/ethical-considerations/#:~:text=considerations%20in%20research%3F-Ethical%20considerations%20in%20research%20are%20a%20set%20of%20principles%20that,for%20harm%2C%20and%20results%20communication>. (Accessed 29 November 2022).
- Bilitewski, B. (2008) From traditional to modern fee systems. *Waste management*, 28(12), pp.2760-2766.
- Boateng, K.S., Agyei-Baffour, P., Boateng, D., Rockson, G.N.K., Mensah, K.A. and Edusei, A.K. (2019) Household willingness-to-pay for improved solid waste management services in four major metropolitan cities in Ghana. *Journal of environmental and public health*, 2019.
- Braun, V. and Clarke, V. (2006) Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), pp.77-101.
- British Plastics Federation (2021) Overview of Deposit Return Scheme. Available at: <https://www.bpf.co.uk/topics/overview-of-deposit-return-scheme.aspx#When%20will%20a%20DRS%20come%20in?> (Accessed 03 May 2022).

Brooks, J., Reed, D.M. and Savage, B., 2016, June. Taking off with a pilot: The importance of testing research instruments. In *ECRM2016-Proceedings of the 15th European Conference on Research Methodology for Business Management*: *ECRM2016. Academic Conferences and publishing limited* (pp. 51-59).

Bryan, M. (2015) Conducting observational research. Swinburne business school. PowerPoint Presentation. Available at: https://www.deakin.edu.au/_data/assets/pdf_file/0004/681025/Participant-observation.pdf (Accessed 01 December 2022).

BSDA (2020) 'Position Statements: Deposit Return Scheme' Available at: <https://www.britishsoftdrinks.com/Position-Statements/deposit-return-scheme> (Accessed 22 December 2020).

Buckley, J. and King-Hele, S. (2014) What is weighting? UK Data Service, University of Essex, and University of Manchester. Available at: <https://ukdataservice.ac.uk/media/285227/weighting.pdf> (Accessed 04 August 2021).

Burgess, M., Holmes, H., Sharmina, M. and Shaver, M.P. (2021) The future of UK plastics recycling: One bin to rule them all. *Resources, Conservation and Recycling*, 164, p.105191.

Byrne, S. and O'Regan, B. (2014) Attitudes and actions towards recycling behaviours in the Limerick, Ireland region. *Resources Conservation and Recycling*, 87, pp.89-96.

Campbell, A. and Groundwater-Smith, S. (2007) *An ethical approach to practitioner research dealing with issues and dilemmas in action research*. New York: Routledge.

Cataldi, S., 2018. A proposal for the analysis of the relational dimension in the interview techniques: a pilot study on in-depth interviews and focus groups. *Quality & Quantity*, 52(1), pp.295-312.

Caulfield, J. (2022). *How to Do Thematic Analysis | Guide & Examples*. Scribbr. Available at: <https://www.scribbr.co.uk/research-methods/thematic-analysis-explained/> (Accessed 05 December 2022).

Cerda Planas, L. and Cerda Planas, L. (2018) 'Moving Toward Greener Societies: Moral Motivation and Green Behaviour', *Environmental and Resource Economics*, 70(4), pp. 835-860. [https:// doi: 10.1007/s10640-017-0167-y](https://doi.org/10.1007/s10640-017-0167-y).

Chamizo-González, J., Cano-Montero, E.I. and Muñoz-Colomina, C.I., (2018) Does funding of waste services follow the polluter pays principle? The case of Spain. *Journal of Cleaner Production*, 183, pp.1054-1063.

Chan, K. (1998) 'Mass communication and pro-environmental behaviour: waste recycling in Hong Kong', *Journal of environmental management*, 52(4), pp. 317-325. [https:// doi: 10.1006/jema.1998.0189](https://doi.org/10.1006/jema.1998.0189).

Christensen, T.H. and Matsufuji, Y. (2011) Source segregation and collection of source-segregated waste. In *Solid Waste Technology and Management* (pp. 296-310). Wiley.

Chung, W., Yeung, I. M. H. (2019) "Analysis of residents' choice of waste charge methods and willingness to pay amount for solid waste management in Hong Kong, *Waste Management*, Volume 96, pp. 136-148.
<https://doi.org/10.1016/j.wasman.2019.07.020>.

Circular (2020) 'Designing a 'world-leading' deposit return scheme' Available at: <https://www.circularonline.co.uk/opinions/designing-a-world-leading-deposit-return-scheme/> (Accessed 15 December 2020).

City Population (2020) 'CITY OF WESTMINSTER: Borough in Greater London (United Kingdom)' Available at: [City of Westminster \(Borough, Greater London, United Kingdom\) - Population Statistics, Charts, Map and Location \(citypopulation.de\)](https://citypopulation.de/en/uk/greater-london/westminster/) (Accessed 19 April 2022).

City Population (2021) City of Westminster [Online] Available at: [City of Westminster \(Borough, United Kingdom\) - Population Statistics, Charts, Map and Location \(citypopulation.de\)](https://citypopulation.de/en/uk/greater-london/westminster/) (Accessed 29 August 2021).

Cohen, R. (2010) *Working Together in Theatre : Collaboration and Leadership*, Macmillan Education UK. ProQuest Ebook Central.
<https://ebookcentral.proquest.com/lib/mdx/detail.action?docID=4762897>.

Cole, C., Quddus, M., Wheatley, A., Osmani, M. and Kay, K., (2014) The impact of Local Authorities' interventions on household waste collection: A case study approach using time series modelling. *Waste management*, 34(2), pp.266-272.

Communities and Local Government (2007) 'National Indicators for Local Authorities and Local Authority Partnerships: Handbook of Definitions'. Available at:

https://www.wastedataflow.org/documents/guidancenotes/NationalIndicators/GN3_1_Handbook_Definitions_1.0.pdf (Accessed 25 April 2021).

Conke, L.S., (2018) Barriers to waste recycling development: Evidence from Brazil. *Resources, conservation, and recycling*, 134, pp.129-135.

Creswell, J. W. (2003) *Research design: Qualitative, quantitative, and mixed methods approaches* (2nd ed.). Thousand Oaks, CA: Sage.

Creswell, J.W. (2014) *Research design: qualitative, quantitative, and mixed method approaches*. 4th edn. Los Angeles: SAGE.

Cristóbal, J., Pierri, E., Antonopoulos, I., Bruns, H., Foster, G. and Gaudillat, P., 2022. Extended discussion paper from AA-CEAP1 Subgroup 3: consumer behaviour.

Cohen, L., Manion, L., & Morrison, K. (2007) *Research methods in education* (6th Edition). London: Routledge.

Costa, I., Massard, G., and Agarwal, A. (2010) Waste management policies for industrial symbiosis development: case studies in European countries. *Journal of Cleaner Production*, (18)8, pp.815-822.

Costley, C., Elliott, G. and Gibbs, P. (2010) *Doing work-based research approaches to enquiry for insider-researchers*. Los Angeles: Sage.

Czajkowski, M., Hanley, N. and Nyborg, K. (2015) 'Social Norms, Morals and Self-interest as Determinants of Pro-environment Behaviours: The Case of Household Recycling', *Environmental & Resource Economics*, 66(4), pp. 647-670. [https://doi: 10.1007/s10640-015-9964-3](https://doi.org/10.1007/s10640-015-9964-3).

Dai, X., Yuping, H., Xiaohong, Z., Wei, H., Liangji, H., Wenpei, D., Siyi, L., Xiaolu, L., and Qian, W. (2017) 'Comparison between students and residents on determinants of willingness to separate waste and waste separation behaviour in Zhengzhou, China', *Waste Management & Research*, 35(9), pp. 949–957. [https://doi: 10.1177/0734242X17715096](https://doi.org/10.1177/0734242X17715096).

Danermark, B., Ekstrom, M. and Jakobsen, L., 2002. *Explaining society: An introduction to critical realism in the social sciences*. Routledge.

De Feo, G., and De Gisi, S. (2010) Public opinion and awareness towards MSW and separate collection programmes: A sociological procedure for selecting areas and citizens with a low level of knowledge. *Waste Management*, (30)6, pp. 958-976.

Defra (2006) Changing behaviour through policy making. Sustainable development unit, Defra. Available at: <http://www.sustainable-development.gov.uk/what/priority/pdf/change-behaviour-model.pdf> (Accessed 19 October 2020).

Defra (2012) Red Tape Challenge — Environment Theme Proposals. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69584/pb13728-red-tape-environment.pdf (Accessed 08 December 2020).

DEFRA (2014) Contamination of recycling by food or general waste. Available at: [Contamination of recycling by food or general waste - GOV.UK \(www.gov.uk\)](http://www.gov.uk/government/uploads/system/uploads/attachment_data/file/298472/contamination-of-recycling-by-food-or-general-waste.pdf) (Accessed 03 May 2022).

Defra (2019) Consistency in recycling collections in England: executive summary and government response. Available at: <https://www.gov.uk/government/consultations/waste-and-recycling-making-recycling-collections-consistent-in-england/outcome/consistency-in-recycling-collections-in-england-executive-summary-and-government-response> (Accessed 10 December 2020).

Defra (2020a) Single-use plastic carrier bags charge: data in England for 2019 to 2020. Available at: <https://www.gov.uk/government/publications/carrier-bag-charge-summary-of-data-in-england/single-use-plastic-carrier-bags-charge-data-in-england-for-2019-to-2020> (Accessed 23 November 2020).

Defra (2020b) Circular economy measures drive forward ambitious plans for waste. Available at: <https://www.gov.uk/government/news/circular-economy-measures-drive-forward-ambitious-plans-for-waste#:~:text=In%20the%20latest%20step%20in,going%20to%20landfill%20by%202035.> (Accessed 30 May 2022).

Defra (2021) Statistics on waste managed by local authorities in England in 2020/21 Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1040756/Statistics_on_waste_managed_by_local_authorities_in_England_in_2020_v2rev_accessible.pdf (Accessed 09 August 2022).

Defra (2022a) UK Statistics on Waste. Available at: <https://www.gov.uk/government/statistics/uk-waste-data/uk-statistics-on-waste#waste-from-households-wfh> (Accessed 03 August 2022).

Defra (2022b) ENV23 - UK statistics on waste data 2022. Available at: <https://www.gov.uk/government/statistical-data-sets/env23-uk-waste-data-and-management> (Accessed 30 May 2022).

Defra (2023) Consultations. Available at: https://consult.defra.gov.uk/consultation_finder/?sort_on=iconsultable_enddate&sort_order=ascending&advanced=1&tx=&st=closed&au=&in=Waste+and+recycling&de=(Accessed 21 January 2023).

De Pascale, A., Arbolino, R., Szopik-Depczyńska, K., Limosani, M. and Ioppolo, G. (2021) A systematic review for measuring circular economy: The 61 indicators. *Journal of Cleaner Production*, 281, p.124942.

Denzin, N. K., Lincoln, Y. S. (1998). *Collecting and interpreting qualitative material*. Thousand Oaks, CA: Sage.

DeWalt, K., & DeWalt, B. (2011) Participant observation a guide for fieldworkers (2nd ed.). Rowman & Littlefield.

Díaz-Meneses, G. and Vilkaite-Vaitone, N., 2020. Pinpointing the barriers to recycling at destination. *Sustainability*, 12(7), p.2635.

<https://doi.org/10.3390/su12072635>

Drimili, E., Herrero-Martin, R., Suardiaz-Muro, J., & Zervas, E. (2020) 'Public views and attitudes about municipal waste management: Empirical evidence from Athens, Greece', *Waste Management & Research*, 38(6), pp. 614–625. [https://doi: 10.1177/0734242X20911708](https://doi.org/10.1177/0734242X20911708)

Driscoll, David L.; Appiah-Yeboah, Afua; Salib, Philip; and Rupert, Douglas J., (2007) "Merging Qualitative and Quantitative Data in Mixed Methods Research: How to and Why Not". *Ecological and Environmental Anthropology* (University of Georgia). (3)1 pp.19-28. Available at: <http://digitalcommons.unl.edu/icwdmeea/18> (Accessed 22 March 2019).

Du Toit, J. and Wagner, C. (2020) "The effect of housing type on householders' self-reported participation in recycling", *Smart and Sustainable Built Environment*. (9) 4, pp. 395-412. <https://doi.org/10.1108/SASBE-04-2019-0055>

Eagly, AH & Chaiken, S. (2005) Attitude research in the 21st century: The current state of knowledge. in D Albaraccín, BT Johnson & MP Zanna (eds), *The Handbook of Attitudes*. Erlbaum, Mahwah, New Jersey, pp. 743-767.

Ebner, N. and Lacovidou, E. (2021) 'The challenges of Covid-19 pandemic on improving plastic waste recycling rates', *Sustainable Production and Consumption*, Volume 28, pp.726-735. <https://doi.org/10.1016/j.spc.2021.07.001>.

Edwin, V.T. and Hundley, V. (2002) The importance of pilot studies. *Nursing Standard* (through 2013), 16(40), pp. 33-6.

Englander, M. (2012) The Interview: Data Collection in Descriptive Phenomenological Human Scientific Research. *Journal of Phenomenological Psychology*, 43(1), 13–35.

- Eichler, W. (2017). Millennials 'apathetic' about recycling, survey reveals. Available at: <https://www.localgov.co.uk/Millennials-apathetic-about-recycling-survey-reveals/44162> (Accessed 22 September 2021).
- Entwistle, T. (1998) 'The ironic compatibility of recycling practice and UK government policy', *Local Environment*, 3(1), pp. 55-65. [https://doi: 10.1080/13549839808725544](https://doi.org/10.1080/13549839808725544).
- Espinoza, L.A.T., 2021. Critical appraisal of recycling indicators used in European criticality exercises and circularity monitoring. *Resources Policy*, 73, p.102208. <https://doi.org/10.1016/j.resourpol.2021.102208>.
- European Commission (2020) Directive 2008/98/EC on waste (Waste Framework Directive). Available at: <https://ec.europa.eu/environment/waste/framework/> (Accessed 26 December 2020).
- European Parliament (2011) A EUROPEAN REFUNDING SCHEME FOR DRINKS CONTAINERS. Available at: [https://www.europarl.europa.eu/RegData/etudes/note/join/2011/457065/IPOL-AFET_NT\(2011\)457065_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/note/join/2011/457065/IPOL-AFET_NT(2011)457065_EN.pdf) (Accessed 23 November 2020).
- Ho, E., (2018) Exploring the social dimensions of multi-residential recycling. *Resources, Conservation and Recycling*, 132, pp.77-78. <https://doi.org/10.1016/j.resconrec.2018.01.027>.
- Ferronato, N., Portillo, M. A. G., Lizarazu, G. E. G., & Torretta, V. (2021) 'Formal and informal waste selective collection in developing megacities: Analysis of residents' involvement in Bolivia', *Waste Management & Research*, 39(1), pp. 108–121. [https://doi: 10.1177/0734242X20936765](https://doi.org/10.1177/0734242X20936765).
- Fishbein, M. and Ajzen, I., (2011) *Predicting and changing behavior: The reasoned action approach*. Psychology press.
- Flick, U. (2018) *Doing triangulation and mixed methods* (Vol. 8). Sage.
- Fontana, M., Iori, M., Montobbio, F. and Sinatra, R. (2020). New and atypical combinations: An assessment of novelty and interdisciplinarity. *Research Policy*, 49(7), p.104063.

Franklin-Wallis, O. In the Guardian (2019) 'Plastic recycling is a myth': what really happens to your rubbish?' [Online] Available at: ['Plastic recycling is a myth': what really happens to your rubbish? | Recycling | The Guardian](#) (Accessed 17 April 2022).

Geislar, S. (2017) The new norms of food waste at the curb: Evidence-based policy tools to address benefits and barriers. *Waste Management*, 68, pp.571-580. <https://doi.org/10.1016/j.wasman.2017.07.010>.

Gellard, C. Dickins, T.E. and Coulson, M. (2019), The ecology of cooperation: Considerations for litter research. JOURNAL OF LITTER AND ENVIRONMENTAL QUALITY VOLUME 3, NUMBER 1 FEBRUARY 2019. Available at: https://www.keepbritaintidy.org/sites/default/files/resource/20132_Journal%20of%20Litter%20and%20Environmental%20Quality_Vol3-V6-ONLINE.pdf (Accessed 13 February 2020).

Gill, S.L. (2020) Qualitative sampling methods. *Journal of Human Lactation*, 36(4), pp.579-581.

Giorgi, A. (2009) *The descriptive phenomenological method in psychology: A modified Husserlian approach*. Pittsburgh, PA: Duquesne University Press.

Glad, W. (2018) Spaces for waste: everyday recycling and sociospatial relationships. *Scottish Geographical Journal*, 134(3-4), pp.141-157. [https://doi: 10.1080/14702541.2018.1500634](https://doi.org/10.1080/14702541.2018.1500634)

Grant, C. and Osanloo, A. (2016). Understanding, selecting, and integrating a theoretical framework in dissertation research: Creating the blueprint for your "house." *Administrative issues journal: connecting education, practice, and research*, 4(2), p.7. [https://doi: 10.5929/2014.4.2.9](https://doi.org/10.5929/2014.4.2.9) (Accessed 12 February 2020).

Greene, J.C. (2011) 'Combining Qualitative and Quantitative Methods in Social Inquiry', in Somekh, B. and Lewin, C. (ed.) *Theory and methods in social research*. 2nd edition

Green Alliance (2014) Wasted opportunities: Smarter systems for resource recovery A report from the Circular Economy Task Force. Available at: https://www.green-alliance.org.uk/resources/Wasted_opportunities.pdf (Accessed 07 December 2020).

Green, J. and Thorogood, N. (2018) *Qualitative methods for health research*. 4th edn. Los Angeles: SAGE.

Grix, Jonathan. (2010) *The foundations of research*. 2nd ed. Basingstoke: Palgrave Macmillan. Los Angeles: SAGE, Page 260.

Gudmundsdottir, G. B., and Brock-Utne, B. (2010) An exploration of the importance of piloting and access as action research. *Educational Action Research*, 18, 359–372. <https://doi.org/10.1080/09650792.2010.499815>.

Halvorsen, B. (2012) Effects of norms and policy incentives on household recycling: An international comparison, *Resources, Conservation and Recycling*, 67, pp. 18-26. <https://doi.org/10.1016/j.resconrec.2012.06.008>. (Accessed 12 February 2020).

Hess, A.S. and Hess, J.R. (2017) 'Understanding tests of the association of categorical variables: the Pearson chi-square test and Fisher's exact test', *Transfusion (Philadelphia, Pa.)*, 57(4), pp. 877–879. Available at: <https://doi.org/10.1111/trf.14057>.

HM Treasury (2018) Tackling the plastic problem Using the tax system or charges to address single-use plastic waste. Available at : https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/690293/PU2154_Call_for_evidence_plastics_web.pdf (Accessed 12 December 2020).

Holloway, I. and Todres, L., 2003. The status of method: flexibility, consistency, and coherence. *Qualitative research*, 3(3), pp.345-357.

Hopewell, J., Dvorak, R., & Kosior, E. (2009) Plastics recycling: challenges and opportunities. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences*, 364(1526), 2115–2126. <https://doi.org/10.1098/rstb.2008.0311>

- Horodytska, O., Valdés, F.J. and Fullana, A., (2018) Plastic flexible films waste management—A state of art review. *Waste management*, 77, pp.413-425.
- Houghton, T. (2011) Does positivism really “work” in the social sciences. *E-International Relations*.
- Huffman, I., 2006. Online questionnaire software advantages/disadvantages. Available at: https://cdr.lib.unc.edu/concern/masters_papers/ff3659295 (Accessed 17 September 2021).
- Hu, S. and He, J. (2022). The willingness to household waste disposal practices of residents in rural China. *Journal of Material Cycles and Waste Management*, 24(3), pp.1124-1133
- ILM (Institute of Leadership and Management) (2017) Workforce 2020: Managing Millennials. Available at: <https://www.institutelm.com/resourceLibrary/workforce-2020-managing-millennials.html> (Accessed 17 September 2021).
- ITV, (2020) 'Councils face rolling out food waste collections to millions more homes' Available at: <https://www.itv.com/news/2020-02-10/councils-face-rolling-out-food-waste-collections-to-millions-more-homes> (Accessed on 08 March 2021).
- Iyer, E.S. and Kashyap, R.K. (2007) Consumer Recycling: Role of Incentives, Information, and Social Class. *Journal of Consumer Behaviour*, 6, 32-47. <http://dx.doi.org/10.1002/cb.206>
- Jackson, R.L., Drummond, D.K. and Camara, S. (2007) 'What Is Qualitative Research?' *Qualitative Research Reports in Communication*, 8(1), pp. 21-28. <https://doi.org/10.1080/17459430701617879>.
- Jatau, S. and Binbol, N.L., 2020. Assessing barriers to household waste recycling: A case study of Coventry University postgraduate students. *International Journal of Scientific and Research Publications (IJSRP)*, 10, pp.542-549.
- Javadi, M. and Zarea, K., (2016) Understanding thematic analysis and its pitfall. *Journal of client care*, 1(1), pp.33-39.

Jenkins, R.R., Martinez, S.A., Palmer, K., Podolsky, M.J., (2003) The determinants of household recycling: a material-specific analysis of recycling program features and unit pricing. *Journal of Environmental Economics and Management* 45, 294-318. Available at: [https://doi.org/10.1016/S0095-0696\(02\)00054-2](https://doi.org/10.1016/S0095-0696(02)00054-2).

Jesson, J. and Stone, I. (2009) A Review of Barriers to Kerbside Recycling Household Waste in the UK. Available at: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.426.9631&rep=rep1&type=pdf> (Accessed 08 December 2020).

Johnson, D.R. (2008) Using Weights in the Analysis of Survey Data. Population Research Institute. Available at: <https://pages.nyu.edu/jackson/design.of.social.research/Readings/Johnson%20-%20Introduction%20to%20survey%20weights%20%28PRI%20version%29.pdf> (Accessed 04 August 2021).

Jones, K. (2011) 'The Practise of Quantitative Methods', in Somekh, B. and Lewin, C. (ed.) *Theory and methods in social research*. 2nd edn Los Angeles: SAGE, pp. 201-202.

Jordan, A., Wurzel, R.K.W., Zito, R., Bruckner, L. (2003) Policy innovation or "muddling through"? "new" environmental policy instruments in the United Kingdom. *Environmental Politics* 12, pp.179–200. [https://doi:10.1080/09644010412331308344a](https://doi.org/10.1080/09644010412331308344a)

Jump (2020) Case Study: London Green Points – Bexley. Available at: <https://teamjump.co.uk/case-studies/> (Accessed 14 December 2020).

Kaplowitz, M.D., Yeboah, F.K., Thorp, L., Wilson, A.M. (2009) 'Garnering input for recycling communication strategies at a Big Ten University', *Resources, Conservation and Recycling*, 53(11), pp. 612-623, <https://doi.org/10.1016/j.resconrec.2009.04.018>.

Keighren, I. M. (2015) Environmental Determinism, *International Encyclopedia of the Social & Behavioral Sciences* (Second Edition), Elsevier, Pages 720-725, ISBN 9780080970875.

Kirakozyan, A. (2016) 'ONE WITHOUT THE OTHER? BEHAVIOURAL AND INCENTIVE POLICIES FOR HOUSEHOLD WASTE MANAGEMENT', *Journal of Economic Surveys*, 30(3), pp. 526-551. [https://doi: 10.1111/joes.12159](https://doi.org/10.1111/joes.12159).

Klockner, C.A. and Oppedal, I.O. (2011) General vs. domain specific recycling behaviour -applying a multilevel comprehensive action determination model to recycling in Norwegian student homes. *Resources, Conservation, Recycling*. 55, pp. 463 - 471.

King, N., Horrocks, C. and Brooks, J., 2018. *Interviews in qualitative research*. sage.

Knickmeyer, D. (2020) Social factors influencing household waste separation: A literature review on good practices to improve the recycling performance of urban areas. *Journal of cleaner production*, 245, p.118605.

Knussen, C. and Yule, F. (2008) 'I'm Not in the Habit of Recycling: The Role of Habitual Behavior in the Disposal of Household Waste', *Environment and Behavior*, 40(5), pp. 683-702. [https://doi: 10.1177/0013916507307527](https://doi.org/10.1177/0013916507307527).

Kurniawan, T.A., Othman, M. H.D., Hwang, G.H., Gikas, P. (2022) 'Unlocking digital technologies for waste recycling in Industry 4.0 era: A transformation towards a digitalization-based circular economy in Indonesia', *Journal of Cleaner Production*, 357, p.131911, <https://doi.org/10.1016/j.jclepro.2022.131911>.

Ladele, O., Baxter, J., Van Der Werf, P., Gilliland, J.A. (2021) 'Familiarity breeds acceptance: Predictors of residents' support for kerbside food waste collection in a city with green bin and a city without', *Waste management (Elmsford)*, 131, pp. 258–267. Available at: <https://doi.org/10.1016/j.wasman.2021.06.010>

Lacovidou, E., Ebner, N., Orsi, B., Brown, A. (2019) 'Plastic packaging - How do we get to where we want to be?' Available at: [14777 Plasticpackaging-howdowegettowherewewanttobe.pdf](https://doi.org/10.1016/j.wasman.2021.06.010) (Accessed 17 April 2022).

Larkin, P.M., Begley, C.M. and Devane, D. (2014) 'Breaking from binaries--using a sequential mixed methods design', *Nurse Researcher*, 21(4), pp. 8. [https://doi: 10.7748/nr2014.03.21.4.8.e1219](https://doi.org/10.7748/nr2014.03.21.4.8.e1219).

- Lavrakas, P. J. 2008, *Encyclopedia of survey research methods*, vol. 0, Sage Publications, Inc., Thousand Oaks, CA. [https://doi: 10.4135/9781412963947](https://doi.org/10.4135/9781412963947).
- Lee, D. S. (2020) 'Restructuring municipal solid waste management and governance in Hong Kong: Options and prospects', *Waste Management & Research*, 38(9), pp. 1047–1063. [https://doi: 10.1177/0734242X20945185](https://doi.org/10.1177/0734242X20945185)
- Lee, D., and Krieger, J.L., (2020) Moving from directives toward audience empowerment: A typology of recycling communication strategies of local governments. *Sustainability*, 12(7), p.2722. [https://doi: 10.3390/su12072722](https://doi.org/10.3390/su12072722).
- Letelier, C., Blazquez, C. and Paredes-Belmar, G. (2021) 'Solving the bin location–allocation problem for household and recycle waste generated in the commune of Renca in Santiago, Chile', *Waste Management & Research*. [https://doi: 10.1177/0734242X20986610](https://doi.org/10.1177/0734242X20986610).
- Lewthwaite, G.R., (1966) Environmentalism and determinism: A search for clarification. *Annals of the Association of American Geographers*, 56(1), pp.1-23.
- Lewin, C. (2011) 'Understanding and Describing Quantitative Data', in Somekh, B. and Lewin, C. (ed.) *Theory and methods in social research*. 2nd edn Los Angeles: SAGE, Pages 220 and 230.
- Li, C., Zhang, Y., Nouvellet, P., Okoro, J.O., Wang, X. and Harder, M.K. (2020a) 'Distance is a barrier to recycling – or is it? Surprises from a clean test', *Waste Management*, 108, pp. 183-188. <https://doi.org/10.1016/j.wasman.2020.04.022>
- Li, C., Wang, Y, Huang, Y & Harder, MK (2020b) 'The incentives may not be the incentive: a field experiment in recycling of residential food waste', *Resources, Conservation and Recycling*. 168, p.105316. <https://doi.org/10.1016/j.resconrec.2020.105316>
- Li, W. and Wang, J. (2021) 'Feasibility study of the unit pricing system for household wastes sorting in the context of China', *Waste Management & Research*. 40(5), pp.586-595. [https://doi: 10.1177/0734242X20988783](https://doi.org/10.1177/0734242X20988783).
- Li, Y., Yang, D., Sun, Y. and Wang, Y., 2021. Motivating recycling behavior—Which incentives work, and why? *Psychology & Marketing*, 38(9), pp.1525-1537.

Liu J.H., Sibley C.G. (2004) Attitudes and behavior in social space: public good interventions based on shared representations and environmental influences. *Journal of Environmental Psychology*, 24(3) pp.373-384.

<https://doi.org/10.1016/j.jenvp.2003.12.003>.

Local Government Association (2018) Local Government Association Briefing Resources and Waste Strategy summary Borough. Available at:

<https://www.local.gov.uk/sites/default/files/documents/LGA%20briefing%20-%20RW%20strategy%2020122018.pdf> (Accessed 26 December 2020).

Local Government Association (2020) *Polling on resident satisfaction with councils: Round 26*. Available at:

<https://www.local.gov.uk/sites/default/files/documents/FINAL%20Resident%20Satisfaction%20Polling%20Round%2026.pdf> (Accessed 18 May 2022).

Lohri, C.R., Camenzind, E.J. and Zurbrügg, C. (2014) Financial sustainability in municipal solid waste management—Costs and revenues in Bahir Dar, Ethiopia. *Waste management*, 34(2), pp.542-552.

<http://dx.doi.org/10.1016/j.wasman.2013.10.014>

London Datastore (2015a) 'Number and Density of Dwellings by Borough'.

Available at: <https://data.london.gov.uk/dataset/number-and-density-of-dwellings-by-borough> (Accessed 08 July 2021).

London Datastore (2015b) 'Workday Population by Sex and Age, Borough and Ward'.

Available at: <https://data.london.gov.uk/dataset/workday-population-by-sex-and-age--borough-and-ward> (Accessed 07 July 2021).

London Datastore (2019) Household Waste Recycling Rates, Borough. Available

at: <https://data.london.gov.uk/download/household-waste-recycling-rates-borough/6f7bc5cd-217b-4eed-9450-af086f17908e/household-recycling-borough.xls> (26 June 2019).

London DataStore (2022) Household Waste Recycling Rates, Borough. Available

at: <https://data.london.gov.uk/dataset/household-waste-recycling-rates-borough> (Accessed 30 May 2022)

- Lyas, J.K., Shaw, P. J., Vugt, M.V. (2005) 'Kerbside recycling in the London Borough of Havering: progress and priorities', *Resources, Conservation and Recycling*, 45 (1) pp. 1-17. <https://doi.org/10.1016/j.resconrec.2004.12.001>.
- Mackenzie, N. and Knipe, S., 2006. Research dilemmas: Paradigms, methods, and methodology. *Issues in educational research*, 16(2), pp.193-205.
- Mahyari, K.F., Sun, Q., Klemeš, J.J., Aghbashlo, M., Tabatabaei, M., Khoshnevisan, B., Birkved, M. (2022) 'To what extent do waste management strategies need adaptation to post-COVID-19?', *Science of The Total Environment*, 837,155829, <https://doi.org/10.1016/j.scitotenv.2022.155829>.
- Mattsson, C.H., Berg, P.E.O., Clarkson, P.A. (2003) 'The development of systems for property close collection of recyclables: experiences from Sweden and England', *Resources, Conservation and Recycling*, 38 (1), pp.39-57, [https://doi.org/10.1016/S0921-3449\(02\)00095-2](https://doi.org/10.1016/S0921-3449(02)00095-2).
- McDonald, S. and Oates, C. (2003) Reasons for non-participation in a kerbside recycling scheme. *Resources, Conservation and Recycling*, 39(4), pp. 369-385, [https://doi.org/10.1016/S0921-3449\(03\)00020-X](https://doi.org/10.1016/S0921-3449(03)00020-X).
- Mee N., Clewes D., Phillips, P.S, Read A.D. (2004) Effective implementation of a marketing communications strategy for kerbside recycling: a case study from Rushcliffe, UK. *Resources Conservation and Recycling*. 42(1) pp.1–26.
- Mee, N. and Clewes, D. (2004) 'The influence of corporate communications on recycling behaviour', *Corporate Communications*, 9(4), pp. 265-275. <https://doi.org/10.1108/13563280410571004>.
- Meert, J., Izzo, A., Atkinson, J.D. (2021) 'Impact of plastic bag bans on retail return polyethylene film recycling contamination rates and speciation' *Waste Management*, 135 (2021), pp. 234-242, <https://doi.org/10.1016/j.wasman.2021.08.043>.
- McHugh, M.L., 2013. The chi-square test of independence. *Biochimica medica*, 23(2), pp.143-149.
- Meneses, G.D., 2006. How to teach recycling at an advanced phase of diffusion. *The Journal of Environmental Education*, 37(4), pp.19-32.

- Meng, X., Tan, X., Wang, Y., Wen, Z., Tao, Y. and Qian, Y. (2019). Investigation on decision-making mechanism of residents' household solid waste classification and recycling behaviors. *Resources, Conservation and Recycling*, 140, pp.224-234.
- Miafodzyeva, S., Brandt, N., (2013) Recycling behaviour among householders: synthesizing determinants via a meta-analysis. *Waste and Biomass Valorization* 4, pp. 221-235. <https://doi.org/10.1007/s12649-012-9144-4>
- Michie, S., Johnston, M., Abraham, C., Lawton, R., Parker, D., Walker, A., & Psychological Theory Group. (2005). Making psychological theory useful for implementing evidence-based practice: A consensus approach. *Quality & Safety in Health Care*, 14(1), pp.26–33.
- Michie, S. and Johnston, M. (2012) Theories and techniques of behaviour change: Developing a cumulative science of behaviour change, *Health Psychology Review*, 6(1), pp.1-6, [https://doi: 10.1080/17437199.2012.654964](https://doi:10.1080/17437199.2012.654964).
- Mofid-Nakhaee E, Barzinpour F, Pishvae MS. (2020) A sustainable municipal solid waste system design considering public awareness and education: A case study. *Waste Manag Research* 38(6) pp.626-638. [https://doi: 10.1177/0734242X20910206](https://doi:10.1177/0734242X20910206)
- Moraga, G., Huysveld, S., De Meester, S. and Dewulf, J. (2022) Resource efficiency indicators to assess circular economy strategies: a case study on four materials in laptops. *Resources, Conservation and Recycling*, 178, p.106099.
- Morgan, D.L. (2019) Commentary—After triangulation, what next? *Journal of Mixed Methods Research*, 13(1), pp.6-11.
- Moss, R. (2018) Millennials Less Likely to Recycle Than Older Generations. Available at: https://www.huffingtonpost.co.uk/entry/woke-millennials-less-likely-to-recycle-than-older-generations_uk_5aab86f6e4b05b2217fdbd1f (Accessed 22 September 2021).

- Mühle, S., Balsam, I. and Cheeseman, C.R. (2010) 'Comparison of carbon emissions associated with municipal solid waste management in Germany and the UK', *Resources, Conservation and Recycling*, 54(11), pp. 793-801. [https://doi: 10.1016/j.resconrec.2009.12.009](https://doi.org/10.1016/j.resconrec.2009.12.009).
- Nihan, S.T., 2020. Karl Pearson's chi-square tests. *Educational Research and Reviews*, 15(9), pp.575-580.
- Noble, H. and Heale, R. (2019) Triangulation in research, with examples. *Evidence-based nursing*, 22(3), pp.67-68.
- Nomis (2011) 'Highest level of qualification by sex'. Available at: https://www.nomisweb.co.uk/census/2011/LC5107EW/view/1946157259?rows=c_hlqpk11&cols=c_sex (Accessed 18 May 2022).
- Norris, L., (2019) Waste, dirt, and desire: fashioning narratives of material regeneration. *Sociology Review*. 67 pp. 886–907. <https://doi.org/10.1177/0038026119854273>.
- Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017) Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *International Journal of Qualitative Methods*. 16(1), p.1609406917733847. <https://doi.org/10.1177/1609406917733847>
- Nunkoo, R., Bhadain, M. and Baboo, S., (2021) Household food waste: attitudes, barriers, and motivations. *British Food Journal*, 123(6). Available at: <https://www.emerald.com/insight/content/doi/10.1108/BFJ-03-2020-0195/full/html> (Accessed 06 September 2022).
- Oakshott, L. (2017) *Essential quantitative methods for business, management, and finance* (Sixth edition.). Palgrave Macmillan.
- Ogiri I.A., Sidique S.F., Talib M.A., Abdul-Rahim A.S., Radam A. (2019) 'Encouraging recycling among households in Malaysia: Does deterrence matter?', *Waste Management & Research*, 37(7), pp. 755–762. [https://doi: 10.1177/0734242X19842328](https://doi.org/10.1177/0734242X19842328).

Oh, H.Y.P., Humaidi M., Chan, Q.Y., Yap, G., Ang, K.Y., Tan, J., Ng, L.C., Mailepessov, D. (2022) 'Association of rodents with man-made infrastructures and food waste in Urban Singapore'. *Infection Ecology & Epidemiology*, 12(1), p.2016560. [https://doi.org/ 10.1080/20008686.2021.2016560](https://doi.org/10.1080/20008686.2021.2016560)

Okonta, F.N. and Mohlalifi, M., 2020. Assessment of factors affecting source recycling among metropolitan Johannesburg residents. *Waste Management*, 105, pp.445-449.

Oluwadipe S, Garelick H, McCarthy S, Purchase D. (2021) 'A critical review of household recycling barriers in the United Kingdom', *Waste Management & Research*. [https://doi: 10.1177/0734242X211060619](https://doi:10.1177/0734242X211060619).

Önder, H. (2018) The Socio-Economic Determiners of Recycling: An Analysis on European Countries Through a Macro Perspective. *Amfiteatru Economic Journal*, 20(48), pp. 405-417. Available from: https://www.researchgate.net/publication/326178025_The_SocioEconomic_Determiners_of_Recycling_An_Analysis_on_European_Countries_Through_a_Macro_Perspective (Accessed November 28, 2020).

ONS (2022) Population and household estimates, England, and Wales: Census 2021. Available at: <https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationandhouseholdestimatesenglandandwalescensus2021> (Accessed 27 July 2022).

Pannucci, C.J. and Wilkins, E.G. (2010). Identifying and avoiding bias in research. *Plastic and reconstructive surgery*, 126(2), p.619.

Peng, B., Tu, Y. and Wei, G. (2018) 'Governance of electronic waste recycling based on social capital embeddedness theory', *Journal of Cleaner Production*, 187, pp. 29-36. [https://doi: 10.1016/j.jclepro.2018.02.265](https://doi:10.1016/j.jclepro.2018.02.265).

Phipps, M., Ozanne, L.K., Luchs, M.G., Subrahmanyam, S., Kapitan, S., Catlin, J.R., Gau, R., Naylor, R.W., Rose, R.L., Simpson, B. and Weaver, T. (2013) 'Understanding the inherent complexity of sustainable consumption: A social cognitive framework', *Journal of Business Research*, 66(8), pp. 1227-1234. <https://doi.org/10.1016/j.ibusres.2012.08.016>.

- Plank, R., 2011. Green behaviour: Barriers, facilitators, and the role of attributions. *Going green: The psychology of sustainability in the workplace*, pp.47-58.
- Pollans, L. B. (2017) 'Trapped in trash: 'Modes of governing' and barriers to transitioning to sustainable waste management', *Environment and Planning A: Economy and Space*, 49(10), pp. 2300–2323. [https://doi: 10.1177/0308518X17719461](https://doi.org/10.1177/0308518X17719461).
- Pollard, Andrew (2002) *Readings for reflective teaching*. London: Continuum.
- Prestin, A., and Pearce, K.E. (2010) We care a lot: Formative research for a social marketing campaign to promote school-based recycling. *Resources, Conservation and Recycling*, 54(11), pp.1017-1026.
- Price, T. (2018) Millennials and the Circular Economy: The New Green Generation. Available at: <https://www.dssmith.com/recycling/insights/blogs/2018/10/millennials-and-the-circular-economy-the-new-green-generation> (Accessed 17 September 2021)
- Qamaruz-Zaman, N., Milke, M.W. (2012) 'VFA and ammonia from residential food waste as indicators of odour potential', *Waste Management*, 32 (12) pp. 2426-2430. <https://doi.org/10.1016/j.wasman.2012.06.023>.
- Rajendran, S., Scelsi, L., Hodzic, A., Constantinou Soutis, C., Al-Maadeed, M. A. (2012) Environmental impact assessment of composites containing recycled plastics, *Resources, Conservation and Recycling*, 60, pp.131-139. <https://doi.org/10.1016/j.resconrec.2011.11.006>.
- Rana, R. and Singhal, R., 2015. Chi-square test and its application in hypothesis testing. *Journal of the Practice of Cardiovascular Sciences*, 1(1), p.69.
- Recycling Magazine (2021) Digital DRS – Has the UK got the bottle? Available at: [Digital DRS - Has the UK got the bottle? - RECYCLING magazine \(recycling-magazine.com\)](https://www.recyclingmagazine.com/digital-drs-has-the-uk-got-the-bottle/) (Accessed 19 April 2022).
- Recycle Now (no date) Recycling helps protect our planet, most people do it. Available at: <https://www.recyclenow.com> (Accessed 14 May 2022)
- Ridley, D. (2012) *The Literature Review*. 2nd edn. SAGE Publications.

- Robertson, S. and Walkington, H. (2009) Recycling and waste minimisation behaviours of the transient student population in Oxford: Results of an on-line survey. *Local Environment*. 14. pp.285-296.
[https://doi:10.1080/13549830902812982](https://doi.org/10.1080/13549830902812982)
- Robinson, G.M., Read, A.D.(2005) 'Recycling behaviour in a London Borough: Results from large-scale household surveys', *Resources, Conservation and Recycling*, 45 (1) pp.70-83. <https://doi.org/10.1016/j.resconrec.2005.02.002>.
- Robson C (2002) *Real World Research*. Blackwell Publishing Ltd, Oxford.
- Rodríguez, O. H., Camilli, C. X. (2018) The neurobiological and environmental origin of ethics: Analysis of biological, social, and religious determinism, *Bioethics Update*, 4(2) pp. 92-102.
- Roe, B.E., Qi, D., Beyl, R.A., Neubig, K.E., Apolzan, J.W. and Martin, C.K. (2022) 'A Randomized Controlled Trial to Address Consumer Food Waste with a Technology-aided Tailored Sustainability Intervention', *Resources, Conservation and Recycling*, 179, pp. 106-121.<https://doi.org/10.1016/j.resconrec.2021.106121>
- Rousta, K., Zisen, L., Hellwig, C., (2020) 'Household Waste Sorting Participation in Developing Countries—A Meta-Analysis', *Recycling*, 5(1), p.6.
<https://doi.org/10.3390/recycling5010006>
- Rowley, J., 2012. Conducting research interviews. *Management research review*.
- Royal, K.D. (2019) Survey research methods: A guide for creating post-stratification weights to correct for sample bias. *Education in the Health Professions*, 2(1), p.48. Available at: <https://www.ehpjournal.com/text.asp?2019/2/1/48/259389> (Accessed 04 August 2021)
- Ryen, A. (2004) 'Ethical Issues' in Clive Seale et al. *Qualitative Research Practice*, SAGE Publications. p. 219. ProQuest Ebook Central. Available at: <https://ebookcentral-proquest.com.ezproxy.mdx.ac.uk/lib/mdx/detail.action?docID=1138447> (Accessed 29 April 2019).

- Sarmiento, P., Motta, M., Scott, I.J., Pinheiro, F.L., Neto, M.D.C (2022) 'Impact of COVID-19 lockdown measures on waste production behavior in Lisbon', *Waste Management*, 138, pp.189-198. <https://doi.org/10.1016/j.wasman.2021.12.002>.
- Satapathy, S. (2017) "An analysis of barriers for plastic recycling in the Indian plastic industry", *Benchmarking: An International Journal*, 24(2) pp. 415-430. <https://doi.org/10.1108/BIJ-11-2014-0103>
- Schill, S. and Deirdre, S. (2016) 'Recycling today, sustainability tomorrow: Effects of psychological distance on behavioural practice', *European management journal*, 34(4), pp. 349–362. [https://doi: 10.1016/j.emj.2016.05.004](https://doi.org/10.1016/j.emj.2016.05.004).
- Schill, M., Godefroit-Winkel, D. and Hogg, M.K. (2020) 'Young children's consumer agency: The case of French children and recycling', *Journal of business research*, 110, pp. 292-305. [https://doi: 10.1016/j.jbusres.2020.01.030](https://doi.org/10.1016/j.jbusres.2020.01.030).
- Schumaker, E. (2016) The Psychology Behind Why People Don't Recycle. Available at: https://www.huffingtonpost.com/entry/psychology-of-why-peopledont-recycle_us_57697a7be4b087b70be605b3?guccounter=1 (Accessed 09 December 2020).
- Sealey, K.S. and Smith, J. (2014) 'Recycling for small island tourism developments: Food waste composting at Sandals Emerald Bay, Exuma, Bahamas', *Resources, Conservation and Recycling*, 92, pp. 25-37. [https://doi: 10.1016/j.resconrec.2014.08.008](https://doi.org/10.1016/j.resconrec.2014.08.008).
- Seng, B., Fujiwara, T. and Spoann, V. (2018) Households' knowledge, attitudes, and practices toward solid waste management in suburbs of Phnom Penh, Cambodia. *Waste Management & Research*, 36(10), pp.993-1000.<https://doi.org/10.1177/0734242X18790800>
- Sewak, A., Kim, J., Rundle-Thiele, S., & Deshpande, S. (2021) 'Influencing household-level waste-sorting and composting behaviour: What works? A systematic review (1995–2020) of waste management interventions', *Waste Management & Research*. [https://doi: 10.1177/0734242X20985608](https://doi.org/10.1177/0734242X20985608).

- Sharma, G. (2017) Pros and cons of different sampling techniques. *International journal of applied research*, 3(7), pp.749-752.
- Shearer, L., Gatersleben, B., Morse, S., Smyth, M. and Hunt, S. (2017) 'A problem unstuck? Evaluating the effectiveness of sticker prompts for encouraging household food waste recycling behaviour', *Waste management (Elmsford); Waste Management*, 60, pp. 164-172. <https://doi.org/10.1016/j.wasman.2016.09.036>.
- Shih, J.H. and Fay, M.P. (2017) 'Pearson's chi-square test and rank correlation inferences for clustered data', *Biometrics*, 73(3), pp. 822–834. Available at: <https://doi.org/10.1111/biom.12653>.
- Skumatz, L. A. (2008) 'Pay as you throw in the US: Implementation, impacts, and experience, *Waste Management*', 28(12) pp. 2778-2785, Available at: <https://doi.org/10.1016/j.wasman.2008.03.033>.
- Smith, L. and Bolton, P. (2018) Research Briefing : Household Recycling in the UK. Available at: <https://commonslibrary.parliament.uk/research-briefings/cbp-7285/> (16 September 2021).
- Smith, J., & Noble, H. (2014). Bias in research. *Evidence-Based Nursing*, 17(4), 100-101. <https://doi.org/10.1136/eb-2014-101946>
- Spoann, V., Fujiwara, T., Seng, B. and Lay, C., 2018. Municipal solid waste management: Constraints and opportunities to improve capacity of local government authorities of Phnom Penh Capital. *Waste Management & Research*, 36(10), pp.985-992. <https://doi.org/10.1177/0734242X18785722>.
- Stacks, D.W. and Hocking, J.E., 1999. *Communication research*. Longman Publishing Group.
- Strydom, W.F., (2018) Barriers to household waste recycling: Empirical evidence from South Africa. *Recycling*, 3(3), p.41.
- Sung, K., Cooper, T. and Kettley, S. (2019) Developing interventions for scaling up UK upcycling. *Energies*, 12(14), p.2778. <https://doi.org/10.3390/en12142778>

Tabernerero, C., Hernández, B., Cuadrado, E., Luque, B. and Pereira, C.R. (2015) 'A multilevel perspective to explain recycling behaviour in communities', *Journal of environmental management*, 159, pp. 192-201. [https://doi: 10.1016/j.jenvman.2015.05.024](https://doi.org/10.1016/j.jenvman.2015.05.024).

Teddlie, C. and Tashakkori, A. (2009) *Foundations of mixed methods research : integrating quantitative and qualitative approaches in the social and behavioral sciences*. Thousand Oaks: SAGE.

Tchetchik, A., Kaplan, S., Blass, V. (2021) 'Recycling and consumption reduction following the COVID-19 lockdown: The effect of threat and coping appraisal, past behavior and information', *Resources, Conservation and Recycling*, 167, p.105370. <https://doi.org/10.1016/j.resconrec.2020.105370>.

Thaler, R.H. and Sunstein A (2008) *Nudge: Improving decisions about health, wealth, and happiness.*, New Haven: Yale University Press.

Thanh, N.C., and Thanh, T.T. (2015) The interconnection between interpretivist paradigm and qualitative methods in education. *American journal of educational science*, 1(2), pp.24-27.

Timlett, R.E. and Williams, I.D. (2009) 'The impact of transient populations on recycling behaviour in a densely populated urban environment', *Resources, Conservation & Recycling*, 53(9), pp. 498-506. [https://doi: 10.1016/j.resconrec.2009.03.010](https://doi.org/10.1016/j.resconrec.2009.03.010).

Timlett, R. and Williams, I.D. (2011) 'The ISB model (infrastructure, service, behaviour): A tool for waste practitioners', *Waste Management*, 31(6), pp. 1381-1392. Available at: <https://www.sciencedirect.com/science/article/pii/S0956053X10006288?via%3Dihub> (Accessed 22 February 2019).

Tsalis, T., Amarantidou, S., Calabró, P., Nikolaou, I., & Komilis, D. (2018) 'Door-to-door recyclables collection programmes: Willingness to participate and influential factors with a case study in the city of Xanthi (Greece)', *Waste Management & Research*, 36(9), pp. 760–766. [https://doi: 10.1177/0734242X18764291](https://doi.org/10.1177/0734242X18764291).

Tonglet, M., Phillips, P.S., and Bates, M.P. (2004) 'Determining the drivers for householder pro-environmental behaviour: waste minimisation compared to recycling', *Resources, Conservation and Recycling*, 42(1), pp. 27-48. [https://doi: 10.1016/j.resconrec.2004.02.001](https://doi.org/10.1016/j.resconrec.2004.02.001).

Turner, D.A., Williams, I.D. and Kemp, S. (2015) Greenhouse gas emission factors for recycling of source-segregated waste materials. *Resources, Conservation and Recycling*, 105 (Part A), pp.186-197. [https://doi:10.1016/j.resconrec.2015.10.026](https://doi.org/10.1016/j.resconrec.2015.10.026)).

UK Government (2021) 'What qualification levels mean'. Available at: <https://www.gov.uk/what-different-qualification-levels-mean/list-of-qualification-levels> (Accessed 04 August 2021)

Vaismoradi, M., Jones, J., Turunen, H. and Snelgrove, S., 2016. Theme development in qualitative content analysis and thematic analysis. <http://dx.doi.org/10.5430/jnep.v6n5p100>

Vicente, P. and Reis, E. (2007) Segmenting households according to recycling attitudes in a Portuguese urban area *Resources. Conservation. Recycling*, 52, pp. 1-12, [https://doi:10.1016/j.resconrec.2007.01.005](https://doi.org/10.1016/j.resconrec.2007.01.005)

Vieira, V., & Matheus, D. R. (2018) The impact of socioeconomic factors on municipal solid waste generation in São Paulo, Brazil. *Waste management & research*, 36(1), pp.79–85. <https://doi.org/10.1177/0734242X17744039>

Wahyuni, Dina (2012) The research design maze: understanding paradigms, cases, methods and methodologies, *Journal of applied management accounting research*, 10(1) pp. 69-80.

Walliman, N.S.R. (2011) *Your research project: designing and planning your work*. 3rd edn. Los Angeles: SAGE.

Wang, J., Veugelers, R. and Stephan, P. (2017) Bias against novelty in science: A cautionary tale for users of bibliometric indicators. *Research Policy*, 46(8), pp.1416-1436.

Watts, A. (2017) No Recycling Please - We're Millennials. Available at: <https://www.recyclingbins.co.uk/blog/no-recycling-please-were-millennials/> (Accessed 22 September 2021).

Waste Data Flow (2021) What is WasteDataFlow? Available at: <https://www.wastedataflow.org/> (Accessed 22 September 2021).

Weaver, K., and Olson, J.K., (2006) Understanding paradigms used for nursing research. *Journal of advanced nursing*, 53(4), pp.459-469.

Wei, Y., Li, J., Shi, D., Liu, G., Zhao, Y. and Shimaoka, T. (2017) Environmental challenges impeding the composting of biodegradable municipal solid waste: A critical review. *Resources, Conservation and Recycling*, 122, pp.51-65.

Welivita, I., Wattage, P., Gunawardena, P. (2015) 'Review of household solid waste charges for developing countries – A focus on quantity-based charge methods', *Waste Management*, 46, pp. 637-645.
<https://doi.org/10.1016/j.wasman.2015.08.018>.

Westminster City Council, (2017) Waste Strategy. Available at: <https://www.westminster.gov.uk/waste-strategy> (Accessed 06 October 2020).

Westminster City Council, (2018) City of Westminster Profile. Available at: https://www.westminster.gov.uk/sites/default/files/city_profile.pdf. (Accessed 06 October 2020).

Westminster City Council, (2022) Facts and figures about Westminster. Available at: <https://www.westminster.gov.uk/about-council/data/facts-and-figures-about-westminster> (Accessed 16 December 2022).

Wiesmeth, H., Shavgulidze, N. and Tevzadze, N. (2018) 'Environmental policies for drinks packaging in Georgia: A mini-review of EPR policies with a focus on incentive compatibility', *Waste Management & Research*, 36(11), pp. 1004–1015.
<https://doi:10.1177/0734242X18792606>.

Whiteman, A., Webster, M. and Wilson, D. C. (2021) 'The nine development bands: A conceptual framework and global theory for waste and development', *Waste Management & Research*, 39(10), pp. 1218–1236.
<https://doi:10.1177/0734242X211035926>.

Willman, K.W. (2015) 'Information sharing and kerbside recycling: A pilot study to evaluate the value of door-to-door distribution of informational literature', *Resources, Conservation and Recycling*, 104, pp. 162-171.

<https://doi.org/10.1016/j.resconrec.2015.08.012>. [Accessed 18 May 2022].

Workentin, J., De Sousa, J.M., Mensink, P.J. (2022) 'The use of recycling bags: An overview of collection policies and a spatial assessment of bag use', *Environmental Challenges*, 8, p.100535.

<https://doi.org/10.1016/j.envc.2022.100535>.

World Economic Forum, Qualtrics and SAP (2021) 'The Climate Progress Survey: Business & Consumer Worries & Hopes. A Global Study of Public Opinion.'

Available at: [Survey reveals why people don't recycle more | World Economic Forum \(weforum.org\)](https://www.weforum.org/articles/2021/04/27/survey-reveals-why-people-dont-recycle-more/) (Accessed 17 April 2022).

WRAP (2008) Kerbside recycling: Indicative costs and performance. Available at: <https://wrap.org.uk/resources/guide/kerbside-recycling-indicative-costs-and-performance> (Accessed 27 April 2021)

WRAP (2014a) Barriers to recycling: A review of evidence since 2008. Available at:

<https://wrap.org.uk/sites/files/wrap/WRAP%20Barriers%20Synthesis%20Full%20Report%20final%20121214%20PUBLISHED%20-%20PDF.pdf> (09 December 2020).

WRAP (2014b) Systematic Survey of Local Authority Plans for Waste and Recycling Services in England. Available at:

<https://www.wrap.org.uk/sites/files/wrap/Local%20Authority%20Survey%20Report%20240316.pdf> (Accessed 16 December 2020)

WRAP (2016a) Local Authority Communications Case Study: Barrow Borough Council. Available at: [https://www.wrap.org.uk/collections-and-](https://www.wrap.org.uk/collections-and-reprocessing/resident-communications/case-studies/local-authority-communications-case-study-barrow)

[reprocessing/resident-communications/case-studies/local-authority-communications-case-study-barrow](https://www.wrap.org.uk/collections-and-reprocessing/resident-communications/case-studies/local-authority-communications-case-study-barrow) (Accessed 14 December 2020)

WRAP (2016b) Communications to Support the Introduction of a New Waste and Recycling Service: Newcastle-under-Lyme Borough Council. Available at: <https://www.wrap.org.uk/content/communications-support-introduction-new-waste-and-recycling-service-newcastle-under-lyme-bor> (Accessed 15 December 2020)

WRAP (2016c) Introducing a New Recycling Service to All Residents: Coventry City Council. Available at: <https://www.wrap.org.uk/cy/collections-and-reprocessing/resident-communications/case-studies/introducing-new-recycling-service-all-residents> (Accessed 16 December 2020)

WRAP (2018) 'Increasing Recycling in Urban Areas'. Available at: [RCY104 Urban Project Report FINAL.pdf \(wrap.org.uk\)](#) (Accessed 24 April 2022).

WRAP (2021) 'Recycling Tracking Survey 2021 Behaviours, attitudes and awareness around recycling' Available at: [Summary report template \(wrap.org.uk\)](#) (Accessed 14 May 2022).

Wright, K.B., (2005) Researching Internet-based populations: Advantages and disadvantages of online survey research, online questionnaire authoring software packages, and web survey services. *Journal of computer-mediated communication*, 10(3), p.JCMC1034.

Yakob, H., Abd Rauf, N. R. A. , Abdullah, Y. A. . and Hoon Leh, O. L. . (2020) "Factors that Contribute to Domestic Waste Recycling: A Preliminary Survey", *Environment-Behaviour Proceedings Journal*, 5(15), pp. 415-422. [https://doi: 10.21834/ebpj.v5i15.2489](https://doi.org/10.21834/ebpj.v5i15.2489).

Yau, Y. (2012). Stakeholder engagement in waste recycling in a high-rise setting *Sustainable Development*, 20, pp. 115-127

Yukalang, N., Clarke, B., & Ross, K. (2017) Barriers to Effective Municipal Solid Waste Management in a Rapidly Urbanizing Area in Thailand. *International journal of environmental research and public health*, 14(9), 1013. <https://doi.org/10.3390/ijerph14091013>

Zero Waste Scotland (2020) 'Scotland's Deposit Return Scheme' Available at: <https://depositreturnscheme.zerowastescotland.org.uk/> (Accessed 22 December 2020).

Zhang, X., Gong, X., Jiang, J. (2021) 'Dump or recycle? Nostalgia and consumer recycling behavior,' *Journal of Business Research*, 132, pp.594-603.
<https://doi.org/10.1016/j.jbusres.2020.11.033>.

Zhou, J., Jiang, P., Yang, J. and Liu, X., 2021. Designing a smart incentive-based recycling system for household recyclable waste. *Waste Management*, 123, pp.142-153.

10 Appendices

A critical review of household recycling barriers in the United Kingdom

Saeed Oluwadipe^{1,2}, Hemda Garelick¹,
Simon McCarthy¹ and Diane Purchase¹ 

Waste Management & Research
2022, Vol. 40(7) 905–918
© The Author(s) 2021



Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/0734242X211060619
journals.sagepub.com/home/wmr



Abstract

The UK recycling rate fluctuates between 45% and 47% and has consistently failed to meet the 65% target set by the post-Brexit Resource and Waste Strategy. Understanding the issues surrounding the low recycling rate in metropolitan cities in the United Kingdom will help to overcome these recycling challenges. The review examines the current situation with regard to the recycling rate and tonnage of waste produced in the United Kingdom based on available secondary waste flow data and explores different barriers related to household recycling. Many areas giving rise to the recycling challenges have been identified, including waste policy constraints, lack of effective communication, public engagement, physical barriers, service constraints, human factors and socio-economic barriers. The literature review reveals that factors such as waste policy, communication and physical factors were the most important aspects in influencing recycling rate or output. It is concluded that a multi-dimension intervention is required, which includes a thorough review of waste policy, a more stringent enforcement, an improved communication strategy and a more integrated planning development policy to mitigate issues affecting the United Kingdom's low recycling rate or output. This approach will propel the local authorities to launch or initiate effective recycling management and to put in place the required infrastructure to facilitate effective recycling activities.

Keywords

Recycling, waste management, barriers, sustainable waste storage, waste planning, behaviours, deposit return scheme, urban environment

Received 4th June 2021, accepted 24th October 2021 by Associate Editor Arne Ragossnig.

Introduction

In 2008, the European Union (EU) Waste Framework Directive (WFD) 2008/98/EC sets a recycling target of 50% for member states by 2020 (European Commission, 2020). The Waste (England and Wales) Regulations 2011 thereafter transposed the EU WFD (2008/98/EC) into law in England and Wales. The UK government has taken over the control of environmental policy from the EU after Brexit and has put in place an ambitious Resource and Waste Strategy to forge a circular economy for England. The Resource and Waste Strategy for England 2018 sets a new recycling target of 65% of municipal waste to be achieved by 2035 (Local Government Association, 2018).

The local authorities' recycling rates are derived from the statutory waste returns submitted by all local authorities on a financial year basis. These returns are provided through the Waste Dataflow portal managed by the Department for Environment Food and Rural Affairs (DEFRA). The National Indicator (NI) 192 formula (equation (1)) (Communities and Local Government, 2007) is used to calculate the percentage of household waste sent for reuse, recycling and composting for each local authority to obtain the recycling rate league table

$$\% \text{ recycling} = \frac{X}{Y} \times 100 \quad (1)$$

where X is the tonnage of reuse, recycling, composting or anaerobic digestion of the household waste collected and Y is the total tonnage of household waste collected.

The X and Y values vary according to the designation of the local authority as it is a waste collection authority (WCA) or a waste disposal authority (WDA) or a unitary authority (UA).

According to the latest waste flow data, the United Kingdom generated around 27 million tonnes per year and the recycling rate was at 46% in 2019 (DEFRA, 2020a). Household waste is collected by 408 local authorities in England, Wales, Scotland and Northern Ireland. Table 1 shows the different tonnage of

¹Department of Natural Sciences, Faculty of Science and Technology, Middlesex University, London, UK

²Environment and City Management, Westminster City Council, London, UK

Corresponding author:

Diane Purchase, Department of Natural Sciences, Faculty of Science and Technology, Middlesex University, The Burroughs, London NW4 4BT, UK.

Email: d.purchase@mdx.ac.uk

Table 1. Waste generated from households in the United Kingdom from 2015 to 2018.

Year	Devolved administration	Household waste generated in thousand tonnes	Household waste recycled in thousand tonnes
Year 2015	England	22,225	9849
	Wales	1278	681
	Scotland	2354	991
	Northern Ireland	818	344
	Total UK	26,675	11,865
Year 2016	England	22,770	10,217
	Wales	1307	716
	Scotland	2378	1018
	Northern Ireland	845	366
	Total UK	27,300	12,318
Year 2017	England	22,437	10,139
	Wales	1271	702
	Scotland	2345	1019
	Northern Ireland	843	390
	Total UK	26,897	12,250
Year 2018	England	22,033	9840
	Wales	1244	673
	Scotland	2292	981
	Northern Ireland	841	401
	Total UK	26,411	11,896

Source: DEFRA (2020a).

waste generated from each devolved administration, and Figure 1 indicates their recycling rates. Wales has the highest recycling rate of 54% but a relatively low volume of waste. England has the highest volume of waste generated from households and Northern Ireland has the lowest volume.

Overall, the UK recycling rate fluctuates between 45% and 47% and has consistently failed to meet even the lower annual recycling target of 50% of household waste set previously under the EU WFD. The data also revealed that densely populated urban boroughs (such as the City of Exeter) have relatively low recycling rates and poor performance compared to the high recycling rates for county boroughs (such as Stroud) that are sparsely populated (Table 2). Different boroughs with similar urban characteristics also present different recycling rates. For example, Newham and Bexley are both outer London boroughs and yet Bexley has the highest recycling rate and Newham has the lowest recycling rate out of all the London boroughs.

Organic materials (food and garden waste) appear to constitute a higher proportion of the recycling elements for the regions that have the highest recycling rates. It may well be possible that the county councils are facing challenges with regard to capturing recyclable materials that are non-organic. Within the London

councils, such as Newham, many are struggling to recover food waste from household waste collections. Some of the local authorities, such as Westminster City Council (WCC), do not currently offer food waste collection in residential properties due to a lack of infrastructure to manage food waste storage before collection.

The recycling issue is highly complex and multifactorial. Various factors or barriers have been attributed to the causes why the target was unattainable. These phenomena could be localised and region-specific, commonly identified in most of the regions, or the results of combined effects of localised and general factors. A critical evaluation of these different barriers will enhance our understanding of the challenges and focus on resources to tackle some of the common factors. Therefore, the essence of this literature review is to reveal the different barriers and their complexity that are affecting the low recycling rate in the United Kingdom.

Methods

This review was conducted using several databases and keywords to yield relevant literature that applies to the title of the review. A wide range of general terms and keywords that relates to the topic was initially used to search for relevant literature on several databases.

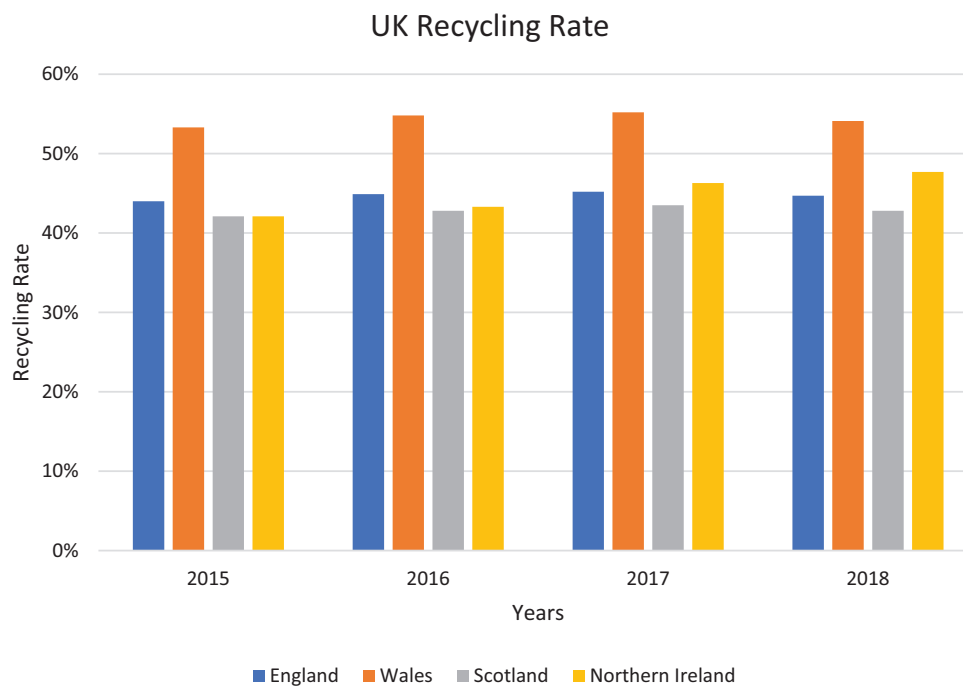


Figure 1. UK recycling rate from 2015 to 2018.

Over one hundred pieces of literature, between 1985 and 2021, including abstracts and full papers sources, were reviewed. This literature was then grouped into different categories depending on the main theme of the literature. Fifty of the studies reviewed were within the last 4 years (2017–2021), 30 sources were within the years 2010–2016, 15 sources were within the years 2000–2009 and 5 works of literature were from sources before the year 2000. In addition, secondary waste flow data were obtained from the UK government websites to interrogate relevant waste data that were used in this review.

A systematic approach was then employed to categorise the search results into the year when the article or literature was published, how relevant the literature is to the research and if the database is a recognised database for waste management. The main literature reviewed was from 2017 to 2021, to ensure that up-to-date information and trends in the waste management industry were adequately covered.

Databases such as ScienceDirect, SAGE journals, Google Scholar and the Web of Science were used to search for relevant literature. There was also limited use of Google to search for other information that was not available on databases cited above. The key terms and search words used include recycling, household recycling, household waste, deposit return scheme (DRS), recycling incentive scheme, recycling schemes in Europe, barriers to recycling, recycling behaviours, waste regulation in the United Kingdom and recycling schemes case studies.

Results and discussion

Six categories of recycling barriers derived from literature sources based on different studies and research into recycling barriers were identified (Table 3).

Barriers to recycling

Barriers to recycling result from a wide range of factors which could be social, physical, lack of effective community engagement, human, economic and policy constraints. Interestingly, these same factors could also be used as an intervention to implement an effective recycling system. It should be noted that all these factors are closely interwoven, and any intervention to increase the recycling rate must address all the relevant factors.

Timlett and Williams (2011) recognised three important key factors: infrastructure, service and behaviour, known as the ISB model that can be utilised to maximise recycling rates through a better understanding of the situation and context for users' behaviours. Recent studies were undertaken by Yukalang et al. (2017); Jatau and Binbol (2020) and Du Toit and Wagner (2020) confirmed this position. It was further suggested that meaningful intervention is only possible when we understand the behaviour of the end users of products and then, to achieve a successful recycling regime, align recycling services to fit the end users' behaviours (Timlett and Williams, 2011).

Physical barriers

Among the top three factors of the ISB model, infrastructure is the most important in increasing the recycling rate (Du Toit and Wagner, 2020; Letelier et al., 2021; Yakob et al., 2020), especially in high-density urban areas. Waste infrastructure includes type of building, allowable internal or external storage space for waste, type of bin infrastructure, proximity to storage or recycling centres and waste collection vehicle accessibility to collect waste (Timlett and Williams, 2011).

Table 2. England local authorities with the highest and lowest household recycling rates in each region in 2018/2019.

Region	Authority	Households recycling rate (%)	Position	Percentage of total recycling that is organic (%)	Population density [Km ²]
London	Newham LB	17	Lowest	22	64,750
	Bexley LB	54	Highest	42	28,490
North East	Stockton-on-Tees Borough Council	26	Lowest	42	6475
	County Durham	42	Highest	31	2176
West Midlands	Birmingham City Council	22	Lowest	37	9451
	Stratford-on-Avon District Council	60	Highest	60	881
South West	Exeter City Council	27	Lowest	30	10,645
	Stroud District Council	60	Highest	42	1735
Yorkshire and the Humber	Kirklees MBC	24	Lowest	38	7200
	East Riding of Yorkshire Council	65	Highest	49	627
East Midlands	Bassetlaw District Council	25	Lowest	30	47
	South Northamptonshire District Council	60	Highest	58	1010
North West	Barrow-in-Furness Borough Council	19	Lowest	40	5698
	Cheshire West and Chester	59	Highest	48	2486
South East	Slough Borough Council	23	Lowest	42	33,670
	South Oxfordshire District Council	63	Highest	54	1399
Eastern	Tendring District Council	27	Lowest	37	2849
	Rochford District Council	63	Highest	61	3367

Source: DEFRA (2020b).

Source segregation, another key element in achieving a high recycling rate, is wholly dependent on infrastructure. Therefore, recycling schemes with no opportunity for source segregation to occur are bound to fail (Turner et al., 2015; WRAP, 2008). The ISB model did affirm this position. In their research findings, Timlett and Williams (2011) indicated that 'Infrastructure' with a 'high convenience factor' influenced 'Service' to capture recyclables, which in turn initiated or triggered more positive action in resident 'Behaviour' than 'Infrastructure' with a 'low convenience factor' that restricted 'Service' to capturing recyclables.

One of the problems relating to recycling infrastructure is the non-involvement of the public in the design of the recycling infrastructure. De Feo and De Gisi (2010) suggest that recycling rates could be increased by consulting the householders in the design of waste storage infrastructure in new developments. This is justified, as these infrastructures will be utilised by the householders.

Some studies (Jatau and Binbol, 2020; Mee et al., 2004; WRAP, 2014a; Yukalang et al., 2017) have found that the common barriers to recycling are lack of space, distance to a recycling facility, inadequate infrastructure and lack of internal storage space. In terms of distance to recycling facilities, Li et al. (2020b) argued that proximity to recycling infrastructure is not a barrier to recycling practice. Their study of recycling habits in a community with similar characteristics and common factors (except for distance) found that an increased distance of 360 m to the recycling facility only has a 3% negative variation to when the distance of the recycling facility was at 80 m to the households. The distance of measurement from the households was between 80 and 360 m to the recycling facility. This assertion is in contrast to the findings of Jakob et al. (2020) and

Letelier et al. (2021), both studies identified an increased distance to a recycling facility as a barrier, as residents with high travel distance to recycling infrastructure were less responsive to recycling activities compared to residents with low travel distance to recycling infrastructure. However, it is important to note that Jakob et al.'s (2020) study was conducted in a community that has different prevailing factors and situations different from the study of Li et al. (2020b), which was carried out in a community with the same factors and prevailing situations. This variance in conditions may explain the difference in the outcome of both studies.

Housing type also plays a crucial situational factor in influencing recycling intentions (Díaz-Meneses and Vilkaite-Vaitone, 2020). A resident's intention to recycle may be obstructed by a lack of storage space, both internally and externally, to store recyclable materials. This fact was corroborated by Du Toit and Wagner (2020); their study found out that there are more recycling activities from houses compared to apartments due to the availability of storage spaces in houses and lack of spaces in flat-ted properties. Since the majority of buildings in the urban areas are high-rise flat-ted properties, in contrast to the rural areas where houses are predominant, this could be the reason why most of the local authorities with high recycling rates are located outside dense urban environments as evidenced in Table 2. In the City of Westminster, 80% of the residential housing stock are flat-ted properties (WCC, 2018), which indicates that the infrastructure and the types of buildings may be contributing factors to the borough's low recycling rate. It is therefore of paramount importance that future new developments should incorporate effective waste management structures to effectively capture recyclable materials and increase recycling output.

Table 3. Types of barriers derived from different literature sources.

Barriers group	Literature sources	Comments
Physical barriers	Letelier et al. (2021); Jatau and Binbol (2020); Li et al. (2020b); Yakob et al. (2020); Díaz-Meneses and Vilkaite-Vaitone (2020); Du Toit and Wagner (2020); Rodríguez and Camilli (2018); Yukalang et al. (2017); WRAP (2014a); Timlett and Williams (2011); Jesson and Stone (2009); Barr and Gilg (2005); Ando and Gosselin (2005); Liu and Sibley (2004)	Li et al. (2020b) state that the distance to recycling facility is not a barrier.
Socio-economic barriers	Zhou et al. (2021); Mofid-Nakhaee et al. (2020); Du Toit and Wagner (2020); Knickmeyer (2020); Tsalis et al. (2018); Seng et al. (2018); Vieira and Matheus (2018); Önder (2018); Rodríguez and Camilli (2018); Yukalang et al. (2017); Dai et al. (2017); Bertoldo and Castro (2016); Becker (2014); Cole et al. (2014); Yau (2012); Prestin and Pearce (2010); Timlett and Williams (2009); Vicente and Reis (2007); Jenkins et al. (2003)	Önder (2018) asserts that income levels do not have significant impact on recycling rate. Dai et al. (2017) concluded that age factor has no substantial effect on recycling behaviours.
Human behaviours	Jatau and Binbol (2020); Rousta et al. (2020); Li et al. (2020a); Schill et al. (2020); Sung et al. (2019); Peng et al. (2018); Price (2018); Moss (2018); Eichler (2017); Institute of Leadership and Management (ILM) (2017); Watts (2017); Schill et al. (2016); Schumaker (2016); Czajkowski et al. (2015); Taberero et al. (2015); Keighren (2015); Phipps et al. (2013); Timlett and Williams (2011); Fishbein and Ajzen (2009); Thaler and Sunstein (2008); Knussen and Yule (2008); Michie et al. (2005); Eagly and Chaiken (2005); Tonglet et al. (2004); Ajzen (1991); Bandura (1986); Ajzen (1985)	Rousta et al. (2020) concluded that human behavioural factors are the major elements that either enable or act as barriers to carrying out recycling activities.
Policy constraints	Li and Wang (2021); Ferronato et al. (2021); Sewak et al. (2021); Ayçin and Kayapinar Kaya (2021); Li et al. (2020a); DEFRA (2019, 2020c); Ogiri et al. (2019); Wiesmeth et al. (2018); Smith and Bolton (2018); HM Treasury (2018); Yukalang et al. (2017); Alfaia et al. (2017); Pollans (2017); Kirakozian (2016); Green Alliance (2014); WRAP (2014b); Cole et al. (2014); DEFRA (2012); Halvorsen (2012); European Parliament (2011); Klockner and Oppedal (2011); Abbott et al. (2011); Costa et al. (2010); DEFRA (2006); Jordan et al. (2003)	Li et al. (2020a); Halvorsen (2012) concluded that incentives, fines and penalty have weak influence on recycling habit.
Communication/public engagement	Sewak et al. (2021); Mofid-Nakhaee et al. (2020); Drimili et al. (2020); Lee (2020); Jump (2020); Lee and Krieger (2020); Al Mamun et al. (2018); Glad (2018); Satapathy (2017); Yukalang et al. (2017); WRAP (2016b); Byrne and O'Regan (2014); Miafodzyeva and Brandt (2013); De Feo and De Gisi (2010); Iyer and Kashyap (2007); Mee and Clewes (2004); Mee et al. (2004); McDonald and Oates (2003); Chan (1998).	Mofid-Nakhaee et al. (2020) indicate that public education facilitates positive influence in improving recycling quality in comparison to municipalities that do not engage in recycling public awareness.
Service/collection	Jatau and Binbol (2020); Tsalis et al. (2018); Yukalang et al. (2017); Shearer et al. (2017); Bernstad Saraiva et al. (2016); WRAP (2016a); WRAP (2016c); Sealey and Smith (2014); Timlett and Williams (2011); Entwistle (1998)	Timlett and Williams (2011) state that recycling service is one of the major factors affecting recycling rate.

Socio-economic barriers

Socio-economic barriers will include population transiency, level of income, level of education, age, knowledge and awareness of environmental harm that influences human behaviour. The list is not exhaustive as the characteristics of socio-economic barriers also include factors such as homeownership, employment status, political beliefs and presence of children in the household (Becker, 2014; Knickmeyer, 2020; Vicente and Reis, 2007; Yau, 2012).

Studies have revealed that the level of education and age do affect or influence recycling outputs (Cole et al., 2014; Jenkins et al., 2003; Tsalis et al., 2018). However, Dai et al. (2017) in their study, although agreed that age is an influencing factor for recycling behaviour, argued that level of education has no substantial effect on waste behaviours of the two groups of residents and students surveyed for recycling activities. Residents with

medium or high level (college or tertiary education) of education are much more aware of the environmental benefits of recycling (Prestin and Pearce, 2010; Seng et al., 2018) or can easily understand recycling communications better and therefore are in a position to respond positively to recycling campaigns or initiatives. Residents with a low level of education (no education or primary education) may not be in a position to understand the environmental benefits and therefore recycling response from this group may be low or negative coupled with other factors.

Timlett and Williams (2009) identified the impact of the transient population as one of the main factors affecting recycling behaviours in urban environments. Portsmouth City was used as a case study in the research. The study results indicate that recycling programmes in high-density housing areas associated with less transience and deprived populations are more likely to succeed than in areas with high transient and deprived populations. However, a cautionary approach has to be considered to avoid

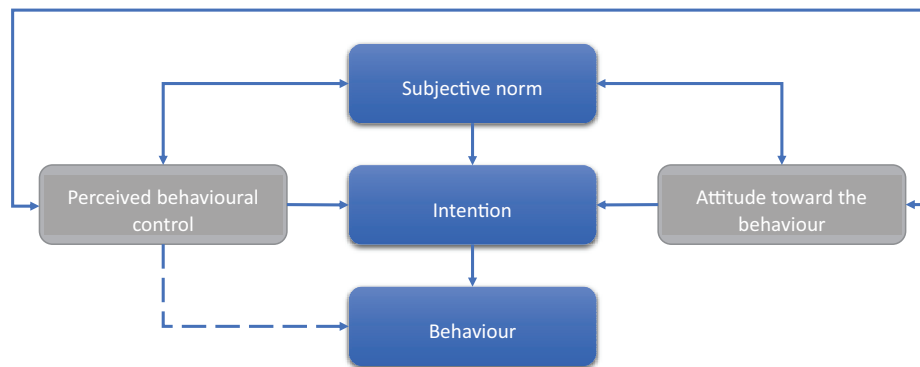


Figure 2. The theory of planned behaviour based on Ajzen (1991).

applying one recycling system to fit all localities (Knickmeyer, 2020), as individual and households' environmental behaviours vary significantly from one locality to another (Klockner and Oppedal, 2011).

Economic factors also play a major role in affecting recycling rates. Residents in areas of deprived households may not allocate time to or focus on recycling activities because they are more pre-occupied with meeting essential needs deemed more important than recycling (Knickmeyer, 2020; Smith and Bolton, 2018). A negative relationship has been found to exist between income levels and recycling rate (Önder, 2018). Seng et al. (2018), however, state that the level of income is related to the level of education and therefore greatly influences the resident's awareness of recycling knowledge, thus resulting in positive recycling actions. This relational factor is corroborated by the study carried out by Vieira and Matheus (2018). The level of income also affects the affordability of the type of housing (Jenkins et al., 2003). Predominantly, people on low income may only afford flatted properties, which results in the low output of recycling rates, in contrast to high- or medium-income residents who can afford houses that are more convenient to accommodate effective recycling infrastructure, thereby facilitating high output recycling rate.

Human factors

Different theories have been expounded to explain human behaviours and attitudes and how they influence response or action in a certain manner. Some researchers (Lethwaite, 1966; Michie et al., 2005; Thaler and Sunstein, 2008) have worked on theories of human behaviours, such as environmental determinism theory, behavioural change theory and the nudge theory, respectively.

The environmental determinism theory is based on the idea that the physical environment has an impact on the behaviour of people living within a specified geographical location or climatic conditions (Lethwaite, 1966). The theory has been criticised widely and rejected because of its use in justifying racial differences and imperialism (Keighren, 2015). However, the environmental determinism theory could be applied and adapted to suit certain perspectives through the application of local variables. In the recycling context, if the natural physical environment is replaced with a man-made environment (building type and type

of recycling infrastructure) and the socio-cultural environment (custom, education and level of income), these replacement environments will play a role in determining individual decision-making processes (Rodríguez and Camilli, 2018) and ultimately influence their recycling behaviour.

DEFRA (2006) suggested an approach of adopting strategies and policies based on behavioural change model to influence recycling habits. This is a key shift in policy governance to move away from enforcement to the nudging approach. There are many behavioural change models and we have reviewed two major concepts: the theory of planned behaviour and the social cognitive theory (SCT).

The theory of planned behaviour was proposed by Ajzen (1985) which describes intention as the basis of any behaviour in conjunction with other motivational factors. The more secure the intention, the higher the performance of the action (Ajzen, 1991). In this model (Figure 2), the motivational factors are attitude, subjective norm and perceived control. Attitude can be defined as hidden or concealed inclination response to physical and non-physical objects, the response could be negative or positive depending on the nature of the inclination (Fishbein and Ajzen, 2009). Eagly and Chaiken (2005) define attitude as a speculative or theoretical configuration of the mind. Norms are societal obligations that could be formal and informal standards or rules. Norms could also be described as social pressure influencing individuals to act in a certain way. The stronger the influence, the more likely the action will be performed in the manner described by the society (Fishbein and Ajzen, 2009). Recycling studies (Byrne and O'Regan, 2014; Knickmeyer, 2020; Timlett and Williams, 2009) have shown that norms or acceptable behaviours could be localised based on the prevailing narratives in the area or peer pressure influence. A good example is 'my neighbourhood recycles so I recycle' or 'my neighbourhood does not recycle so I do not recycle'.

Perceived control refers to the ability to act and self-confidence to project a successful outcome. This ability may include skills, awareness and other resources that may well include enabling and disabling factors to perform the required action (Fishbein and Ajzen, 2009). In the recycling behaviour context, a positive attitude coupled with positive societal norms and the ability to act (including enabling environment and positive intention) will result in positive recycling habits and an increase in

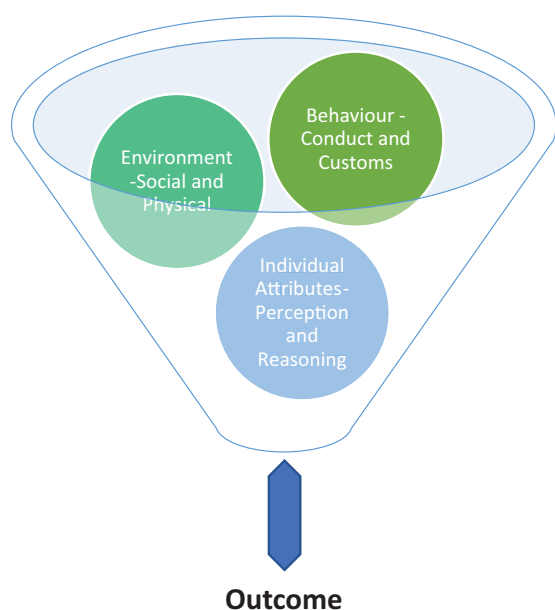


Figure 3. The social cognitive theory (SCT) based on Phipps et al. (2013).

recycling outputs (Sung et al., 2019). In contrast, a negative attitude from the inception of thought to act or not will lead to negative recycling behaviour. However, in reality, there will be other barriers or factors that may interact with the process and result in different behaviours. Rousta et al. (2020) reached the same conclusion in their study that human behavioural factors are major elements that either enable or act as barriers to carrying out recycling activities.

As an illustration, an individual may have a good attitude coupled with a positive disposition to societal norms and good intentions but lack the ability to perform the required actions (e.g. the lack of recycling infrastructure or resources to enable recycling), such individual will have no choice but to dispose of the recyclable materials as rubbish. Here, the good intentions and attitude were obstructed by external factors beyond the individual's control.

The SCT (Figure 3) proposed that learning takes place in a social setting influenced by the dynamic interplay between the personal, behaviour and the environment (Bandura, 1986). In this scenario, the three factors are interconnected rather than isolated in creating an outcome. There is a need to emphasise that the 'environment' in SCT includes both the 'physical and socio-cultural environment' different from the solely 'physical environment' in the environmental determinism theory. SCT is very useful in understanding the dynamics and complexity underlying different elements of sustainable consumption behaviours to facilitate relevant interventions (Phipps et al., 2013), which can also be applied to understanding individual or communal recycling behaviour and the prevailing situations. Extensive works (Bertoldo and Castro, 2016; Cerda Planas, 2018; Czajkowski et al., 2015; Kirakozian, 2016; Knussen and Yule, 2008; Peng et al., 2018; Taberner et al., 2015) have been carried out to link SCT to recycling behaviours.

Schill et al. (2020) used SCT to research children's recycling behaviour by exposing the children to different recycling settings. The results indicate that the level of recycling participation and compliance depends on each child's family setting, the position of the recycling point and family interaction influence. Here, the personal (knowledge), the environment (school or home) and the behaviour (past experiences) are at play in influencing different outcomes in different settings. Schill and Deirdre (2016) also found that selected interventions can be used to facilitate recycling habits. Similarly, exhibited recycling behaviours are based on attitudes, which in turn are influenced by adequate recycling awareness, accessible recycling infrastructure and not being constrained by situational factors (Tonglet et al., 2004).

Research carried out by the Institute of Leadership and Management (ILM, 2017) in 2017 shows that the younger generation (20–38 years) also known as millennials will constitute 50% of the UK workforce by 2020. It is therefore important to focus on this group to characterise their consumer behaviours.

Price (2018) detailed five characteristics of millennials with regard to the circular economy. Among these characteristics is the spending power of this age category as a prolific consumer group that will initiate greater demand for products and services specially tailored to their style and taste. Their high preference for online shopping has increased the flow of packaging waste which has necessitated the need to promote recycling education among the younger generation. Surveys carried out in the United Kingdom have indicated different recycling behaviours for the millennials. A poll of 3000 respondents carried out in 2017 found out that 49% of the age group 16–34 years always recycle compared to 70% of the age group 35–54 years who always recycle. The highest barrier to recycling cited by the younger population surveyed was the ambiguity in determining what materials can be recycled (Eichler, 2017).

A similar survey carried out by the waste company Veolia found that 71% of the age range 18–24 years have the opinion that the greatest responsibility to recycle lies with the local authorities compared to 58% of people over 55 years who share the same opinion (Watts, 2017). Another survey indicates that 78% of the age range 25–34 years are in the habit of recycling compared to 94% of people over the age of 55 years (Moss, 2018).

These surveys indicate that the younger generation is recycling less than the older generation. Therefore, the younger generation must be educated about the benefits of recycling, which is vital in embedding a circular economy in modern society – especially, considering that the younger generation is the future generation that will benefit most from the preservation of the environment.

Waste policy constraints

Many studies have identified policy constraints and limitations as one of the barriers in achieving a high recycling rate in the United Kingdom even though the same policies are geared towards this objective. Li and Wang (2021) surmised that recycling schemes can only be successful when policy or decision-making tools are aligned with citizen or public behaviour. Although the United

Kingdom has one of the more ambitious waste strategies to translate waste and resource management into a circular economy, these strategies lacked a robust process or system in place to achieve their objectives. Jordan et al. (2003) echoed the same concern that desired policy objectives do not always harmonise with stakeholders' capabilities to implement the required policy ambitions.

Most waste policy interventions are devoid of coproduction in terms of understanding the user's needs and situations and involving them in formulating strategies to resolve household recycling issues (Alfaia et al., 2017; Sewak et al., 2021). The non-involvement of citizens in formulating waste policies and strategies has resulted in public distrust in government waste policies, and thus a barrier to effective implementation of such policies (Drimili et al., 2020; Pollans, 2017). The majority of the citizens doubt whether the materials collected are genuinely recycled; many believed the materials are burned to generate electricity just like the rubbish collected, hence questioning the need to separate recyclable waste from non-recyclable waste.

Consultations carried out by DEFRA in 2012 on red tape bureaucracy with a specific theme on environmental regulation reported that stakeholders in the waste industry raise a concern about the complexity and inconsistent of 257 regulatory instruments within the UK environmental legislation framework (DEFRA, 2012). Such complexity, inconsistency and ambiguity are obstacles in delivering policy objectives (Ayçin and Kayapinar Kaya, 2021).

One of the shortcomings of waste policies and strategies in the United Kingdom is the non-recognition of adequate waste infrastructure and system to ensure source segregations of quality recyclable high-value materials for further processing into new products without recourse to virgin materials (Green Alliance, 2014). Policies are mainly directed to manufacturers, superstores, local authorities and waste companies but not to the householders who are primarily the producer of the waste. DEFRA (2019) identified that householders' compliance is fundamental to increasing the recycling rate. This then suggests that, at the national level, there is a gap in waste policies which may aim for a holistic approach to waste management in the United Kingdom.

The issue of non-direct charging of householders for waste generated meant that local authorities rely on council tax and national government grants to run effective waste and recycling schemes. With recent national government cutbacks on funds available to local authorities, it is natural that most councils will give much credence to waste management from economic viability approach rather than to meet national recycling targets (Entwistle, 1998.). Abbott et al. (2011) also asserted that the policy which prevents local authorities in the United Kingdom to charge households directly on the amount of waste they generate is fuelling negative incentives for the majority of householders to improve their recycling habits.

Users of recycling receptacles are often confused about which material to put in correct receptacles because of a wide range of different receptacles with different colours and labels provided

by the local authorities (Jesson and Stone, 2009); this situation and confusion are even more compounded if householders moved from one local authority area to another with receptacle provided in different colours and labels. This complexity and confusion stem from waste policies limitations in forging a uniform collection system among the local authorities for the whole of the United Kingdom (DEFRA, 2019). Schumaker (2016) suggested that one label is used for each material and adopted everywhere. Although it has been found that harmonising the collection system across the board may also create other problems (Knickmeyer, 2020); for example, the housing types and environmental behaviour vary in different local authority areas. Therefore, it has been argued that recycling schemes have to be tailored or modelled in line with local characteristics (Klockner and Oppedal, 2011).

The economic intervention or policy instrument to resolve the recycling problem is of two facets: the positive incentive gain (DRSs, vouchers and card points) and the negative incentive gain (fines and tax) that can be used to stimulate recycling habits in households. Mofid-Nakhaee et al. (2020) suggested that giving financial incentives to residents could promote effective recycling activities. Similarly, Zhou et al. (2021) applied the use of financial incentives to the residents where the residents see their recyclable materials as resources that they could trade to the waste collection companies for financial gain. This approach increased the recyclable waste collection by 229% in the community surveyed.

A comparison of the impact of financial penalties on the recycling rate worldwide carried out by Halvorsen (2012) found that the introduction of economic penalties resulted in negative effects. The introduction of penalties or 'pay as you throw' may increase incidents of waste fly-tipping or dumping in public places to avoid paying for waste disposal. In contrast, Ogiri et al. (2019) in their study of using a deterrence approach to nudge citizens to carry out recycling activities found that the introduction of negative incentives in form of fines and sanctions was a substantial factor in increasing residents' participation in recycling activities. Similarly, the plastic bag tax introduced in the United Kingdom has cut down the rate of plastic bag usage; the latest data published by DEFRA indicate an 85–95% reduction in the use of plastic bags, in the United Kingdom, between 2018 and 2020 (DEFRA, 2020c).

In Europe, the EU Packaging Directive (94/62/EC) was the driver behind the introduction of DRS for empty drink bottles and containers. The scheme has been largely successful in increasing the recycling rates of the EU member states with mandatory DRS (European Parliament, 2011). European Parliament (2011) briefing paper on review of DRS in some European countries found that there was between 82% and 98% return rate of bottles and cans. Denmark DRS was successful in achieving an 84% recycling rate through the implementation of a mandatory DRS for drinks containers. Other EU members states, such as Germany and Estonia, also achieved a high recycling rate and return as a result of DRS implementation (European Parliament, 2011). It can therefore be concluded that any financial penalties

or incentives to increase recycling need to be selective and targeted to certain recyclable materials to achieve effective implementation.

It is noteworthy that the United Kingdom is currently drafting contingency plans to implement the DRS in England (Circular, 2020). Scotland has already passed legislation to implement the scheme from July 2022 before which relevant infrastructure will be in place for the take-back scheme (Zero Waste Scotland, 2020). The scheme is also under consideration in Wales and Northern Ireland (BSDA, 2020). In introducing the DRS in the United Kingdom, Wiesmeth et al. (2018) cautioned that the scheme could only be effective if there are policy regulations that require mandatory rather than voluntary or informal deposits; in addition, such DRS must be managed, monitored and enforced by the government.

As a result of both past and current UK waste policies, the household recycling rate has increased (Abbott et al., 2011) from zero to the current 45% rate, and a shift in public behaviour and attitude towards recycling was observed. However, more work needs to be done on waste legislation to ensure future policies are formulated through stakeholders' collaborations in aligning shared objectives to achieve effective implementation (Norris, 2019).

Effective communication and public engagement

Recycling information and knowledge available to householders have been identified as one of the barriers to achieve a high recycling rate (Byrne and O'Regan, 2014; Lee, 2020; Miafodzyeva and Brandt, 2013). In terms of communication and resident engagement, the barriers may range from lack of public education or awareness on the benefit of recycling (Satapathy, 2017) to use of the language of instruction.

Ecoliteracy and environmental awareness play a significant role in influencing positive recycling activities of a low-income community surveyed (Al Mamun et al., 2018). This research suggested that intense public engagement can be strategically planned to target such communities to increase recycling output. Glad (2018) highlighted that the language of communication could be seen as discriminative if users or citizens within the community cannot all understand the language of communication. Therefore, the non-native English-speaking section of the community is formally excluded from recycling activities.

In the United Kingdom, in the absence of a national statutory regime, there is a variety of recycling regimes in operation. Therefore, many local authorities have taken advantage of this autonomy to introduce relevant intervention recycling schemes and collection systems to meet their national target of 50% (Cole et al., 2014) and specific local needs, such as housing types (Mühle et al., 2010) and prevailing demographical variation. A number of examples are illustrated below.

Bexley Council, a borough in Greater London Area, introduced a recycling scheme in 2011, branded as 'London Green

Points' to nudge and engage residents to increase their recycling behaviour. Under the scheme, residents are awarded accumulated green points every time they recycle to obtain vouchers from the local authority which can be used at local retailers. Bexley Council has achieved a 54.1% recycling rate in the 2018/2019 financial year (London Data Store, 2019), which is 4% above the national target; the green point scheme has been identified as a factor in achieving this success (Jump, 2020).

The Waste and Resources Action Programme (WRAP) designed a new communication strategy for Barrow Borough Council to implement a new recycling scheme in 2008. The council wants to introduce a separate collection for cardboard and plastic and replace the existing 240-L bin with a 120-L bin for weekly collection (WRAP, 2016a). As a result of the new scheme implementation, the council achieved an increase in recycling from 22% in 2007/2008 to 36% in 2009/2010 (WRAP, 2016a).

Newcastle-under-Lyme Borough Council introduced two-phased plans to implement a new kerbside service and a fortnightly waste collection accompanied by separate weekly food waste collections. To achieve the scheme objectives, the council formed a partnership with WRAP to help improve the council communication strategy and resident engagement approach. The scheme achieved a savings of £500,000 in the year 2010/2011 and the recycling rate increased from 27% to 50% (WRAP, 2016b).

Coventry City Council introduced a new larger mixed recycling 240-L bin collection and reduced smaller bins for residual waste. WRAP helped the council to design a communication strategy to increase resident participation and the recycling rate. After the scheme was implemented, the Council made a saving of £1m and a 6% increase in recycling rate (WRAP, 2016c).

These four UK local authorities' examples provide an insight into how different local authorities manage their recycling schemes differently as suggested by Klockner and Oppedal (2011). It also shows that majority of the UK local authorities are focussing more on communication campaigns (WRAP, 2014b) rather than carrying out in-depth studies and analyses to determine recycling behaviours. The only exception to this trend was Bexley's Green Point scheme that focuses on behavioural change through practical residents' involvement.

In summary, although communication has been identified as an important factor in influencing recycling, either positively through efficient recycling communication system or negatively through lack of awareness and recycling information (McDonald and Oates, 2003; WRAP, 2014b), other factors such as resident behaviours, situations, infrastructure and space also play important roles in influencing recycling rate or output (Timlett and Williams, 2011). Communication strategies employed by most local authorities in dealing with public recycling behaviour still depend on traditional approaches (Sewak et al., 2021), and therefore, there is a need to shift to contemporary methods of communication and residents' engagement to capture a wider audience.

As evident from the review, good communication strategy plays an important role (Chan, 1998; Lee and Krieger, 2020; Mee and Clewes, 2004) in creating awareness about the UK local

authorities' recycling programmes. Local authorities could also embark on programmes, such as residents' site tours of the recycling facilities for residents, so they can become familiar with what eventually happens to the materials collected from their households. This will dispel the recycling myth and doubts that all the materials collected are burned and there is no need to carry out source segregation. Public engagement through effective communication and organising awareness programmes to disseminate information on recycling schemes could nudge residents and householders to actively participate in recycling activities and ultimately result in a higher recycling rate.

Service constraints

The recycling services provided to the residents by the local authorities can create conditions that are either favourable or unfavourable to the recycling activities (Timlett and Williams, 2011; Yukalang et al., 2017). Similarly, Tsalis et al. (2018) surmised that effective recycling services are an important factor in enabling a high recycling rate. This assertion was elucidated through their study where bespoke recycling services were tailored to the specific needs of different communities.

This barrier seems to be localised in certain areas, and it is situational depending on local factors such as inadequate spaces to offer additional waste streams collection (e.g. food waste) or to hold or store a large number of recyclable materials for 7 days prior to the weekly collection service. Jatau and Binbol (2020) found that collection frequency is a factor that can increase the recycling rate in urban areas' flatted developments. Where storage space is scarce and residents rely on increased recycling collection frequency to keep up the recycling activities, these recycling materials will be lost to rubbish collection.

Less than half of councils in England (160 out of the 326) do not offer food waste collection (ITV, 2020). However, separate collection of household food waste can increase the recycling rate through a reduction in the volume of residual waste (Bernstad Saraiva et al., 2016; Sealey and Smith, 2014; Shearer et al., 2017). Therefore, local authorities with low recycling rates could benefit greatly by the introduction of borough-wide household food waste collection which can increase the borough recycling rate by at least 25%.

This assertion is evidenced from Table 2, which shows that local authorities with high recycling rates also have a high percentage of total recycling that is organic materials. For example, Stratford-on-Avon District Council recycling rate in 2019 is 60%, and the percentage of total organic that is recycling is also 60%. However, there are challenges to food waste collection, such as existing infrastructure may not be capable to support its separate collection and how food waste will be stored in flatted properties before its collection to prevent odour and rodent infestations.

Recommendations

It is a challenging task to generalise the barriers for household recycling and one general approach would not resolve all these

barriers due to specific localised conditions, prevailing situations and difficulty in predicting human behaviours. Nevertheless, the comprehensive literature review identified that the following barriers are essential to recycling in the United Kingdom: waste policy constraint, lack of effective communication /public engagement, physical barriers, service constraints, human factors and socio-economic barriers. These factors are interrelated and interdependent in most cases; when one factor is ineffective, it could result in a domino effect impacting the whole recycling system.

Out of all these barriers, the three main barriers appeared to be most impactful: the physical factors, the effectiveness of communication /public engagement employed and the influence of prevailing waste policy (Figure 4). These three main factors, therefore, need more conscientious effort in addressing the UK's low recycling rate.

The most fundamental of all the three main causes stated above is the constraint of the available waste policy in the United Kingdom. It is fundamental as it is the bedrock of how local authorities manage and collect household waste. An effective waste policy could address all the remaining factors and will propel the local authorities to launch or initiate effective service and required infrastructure to mitigate issues affecting the United Kingdom's low recycling output.

Furthermore, Ferronato et al. (2021) suggest the use of a selective recycling policy to target low-income communities, where neighbourhood associations in these areas can manage recycling activities to generate income for the residents and also to improve the recycling rate.

Based on these findings, the following are recommended (Figure 4):

- A co-production approach should be taken in formulating future waste policy and legislation through local community and neighbourhood involvement to gain insight into different local community situations and aligning legislature to address such situational context. Currently, no policy or regulation in England demands compulsory or mandatory recycling from householders. Therefore, the UK government should review the possibility of direct charging of residents for waste disposal to reduce the amount of waste generation and providing financial incentives to householders who recycle more of their household waste or better still make recycling a statutory or mandatory requirement on householders. This approach among other interventions will resolve the barriers associated with socio-economic factors.
- Local authorities' communication strategy should mirror contemporary communication tools and outlets to achieve effective communication and residents' engagement and eventually participation in recycling activities. The language of communication should be appropriate and relevant to local needs and requirements. Public engagement on recycling activities should also include the introduction of circular economy and sustainability topics in schools, colleges and universities curriculum

The Three Main Barriers Versus Solutions



Figure 4. Main barriers of households recycling and potential solutions.

to educate the younger generation about the benefits of recycling. Also, more importantly, to prepare the youth for future sustainable living.

Conclusion

To achieve a high recycling rate or meet the new recycling targets of 65% set by the UK government, it is important to highlight the key barriers and address them accordingly. Of the six constraints and factors presented in this review, three have been identified as the major barriers for household recycling: physical factors, the effectiveness of communication /public engagement employed and the influence of prevailing waste policy. Therefore, a multi-dimension strategy is needed, including a thorough review of waste policy, more stringent enforcement, improved communication strategy and a more integrated development/redevelopment plan to overcome these complex and multifaceted recycling challenges.

Acknowledgements

The authors thank the Westminster City Council for the project approval and financial support for S.O.'s Professional Studies Doctorate studentship.

Data availability statement

All cited articles are available in the public domain and the waste flow data can be obtained from the Waste Dataflow website: <https://www.wastedataflow.org/>

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship and/or publication of this article.

ORCID iD

Diane Purchase  <https://orcid.org/0000-0001-8071-4385>

References

- Abbott A, Nandeibam S and O'Shea L (2011) Explaining the variation in household recycling rates across the UK. *Ecological Economics* 70: 2214–2223.
- Ajzen I (1985) From intentions to actions: A theory of planned behavior. In: Kuhl J and Beckmann J (eds) *Action-Control: From Cognition to Behavior*. Heidelberg: Springer, pp.11–39.
- Ajzen I (1991) The theory of planned behavior. *Organizational Behavior and Human Decision Processes* 50: 179–211.
- Al Mamun A, Mohiuddin MA, Ghazali B, et al. (2018) Recycling intention and behavior among low-income households. *Sustainability* 10: 2407.
- Alfaia RG, Costa AM and Campos JC (2017) Municipal solid waste in Brazil: A review. *Waste Management & Research* 35: 1195–1209.
- Ando AW and Gosselin AY (2005) Recycling in multifamily dwellings: Does convenience matter? *Economic Inquiry* 43: 426–438.
- Ayçin E and Kayapinar Kaya S (2021) Towards the circular economy: Analysis of barriers to implementation of Turkey's zero waste management using the fuzzy DEMATEL method. *Waste Management & Research* 39: 1078–1089.
- Bandura A (1986) *Social Foundations of Thought and Action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice Hall.
- Barr A and Gilg A (2005) Conceptualising and analysing household attitudes and actions to a growing environmental problem: Development and application of a framework to guide local waste policy. *Applied Geography* 25: 226–247.
- Becker N (2014) Increasing High Recycling Rates, Socio-Demographics as an Additional Layer of Information to Improve Waste Management Lunds universitet Internationella miljöinstitutet (IHIEE). Available at: https://scholar.google.com/scholar_lookup?title=Increasing%20High%20Recycling%20Rates%2C%20SocioDemographics%20as%20an%20

- Additional%20Layer%20of%20Information%20to%20Improve%20Waste%20Management&publication_year=2014&author=N.%20Becker (accessed 26 November 2020).
- Bernstad Saraiva A, Davidsson Å and Bissmont M (2016) Lifecycle assessment of a system for food waste disposers to tank – A full-scale system evaluation. *Waste Management (Elmsford)* 54: 169–177.
- Bertoldo R and Castro P (2016) The outer influence inside us: Exploring the relation between social and personal norms. *Resources, Conservation and Recycling* 112: 45–53.
- BSDA (2020) Position Statements: Deposit Return Scheme. Available at: <https://www.britishsoftdrinks.com/Position-Statements/deposit-return-scheme> (accessed 22 December 2020).
- Byrne S and O'Regan B (2014) Attitudes and actions towards recycling behaviours in the Limerick, Ireland region. *Resources Conservation and Recycling* 87: 89–96.
- Cerda Planas L (2018) Moving toward greener societies: Moral motivation and green behaviour. *Environmental and Resource Economics* 70: 835–860.
- Chan K (1998) Mass communication and pro-environmental behaviour: Waste recycling in Hong Kong. *Journal of Environmental Management* 52: 317–325.
- Circular (2020) Designing a 'world-leading' deposit return scheme. Available at: <https://www.circularonline.co.uk/opinions/designing-a-world-leading-deposit-return-scheme/> (accessed 15 December 2020).
- Cole C, Qudus M, Wheatley A, et al. (2014) The impact of local authorities' interventions on household waste collection: A case study approach using time series modelling. *Waste Management (Elmsford)* 34: 266–272.
- Communities and Local Government (2007) National Indicators for Local Authorities and Local Authority Partnerships: Handbook of Definitions. Available at: https://www.wastedataflow.org/documents/guidancenotes/NationalIndicators/GN31_Handbook_Definitions_1.0.pdf (accessed 25 April 2021).
- Costa I, Massard G and Agarwal A (2010) Waste management policies for industrial symbiosis development: Case studies in European countries. *Journal of Cleaner Production* 18: 815–822.
- Czajkowski M, Hanley N and Nyborg K (2015) Social norms, morals and self-interest as determinants of pro-environment behaviours: The case of household recycling. *Environmental and Resource Economics* 66: 647–670.
- Dai X, Yuping H, Xiaohong Z, et al. (2017) Comparison between students and residents on determinants of willingness to separate waste and waste separation behaviour in Zhengzhou, China. *Waste Management & Research* 35: 949–957.
- De Feo G and De Gisi S (2010) Public opinion and awareness towards MSW and separate collection programmes: A sociological procedure for selecting areas and citizens with a low level of knowledge. *Waste Management* 30: 958–976.
- DEFRA (2006) Changing behaviour through policy making. Sustainable development unit, Defra. Available at: <http://www.sustainable-development.gov.uk/what/priority/pdf/change-behaviour-model.pdf> (accessed 19 October 2020).
- DEFRA (2012) Red Tape Challenge – Environment Theme Proposals. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69584/pb13728-red-tape-environment.pdf (accessed 8 December 2020).
- DEFRA (2019) Consistency in recycling collections in England: Executive summary and government response. Available at: <https://www.gov.uk/government/consultations/waste-and-recycling-making-recycling-collections-consistent-in-england/outcome/consistency-in-recycling-collections-in-england-executive-summary-and-government-response> (accessed 10 December 2020).
- DEFRA (2020a) UK Statistics on Waste. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/918270/UK_Statistics_on_Waste_statistical_notice_March_2020_accessible_FINAL_updated_size_12.pdf (accessed 1 March 2021).
- DEFRA (2020b) ENV18 – Local Authority Collected Waste: Annual Results Tables. Available at: <https://www.gov.uk/government/statistical-data-sets/env18-local-authority-collected-waste-annual-results-tables> (accessed 3 March 2021).
- DEFRA (2020c) Single-use plastic carrier bags charge: Data in England for 2019 to 2020. Available at: <https://www.gov.uk/government/publications/carrier-bag-charge-summary-of-data-in-england/single-use-plastic-carrier-bags-charge-data-in-england-for-2019-to-2020> (accessed 23 November 2020).
- Díaz-Meneses G and Vilkaite-Vaitone N (2020) Pinpointing the barriers to recycling at destination. *Sustainability* 12: 2635.
- Drimili E, Herrero-Martin R, Suardiaz-Muro J, et al. (2020) Public views and attitudes about municipal waste management: Empirical evidence from Athens, Greece. *Waste Management & Research* 38: 614–625.
- Du Toit J and Wagner C (2020) The effect of housing type on householders' self-reported participation in recycling. *Smart and Sustainable Built Environment* 9: 395–412.
- Eagly AH and Chaiken S (2005) Attitude research in the 21st century: The current state of knowledge. In: Albaraccín D, Johnson BT and Zanna MP (eds) *The Handbook of Attitudes*. Mahwah, NJ: Erlbaum, pp.743–767.
- Eichler W (2017) Millennials 'apathetic' about recycling, survey reveals. Available at: <https://www.localgov.co.uk/Millennials-apatetic-about-recycling-survey-reveals/44162> (accessed 22 September 2021).
- Entwistle T (1998) The ironic compatibility of recycling practice and UK government policy. *Local Environment* 3: 55–65.
- European Commission (2020) Directive 2008/98/EC on waste (Waste Framework Directive). Available at: <https://ec.europa.eu/environment/waste/framework/> (accessed 26 December 2020).
- European Parliament (2011) A European refunding scheme for drinks containers. Available at: [https://www.europarl.europa.eu/RegData/etudes/note/JOIN/2011/457065/IPOL-AFET_NT\(2011\)457065_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/note/JOIN/2011/457065/IPOL-AFET_NT(2011)457065_EN.pdf) (accessed 23 November 2020).
- Ferronato N, Portillo MAG, Lizarazu GEG, et al. (2021) Formal and informal waste selective collection in developing megacities: Analysis of residents' involvement in Bolivia. *Waste Management & Research* 39: 108–121.
- Fishbein M and Ajzen I (2009) *Predicting and Changing Behavior: The Reasoned Action Approach*. London: Taylor & Francis Group.
- Glad W (2018) Spaces for waste: Everyday recycling and sociospatial relationships. *Scottish Geographical Journal* 134: 141–157.
- Green Alliance (2014) Wasted opportunities: Smarter systems for resource recovery. A report from the Circular Economy Task Force. Available at: https://www.green-alliance.org.uk/resources/Wasted_opportunities.pdf (accessed 7 December 2020).
- Halvorsen B (2012) Effects of norms and policy incentives on household recycling: An international comparison. *Resources, Conservation and Recycling* 67: 18–26. Available at: <https://doi.org/10.1016/j.resconrec.2012.06.008> (accessed 12 February 2020).
- HM Treasury (2018) Tackling the plastic problem Using the tax system or charges to address single-use plastic waste. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/690293/PU2154_Call_for_evidence_plastics_web.pdf (accessed 12 December 2020).
- Institute of Leadership and Management (ILM) (2017) Workforce 2020: Managing Millennials. Available at: <https://www.institutelm.com/resourceLibrary/workforce-2020-managing-millennials.html> (accessed 17 September 2021).
- ITV (2020) Councils face rolling out food waste collections to millions more homes. Available at: <https://www.itv.com/news/2020-02-10/councils-face-rolling-out-food-waste-collections-to-millions-more-homes> (accessed 8 March 2021).
- Iyer ES and Kashyap RK (2007) Consumer Recycling: Role of incentives, information, and social class. *Journal of Consumer Behaviour* 6: 32–47. Available at: <http://dx.doi.org/10.1002/cb.206>
- Jatau S and Binbol NL (2020) Assessing barriers to household waste recycling: A case study of Coventry University postgraduate students. *International Journal of Scientific and Research Publications (IJSRP)* 10: 542–549.
- Jenkins RR, Martinez SA, Palmer K, et al. (2003) The determinants of household recycling: A material-specific analysis of recycling program features and unit pricing. *Journal of Environmental Economics and Management* 45: 294–318. Available at: [https://doi.org/10.1016/S0095-0696\(02\)00054-2](https://doi.org/10.1016/S0095-0696(02)00054-2) (accessed 19 October 2020).
- Jesson J and Stone I (2009) A Review of Barriers to Kerbside Recycling Household Waste in the UK. Available at: <http://citeseerx.ist.psu.edu/>

- viewdoc/download?doi=10.1.1.426.9631&rep=rep1&type=pdf (accessed 8 December 2020).
- Jordan A, Wurzel RKW, Zito R, et al. (2003) Policy innovation or ‘muddling through’? ‘New’ environmental policy instruments in the United Kingdom. *Environmental Politics* 12: 179–200.
- Jump (2020) Case Study: London Green Points – Bexley. Available at: <https://teamjump.co.uk/case-studies/> (accessed 14 December 2020).
- Keighren IM (2015) Environmental determinism. In: Keighren IM (ed.) *International Encyclopedia of the Social & Behavioral Sciences* (2nd edn). Oxford: Elsevier, pp.720–725.
- Kirakozian A (2016) ONE without the other? Behavioural and incentive policies for household waste management. *Journal of Economic Surveys* 30: 526–551.
- Klockner CA and Oppedal IO (2011) General vs. domain specific recycling behaviour -applying a multilevel comprehensive action determination model to recycling in Norwegian student homes. *Resources, Conservation and Recycling* 55: 463–471.
- Knickmeyer D (2020) Social factors influencing household waste separation: A literature review on good practices to improve the recycling performance of urban areas. *Journal of Cleaner Production* 245: 118605.
- Knussen C and Yule F (2008) I’m not in the habit of recycling: The role of habitual behavior in the disposal of household waste. *Environment and Behavior* 40: 683–702.
- Lee D and Krieger JL (2020) Moving from directives toward audience empowerment: A typology of recycling communication strategies of local governments. *Sustainability (Basel, Switzerland)* 12: 2722.
- Lee DS (2020) Restructuring municipal solid waste management and governance in Hong Kong: Options and prospects. *Waste Management & Research* 38: 1047–1063.
- Letelier C, Blazquez C and Paredes-Belmar G (2021) Solving the bin location-allocation problem for household and recycle waste generated in the commune of Renca in Santiago, Chile. *Waste Management & Research*. Epub ahead of print 20 January. DOI: 10.1177/0734242X20986610.
- Lethwaite G (1966) Environmentalism and determinism: A search for clarification. *Annals of the Association of American Geographers* 56: 1–23.
- Li C, Wang Y, Huang Y, et al. (2020a) The incentives may not be the incentive: A field experiment in recycling of residential food waste. *Resources, Conservation and Recycling*. Available at: <https://doi.org/10.1016/j.resconrec.2020.105316>
- Li C, Zhang Y, Nouvellet P, et al. (2020b) Distance is a barrier to recycling – Or is it? Surprises from a clean test. *Waste Management* 108: 183–188.
- Li W and Wang J (2021) Feasibility study of the unit pricing system for household wastes sorting in the context of China. *Waste Management & Research*. Epub ahead of print 8 February. DOI: 10.1177/0734242X20988783.
- Liu JH and Sibley CG (2004) Attitudes and behavior in social space: Public good interventions based on shared representations and environmental influences. *Journal of Environmental Psychology* 24: 373–384.
- Local Government Association (2018) Local Government Association Briefing Resources and Waste Strategy summary Borough. Available at: <https://www.local.gov.uk/sites/default/files/documents/LGA%20briefing%20-%20RW%20strategy%2020122018.pdf> (accessed 26 December 2020).
- London Data Store (2019) Household Waste Recycling Rates, Borough. Available at: <https://data.london.gov.uk/download/household-waste-recycling-rates-borough/6f7bc5cd-217b-4eed-9450-af086f17908e/household-recycling-borough.xls> (accessed 26 June 2019).
- McDonald S and Oates C (2003) Reasons for non-participation in a kerbside recycling scheme. *Resources, Conservation and Recycling* 39: 369–385.
- Mee N and Clewes D (2004) The influence of corporate communications on recycling behaviour. *Corporate Communications* 9: 265–275.
- Mee N, Clewes D, Phillips PS, et al. (2004) Effective implementation of a marketing communications strategy for kerbside recycling: A case study from Rushcliffe, UK. *Resources Conservation and Recycling* 42: 1–26.
- Miafodzyeva S and Brandt N (2013) Recycling behaviour among householders: Synthesizing determinants via a meta-analysis. *Waste and Biomass Valorization* 4: 221–235.
- Michie S, Johnston M, Abraham C, et al. (2005) Making psychological theory useful for implementing evidence based practice: A consensus approach. *Quality & Safety in Health Care* 14: 26–33.
- Mofid-Nakhaee E, Barzinpour F and Pishvae MS (2020) A sustainable municipal solid waste system design considering public awareness and education: A case study. *Waste Management & Research* 38: 626–638.
- Moss R (2018) Millennials Less Likely to Recycle Than Older Generations. Available at: https://www.huffingtonpost.co.uk/entry/woke-millennials-less-likely-to-recycle-than-older-generations_uk_5aab86f6e4b05b2217fdbd1f (accessed 22 September 2021).
- Mühle S, Balsam I and Cheeseman CR (2010) Comparison of carbon emissions associated with municipal solid waste management in Germany and the UK. *Resources, Conservation and Recycling* 54: 793–801.
- Norris L (2019) Waste, dirt and desire: Fashioning narratives of material regeneration. *Sociology Review* 67: 886–907.
- Ogiri IA, Sidiq SF, Talib MA, et al. (2019) Encouraging recycling among households in Malaysia: Does deterrence matter? *Waste Management & Research* 37: 755–762.
- Önder H (2018) The socio-economic determiners of recycling: An analysis on European countries through a macro perspective. *Amfiteatru Economic* 20: 405–417. Available at: https://www.researchgate.net/publication/326178025_The_SocioEconomic_Determiners_of_Recycling_An_Analysis_on_European_Countries_Through_a_Macro_Perspective (accessed 28 November 2020).
- Peng B, Tu Y and Wei G (2018) Governance of electronic waste recycling based on social capital embeddedness theory. *Journal of Cleaner Production* 187: 29–36.
- Phipps M, Ozanne LK, Luchs MG, et al. (2013) Understanding the inherent complexity of sustainable consumption: A social cognitive framework. *Journal of Business Research* 66: 1227–1234.
- Pollans LB (2017) Trapped in trash: ‘Modes of governing’ and barriers to transitioning to sustainable waste management’. *Environment and Planning A: Economy and Space* 49: 2300–2323.
- Prestin A and Pearce K (2010) We care a lot: Formative research for a social marketing campaign to promote school-based recycling. *Resources, Conservation and Recycling*; 54: 1017–1026.
- Price T (2018) Millennials and the Circular Economy: The New Green Generation. Available at: <https://www.dssmith.com/recycling/insights/blogs/2018/10/millennials-and-the-circular-economy-the-new-green-generation> (accessed 17 September 2021).
- Rodríguez OH and Camilli CX (2018) The neurobiological and environmental origin of ethics: Analysis of biological, social and religious determinism. *Bioethics Update* 4: 92–102.
- Rousta K, Zisen L and Hellwig C (2020) Household waste sorting participation in developing countries – A meta-analysis. *Recycling* 5: 6.
- Satapathy S (2017) An analysis of barriers for plastic recycling in the Indian plastic industry. *Benchmarking: An International Journal* 24: 415–430.
- Schill M, Godefroit-Winkel D and Hogg MK (2020) Young children’s consumer agency: The case of French children and recycling. *Journal of Business Research* 110: 292–305.
- Schill S and Deirdre S (2016) Recycling today, sustainability tomorrow: Effects of psychological distance on behavioural practice. *European Management Journal* 34: 349–362.
- Schumaker E (2016) The Psychology Behind Why People Don’t Recycle, 3 August. Available at: https://www.huffingtonpost.com/entry/psychology-of-why-peopledont-recycle_us_57697a7be4b087b70be605b3?guccounter=1 (accessed 9 December 2020).
- Sealey KS and Smith J (2014) Recycling for small island tourism developments: Food waste composting at Sandals Emerald Bay, Exuma, Bahamas. *Resources, Conservation and Recycling* 92: 25–37.
- Seng B, Fujiwara T and Spoann V (2018) Households’ knowledge, attitudes, and practices toward solid waste management in suburbs of Phnom Penh, Cambodia. *Waste Management & Research* 36: 993–1000.
- Sewak A, Kim J, Rundle-Thiele S, et al. (2021) Influencing household-level waste-sorting and composting behaviour: What works? A systematic review (1995–2020) of waste management interventions. *Waste Management & Research* 39: 892–909.
- Shearer L, Gatersleben B, Morse S, et al. (2017) A problem unstuck? Evaluating the effectiveness of sticker prompts for encouraging household food waste recycling behaviour. *Waste Management (Elmsford)* 60: 164–172.

- Smith L and Bolton P (2018) Research Briefing: Household Recycling in the UK. Available at: <https://commonslibrary.parliament.uk/research-briefings/cbp-7285/> (accessed 16 September 2021).
- Sung K, Cooper T and Kettley S (2019) Developing interventions for scaling up UK upcycling. *Energies* 12: 2778.
- Taberner C, Hernández B, Cuadrado E, et al. (2015) A multilevel perspective to explain recycling behaviour in communities. *Journal of Environmental Management* 159: 192–201.
- Thaler RH and Sunstein A (2008) *Nudge: Improving Decisions about Health, Wealth and Happiness*. New Haven, CT: Yale University Press.
- Timlett R and Williams ID (2011) The ISB model (infrastructure, service, behaviour): A tool for waste practitioners. *Waste Management* 31: 1381–1392. Available at: <https://www.sciencedirect.com/science/article/pii/S0956053X10006288?via%3DIihub> (accessed 22 February 2019).
- Timlett RE and Williams ID (2009) The impact of transient populations on recycling behaviour in a densely populated urban environment. *Resources, Conservation and Recycling* 53: 498–506.
- Tonglet M, Phillips PS and Bates MP (2004) Determining the drivers for householder pro-environmental behaviour: Waste minimisation compared to recycling. *Resources, Conservation and Recycling* 42: 27–48.
- Tsalis T, Amarantidou S, Calabró P, et al. (2018) Door-to-door recyclables collection programmes: Willingness to participate and influential factors with a case study in the city of Xanthi (Greece). *Waste Management & Research* 36: 760–766.
- Turner DA, Williams ID and Kemp S (2015) Greenhouse gas emission factors for recycling of source-segregated waste materials. *Resources, Conservation and Recycling* 105: 186–197.
- Vicente P and Reis E (2007) Segmenting households according to recycling attitudes in a Portuguese urban area. *Resources, Conservation and Recycling* 52: 1–12.
- Vieira V and Matheus DR (2018) The impact of socioeconomic factors on municipal solid waste generation in São Paulo, Brazil. *Waste Management & Research* 36: 79–85.
- Watts A (2017) No Recycling Please – We’re Millennials. Available at: <https://www.recyclingbins.co.uk/blog/no-recycling-please-were-millennials/> (accessed 22 September 2021).
- Westminster City Council (WCC) (2018) City of Westminster Profile. Available at: https://www.westminster.gov.uk/sites/default/files/city_profile.pdf (accessed 6 October 2020).
- Wiesmeth H, Shavgulidze N and Tevzadze N (2018) Environmental policies for drinks packaging in Georgia: A mini-review of EPR policies with a focus on incentive compatibility. *Waste Management & Research* 36: 1004–1015.
- WRAP (2008) Kerbside recycling: Indicative costs and performance Available at: <https://wrap.org.uk/resources/guide/kerbside-recycling-indicative-costs-and-performance> (accessed 27 April 2021).
- WRAP (2014a) Barriers to recycling: A review of evidence since 2008. Available at: <https://wrap.org.uk/sites/files/wrap/WRAP%20Barriers%20Synthesis%20Full%20Report%20final%20121214%20PUBLISHED%20-%20PDF.pdf> (accessed 9 December 2020).
- WRAP (2014b) Systematic Survey of Local Authority Plans for Waste and Recycling Services in England. Available at: <https://www.wrap.org.uk/sites/files/wrap/Local%20Authority%20Survey%20Report%20240316.pdf> (accessed 16 December 2020).
- WRAP (2016a) Local Authority Communications Case Study: Barrow Borough Council. Available at: <https://www.wrap.org.uk/collections-and-reprocessing/resident-communications/case-studies/local-authority-communications-case-study-barrow> (accessed 14 December 2020).
- WRAP (2016b) Communications to Support the Introduction of a New Waste and Recycling Service: Newcastle-under-Lyme Borough Council Available at: <https://www.wrap.org.uk/content/communications-support-introduction-new-waste-and-recycling-service-newcastle-under-lymebor> (accessed 15 December 2020).
- WRAP (2016c) Introducing a New Recycling Service to All Residents: Coventry City Council. Available at: <https://www.wrap.org.uk/cy/collections-and-reprocessing/resident-communications/case-studies/introducing-new-recycling-service-all-residents> (accessed 16 December 2020).
- Yakob H, Abd Rauf NRA, Abdullah YA, et al. (2020) Factors that contribute to domestic waste recycling: A preliminary survey. *Environment-Behaviour Proceedings Journal* 5: 415–422.
- Yau Y (2012) Stakeholder engagement in waste recycling in a high-rise setting. *Sustainable Development* 20: 115–127.
- Yukalang N, Clarke B and Ross K (2017) Barriers to effective municipal solid waste management in a rapidly urbanizing area in Thailand. *International Journal of Environmental Research and Public Health* 14: 1013.
- Zero Waste Scotland (2020) Scotland’s Deposit Return Scheme. Available at: <https://depositreturnscheme.zerowastescotland.org.uk/> (accessed 22 December 2020).
- Zhou J, Jiang P, Yang J, et al. (2021) Designing a smart incentive-based recycling system for household recyclable waste. *Waste Management (New York, N.Y.)* 123: 142–153.

Appendix A2 - Google Scholar citations of the published review paper

Saeed Oluwadipe
Middlesex University
Verified email at westminster.gov.uk
waste management

TITLE	CITED BY	YEAR
A critical review of household recycling barriers in the United Kingdom S Oluwadipe, H Garelick, S McCarthy, D Purchase Waste Management & Research 40 (7), 905-918	11	2022
Investigating Household Recycling Barriers in Westminster City, UK S Oluwadipe, D Purchase, H Garelick, S McCarthy, H Jones	1	2022

Articles 1-2 SHOW MORE

	All	Since 2018
Citations	11	11
h-index	1	1
i10-index	1	1

8
4
0
2022 2023

[A case study of unwillingness toward PET bottle recycling behaviors-a new contingent valuation approach which requests only simple comparison of perceptive ...](#)

[D Dilixiati, S Suzuki, H Yoshida, F Takahashi - ... Conservation and Recycling, 2023 - Elsevier](#)

This study aims to answer why the quality of PET bottles collected from supermarkets and public waste drop-off stations waste were contrastingly high and poor, respectively. This ...
[SaveCite](#)

[\[HTML\] Nudging student recycling behaviour: An experimental study in Kazakhstan and UK higher education](#)

[G Lakshmi, K Nguyen, A Mazhikeyev... - Journal of Cleaner ..., 2022 - Elsevier](#)

We study the effects of influencing the recycling decisions of young people in the UK and Kazakhstan Universities using a public good experiment with an information nudge (through ...

[SaveCiteAll 4 versions](#)

[PDF] [mdpi.com](https://www.mdpi.com)

Potential analysis of the plastics value chain for enhanced recycling rates: a case study in Iceland

M Mager, I Traxler, J Fischer, DC Finger - Recycling, 2022 - [mdpi.com](https://www.mdpi.com)

In light of the circular economy gaining momentum, plastics recycling is regarded as a key solution to keep materials in the loop. Continuous efforts are needed to achieve the ...

[SaveCiteAll 5 versions](#)

[PDF] [cambridge.org](https://www.cambridge.org)

The Simple Bare Necessities: Scales and Paradoxes of Thrift on a London Public Housing Estate

C Alexander - Comparative Studies in Society and History, 2022 - [cambridge.org](https://www.cambridge.org)

This article tracks how a trope of middle-class household thrift, grounded on the autarchic Aristotelian oikos, has long fuelled derogatory discourses in Britain aimed at low-income ...

[SaveCiteRelated articlesAll 3 versions](#)

[PDF] [researchgate.net](https://www.researchgate.net)

[PDF] Extended discussion paper from AA-CEAP1

Subgroup 3: consumer behaviour

J Cristóbal, E Pierri, I Antonopoulos, H Bruns, G Foster... - 2022 - [researchgate.net](https://www.researchgate.net)

Municipal solid waste management systems vary greatly across Europe. However, due to the Waste Framework Directive and the Circular Economy Action Plan, they share the ...

[SaveCiteAll 2 versions](#)

[PDF] [undip.ac.id](https://www.undip.ac.id)

[PDF] Improvement of Waste Management Through Community Awareness of Plastic Controlling in Garang Watershed, Semarang City, Indonesia

T Triadi Putranto - doc-pak.undip.ac.id

This study aims to analyze the condition and awareness of community plastic waste management in the Garang watershed to increase institutional capacity in reducing plastic ...

[SaveCiteAll 2 versions](#)

[PDF] [diva-portal.org](https://www.diva-portal.org)

Hjälpmedel för spårning och rapportering av avfall

A Sahlin, R Kramare, E Birgersson, M Englund... - 2022 - [diva-portal.org](https://www.diva-portal.org)

Denna rapport redogör för ett projekt utfärdat av sju teknologer vid Linköpings universitet som en del av kursen TDDD96 Kandidatprojekt i programvaruutveckling på uppdrag av ...

[SaveCiteAll 2 versions](#)

[HTML] [mdpi.com](https://www.mdpi.com)

[HTML] Life Cycle Assessments of Takeaway Food and Beverage Packaging: The Role of Consumer Behavior

J Caspers, E Süßbauer, VC Coroama, M Finkbeiner - Sustainability, 2023 - [mdpi.com](https://www.mdpi.com)

Consumer behavior can significantly influence the environmental impact of products. Takeaway food and beverage packaging can be assumed to be an example of this effect, as ...

[SaveCiteAll 4 versions](#)

[\[PDF\] undip.ac.id](#)

[\[PDF\] Improvement of Waste Management Through
Community Awareness of Plastic Controlling in Garang
Watershed, Semarang City, Indonesia](#)

[W Setyaningsih, H Hadiyanto, TT Putranto - Planning, 2022 - doc-pak.undip.ac.id](#)

Accepted: 16 March 2022 This study aims to analyze the condition and awareness of community plastic waste management in the Garang watershed to increase institutional ...

[SaveCite](#)

[Using Web 3D and WebXR Game to Enhance
Engagement in Primary School Learning](#)

[X Guo, I Mogra - 2022 IEEE International Symposium on ..., 2022 - ieeexplore.ieee.org](#)

Plastic recycling has been a global issue for many years. Thus, it is important to provide education to today's youth. However, designing an efficient learning resource for primary ...

[SaveCiteAll 2 versions](#)

[\[PDF\] mdpi.comFull View](#)

[Self-Reported Household Waste Recycling and
Segregation Practices among Families in Eastern Region
of Saudi Arabia: A Cross-Sectional Study](#)

[YM Elmosaad, AM Al Rajeh, MBB Llaguno... - International Journal of ..., 2023 - mdpi.com](#)

Self-Reported Household Waste Recycling and Segregation Practices among Families in Eastern Region of Saudi Arabia: A Cross-Sect Page 1 Int. J. Environ. Res. Public Health 2023 ...

[SaveCiteRelated articlesAll 3 versions](#)

Appendix B- Pilot In-depth Interview Guide- Residents

1. How long have you lived in the City of Westminster?
2. What ward do you live in the City of Westminster?
3. What is your level of education?
4. What is your age?
5. What is your occupation?
6. What do you understand to be recycling?
7. What do you understand by the term “cross contamination” in relation to waste and recycling?
8. What are the types of recyclable materials that do you generate?
9. Do you recycle all these recyclable materials?
10. Are you consistent with your recycling habit? Please explain
11. How many people are in your household?
12. If everyone in your household is not keen to recycle or have passion for recycling, how do you manage the situation?
13. Is there enough space for internal bins storage for segregated waste and recycling within your flat or house?
14. Is there enough external bin storage for segregated waste and recycling?
15. How far are the external bins to your flat entrance?
16. Please specify the types of external bins.
17. How do you differentiate which of these external bins to use in putting different items into them?

18. If these external recycling bins are already filled to the top, when you accessed them, what do you do with your recyclable materials?
19. Please could you identify any obstacles or barriers to recycle properly or to put recyclable materials in segregated external bins?
20. How do you avoid or prevent contamination of the recycling bins?
21. How does the council communicate with you about recycling?
22. Do you think this communication mode effective and why?
23. How do you want to be contacted by the council to enhance effective communication?
24. Are there any suggestions on how the council can help you to recycle more?
25. Tell me briefly about your recycling experience as a resident living in the City of Westminster.
26. The Westminster City Council have one lowest recycling rate in London and in the country, what do you think in your own opinion and experience is causing this low rate?

Appendix C- Main In-Depth Interview Guide Residents

1. How long have you lived in the City of Westminster?
2. What is your level of education?
3. What is your occupation?
4. In general, what do you understand to be mixed recycling?
5. What do you understand by the term “contamination” in relation to rubbish and mixed recycling?
6. How do you manage storage of rubbish and mixed recycling to avoid contamination?
7. How consistent are you in carrying out your recycling habit? Please explain
8. Is there enough space for internal bins storage for segregated rubbish and recycling within your flat or house?
9. Is there enough external bin storage for segregated rubbish and recycling?
10. If these external recycling bins are already filled to the top, when you accessed them, what do you do with your recyclable materials?
11. When the chute is blocked as you said, do some people leave the recycling and the waste near the chute instead of taking it to the bins on the ground floor?
12. Please could you identify any barriers to recycle properly?
13. Will that be because you have two readily accessible chutes for you to use. One for recycling and one for waste that is allowing you to recycle more properly.
14. How does the council communicate with you about recycling?
15. Do you think these communication methods are effective and why?
16. How do you want to be contacted by the council to encourage you to recycle correctly?
17. The Westminster City Council have one lowest recycling rate in London and in the country, what do you think in your own opinion and experience is causing this low rate?
18. What is your view on incentives to drive residents to recycle more?
19. Do you think incentives will motivate you to recycle more?

20. Do you think reduced rubbish collection frequency would help you to recycle more?
21. Tell me briefly about your recycling experience as a resident living in the City of Westminster.
22. Are there any suggestions on how the council can help you to recycle more?

Appendix D - Pilot Self-Completed Questionnaire (Residents)

1. How long have you lived in the City of Westminster?

- A. 0-5 years
- B. 6-10 years
- C. 11-16 years
- D. over 16 years

2. What is your level of education?

- A. No Education
- B. Primary School
- C. Middle School or Junior High
- D. High School
- E. Vocational College
- F. Diploma
- G. Bachelor's Degree
- H. Master's degree
- I. PhD

3. What is your age bracket?

- A. 16-25 years
- B. 26-35 years
- C. 36-45 years
- D. 46-54 years
- E. over 55 years

4. What type of residence do you live in?

- A. House
- B. Flat
- C. Shared house
- D. Shared flat
- E. Hostel accommodation

5. Is this accommodation (Note: This question is irrelevant as it does not affect how people recycle)

- A. Private rented
- B. Council rented
- C. Housing Association
- D. Owned
- E. Don't know

6. How many people are in your household age 18 and above?

- A. 1
- B. 2
- C. 3
- D. 4
- E. 5
- F. More than 5

7. Who in your household or how many people in your household, recycle unwanted mixed recyclable materials (such as plastics tubs, pots, tray and bottles, food and drink tin cans, glass, paper, Tetrapaks and cardboards)

- A. Only one person recycles in my household
- B. Only two persons recycles in my household
- C. Only three persons recycles in my household
- D. Only four persons recycles in my household
- E. Everybody in my household recycles

8. Which ward do you live in the City of Westminster? Drop down box

- A. Abbey Road Ward
- B. Bayswater Ward
- C. Bryanston and Dorset Ward
- D. Church Street Ward
- E. Churchill Ward
- F. Harrow Road Ward
- G. Hyde Park Ward
- H. Knightsbridge and Belgravia Ward
- I. Lancaster Gate Ward
- J. Little Venice Ward
- K. Maida Vale Ward
- L. Marylebone High Street Ward
- M. Queens Park Ward
- N. Regent's Park Ward
- O. St James's Ward
- P. Tachbrook Ward
- Q. Vincent Square Ward
- R. Warwick Ward
- S. West End Ward
- T. Westbourne Ward

9. Do you usually experience waste dumping or fly tipping in your area or ward? (Note: 5 out of the 9 respondents said NO)

- A. No
- B. Yes
- C. Sometimes
- D. Don't Know

10. Do you recycle any of your unwanted mixed recyclable materials (such as plastics tubs, pots, tray and bottles, food and drink tin cans, glass, paper, Tetrapaks and cardboards)? Attach a photo

- A. No
- B. Yes

11. How consistent are you in carrying out mixed recycling (of plastics tubs, pots, tray and bottles, food and drink tin cans, glass, paper, Tetrapaks and cardboards)? Attach a photo

- A. I always recycle all unwanted mixed recyclable materials
- B. I sometimes recycle some unwanted mixed recyclable materials
- C. I only recycle unwanted mixed recyclable materials when I feel like it
- D. I never recycle unwanted mixed recyclable materials

12. If you put the rubbish in the mixed recycling bin by mistake or you put the mixed recycling material in the rubbish bin by mistake, do you try to remove the material and then place it in the correct bin?

- A. No
- B. Yes, always
- C. Yes, sometimes
- D. This never happens to me

13. Do you clean your mixed recyclable materials (such as drink bottles and food cans) before putting it in the recyclable bins to avoid contamination? (Note: I have been advised by my waste operation team that not cleaning the containers is not a problem. The real problem is cross contamination where rubbish is put inside a recycling bin. Q13 has addressed this issue)

- A. Yes, always
- B. Yes, sometimes

C. No, I just put the recyclable materials in the recycling bin without cleaning

D. No, I do not recycle

14. Which of the following factors makes you more conscious, motivate and influence you to carry out mixed recycling appropriately? Tick all that applies.

- A. Knowledge and awareness of the environmental benefits and harm
- B. The blue planet effects
- C. Moral obligations- It is the right thing to do
- D. Recycling is now a modern trend /norm
- E. All my neighbours recycle, and I don't want to be different
- F. My neighbours do not recycle, so I do not recycle
- G. I am not motivated to recycle

15. Do you have enough internal space for two separate bins, one for mixed recycling and one for rubbish in your flat, house or hostel accommodation?

- A. Yes, there is space and I have two separate internal bins for recycling and rubbish
- B. Yes, there is space, but I only have one internal bin for both rubbish and recycling
- C. No, I am struggling with space, but I manage to have two internal separate bins for recycling and rubbish
- D. No, there is not enough space, I only have one internal bin for both rubbish and recycling

16. Do you have enough external space for two separate bins (or black recycling boxes if you live in a house), one for mixed recycling and one for rubbish in your place of residence?

- A. Yes, there is space, and we have different external bins for mixed recycling and rubbish
- B. Yes, there is space, but we only have one type of external bins for rubbish and no recycling
- C. Yes, there is space, but we only have external bins for mixed recycling and use chute for rubbish
- D. We have two separate chutes, one chute to collect mixed recycling and the other chute to collect rubbish
- E. No, there is no space, but we only have one type of external bins for rubbish and no recycling

17. How far are the external recycling bins from your flat if you live in a tower block or block of flats? (Note: judging by the responses of the 8 respondents to this question, this factor is not an issue because it does not prevent the 9 respondents from recycling. The real issue is about the availability of the recycling bins not its proximity. This is the reason for removal of this question)

- A. Less than 10m (33ft)
- B. Between 11m to 20m (36ft to 66ft)
- C. Greater than 21m (69ft)
- D. Don't Know
- E. Not applicable, we use chute for recycling
- F. Not applicable, I live in a house

18. If you use chute for recycling, how often does it get blocked?

- A. This always happens, I have to force materials inside the chute, for the materials to go inside the chute or take it to external storage
- B. This always happens, I just leave the materials near the chute
- C. This always happens, I just put the recyclable materials in the rubbish chute

- D. This rarely happen, but there is alternative storage at the ground floor or basement to use if this happens
- E. This never happens
- F. Not applicable to me

19.If you use chute for recycling and the chute is blocked, what do you do with the recyclable materials? (I merged Q19 and 20 together)

- A. I take it to alternative external recycling storage in the basement or ground floor
- B. I force the materials inside the chute
- C. I leave the materials near the chute
- D. I put the recyclable materials in the rubbish chute
- E. Not applicable to me

20.Do you have a public micro recycling centre close to your place of residence? (Micro-recycling centres in Westminster borough are provided for residents to recycle unwanted materials that are recyclable. There are 160 micro recycling centres in Westminster located close to the public highway. Each recycling centre consist of six or more large bins to collect up to six streams of materials which are textiles and shoes, mixed paper and cardboard, mixed plastic bottles and tin cans, small electrical appliances, glass and books. Using your postcode, you can locate the nearest micro-recycling centre to you using this link <https://www.recyclenow.com/local-recycling>) attach a photo

- A. Yes, and I do use it when the need arises
- B. Yes, but I do not use it
- C. No
- D. Don't know

21. Do you know how often when the external recycling bins, black recycling boxes or your mixed clear recycling bags are collected?

- A. Daily
- B. Once a week
- C. Twice a week
- D. Thrice a week
- E. Don't know

22. Do you think reduction in rubbish collection frequency will influence residents behaviour to recycle more?

- A. No, reduction of rubbish collection will increase waste dumping and fly tipping
- B. Yes, reduction of rubbish collection will force residents to recycle more
- C. No, maintain current frequency of rubbish collection and increase frequency of collection for mixed recycling
- D. No maintain current frequency of collection for both rubbish and mixed recycling

23. Is it easy to access the council recycling service such as requesting for the council recycling bag, enquiring about collection time or information about what to recycle? (Note I have merged Q24 with Q27 because both are talking about the service the council provide)

- A. No, very difficult
- B. Yes, very easy
- C. Sometimes it is easy to access some service and difficult to access some service
- D. I have never contacted the council recycling service

24. Do you know how and where to request the recycling bag from the council? Tick all that applies

- A. No, I don't know. I have never requested a recycling bag from the council
- B. Yes, I have requested the recycling bag online and it was posted to my address
- C. Yes, I have requested the recycling bag from the library
- D. Yes, I have requested the recycling bag from the bin men collecting the bins during collection round
- E. Yes, I know where to request the recycling bag, but it is difficult to get them in this current Covid 19 pandemic crisis
- F. Yes, I know where to request the recycling bag. I did request for some but never received them.

25. Do you want the council to start collection of food waste from your property? Tick all that applies

- A. Yes, collection of food waste will increase recycling rate
- B. Yes, I have internal space to cater for additional bin for food waste
- C. Yes, collection of food waste will decrease number of materials going into the rubbish bins
- D. Yes, but I do not have space to cater for additional bin for food waste
- E. No, I do not have space to cater for additional bin for food waste

26. Overall, what is your experience with the council recycling service including collection, requesting recycling bag and ease of access to recycling service?

- A. Poor service
- B. Good service
- C. Very good service
- D. Excellent service
- E. Other

27. Have you received any communication from the council about recycling? Tick all that applies

- A. Yes, I have received a council Newsletter, The Westminster Reporter, which contains some information about recycling
- B. Yes, I have received emails from the council about recycling
- C. Yes, I have received some information from the council about recycling through social networks (Westminster Recycles on Facebook)
- D. Yes, I have received specific or dedicated leaflet (Flyers inserted with council tax letters) about recycling from the council
- E. Yes, I have received text messages about information relating to recycling
- F. Yes, I have received information relating to recycling through door to door knocking exercise
- G. Yes, I have received letters addressing specific recycling contamination issues
- H. No, I have not received any communication about recycling from the council

28. Is this communication mode effective and consistent?

- A. Yes, the communication received was effective and consistent
- B. Yes, the communication received was effective but not consistent
- C. No, the communication was not effective because it was not available in my native language that I understand best
- D. No, the communication was not effective because the Language of communication does not reflect residents diversity
- E. No, the communication was not effective because I find it difficult to understand the terms and jargons used in the communication
- F. I don't know if the communication is effective or consistent
- G. I have never received any communication about recycling from the council

29. Have you in the past 3 years been aware of, or attended any recycling workshop, Mobile Recycling Centre, Library outreach programmes or public engagement programmes offering detailed information about recycling and encouraging you to recycle more?

- A. Yes, I have attended such programme once in the past
- B. Yes, I have attended such programme twice in the past
- C. Yes, I have attended such programme three times in the past
- D. Yes, I have attended such programme more than three times in the past
- E. I was aware of such programmes but could not attend due to personal busy schedules
- F. I was aware of such programmes but could not attend due to distance of the venue to my house
- G. I was aware of such programmes but do not want to attend
- H. I am not aware of such programmes is organised by the council

30. Which of the following factors prevents you to recycle appropriately? – Tick all that applies

- A. Lack of internal space to have separated bins for recycling and rubbish
- B. Lack of external space for recycling bins
- C. The labels on the bins are ambiguous and not very clear to help determine the correct bin to use
- D. I am confused about how to recycle
- E. I don't like using the communal bins (due to location/ maintenance)
- F. The labels on the packaging materials are ambiguous and sometimes I am not sure whether they are recyclable or not
- G. I am unable to obtain recycling bag easily from the council
- H. There are no financial incentives involved
- I. Lack of incentives schemes in my ward
- J. Disability issues
- K. Conflict of household opinions regarding recycling

- L. I cannot be bothered
- M. I am not sure about what the council do with the recyclable materials collected
- N. I have a busy tight schedule to be bothered about recycling
- O. My neighbours do not recycle, so why should I waste my time in recycling

31. Which of the following will enable you to recycle more? – Tick all that applies

- A. Clear communication and information from the council about recycling
- B. Clear and consistent labels on bins
- C. Siting of a public mini recycling centre in my area
- D. Introduce recycling incentive scheme in my area
- E. Introduce borough wide food waste collection
- F. Introduce local competitions between the wards
- G. Discount in the council tax
- H. Provision of external recycling bin storage by my landlord
- I. I will recycle more if incentive scheme is linked to localised employment or something visible in the local community
- J. Introduction of the deposit return scheme
- K. I will recycle more if I have easy access to the council recycling bag
- L. I will recycle more if I have enough internal space to store two or three types of bins
- M. Nothing will enable me to recycle, I am not interested

32. What kind of recycling incentives would you prefer most?

- A. Individual financial reward like cash reward or council tax discount
- B. Individual financial reward like voucher to spend in shops
- C. Communal financial reward like cash reward to charity voted by the local community
- D. Fines on households that do not recycle
- E. Deposit Return Schemes- (example: pay deposit on drinks bottles and get deposit back, when empty bottle is returned)

33. Are you aware of the council recycling policy on end destination of the recyclable materials collected? (End destination is what happen finally to the mixed recycling collected by the council) - Tick all that applies

- A. Yes, I am aware, but more clarity and transparency are required on end use of recycling in order to increase residents motivation
- B. Yes, I am aware but doubt the end destination of the recyclable materials collected
- C. No, I am not aware
- D. No, I am not aware. Anyway, I doubt the end destination of the recyclable materials collected
- E. No, I am not aware, and I need to know where all the recycling collected by the council ends up
- F. I don't believe in the council policy on recycling, recycling is all a myth
- G. I don't know

34. Which of the followings, do you think should be addressed by future government legislation to increase recycling rate? - Tick the ones that applies

- A. Ban manufacturers from producing goods and packaging that are not recyclable
- B. Hold landlord responsible for recycling and force them to include recycling terms in contracts

- C. Make it compulsory for landlords to provide recycling storage in their properties
- D. Legislate that all councils should comply with one recycling regime that is consistent throughout the country

35. Do you have a community association in your area in which recycling is part of their community agenda? (Note: judging by the response, 6 out of the 9 respondents said, "I don't know" and yet they are good recyclers means that this factor does not impact recycling rate. That's why I am removing it)

- A. Yes
- B. No
- C. I don't know

36. Are you aware of the council recycling champion network in which residents can volunteer as Recycling Champions and help others in their community to waste less and recycle more (Note: If you are interested in becoming a recycling champion register online using this link. <https://www.westminster.gov.uk/volunteer-recycling-champion>)

- A. Yes, I am aware, and I am already a recycling champion
- B. Yes, I am aware, but I am not interested in becoming a recycling champion
- C. No, I am not aware and, but I am interested in becoming recycling champion
- D. No, I am not aware, and I am not interested in becoming recycling champion

37. The Westminster Council currently use the same colour 'black' for both mixed recycling bins and rubbish bins but with clear labels to differentiate these two types of bins. Do you think it is easy to differentiate between the bins for rubbish and bins for mixed recycling?

- A. Yes, it is easy for me to differentiate between these two types of bins because the labels are very clear and conspicuous
- B. Yes, it is easy for me to differentiate between these two types of bins because the labels are very clear, but I will prefer the mixed recycling bin to have a different colour to the rubbish bins
- C. No, it is difficult for me to differentiate between these two types of bins because the labels are not very clear
- D. No, it is difficult for me to differentiate between these two types of bins, the bins should have different colour for mixed recycling and different colour for rubbish

The pilot survey was sent to 10 participants, only 9 responses was received. The following comments and suggestions were provided by 3 respondents:

- There are a lot of questions, might put people off from filling the survey out. Why don't people recycle. Do kids get taught about the importance of recycling in schools.
- Q31 what prevents you from recycling properly. You need to included disability and elderly, conflict of household opinions regarding recycling.
- The first few questions were too personal (age, education) are unrelated to this survey. What difference does my age and education level make to whether I recycle.

Reflecting on the comments and suggestions of the respondents, I have reduced the 37/38 questions to 30 questions to make it easier for the participants to complete the survey quickly and allow high completion rate for the survey. Q31 has been revised to include disability issues.

I will be retaining the age and education questions because they are important factors in monitoring trends in recycling behaviours. The rationale for removing some questions and merging some questions are noted within the questions that will be removed and marked Pink Colour.

Some of the questions that will be retained but revised are marked in Yellow Colour within the draft Survey question version1. Version 2 of the revised final 30 questions is available in Appendix E.

Appendix E- Main Self-Completed Questionnaire (Residents)

1. How long have you lived in the City of Westminster?

- A. 0-5 years
- B. 6-10 years
- C. 11-16 years
- D. over 16 years

2. Which ward do you live in the City of Westminster? Drop down box

- A. Abbey Road
- B. Bayswater
- C. Bryanston and Dorset Square
- D. Church Street
- E. Churchill
- F. Harrow Road
- G. Hyde Park
- H. Knightsbridge and Belgravia
- I. Lancaster Gate
- J. Little Venice
- K. Maida Vale
- L. Marylebone High Street
- M. Queen's Park
- N. Regent's Park
- O. St James's
- P. Tachbrook
- Q. Vincent Square

- R. Warwick
- S. West End
- T. Westbourne

3. What is the highest level of education you have completed?

- A. Primary school
- B. Secondary school up to 16 years
- C. Higher or secondary or further education (A-levels, BTEC, etc.)
- D. College or university
- E. Post-graduate degree
- F. No education

4. What is your age bracket?

- A. 16-21 years
- B. 22-38 years
- C. 39-45 years
- D. 46-54 years
- E. over 55 years

5. What type of residence do you live in?

- A. House – by yourself or with family members including partners and children
- B. Flat – by yourself or with family members including partners and children
- C. House - shared with housemates, tenants or lodgers
- D. Flat - shared with housemates, tenants or lodgers
- E. Hostel accommodation

6. How many people are in your household age 18 and above?

- A. 1
- B. 2
- C. 3
- D. 4
- E. 5
- F. 6 or more

7. How often is your rubbish collected?

- A. Once a week
- B. Twice a week
- C. Three times a week
- D. Daily
- E. Don't know

8. How often is your recycling collected?

- A. Once a week
- B. Twice a week
- C. Three times a week
- D. Daily
- E. Don't know

9. How many members of your household recycle these items (like plastic tubs, food and drink cans, glass bottles, paper, cartons and cardboard)?

- A. 1
- B. 2
- C. 3
- D. 4
- E. 5
- F. 6 or more

10. How often do you recycle these items (plastic tubs, food and drink cans, glass bottles, paper, cartons and cardboard)? Attach a photo

- A. I / we always recycle
- B. I / we sometimes recycle
- C. I / we never recycle

11. If you recycle always or sometimes, which of the following factors motivates you to do it? Tick all that apply.

- A. It helps to reduce the amount of waste I put in my general rubbish
- B. It helps to reduce pollution in the ocean
- C. It is the right thing to do
- D. It is easy to do
- E. All my neighbours recycle, and I don't want to be different
- F. other please state

12. If you never recycle which of the following factors discourages you from recycling? Tick all that apply.

- A. Lack of internal space to have separate bins for recycling and rubbish
- B. Lack of external space for recycling bins
- C. The labels on the bins are not clear
- D. The labels on the products/ packaging are not clear
- E. I don't like using the recycling bins / recycling chutes
- F. I cannot get recycling bags easily
- G. There are no financial incentives to recycle
- H. I have a disability which makes it difficult
- I. Conflicting household opinions regarding recycling
- J. I am too busy
- K. I cannot be bothered
- L. I am not sure what the council does with the materials collected
- M. My neighbours do not recycle, so there is no point
- N. Not applicable to me, I always or sometimes recycle
- O. Other, please state

13. Which of the following would encourage you to recycle these items (plastic tubs, food and drink cans, glass bottles, paper, cartons and cardboard)? Tick all that apply

- A. Clear information from the council about recycling
- B. Clear and consistent labels on bins
- C. Clear and consistent labels on products and packaging
- D. Internal space to store separate bins
- E. Provision of external recycling bin storage by my landlord
- F. A public micro recycling centre in my area
- G. Local recycling competitions between the wards
- H. Easy access to council recycling bags
- I. A recycling incentive scheme in my area
- J. I will recycle if recycling was compulsory
- K. None of the above

14. If you ticked option I, an incentive scheme, what kind of recycling incentive would you prefer most?

- A. Individual financial reward like cash reward or council tax discount
- B. Individual financial reward like voucher to spend in shops
- C. Communal financial reward like cash reward to charity selected by the local community
- D. Deposit Return Schemes (e.g., customers pay a deposit on bottles and get the deposit back when empty bottle is returned)
- E. Other, please state

15. If you put a piece of rubbish or recycling in the wrong bin by mistake, do you try to remove it and place it in the correct bin?

- A. No
- B. Yes, always
- C. Yes, sometimes
- D. This never happens to me

16. Do you have enough internal space for two separate storage bins, one for mixed recycling and one for rubbish in your home?

- A. Yes, there is space and I have two separate internal bins for recycling and rubbish
- B. Yes, there is space, but I only have one internal bin for both rubbish and recycling
- C. No, there is not enough space, I only have one internal bin for both rubbish and recycling
- D. Other, please state

17. Do you have external storage for two separate storage bins, one for rubbish and one for mixed recycling (either in your black recycling box or in your clear mixed recycling bags) at your residence?

- A. Yes, we have two separate storages for mixed recycling and rubbish
- B. No, we only have one type of external bin for rubbish and no storage for mixed recycling
- C. No, we only have external bin for mixed recycling and use a chute for rubbish
- D. No, we have two separate chutes, one to collect mixed recycling and one to collect rubbish

18. If you use a chute for recycling, what do you do if it gets blocked?

- A. I have to force recycling inside the chute or take it to external storage
- B. I leave the recycling near the chute
- C. I put the recycling in the rubbish
- D. There is alternative storage to use if this happens
- E. This never happens
- F. Not applicable

19. Micro-recycling centres are provided for residents to recycle unwanted materials including textiles and shoes, small electrical appliances, books and more. Do you have a on street micro-recycling centre close to your home? Attach a photo

- A. Yes, and I use it
- B. Yes, but I do not use it
- C. No
- D. Don't know

20. If you ticked option A above, what do you recycle at the micro recycling centre?

- A. Mixed recycling items (glass, plastics, cans, paper and cardboard)
- B. Electricals
- C. Textiles and shoes
- D. Books
- E. I do not use the on-street micro-recycling centre

21. Westminster City Council uses black bins for both recycling and rubbish, which are labelled 'mixed recycling' and 'rubbish'. What do you think of this?

- A. The labels are clear
- B. The labels are clear, but the bins should be different colours
- C. The labels are not clear
- D. The labels are not clear, and the bins should be different colours
- E. Not applicable as I use chutes for recycling and rubbish
- F. Not applicable as I use clear recycling bag/ black box for recycling, and I use black bag for rubbish

22. What methods have you used to request recycling bags from the council? Tick all that apply

- A. I have requested recycling bags online via email/ using the online form
- B. I have picked up clear recycling bags from the library
- C. I have requested clear recycling bags from the recycling collection crews
- D. I called Westminster City Council to order clear recycling bags
- E. I picked some up from the Mobile Recycling Centre outside Warwick Avenue tube station
- F. I picked some up at a community event/ recycling information stand
- G. I have never requested clear recycling bags as I use my black recycling box
- H. I have never requested clear recycling bags as I use communal recycling bins
- I. I use the bins at the micro-recycling centres
- J. I do not recycle
- K. I do not know how to request clear recycling bags

23. If the council collected the rubbish less often, do you think this could encourage more residents to recycle? Tick one option

- A. Yes, reduction of rubbish collections could encourage more residents to recycle
- B. No, reduction of rubbish collections could increase fly tipping
- C. No, the council should maintain the same frequency of rubbish collections and increase frequency of collections for recycling
- D. No, the council should maintain the same frequency of collections for both rubbish and recycling

24. If the council introduced a city-wide food waste collection service, how would this service affect you? Tick one option

- A. I would like to have food waste collected for recycling and I have internal space for an additional caddy or bin for food waste
- B. I would like to have food waste collected, but I do not have internal space for an additional caddy or bin for food waste
- C. I would not like to have food waste collected as I do not have internal space for an additional caddy or bin for food waste
- D. Other, please state

25. What council communications have you seen or received any information about mixed recycling? Tick all that apply

- A. Council e-newsletter (e.g., quarterly recycling e-newsletter)
- B. Council flyer / leaflets
- C. Council letter
- D. Information within my council tax bill
- E. Council website
- F. Reporter magazine- e.g., mixed recycling adverts
- G. Westminster Plus magazine e.g., mixed recycling adverts
- H. Social media posts
- I. Spoken to staff who knocked at my door during a door knocking exercise

J. Spoken to staff at a local event/ community event/ library recycling information stand/ estate event

K. Spoken to staff at the Mobile Recycling Centre outside Warwick Avenue tube station

L. Spoken to the recycling collection crew team

M. None

26. What do you think of the communications you saw / received?

A. It was useful and clear

B. The language was not easy to understand, there was too much jargon

C. The language was not easy to understand, I need it in another language

D. I don't know

E. I have not seen / received any communication about recycling

27. Have you ever attended an event in Westminster about recycling including workshops, library recycling information stands or workshops or the Mobile Recycling Centre (MRC)?

A. Yes, I have attended one event

B. Yes, I have attended two events

C. Yes, I have attended three events

D. Yes, I have attended four or more events

E. I am aware of these events but could not attend due to my schedule

F. I am aware of these events but could not attend due to distance of the venue to my house

G. I was aware of these events but do not want to attend

- H. I am not aware of these events
- I. I cannot remember if I have attended any of these events in the past

28. Are you aware of the council's approach to processing its recycling in local facilities? Tick all that apply

- A. Yes, I am aware recycling is processed in local facilities
- B. Yes, I am aware, but I do not believe it happens locally
- C. No, I am not aware of where recycling is processed
- D. No, I am not aware, but I do not believe it happens locally

29. Overall, how would you rate the council's recycling service collection of mixed recycling, requesting clear bags and delivery, the frequency of collections and the range of items that can be put in the mixed recycling?

- A. Poor
- A. Average
- B. Good
- C. Very good
- D. Excellent

30. Which of the following proposals do you think should be addressed by future national legislation to increase recycling? Tick all that apply

A. Ban manufacturers from producing packaging/ products that are not recyclable

B. Hold landlords responsible for having overall management of mixed recycling in their building in tenants' contracts

C. Make it compulsory for landlords to provide recycling storage in their properties

D. Create one recycling system (e.g., same types of containers/ same colour of containers/ same materials go into the mixed recycling) that is consistent throughout the country

Appendix F- Council Staff In-Depth Interview Guide

Major barriers to achieving high recycling rate

- What are the barriers the council is facing in achieving a high recycling rate?

MRC use and non-use

- Are electrical items, clothes and shoe materials observed being dumped in the mixed recycling bins collected at properties?
- If yes, what is the average contamination levels of these materials on a weekly or monthly basis?
- What are the contamination levels observed in bins located at the recycling centres?
- What eventually happened to contaminated recycling load or bin?
- How frequent are the MRC sites emptied, cleaned, and maintained?
- What do you think in your experience is causing dumping of large card boxes around the bins located at the MRCs?
- Accessibility issues for wheel chair users and blind residents

Recycling Bags

- How would you explain the process of waiting for 10 working days to received them after ordering them online or by phone? We state a 10-day delivery time for disposable bags, with residents being able to collect recycling bags from libraries in an emergency should they need them. What are the other options available in case of emergency if there are no libraries close to the residents?
- Have the council observed the residents misusing the free recycling bag?
- If yes, is it on a large scale?
- Do you think the use of recycling bags are sustainable?

Food Waste

- What are the plans to roll out the food waste service in the immediate future?
- What are the results of the trial food waste collection?

Recycling Collection Frequency

- What are the future plans to increase recycling collection frequency?
- What are the reasons for more frequent collection for rubbish than for mixed recycling?

General Questions

- What are the challenges facing the recycling service?
- What are the possible interventions to mitigate these challenges?
- What are the future plans or strategy to increase the council recycling rate?
- How has the covid pandemic affect the recycling service we render to the residents
- What are these impacts
- How did you adapt to these impacts?
- Do you know any other colleagues that can provide other information that may be pertinent to

the research, like one or two recycling crew collection operatives?

- What are the barriers the council is facing in achieving a high recycling rate?
- What are the results of the trial food waste collection?

Communications

- In general, how would you describe the council recycling communication objectives?
- What are the mechanisms in place to monitor whether these objectives are achieved?
- What are the council current recycling communication strategies?
- How is the council dealing with language barriers expected from a diverse borough like Westminster?
- What are the mediums of communicating recycling information to the residents?
- How do you know if the means of communication are achieving communication objectives?
- Facebook followers are very low (552), what are the plans to increase online followers ?
- What are the other possible means of social media apart from Facebook to communicate to the residents?
- CP1 mentioned the assisted collection service for vulnerable residents, could you please explain how this work?
- What are the mechanism in place to identify new residents to the borough to communicate required recycling information to them?
- What are your thoughts on using role models or public influencers to do paid commercial on recycling?

Public Engagement

- What are the council current public engagement activities or recycling events?
- How often are these activities organised?
- How would you describe the attendance levels at these events?

- What are the factors that could possibly be causing the low or high attendance?
- What are there coordinated approach to organise constant site visit for residents to recycling processing plants to dispel rumours about these recycling myths?
- How are the visits advertised?
- How as the covid pandemic affect the public engagement with the resident
- How did you adapt to these impacts?
- How do you process the feedbacks received after recycling events?

Incentives

- How efficient is the council recycling incentive scheme in some selected estates?
- What is the objective behind incentives for selective estates rather than the whole borough?

What is the estimate number of residents that participates in this incentive schemes?

Appendix G- Some Transcripts of the Residents In-Depth Interviews

Infrastructure Theme

Storage Capacity:

“We have enough external storage capacity for rubbish but none for recycling even though there is space available externally to store the recycling bins, we therefore need storage capacity to recycle plastics and some other recyclable materials that are left in the rubbish bins” (Participant 3).

“Since the external recycling bins are small, it fills up very quickly. So, most of the time when I want to use the recycling bins they are already filled up and I just left my recycling near the bins on the floor. Sometimes, the external bin storage area is full and with bins overflowing that it is difficult to differentiate which bin is for recycling and which bin is for rubbish” Participant 8).

Source Segregation:

“There is no internal space to separate recycling and rubbish so as not to contaminate the recycling. This means I do not have separate bins for recycling” (Participant 6).

“We have separate bag for rubbish and separate bag for recycling in the kitchen, although it can be quite congested. What we do is as soon as the rubbish bag is full, we take it outside to the rubbish bin, and for recycling we put in the recycling black box outside in the front garden. Because we do not have enough space inside the kitchen” (Participant 11 H).

“Although I do not have enough space inside my flat for two bins. I have one bin for rubbish, and I keep a bag for recycling. There is not much space internally within my flat. However, there is enough space in the communal bin store that accommodate bins for both rubbish and recycling where the recyclable materials and rubbish from my flat can be transferred to” (Participant 7).

Refuse Bins:

“So, we have two types of external bins. One is for rubbish and the other for recycling” (Participant P12 H).

“Since the recycling bins are small, it fills up quickly and people in my block end up putting recycling in the rubbish bins” (Participant 8).

We have three kinds of extensive bins near my flat which include rubbish bins. I must say there are quite many bins where I live. So, if the bins near me are filled up, I can find some other bins. I know the bins' location in my area very well” (Participant P2).

“We can access the rubbish bins on the ground floor easily” (Participant 4).

“There is provision for waste bins on the ground floor where you can take your rubbish to” (Participant 5).

Recycling Bins:

“We do not have separate bin in our flat for recycling, we have to put everything in the black bag and then put it in the rubbish bin. No there is no recycling in this block as there is no external bin for recycling” (Participant 3).

“We do not have any external storage facility for recycling. Although there is no further space at the block for an extra bin. The property owner could have rededicated one of the rubbish bins to be used for recycling. But the property owner cannot be bothered. But generally, all the residents in my street put their recycling in the council recycling bag and then leave it on the street for collection” (Participant 9).

“Sometimes, there are contamination, where some people have put rubbish in the recycling bins as well. Sometimes, the external bin storage area is full and with bins overflowing that it is difficult to differentiate which bin is for recycling and which bin is for rubbish” (Participant 8).

“People leaving stuff that should not be going to the recycling anyway next to bins. Generally, to use the recycling bin, there is a slot or small hole to put bags through. Sometimes the small slot is blocked, and you cannot put the bag in” (Participant 4).

The major issue about the external recycling bins is non-availability of these bins or insufficient number or capacity to cope with the growing pressure and demand to recycle, which then acts a barrier to achieve effective recycling.

“The reason I am not consistent with my recycling habit is because there is not enough space for more recycling bins. The recycling bins are insignificant compared to the number of people using the recycling bins. Because of lack space for big or more recycling bins, I am forced to put them in the rubbish bins to make the external bins area tidy” (Participant 8).

“The area I lived at is very condensed area. The recycling bins are always full of rubbish and recycling dumped around the bins when it is full. When I get to the bins and it is full, I leave the recycling near the bins” (Participant 6).

Internal Storage:

“There is enough space within my flat for storage of segregated rubbish and recycling. If the council introduces collection for food waste, I will create a space for the third bin” (Participant 9).

Participant 7 admitted that they lack enough internal storage to effectively accommodate the two different waste streams, therefore, rely on makeshift recycling bag to keep recyclable materials.

“I do not have enough space inside my flat for two bins. I have one bin for rubbish, and I keep a bag for recycling. There is not much space” (Participant 7).

External Storage:

“There are enough external storage bin facilities within where I live. I have got one (bin) across the road and one (bin) behind my flat and one (bin) on top of the road. There are three facilities, I have got no excuse of where not to put things. One bin empty, I go to the next one. So, I have three kinds of extensive bins near my flat which is very easy to access” (Participant 2).

“We have enough external storage for segregated rubbish and recycling. it is just about, and it work because we have our own external bins to ourselves, and we are the only one using it as I live in a house” (Participant 12 H).

“There are bins for rubbish and recycling in the external storage. But the bins in the external storage are insignificant compared to the number of people using the bins, so it fills up very quickly and with bins overflowing” (Participant 8).

Chutes:

“Yes, the chute gets blocked and that happens every now and then again, to my frustration. So, If I can get the rubbish down the chute, I will see what is blocking it, If I can try to free it myself and If I cannot do that. I will go out round the back of my flat where the rubbish bins are and put it in the bins outside. I do not leave it on the landing or by the chute. It is my job to make sure it is done properly. If I cannot get it down the chute. I take it out to the back of the house where the actual bins are” (Participant 2).

“We have a chute in the building for rubbish, sometimes some people have put recycling down the chute. It is challenging to other people to walk downstairs to recycle. The chute is then blocked with stuff or bags that is too big to go into the chute. The chute hole is not big enough to hold the stuffs which then obstructs” (Participant 4).

“We have the chute facility in the tower block. There are three different chutes one for rubbish, one for recycling and the other for food waste. Sometimes the chute is blocked and there is provision for recycling and rubbish bins on the ground floor where you can take your refuse to” (Participant 4).

Building Types:

“Westminster is densely populated with flats not with many buildings with frontage to store different bins as found in houses” (Participant 4).

“Also, the problem for people living combined places (flats) in Westminster is that there is no space to separate rubbish so as not to contaminate recycling” (Participant 6).

“There are no barriers for me at all to recycle living in a high-rise building. Even if we have to take the recyclables materials to the ground floor bins in the absence of a chute, I do not see that as a barrier. But I do not know how recycling incentive schemes will operate in tower blocks” (Participant 5).

“There is not much of barrier because I live in a house on street level with easily accessible recycling boxes in the front garden. I think this will be a barrier to people living in high rises” (Participant 11 H).

Accessibility:

“I have 3 kinds of extensive bins near my flat which is very easy to access” (Participant 2).

“I live in a house on street level with easily accessible recycling boxes in the front garden. I think this will be a barrier to people living in high rises that do not have this kind of accessibility” (Participant 11 H).

Transparency:

“We need more information on what happens to the recyclable materials collected. These are not clear, okay I am recycling, but what happens to my recyclable materials collected. Where is these recycling stuff going”? (Participant 1)

“There are this question other people are asking about where does all this recycling goes? I think the council should be able to work on this. We need to communicate to people what happens to the recycling.” (Participant 5)

Progress:

“I don’t understand that, and I am quite surprised about this information about the council low recycling rate” (Participant 2).

“I am surprised to hear that we have a low recycling rate as a borough, very disappointed and very shock” (Participant 5).

Participant 11 H thought the recycling scheme was going well in the borough because their recyclable materials were always collected promptly.

“My expectation was Westminster City Council as a leading council will be top of recycling. It is a bit of a shock that the borough has a low recycling rate. Also, because my recycling is always collected, I was under assumption that recycling in Westminster is going well.” (Participant 11 H)

Methods of Communication:

“I know the council sends out regular newsletter, so that I like to read them. That is always good. I also receive emails, and magazines that comes in through the post. I prefer emails because it is greener and does not require using paper. But email preferably.” (Participant 10 H).

“Also, I find it very irony that we want to reduce waste but sending paper leaflets out which creates more waste. Perhaps use of electronics means such as text messages, electronic newsletters, knocking on the doors talking to people and emails will cut out paper waste.” (Participant 11 H)

“No, they are not effective. If the council communication methods are effective, I would have received any sort of communication to advice my household about recycling.” (Participant 8)

“Whatever communication method employed must be effective on what you can recycle and how and all of that.” (Participant 1)

“I think as well as writing, knocking on the door and talking to people and explaining what is in the paper. Word of mouth is more effective way of conveying the message.” (Participant 11 H)

“A year ago, may be, someone knocking through the door talking about recycling as well talking to each household. Which is good.” (Participant 2)

“Leaflets or information about competition between different buildings about which building recycle most.” (Participant 4)

Language:

“As long as the method are effective across language, there is no reason why people cannot do it or recycle properly.” (Participant 5)

“You may leave a leaflet through the door but unless English is their first language, or can they speak and read English otherwise they might think it is junk and bin the leaflet.” (Participant 11 H)

“I think the message is not quite there in this area. It could be because of lack of knowledge or language barrier.” (Participant 11 H)

“Although the leaflet is in English, there are some small print in English asking people who cannot understand English to call a number for interpretation. I doubt it if anybody will ever ring the number because they cannot understand the instruction in English in the first instance”! (Participant 11 H)

“I think the website is understandable, but I do not think it answers everything, I still have questions. There could be better information on the website, and I think most people will just go to the website to look for information.” (Participant 10 H)

Engagement:

“We need to see councillor engage as kind of people that the residents look up to or showcasing famous residents on campaigns on why it is good to recycle” (Participant 1)

“Also, a bit more attention can be given or collaborating with local community and councillors to raise more awareness or working with local organisations to reach out to BAME. Or even using the library or mosques or places of worship to get message across than just dropping a leaflet.” (Participant 11 H)

“I think positive education and interaction is much more needed before this can be done. A lot of campaign drives in schools should be planned to educate the kids who can be advocates of recycling to their parents.” (Participant 11 H)

“I think it was in 2006, we have this gentleman from the recycling team coming into the library to talk about recycling. He brought some beautiful things with him such as a pen made from plastic recycling, a can made from yoghurt pot. And I remember he gave us lots of these things to encourage us to recycle. That was the reason I started recycling long time ago since 2006. Since then, we have been recycling everything” (Participant 11 H).

Human Factors Theme

Zeal:

“I have never forgotten not to recycle. I am tedious about it.” (Participant 5)

“I recycle every day. Anytime, I use something that is recyclable I give it a rinse and put it in my recycle bag. Sometimes, if I am not sure I check the packaging and the packaging will indicate whether it is recyclable.” (Participant 10 H)

Participant 2 in their remarks, is trying to familiarise themselves with recycling activities to be confident about recycling and more importantly looking forward to participating in the future food waste collection service currently being planned by the council.

“I am trying to educate myself to make sure I am putting in the right thing. I am keen about also recycling my food waste like potatoes peels, carrot skins and that sort of things.” (Participant 2)

Responsibility:

“I pasted this leaflet on the information board.” (Participant 1)

“Call the council to say that the bins are full, could someone come to empty the bins they are all full. It is my job to make sure it is done properly”
(Participant 2)

Participants 2 and 5 went further to relate their experience in challenging other residents when misusing the communal recycling bins by putting rubbish in the recycling bins.

“Yes, I have, and I have told them. Some people will say oh I did not realise, I am sorry. Some people will ignore you. But I will tell them. Most people may be just not aware, I think.” (Participant 2)

“Have been an advocate of this for a very long time so I can make a very positive comment about it.” (Participant 5)

Motivation:

“I am very enthusiastic about it. but I also think because I am interested in recycling. I think some people still really do not care. But for me, it is effective because I want to know, I want to know the latest things is if they are changing things.” (Participant 2)

“For example, inside my flat, half of my household. Me and my daughter are recycling. The other half of my household are not motivated to recycle.”
(Participant 6)

Habit:

“I recycle every time and I am consistent with recycling.” (Participant 12 H)

“I have recycling bag in my kitchen and that get filled up very quickly because I filled it up as much it can be that can be recycled. Can I just say I do not like waste? It does annoy me. I make use of unwanted materials to another things for use.” (Participant 2)

“I am a strict recycler.” (Participant 4)

“For the past ten years, I recycle consistently as much as I can with people in my household.” (Participant 6)

I am very consistent. 100% consistent. (Participant 9)

“It is extremely hard to recycle. I do not really recycle very often and do not know if people around are recycling or not.” (Participant 7)

“My recycling habit is not consistent. Sometimes, I recycle sometimes I do not recycle.” (Participant 8)

Contamination:

“I do not know what qualify as contaminated. In some areas they say the pizza boxes cannot be recycled because it is contaminated with food like cheese, tomato sauce and in some instances, I read that pizza box can be recycled. So, I do not know what criteria for contamination is.” (Participant 10 H)

“Anything that is not supposed to be left with recycling. It is different for different council with different rules and schemes.” (Participant 4)

“Just chucking their rubbish into a bin regardless of whether it is recycling or the normal rubbish.”(Participant 2)

However, majority of the respondents are aware of the contamination issues and are trying their best to avoid contamination of the recyclable materials.

“When you put food waste in plastic and paper recycling that is contamination.” (Participant 4)

“I understand the term contamination is when recycling is contaminated by something different such as rubbish.” (Participant 6)

“Contamination is when other materials such as rubbish are mixed together with recyclable materials.” (Participant 8)

Awareness:

“Mixed recycling is when you can put together recyclables like plastics, tins and glass together in the same bin.” (Participant 1)

“Mixed recycling is when we mixed and store paper, glass and plastics together in one bin.” (Participant 5)

“Also, there are lot of transient population and visitors visiting the borough who have no loyalty to borough. They are only in the borough for short periods living in AIR BNB accommodations for 3 months or less and may not understand how recycling is conducted in the borough”. (Participant 5)

“Westminster is a tourist area with lot of tourists that may not be aware of how recycling is carried out in Westminster.” (Participant 6)

“Yes, I have, and I have told them. Some people will say oh I did not realise, I am sorry. Some people will ignore you. But I will tell them. Most people may be just not aware, I think.” (Participant 2)

Commitment:

“I am not consistent with my recycling; I only recycle when I can. I am remarkably busy and do not have time to sort the recycling out and may end up in the rubbish bin.” (Participant 7)

“We would like to recycle. There is no recycling in this block as there is no external bin for recycling.”(Participant 3)

“I am very consistent. I recycle everything I can recycle. You know I am happy to walk further down the road and see if I can find some other recycling bins if the one in our block is full.” (Participant 2)

“I am consistent 100 percent”. (Participant 5)

“For the past ten years, I recycle consistently.” (Participant 6)

“Yes, we recycle everything, and we recycle all the time.” (Participant 11 H)

Influence:

“Even my 14 years old, when she was two, I use to encourage her to put things in the recycling bin. She is 14yrs old now and that is how long we have been recycling”. (Participant 11 H)

“I make sure my girlfriend does as well. We should be influencing people to do the right thing and not push them to the wrong direction.” (Participant 4)

“But I know that I do not see many of my neighbours carrying out recycling because I rarely see the recycling bags at the bin storage area.” (Participant 8)

Service Constraints Theme**Rubbish Collection:**

“Some people have more rubbish than recycling and will just chuck the rubbish into the recycling bins thereby contaminating the recyclable materials or dump them on the streets.” (Participant 1)

“We have two rubbish collections a week and even it is crazy with rubbish piling up with nowhere to store them.” (Participant 4)

“No, the rubbish needs to be collected frequently otherwise people will be dumping rubbish on the street. This cannot happen.” (Participant 7)

Participants 8 and 9 were the only dissenting voice and of the opinion that reducing the rubbish collection frequency will compel the residents to recycle more.

“Reduced rubbish collection will force people to separate the rubbish and recycling.” (Participant 8)

Recycling Collection:

“Although, during Christmas time, it does happen all the time when people have lot of packaging to recycle. I will suggest that the council increase the number of times they collect at Christmas time to avoid these situations.” (Participant 7)

“I think personally, recycling is a low priority for the council, and they give high priority to refuse collection. For me, they should balance out. But residents can put rubbish out every time on the streets and it gets taken away very quickly. You throw a bag away on the street and it is taken away straightaway by the council. I think the council should spent more on recycling and reduce frequent collection of waste.” (Participant 9)

Recycling Bag:

“Another barrier is the COVID 19 with regards to the recycling bags. Due to the pandemic, I am not able to get the plastic bag for recycling from the library. Or is there any other way of recycling without using these bags.” (Participant 12 H)

“Before, in Westminster, they distribute recycling bags to the residents. I do not know why they have stopped it. They distribute the recycling bags and then collect it once a week. We want to recycle but we are not encouraged to recycle.” (Participant 6)

“Some of the residents they say they live in a flat, they have to bring them down, but they do not have the recycling bag.” (Participant 11 H)

“I went on the Westminster website to request a recycling bin; it is like a black bin and some bags. Anytime, I request the bags they just deliver it. Even if I went to the drivers picking up the recycling and I ask, they give it to me.” (Participant 10 H)

“We would like to have a system where we do not have to use bag for normal or mixed recycling.” (Participant 12 H)

“There should be other way to distribute constantly the recycling bags.” (Participant 6)

Food waste:

“What I missed really is the food recycling. The council currently does not recycle food waste which is a big problem. Food waste recycling is the biggest issue for me.” (Participant 1)

“We would like to have food waste recycling because we know other borough do collect food waste.” (Participant 12 H)

“Another thing is that we do not have food waste collection, which is a substantial chunk of waste that can be recycled or recovered which goes into rubbish bins”.(Participant 4)

“Being able to recycle food skins like vegetables skins and food waste would even be better, that means my normal bin would be very empty because most things that are in there are food waste. That would be good.”
(Participant 2)

“Yes, I will make space for it but then because I want to do it. But then people who are not interested may be challenged in find space for food waste storage.” (Participant 2)

“If the council introduce collection for food waste, I will create a space for the third bin.” (Participant 9)

Policy Constraints Theme

Waste legislation:

“It would be useful for the council to break down the recycling rate by wards to identify which wards are recycling and the wards not recycling. This will allow council to adopt strategies targeted towards the wards not recycling enough.” (Participant 11 H)

“You know those Airbnb accommodations, if property owners can be hold responsible which will force them to include recycling terms in the contracts before it is let out. This will be another obligation on the tenants to fulfil while living in the short term.” (Participant 11 H)

Recycling regimes:

“It is different for different council with different rules and schemes. People moving in and out of Westminster. People do not stay long. They have come from somewhere, where there are different recycling rules. So, recycling consistency within various council in London and the country is one, your transient population, short term let, there are lot of visitors as well living in B&B who may not know about the recycling rules or recycle different from where they have come from” (Participant 4).

“Above all, the recycling regime in terms colours, material collected, and labels should be consistent across the country.” (Participant 4)

Mandatory recycling:

“If they do not recycle, I think they should get fines. That what I think, that should be the incentive. It is a negative incentive, and it is not positive incentive, but to me that is what is going to motivate people to do the right thing.” (Participant 10 H)

“The council should chase up property owners to ensure they provide recycling storage in their properties. New tenants moving into old blocks of flat may not be aware of any recycling service since there are no bins for recycling and will just put all recyclable materials in the rubbish bins.” (Participant 9)

Packaging labelling:

“For instance, when I buy tomatoes, fresh tomatoes, they come in plastic tubs. So, when I take off the plastic cover, I know that plastic wrap cannot be recycled so I put that in the rubbish. But the plastic tub, I am not sure if that could be recycle so I put it in the recycling bag. As I have said with the pizza box, I am not sure, so I put it in the recycling bag. I do not think it is 100% clear of what is recyclable and what is not. And just clear instruction on what is not recyclable and what it is.” (Participant 10 H)

“I think the information could be clearer on the labels what can be recycled and what cannot be recycled, which would be helpful. You know there is four of us including the children. If something is clear it extremely easy and simple to tutor small children than when it is quite confusing.” (Participant 12 H)

“There is a lot of packaging that people think can be in the cardboard bin or not”? (Participant 2)

“Sometimes, I am not sure whether a packaging is recyclable or not. When I am not sure I just put it in the rubbish bag. I do not have the time to search for information.” (Participant 7)

Ban:

“I will also say that manufacturers, this is beyond the remit of the Westminster Council. I will say that manufacturer of goods should be encourage not use materials that are not recyclable. When I buy bananas, they are in plastic bags that cannot be recycled. What is the point in that, I do not understand? Maybe Westminster can engage with manufacturers and supermarkets and say there is no need to put a bunch of bananas in a plastic bag. There is no need for that.” (Participant 10 H)

“I would like to see the council working with manufacturers to reduce, to eliminate single-use plastics it is just really should be a crime to use single-use plastic.” (Participant 10 H)

Incentives Theme:

Rewards:

“I think incentives is a great idea to support a local cause or charity.” (Participant 4)

“But I will favour incentives schemes like cash backs, reduction in council tax which I know will never happen. Or even free parking for a week or free voucher to use in library or stores.” (Participant 1)

Motivation:

“It is a great idea, and it will motivate people to recycle. It will also encourage people to have unified mind, cohesion, and effort towards recycling.”

(Participant 11 H)

“The council should introduce incentives throughout the borough to motivate residents to recycle more and to bring attention of people to recycling.”

(Participant 6)

“Maybe it may encourage me and other people” (Participant 8).

Fines:

“I think that the council instead of reducing the pick-up should levy fines on the households who do not dispose their waste responsibly. That is the way I see it. Probably very draconian, I think everyone is a mature adult and if you act as a child, you should be treated as a child. Punitive measures to me are source of income to the council and act more as a deterrent to me.”

(Participant 10 H).

“If people are not recycling may be introduction of fines will force residents to recycle more.” (Participant 8).

Competitions:

“They are making zero efforts. So, an incentive campaign through competition, prize draw to motivate people by rewarding for recycling.”

(Participant 9)

Deposit Return Scheme:

“Incentives scheme like deposit return scheme may help people from low income.” (Participant 1).

“But I do not how this will operate in tower blocks.” (Participant 5).

Environmental Protection Theme

Littering:

“You will still see neighbours just throwing out trash whenever they are ready. Whenever the bag is full, they throw it out they do not keep it in their house. And they put it on the ground, and the foxes and the rats’ tears open all the bags. And it happens all the time.” (Participant 10 H)

“The Queens Park where I live is one of the deprived areas, if you walk along Queens Park, you will see plastics, and things lying on the ground. I think the message is not quite there in this area.” (Participant 11 H)

“The bins are always full of rubbish and recycling dumped around the bins when it is full. When I get to the bins and it is full, I leave the rubbish and recycling near the bins.” (Participant 11 H)

Hygiene:

“Mice and rodents coming out of the rubbish bins when people leave the door of the bin house open. We could avoid that if the council has a better proposal.” (Participant 3)

Fly tipping:

“If the council reduce the frequency of rubbish collection, people will not care but dump waste in public area, and this will not increase recycling.”
(Participant 11 H)

“Otherwise, people will be dumping rubbish on the street. This cannot happen.”(Participant 4)

“Waste dumping and fly tipping in some part of the borough especially in the areas I was living before.” (Participant 4)

Ecosystem Protection:

“All of the above. moral principle, blue planet effect or environmental harm/benefit. Definitely. Can I just say I do not like waste? It does annoy me. I make use of unwanted materials to another things for use. We all must do it not just one person” (Participant 2).

“The right thing for the environment, and it is the right.” (Participant 10 H)

“It is good for the environment.” (Participant 11 H)

“It will be good for the environment. It would be good if the scheme, which help the environment.” (Participant 7)

Codebook - Residents Interviews

Nodes

Name	Description	Files	References
Communication and Public Engagement		10	23
Engagement	Public Engagement	8	24
Language	Barriers, Jargons	3	5
Methods of Communication	Methods of communication	11	25
Progress	Progress report on recycling rate	4	6
Transparency	Residents not aware of end destination of recycling materials	4	6
Environmental Protection		7	9
Ecosystem Protection	Environmental protection	1	1
Flytipping	Waste Fly tipping	4	5
Hygiene		2	2
Littering	Waste litters and dumping	5	5
Human Factors		1	1
Awareness	Recycling and contamination awareness	11	23
Commitment	Coomunal storage lack personal responsibility	9	17
Contamination		11	18
Habit	Is recycling habit consistent	10	14
Influence	Peer or Neighbour influence	3	4
Motivation	Personal Motivation	3	4
Responsibility		4	6

Name	Description	Files	References
Zeal	zeal and passion for recycling	3	6
Incentives		10	17
Competitions	Prizes for good recyclers	1	1
Deposit Return Scheme		2	2
Fines		2	4
Motivation	nudging of residents	6	9
Rewards	Financial, vouchers	2	2
Physical Factors	Interviews	6	10
Accessibility	Proximity to waste infrastructure	5	11
Building types	Building types affect the kind of available waste infrastructure	5	8
Chutes	Blockages and contamination issues	3	14
External Storage	Lack of external storage space for recycling	7	11
Internal Storage	Lack of internal storage space for source segregation for two or three waste stream	8	13
Recycling Bins	types of bins and number	9	24
Refuse Bins		3	3
Source segregation	Source segregation could be facilitated by already installed under counter compartment storage	12	14
Storage Capacity	Inadequate storage capacity for recycling	3	5
Policy Constraints		3	5
Ban	Banning of non recyclable packaging	1	2
Labelling	Ambiguous packaging labelling causing confusion	8	15
Mandatory Recycling	Make recycling mandatory for residents	2	2

Name	Description	Files	References
Recycling Regimes		1	3
Waste Legislation		4	5
Service Constraints		2	4
Food Waste	Food Waste Collection	5	14
Recycling Bag	Access to recycling bag	5	10
Recycling Collection		3	4
Rubbish Collection		10	13
Socio - Economic Factors		7	9
Education	Level of Education	11	11
Employment		12	13
Income	Level of Income	2	2
Residency		12	13

Appendix H- Transcripts of the Council Staff In-Depth Interviews

Barriers Theme Transient

Population:

“So, I think about 30 per cent residents every year move in and out of Westminster” (Participant CP2- Recycling Officer).

“I got permission from the council tax team to do this. I send them proactive recycling information as soon as they moved in. That is about a month after they moved in. The issues with that, is that it is quite cumbersome to do so. It is quite manual” (Participant CP2- Recycling Officer).

Recycling Regimes:

“The problem is, as I said before, I am sure you will have found it in your research as well is that recycling varies so much between different boroughs, and it is really confusing that you can genuinely want to do the right thing. And I mean both of us were overconfident in what we thought in our ability to recycle in Westminster. And you know most people are wanting to be right, and to get it right. You know I live in Southwark, and we have different coloured bins, and you go to the neighbouring and the bin means something different. You can recycle bags there, you cannot do that here, and it is just so easy to make a mistake is not it” (Participant CP3- Innovation)

Misconceptions:

“So, that is a common misconception residents have, and I think often, it is to do with what they have seen in some documentaries and the news. And that is often a barrier. When we form the focus group on food waste before, they mention that sort of element of confusion, and concern about where the recycling went. Is my effort being wasted and are they being recycled?” (Participant CP2- Recycling Officer).

Data:

“Another thing that I thought of, is the way that the data collected currently. So, the recycling tonnage includes both resident and commercial. It is not easy to measure change in residence behaviours or you know in a particular group. It is hard to disassociate between businesses and residents, and

there is no standard method of measuring”(Participant CP3- Innovation Team Manager).

“So, I am really hoping that when they are re letting the contract now. There is going to be better ways of measuring because it is almost impossible to tell if your behavioural insights method has been effective” (Participant CP3- Innovation Team Manager).

Behaviours:

Participant CP1 (Recycling Manager) states “Laziness..... People are just inherently lazy. And I can see that with any just recycling bin, they are just prepared to open the lid and chuck whatever they got inside whether the cardboard contains polystyrene or wood or whatever. People are not going to break the bit of the cardboard down. If they could put it in the bin, they open the lid and put it in the bin.” “It might just be done on purpose because people want to contaminate the recycling bins. There are elements of some residents that do it woefully and others probably do not know or do not think about it. And they see a bin and they throw the materials in. So, we get clothes, shoes and electrical items dumped in some regular waste bins. They also end up in the litter bins because people are just use to it, to get rid of it quickly or easily as they could” (Participant CP1- Recycling Manager).

“Peoples have lived in various places, and they are bringing on different experiences and behaviours with them in their last place they have been living. And not necessarily right for Westminster. I guess, it is kind of getting your head around that is tough. Trying to understand the audience, when you are doing behavioural insight, you need to know your audience, know what their behaviours are, know what their perceptions are and know what drives them. What they are interested in, and what they found to be rewarding. Understanding the audience is tough” (Participant CP3- Innovation Team Manager).

“And so, if we can use behavioural insight which will allow people to do the right thing without even realising, they have done the right thing. By following one of the social instincts to recycle, that is a better way of getting people to recycle in Westminster. If you use behavioral change insight that might at

least bring greater benefits than just keep explaining in letters or other forms of communication engagement” (Participant CP3- Innovation Team Manager)

“So, that is quite hard to understand motivations and that is really the key to behaviour insights, is understanding what people’s motivations and behaviours are in the first place before you can start change them. So, I said that is one of the hardest things to do yeah.” Physical Factors: “There are restrictions on high security areas on placing waste infrastructure out. I think it is very difficult, purely because we are a big city and big cities tend to have lower recycling rate than most of the suburban settings” (Participant CP1- Recycling Manager).

“In the suburban setting you can easily restrict, for example, the residual waste capacity, you can give people a smaller wheelie bin or collect less frequently, urging them not to throw away waste mixed but segregated out into the components that you want to collect. We do not have that option because most of the waste is collected in a communal waste it is either in a bin room or chute or goes out in a pile of bags on the street. There is no way for us to restrict that” (Participant CP1- Recycling Manager).

“So, you have lots of old properties, it is residential mixed with commercial, it is residential above flats, it is high density” (Participant CP2- Recycling Officer).

“Most of Westminster was designed during the period of when there was not much waste and a little bit of coal ash and some incombustible items. As such most properties do not have the storage base for the current generation waste levels created by 500kg per head now. Capturing such recycling requires infrastructure to be put in place, different bins, different areas for materials to be stored before they can be presented for collection. That is not possible in Westminster. In addition, properties are small, so they cannot have the extensive facility for waste segregation. Just of general inability of people to segregate waste because their properties cannot support it.” (Participant CP1- Recycling Manager).

“You know, another thing that we will not be able to resolve is how we are going to deal with all our historic properties, most of them are listed and substantial number of them cannot be easily modified to modern waste management. So, there is lots of barriers from the residential point of view. We have a very mixed housing stock” (Participant CP1- Recycling Manager).

“The different types of buildings, we have got historic buildings, and flats that cannot accommodate all types of recycling bins” (Participant CP3- Innovation Team Manager).

Diverse Residents:

“It depends on the area. I must check. Sorry, but from memory it is like we have Portuguese, Bengali, Arabic, and I think that there is like two others” (Participant CP2- Recycling Officer).

“I mean we do not translate, and we can do on request. We do not generally translate printed communication. One reason being recycling communications do change. So, we sought of look, which is from the national guidance which is also from sort of London based guidance from Re London, logos and information, and the way things should be presented are changed according to the research they do. Additionally, if it is translated sometimes, it is exceedingly difficult to tell how accurate that information is. And we do not want to print a lot of stock and then waste it. So, that is why we do not tend to do that” (Participant CP2- Recycling Officer).

“So, that is always useful, so they have the skills to communicate with doorstep residents in their own language. Even if the resident struggles to communicate or understand some information, we will have all the recycling sort of categories of materials translated into the tops or five languages for that area, and so the resident can understand basically what the door knocker is trying to tell them and door knockers are very some resourceful because they have got a phone on them, they can try to translate on their phones as well” (Participant CP2- Recycling Officer).

Costs:

“Part of it (barrier to recycling), is the cost as well” (Participant CP1- Recycling Manager).

Contamination:

“So, we do not record it for individual sites. So, if a site (MRC) is contaminated and the recycling crew visit, and they cannot collect what is in the bin. The bin (contaminated recycling bin) will be obviously left behind. And a call will be raised for the bin (contaminated recycling bin) to be collected as a general waste instead” (Participant CP1- Recycling Manager).

“Basically, all our mixed recycling is sampled on an on-going basis and that is reported monthly about what was the contamination and what was in the dry mixed recycling that we cannot recycle. But we do not actively keep a log of what each of the site is doing” (Participant CP1- Recycling Manager).

“We know that some of our sites are problematic because they keep on being repeatedly contaminated like the site on the junction of Sussex Garden and Edgware Road is a good example that was contaminated daily. In a worst case, when a site becomes detrimental to recycling, meaning that the site is just collecting general waste and it must be tipped as general waste every single collection, we can then look at removing the site because the site is not just contributing towards recycling” (Participant CP1- Recycling Manager).

Collaboration Theme

“Plus, for joining forces with the climate change team and keeping each other in loop about events they are attending so we can attend too.” (Participant CP2- Recycling Officer).

Research:

“Well. So, the recycling team bring us into, or ask us for data, or if they need some insights, or that they need something. You know something about research from us” (Participant CP3- Innovation Team Manager).

Participant CP3 stated the two ongoing research collaborations on recycling. The first one relates to changing behaviour on how to use the mixed recycling bins correctly. The second research is on the life cycle analysis of food waste. “We have a PhD student now, who is looking at food waste. But she is looking at the end-to-end life cycle of food with our staff. She has already done a survey last year, I think about our buying habits, and whether something is packaged sustainably, and influences on buying behaviours, how much more are we willing to pay for something that is more environmentally friendly. So, she is collecting data from thirty participants or something over a four-month period. Just to see how much food waste we are wasting” (Participant CP3- Innovation Team Manager).

“So, there is a good piece of work done last year which was around gambling. The idea was if they could they put together an index, the geographical index which covers the whole borough and the squares in the squares could be rated on an index of high to low of whether people living there were likely to be vulnerable to the risk of gambling. Until that is now being used by the gambling policy, as a strategy to reduce the number of gambling establishments that could be licenced in a particular area. So, it is using data to identify hotspots and reduce risk, and the council’s is using its licencing powers to reduce that risk to the residents” (Participant CP3- Innovation Team Manager).

So, I just thought one thing, and that is before as well, you were saying about something that is a challenge to do research around recycling in Westminster. Another thing that I thought of, is the way that the data is collected currently. So, the recycling tonnage includes both residential and commercial. It is not easy to measure a change in residence behaviours or you know in a particular group. It is hard to disassociate between businesses

and residents, and there is no standard method of measuring. (Participant CP3- Innovation Team Manager).

Innovation:

“It was another university project using behavioural insights in an app, to encourage people to get better at recycling. And the idea was that you could share a problem, or you could ask the council if it is okay to recycle a material. You could sort of scan the items. So, if you were not quite sure of something is recyclable, you could scan it, and the app would say you can or you cannot” (Participant CP3 – Innovation Team Manager).

“And another is using distinct types of messaging to send letters directly to people with their names and address on the letter. For example, saying “Dear Johnson.” So, it is just like using such tactical approach. And the economy team are working on that to do some analysis to see if the technique is changing behaviours. That is current.” (Participant CP3 – Innovation Team Manager).

“There is a lot of different techniques that is being used at the pavement sites. One which is about like a bin shaped sort of post box hole to put the boxes into” (Participant CP3 – Innovation Team Manager).

“So, one of the projects that is currently happening now at the pavement sites (On-street MRC) is to get people to fold the boxes before they put them in the bin. So, in that way, that will not cause the bin to look full” (Participant CP2- Recycling Officer).

Communication Theme Strategies:

“I think this strategy generally is to put the recycle message out there in a variety of forms to reach a variety of audiences” (Participant CP2 -Recycling Officer).

Response: “Recycling communication plan attached. The council does not have specific written recycling strategy but rely on ReLondon communication

assets produced for all London boroughs. Be That Person Campaign Toolkit - 'Be that person' campaign communications assets - ReLondon which was launched in December 2021" Participant CP2 (Recycling Officer).

Response: "For children due to staffing constraints this is not something we focus on. However, if a request comes in from a school, we will deliver an activity (reading a recycling story book 'Munch and his Funny Tummy' or give a presentation depending on the key stage). Very few of these requests over the past 18months due to schools not wanting visitors on their premises. Additionally, a portion of Westminster students are not Westminster residents- therefore not a priority area. 18-34year olds- ReLondon have completed a report. Report - Motivating young Londoners to recycle - ReLondon. The council do not have their own specific documentation" Participants CP2 (Recycling Officer).

For the request for documentation relating to a resolute communication expert that manages recycling communication.

The response below was obtained.

Response: "CP2, coordinate the recycling operational communication and engagement collaborating with the council Corporate Communication Team, along with various contractors. The recycling team do not have a wholly resolute recycling communication expert" Participant CP2 (Recycling Officer).

For the request for documentation detailing an external organisation managing the council recycling communication.

Response: "Such document does not exist. The council engagement contractors do not manage our recycling comms they provide a service that feeds into our comms and engagement plan" (Participant CP2 - Recycling Officer).

Media:

“Okay. So, social media engagement for Facebook, we have 5,892 followers, and for Twitter we have 29,500. And yes certainly, Twitter more than Facebook, has good reach as well. They quite often do pay social as well” (Participant CP3- Innovation Team Manager).

“No immediate plans. Because it is quite niche in terms of the residents that would have follow or have that level of interests. It is fine. It is remarkably similar; I think to other local authorities that have a specific recycling social media page. Because also now corporately social media team, we can include a lot more sort of greener sustainability agenda, recycling information corporately which has a much wider reach anyway. I do not think there is a massive priority for us to do that. But we will continue to put information out there for residents that have that interest, and again it might increase again once the recycling champion scheme is sort of refreshed and re-launched. We might have more events to advertise, it might have like an organic increase anyway, but I would not say it is a top priority” (Participant CP2 - Recycling Officer).

“Christmas collection changes, then sort of social media focus for people who are very social media savvy, which is how they like to receive their information” (Participant CP2 -Recycling Officer).

“There is a quite bit on there, on the social media about the recycling behaviours. There are some videos and things as well. Perhaps there is more that could be done” (Participant CP3- Innovation Team Manager).

“It is true that we can probably use social media more. I think it is just trying to hit the right balance of not preaching to people, and not boring them with the messaging. Do you know what I mean? So, you can just go overboard and ends up telling people off. It is just about hitting that right balance between not sort of making people feel like they are being told off. If you can get Justin Bieber onto the Westminster website. I am sure it will be extremely welcomed by the communications team. You are right though; influence is important. I think that was what I was trying to say before about messaging. It is like how you get the message across without it appearing to be you

know like a like a naughty case” (Participant CP3- Innovation Team Manager).

“There are always adverts in the corporate publications such as the Reporter, Westminster plus and the children’s magazines which is not there anymore. But yes, the Reporter, Westminster plus” (Participant CP3- Innovation Team Manager). “Yeah, but it is an e-newsletter though, the Westminster. So, I think it goes out..... The click rate is around between 30% and 40%. And the usual..... last week, the city average successful deliveries over the last year it has been 110,000. So, it does it does have good reach, my Westminster newsletter” (Participant CP2 -Recycling Officer).

“I mean we also generally on a regular year do a big door knocking campaign and face to face engagement. We hire a contractor; they hire a team for us, and we have a specific face to face on the resident’s doorstep project every year. So, we had one which was pulled at the start of Covid in March 2020, and we build that sorry November 2021” (Participant CP2 - Recycling Officer).

“So, as I said we have the council tax packs and standard written communication, so that would be from council tax packs, which will be the mass mail outs that usually happen every year. This year, it is not happening because of the food waste implementation” (Participant CP2 -Recycling Officer).

“So, again there was a map that was done, an online map that could identify areas that were most vulnerable to digital exclusion. It is done with the Lottie funding from Greater London Authority. Westminster relied on this and got funding for it as well. Someone from my team did the research. So, you can see the digital exclusion map, but again I think this could be a nice method, potentially to use it” (Participant CP3- Innovation Team Manager).

“Not particularly, because if they are digitally excluded, they would still get the paper communication sent to them twice a year. So, they are still able to receive information from the council, and for any substantial changes for example like food waste, using that example of food waste roll out. If

somebody is not online, did not see about food waste on Twitter, did not check our web pages, does not have an email address, they would have still received information about food waste coming to their property by Royal Mail three or four weeks before we started delivering containers. After that point, they would have somebody on their doorstep knocking to say this is a new service explaining the service, delivering the containers, and delivering another leaflet with further information about the service. So, they would have two opportunities to see something printed. One opportunity to have face to face engagement, and a resident who might be digitally excluded will likely know the council phone number if they were happy as choice of method in contacting us. They would contact the call centre who had been briefed about the service” (Participant CP2 -Recycling Officer).

Monitoring:

“So, as I said before, it could be that we get more container orders. That is a big one. We monitor website hit. If needed and if we really want to be specific, we can look at call centres figures, but we have not done that recently, because we have the need. Because we are starting the food waste roll out, we started at the end of February, we must send communications out few weeks in advance. The recycle team managed the food waste in email inbox. So, we get the direct customer service interactions with residents. So, we know if residents have received things and how they have reacted to things, because people are very quick to complain obviously, or quicker to question, or query what is going to happen, when are they going to collect the bins. How is it going to work and how are they going to be affected” (Participant CP2 -Recycling Officer)

“So, we introduced the food waste trial, I was conscious that obviously there is 30% churn in the city, that new residents would come and not know about the food waste trial service they get. So, for about 18 months they will probably receive information corporately. I got permission from the council tax team to do this. I send them proactive recycling information as soon as they moved in. That is about a month after they moved in, monthly. The issues with that, is that it is quite cumbersome to do so. It is quite manual.

And if you start talking about food waste, you must start talking about mixed recycling and refuse. And at that point really, you want to give a new resident information about what containers they use, what collection day it is, how they should get the containers, and where they should be presented” (Participant CP2 -Recycling Officer).

Engagement Theme:

“We can supply a list of engagement activities over the past 12 months if useful? To note this timeframe is not reflective of the usual amount of engagement we would undertake in a normal year due to covid and staffing issues. Our waste collection contractor mainly attends these events or activities on behalf of WCC due to staffing levels. Engagement list attached” (Participant CP2 -Recycling Officer).

Events:

“Also, in terms of like face to face engagement obviously because of COVID has not happened frequently over the parts of 2 years, but over the past six months, it is a bit more past year really. We have had a bit more consistency in having face to face events but it kind of depends how things are” (Participant CP2 -Recycling Officer).

Participant CP3 commented that people are now keen to attend hybrid workshops (physical and online) due to busy schedules or venue distance. “Well, I mean we are keeping up doing online focus groups and workshops. So, we can do the hybrids and some people welcome that because, it means that they could attend, where otherwise you would be able due to childcare, because of travel and because of accessibility. The people are keen to come back in person and to attend workshops because they feel digitally excluded” (Participant CP3-Innovation Team Manager).

“So, it is always hard, and this is just not in Westminster, this is everywhere to get a good turnout at a recycling event. I can check, however the numbers we have now would not be reflective of the normal years. Every event we do, we keep a record of how many residents we engaged with but again it is hard to say how things are going to play out in the next year and how

reflective the past two years have been again because of covid are not regular attenders' levels" (Participant CP2 -Recycling Officer).

"No. We can get it, but it totally depends on the event, and they do vary. And if it is outdoor event, obviously if it is raining that is going to have a massive impact due to severe weather. You are not going to get the same footfall if the events are on the border with Kensington and Chelsea or Camden. You are not particularly going to have..... There is a risk, you are not going to have a lot of Westminster residents. You may speak to a lot of people, but would they be Westminster residents or would they be tourists. Again, the nature Westminster is quite difficult. So, it kind of depends on the day really" (Participant CP2 -Recycling Officer).

The other challenges are issues associated with using online technology, which is detailed below "And then also we had repair week, which took place a different point in time, whenever it was last year or the year before. It was a repair event which would always take place in person because it covered, we had to run it online. Which had its own sort of complications because the people who do the repair workshops might be very skilled at repair, but it might not necessarily be.....It is a learning process for anybody trying to run a webinar to make sure that obviously the camera is on the actual selling, so they can see what is happening so that it is useful for the people attending" (Participant CP2 -Recycling Officer).

"So, after any event we must inform Veolia or the Westminster recycling team attend and we monitor how many people we engage with, lots of leaflets were given out, what sort of questions were raised, and any sort of further actions. So, if a resident come along and complained about something, was curious about something, or whatever they want. We will action what has been raised at that event. Yes. So, it could be service issues saying that the bins at this location are always overflowing, we can raise that with Veolia. It could be an information issue. For example, they could be saying that this information on the webpage that we need, is not there. It could be a complaint relating to something recently..... somebody came along and told us they were happy with food waste recycling but have not

received their containers as they should have done” (Participant CP2 - Recycling Officer).

Recycling Champions:

“So, the recycling champions were obviously an immense help with that, they have been kind of put-on board and helped in sporadic ways recently. But hopefully that scheme will be re-energise shortly, re-launched, and will have more sort of forward plan with engagement for the next 12 months. Whereas for the past two years because of personnel changes and then Covid, it is been difficult to plan face to face engagement. what we did on corporate communication on last year was to use recycling champions in videos. And I thought that was good because they are keen about recycling obviously, and they are Westminster residents. So, they did videos for us for Christmas, they dressed up in Christmas outfit like Santa outfits and stuff like that and talked about the Christmas tree recycling or what should be recycled during Christmas. For example, no glittery materials and why it is good to recycle. I think that resonates better than sort of public influences but that is my personal perspective. But anything to do with public influences on social media that would be very much led by corporate” (Participant CP2 -Recycling Officer).

Incentives:

“And that was focusing on a win it schemes on housing estates in Westminster, the housing estates in the north and that was twofold. One was to increase recycling generally on the estates. Because anywhere that has a communal facility to recycle, participation is generally lower than a kerbside service because it is communal. So, people are more likely to participate if it is their own rather than something communal. Getting good recycling from anywhere with communal bin is always harder. Particularly, in a housing estate. So, that is why, there is that focus” (Participant CP2 -Recycling Officer).

“You just recycling in your normal way. The only differences are that we will monitor the recycling levels of the bins. We monitor how much the approximate recycling is coming out of that estate. They do not have to opt into it. You do not really do anything. You just conduct recycling in your normal way. We just give communications, and try to encourage people to recycle, because of the incentive that your estate will win something. You will then help suggest and vote if you live in the estate, and it is for the community benefit. You can do what you want really with the money. So, it could be so for activities for the elderly residents on these estates, they could do a visit or something, we would put money towards that. That could be towards pantomime for children, it could be for energy efficient light bulbs, it could be for trees, it could be for a table tennis table for the youth club” (Participant CP2 - Recycling Officer).

“You will not get an accurate participation information anyway. The only way to obtain participation information is sort of check the fill levels when you monitor the sensors in the recycling bins. Unless you have somebody there seeing who uses the bins, you will never be going to have an accurate information. You can only accurately monitor who put their recycling out on the kerbside service, but you cannot do that for a communal bin” (Participant CP2 -Recycling Officer).

“I think some estates are extremely hard to engage with even if they won a price sometimes, it is difficult to get a person or anybody to engage from this state to decide how to spend their incentive reward. So, that is going to be surprising that we have money sometimes for certain states to spend, and there is no engagement from the estate as to suggestions for the prices to be spent and votes really. Additionally, it would be very logistically difficult. And I do not know how you will do it, unless everything is bar coded on the kerbside services to monitor who recycles and who does not recycle on, an ongoing basis to implement a scheme like this” (Participant CP2 -Recycling Officer).

Food Waste Theme Trial:

“Yes, the trial run in autumn 2019 until the end of February. So, we had an enjoyable time with the trial. It won a waste performance award. It went well. I must check the figures but on top of my head it was like six hundred tonnes over that period. But it was an effective way to assess out, how to roll out a service with very various and varied housing stock. So, we did it in residential kerbside streets. Fifteen houses in the north Westminster, we did it in about five housing estates with communal waste bins, and we ran it in about fifteen or sorry maybe twenty mansion private blocks of flats. I think as we are expanding obviously the trial was only seven thousand households. So, relatively small” (Participant CP2 -Recycling Officer).

“So, the results of the trial were that the set-up we have chosen for this food waste collection service works, the results were promising, the use was reasonable, and it is becoming a compulsory service to provide” (Participant CP1 -Recycling Manager).

Feedbacks:

“And it was successful and well received. We ran focus groups in the first few months to evaluate out how the communications were received, evaluate out how the customer service was received, and general service delivery. And all the feedback came back positive” (Participant CP2 -Recycling Officer).

“And it was successful and well received. We ran focus groups in the first few months to assess out how the communications were received, assess out how the customer service was received, and general service delivery. And all the feedback came back incredibly positive” (Participant CP2 -Recycling Officer).

Implementation:

“We are rolling it now as we speak. So, we are planning to cover the whole of the city by the end of the year. We are now rolling out the residential food waste collection through a phased approach” “So, we got approval last October to expand. So, now the service is permanent, and it has been expanded from the north and across the city this year” (Participant CP2 -Recycling Officer).

Constraints:

“So, that is to develop a collection method to collect food waste for example, some flats in Soho above shops that cannot have caddies that have a communal doorway that cannot accommodate anything. So it is that type of properties sort of in the City, Soho, Convent Garden, in parts of Marylebone, parts of Mayfair, there are quite a few residential properties that we have got no way yet to collect from them. And the new burdens funding will probably go towards developing a collection system that can accommodate those properties. I understand in some areas we might want to rely on elements of accommodating food waste in the public realm. However, we want to keep that to a minimum. Because using the public real for waste is not where we want to be” (Participant CP1 -Recycling Manager).

Impact:

“The challenge now is, I think there is lots of perception issues about food waste, it is like the yuck factor. People often think it is going to increase vermin, it is disgusting to do, it is going to increase rats whereas we are not creating new waste, which is separating waste from otherwise would have been in a rubbish bin. But I think people before they use it, they are concerned about that” (Participant CP2 -Recycling Officer).

“It is a bit of a super flux comment. In general, that food waste will now be in a residual waste. So, with regards to smell, if waste is collected frequently, it does not leave the smell issue. Also, with regards to access to rodents, I will say it is more secure because the food waste is in a more lockable bin that rodents cannot get access to it. But when you put your food waste in the black sack and leave it in your front garden, it is much easier for rodents to get access to it. So, I think in that respect food waste collection improves rodent control because it is in a lockable container. The containers in all the estate are encased as well. So, there is no easy access to rodents. The current open chamberlain bins are accessible to rats, even euro bins are accessible to rats if the lids are open. I used food waste bin here in my flat, I have to say that my residual bin does not smell because my residual bin

tends to smell when food waste is thrown into it” (Participant CP1 -Recycling Manager).

“So, that can be for some residents a massive change. But for neighbouring local authorities this is done as standard. We are not doing anything other than what other local authorities do, and where we are introducing the change, it is in areas that are very residential. So, obviously in the north of Westminster we border Brent (another local authority), the properties in Harrow Road are remarkably like properties in the neighbouring Brent who offers similar services” (Participant CP2 -Recycling Officer).

Legislation Theme Political Agenda: “I cannot see that legislation coming in, probably not in my lifetime. There is no political appetite to push it that far. You know waste production is still not high on the political agenda. And no one really knows how we can really push the reduction of waste” (Participant CP1- Recycling Manager).

“And that was done on the political grounds because a lot of the powers that the local authorities had on forcing residents and the people that manage their waste to recycle was taken out of the legislation. The political desire is still there to have a light touch approach on residents and the properties they live in around recycling” (Participant CP1- Recycling Manager).

“And that is purely because reduction of waste means consuming less and consuming less means that less money going into economy in the end. And with the increase in the online shopping, there is increased cardboard coming out compared to previously. The problem is just getting worse as well with regards to how much cardboard is in the system” (Participant CP1- Recycling Manager).

Recycling Rate:

“You need to have a look at what is the methodology for recycling rate. And what is being compared to what. You compare the recycling rate for example between Westminster and an outer London borough, what you should realise is that those the outer London boroughs recycling rate is half made up of garden waste which they have collected for composting. We do not have that

in Westminster. So, you know comparing our rate to Bexley is not fair because Bexley have so much garden waste. When you look on the dry materials that we collect, our recycling rate is sort of in the middle, it is not the lowest, there are boroughs that collected far less dry recycling than we do. So, to say that our recycling rate is not high, I think it is just we do not have garden waste in there, but if you look at how much dry recycling materials that we collected, we are sort of an average performer” (Participant CP1- Recycling Manager).

“Compared to other local authorities, we do not have a garden waste service and that is a very..... because your recycling rates is based on the weight tonnage. That increases recycling rate for other local authorities where it is very residential, people have wheelie bins, people have a lot of garden waste. I think it is very difficult, purely because we are a big city and big cities tend to have lower recycling rate than most of the suburban settings” (Participant CP1- Recycling Manager). “Internationally, the recycling rate are calculated in a unique way. How we calculate it in the UK, or in England at least, is that the materials collected minus anything that cannot go into the recycling process like rejects or residues. Now, in some other places in the world, it is simply recorded as what is collected in the trucks. So, you can collect trucks full of bricks (demolition and construction waste), and it will count towards recycling or their recycling rate. Now, a more correct description of such... would have to be segregation rate rather than recycling rate. It is often you know.... International recycling rate often compared to some other places, it might also include construction and demolition waste, or part of the commercial waste stream” (Participant CP1- Recycling Manager).

Enforcement:

“We cannot issue a fine if we find a glass bottle in the residual bin. We just do not have that option. But in the other places in the world, they have got more draconian measures, and if there is a recycling found in a general waste bin, the property owner will get fined for it. Yes, yes, the only way you could do that is by holding the managing agent, or the property owner or the

estate manager responsible for the format the waste come out to be collected. So, you will act against the property owner for not being in control of all the internal waste segregation. Even in the Environment Bill that is in effect now, there is no legislation, there is no clauses that enables us to do so. There are clauses that we can force businesses to recycle including the managing agent of those businesses that manage their waste. But that is not replicated for the residential element” (Participant CP1- Recycling Manager).

“CCTV will not do anything at all. The only thing you will see on CCTV is someone walking up with a black bag and throwing it in a recycling bin and walking away. Unless someone is using a vehicle to dump contamination, from an enforcement point of view CCTV is useless if it is done on foot. Because you can only see someone walk up, leave something, and then walk off. It does not allow us to establish who has done it, where it comes from, and it does not provide the evidence based that we are after. If it is done by a vehicle, you have a vehicle registration number, so it is much easier to follow up who used that vehicle and then take enforcement action against the owner of the vehicle who was controlling the vehicle at the time” (Participant CP1- Recycling Manager).

Micro Recycling Facilities Theme Misuse:

“And something that was identified was that people when they are using the on-street paper and cardboard or mixed recycling bins, they do not often fold the boxes before they put them in the bins, which leads to bins being full when they are not full. Just because of the un-collapsed box takes up more space. So, it is just a way of trying to encourage residents to flatten their box before putting them in the bin. Because obviously this would lead to overflowing bins, and then people just leave waste around the bins. So, resulting in fly tipping another detrimental behaviour” (Participant CP2 - Recycling Officer).

“But I would say it is because they are not bins in enclosed area, they are not bins in the flat, there is a lot of uncontrolled behaviour with anything that is on the public footpath. So, you can have abuse by businesses, any commercial waste people should not use those bins but can use those bins. So, it is not an environment that you can easily manage to make sure it is like scientific. There are still uncontrollable factors involved if you get what I am saying” (Participant CP2 -Recycling Officer).

Bin Design:

“So, the current stage of the project is that the team has done the baselining, there is new lids on the bins which are slightly wider to help fit in the cardboard boxes inside” (Participant CP2 -Recycling Officer).

“And there is sort of clearer messaging on the bins, and then I think there is nine trial sites or bins with the lids, and with stickers which I have to check, and then some control sites as well. And then, these are just paper and cardboard bins they are not mixed recycling bins for the on-street paper cardboard bins. And then shortly the residents that are local to the micro cycling centre sites that have the new lids and stickers on them will receive letters to remind them, and how to spell colour boxes essentially” (Participant CP2 -Recycling Officer).

“Some MRC are collected daily; some sites are collected twice a day. In terms of cleaning, they are jet wash around every week, there is a team that goes out to clean, and clean any spillage or staining. Maintenance wise, all the bins get refurbished once a year” (Participant CP1 -Recycling Manager).

Recycling Bags Theme Ordering:

“So, in all our communication, it says you can order the bags online, or they can call the call centre. In that way, it is noticeably clear how they can get the bags. So, making the call-to-call centre or order it online, there is also a proactive delivery, there is also the libraries. They go to any of their local libraries, they just have to ask the librarians and they can give them the clear bags. Any events that we are, obviously the engaging events, we can give

bags as we have the stocks of the bags there too” (Participant CP1 - Recycling Manager).

“So, every six months they get fifty bags, so that is an average of two bags a week at their disposal. On top of that if they ordered from us, then within ten working days they would have received the order they make. Often the 10 days is a maximum, so it can be if they phone today, and we have the capacity that they already have their bags tomorrow. So, it is very straight forward to get bags delivered” (Participant CP1 -Recycling Manager).

“So, it is not all the residents. There is a caveat to that. So, it is kerbside properties and mansion blocks that are on the kerbside doorstep service. So, the bags are not sent.....the disposable transparent plastic bags are not sent to the estates for example, because they are on a blue bag service. And if a mansion block is on a blue bag service, they have a communal bin and they have a blue bag and they empty the bag out all the time into the bins. They would not have a proactive delivery but everybody else does. I think it is one or two clear packs delivered twice a year” (Participant CP1 -Recycling Manager).

Information:

“All the information is available online. You know, we do regular outreach, we do door knocking where we knock on everybody’s door at various times as well to avoid people been away. So, there is a wealth of information in there. Some point you must sort of be realistic, what more do you want us to do. All the information is available. If I live somewhere and I do not know how to recycle. The first place, I will go is to my local authority website. what more is expected to communicate and make it clear how the system works. And we repeat the process 3 months down the line because someone has move on again” (Participant CP1 -Recycling Manager).

“So, in all our communication, it says you can order the bags online, or they can call the call centre. In that way, it is clear how they can get the bags” (Participant CP2 - Recycling Officer).

Alternatives:

“Then they can also get to the library to pick them up if they really want them. And furthermore, if they are using the on-street MRC bins, they do not need to put the recycling in the bag. They can put in, loose as well” (Participant CP1 -Recycling Manager).

Benefits:

“The main reasons why we have recycling bags is that the only way we can collect recycling from a lot of properties. These properties cannot have wheelie bins, they cannot have big euro bins, etc. So, there is no way for us to collect recycling otherwise. We have some areas in Westminster where they are using boxes and crates, these are far from ideal because the contents often spill out. At least in a bag, it is held, and it is more user friendly. Regardless, we will still need to have that waste contained somehow. Most properties in Westminster just cannot accommodate bins or wheelie bins system that are in use elsewhere to hold waste. So, for us it is unavoidable” (Participant CP1 -Recycling Manager).

“I agree it is a single-use plastic, at least these bags are made from recycled materials, and they are also segregated at the MRF (Material Recycling Facilities) for recycling as well. But in an ideal world, we would never collect mixed recycling to begin with. Because mixed recycling allows a cheap way to collect recycling in most areas. In an ideal world, we will have sort of a more segregated system, three streams or two streams whatever” (Participant CP1 -Recycling Manager).

“That happens. I do not want to say it is widespread. But there will always be people that think, oh great free bin bags. I do not have to buy the three quid roll at the local supermarket so they are using for general waste, some people use it for garden waste because they think they can use it for garden

waste. So, yes there will always be element of abuse within the recycling bag set up. But I would not say it is widespread that everyone is using their recycling bags for general waste” (Participant CP1 -Recycling Manager).

Service Theme Recycling Regimes:

“Different boroughs have different recycling methods. And the other thing is the visitors. We have the huge influx of visitors to Westminster every day. So, they will all have different recycling processing in their borough. And trying to get them recycle better as well” (Participant CP3 – Innovation Team Manager).

Recycling Collection:

“So, you need to bear in mind as well that in most local authority areas in the UK, their recycling collection is fortnight . In Westminster, the minimum is once a week which is already more. Now as we roll out food waste collection across Westminster, we will be moving to a one-day collection scheme where refuse, recycling and food waste are collected on a single day” (Participant CP1- Recycling Manager).

“When residents are in the commercial street where we collected waste daily as many businesses produces so much waste. So, other residents in these commercial streets can access this daily service of waste collection as well. Every street where we run daily waste collection, we also have a daily recycling collection. So, I do not quite agree with the notion that we do not quite collect recycling as often as we do with rubbish collection. All the commercial streets are mirrored by the recycling collection, and that will only increase. And in the streets that are still getting two waste collection and one recycling collection, will all have moved to one day collection systems” (Participant CP1- Recycling Manager).

“Because that is the only time of the year that our collections ever differ. In other local authorities, even their kerbside service might change on any bank holidays or in Easter. Our residents are affected only at Christmas and new year. In the same way because we offer that Christmas tree recycling service over the festive period” (Participant CP2- Recycling Officer).

“Yes, for certain residents who have disabilities, or who are elderly, who cannot present their waste. So, this will mainly be for residents on the kerbside collection. We can offer an assisted collection, and that would just mean that the crew would just come further into the property in the front garden, then collect the mixed recycling or the rubbish. I mean crews come into gardens anyway, so it is not a massive difference, but I think the difference now would be, because we are having a food waste service there is actual bins that we provide. So, it is making sure that the crews collect the bins from right where the resident leaves them, and take them, empty them, and bring them back to the exact spot right by the doorstep. But the assisted collection, it is more we offer it for bulky waste service is probably the biggest difference. So, bulky waste right now you must collect from outside the property, but if the resident when they book the service and this is a service they pay for unless they receive benefits, they can book in for assisted collection. Where the crew will come inside to collect the bulky waste items. We put on the website if you require assisted collection for food waste, please let us know” (Participant CP2- Recycling Officer).

Challenges:

“This is all related to your point about, can you source separate residential and commercial? It is kind of to do with collection round efficiency. So, the wards are not based..... The rounds are not based on wards. Again, to make them as efficient as possible, so you can have a refuse crew starting but maybe in the West End of the start of their shift, and they collect some on-street rubbish bins or bins from commercial or bins from mansion blocks, and they might do the rest of their round further up north, just because this is how the rounds are designed” (Participant CP2- Recycling Officer).

“Even if you do, that all depends on the rounds, and what makes the most efficient sense for the vehicles. Because a lot of the area are mix, so someone in the West End, you got residential with commercial so does not make sense particularly have separate rounds. You must collect it together otherwise it is an inefficient use of vehicle movements. So, also you got on-street bins as well. So, it is kind of altogether. It does not make logistical emissions, vehicle efficiency crew sense to separate the streams” (Participant CP1- Recycling Manager).

Pandemic:

“I cannot say it has affected us very much in Westminster. Yes, there is no impact on services. We have run the service throughout the pandemic. And we collected whatever that must be collected. I do not agree with the notion that it was difficult to access the bags. We have delivered the recycling bags throughout the pandemic. Just because they could not pick up the bags at the libraries, we were still delivering them” (Participant CP1- Recycling Manager).

“In terms of like face to face engagement obviously because of COVID has not happened often. Whereas for the past two years because of personnel changes and then Covid, it is been exceedingly difficult to plan face to face engagement. I mean we also generally on a regular year do a big door knocking campaign and face to face engagement. So, we had one which was pulled at the start of Covid in March 2020 and November 2021. Yes. Events. So, in terms of events as I said before due to COVID it has been on a very reactive basis. Because we are not sure what was going to happen. But obviously, because of covid we have not be able to run those events. Well. Obviously, we have not been able to do what we would normally do. And I have seen in a normal year, we sort of plan out exactly what events we can do. This one is a bit more of reactive. So, it kind of restricts the

interactive activities that you can run with residents, not only the footfall and but the number of residents that you can engage with, restrict what you can do with them” (Participant CP2- Recycling Officer)

Codebook - Council Staff Interviews

Nodes

Name	Description	Files	References
Barriers	Barriers to achieving recycling rate	3	43
Behaviours	Residents attitude to waste management	3	9
Buildings	Different types of buildings and their structure	2	3
Constraints	Restrictions on what the public realms can be used for	2	4

Name	Description	Files	References
Costs	Costs of delivering recycling service	1	1
Data	The way waste data is collected	2	6
Diverse Residents	Diverse Residents of different background, culture, ethnic group, and languages	2	3
Infrastructure	lack of adequate storage facilities	1	1
Language	different languages of the residents	2	5
Challenges	Challenges faced by the service in translating to different languages	1	1
Mitigations	Mitigations to challenges faced by language translation	1	1
Types	Main types of languages in the borough	1	1
Location	High security area being the seat of national government	2	4
Misconceptions	about what happened to recyclable materials collected	1	1
Recycling Regimes	Recycling Regimes that operates in other boroughs	1	2
Space	Properties are small in sizes	1	2
Transient population	Residents moves on very quickly	1	1
Collaboration	With managing agents for properties	2	3
Contamination	Of the bins in MRC	1	15
Bin Labels	Of the bins in MRC	1	1
Levels	Of the contamination in MRC	1	2
Records	Of the bin contents in MRC	1	3
Sampling	Of the bins in MRC	1	2
Sites	MRC Sites	1	3
Types	Of the bins in MRC	1	2

Name	Description	Files	References
Economy	Impact of waste reduction on the economy	1	4
Consumption	Impact of waste reduction on the economy, less consumption, less waste, and less money in the economy	1	1
Online Shopping	Shift to online Shopping has led to high increase of packaging materials	1	1
Waste Reduction	Impact of waste reduction on the economy	1	2
Engagement	Mitigations to influence behaviours	3	61
Communication	Communication with residents	2	27
Monitoring	Monitoring of communication impact	1	3
New Residents	Identification and Communication to new residents	1	2
Newsletter	Online Newsletter	2	4
Objectives	Communication objectives	1	1
Social Media	Facebook and Twitter	2	8
Strategies	Communication Strategies	1	1
Website	Council website	1	1
Door Knocking	Mitigations to influence behaviours	3	3
Events	Recycling Events	1	12
Attendance	at events	1	2
Challenges	Challenges relating to events	1	2
Feedbacks	Feedbacks from events	1	2
Letters	Mitigations to influence behaviours	2	4
Outreach	Mitigations to influence behaviours	3	5
Recycling Champions		1	2
Role Model	Use of role model to do recycling advert	1	2

Name	Description	Files	References
Workshops	Online and hybrid Workshops	1	2
Food Waste	Food Waste Collection	2	15
Constraints	Constraints of food waste collection service	1	1
Feedbacks	feedbacks from food waste trials	1	1
Impact	Impact of food waste collection	2	3
Implementation	Roll out of food waste collection service	2	3
Storage	storage facility for food waste	1	4
Trial	Results of the food waste trial	2	3
Incentives	Incentives in selected estates	1	6
Challenges	Challenges faced in implementing the scheme	1	2
Effectiveness	Effectiveness of the scheme	1	1
Focus	Area of focus for the incentive scheme	1	1
Participation Level	Participation Level for the scheme	1	1
Process	How the scheme operates	1	1
Legislation	Waste legislation and enforcement	1	10
Enforcement	Enforcement of non-compliance	1	2
Fines	Fines and penalties	1	3
Businesses	Legislation in place to compel businesses to recycle	1	1
Residential	No waste legislation compelling residents to recycle	1	1
Political Agenda	No political motivation to change waste legislation	1	3
Micro Recycling Facility	On-street recycling facilities	2	10
Bin Design	Bin design to encourage better use	1	1
Bin Labels	Bin Labels and information	1	1

Name	Description	Files	References
Collection	Frequency of collection and emptying schedule	1	1
Maintenance	cleaning and washing of the MRC sites	1	1
Misuse	Misuse of the recycling bins	1	2
Monitoring	Monitoring of the new design MRC bins	1	1
Servicing	Repairs of the bins	1	1
Properties	Old historic properties and listed buildings	1	2
Age	old historical properties	1	1
Refurbishment	Cannot be Refurbished	1	1
Recycling Bags	Recycling Bags accessibility	2	19
Advantages	Why use recycling bags?	1	2
Alternative	other options available to access the bags	1	4
Delivery	Delivery of bags to residents	2	3
Disadvantages	Disadvantages of using bags	1	1
Information	Information on how to access the bags	2	3
Misuse	Abuse of use of the recycling bag by residents	1	1
Order	Different ways of ordering recycling bags	1	1
Quantity	Quantity of bags given at any time	1	1
Time frame	Timeframe to receive the bag	2	3
Recycling Collection	Recycling Collection frequency and service	2	5
Constraints	Constraints in separating commercial collection from residential collection	1	1
Frequency	Times and frequency of collection	1	3
Recycling Rate	Barriers to achieving high recycling rate	2	13
Calculation	Uk calculation vs Other Countries calculation	2	3

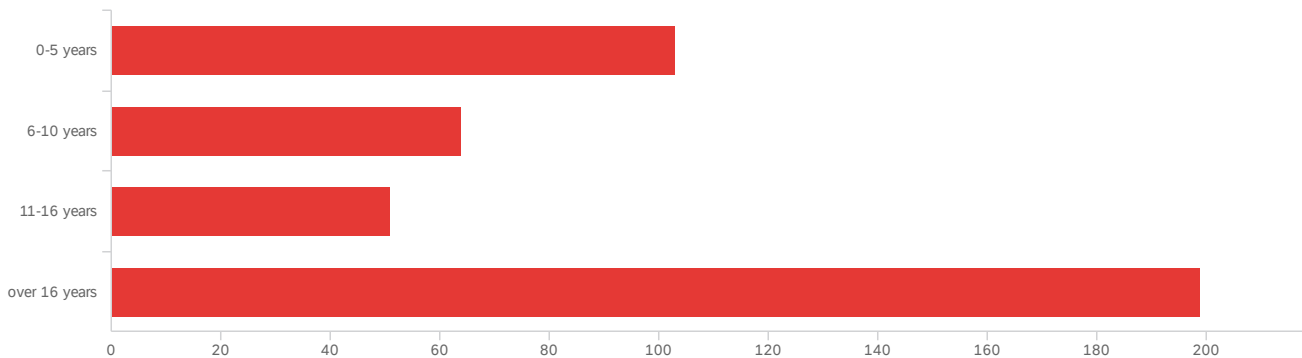
Name	Description	Files	References
Comparison	Comparison to different borough with different types of recyclable materials	1	2
Incentives	Incentives to increase recycling rate and resident participation	1	1
Methodology	Recycling rate measurement criteria	1	2
Research	Research into behavioural changes	2	32
Behavioural Insights	Behavioural Insights on residents' behaviours and attitude	2	15
Ability	Confidence in ability to recycle	1	3
Challenges	Research challenges	2	2
Collaboration	Collaboration with waste team	1	3
Demographics	Demographics of residents surveyed	1	1
Innovation	Innovations on influencing residents	2	5
Sustainability	Research on climate change, air quality and use of electric vehicle	1	1
Service	Recycling Service provided to residents	3	26
Assisted Service	Assisted Service for vulnerable and disabled residents	1	2
Challenges	Challenges facing recycling service	2	2
Exclusion	Some residents are not able to access the council service because they are digitally excluded	2	4
Inclusion	Special service for vulnerable and disabled residents	1	1
Mitigations	Mitigations to challenges	1	1
Pandemic	Pandemic impact to service	3	13
Recycling Regimes	Recycling Regimes with regards to different boroughs	2	3

Default Report

Sustainable Urban Waste Management Through the Lens of Service Users

January 3, 2021 10:38 AM MST

Q1 - How long have you lived in the City of Westminster?



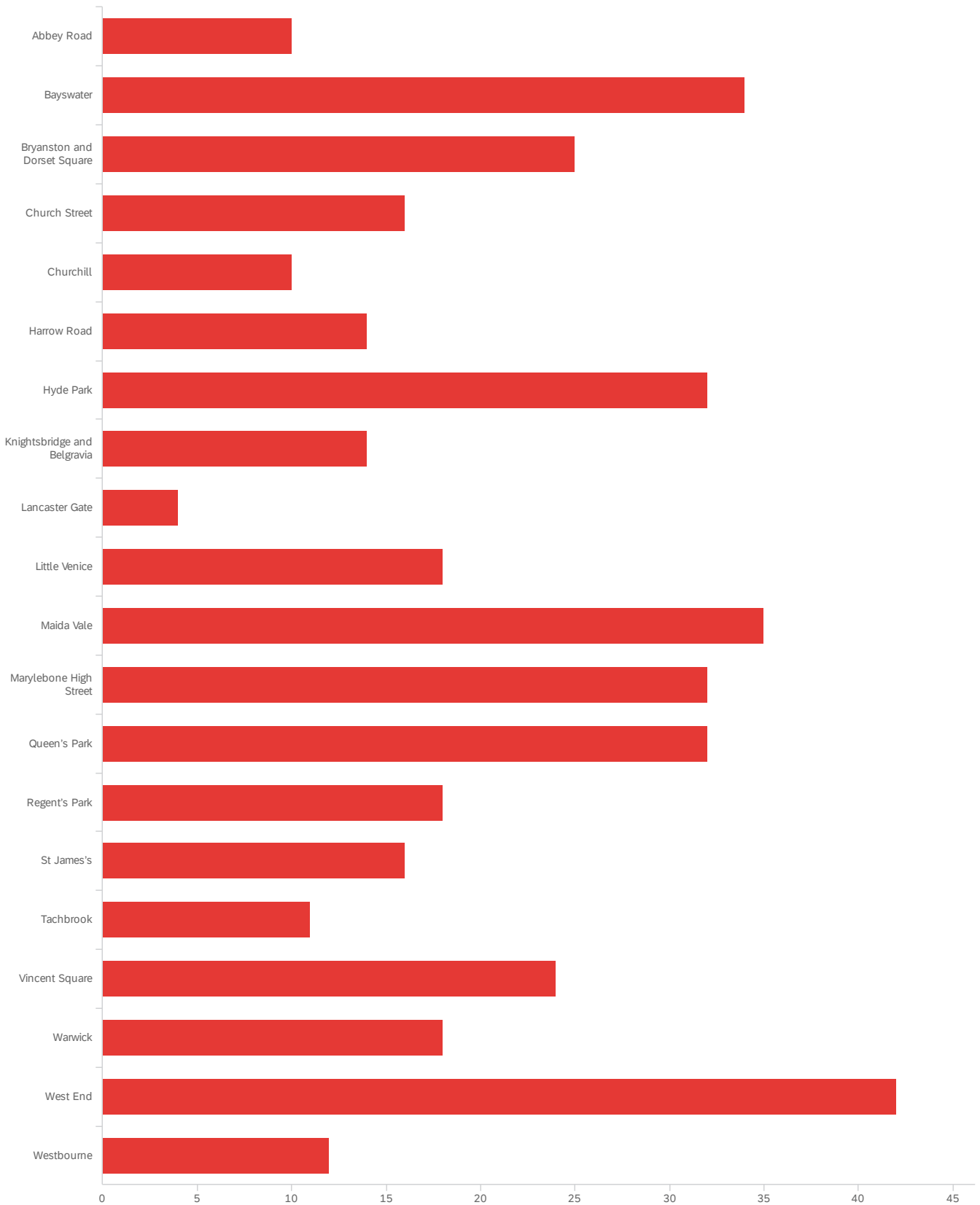
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	How long have you lived in the City of Westminster?	1.00	4.00	2.83	1.26	1.59	417

#	Field	Choice Count
1	0-5 years	24.70% 103
2	6-10 years	15.35% 64
3	11-16 years	12.23% 51
4	over 16 years	47.72% 199

417

Showing rows 1 - 5 of 5

Q2 - Which ward do you live in the City of Westminster?

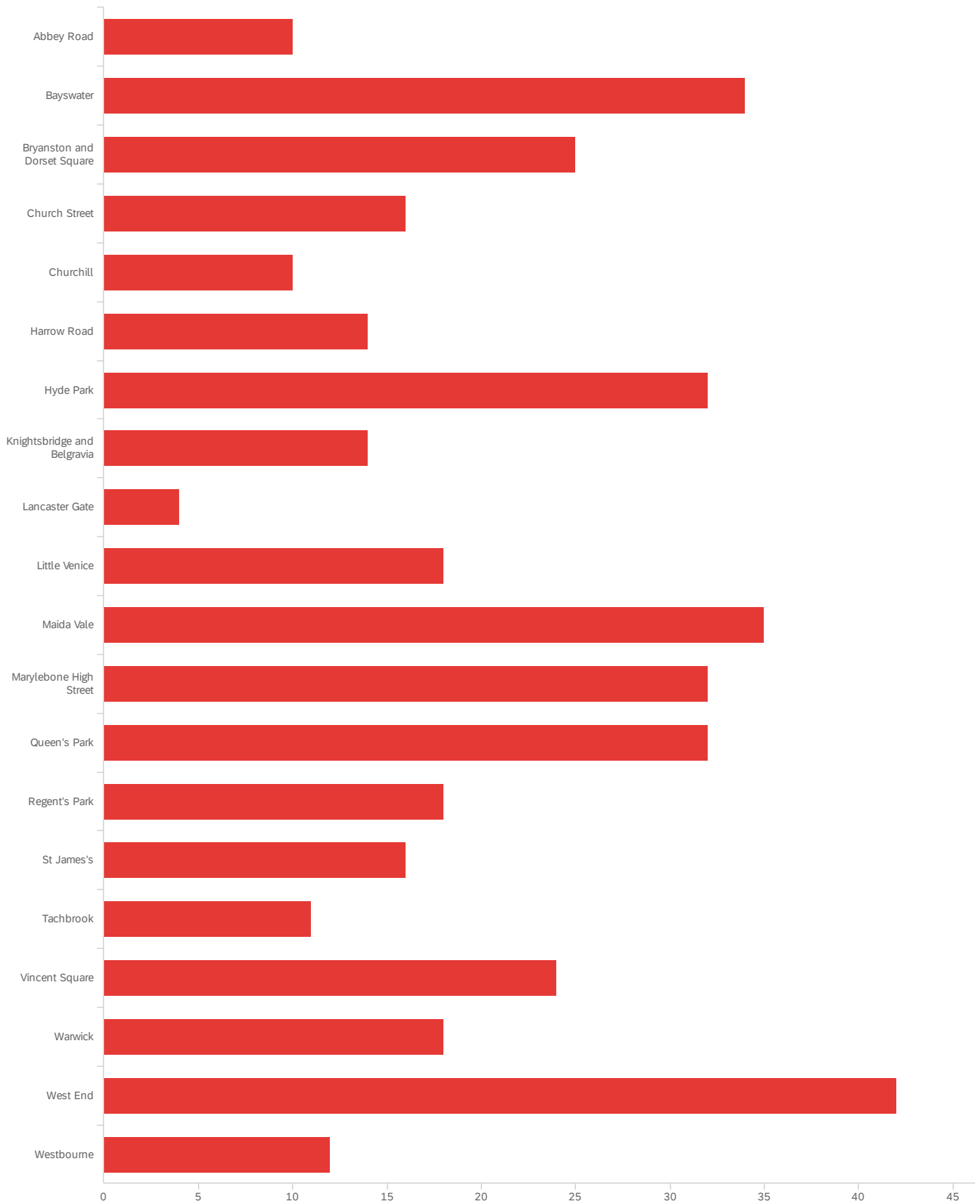


#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Which ward do you live in the City of Westminster?	1.00	20.00	10.85	5.75	33.02	417

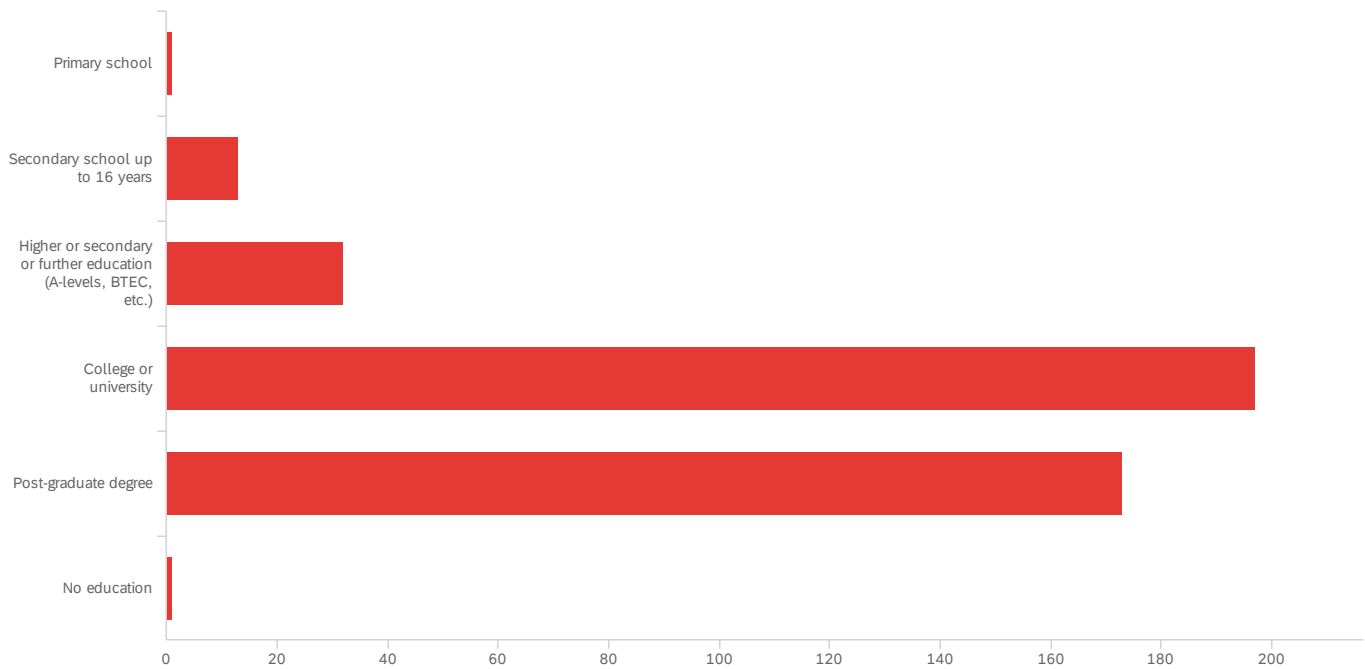
#	Field	Choice	Count
1	Abbey Road	2.40%	10
2	Bayswater	8.15%	34
3	Bryanston and Dorset Square	6.00%	25
4	Church Street	3.84%	16
5	Churchill	2.40%	10
6	Harrow Road	3.36%	14
7	Hyde Park	7.67%	32
8	Knightsbridge and Belgravia	3.36%	14
9	Lancaster Gate	0.96%	4
10	Little Venice	4.32%	18
11	Maida Vale	8.39%	35
12	Marylebone High Street	7.67%	32
13	Queen's Park	7.67%	32
14	Regent's Park	4.32%	18
15	St James's	3.84%	16
16	Tachbrook	2.64%	11
17	Vincent Square	5.76%	24
18	Warwick	4.32%	18
19	West End	10.07%	42
20	Westbourne	2.88%	12

417

Showing rows 1 - 21 of 21



Q3 - What is the highest level of education you have completed?



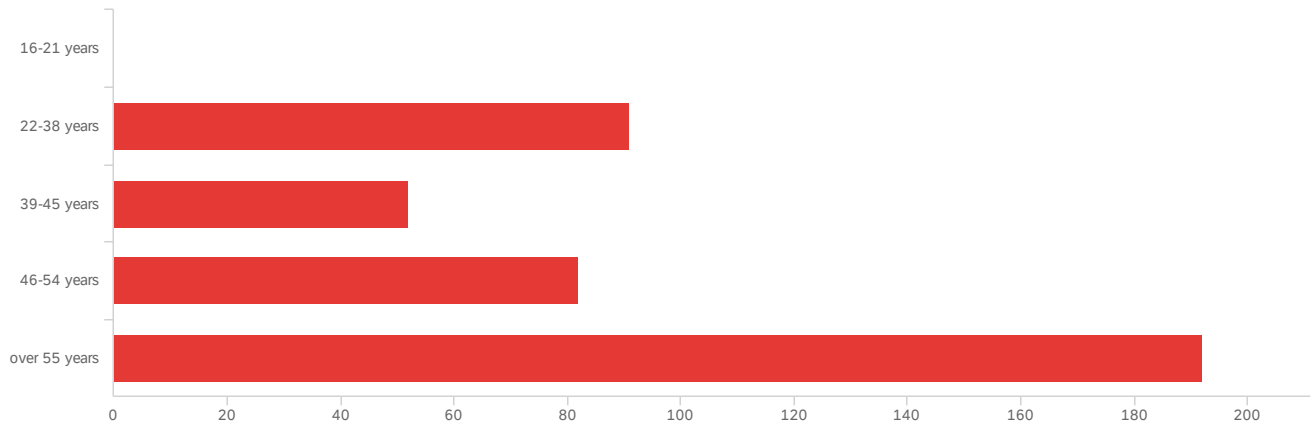
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	What is the highest level of education you have completed?	1.00	6.00	4.27	0.76	0.57	417

#	Field	Choice Count
1	Primary school	0.24% 1
2	Secondary school up to 16 years	3.12% 13
3	Higher or secondary or further education (A-levels, BTEC, etc.)	7.67% 32
4	College or university	47.24% 197
5	Post-graduate degree	41.49% 173
6	No education	0.24% 1

417

Showing rows 1 - 7 of 7

Q4 - What is your age bracket?

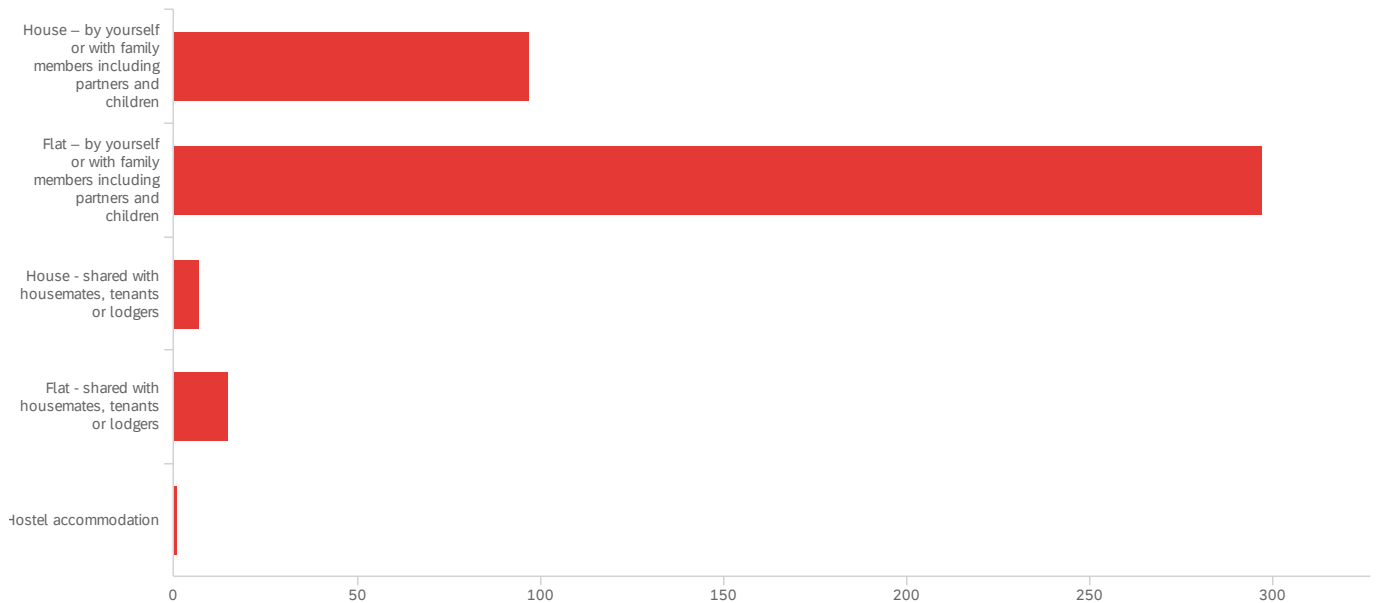


#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	What is your age bracket?	2.00	5.00	3.90	1.20	1.45	417

#	Field	Choice Count
1	16-21 years	0.00% 0
2	22-38 years	21.82% 91
3	39-45 years	12.47% 52
4	46-54 years	19.66% 82
5	over 55 years	46.04% 192
		417

Showing rows 1 - 6 of 6

Q5 - What type of residence do you live in?

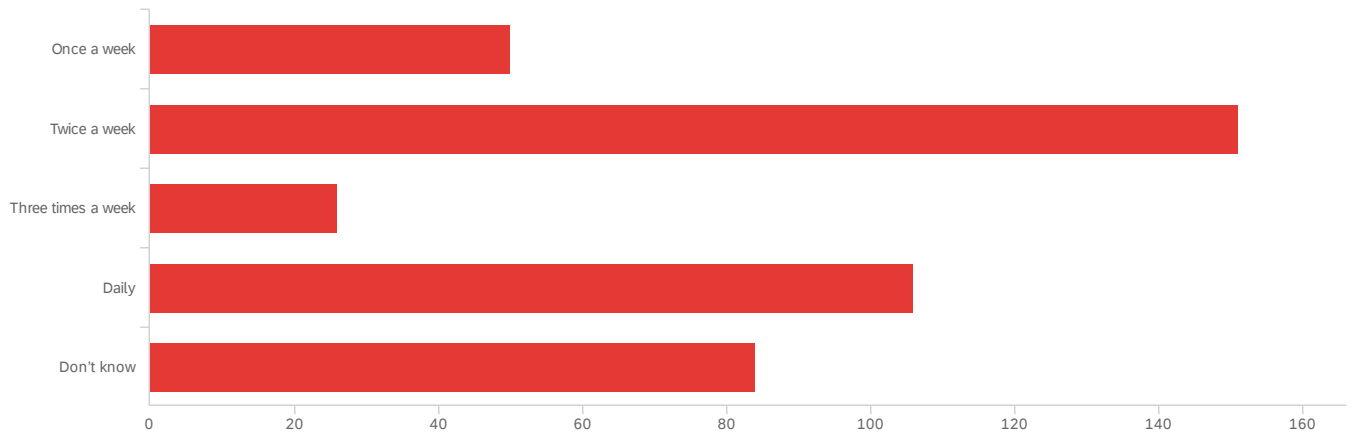


#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	What type of residence do you live in?	1.00	5.00	1.86	0.63	0.40	417

#	Field	Choice Count
1	House – by yourself or with family members including partners and children	23.26% 97
2	Flat – by yourself or with family members including partners and children	71.22% 297
3	House - shared with housemates, tenants or lodgers	1.68% 7
4	Flat - shared with housemates, tenants or lodgers	3.60% 15
5	Hostel accommodation	0.24% 1
		417

Showing rows 1 - 6 of 6

Q6 - How often is your rubbish collected?

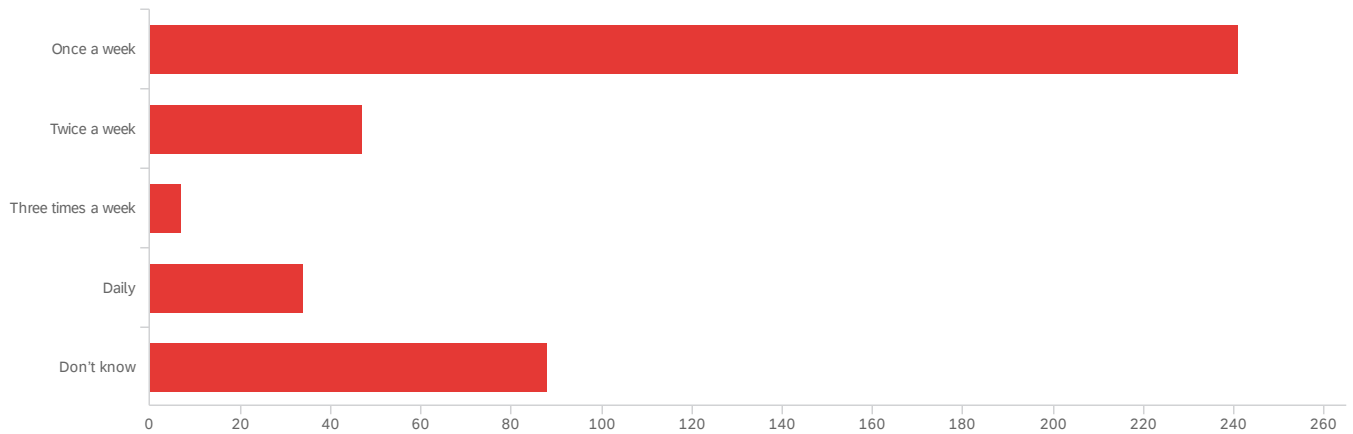


#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	How often is your rubbish collected?	1.00	5.00	3.06	1.38	1.90	417

#	Field	Choice Count
1	Once a week	11.99% 50
2	Twice a week	36.21% 151
3	Three times a week	6.24% 26
4	Daily	25.42% 106
5	Don't know	20.14% 84
		417

Showing rows 1 - 6 of 6

Q7 - How often is your recycling collected?

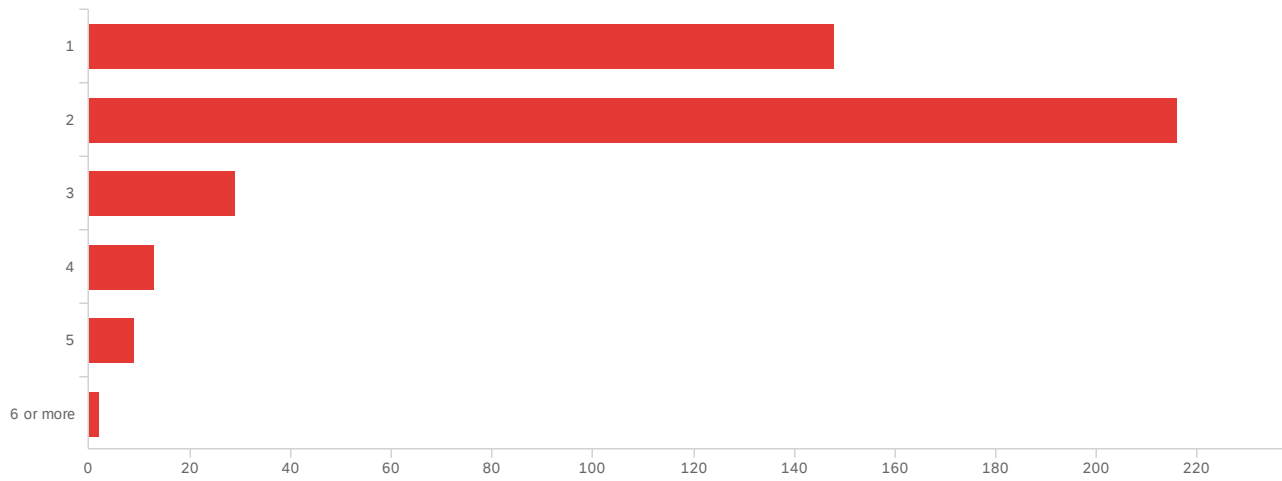


#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	How often is your recycling collected?	1.00	5.00	2.24	1.66	2.76	417

#	Field	Choice Count
1	Once a week	57.79% 241
2	Twice a week	11.27% 47
3	Three times a week	1.68% 7
4	Daily	8.15% 34
5	Don't know	21.10% 88
		417

Showing rows 1 - 6 of 6

Q8 - How many people are in your household age 18 and above?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	How many people are in your household age 18 and above?	1.00	6.00	1.86	0.89	0.80	417

#	Field	Choice Count
1	1	35.49% 148
2	2	51.80% 216
3	3	6.95% 29
4	4	3.12% 13
5	5	2.16% 9
6	6 or more	0.48% 2

417

Showing rows 1 - 7 of 7

Appendix J - Sample Representativeness

Data Representation

The demographic data within the survey were compared to the existing secondary baseline demographic data to decide if the sample population was representative of all the residents living in the borough of Westminster. This approach ensured that the sample data was close to the true population. A purposeful quota sampling (selective sampling) approach was not undertaken in this survey simply because the data required to fulfil research aims needs to be objective in seeking views from all possible residents of Westminster.

Three demographic data were collected as part of the survey, which are age, the highest level of education obtained and type of housing. These three data were compared to the existing secondary baseline data obtained from the London Datastore (2015) which is derived from the Office for National Statistics (ONS) for data collected in 2011. The full report of the census 2021 were not available at the time of publishing this report.

Comparison of the Type of Housing Data

The highest percentage of the predominant type of housing is the flatted properties which constitute 75% of where most of the participants are living. The remaining 25% of the participants are living in houses either with their families or sharing with housemates and lodgers.

This data suggest that the prevailing type of housing is flatted properties which correspond to assumptions about the borough's housing stock. This is evidenced from the ONS survey data collected in 2011 that indicate that 70% of the housing stocks are flats, houses constitute 24% and other types of accommodation such as hostels, caravans, boats, and temporary structures (modular buildings) constitutes 6%.

However, to facilitate an effective comparison, the ONS housing data was modified to remove the other types of accommodation not sampled in the survey.

Table 1 shows the original housing data comparison between the survey data and baseline data while table 2 indicates the comparison between the survey data and the modified baseline data after the baseline data have been re-percentage.

Table 1 Housing Data Comparison (Original)

Housing Type	ONS Data (London Datastore, 2015a)	Survey Data 2020
Houses	24% of Housing Stocks in Westminster	25% of Sampled Population Housing Stock
Flats	70% Housing Stocks in Westminster	75% of Sampled Population Housing Stock
Other Accommodations	6% Housing Stocks in Westminster	0% of Sampled Population Housing Stock
Percentage of Housing Stock	100%	100%
Total Number	125,596	417

Table 2: Housing Data Comparison (Modified)

Housing Type	ONS Data (London Datastore, 2015a)	Survey Data 2020
Houses	24% of Housing Stocks in Westminster	25% of Sampled Population Housing Stock
Flats	70% Housing Stocks in Westminster	75% of Sampled Population Housing Stock
Percentage of Housing Stock	100%	100%
Total Number	125,596	417

Comparison of the Age Data

The age groupings used in the secondary baseline data vary widely from the age groupings in the survey data collected. Therefore, data from the baseline data were merged into the four categories like the survey data to facilitate an effective weighting process and meaningful comparison. Both data were modified by excluding the age group 16-19 years in the ONS data and 16-21 years in the survey data since the age group 16-21 years were not sampled in the survey.

In modifying the data, the age range from 20-39 years in the ONS data were collated to correspond to the age group 22-38 years in the survey data. A similar approach was undertaken to match age groups 40-44 years, 45-54 years, over 55 years in the ONS data to age groups 39-45 years, 46-54 years and over 55 years in the survey data, respectively.

Table 2 shows the original age data comparison between the survey data and baseline data while table 3 indicates the comparison between modified survey data and baseline data after these data have been re-percentage.

Table 2: Age Data Comparison (Original)

ONS Data (London Datastore, 2015b)		Survey Data 2020	
16-19 years	2%	16-21 years	0%
20-24 years	10%	22-38 years	22%
25-29 years	17%	39-45 years	12%
30-34 years	17%	46-54 years	20%
35-39 years	13%	Over 55 years	46%
40-44 years	11%	Total Percentage	100%
45-49 years	9%		
50-54 years	7%		
Over 55 years	14%		
Total Percentage	100%		
Total Number	656,988	417	

Table 3: Age Data Comparison (Modified)

Age	ONS Data (London Datastore, 2015b)	Survey Data 2020
22 – 38 years	58%	22%
39 – 45 years	11%	12%
46-54 years	17%	20%
Over 55 years	14%	46%
Total Percentage	100%	100%
Total Number	642,511	417

Comparison of Highest Qualification Data

The format of the ONS baseline data on educational qualification was collected in levels from level 1 to level 8 which is different from the format in the survey data. Therefore, to allow effective comparison of these two data, the survey data on the level of education were grouped under the appropriate levels (1 to 8) in the ONS

data. The UK Government (2021), interpretation scale for levels of qualification was used for the groupings.

In modifying the survey data, the 'No Qualification' and the primary school education were excluded for analysis purposes because the response percentages were less than 1%. Also, in the ONS data the 'No Qualification,' apprenticeship and 'Other Qualification' percentages were excluded because they were not sampled.

Finally, the secondary school qualification, the further education qualification, the college or university qualification, and the postgraduate degree qualification in the survey data were matched across to level 1, level 2, level 3, and level 4 and above respectively.

Table 4 shows the original level of education data comparison between the survey data and baseline data while table 5 indicates the comparison between modified survey data and baseline data after the survey data has been grouped under the various educational levels in the ONS data.

Table 4: Education Data Comparison (Original)

ONS Data (Nomis, 2011)		Survey Data, 2020	
No Qualification	13%	No Education	0%
Level 1	7%	Primary School	0%
Level 2	8%	Secondary School up to 16	4%
Apprenticeship	1%	Higher or Further Education	8%
Level 3	9%	College or University	47%
Level 4 to Level 8	50%	Postgraduate Degree	41%
Other Qualification	12%		
Total Percentage	100%	Total Percentage	100%
Total Number	186,812	Total Number	417

Table 5: Education Data Comparison (Modified)

Level of Education	ONS Data (London Datastore, 2015)	Survey Data 2020
Secondary School up to 16	9%	4%
Higher or Further Education	11%	8%
College or University	12%	47%
Postgraduate Degree	68%	41%
Total Percentage	100%	100%
Total Number	137,864	417

Demographic Data Adjustment

The comparison of the survey demographic data (age and education) to the baseline data indicates that these two data collected are not representative of the true population. This anomaly was corrected by subjecting the age and the education data to weighting. The type of housing data was not weighted because the survey data is close to the baseline data.

Weighting is a mitigating process to address data imbalance or bias towards a variable or variables to improve data collection. Lavrakas (2008) identified two bases for weighting data. Firstly, to appropriate unbalanced data in terms of data representation. Secondly, to offset data for an unresponsive group or survey subjects. In this instance, the essence of data weighting is based on the former.

Since the variables (age and education) to be weighted are stratified levels of the population concerned, post-stratification weighting is the most applicable method of weighting to correct stratified survey data. This is achieved by matching the survey data to the true population using available baseline data (Buckley and King-Hele, 2014).

Royal (2019), stated three benefits of post-stratification which are efficacy in adjusting sample bias, estimation of bias, and the ease of application. However, he pointed out the limitation of the weighting method in terms of reliance on baseline data, in which inaccurate baseline data will affect the accuracy of weighing the result.

Johnson (2008) explained that post-stratification weighting (CW) is calculated by dividing the target population (TP) proportion with the unweighted distribution (UD).

$$CW=TP/UD$$

Tables 6 and 7 indicates the result of the calculated weight for age and education distribution.

Table 6: Age Data Adjustment

Age Range	Raw Survey Data (%)	Raw Survey Count	Target Population (%)	Calculated Weight	Adjustment Count
22-38 years	22	91	58	2.63	242
39-45 years	12	52	11	0.91	46
45-54 years	20	82	17	0.85	71
over 55 years	46	192	14	0.30	58
Total	100	417	100		417

Table 7: Education Data Adjustment

Level of Education	Raw Survey Data (%)	Raw Survey Count	Target Population (%)	Calculated Weight	Adjustment Count
Secondary School up to 16	4	15	9	2.25	38
Higher or Further Education	8	32	11	1.37	46
College or University	47	197	12	0.25	50
Postgraduate Degree	41	173	68	1.65	283
Total	100	417	100		417

Appendix K - Participation Information Sheet (PIS)

MIDDLESEX UNIVERSITY PARTICIPANT SHEET (PIS)

Participant ID CodeXXX

SECTION 1

1. Study title

Sustainable Urban Waste Management Through the Lens of Service Users

2. Invitation paragraph

You are being invited to take part in a research study. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Thank you for reading this.

3. What is the purpose of the study?

The research will focus on sustainable waste storage and collection system within urban environment, looking at the existing practises with a view to proffer new waste management model to tackle the issues of falling recycling rate and high level of contamination of the recyclable materials. This will be achieved through interviewing and surveying of the residents within borough of Westminster City Council. These views will be used to implement key changes that will positively impact the recycling rate and reduce the contamination levels. This research is ongoing and will be concluded in 2023.

4. Why have I been chosen?

It is important that we assess as many participants as possible, and you have indicated that you are interested in taking part in this study. You have been selected to take part in this research because you have been identified as a resident or visitor or worker within the Borough of Westminster that would be able to provide the necessary information needed for this research.

5. Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason. If you do decide to withdraw from the study then please inform the researcher as soon as possible, and they will facilitate your withdrawal. If, for any reason, you wish to withdraw your data please contact the researcher within a month of your participation. After this data it may not be possible to withdraw your individual data as the results may have already been published. However, as all data are anonymised, your individual data will not be identifiable in any way.

You can also decide to withdraw at any point without a reason, which is acceptable and your withdrawal from the research will not have any impact on you as an individual or resident living in this borough.

6. What will I have to do?

- If you do take part, I will be conducting an interview with you and the interview should only last for about 45 minutes for each individual and the interview will be recorded and transcribed for data analysis as part of the research.

- The interview will be conducted within a suitable location of your choice that is convenient for you.

- For survey, it will take around 15 minutes to complete the survey

Please note that in order to ensure quality assurance and equity this project may be selected for audit by a designated member of the committee. This means that the

designated member can request to see signed consent forms. However, if this is the case your signed consent form will only be accessed by the designated auditor or member of the audit team.

7. Will I have to provide any bodily samples (i.e. blood/saliva/urine)?

NO

8. What are the possible disadvantages and risks of taking part?

There are no risks associated with this interview. We just want to learn your perspective to waste management issues.

Appropriate risk assessments for all procedures have been conducted and will be followed throughout the duration of the study.

9. What are the possible benefits of taking part?

We hope that participating in the study will help you. However, this cannot be guaranteed. The information we get from this study may help us to increase recycling rate. Benefits of taking part in this research includes improved and efficient waste management services to your local community.

10. Will my taking part in this study be kept confidential?

The research team has put a number of procedures in place to protect the confidentiality of participants. You will be allocated a participant code that will always be used to identify any data you provide. Your name or other personal details will not be associated with your data, for example, the consent form that you sign will be kept separate from your data. All paper records will be stored in a locked filing cabinet, accessible only to the research team, and all electronic data will be stored on a password protected computer. All information you provide will be treated in accordance with the UK Data Protection Act.

11. What will happen to the results of the research study?

The results of the research study will be used as part of a Postgraduate dissertation. The results may also be presented at conferences or in journal articles. However, the data will only be used by members of the research team and at no point will your

personal information or data be revealed. Results may be used for future research, but your confidentiality would be strictly observed.

12. Who has reviewed the study?

The study has received full ethical clearance from the Research ethics committee who reviewed the study. The committee is the Natural Science Research Ethics Committee.

13. Contact for further information

If you require further information, have any questions or would like to withdraw your data then please contact:

Name and Contact Details of the Researcher: Saeed Oluwadipe
(so764@live.mdx.ac.uk)

Name and Contact Details of the Supervisor: Dr Alan Page (A.Page@mdx.ac.uk)

Thank you for taking part in this study. You should keep this participant information sheet as it contains your participant code, important information and the research teams contact details

SECTION 2

Middlesex University Privacy Notice for Research Participants

The General Data Protection Regulation (GDPR) protects the rights of individuals by setting out certain rules as to what organisation can and cannot do with information about people. A key element to this is the principle to process individuals' data lawfully and fairly. This means we need to provide information on how we process personal data.

The University takes its obligation under the GDPR very seriously and will always ensure personal data is collected, handled, stored and shared in a secure manner. **The University's Data Protection Policy can be accessed here:** https://www.mdx.ac.uk/_data/assets/pdf_file/0023/471326/Data-Protection-Policy-GPS4-v2.4.pdf.

The following statements will outline what personal data we collect, how we use it and who we share it with. It will also provide guidance on your individual rights and how to make a complaint to the Information Commissioner's Officer (ICO), the regulator for data protection in the UK.

Why are we collecting your personal data?

As a university we undertake research as part of our function and in our capacity as a teaching and research institution to advance education and learning. The specific purpose for data collection on this occasion is to understand the barriers and challenges in achieving high recycling rate. The result of the research will then be used to develop a new strategy and policy approach to urban waste management based on information obtained from service users.

The legal basis for processing your personal data under GDPR on this occasion is Article 6(1a) consent of the data subject.

Transferring data outside Europe

In the majority of instances your data will be processed by Middlesex University researchers only or in collaboration with researchers at other UK or European institutions so will stay inside the EU and be protected by the requirements of the GDPR.

In any instances in which your data might be used as part of a collaboration with researchers based outside the EU all the necessary safeguards that are required under the GDPR for transferring data outside of the EU will be put in place. You will be informed if this is relevant for the specific study you are a participant of.

Your rights under data protection

Under the GDPR and the DPA you have the following rights:

- to obtain access to, and copies of, the personal data that we hold about you;
- to require that we cease processing your personal data if the processing is causing you damage or distress;
- to require us to correct the personal data we hold about you if it is incorrect;
- to require us to erase your personal data;
- to require us to restrict our data processing activities;
- to receive from us the personal data we hold about you which you have provided to us, in a reasonable format specified by you, including for the purpose of you transmitting that personal data to another data controller;
- to object, on grounds relating to your particular situation, to any of our particular processing activities where you feel this has a disproportionate impact on your rights.

Where Personal Information is processed as part of a research project, the extent to which these rights apply varies under the GDPR and the DPA. In particular, your rights to access, change, or move your information may be limited, as we need to manage your information in specific ways in order for the research to be reliable and accurate. If you withdraw from the study, we may not be able to remove the information that we have already obtained. To safeguard your rights, we will use the minimum personally-identifiable information possible. The Participant Information Sheet will detail up to what point in the study data can be withdrawn.

If you submit a data protection rights request to the University, you will be informed of the decision within one month. If it is considered necessary to refuse to comply with any of your data protection rights, you also have the right to complain about our decision to the UK supervisory authority for data protection, the Information Commissioner's Office.

None of the above precludes your right to withdraw consent from participating in the research study at any time.

Collecting and using personal data

The only personal data that will be collected are resident addresses. The data are only collected to ensure that data is only obtained from residents living within specified location for the research study. The addresses will be deleted after the interview and survey and will not appear in the submitted thesis.

Data sharing

Your information will usually be shared within the research team conducting the project you are participating in, mainly so that they can identify you as a participant and contact you about the research project.

Responsible members of the University may also be given access to personal data used in a research project for monitoring purposes and/or to carry out an audit of the study to ensure that the research is complying with

applicable regulations. Individuals from regulatory authorities (people who check that we are carrying out the study correctly) may require access to your records. All of these people have a duty to keep your information, as a research participant, strictly confidential.

If we are working with other organisations and information is shared about you, we will inform you in the Participant Information Sheet. Information shared will be on a 'need to know' basis relative to achieving the research project's objectives, and with all appropriate safeguards in place to ensure the security of your information.

Storage and security

The University takes a robust approach to protecting the information it holds with dedicated storage areas for research data with controlled access.

Alongside these technical measures there are comprehensive and effective policies and processes in place to ensure that users and administrators of University information are aware of their obligations and responsibilities for the data they have access to. By default, people are only granted access to the information they require to perform their duties. Training is provided to new staff joining the University and existing staff have training and expert advice available if needed.

Retention

Under the GDPR and DPA personal data collected for research purposes can be kept indefinitely, providing there is no impact to you outside the parameters of the study you have consented to take part in.

Having stated the above, the length of time for which we keep your data will depend on a number of factors including the importance of the data, the funding requirements, the nature of the study, and the requirements of the publisher. Details will be given in the information sheet for each project.

Contact us

The Principal Investigator leading this research is Saeed Oluwadipe

Science and Technology Faculty

Professional Doctorate

Middlesex University

The Burroughs

London

NW4 4BT

07920885116

so764@live.mdx.ac.uk

The University's official contact details are:

Data Protection Officer

Middlesex University

The Burroughs

London

NW4 4BT

Tel: +44 (0)20 8411 5555

Email: dpaofficer@mdx.ac.uk

Appendix L- Template for the Participant Consent Form

Participant Identification Number: XXX

CONSENT FORM

Title of Project: *Sustainable Urban Waste Management Through the Lens of Service Users*

Name and Contact Details of the Researcher: Saeed Oluwadipe
(so764@live.mdx.ac.uk)

Name and Contact Details of the Supervisor: Dr Alan Page
(A.Page@mdx.ac.uk)

Please initial box

1. I confirm that I have read and understand the information sheet datedfor the above study and have had the opportunity to ask questions.

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason and without penalty.

3. I agree that this form that bears my name and signature may be seen by a designated auditor.

4. I agree that my non-identifiable research data may be stored in National Archives and be used anonymously by others for future research. I am

assured that the confidentiality of my data will be upheld through the removal of any personal identifiers.

5. I understand that my interview may be taped and subsequently transcribed.

6

7. I agree to take part in the above study.

7

Name of participant	Date	Signature

Name of person taking consent (if different from researcher)	Date	Signature

Researcher	Date	Signature

1 copy for participant; 1 copy for researcher.




City of Westminster

To: Saeed Oluwadipe MU Number M00661269
Middlesex University
Dept of Natural Sciences; Faculty of Science and Technology
Middlesex University
The Burroughs
Hendon
NW4 4BT

Date: 12 July 2019

Release of Westminster City Wards Waste Data between 2009 and 2018

This letter is confirmation of permission for the above named Middlesex University Research Student to access this organisation waste data stated above, to undertake a research study Titled: ***Sustainable Urban Waste Management Through the Lens of Service Users*** within Waste and Cleansing department and collect data as agreed.


Head of Service (Waste and Parks)
Westminster City Council
64 Victoria Street
London
SW1E 6QP

Telephone: 
Email: 

Appendix N - Uni Ethics Approval



Natural Science REC

The Burroughs
Hendon
London NW4 4BT

Main Switchboard: 0208 411 5000

19/12/2019

APPLICATION NUMBER: 6809

Dear Saeed Olaniyi Oluwadipe and all collaborators/co-investigators

Re your application title: Sustainable Urban Waste Management

Supervisor: Diane Hemda Garelick Purchase

Co-investigators/collaborators:

Thank you for submitting your application. I can confirm that your application has been given APPROVAL from the date of this letter by the Natural Science REC.

The following documents have been reviewed and approved as part of this research ethics application:

Document Type	File Name	Date	Version
Participant Information Sheet	Consent Form -App G		
Data Access Approval	Westminster Approval To Access Data- App I		
Materials	App B- Questionnaires- Residents	11/12/2019	vs1
Materials	App C -Questionnaire- Businesses	11/12/2019	vs1
Materials	App D - Questionnaire -Transient Population	11/12/2019	vs1
Materials	App E - Interview questions- Residents	11/12/2019	vs1
Materials	App F -Interview questions- Businesses	11/12/2019	vs1
Materials	App G -Interview questions- Other Stakeholder	11/12/2019	vs1
Materials	App I -Participant Consent Form	11/12/2019	vs1
Participant Information Sheet	App H- Participation Information Sheet (PIS)	11/12/2019	vs2
Materials	App H- Participation Information Sheet (PIS)	11/12/2019	vs2
Data Protection Act checklist	Data Protection Form V2	11/12/2019	vs1
GDPR Declaration	Data Protection Declaration Form	11/12/2019	VS1
Participant Recruitment Information	App H- Participation Information Sheet (PIS)	12/12/2019	vs2

Although your application has been approved, the reviewers of your application may have made some useful comments on your application. Please look at your online application again to check whether the reviewers have added any comments for you to look at.

Also, please note the following:

1. Please ensure that you contact your supervisor/research ethics committee (REC) if any changes are made to the research project which could affect your ethics approval. There is an Amendment sub-form on MORE that can be completed and submitted to your REC for further review.
2. You must notify your supervisor/REC if there is a breach in data protection management or any issues that arise that may lead to a health and safety concern or conflict of interests.

3. If you require more time to complete your research, i.e., beyond the date specified in your application, please complete the Extension sub-form on MORE and submit it your REC for review.

4. Please quote the application number in any correspondence.

5. It is important that you retain this document as evidence of research ethics approval, as it may be required for submission to external bodies (e.g., NHS, grant awarding bodies) or as part of your research report, dissemination (e.g., journal articles) and data management plan.

6. Also, please forward any other information that would be helpful in enhancing our application form and procedures - please contact MOREsupport@mdx.ac.uk to provide feedback.

Good luck with your research.

Yours sincerely

Chair Dr Sandra Appiah

Natural Science REC

Appendix O- Participants Comparison Analysis

Participants Comparison Analysis

To summarise all the emerged issues, three random comparison analysis were conducted by pairing participants of different and same buildings characteristic to display quick overview of the similarities and differences that may exist between the participants in all themes into three groups. The groups are as follows

- Comparison between two participants living in houses (Group A).
- Comparison between two participants living in flats (Group B).
- Comparison between one participant living in a flat and one participant living in a house (Group C).

Group A: P10 H and P11 H Comparison (House and House)

The two participants compared in this category share similar building characteristics as both participants live in houses. Surprisingly, they have different opinions and experiences in terms of infrastructure, storage capacities, recycling communication, recycling service received and different views on waste legislation and policy. Figure 1 indicates the comparison diagram.

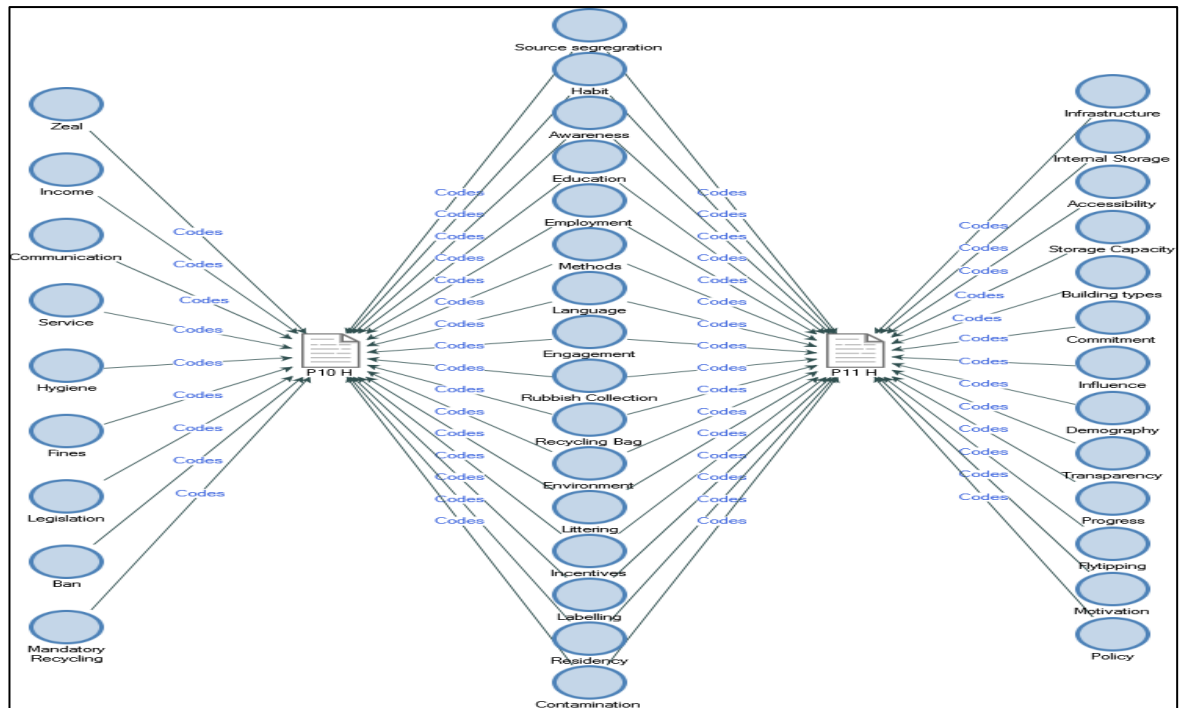


Figure 1: Participants Comparison for Houses Characteristics

Conversely, the two participants living in houses compared, share similar views on issues such as recycling habit, social economic factors, environmental protection, waste collection and access to recycling bag.

Group B: P1 and P12 H Comparison (Flat and House)

The participants in this group lives in different building types (flat and house) but share common characteristics in terms of external storage facilities, socio-economic factors, packaging labelling and service issues on rubbish collection, non-collection of food waste and incentive schemes. The differences among the participants in this group are on issues such as internal storage, service perception, varied recycling habits, recycling bins availability, recycling bag accessibility and recycling collection. Figure 2 indicates the flat and house comparison diagram.

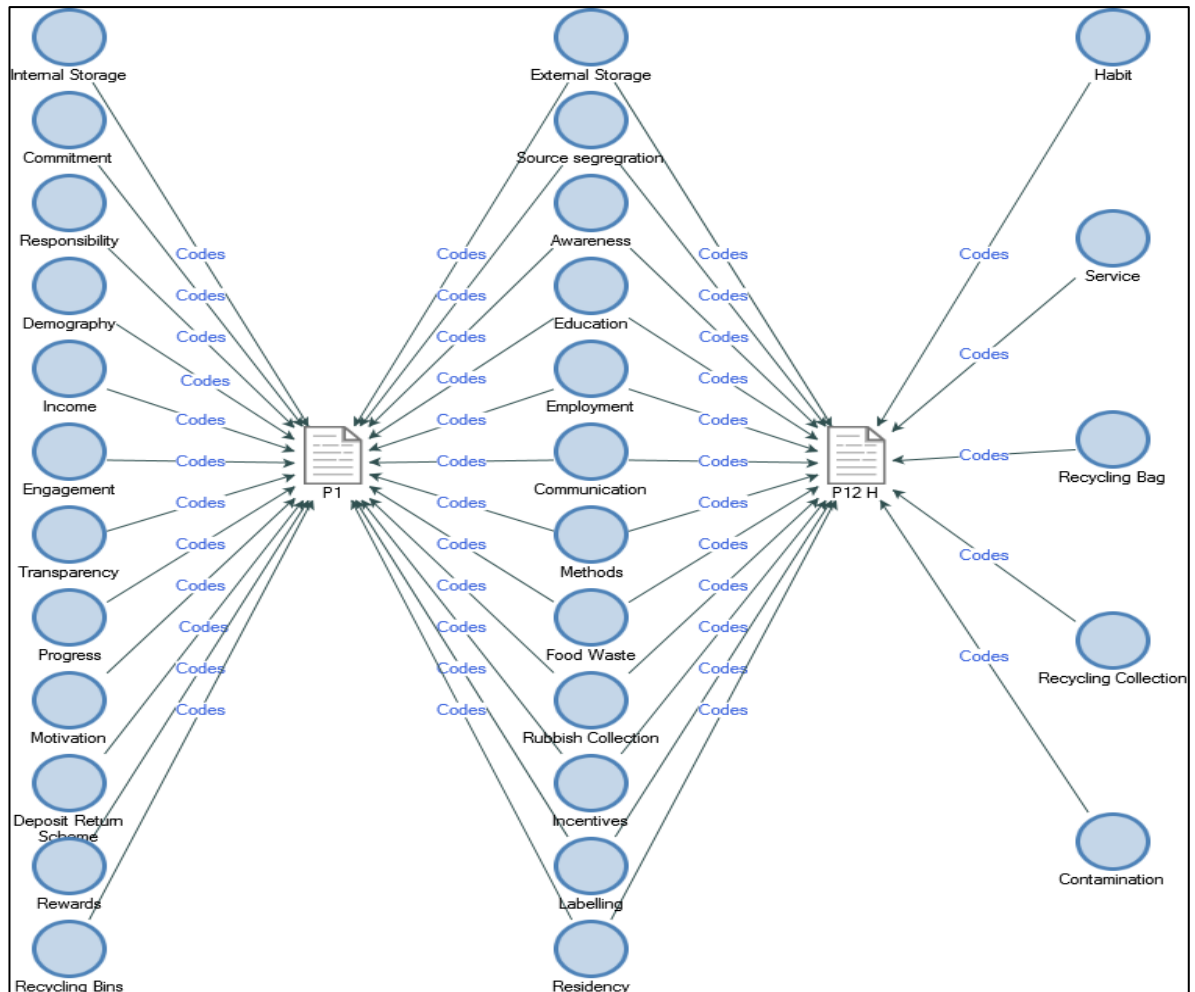


Figure 2: Participants Comparison for Flat (P1) and House (P12) Characteristics

P2 and P4 Comparison (Flat and Flat)

The participants in this group lives in the same building type (flatted properties). This group have more factors in common than their differences. The commonality that exists in this grouping are internal storage bordering around source segregation issues, varied recycling habit, socio-economic factors, perception to the environment, views on waste legislation, views on communication and public engagement, food waste issues, non-availability of recycling bins and frequency of rubbish collection. The differences indicated are differences in views and opinions of the sub themes of the commonality factors. Figure 3 shows the comparison diagram for P2 and P4.

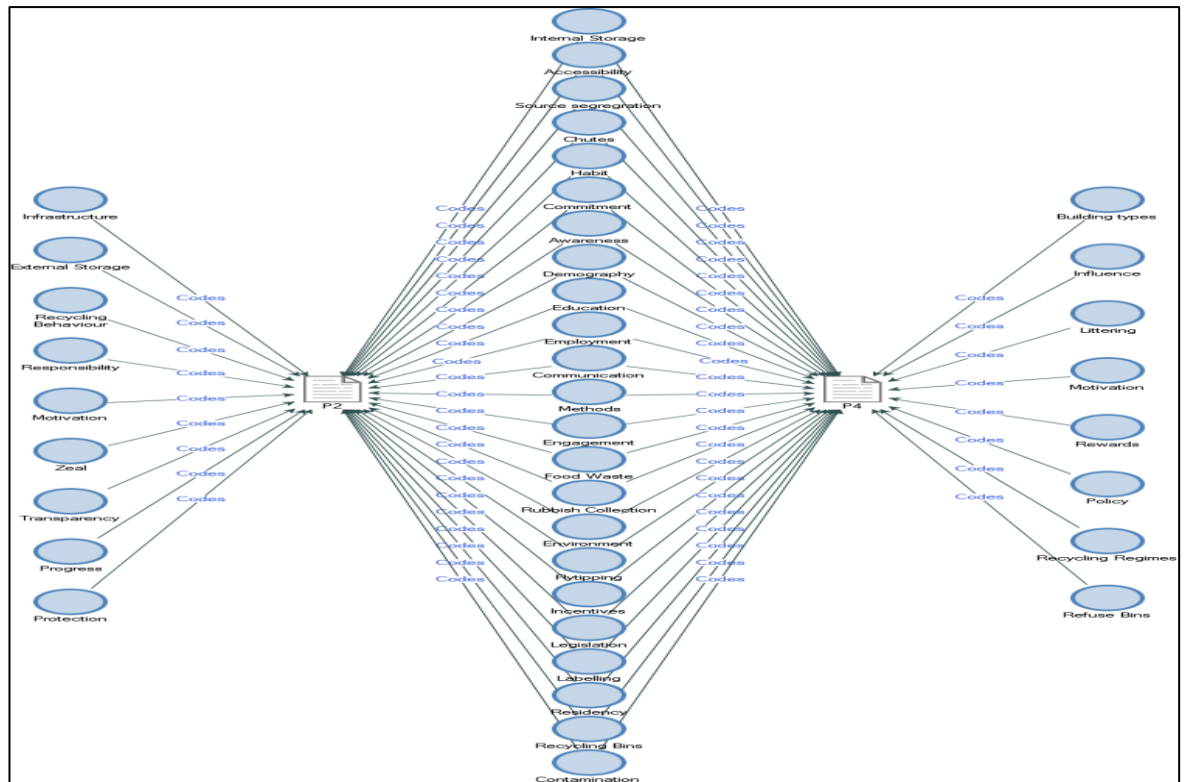


Figure 3: Participants Comparison for Flat and Flat Characteristics

In general, it can then be deduced from the comparison that participants living in the same building type or different building types have the same barriers to recycling activities or similar views on recycling activities, and at the same time have barriers or views that are peculiar or specific to each participant. Therefore, any possible intervention must be holistic and robust to capture the commonality and the differential factors shown above that exists among the participants.

Appendix P - The Adjusted Data Phase 2

Recycling Behaviour

Table 1a: Age and Behaviour Tabulation (Raw Survey Data)

How often do you recycle?				
Age	Always recycle	Sometimes recycle	Never recycle	Total Percentages
22-38 years	85%	15%	1%	100%
39-45 years	96%	4%	0%	100%
46-54 years	92%	7%	1%	100%
over 55 years	93%	5%	2%	100%
Number of Respondents				417
Chi Square Tests - P value				0.120

Table 1b: Age and Behaviour (Age-Adjusted Data)

How often do you recycle?				
Age	Always recycle	Sometimes recycle	Never recycle	Total Percentages
22-38 years	85%	15%	1%	100%
39-45 years	96%	4%	0%	100%
46-54 years	93%	7%	0%	100%
over 55 years	94%	4%	2%	100%
Number of Respondents				417
Chi Square Tests - P value				0.175

Table 2a: Education and Behaviour (Raw Survey Data)

How often do you recycle?				
Education	Always recycle	Sometimes recycle	Never recycle	Total Percentages
Secondary school	80%	0%	20%	100%
Higher or further education	92%	6%	2%	100%
College or university	90%	8%	2%	100%
Post-graduate degree	93%	7%	0%	100%
Number of Respondents				417
Chi Square Tests - P value				0.01

Table 2b: Education and Behaviour (Education-Adjusted Data)

How often do you recycle?				
Education	Always recycle	Sometimes recycle	Never recycle	Total Percentages
Secondary school	92%	0%	8%	100%
Higher or further education	91%	7%	2%	100%
College or university	92%	6%	2%	100%
Post-graduate degree	93%	7%	0%	100%
Number of Respondents				417
Chi Square Tests - P value				0.002

Table 3a: Age and Motivation (Raw Survey Data)

If you recycle always or sometimes, which of the following factors motivates you to do it? Multiple Answers							
Age	Reduce rubbish	Reduce pollution	Right thing to do	Easy to do	Peer Influence	Good for environment	Never recycle
22-38 years	63%	82%	90%	53%	0%	97%	3%
39-45 years	65%	81%	90%	64%	2%	96%	2%
46-54 years	74%	78%	87%	71%	0%	93%	1%
over 55 years	69%	68%	82%	59%	1%	88%	2%
Number of Respondents							417
Chi Square Tests - P value							0.152

Table 3b: Age and Motivation (Age-Adjusted Data)

If you recycle always or sometimes, which of the following factors motivates you to do it? Multiple Choice Answers							
Age	Reduce rubbish	Reduce pollution	Right thing to do	Easy to do	Peer Influence	Good for environment	Never recycle
22-38 years	62%	83%	89%	53%	0%	95%	3%
39-45 years	65%	80%	87%	63%	2%	93%	2%
46-54 years	73%	80%	80%	72%	0%	93%	1%
over 55 years	71%	69%	83%	59%	2%	88%	2%
Number of Respondents							417
Chi Square Tests - P value							0.165

Table 4a: Education and Motivation (Raw Survey Data)

If you recycle always or sometimes, which of the following factors motivates you to do it? Multiple Choice Answers							
Education	Reduce rubbish	Reduce pollution	Right thing to do	Easy to do	Peer Influence	Good for environment	Never recycle
Secondary school	92%	46%	69%	62%	0%	69%	8%
Higher or further education	63%	72%	78%	56%	3%	84%	3%
College or university	66%	73%	86%	57%	0%	92%	3%
Post-graduate degree	71%	81%	88%	65%	1%	94%	1%
Number of Respondents							417
Chi Square Tests - P value							0.218

Table 4b: Education and Motivation (Education-Adjusted Data)

If you recycle always or sometimes, which of the following factors motivates you to do it? Multiple Answers							
Education	Reduce rubbish	Reduce pollution	Right thing to do	Easy to do	Peer Influence	Good for environment	Never recycle
Secondary school	94%	42%	66%	61%	0%	68%	8%
Higher or further education	65%	70%	78%	61%	2%	83%	2%
College or university	66%	76%	86%	58%	0%	90%	2%
Post-graduate degree	72%	82%	89%	65%	1%	95%	1%
Number of Respondents							417
Chi Square Tests - P value							0.200

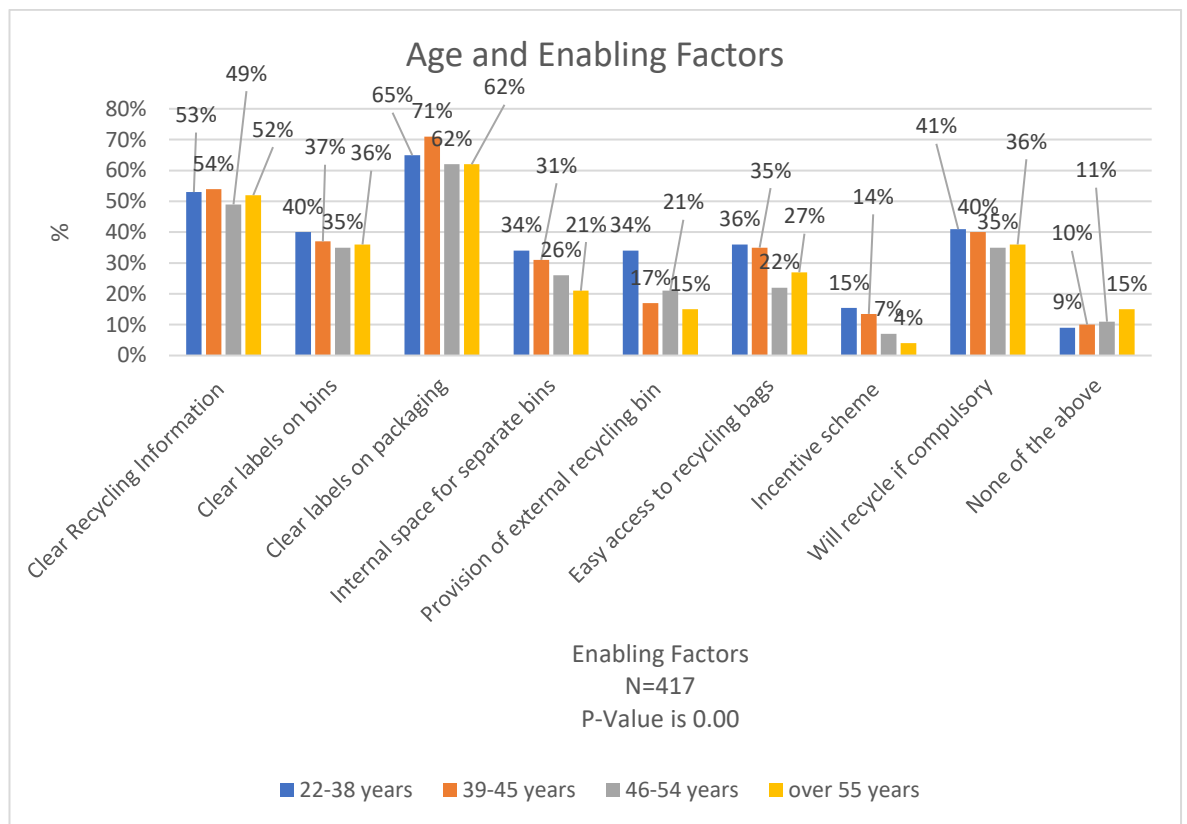


Figure 1a: Age and Enabling Factors (Raw Survey Data)

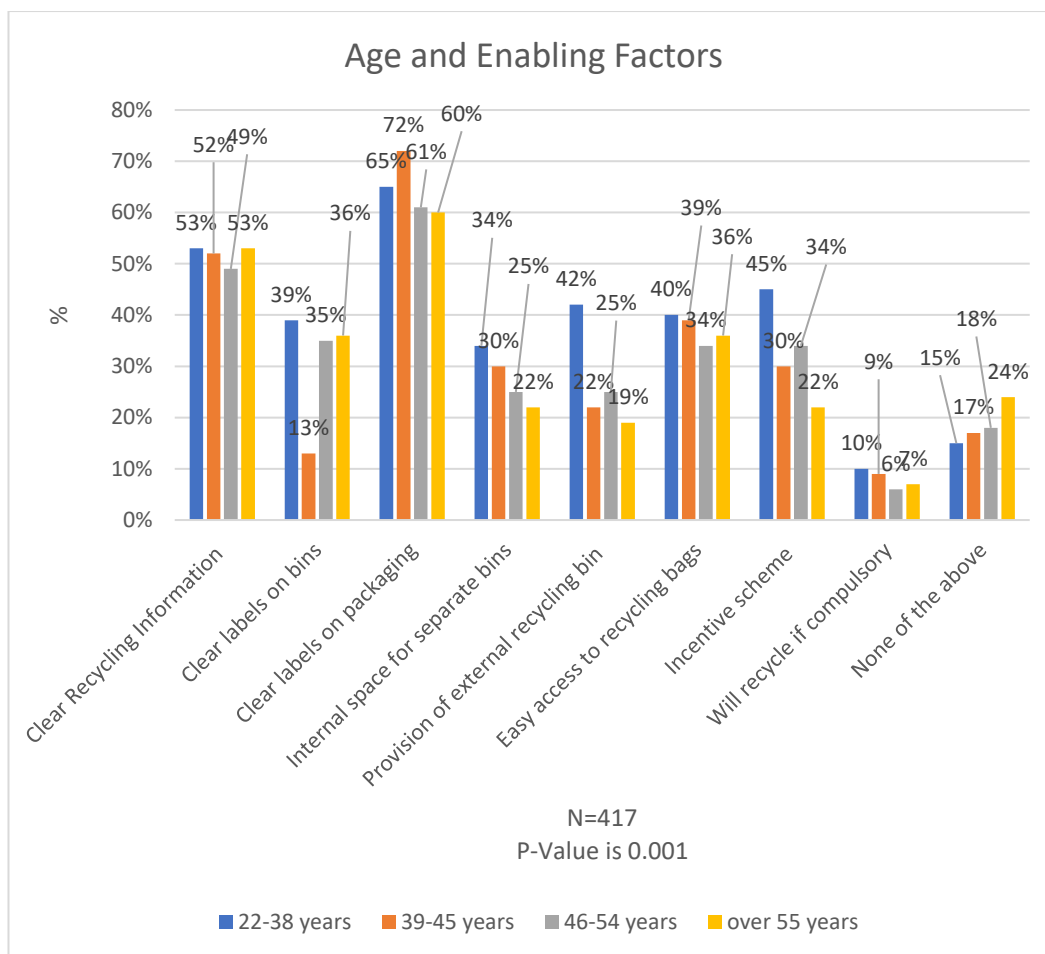


Figure 1b: Age and Enabling Factors (Age-Adjusted Data)

Table 5a: Age and Incentives (Raw Survey Data)

If you ticked a recycling incentive scheme in Q13 above, what kind of recycling incentive would you prefer most?						
Age	Individual cash reward	Vouchers	Communal cash reward to charity	Deposit Return Schemes	No Incentives	Total Percentages
22-38 years	22%	4%	10%	18%	46%	100%
39-45 years	21%	4%	12%	6%	57%	100%
46-54 years	20%	5%	10%	9%	56%	100%
over 55 years	9%	6%	12%	12%	61%	100%
Number of Respondents						417
Chi Square Tests - P value						0.044

Table 5b: Age and Incentives (Age-Adjusted Data)

If you ticked a recycling incentive scheme in Q13 above, what kind of recycling incentive would you prefer most?						
Age	Individual cash reward	Vouchers	Communal cash reward to charity	Deposit Return Scheme	No Incentives	Total Percentages
22-38 years	20%	5%	10%	18%	47%	100%
39-45 years	22%	4%	11%	7%	56%	100%
46-54 years	20%	4%	10%	8%	58%	100%
over 55 years	9%	5%	10%	10%	66%	100%
Number of Respondents						417
Chi Square Tests - P value						0.2

Table 6a: Education and Incentives (Raw Survey Data)

what kind of recycling incentive would you prefer most?						
Education	Individual cash reward	Vouchers	Communal cash reward to charity	Deposit Return Schemes	No Incentives	Total Percentages
Secondary school	8%	8%	23%	8%	53%	100%
Higher or further education	16%	3%	16%	13%	52%	100%
College or university	18%	5%	9%	12%	56%	100%
Post-graduate degree	12%	6%	10%	10%	62%	100%
Number of Respondents						417
Chi Square Tests - P value						0.985

Table 6b: Education and Incentives (Education-Adjusted Data)

what kind of recycling incentive would you prefer most?						
Education	Individual cash reward	Vouchers	Communal cash reward to charity	Deposit Return Schemes	No Incentives	Total Percentages
Secondary school	8%	8%	24%	8%	52%	100%
Higher or further education	15%	2%	15%	13%	55%	100%
College or university	16%	6%	10%	12%	56%	100%
Post-graduate degree	12%	5%	11%	11%	61%	100%
Number of Respondents						417
Chi Square Tests - P value						0.618

Table 7a: Age and Commitment (Raw Survey Data)

If you put a piece of rubbish or recycling in the wrong bin by mistake, do you try to remove it and place it in the correct bin?						
Age	No	Yes, always	Yes, sometimes	This never happens to me	Have one bin for recycling and rubbish	Total Percentages
22-38 years	7%	47%	34%	8%	4%	100%
39-45 years	8%	57%	17%	12%	6%	100%
46-54 years	2%	54%	22%	17%	5%	100%
over 55 years	6%	47%	19%	20%	8%	100%
Number of Respondents						417
Chi Square Tests - P value						0.112

Table 7b: Age and Commitment (Age-Adjusted Data)

If you put a piece of rubbish or recycling in the wrong bin by mistake, do you try to remove it and place it in the correct bin?						
Age	No	Yes, always	Yes, sometimes	Never happens to me	Have one bin for recycling and rubbish	Total Percentages
22-38 years	7%	47%	33%	8%	5%	100%
39-45 years	9%	59%	17%	11%	4%	100%
46-54 years	4%	53%	22%	17%	4%	100%
over 55 years	7%	47%	20%	19%	7%	100%
Number of Respondents						417
Chi Square Tests - P value						0.062

Table 8a: Education and Commitment (Raw Survey Data)

If you put a piece of rubbish or recycling in the wrong bin by mistake, do you try to remove it and place it in the correct bin?						
Education	No	Yes, always	Yes, sometimes	Never happens to me	Have one bin for recycling and rubbish	Total Percentages
Secondary school	8%	31%	31%	15%	15%	100%
Higher or further education	3%	22%	28%	41%	6%	100%
College or university	4%	53%	19%	15%	9%	100%
Post-graduate degree	7%	53%	25%	12%	3%	100%
Number of Respondents						417
Chi Square Tests - P value						0.000

Table 8b: Education and Commitment (Education Adjusted Data)

If you put a piece of rubbish or recycling in the wrong bin by mistake, do you try to remove it and place it in the correct bin?						
Education	No	Yes, always	Yes, sometimes	Never happens to me	Have one bin for recycling and rubbish	Total Percentages
Secondary school	8%	31%	31%	15%	15%	100%
Higher or further education	2%	22%	28%	41%	7%	100%
College or university	4%	52%	20%	16%	8%	100%
Post-graduate degree	7%	53%	24%	12%	4%	100%
Number of Respondents						417
Chi Square Tests - P value						0.000

Table 9a: Age and MRC Use (Raw Survey Data)

what do you recycle at the micro recycling centre? Multiple Answers					
Age	Mixed recycling items (glass, plastics, cans, paper and cardboard)	Electricals	Textiles and shoes	Books	I do not use the on-street micro-recycling centre
22-38 years	26%	45%	48%	12%	41%
39-45 years	23%	35%	39%	19%	54%
46-54 years	22%	48%	49%	17%	42%
over 55 years	27%	44%	43%	15%	40%
Number of Respondents	417				
Chi Square Tests - P value	0.795				

Table 9b: Age and MRC Use (Age Adjusted Data)

what do you recycle at the micro recycling centre? Multiple Answers					
Age	Mixed recycling items (glass, plastics, cans, paper and cardboard)	Electricals	Textiles and shoes	Books	I do not use the on-street micro-recycling centre
22-38 years	26%	45%	48%	12%	40%
39-45 years	24%	36%	39%	20%	54%
46-54 years	23%	46%	35%	16%	42%
over 55 years	28%	45%	44%	15%	39%
Number of Respondents	417				
Chi Square Tests - P value	0.985				

Table 10a: Age and Bin Labelling and Colours (Raw Survey Data)

Westminster City Council uses black bins for both recycling and rubbish, which are labelled 'mixed recycling' and 'rubbish'. What do you think of this?								
Age	Labels are clear	Labels are clear, bins should be in colours	Labels are not clear	Labels are not clear bins should be in colours	Use chute	Use other storage	Have one bin for recycling and rubbish	Total Percentages
22-38 years	11%	32%	2%	23%	2%	29%	1%	100%
39-45 years	18%	27%	2%	8%	0%	39%	6%	100%
46-54 years	18%	24%	6%	12%	1%	37%	2%	100%
over 55 years	30%	27%	2%	7%	1%	30%	3%	100%
Number of Respondents								417
Chi Square Tests - P value								0.004

Table 10b: Age and Bin Labelling and Colours (Age Adjusted Data)

Westminster City Council uses black bins for both recycling and rubbish, which are labelled 'mixed recycling' and 'rubbish'. What do you think of this?								
Age	Labels are clear	Labels are clear, bins should be in colours	Labels are not clear	Labels are not clear bins should be in colours	Use chute	Use other storage	Have one bin for recycling and rubbish	Total Percentages
22-38 years	12%	31%	3%	23%	2%	28%	1%	100%
39-45 years	19%	26%	2%	9%	0%	39%	5%	100%
46-54 years	17%	24%	6%	13%	1%	36%	3%	100%
over 55 years	30%	27%	2%	6%	2%	30%	3%	100%
Number of Respondents								417
Chi Square Tests - P value								0.007

Table 11a: Education and Bin Labelling and Colours (Raw Survey Data)

Westminster City Council uses black bins for both recycling and rubbish, which are labelled 'mixed recycling' and 'rubbish'. What do you think of this?								
Education	Labels are clear	Labels are clear, bins should be in colours	Labels are not clear	Labels are not clear bins should be in colours	Use Chutes	Use other storage	Have one bin for recycling and rubbish	Total Percentages
Secondary school	23%	8%	0%	15%	8%	38%	8%	100%
Higher or further education	19%	34%	3%	16%	0%	22%	6%	100%
College or university	21%	29%	2%	10%	1%	33%	4%	100%
Post-graduate degree	23%	27%	3%	13%	1%	32%	1%	100%
Number of Respondents								417
Chi Square Tests - P value								0.000

Table 11b: Education and Bin Labelling and Colours (Education-Adjusted Data)

Westminster City Council uses black bins for both recycling and rubbish, which are labelled 'mixed recycling' and 'rubbish'. What do you think of this?								
Education	Labels are clear	Labels are clear, bins should be in colours	Labels are not clear	Labels are not clear bins should be in colours	Use Chutes	Use other storage	Have one bin for recycling and rubbish	Total Percentages
Secondary school	21%	8%	0%	16%	8%	39%	8%	100%
Higher or further education	17%	35%	4%	15%	0%	22%	7%	100%
College or university	20%	28%	3%	10%	3%	32%	4%	100%
Post-graduate degree	22%	27%	4%	12%	1%	33%	1%	100%
Number of Respondents								417
Chi Square Tests - P value								0.013

Table 12a: Age and Collection Frequency (Raw Survey Data)

If the council collected the rubbish less often, do you think this could encourage more residents to recycle?					
Age	Reduction of rubbish collections could encourage residents to recycle	Reduction of rubbish collections could increase fly tipping	Maintain the same frequency of for rubbish and increase frequency collections for recycling	Maintain the same frequency of collections for both rubbish and recycling	Total Percentages
22-38 years	7%	30%	44%	19%	100%
39-45 years	15%	27%	35%	23%	100%
46-54 years	6%	32%	35%	27%	100%
over 55 years	4%	41%	27%	28%	100%
Number of Respondents					417
Chi Square Tests - P value					0.013

Table 12b: Age and Collection Frequency (Age-Adjusted Data)

If the council collected the rubbish less often, do you think this could encourage more residents to recycle?					
Age	Reduction of rubbish collections could encourage residents to recycle	Reduction of rubbish collections could increase fly tipping	Maintain the same frequency of for rubbish and increase frequency collections for recycling	Maintain the same frequency of collections for both rubbish and recycling	Total Percentages
22-38 years	7%	30%	44%	19%	100%
39-45 years	15%	25%	36%	24%	100%
46-54 years	7%	31%	35%	27%	100%
over 55 years	3%	43%	26%	28%	100%
Number of Respondents					417
Chi Square Tests - P value					0.076

Table 13a: Age and Food Waste Collection (Raw Survey Data)

If the council introduced a city-wide food waste collection service, how would this service affect you?				
Age	Want food waste collection and have additional storage space	Want food waste collection but no additional storage space	Do not want food waste collection and no storage space	Total Percentages
22-38 years	56%	33%	11%	100%
39-45 years	46%	39%	15%	100%
46-54 years	43%	34%	23%	100%
over 55 years	37%	26%	37%	100%
Number of Respondents				417
Chi Square Tests - P value				0.000

Table 13b: Age and Food Waste Collection (Age-Adjusted Data)

If the council introduced a city-wide food waste collection service, how would this service affect you?				
Age	Want food waste collection and have additional storage space	Want food waste collection but no additional storage space	Do not want food waste collection and no storage space	Total Percentages
22-38 years	56%	33%	11%	100%
39-45 years	46%	39%	15%	100%
46-54 years	44%	33%	23%	100%
over 55 years	36%	26%	38%	100%
Number of Respondents				417
Chi Square Tests - P value				0.000

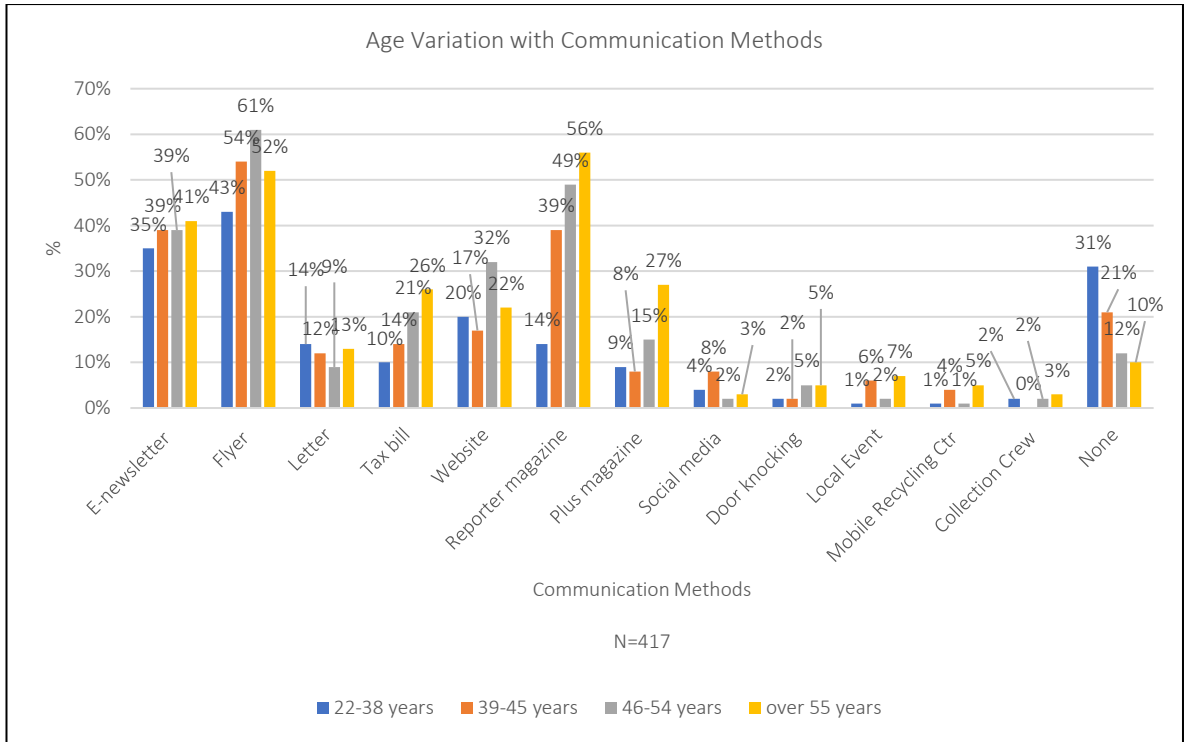


Figure 2a: Age and Communication Methods (Raw Survey Data)

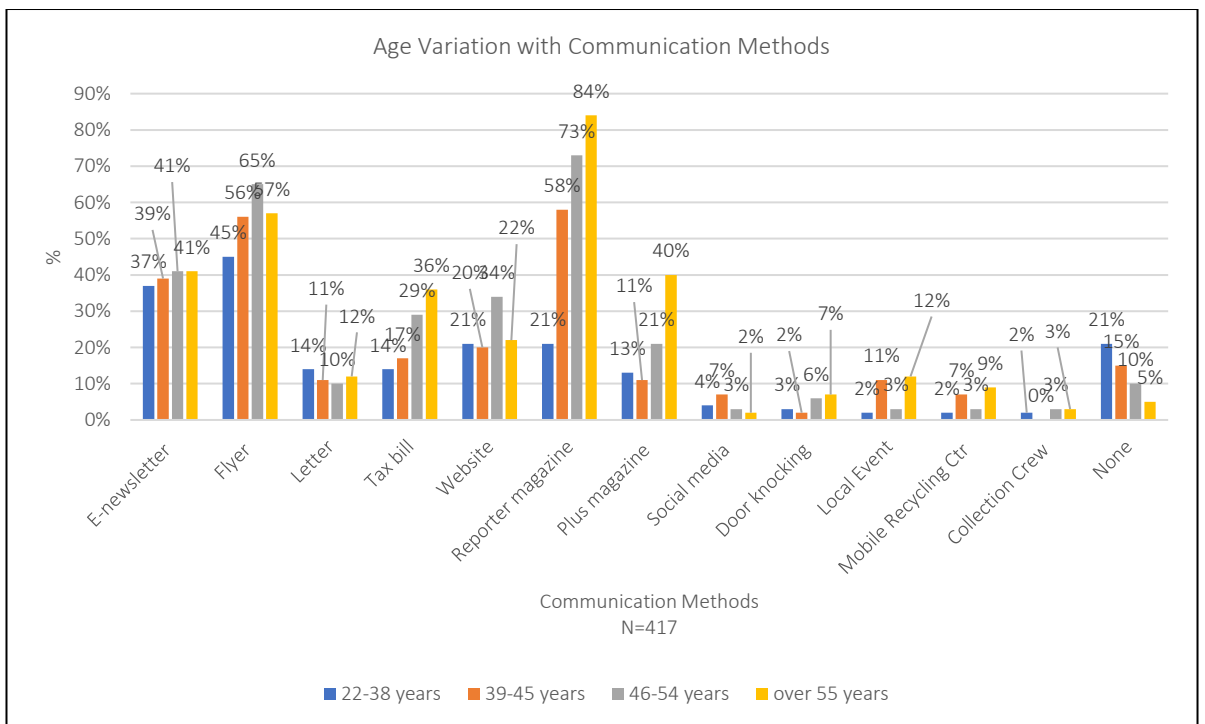


Figure 2b: Age and Communication Methods (Age-Adjusted data)

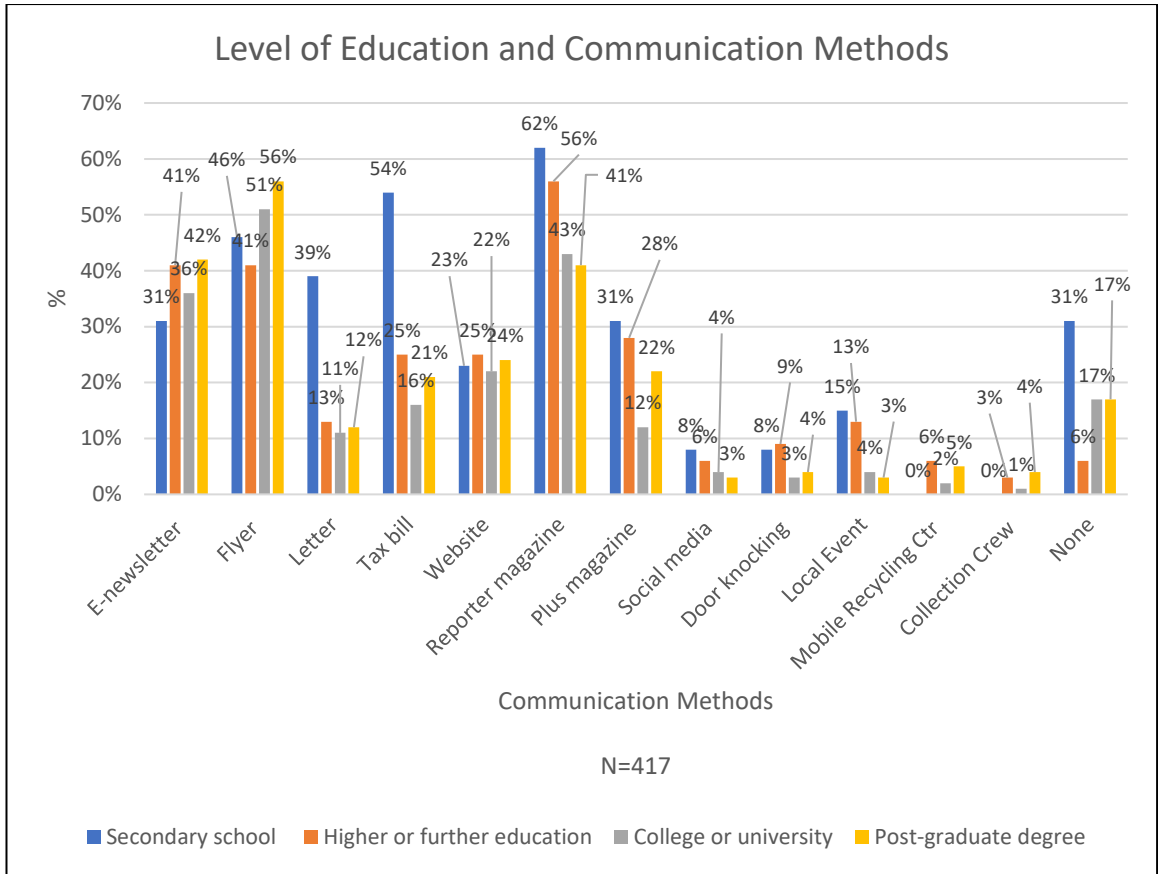


Figure 3a: Education and Communication Method (Raw Survey Data)

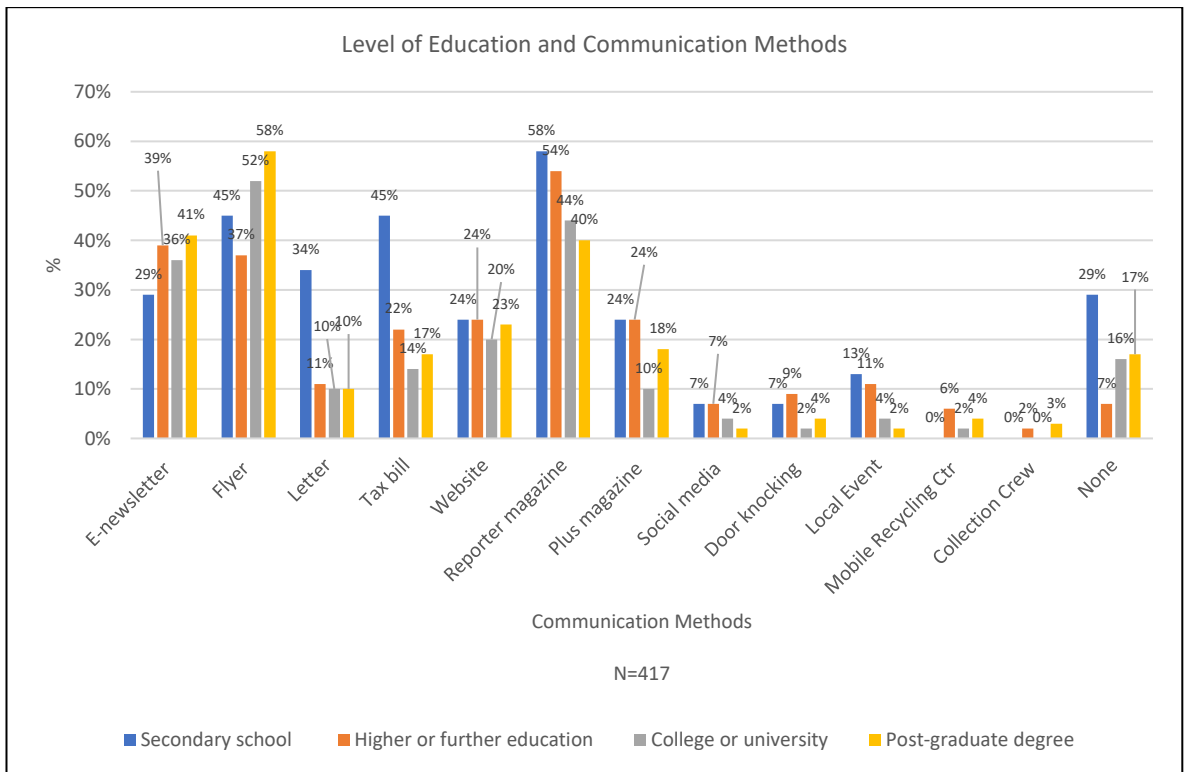


Figure 3b: Education and Communication Method (Education Adjusted Data)

Table 14a: Age and Communication Effect (Raw Survey Data)

What do you think of the communications you received?						
Age	Useful and clear	Language not easy to understand	Need in another language	I don't know	No Communication	Total Percentages
22-38 years	55%	4%	0%	10%	31%	100%
39-45 years	69%	0%	0%	14%	17%	100%
46-54 years	70%	2%	1%	12%	15%	100%
over 55 years	76%	2%	0%	13%	9%	100%
Number of Respondents						417
Chi Square Tests - P value						0.001

Table 14b: Age and Communication Effect (Age-Adjusted Data)

What do you think of the communications you received?						
Age	Useful and clear	Language not easy to understand	Need in another language	I don't know	No Communication	Total Percentages
22-38 years	55%	5%	0%	9%	31%	100%
39-45 years	68%	0%	0%	14%	18%	100%
46-54 years	69%	3%	1%	13%	14%	100%
over 55 years	76%	2%	0%	12%	9%	100%
Number of Respondents						417
Chi Square Tests - P value						0.003

Table 15a: Level of Education and Communication Effect (Raw Survey Data)

What do you think of the communications you received?						
Education	Useful and clear	Language not easy to understand	Need in another language	I don't know	No Communication	Total Percentages
Secondary school	54%	0%	0%	15%	31%	100%
Higher or further education	66%	6%	3%	19%	6%	100%
College or university	72%	1%	0%	12%	15%	100%
Post-graduate degree	70%	3%	0%	10%	17%	100%
Number of Respondents						417
Chi Square Tests - P value						0.094

Table 15b: Level of Education and Communication Effect (Education-Adjusted Data)

What do you think of the communications you received?						
Education	Useful and clear	Language not easy to understand	Need in another language	I don't know	No Communication	Total Percentages
Secondary school	53%	0%	0%	16%	31%	100%
Higher or further education	66%	6%	2%	19%	7%	100%
College or university	74%	0%	0%	12%	16%	100%
Post-graduate degree	70%	3%	0%	10%	17%	100%
Number of Respondents						417
Chi Square Tests - P value						0.007

Table 16a: Age and Recycling Events (Raw Survey Data)

Have you ever attended an event in Westminster about recycling?									
Age	One	Two	Four or more	Could not attend due to schedule	Could not attend due to venue distance	Do not want to attend	Not aware	Don't Know	Total Percentages
22-38 years	1%	0%	2%	0%	0%	6%	87%	4%	100%
39-45 years	6%	2%	4%	10%	0%	6%	68%	4%	100%
46-54 years	4%	1%	1%	1%	2%	9%	80%	2%	100%
over 55 years	2%	1%	3%	3%	0%	6%	80%	5%	100%
Number of Respondents									417
Chi Square Tests - P value									0.073

Table 16b: Age and Recycling Events (Age Adjusted Data)

Have you ever attended an event in Westminster about recycling?									
Age	One	Two	Four or more	Could not attend due to schedule	Could not attend due to venue distance	Do not want to attend	Not aware	Don't Know	Total Percentages
22-38 years	1%	0%	2%	0%	0%	5%	87%	5%	100%
39-45 years	7%	2%	4%	11%	0%	7%	67%	2%	100%
46-54 years	3%	1%	1%	1%	3%	8%	80%	1%	100%
over 55 years	2%	0%	2%	2%	0%	5%	84%	5%	100%
Number of Respondents									417
Chi Square Tests - P value									0.002

Table 17a: Age and Recycling Destination (Raw Survey Data)

Are you aware of the council's approach to processing its recycling in local facilities?					
Age	Aware recycling is processed in local facilities	Aware, but do not believe happens locally	No, I am not aware of where recycling is processed	Not aware, but do not believe happens locally	Total Percentages
22-38 years	8%	4%	71%	17%	100%
39-45 years	10%	4%	74%	12%	100%
46-54 years	4%	1%	82%	13%	100%
over 55 years	8%	5%	80%	7%	100%
Number of Respondents					417
Chi Square Tests - P value					0.254

Table 17b: Age and Recycling Destination (Age-Adjusted Data)

Are you aware of the council's approach to processing its recycling in local facilities?					
Age	Aware recycling is processed in local facilities	Aware, but do not believe happens locally	No, I am not aware of where recycling is processed	Not aware, but do not believe happens locally	Total Percentages
22-38 years	7%	4%	71%	18%	100%
39-45 years	9%	4%	76%	11%	100%
46-54 years	4%	1%	83%	12%	100%
over 55 years	9%	5%	79%	7%	100%
Number of Respondents					417
Chi Square Tests - P value					0.541

Table 18a: Age and Legislation (Raw Survey Data)

Which of the following proposals do you think should be addressed by future national legislation to increase recycling? Multiple Answers					
Age	Ban non-recyclable packaging	Recycling requirements in tenants' contracts	Compulsory recycling storage	uniform recycling system	
22-38 years	89%	31%	67%	62%	
39-45 years	94%	37%	50%	62%	
46-54 years	90%	21%	40%	57%	
over 55 years	85%	27%	45%	61%	
Number of Respondents					417
Chi Square Tests - P value					0.023

Table 18b: Age and Legislation (Age-Adjusted Data)

Which of the following proposals do you think should be addressed by future national legislation to increase recycling? Multiple Answers				
Age	Ban non-recyclable packaging	Recycling requirements in tenants' contracts	Compulsory recycling storage	uniform recycling system
22-38 years	88%	31%	66%	61%
39-45 years	93%	37%	50%	59%
46-54 years	82%	20%	37%	52%
over 55 years	81%	24%	40%	55%
Number of Respondents	417			
Chi Square Tests - P value	0.047			

Table 19a: Education and Legislation (Raw Survey Data)

Which of the following proposals do you think should be addressed by future national legislation to increase recycling? Multiple Answers				
Education	Ban non-recyclable packaging	Recycling requirements in tenants' contracts	Compulsory recycling storage	uniform recycling system
Secondary school	91%	27%	18%	73%
Higher or further education	84%	29%	36%	65%
College or university	88%	26%	52%	56%
Post-graduate degree	88%	29%	50%	63%
Number of Respondents	417			
Chi Square Tests - P value	0.446			

Table 19b: Education and Legislation (Education-Adjusted Data)

Which of the following proposals do you think should be addressed by future national legislation to increase recycling? Multiple Answers				
Education	Ban non-recyclable packaging	Recycling requirements in tenants' contracts	Compulsory recycling storage	uniform recycling system
Secondary school	76%	26%	18%	58%
Higher or further education	87%	28%	46%	65%
College or university	86%	26%	64%	54%
Post-graduate degree	88%	30%	60%	60%
Number of Respondents	417			
Chi Square Tests - P value	0.909			

Appendix Q- Variables with Non-Significant Relationships- Phase 2 Data

In enabling data analysis, and to understand the recycling views and behaviours across the different demographic factors, the relevant data group that will facilitate these analyses were grouped into the explanatory variables and the responsive variables which are tabulated below. The four explanatory variables that will be utilised are age, level of education, type of residence and ward level. Table I indicates how the groups will be compared using the explanatory variables to show the different variations of the responsive variables. This appendix only detailed variables with no significant relationships

Table I: Details of cross tabulation for Explanatory and Responsive Variables

Explanatory Variables with Non-Significant Relationship with Responsive Variables	Explanatory Variables with Significant Relationship with Responsive Variables	Responsive Variables
Age, Residence, Ward Area Type,	Education	Q10 Recycling Behaviour
Education, Ward Area	Age	Q13 Enabling Factors
Age, Ward Area	Education, Residence Type	Q15 Commitment
Age, Education	Residence Type, Ward Area	Q19 Micro Recycling Centre Proximity
Residence Type, Ward Area	Age, Education	Q21 Bins Colour and Labels
Age, Education	Residence Type, Ward Area	Q22 Recycling Bags

Explanatory Variables with Non-Significant Relationship with Responsive Variables	Explanatory Variables with Significant Relationship with Responsive Variables	Responsive Variables
Age, Education, Ward Area	Residence Type	Q23 Collection Frequency
Education, Residence Type, Ward Area	Age	Q24 Food Waste Collection
Education, Residence Type, Ward Area	Age	Q25 Communication Type
Residence Type, Ward Area	Age, Education	Q26 Communication Effect
Education, Residence Type, Ward Area	Age	Q27 Recycling Events
Education, Residence Type	Age	Q30 Future Waste Legislation

Recycling Behaviour

Age and Recycling Behaviour: Table 1 shows the raw survey data. The chi-square test results provide a probability value (P-value) of 0.120 for the raw survey analysis which indicates that there is no significant relationship between variation in age and recycling behaviour exhibited since the P values are greater than 0.05.

Deducting from the data presented in table 1, it could be seen that all the age groups exhibit good recycling behaviours, compared to the low proportion of respondents that sometimes recycle or never recycle in each age group. The result indicates that the respondents in the age group 39- 45 years have the highest proportion of respondents (96%) that always recycle, and the age

group 22-38 years have the lowest proportion (84%) compared to other age groups. This suggests that the millennials (22-38 years) recycle less than the older generation. The same trend could be observed in table 9b when the data is adjusted to the true population, which shows that there is not much statistical difference between the survey data and the true population.

The age factor although not related to recycling behaviour in this survey provides some data, that corroborates earlier studies on UK millennials recycling behaviours.

A different study indicates that 78% of the age range 25-34 years are in the habit of recycling compares to 94% of people over the age of 55 years (Moss, 2018). The highest barrier to recycling, cited by the younger population surveyed for recycling habit is the ambiguity in determining what materials can be recycled (Eichler, 2017).

It can then be concluded from the chi-square tests, that recycling behaviour is not influenced by the age factor in this survey. Therefore, there would be no need to specifically target or focus on a particular age group when planning interventions to increase recycling participation in Westminster. However, more recycling education and engagement could be directed towards the millennials to level up their recycling participation to that of the older generation.

Table 1: Age and Behaviour Tabulation

How often do you recycle?				
Age	Always recycle	Sometimes recycle	Never recycle	Total Percentages
22-38 years	85%	15%	1%	100%
39-45 years	96%	4%	0%	100%
46-54 years	92%	7%	1%	100%
over 55 years	93%	5%	2%	100%
Number of Respondents	417			
Chi Square Tests - P value	0.120			

Type of Residence and Recycling Behaviour: Table 2 shows the variation in recycling behaviour across residence types. The chi-square test results provide a probability value (p-value) of 0.508 for the analysis which indicates that there is no significant relationship between the type of residence and the recycling behaviour exhibited since the P-value is greater than 0.05.

The data shown in table 2, indicates that 97% of respondents living in houses with families exhibited the highest proportion of recycling behaviour and always recycle their waste. In contrast, respondents living in houses with non-family sharers account for the lowest proportion (87%) in the always recycle group.

Overall, the data suggest that the respondents living in houses recycle more than respondents living in flatted properties. Even though all the residence types indicates high percentages of recycling activities. This is as a result of the occurrence of adequate space in houses to facilitate both internal and external segregation of waste, as evident in the data showing the distribution of availability of internal and external space in types of residences .

Table 2: Residence and Behaviour

How often do you recycle?				
Type of Residence	Always recycle	Sometimes recycle	Never recycle	Total Percentages
House with family members	97%	3%	0%	100%
Flat with family members	90%	8%	2%	100%
House with sharers	86%	14%	0%	100%
Flat with sharers	87%	13%	0%	100%
Number of Respondents	417			
Chi Square Tests - P value	0.508			

Although the chi-square test result indicates no significant relationship between the type of residence and the recycling behaviour, special attention would need to be focused on flatted properties when planning relevant interventions. Since most of the respondents that sometimes recycle or never recycle are located within flatted properties.

Ward Level and Recycling Behaviour: The chi-square test results (Table 3) provide a probability value (p-value) of 0.589 for the analysis which indicates that there is no significant relationship between the ward level and the recycling behaviour exhibited since the p-value is greater than 0.05

In terms of ward level recycling behaviour, a good recycling habit is exhibited across all the respondents in the 20 wards surveyed. Abbey Road, Hyde Park, Lancaster Gate, Tachbrook, Warwick, and Westbourne are among the wards with a high number of respondents that always recycle. All the respondents in the wards mentioned above always recycle. The wards with the lowest proportions of respondents that always recycle are Church Street, Churchill, and St James's. St James's ward has the highest proportion (19%) of respondents that sometimes recycle while Churchill ward has the highest percentage (10%) that never recycle.

Given the fact that the recycling behaviour is not influenced by ward location, strategies to increase recycling participation should be similar since all the wards almost exhibit the same recycling behaviour characteristics.

Table 3: Ward Level and Behaviour Distribution

How often do you recycle ?				
Ward Level	Always recycle	Sometimes recycle	Never recycle	Total Percentages
Abbey Road	100%	0%	0%	100%
Bayswater	94%	6%	0%	100%
Bryanston and Dorset Square	96%	4%	0%	100%
Church Street	81%	13%	6%	100%
Churchill	80%	10%	10%	100%
Harrow Road	93%	7%	0%	100%
Hyde Park	100%	0%	0%	100%
Knightsbridge and Belgravia	93%	7%	0%	100%
Lancaster Gate	100%	0%	0%	100%
Little Venice	94%	6%	0%	100%
Maida Vale	86%	14%	0%	100%
Marylebone High Street	87%	13%	0%	100%
Queen's Park	90%	7%	3%	100%
Regent's Park	94%	6%	0%	100%
St James's	81%	19%	0%	100%
Tachbrook	100%	0%	0%	100%
Vincent Square	88%	8%	4%	100%
Warwick	100%	0%	0%	100%
West End	83%	12%	5%	100%
Westbourne	100%	0%	0%	100%
Number of Respondents	417			
Chi Square Tests - P value	0.589			

Motivation

Age and Motivation: Table 4 show the raw survey data. The chi-square test results provide a probability value (p-value) of 0.152 for the raw survey analysis This means that the different age groups are motivated to recycle by different factors as shown in table 4.

Table 4: Age and Motivation

If you recycle always or sometimes, which of the following factors motivates you to do it? Multiple Answers							
Age	Reduce rubbish	Reduce pollution	Right thing to do	Easy to do	Peer Influence	Good for environment	Never recycle
22-38 years	63%	82%	90%	53%	0%	97%	3%
39-45 years	65%	81%	90%	64%	2%	96%	2%
46-54 years	74%	78%	87%	71%	0%	93%	1%
over 55 years	69%	68%	82%	59%	1%	88%	2%
Number of Respondents							417
Chi Square Tests - P value							0.152

The result indicates that almost all of the respondents across all the age groups are highly motivated to carry out recycling activities. Concern for the environment is the most popular motivation across all the age groups with the millennials (22-38 years) being the most highly motivated age group (97%).

Contrary to expectations, the respondents in the age group 22-38 years are not influenced by the peer pressure to carry out recycling activities, while some of the older generation respondents except for the 46-54 years are motivated by peer influence to participate in recycling activities. Also, the respondents in the older generation group, 39-45 years (64%), 46-54 years

(71%), and over 55 years (59%) find it easy to carry out recycling activities than the 22-38 years age group (53%). This is an interesting revelation, as it is expected that the older generation would find it difficult to carry out recycling, compare to the younger generation that is agile and have more time to spare for recycling activities.

The age-adjusted population data (Table 13a) did not show a significant difference from the survey data as proportions across all the age groups are very close in both data. Although the chi-square test indicates no association between the age variation and motivation, consented efforts should be directed to the age group 22-38 years, to make recycling activities easy for this group.

Education and Motivation: Table 5 show the raw survey data. The chi-square test results provide a probability value (P-value) of 0.218 for the raw survey analysis. Respondents (table 5) across all levels of education are highly motivated by different factors to carry out recycling activities, which is similar to the pattern observed in the age group variation.

The most motivational factor for recycling among the respondents with secondary school qualifications (92%) is to reduce the rubbish pile. While for the other respondents with higher education (84%), college or university (92%), and postgraduate (94%) qualifications, the most motivational factor to recycle is the concern for the environment. They could be as a result of the respondents with higher educational qualifications being exposed to the environmental knowledge and benefits of recycling as they moved up further the educational hierarchy.

Table 5: Education and Motivation

If you recycle always or sometimes, which of the following factors motivates you to do it? Multiple Choice Answers							
Education	Reduce rubbish	Reduce pollution	Right thing to do	Easy to do	Peer Influence	Good for environment	Never recycle
Secondary school	92%	46%	69%	62%	0%	69%	8%
Higher or further education	63%	72%	78%	56%	3%	84%	3%
College or university	66%	73%	86%	57%	0%	92%	3%
Post-graduate degree	71%	81%	88%	65%	1%	94%	1%
Number of Respondents							417
Chi Square Tests - P value							0.218

Peer pressure influence is more evident with the respondents with higher or further educational qualifications than other qualification groups. The percentages of respondents that claimed that carrying out recycling activities is easy, is higher with the respondents that hold secondary school qualification (62%) than the respondents that holds higher education (56%) and college (57%) qualifications. But lower than the respondents with postgraduate qualification (65%).

Type of residence and Motivation: The chi-square test result provided a p-value of 0.499 (Table 6) which indicates that there is no significant relationship between the type of residence and the motivation to recycle since the p-value is greater than 0.05. This means significant variation in the type of residence is not observed for different motivational factors among the respondents.

In terms of the type of residence variation with motivation to recycle (Table 6), concern for the environment is high across all the respondents living in different types of residence as expected, due to similar patterns observed in other explanatory variables discussed above.

Interestingly, all the respondents influenced by peer influence (2%) are located within houses living with family members, and all the respondents that never recycle (3%) are located within flats living with family members.

Table 6: Residence and Motivation

If you recycle always or sometimes, which of the following factors motivates you to do it?							
Multiple Choice Answers							
Residence	Reduce rubbish	Reduce pollution	Right thing to do	Easy to do	Peer Influence	Good for environment	Never recycle
House with family members	76%	70%	81%	61%	2%	95%	0%
Flat with family members	65%	76%	87%	60%	0%	90%	3%
House with sharers	71%	86%	100%	86%	0%	100%	0%
Flat with sharers	73%	87%	87%	53%	0%	100%	0%
Number of Respondents							417
Chi Square Tests - P value							0.499

Respondents living in houses (61% and 86%) find it easier to carry out recycling activities than the respondents living in flats (60% and 53%). There are several reasons for this difference.

Firstly, the lack of adequate space (internal and external) in flatted properties to facilitate waste segregation give rise to difficulties to enable effective recycling activities. This issue of lack of space is not common with houses.

Secondly, the use of communal waste storage in high rise properties is a barrier to some people to actively engage in recycling activities. Absence of individual responsibility for the communal waste storage results in misuse and contamination of the recycling receptacles. This issue may discourage many people from recycling due to fear of contamination and waste of their precious time.

Notwithstanding, any proposed recycling scheme design should have a special focus on flatted properties to increase recycling participation. This is important, as 75% of the borough housing stock are flatted properties.

Also, from this analysis, the profiles of the very few respondents that never recycle or are not motivated to recycle have emerged in terms of age group, level of education and type of residence. These specific respondents can be found within the age range of 22 to 45 years with higher percentage having secondary school qualification, and they live in flatted properties.

Box 1 provides the summary of recycling motivation for age, education and type of residence. Test analysis indicates no significant relationships between the three explanatory variables and recycling motivation. However, information from the data could be used to understand what motivates the respondents across age, education and type of residence.

Summary of Recycling Motivation

Determinant Variables

- None. All explanatory variables indicates no significant relationship.

Issues

- The respondents in the older generation group, 39-45 years (64%), 46-54 years (71%), and over 55 years (59%) find it easy to carry out recycling activities than the 22-38 years age group (53%)
- The most motivational factor for recycling among the respondents with secondary school qualification (92%) is to reduce the rubbish pile.
- Respondents living in houses, find it easier to carry out recycling activities than the respondents living in flats.

Causes/Impacts

- Lower exposure to environmental education for secondary school qualification holders.
- Lack of adequate space (internal and external) in flatted properties to facilitate waste segregation give rise to difficulties to enable effective recycling activities.



Intervention

- Provide enabling environment to facilitate recycling such as adequate infrastructure.
- Make recycling easy to do by providing seamless connection from source segregation of materials to external storage facilities.
- Educate the residents about the benefits of recycling to the local community, the wider community, and the ecosystem.

Box 1: Summary of Recycling Motivation

Recycling Barriers

Age and Recycling Barriers: Figure 1 shows the raw survey data. The chi-square test results provide a probability value (p-value) of 0.909 for the raw survey data analysis which indicates that there is no significant relationship between age variation and recycling barriers since the P-values are greater than 0.05.

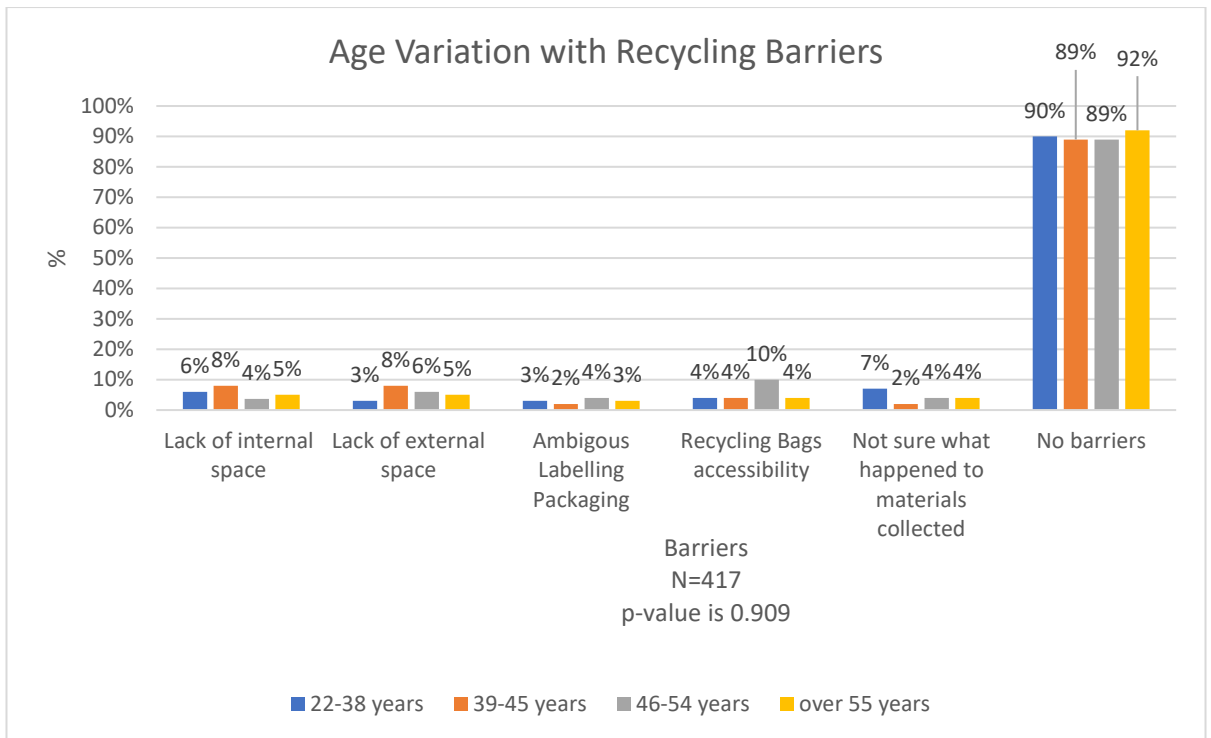


Figure 1: Age Variation with Recycling Barriers

Figure 6a indicates that the most two common barriers faced by the age group 22-38 years are lack of internal space (6%) and lack of transparency (7%) regarding the end process of the collected recyclable materials. In other words, they suspect that the recyclable materials collected are not recycled but burn to generate energy.

In comparison, the most common barrier faced by the age group 39-45 years (8%) is the lack of external space for waste storage. While the major issue for the 46-54 years age group is the inaccessibility to free recycling bags (10%) to utilise for recycling activities. The most common barrier for the over 55 years age group is the lack of internal and external storage spaces (5%).

The “No Barriers” to recycling survey data in figure 6a suggest that the youngest generation (10%) are slightly facing more recycling barriers than the oldest generation (8%). However, the age-adjusted population (figure 6b) for the “No Barriers” to recycling data, indicates no difference in the percentages of respondents across all the age groups.

Since there is no significant relationship between the age variation and recycling barriers, it can be deduced that recycling barriers faced by the different age groups have other underlying factors different from age influence. However, it is important to take into consideration three key barriers (lack of internal storage space, lack of external storage space, and inaccessibility to the council free recycling bag) when devising new recycling schemes for the borough.

Type of Residence and Recycling Barriers: The chi-square test result provided the p-value of 0.328 which indicates that there is no significant relationship between the type of residence and the recycling barriers since the p-value is greater than 0.05. This indicates that different types of residence are facing different recycling barriers.

Table 7 shows that the types of barriers facing the respondents living in houses are different from the barriers facing the respondents that live in flats. Ambiguous packaging labelling (3%) and lack of transparency regarding mixed recycling collected (3%) are the major issues with the respondents living in houses with family members. These two barriers mentioned earlier fall under waste policy constraints and lack of effective public engagement respectively.

The respondents living in houses have fewer percentages compared to respondents living in flatted properties with regards to lack of internal (2%) and external (1%) storage spaces. This is expected as houses due to their characteristics will have adequate storage spaces both internally and externally.

In comparison, the major issues with the respondents living in flats with family members are lack of external space (6%), lack of internal space (7%), and the inaccessibility to the council free recycling bag (6%). These three barriers are closely related, as lack of internal and external spaces means that these respondents will have to rely heavily on the council free recycling bag to store mixed recycling before collection. Hence, the non-availability of

these enabling factors would result in non-recycling activities for these respondents. These three barriers fall under physical barriers and recycling service barriers.

Table 7 Type of Residence and Recycling Barriers Data

If you never recycle which of the following factors discourages you from recycling? Multiple Choice Answers						
Residence	Lack of internal space	Lack of external space	Ambiguous Packaging Labelling	Recycling Bags accessibility	Not sure what happened to materials collected	No barriers
House with family members	2%	1%	3%	1%	3%	98%
Flat with family members	7%	6%	3%	6%	5%	88%
House with sharers	0%	0%	0%	0%	0%	0%
Flat with sharers	0%	7%	0%	7%	0%	87%
Number of Respondents	417					
Chi Square Tests - P value	0.328					

The barriers across the type of residence indicate that majority of the respondents (98%) that do not face any barriers to recycling live in houses with family members compared to the 88% of the respondents that live in the block of flats with family members. This suggests that respondents living in flatted properties are facing more barrier issues than respondents living in houses.

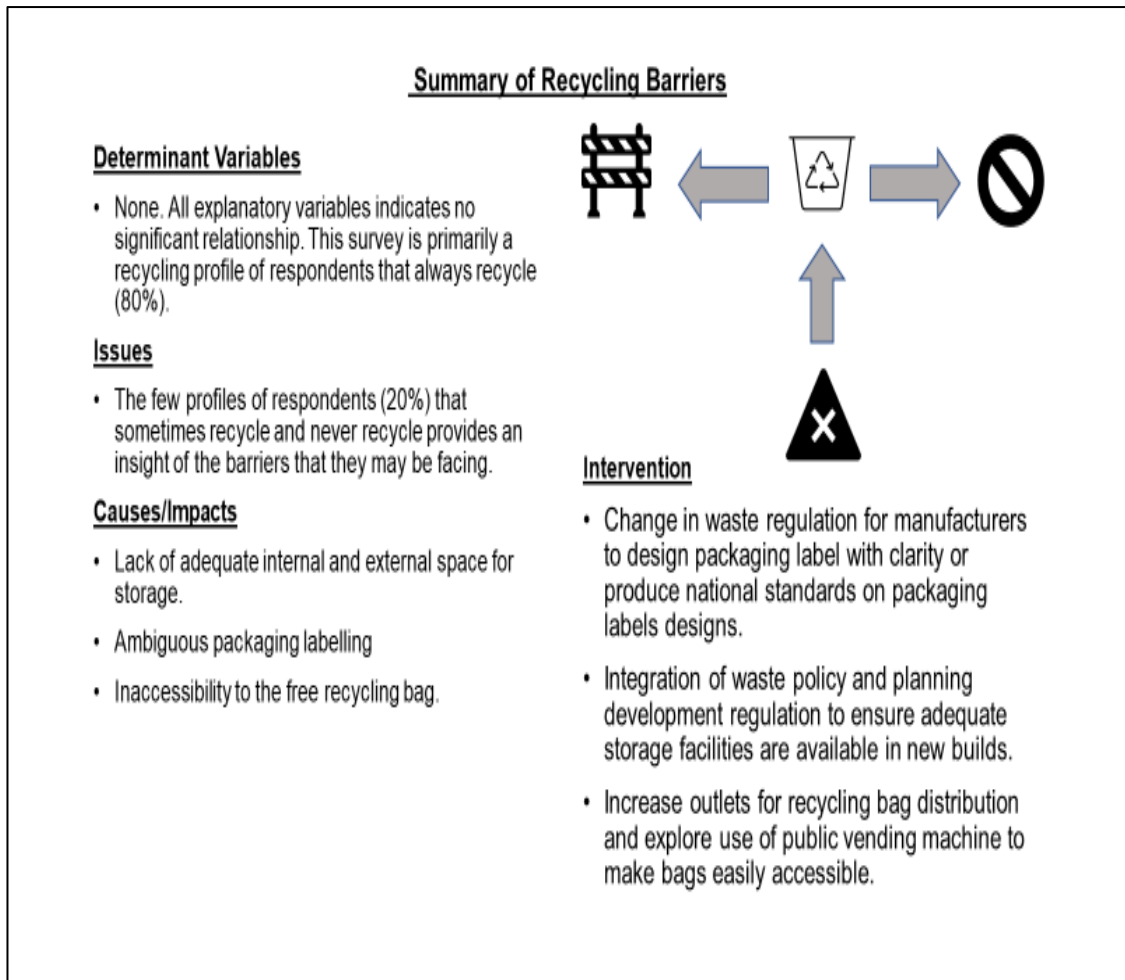
Although, the chi-square has indicated that there is no relationship between residence types and recycling barriers. Relevant intervention should consider the recommendations in the literature review to mitigate recycling barriers.

In summary (Box 2), tests analysis for age and type of residence for recycling barriers also shows no significant relationship as with the level of

education. This result is logical since the survey data is primarily a profile of respondents that always recycle.

However, the small profiles of respondents that sometimes recycle and never recycle provide an insight into the barriers that they may be facing. The main barriers faced by this group are lack of adequate internal and external space for storage, ambiguous packaging labelling and inaccessibility to the free recycling bag.

A thorough review of the national waste legislation to effect appropriate packaging labelling, an effective waste policy that will facilitate efficient recycling service, integration of development planning legislation with waste legislation to ensure appropriate waste infrastructure in developments, and effective resident engagement strategies are key in increasing the households mixed recycling rate.



Box 2: Summary of Recycling Barriers

Preferred Incentives

Education and Incentives: Table 8 show the raw survey data and the education-adjusted data respectively. The chi-square test results provide a p-value of 0.985 for the survey analysis and 0.618 for the education-adjusted analysis. This indicates that there is no significant relationship between the level of education and incentives since the p-value are greater than 0.05.

Table 8: Education and Incentives

what kind of recycling incentive would you prefer most?						
Education	Individual cash reward	Vouchers	Communal cash reward to charity	Deposit Return Schemes	No Incentives	Total Percentages
Secondary school	8%	8%	23%	8%	53%	100%
Higher or further education	16%	3%	16%	13%	52%	100%
College or university	18%	5%	9%	12%	56%	100%
Post-graduate degree	12%	6%	10%	10%	62%	100%
Number of Respondents						417
Chi Square Tests - P value						0.985

Table 8 indicates that respondents with secondary school qualifications (23%) prefer communal cash rewards to charity as the most preferred incentives. While respondents with college or university qualifications (18%) and respondents with post-graduate degree qualifications (12%) prefer individual cash reward as the most preferred incentive.

Respondents with further education qualification have the same preference for both individual cash reward (16%) and communal cash reward (16%). Respondents with post-graduate qualifications prefer no incentives (62%) to induce or nudge them towards recycling participation. This could be as a result of their awareness of the environmental benefits of recycling, due to their level of education, and simply would recycle their waste without being nudged by incentives.

This indication is key to designing incentive schemes within the borough because more than half of the borough population have either a first degree or post-graduate degree qualification. Therefore, the use of incentive schemes would be most efficient in some targeted areas of the borough using demographic profiles (such as low-level qualifications) as a guide.

Type of Residence and Incentives: The chi-square test result provided (Table 9) a p-value of 0.690 which indicates that there is no significant relationship between the type of residence and incentives since the P-value is greater than 0.05. This means that these two variables are not influenced by each other. However, it would help build the profile of different building occupiers and their incentive preferences.

Table 9: Type of Residence and Incentives

what kind of recycling incentive would you prefer most?						
Type of Residence	Individual cash reward	Vouchers	Communal cash reward to charity	Deposit Return Schemes	No Incentives	Total Percentages
House with family members	18%	4%	12%	14%	52%	100%
Flat with family members	22%	3%	8%	13%	54%	100%
House with sharers	10%	4%	6%	8%	72%	100%
Flat with sharers	13%	6%	12%	11%	58%	100%
Number of Respondents						417
Chi Square Tests - P value						0.618

The preferred incentive distribution across the type of residence indicates that the most preferred incentives for respondents living in houses with family members is individual cash reward (18%), and the least preferred incentive is the use of vouchers (4%). Similarly, respondents living in flats with family members would prefer individual cash reward (22%) as the most preferred incentive and the least preferred incentive is the use of vouchers (3%).

Commitment to recycling

Age and Commitment: Table 10 show the raw survey data. The chi-square test results provide a p-value of 0.112 for the raw survey analysis. This indicates that there is no significant relationship between age and commitment since the P-value are greater than 0.05. This means that commitment to recycling is not influenced by age, and other factors may be at play in influencing commitment to recycling.

Table 10: Age and Commitment

If you put a piece of rubbish or recycling in the wrong bin by mistake, do you try to remove it and place it in the correct bin?						
Age	No	Yes, always	Yes, sometimes	This never happens to me	Have one bin for recycling and rubbish	Total Percentages
22-38 years	7%	47%	34%	8%	4%	100%
39-45 years	8%	57%	17%	12%	6%	100%
46-54 years	2%	54%	22%	17%	5%	100%
over 55 years	6%	47%	19%	20%	8%	100%
Number of Respondents						417
Chi Square Tests - P value						0.112

Table 10 shows that these two age groups 39-45 years and 46-54 years have the highest commitment to recycling activities than the other age groups if the three responses (yes always, yes sometimes and this never happens to me) are considered together. The percentage for the “Yes,

always” for the age group 39-45 years is 59% and 53% for the age group years 46-54.

Although the age groups 22-38 years (47%) and over 55 years (47%) have the same percentages for the “Yes, always” response, the 22-38 years age shows the lowest commitment to recycling activities considering their responses to “Yes, always” and “Never happens to me” compared to other age groups.

The over 55 years age group is the most cautious, as this age group (20%) have the highest percentage of respondents that never made the mistake of putting a waste material in the wrong bin. The result also indicates that over 55 years of age have the highest proportion of respondents (8%) that have only one bin for both rubbish and mixed recycling. This means that these respondents are not recycling their mixed recycling probably due to a lack of internal space for storage.

Materials Recycled at the Micro Recycling Centre

Age and Materials Recycled at MRCs: Table 11 show the raw survey data. The chi-square test results provide a p-value of 0.795 for the raw survey analysis and 0.985 for the age-adjusted analysis. This indicates that there is no significant relationship between education and commitment since the P-values are greater than 0.05.

This means that age and the type of materials recycled at the MRCs are independent of each other. In other words, the materials recycled at the sites are not influenced by the respondent age group.

Table 11: Age and MRC Use

what do you recycle at the micro recycling centre? Multiple Answers					
Age	Mixed recycling items (glass, plastics, cans, paper and cardboard)	Electricals	Textiles and shoes	Books	I do not use the on-street micro- recycling centre
22-38 years	26%	45%	48%	12%	41%
39-45 years	23%	35%	39%	19%	54%
46-54 years	22%	48%	49%	17%	42%
over 55 years	27%	44%	43%	15%	40%
Number of Respondents	417				
Chi Square Tests - P value	0.795				
Chi Square Tests - P value	0.985				

Table 11 indicates that all of the age groups use the MRC mainly for the deposit of electricals, textiles, and shoes. The age group 46-54 years use the MRC for electricals (48%), textiles and shoes (49%) than any other age group.

The over 55 years age group use the MRC more for mixed recycling (27%) than any other age group. The respondents that use the MRC site for mixed recycling items (such as glass, plastics, cans, paper and cardboard) may be doing so for two reasons:

- There is no external storage for recycling bins at their place of residence and they are passionate about recycling and ready to go the extra mile to recycle their waste.
- The external recycling storage is already filled up and cannot wait for the next cycle of recycling collection to store the materials in their

residence and therefore the nearby MRC sites are handy to resolve the situation.

However, questions need to be asked about the respondents that do not use the MRC sites. It would be interesting to know how these respondents dispose of small electrical items, shoes and textiles because these materials are not collected from residential properties. One assumption is that these materials are donated to charities for reuse or are dumped in the recycling bins present at the residential properties thereby causing contamination issues. (Question to be explored during an interview with waste operation team).

The data for the respondents that do not use the MRC suggests that the age groups 22-38 years (59%) and over 55 years (60%) use the MRC more than the remaining age groups.

Type of Residence and Materials Recycled at MRCs: The chi-square test results (Table 12) provide a p-value of 0.357. This indicates that there is no significant relationship between the type of residence and materials recycled at the MRCs since the P-values are greater than 0.05. This means the two variables are independent of each other, but the data provides information on the type of materials recycled by residence type.

Table 12: Type of Residence and MRC Use

what do you recycle at the micro recycling centre? Multiple Answers					
Type of Residence	Mixed recycling items (glass, plastics, cans, paper and cardboard)	Electricals	Textiles and shoes	Books	I do not use the on-street micro-recycling centre
House with family members	26%	24%	26%	24%	25%
Flat with family members	9%	30%	29%	10%	23%
House with sharers	14%	24%	30%	9%	22%
Flat with sharers	17%	25%	24%	9%	25%
Number of Respondents	417				
Chi Square Tests - P value	0.357				

Table 12 indicates that respondents living in houses with family members use the MRC sites mostly for mixed recycling (26%) and textiles/shoes (26%).

Respondents living in flats with family members use the MRC sites mostly for electricals (30%) and textiles/shoes (29%). This same trend is observed with respondents living in houses and flats with sharers.

The data on respondents that do not use the MRC indicates that respondents living in flats with family members (77%) and respondents living in houses with sharers (78%) use the MRC more than other types of residences.


In summary (Box 3), tests analysis indicates no significant relationship with age and type of residence. However, the data could be useful for planning purposes on how the MRCs are maintained.

In terms of planning purposes, since the sites are used for more disposal of electrical items, textiles and shoes than other materials. There may be a need to increase the storage capacity of these materials at the MRCs to prevent overspilling of the containers.

Also, it would be prudent to provide food waste bins at the MRCs to capture future food waste collection from the residential properties that may be having storage issues. This is recommended due to the high usage of the MRCs as revealed by the survey and the age-adjusted data.

In terms of the impact of use, constant use of the MRC for electricals, shoes and textiles would prevent contamination of the mixed recycling bins located at the residential properties. Also, the use of the MRC would prevent fly-tipping and waste dumping in public places.

Summary of MRC Use

<p><u>Determinant Variables</u></p> <ul style="list-style-type: none">• No significant relationship with all explanatory variables <p><u>Issues</u></p> <ul style="list-style-type: none">• 85% of the respondents use the MRC for to deposit various recyclable materials.• 15% of the respondents do not use the MRC <p><u>Impacts</u></p> <ul style="list-style-type: none">• Constant use of the MRC for electricals, shoes and textiles would prevent contamination of the household mixed recycling bins.• Use of the MRC would prevent fly tipping and waste dumping in public places.• Adequate provision of the MRC would support households that lack external storage or adequate external storage to effectively recycle their waste.	 <p><u>Intervention</u></p> <ul style="list-style-type: none">• The problem of space to site the MRC could be addressed in large proposed residential builds, where the MRC can be integrated into the design of the developments.• Increase storage capacity for the most widely deposited materials to prevent overspilling.• Provide food waste storage provisions at Micro Recycling Centres since the MRC is widely used.
---	---

Box 3: Summary of MRC Use

Recycling Events

Ward Level and Recycling Events: The chi-square test result (Table 13) provides a p- value of 0.081 which indicates that there is no significant relationship between the ward level and attendance at recycling events since the p-value is greater than 0.05. This means that attendance at the events is not fundamentally based on the location of the respondents.

Table 13 indicates that Warwick (11%) and Abbey Road (10%) have the highest proportion of respondents that have attended one recycling event in the borough. Church Street (6%) and Harrow Road (7%) have the majority of respondents that have attended two recycling events.

Church Street (13%) and Tachbrook (9%) have the highest percentage of respondents that have attended 4 or more recycling events in the borough.

Table 13: Ward Level and Recycling Events

Have you ever attended a recycling event in Westminster									
Ward Level	One	Two	Four or More	Could not attend due to schedule	could not attend due to venue distance	Do not want to attend	Not aware	Don't Know	Total Percentages
Abbey Road	10%	0%	0%	0%	0%	10%	80%	0%	100%
Bayswater	3%	0%	6%	6%	0%	3%	79%	3%	100%
Bryanston and Dorset Square	0%	0%	0%	0%	0%	4%	96%	0%	100%
Church Street	0%	6%	13%	6%	0%	0%	69%	6%	100%
Churchill	0%	0%	0%	10%	0%	10%	70%	10%	100%
Harrow Road	0%	7%	0%	0%	0%	7%	86%	0%	100%
Hyde Park	3%	0%	0%	0%	0%	13%	81%	3%	100%
Knightsbridge and Belgravia	0%	0%	0%	0%	0%	7%	93%	0%	100%
Lancaster Gate	0%	0%	0%	25%	0%	25%	50%	0%	100%
Little Venice	6%	0%	0%	17%	6%	0%	67%	6%	100%
Maida Vale	0%	0%	6%	3%	0%	6%	83%	3%	100%
Marylebone High Street	0%	0%	0%	0%	0%	3%	91%	6%	100%
Queen's Park	6%	3%	3%	3%	0%	7%	74%	3%	100%
Regent's Park	0%	0%	0%	0%	0%	6%	94%	0%	100%
St James's	0%	0%	0%	0%	0%	13%	81%	6%	100%
Tachbrook	0%	0%	9%	9%	9%	9%	64%	0%	100%
Vincent Square	0%	0%	4%	0%	0%	4%	83%	8%	100%
Warwick	11%	0%	0%	0%	0%	6%	83%	0%	100%
West End	2%	0%	0%	0%	0%	7%	86%	5%	100%
Westbourne	8%	0%	8%	0%	0%	8%	51%	25%	100%
Number of Respondents	417								
Chi Square Tests - P value	0.081								

Bryanston and Dorset Square have the highest percentage of respondents (96%) and Lancaster Gate has the lowest percentage of 50% of respondents that were not aware of any recycling events taking place in Westminster.

Recycling Destination

Age and Recycling Destination: Table 14 show the raw survey data. The chi-square test results provide a p-value of 0.254 for the raw survey analysis. This indicates that there is no significant relationship between age and recycling destination since the p-values are greater than 0.05. This means that age is not a factor that influences the respondents' views on recycling destinations.

Table 14: Age and Recycling Destination

Are you aware of the council's approach to processing its recycling in local facilities?					
Age	Aware recycling is processed in local facilities	Aware, but do not believe happens locally	No, I am not aware of where recycling is processed	Not aware, but do not believe happens locally	Total Percentages
22-38 years	8%	4%	71%	17%	100%
39-45 years	10%	4%	74%	12%	100%
46-54 years	4%	1%	82%	13%	100%
over 55 years	8%	5%	80%	7%	100%
Number of Respondents	417				
Chi Square Tests - P value	0.254				

Table 14 indicates that the majority of the respondents (89%) across all the age groups are not aware of where the recyclable materials are processed.

This shows that all the age groups views are consistent with their proportion in the age range percentages.

Among the respondents that are aware of the recycling materials destination, the majority in this category are found within the age groups 39-45 years (14%) and over 55 years (13%). These two age groups seem to be more informed about recycling destinations than the remaining age groups. The less informed age group relating to lack of awareness of the recycling destination is the 46-54 years age group. As 95% of this group have the highest percentage of respondents in this category.

This result should not be surprising since earlier results have indicated a lack of effective resident engagement. However, it is important to know that majority of the respondents are still involved in recycling activities despite the lack of this information.

The council should then consider introducing constant awareness information on recycling destination in their regular communication to the residents to dispel the recycling myth among the few residents that believes this myth.

Ward Level and Recycling Destination: The chi-square test result provides a p-value of 0.633 which indicates that there is no significant relationship between the ward level and recycling destination since the p-value is greater than 0.05. This means that the views of the respondents is not influenced by the ward location.

Table 15 shows that Lancaster Gate (25%) and Westbourne (17%) has the highest percentages of respondents that are aware that the recyclable materials are processed locally. Also, Harrow Road have the highest proportion (15%) of respondents that are aware of the council claim that the materials are processed locally but do not believe it happens locally

St James's have the highest percentage of respondents (94%) and Lancaster Gate have the lowest percentage (50%) of the respondents, not aware of where the recyclable materials are processed. Lancaster Gate (25%) have the highest percentages of respondents that are not aware of the

council claim of processing the materials locally but do not believe it is processed locally.

The council may use this result to target wards that have a higher percentage of respondents that are not aware of recycling destination and concentrate on awareness programme in these wards.

variables, such as age and ward level are not significantly related to awareness of the mixed recycling destination. A similar situation with the inadequacy of publicity for recycling events could be the major reason for this non-awareness.

Also, 15% of the respondents doubt that the mixed recycling collected are reprocessed for re-use. To gain residents trust, the council need to include in their public engagement strategy, regular site visits to its recycling facilities to expel the myths, and doubts about the mixed recycling end-use.

Summary of Recycling Destination

Determinant Variables

- None. All explanatory variables indicates no significant relationship.

Issues

- 78% of the respondents not aware of mixed recycling end destination.
- Non-availability of this information may not encourage some residents to recycle.
- 15% of the respondents doubt that the mixed recycling collected are really re -processed for re-use.

Causes

- Bad publicity in the mass media regarding some local authorities handling of their mixed recycling collected.
- Non- availability of the information in the public domain, relating to end destination of mixed recycling



Intervention

- Constant release of information on reprocessing of the materials collected in public forums, recycling communication media and recycling events.
- Organise constant residents site visits to the council recycling processing facilities.
- Design short video clips of what happened to the materials collected and make it go viral on social media platform.

Box 4: Summary of Recycling Destination

Future Waste Legislation

Education and Legislation: Table 16 show the raw survey data. The chi-square test results provide a p-value of 0.446 for the raw survey analysis.

This indicates that there is no significant relationship between education and future legislation since the p-values are greater than 0.05. This means that education is not a factor that influences the respondents' views on future waste legislation.

Table 16: Education and Legislation

Which of the following proposals do you think should be addressed by future national legislation to increase recycling? Multiple Answers				
Education	Ban non-recyclable packaging	Recycling requirements in tenants' contracts	Compulsory recycling storage	uniform recycling system
Secondary school	91%	27%	18%	73%
Higher or further education	84%	29%	36%	65%
College or university	88%	26%	52%	56%
Post-graduate degree	88%	29%	50%	63%
Number of Respondents	417			
Chi Square Tests - P value	0.446			

Similarly, as observed in the age and legislation variables, there is support for various changes to future waste legislation across all the different levels of education, except for the very low support for mandatory recycling storage from respondents with secondary school qualifications (18%).

Type of Residence and Legislation: The chi-square test result provides a p-value of 0.503 which indicates that there is no significant relationship between the type of residence and legislation since the p-value is greater than 0.05.

Table 17 indicates the different views of the respondents with regards to future waste legislation across types of residence. The desire to ban non-recyclable packaging is most popular among all the respondents living in all types of residence. The view to hold landlords responsible to include recycling elements in tenant contracts is the least popular change expected in future waste legislation for all types of residences.

Table 17: Type of Residence and Legislation

Which of the following proposals do you think should be addressed by future national legislation to increase recycling? Multiple Answers				
Type of Residence	Ban non-recyclable packaging	Recycling requirements in tenants' contracts	Compulsory recycling storage	uniform recycling system
House with family members	88%	28%	38%	62%
Flat with family members	88%	29%	53%	59%
House with sharers	83%	0%	33%	67%
Flat with sharers	87%	27%	53%	73%
Number of Respondents	417			
Chi Square Tests - P value	0.503			

Appendix R

Survey Data Analysis for Variables with Significant Relationship (but not presented in the main report)

Ward Level and Recycling Bag: The chi-square test result (Table 1) provides a p-value of 0.000 which indicates that there is a significant relationship between ward location and recycling bag since the p-value is less than 0.05. This signifies that these two variables are connected and dependent on each other.

Table 1: Ward Level and Recycling Bag

What methods have you used to request recycling bags from the council? Multiple Answers											
Ward Level	Do not recycle	Only use recycling box	Collect from the mobile recycling centre	Collect from the recycling collection crews	Collect at community event	I use the bins at the micro-recycling centres	Do not know how to request recycling bag	Only use communal recycling bins	Telephone Request	Collect from the library	Electronic Request
Abbey Road	60%	20%	0%	20%	0%	0%	0%	20%	0%	0%	0%
Bayswater	60%	38%	3%	9%	3%	0%	3%	18%	12%	0%	3%
Bryanston and Dorset Square	40%	20%	4%	16%	0%	4%	4%	12%	8%	0%	16%
Church Street	25%	31%	0%	13%	0%	25%	0%	0%	13%	6%	25%
Churchill	20%	40%	0%	0%	0%	0%	10%	10%	10%	10%	0%
Harrow Road	50%	29%	7%	14%	14%	0%	21%	7%	14%	0%	0%
Hyde Park	53%	19%	3%	6%	0%	6%	3%	16%	6%	0%	6%
Knightsbridge and Belgravia	50%	7%	7%	14%	0%	0%	7%	0%	0%	0%	29%
Lancaster Gate	25%	50%	25%	0%	0%	0%	0%	0%	25%	0%	0%
Little Venice	33%	39%	0%	11%	11%	0%	17%	11%	11%	0%	11%
Maida Vale	51%	34%	3%	14%	3%	6%	0%	6%	3%	0%	11%
Marylebone High Street	56%	47%	0%	22%	0%	0%	0%	6%	16%	0%	16%
Queen's Park	71%	42%	7%	19%	10%	3%	3%	0%	3%	0%	3%
Regent's Park	44%	22%	6%	22%	0%	0%	0%	17%	0%	0%	22%
St James's	25%	13%	0%	6%	0%	0%	0%	38%	6%	0%	25%
Tachbrook	27%	9%	0%	9%	0%	0%	0%	18%	18%	0%	18%
Vincent Square	21%	21%	4%	8%	0%	4%	4%	25%	13%	4%	38%
Warwick	33%	33%	6%	17%	6%	17%	0%	17%	17%	0%	17%
West End	69%	29%	0%	10%	0%	5%	2%	2%	5%	0%	12%
Westbourne	58%	17%	0%	8%	8%	17%	0%	25%	17%	0%	0%
Number of Respondents											417
Chi Square Tests - P value											0.00

Table 1 indicates that Queen's Park ward has the highest percentage of 71% of the respondents that make an online request for the clear free recycling bag, this is followed by 69% from West End, 60% from Abbey Road, and 60% from Bayswater. Lancaster Gate (50%), Queens Park (42%), and Marylebone High Street (47%) have the highest proportion of respondents requesting the recycling bag from the library. Collecting the free recycling bag from the refuse collection crew is most popular in Lancaster Gate with a percentage of 25%.

Abbey Road (20%), Marylebone High Street (22%), and Regents Park (22%) have the highest percentages of respondents using the telephone to request the recycling bag. Harrow Road ward also has the highest percentage of 14% followed by Little Venice (11%) of picking up the recycling bags at the mobile recycling centres.

Church Street ward also has the highest percentage of 25% followed by Warwick (17%) and Westbourne (17%) of picking up the recycling bags at other recycling community events. Vincent Square (38%) also have the highest percentage of respondents that are not aware of how to order the free clear recycling bag.

This data could be used to improve how the recycling bag can be made accessible to each ward. Interpreting this result indicate wide usage of recycling bag among the respondents across all the wards in the borough.

External Storage and Food waste Collection: A chi-square test of independence showed that there was significant association between external storage and food waste collection (p-value = 0.01). This means that the preference for food waste collection is influenced by external storage availability.

Table 2 indicates that more than half of the respondents across all the internal space categories would prefer food waste collection but one-third of respondents in each category lack adequate external storage facility for its collection. The only exception to this, is the respondents that use a mixture of

bin and chute for waste storage. This category has 68% of respondents that are interested in food waste service but lack adequate external space.

Table 2: External Storage and Food Waste Collection

If the council introduced a city-wide food waste collection service, how would this service affect you?				
External Space	Want food waste collection and have additional storage space	Want food waste collection but no additional storage space	Do not want food waste collection and no storage space	Total Percentages
Have two separate storages	50%	25%	25%	100%
Have external bin for rubbish and no external storage for recycling	40%	28%	32%	100%
Have external bin for recycling and use a chute for rubbish	16%	68%	16%	100%
Use Chutes for both rubbish and recycling	40%	40%	20%	100%
No external storage for both recycling and rubbish	40%	34%	26%	100%
Number of Respondents	417			
Chi Square Tests - P value	0.010			

This data also shows the difference between respondents that lack external storage facility and the respondents that lack adequate space for external storage. The former, do not have any external storage at all even though there may be space available. While the latter, do have an external storage facility but lack adequate space to cater for more bins.

For respondents that lack external storage facilities, 40% of this group have external space that can accommodate food waste storage, and 60% of this

same group do not have external space where food waste storage facilities can be located. In general, 32% of the respondents lack additional external storage space to accommodate food waste.

Age and Communication Effect: A chi-square test of independence showed that there was a significant association between age and communication effect (p -value = 0.00). This means that the effectiveness of communication received varies with age groups.

There is a clear consensus among all the age groups that the recycling information received is useful and clear. The age group 22-38 years have the lowest percentage (55%) and the over 55 years age group have the highest percentage of 76% in this category (Table 3).

The only respondent that requires the recycling information in another language is located within the age group 46-54 years. However, few respondents believe that the recycling information received lacks clarity and is difficult to understand. In this category, 4% of the respondents are from the 22-38 age group, 2% are from the 46-54 age group, 2% are from the over 55 years age group and none from the 39-45 age group. In terms of no communication received, the age group 22-38 have the highest proportion (31%) and the over 55 years (9%) group have the lowest percentage.

Table 3: Age and Communication Effect

What do you think of the communications you received?						
Age	Useful and clear	Language not easy to understand	Need in another language	I do not know	No Communication	Total Percentages
22-38 years	55%	4%	0%	10%	31%	100%
39-45 years	69%	0%	0%	14%	17%	100%
46-54 years	70%	2%	1%	12%	15%	100%
over 55 years	76%	2%	0%	13%	9%	100%
Number of Respondents						417
Chi Square Tests - P value						0.001

The result indicates that most of the respondents agrees that the recycling information received is clear and useful which is fairly distributed across all the age groups. Therefore, the survey suggested that the current existing recycling information is clear and accessible to all age groups. However, the council may still review the use of words employed in the recycling communication to make the information accessible to all residents living in the borough.

Storage Space

The explanatory variables of type of residence were assessed for analysis with internal and external space for storage. These variables were only used because age and level of education have no direct bearings on internal and external space availability.

The result of the analysis of the tests shows that both responsive variables of internal and external space have no significant relationship with the type of residence. However, when the internal space availability was evaluated against the external space availability, a meaningful relationship was proved.

Internal Storage Availability

The question was asked (single answer), do you have enough internal space for two separate storage bins, one for mixed recycling and one for rubbish in your home?

Seventy-nine percent of the respondent's state (Figure 1) that they have enough internal space for two bins to facilitate source segregation of rubbish and recycling. Four percent of the respondents do have enough internal space in their residency for two bins to segregate rubbish and recycling, but they only have one bin for both waste streams. This group seems to belong to the respondents that are not interested in conducting recycling activities or who cannot access the free recycling bags from the council or who do not have an external recycling bin facility to facilitate internal segregation.

Eighteen percent of the respondents do not have enough internal space for two bins to allow source segregation of rubbish and recycling, therefore end up putting both rubbish and recycling into one rubbish bin.

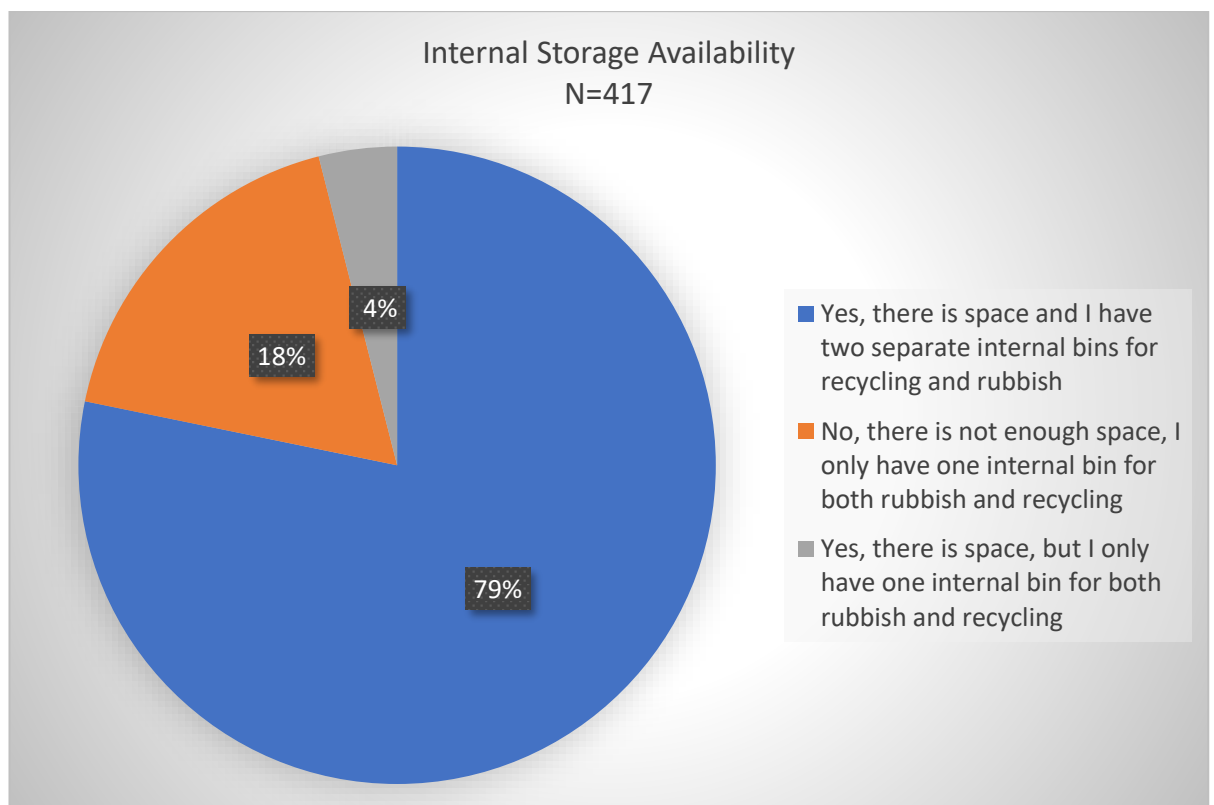


Figure 1: Distribution of internal Storage Availability

External Storage Availability

The question was asked (single answer), do you have external storage for two separate waste streams, one for rubbish and one for mixed recycling (either in your black recycling box or in your clear mixed recycling bags) at your residence?

Forty-two percent of the respondents (Figure 2) have two separate external storage for mixed recycling and rubbish. Twenty-three percent of the sample population only have external storage for rubbish and no external storage for mixed recycling. Five percent of the respondents only have an external bin for mixed recycling and use an internal chute for rubbish. Twenty-nine percent of the survey participants do not have external storage for both recycling and rubbish.

This data indicates that a total of 48% of the respondents have their waste collected from their properties as segregated into rubbish and mixed recycling. Twenty-three percent of the respondents have no mixed recycling collected from their residence due to lack of this facility and all waste are collected as rubbish. The remaining 29% of the respondents do not have external storage for both recycling and rubbish must belong to residents in flatted properties that do not have communal bins for mixed recycling and rubbish, and they present them in bags on the public highway.

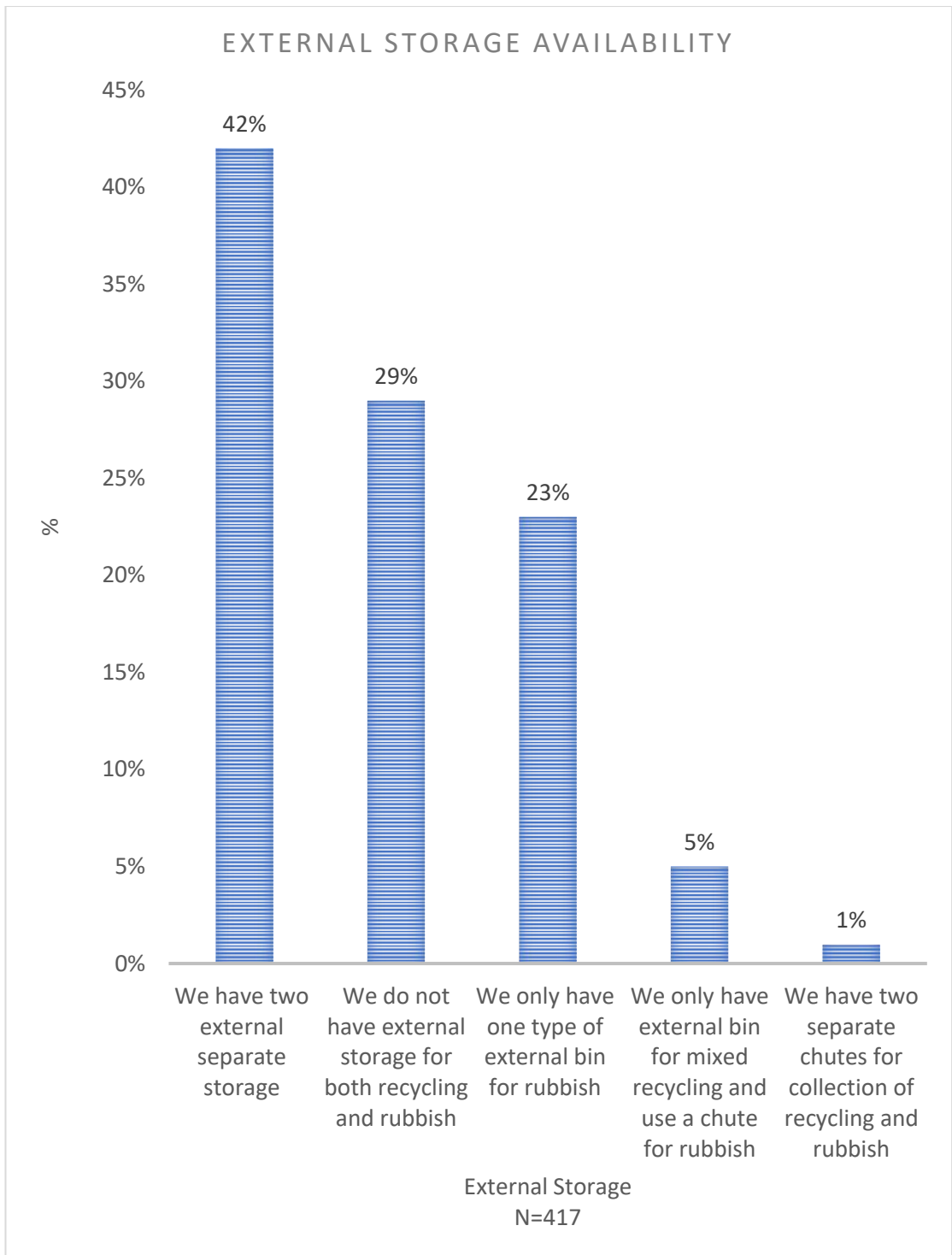


Figure 2: Distribution of External Storage Availability

Internal Storage and External Storage Availability

Both responsive variables, internal and external space were assessed for analysis. The chi-square test result (Table 4) provides a p-value of 0.006 which indicates that there is a significant relationship between the internal storage and external storage space. This signifies that these two variables are connected and dependent on each other. This means that the availability of internal space and external space for storage are important enabling factors for effective recycling activities.

Table 4 shows that only 36% of the respondents have adequate internal space for source segregation of waste, simultaneously with adequate external space for two separate storages. This group of respondents (36%) and the respondents that use chutes and external recycling storage (4%) are the only respondents that conduct effective recycling activities. This is because the internal waste infrastructure matches the exact external waste infrastructure.

It also means that the mixed recycling of another 40% of other respondents, which have two internal separate storages but no external storage for recycling is at elevated risk of being collected as a rubbish stream, if they missed the weekly collection or cannot easily access the free recycling bag distributed by the council.

The remaining 20% of the respondents do not have adequate internal and external space to separate waste for recycling. Thirteen percent (if the 7% of respondents that never recycle is deducted) of respondents in this group would also have to rely on the free recycling bag.

Table 4 Internal Storage Availability and External Storage Availability

Do you have enough internal space for two separate storage bins, one for mixed recycling and one for rubbish in your home?			
Do you have external storage for two separate waste streams, one for rubbish and one for mixed recycling at your residence?	Internal space with two separate storages	Internal space but one storage for both rubbish and recycling	Inadequate internal space, only one bin for both rubbish and recycling
Have two external separate storages	36%	1%	4%
Have external bin for rubbish and no external storage for recycling	15%	1%	7%
Have external bin for recycling and use a chute for rubbish	3%	0%	1%
Use Chutes for both rubbish and recycling	1%	0%	1%
No external storage for both recycling and rubbish	25%	1%	4%
Number of Respondents	417		
Chi Square Tests - P value	0.006		
Total Percentages	100%		

In summary (Box 1), tests analysis for external and internal space against the type of residence yield no significant relationship. However, test analysis using two variables of internal and external space shows a significant

relationship between the two variables. The test data for the two variables, shows that 20% of the respondents lack adequate internal space, and 60% of the respondents lack external storage, and the remaining 20% lack both external and internal space for waste segregation.

Relevant interventions should include Integration of waste policy and planning development regulation to ensure adequate storage facilities are available in new builds. For the existing builds, the council should increase the outlets for recycling bag distribution and explore the use of public vending machine to make bags easily accessible. In addition, the council should increase the mixed recycling collection frequency to the same level as the rubbish collection, and to install more micro recycling centres for a wider coverage of the borough.

Summary of Storage Space

Determinant Variables


- Internal Space Storage
- External Space Storage

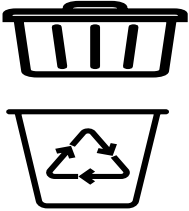
Issues

- 20% of the respondents lacks adequate internal space.
- 60% of the respondents lack external storage.
- 20% lack both external and internal space for waste segregation.

Causes/Impacts

- Lack adequate internal and external storage facilities resulting in loss of mixed recycling to rubbish collection.
- Lack of external storage facility may result in waste dumping in public spaces.





Intervention

- Increase mixed recycling collection frequency to the same level of rubbish collection.
- Use the planning regime to ensure new residential properties have adequate internal and external storage space.
- Increase installation of Micro Recycling Centres to provide wider coverage of the borough.
- Increase the outlets for recycling bag distribution and explore use of public vending machine to make bags easily accessible.

Box 1: Summary of Storage Space

Appendix S - Council Recycling Communication Plan

		Audience	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22
Social Media	Corporate WCC channels															
Social Media	Facebook Westminster Recycles															
Advert	Westminster Reporter	All									22/10/2021 Advert Parker RC on front RC info, photo someone recycling, EV launch			Jan 7- xmas trees, regular DMR advert		
Advert	Westminster Plus	Senior residents				Spring/ Summer 2021. Available online: https://www.westminster.gov.uk/news/latest-issue-westminster-plus-arriving-residents				Advert approval Aug - Claire A						
Advert	Council Tax booklet	All		Sent out												Sent out
Mail out	Council Tax leaflet insert 2022-2023	All		Sent out								Heard from Sue Bush and asked for recycling flyer- awaiting WCC comms. Nov 10. Agreement can include recycling flyer.				Sent out
E-newsletter	Recycling Champions newsletter	RCs			April 16 (from Veolia)			July 27 (from Veolia)								
Handbook	Westminster Housing Leaseholder handbook online (2 pages recycling info)	Westminster Housing leaseholders						Online Aug 17					Content check-in for updates- Zakiya Qureshi Leasehold Team Leader - update with IITW info (EF)			
Events	Various engagement events						Queen's Park Community Clean Up (World Environment Day)	SouthWestfest x 2, Westbourne Festival	Queen's Park Festival	Lisson Green estate event, Recycle Week events- Tachbrook Market, Church Street Market, Ken Gardens	Pad rec Oct 3					
E-newsletter	Recycling e-newsletter	Signed up residents		Spring 2021 March 1 2021			Summer 2021- not sent out			Autumn 2021 Sent out Sept 21			Winter 2021 Dec 13			Spring 2022
National/regional campaign	Recycle Week 2021									20-26 September. 3 x info stands, ReLondon social media adverts, WCC social media, FB WR						
Face2Face Engagement	Door knocking								Prep		Prep	IITWI				
Christmas campaign	Christmas campaign								Xmas tree sites- Sept 24-GOC and LF- dates for tags	Design tags/ print		Use film clips (RC) from xmas 2020	Xmas tree sites until Jan 11 22			
National/regional campaign	Food Waste Action Week 2022															March 7- March 13
Easter campaign	Easter campaign															
Engagement event- waste reduction	Reusable nappy events- TBC. 2 events as part of contract															
National/regional campaign	London Recycles- 18-34 year olds/ food waste campaign												Campaign launch			
National/regional campaign	Reusable Nappy Week				Env newsletter: 08/04/2021 inc 19 - 25 April											
Food waste trial	Food waste info sent to new residents															

Appendix T - Council Engagement Activities

Date	Time	Event	Address	# Residents Engaged
05 June 2021	10am-12noon	Queen's Park Community Clean Up (World Environment Day)	Queen's Park Gardens, W10	30
02 July 2021	1.30pm-3.30pm	SouthWestFest	Abbey Centre/ Denbigh Triangle, Denbigh Street	30
17 July 2021	1pm-5pm	Westbourne Summer Festival	Canalside, next to Warwick Estate, W2 STF	30
20 July 2021	9.30am-2.30pm	SouthWestFest	St George's Square Gardens, Pimlico SW1V 3QW	20
07 August 2021	12noon-6pm	Queen's Park Festival	Queen's Park Gardens, W10	45
26 August 2021	10am – 3pm	Church Street Market		32
04 September 2021	1pm-4pm	Lisson Green event-estate event	Lisson Green estate	23
21 September 2021	10am-3pm	Tachbrook Street Market		53
23 September 2021	10am-3pm	Church Street Market		36
25 September 2021	10am-3pm	Kensington Gardens Animal control - (Responsible ownership / licensing / animal welfare awareness)	Kensington Gardens	26
03 October 2021	10am-3pm	Wellbeing, potentially with a Silver theme/show	Paddington Recreation Ground	12
26 October 2021	2pm-4pm	St John's Wood Library	El to organise	26
10 November 2021	3pm-7pm	Marylebone Village's Christmas lights event	Via Claire A	10
13 November 2021		Sustainability festival community open days/ Climate Action Open Days	Event two: Date: Saturday 13 November, midday to 6pm (includes set up and break down time) Venue: WECH Community Centre, Salbourne House, Ground Fl, 36A, Elgin Ave, London W9 3AZ	32
15 November 2021	2pm-4pm	Beethoven centre meeting	Beethoven Centre, Queen's Park	2
18 November 2021	2pm-4.30ppm	Library recycling info stand	Paddington Library	10
27 November 2021	11am - 2pm	Church Street Youth Market - Veolia - Reduce, Reuse, Recycle (see leaflet attached)	Church Street Market	0
07 December 2021	2pm-4.30ppm	Library recycling info stand	Maida Vale Library	10
13 December 2021	11:30-12:20	Library recycling info stand	Queen's Park Library	1
17 December 2021	2pm-4.30ppm	Library recycling info stand	Paddington Library	0
06 January 2022	2pm-4.30pm	Library recycling info stand	Pimlico Library	
26 February 2022	2pm-5pm	Climate Action Community Day	The Abbey Community Centre, 34 Great Smith Street, London, SW1P 3BU	

Appendix U

The Current Interventions being Researched by the Council Innovation Team

The recycling team are using the innovation team's expertise to carry out studies on behavioural change, and how it could be applied to influence the residents towards positive recycling behaviours. This approach matches Zhang et al. (2021) assertion of a circular economy. Zhang et al. (2021) highlighted that a circular economy cannot be attained, without undertaking behavioural insight that will shed light on peoples' environmental behaviour, and how best to influence or nudge them to recycle properly.

“Well. So, the recycling team bring us into, or ask us for data, or if they need some insights, or that they need something. You know something about research from us” (Participant CP3- Innovation Team Manager).

Participant CP3 stated the two ongoing research collaborations on recycling. The first one relates to changing behaviour on how to use the mixed recycling bins correctly. The second research is on the life cycle analysis of food waste.

“We have a PhD student now, who is looking at food waste. But she is looking at the end-to-end life cycle of food with our staff. She has already done a survey last year, I think about our buying habits, and whether something is packaged sustainably, and influences on buying behaviours, how much more are we willing to pay for something that is more environmentally friendly. So, she is collecting data from thirty participants or something over a four-month period. Just to see how much food waste we are wasting” (Participant CP3- Innovation Team Manager).

There is the other ongoing research mentioned by Participant CP3, which is not related to recycling. However, Participant CP3 believes that lessons learnt from such research can be applied to recycling research. One of this research was around gambling.

“So, there is a good piece of work done last year which was around gambling. The idea was if they could they put together an index, the geographical index which covers the whole borough and the squares in the squares could be rated on an index of high to low of whether people living there were likely to be vulnerable to the risk of gambling. Until that is now being used by the gambling policy, as a strategy to reduce the number of gambling establishments that could be licenced in a particular area. So, it is using data to identify hotspots and reduce risk, and the council’s is using its licencing powers to reduce that risk to the residents” (Participant CP3 Innovation Team Manager).

The same logic could be extrapolated to identify wards or areas that are likely not to participate in recycling activities, and then focus more campaigns in these areas to improve the recycling rate. However, the constraint to this application is the lack of accurate data on household collections.

So, I just thought one thing, and that is before as well, you were saying about something that is a challenge to do research around recycling in Westminster. Another thing that I thought of, is the way that the data is collected currently. So, the recycling tonnage includes both residential and commercial. It is not easy to measure a change in residence behaviours or you know in a particular group. It is hard to disassociate between businesses and residents, and there is no standard method of measuring. (Participant CP3- Innovation Team Manager).

Innovation:

The innovation code detailed the recycling innovations that have resulted from the research. Participant CP3 mentioned three innovations. The first one centred around a recycling app. This app was invented to help residents determine if a material can be placed in a mixed recycling bin or the residual bin. This intervention will remove the ambiguity about whether a material can be recycled by the council or not and, resolve issues around mixed recycling contamination.

“It was another university project using behavioural insights in an app, to encourage people to get better at recycling. And the idea was that you could share a problem, or you could ask the council if it is okay to recycle a material. You could sort of scan the items. So, if you were not quite sure of something is recyclable, you could scan it, and the app would say you can or you cannot” (Participant CP3 – Innovation Team Manager).

However, the app is still in the prototype stage because the technology to aid the app is not yet available in the UK. All materials will require a recycling bar code for scanning before the app can be operational. Such technology (refers to as “digital DRS”) is already operational for a deposit return scheme (DRS) in most EU countries (Recycling Magazine, 2021).

Kurniawan et al (2022) quantified the benefits of digitalised recycling system, where a recycling app in Indonesia has diverted waste from landfills to about 65%. More importantly, the app allows citizens to trade their waste materials using personal mobile phones to scan and trade the materials online. It is expected that such technology will be available in the UK by 2024 when the deposit return scheme is implemented (British Plastics Federation, 2021).

The second innovation was around a change in approach to how recycling messages are communicated. This entails a personalised message rather than a general messaging approach that is not personalised to the individual resident.

The essence of this approach is to make the communication very personal to achieve maximum impact. The project is currently being monitored to measure effect and impact.

“And another is using distinct types of messaging to send letters directly to people with their names and address on the letter. For example, saying “Dear Johnson.” So, it is just like using such tactical approach. And the economy team are working on that to do some analysis to see if the technique is changing behaviours. That is current.” (Participant CP3 – Innovation Team Manager).

The third innovation involved using behavioural techniques at the micro recycling centres to nudge the residents to conduct recycling properly. One such technique was the modelling of the bins to replicate a post box. Participants' CP3 and CP2 statements about this technique are quoted below.

“There is a lot of different techniques that is being used at the pavement sites. One which is about like a bin shaped sort of post box hole to put the boxes into” (Participant CP3 – Innovation Team Manager).

“So, one of the projects that is currently happening now at the pavement sites (Onstreet MRC) is to get people to fold the boxes before they put them in the bin. So, in that way, that will not cause the bin to look full” (Participant CP2- Recycling Officer).

Also, this project is currently being monitored to measure its impact. Therefore, it will be difficult to know whether these techniques will work or not.