Supplementary Material

Supplementary A: Westminster Borough Demographic Information

The borough of Westminster is divided into 18 wards (Figure S1) 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 (Westminster City Council, 2022).

Eighty-eight percent of the population are educated (from primary to university level) and in employment, with 56% graduating from a UK Higher Education Institution % (Westminster City Council, 2022). Recent data indicates that 6% of the residents have no educational qualification, and the borough has a transient population of 30% (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, 2022). The 2021 census indicates that 73% of the residents are between 18-64 years old, 15% are under 17 years, and 10% are over 65 years old (ONS, 2022).

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 an 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).

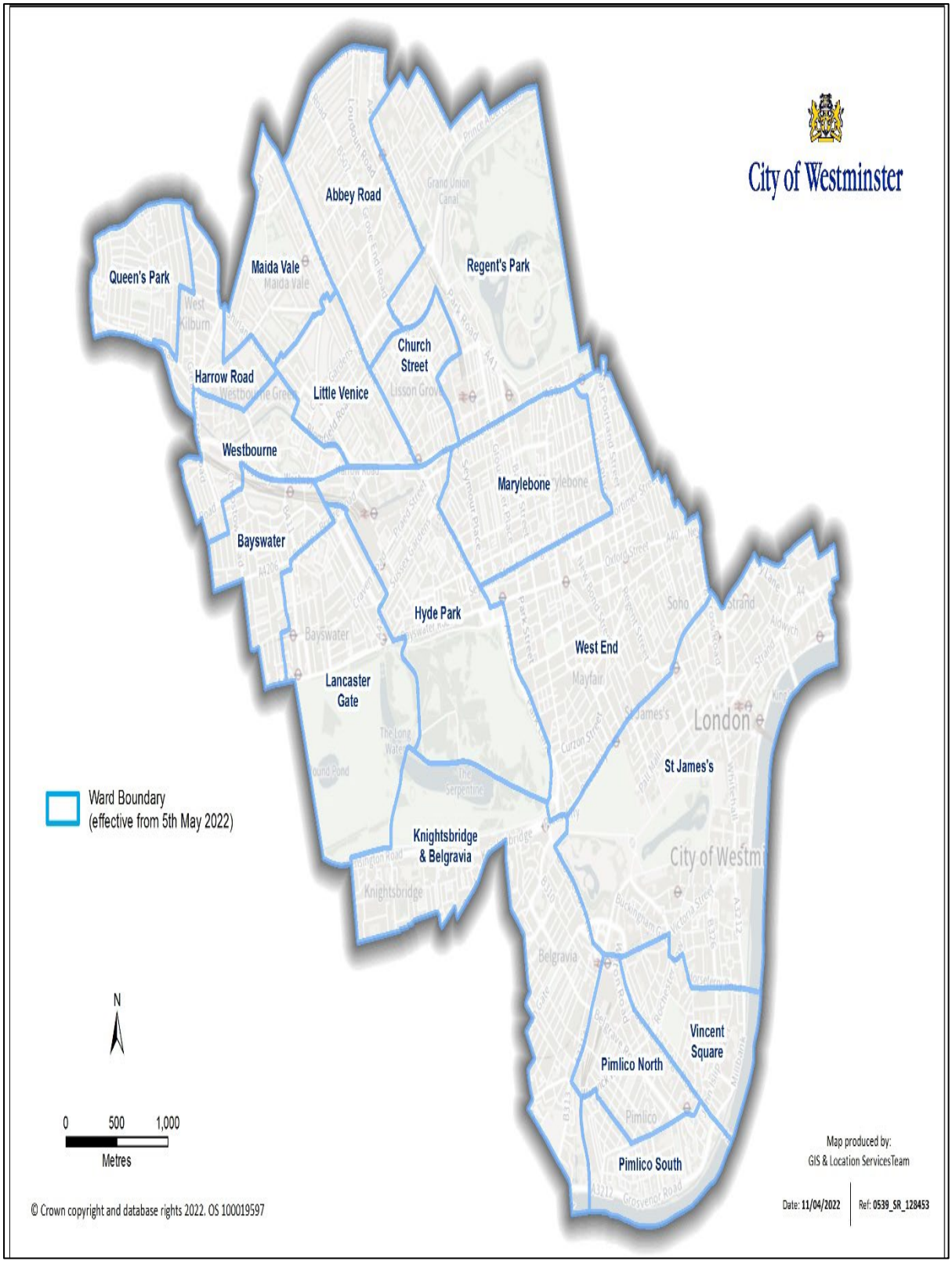

Figure S1: Map of Westminster showing eighteen administrative wards effective from May 2022 (Map produced by the Westminster City Council GIS Team)

Table S1 indicates the annual recycling rate between 2011 and 2021. The current goal is to achieve a 65% recycling rate by 2035 (Defra, 2020).

Table S1: Westminster Recycling Rate over 10-year period from 2011 to 2021 (Source: London DataStore, 2022).

Westminster Recycling Rate from 2011 to 2021	
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%

Supplementary A - References:

Defra, 2020. Circular economy measures drive forward ambitious plans for waste. 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).

London DataStore, 2022. Household Waste Recycling Rates, Borough. https://data.london.gov.uk/dataset/household-waste-recycling-rates-boroug h [accessed 30 May 2022].

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).

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).

Supplementary B: Mixed Methods and Recycling Literature Sources

The research utilises quantitative and qualitative methods (sequential methods) to collect data (Figure S2). Quantitative research aims to understand and explain the world phenomenon using theory to project realities (Danermark et al., 2022), resulting in numerical data suitable for quantitative analysis (Pollans, 2017). On the other hand, qualitative research is concerned with a detailed understanding of human experiences, the reality of research participants, and the researcher's experiences (Creswell, 2014), as theory alone may fall short in explaining the complexity of human behaviours (Grix, 2010). Qualitative research's flexible questioning and rich responses allowed for a detailed exploration of participant realities, revealing hidden issues and experiences of the social phenomenon under study (Thanh and Thanh, 2015; Wahyuni, 2012).

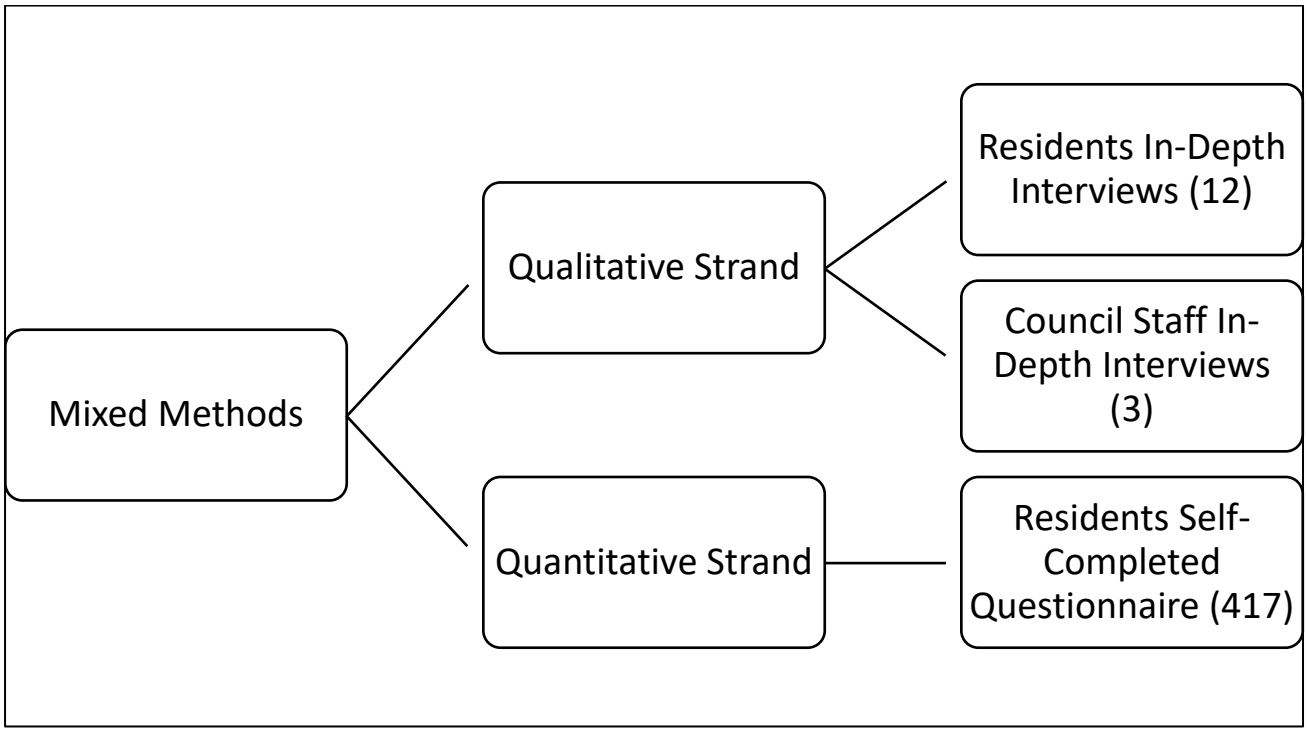

Figure S2: Research design showing integrated strategy and analytical approach to address research problems

Jones (2011) advocates the benefit of quantitative research, emphasising its ability to provide solutions to critical issues through the acquisition of quality and substantial data that unveil trends and remove ambiguity. Table S2 further illustrates the limitations and strengths of each method.

Table S2: Strengths and Weaknesses of the Quantitative and the Qualitative Methods

Quantitative Method		**Qualitative Method**	
Strength	**Weakness**	**Strength**	**Weakness**
Findings can be generalised and applied to the true population	Difficult to gather data	It is flexible and fluid	Findings cannot be generalised to the true population
Data are concise, precise, and reliable	It is not robust for complex issues	In -Depth understanding of complex issues	Difficult to analyse and categorise data into standards
Easy to analyse data	It is difficult to understand the context of a phenomenon	It is easy to understand the context of a phenomenon	It is time consuming

The weaknesses of each method negate the intention of using either method solely as an alternative method. Therefore, this research adopted a mixed-method approach to achieve project outcomes by harnessing both paradigms' strengths (as suggested by Lewin (2011) that provided an in-depth analysis of the resident population's behaviour towards recycling. The proposed research bordered on service users' behaviour and perception of recycling. Therefore, an understanding of human behaviour enables the formulation of a conceptual framework for the research utilising the Behaviour Change Theory (BCT) and the Nudge Theory. BCT is an important intervention technique using education and knowledge to create awareness about an issue, which in turn modifies people's attitude towards a desired outcome (Michie et al., 2005).

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 compensates for this discord in combining the three crucial elements (behavioural science, political theory, and behavioural economics) to allow effective interventions. The above theories have the fundamental principles that communication, education, and knowledge coupled with good intention and rational thought can change people's attitudes to recycling which ultimately will change their behaviour when participating in recycling activities. Six categories of recycling barriers were identified through literature sources (as shown in Table S3) and guided the research.

Supplementary B – References:

Creswell, J.W. (2014) *Research design: qualitative, quantitative, and mixed method approaches.* 4th edn. Los Angeles: SAGE.

Danermark, B., Ekstrom, M. and Jakobsen, L., 2002. *Explaining society: An introduction to critical realism in the social sciences*. Routledge.

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).

Grix, J. (2010) *The foundations of research.* 2nd ed. Basingstoke: Palgrave Macmillan. Los Angeles: SAGE, Page 260.

Jones, K., 2011. The Practise of Quantitative Methods. In: Somekh, B., Lewin, C. (Eds.), Theory and methods in social research, 2nd edn Los Angeles, SAGE, pp. 201–202.

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.

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.

Pollans, L.B., 2017. Trapped in trash: Modes of governing' and barriers to transitioning to sustainable waste management. Environ. Plan. A. 49 (10), 2300–2323. https://doi.org/10.1177/0308518X17719461.

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.

Wahyuni, D (2012) The research design maze: understanding paradigms, cases, methods and methodologies, *Journal of applied management accounting research*, 10(1) pp. 69-80.

Table S3: Recycling barriers derived from different literature sources and the comments indicating views in agreement and disagreement with research results

Barriers Group	Literature Sources that agree with research results	Comments and disagreement (highlighted grey) to research results
Physical Barriers	Yakob et al., 2020; Barr and Gilg, 2005; Ando and Gosselin, 2005; Shaw and Maynard, 2008; Kattoua et al., 2019; Schoeman & Rampedi, 2022; Geislar, 2017; Glad, 2018; Robertson and Walkington, 2009	All shows that inadequate waste infrastructure affects recycling output. Additionally, Kattoua et al., 2019 and Schoeman & Rampedi, 2022 study shows that higher level of education and awareness with inadequate waste storage facilities will still result in low recycling output.
Human Behaviours	Rousta et al., 2020; Schill et al., 2020; Czajkowski et al., 2015; Watts, 2017; Schumaker, 2016; Huber et.al., 2020; Guiot et al., 2019; Pretorius et al., 2023; Jatau and Binbol, 2020; Klockner and Oppedal, 2011; Knickmeyer, 2020; Sewak et al., 2021; WRAP, 2021.	All concluded that positive human behaviour is one of the major elements that enables or initiate recycling activities. Except Guiot et al., 2019 study which indicate that age factor has contradictory effect on recycling behaviour. Pretorius et. al., 2023 study indicates that the awareness of recycling benefits can impact positive recycling behaviour. Thøgersen, 2003; Zhang et al., 2022 indicate that differential charging based on PAYT (Pay as you throw) is the most efficient behavioural tool to increase household participation in recycling activities.
Policy Constraints	Ayçin and Kayapinar Kaya, 2021; Ferronato et al., 2021; Ogiri et al., 2019; Wiesmeth et al., 2018; Smith and Bolton, 2018; Alfaia et al., 2017; Pollans, 2017; Kirakozian, 2016; Cole et al., 2014; Jordan et al., 2003; Reschovsky and Stone, 2017; Bruno et al., 2022; Chen et al., 2023; Ebner and Lacovidou, 2021; Saadeh et al., 2023.	All indicate that effective policy is one the main factors in achieving sustainable waste management. Reschovsky and Stone, 2017 indicate high waste disposal charges will limit recycling participation. Li and Wang, 2021 concluded that direct charging of householders for waste will increase recycling participation. Wang et al., 2021 indicate that both financial and non-financial incentives will increase recycling participation.
Communication/Public Engagement	Drimili et al., 2020; Lee, 2020; Al Mamun et al., 2018; Byrne and O'Regan, 2014; Miafodzyeva and Brandt, 2013; Iyer and Kashyap, 2007; Vicente and Reis, 2008; Issock et al., 2021; Helmefalk et al., 2023; Elmosaad et al., 2023; Xia et al., 2023; Khuc et al., 2023; Kasmuri, et al., 2023; Guven et al., 2023; Leggett et al., 2023	All indicate that communication and public engagement are one the main factor in achieving effective waste management.
Service Constraints	Shearer et al., 2017; Sealey and Smith, 2014; Andersson et al., 2023; Siepelmeyer et al., 2023; Ladele et al., 2021; Robinson and Read, 2005	All indicate that a well-designed recycling service are one the main factor in achieving effective waste management.

References for Table S3

Al Mamun, A., Mohiuddin, M.A., Ghazali, B., 2018. Recycling intention and behavior among low-income households. Sustain. 10 (7), 2407. https://doi.org/10.3390/su10072407.

Alfaia, R.G., Costa, A.M., Campos, J.C., 2017. Municipal solid waste in Brazil: A review. Wast. Manage. Res. 35 (12), 1195–1209. https://journals.sagepub.com/doi/pdf/10.1177/0734242X17735375.

Andersson, S., Söderholm, P., Berglund, C., 2023. The mixed blessing of responsibility relief: An application to household recycling and curbside waste collection. *Front. Environ. Econo. 1*. https://doi.org/10.3389/frevc.2022.1081926.

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., Kayapinar, K.S., 2021. Towards the circular economy: Analysis of barriers to implementation of Turkey's zero waste management using the fuzzy DEMATEL method. Wast. Manage. Res. 39 (8), 1078–1089. https://doi.org/10.1177/0734242X20988781.

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.

Bruno, J.M., Bianchi, E.C., Sánchez, C., 2022. Determinants of household recycling intention: The acceptance of public policy moderated by habits, social influence, and perceived time risk. *Environ. Sci. Pol. 136,* 1-8. https://doi.org/10.1016/j.envsci.2022.05.010.

Byrne, S., O'Regan, B., 2014. Attitudes and actions towards recycling behaviours in the Limerick, Ireland region. Res. Con. Recy. 87, 89–96. https://doi.org/10.1016/j.resconrec.2014.03.001

Chen, R., Fan, R., Wang, D., Yao, Q., 2023. Exploring the coevolution of residents and recyclers in household solid waste recycling: Evolutionary dynamics on a two-layer heterogeneous social network. *Wast. Manage. 157*, 279-289. https://doi.org/10.1016/j.wasman.2022.12.030.

Cole, C., Quddus, M., Wheatley, A., 2014. The impact of local authorities' interventions on hsousehold waste collection: A case study approach using time series modelling. Wast. Manage. 34 (2), 266–272. https://doi.org/10.1016/j.wasman.2013.10.018.

Czajkowski, M., Hanley, N. and Nyborg, K. (2015) 'Social Norms, Morals and Selfinterest 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.

Drimili, E., Herrero-Martin, R., Suardiaz-Muro, J., 2020. Public views and attitudes about municipal waste management: Empirical evidence from Athens, Greece. Wast. Manage. Res. 38 (6), 614–625. https://doi.org/10.1177/0734242X20911708.

Ebner, N., Lacovidou, E., 2021. The challenges of Covid-19 pandemic on improving plastic waste recycling rates. *Sustain. Prod. Consum.* 28, 726-735. https://doi.org/10.1016/j.spc.2021.07.001.

Elmosaad, Y.M., Al Rajeh, A.M., Llaguno, M.B.B., Alqaimi, S.S., Alsalman, A.M., Alkishi, A.Y., Hussain, H., Alhoudaib, M.A., Alnajim, O.S., Belal, S., 2023. Self-Reported Household Waste Recycling and Segregation Practices among Families in Eastern Region of Saudi Arabia: A Cross-Sectional Study. *Intern. Journ. Environ. Res. Pub. Hea*. *20*(3), 1790. https://doi.org/10.3390/ijerph20031790.

Ferronato, N., Portillo, M.A.G., Lizarazu, G.E.G., 2021. Formal and informal waste selective collection in developing megacities: Analysis of residents' involvement in Bolivia. Wast. Manage. Res. 39 (1), 108–121. https://journals.sagepub.com/doi/pdf/10.1177/0734242X20936765.

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. Glad, W. (2018) Spaces for waste: everyday recycling and sociospatial relationships. *Scottish Geographical Journal*, *134*(3-4), pp.141-157. https://doi.org/10.1080/14702541.2018.1500634.

Glad, W., 2018. Spaces for waste: everyday recycling and sociospatial relationships. *Scott. Geograph. Journ. 134*(3-4), 141-157. https://doi.org/10.1080/14702541.2018.1500634

Guiot, D., Malas, Z., Urien, B., 2019. Re-examining the effects of aging on household recycling behavior: A study in France. *Psychology & Marketing*, *36*(6), 618-629. https://doi.org/10.1002/mar.21200.

Guven, E.D., Akinci, G., Temel, D., 2023. Driving Forces on Household Solid Waste Management Behaviors: A Research for the City of Izmir, Türkiye. *Indust. Domes. Wast. Manage. 3*(1), 1-16. https://doi.org/10.53623/idwm.v3i1.165.

Helmefalk, M., Palmquist, A., Rosenlund, J., 2023. Understanding the mechanisms of household and stakeholder engagement in a recycling ecosystem: The SDL perspective. *Wast. Manage. 160*, 1-11. https://doi.org/10.1016/j.wasman.2023.01.030.

Huber, J., Viscusi, W.K., Bell, J., 2020. Dynamic relationships between social norms and pro-environmental behavior: Evidence from household recycling. *Behavio. Pub. Pol. 4*(1), 1-25. https://doi.org/10.1017/bpp.2017.13.

Issock, P.B., Mpinganjira, M., Roberts-Lombard, M., 2021. Investigating the relevance of the traditional marketing mix across different stages of change: Empirical evidence from household recycling. *Journ. Soc. Market. 11*(4), 489-506. https://doi.org/10.1108/JSOCM-11-2020-0221.

Iyer, E.S., Kashyap, R.K., 2007. Consumer Recycling: Role of incentives, information, and social class. Journ. Consum. Behavio. 6, 32–47. http://dx.doi.org/10.1002/cb.206.

Jatau, S., Binbol, N.L., 2020. Assessing Barriers to Household Waste Recycling: A Case Study of Coventry University Postgraduate Students. Interna. Journ. Scien. Res. Public. 10 (1), 9781. http://dx.doi.org/10.29322/IJSRP.10.01.2020.p9781.

Jordan, A., Wurzel, R.K.W., Zito, R., 2003. Policy innovation or 'muddling through'? 'New' environmental policy instruments in the United Kingdom. Environ. Pol. 12 (1) 179–200. https://doi.org/10.1080/0964401041233130834 4a.

Kasmuri, N., Razak, S.N.A., Yaacob, Z., Miskon, M.F., Ramli, N.H., Zaini, N., 2023. Waste Segregation through Recycle and Composting Activities in Urban and Suburban Areas. In *IOP Conference Series: Earth Environ. Sci.* 1135 (1). 012059. https://iopscience.iop.org/article/10.1088/1755-1315/1135/1/012059/meta#:~:text=10.1088/1755%2D1315/1135/1/012059.

Kattoua, M.G., Al-Khatib, I.A. & Kontogianni, S. Barriers on the propagation of household solid waste recycling practices in developing countries: State of Palestine example. *J Mater Cycles Waste Manag* **21**, 774–785 (2019). https://doi.org/10.1007/s10163-019-00833-5.

Khuc, Q.V., Dang, T., Tran, M., Nguyen, D.T., Nguyen, T., Pham, P., Tran, T., 2023. Household-Level Strategies to Tackle Plastic Waste Pollution in a Transitional Country. *Urban Sci. 7*(1), 20. https://doi.org/10.3390/urbansci7010020.

Kirakozian, A., 2016. ONE without the other? Behavioural and incentive policies for household waste management. Journ. Econo. Surv. 30, 526–551. https://doi.org/10.1002/9781119328223.ch7.

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. Resour. Cons. Recy. 55 (4), 463-471. https://doi.org/10.1016/j.resconrec.2010.12.009.

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. https://doi.org/10.1016/j.jclepro.2019.118605.

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. *Wast. manage.* 131, 258–267. https://doi.org/10.1016/j.wasman.2021.06.010.

Lee, D.S., 2020. Restructuring municipal solid waste management and governance in Hong Kong: Options and prospects. Wast. Manage. Res. 38, 1047–1063. https://doi.org/10.1177/0734242X20945185.

Leggett, K.L., Lammi, M., Walsh, L., 2023. Shoving Not Nudging: A Case of Shaming 'Waster'Stickers. In *Sustainable Design and Manufacturing: Proceedings of the 9th International Conference on Sustainable Design and Manufacturing (SDM 2022)*, pp.110-120. Singapore: Springer Nature, Singapore.

Li, C., Zhang, Y., Nouvellet, P., Okoro, J.O., Wang, X., Harder, M.K., 2020. Distance is a barrier to recycling – or is it? Surprises from a clean test. Wast. Manage. 108, 183–188. doi:10.1016/j.wasman.2020.04.022.

Li, W., Wang, J., 2021. Feasibility study of the unit pricing system for household wastes sorting in the context of China. Wast. Manage. Res. 40 (5), 586–595. https://uk.sagepub.com/en-gb/journals-permissions.

Miafodzyeva, S., Brandt, N., 2013. Recycling behaviour among householders: Synthesizing determinants via a meta-analysis. Wast. Biom. Valor. 4,221–235. https://doi.org/10.1007/s12649-012-9144-4.

Ogiri, I.A., Sidique, S.F., Talib, M.A., 2019. Encouraging recycling among households in Malaysia: Does deterrence matter? *Wast. Manage. Res.* 37 (7), 755–762. https://doi.org/10.1177/0734242X19842328.

Pollans, L.B., 2017. Trapped in trash: Modes of governing' and barriers to transitioning to sustainable waste management. Environ. Plan. A. 49 (10), 2300–2323. https://doi.org/10.1177/0308518X17719461.

Pretorius, A., Blaauw, D., Schenck, R., Grobler, L., 2023. Towards a circular economy: A cross-case analysis of recycling in three South African towns. *Develop. South. Afric*. 1-17. https://doi.org/10.1080/0376835X.2022.2162857.

Reschovsky, J.D., Stone, S.E., 2017. Market incentives to encourage household waste recycling: Paying for what you throw away, in: Kinnaman, T.C. (Eds.), *The Economics of Residential Solid Waste Management*, pp. 233-252. Routledge.

Robinson, G.M., Read, A.D., 2005. Recycling behaviour in a London Borough: Results from large-scale household surveys. *Resour. Cons. Recy.* 45 (1), 70-83, https://doi.org/10.1016/j.resconrec.2005.02.002.

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

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

Saadeh, D., Al-Khatib, I. A., & Anayah, F. M. (2023). Evaluating strategies for sustainable recovery and recycling of plastic waste in the West Bank of Palestine: The perspectives of plastic companies. Environmental Monitoring and Assessment, 195(1), 1-15. https://cas5-0-urlprotect.trendmicro.com:443/wis/clicktime/v1/query?url=https%3a%2f%2fdoi.org%2f10.1007%2fs10661%2d022%2d10842%2dx&umid=a3e206bc-0721-4747-86ac-671a1389e98e&auth=f23bd3b3794c7a5914053bd0a99b1b4837b89b14-356bb1fb33154a5a5f107bb2b795f58403044871

Schill, S. and Deirdre, S. (2016) 'Recycling today, sustainability tomorrow: ffects of psychological distance on behavioural practice', *European management journal*, 34(4), pp. 349–362. https://doi: 10.1016/j.emj.2016.05.004.

Schoeman DC, Rampedi IT. Drivers of Household Recycling Behavior in the City of Johannesburg, South Africa. Int J Environ Res Public Health. 2022 May 20;19(10):6229. doi: 10.3390/ijerph19106229.

Schumaker, E. (2016) The sychology Behind Why eople Don't Recycle. Available at: https://www.huffingtonpost.com/entry/psychology-of-why-peopledontrecycle_us_57697a7be4b087b70be605b3?guccounter=1 (Accessed 09 December 2020).

Sealey, K.S., Smith, J. 2014. Recycling for small island tourism developments: Food waste composting at Sandals Emerald Bay, Exuma, Bahamas. Resour. Cons. Recy. 92, 25–37. https://doi.org/10.1016/j.resconrec.2014.08.008.

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. *Wast. Manage. Res*. *39*(7), 892-909. https://doi.org/10.1177/0734242X20985608.

Shaw PJ, Maynard SJ. The potential of financial incentives to enhance householders' kerbside recycling behaviour. Waste Manag. 2008;28(10):1732-41. doi: 10.1016/j.wasman.2007.08.008.

Shearer, L., Gatersleben, B., Morse, S., 2017. A problem unstuck. Evaluating the effectiveness of sticker prompts for encouraging household food waste recycling behaviour. Wast. Manage. 60, 164–172. https://doi.org/10.1016/j.wasman.2016.09.036.

Siepelmeyer, H., Otterbring, T., Mäkivierikko, A., 2023. There's an App for that: Rethinking Waste Service Provision through App-Based Social Norms to Drive Household Recycling Behavior. https://www.diva-portal.org/smash/record.jsf?pid=diva2%3A1729680&dswid=9978

Smith, L., Bolton, P., 2018. Research Briefing: Household Recycling in the UK. https://commonslibrary.parliament.uk/researchbriefings/cbp-7285/ (accessed 16 September 2021).

Thøgersen, J., 2003. Monetary incentives and recycling: Behavioural and psychological reactions to a performance-dependent garbage fee. Journ. Consum. Pol. 26 (2), 197–228. doi:10.1023/A:1023633320485.

Vicente, P., Reis, E., 2008. Factors influencing households' participation in recycling. *Wast. Manage. Res. 26*(2), 140-146. https://doi.org/10.1177/0734242X07077371.

Watts, A., 2017. No Recycling Please – We're Millennials. https://www.recyclingbins.co.uk/blog/no-recycling-please-were-millennials/ (accessed 22 September 2021).

WRAP, 2021. Recycling Tracking Survey 2021 Behaviours, attitudes and awareness around recycling' https://wrap.org.uk/sites/default/files/2021-09/WRAP-Recycling-Tracker-2021-report.pdf. (accessed 14 May 2022).

Wiesmeth, H., Shavgulidze, N., Tevzadze, N., 2018. Environmental policies for drinks packaging in Georgia: A mini review of EPR policies with a focus on incentive compatibility. Wast. Manage. Res. 36, 1004–1015. https://doi.org/10.1177/0734242X18792606.

Xia, Z., Gu, Y., Li, J., Xie, J., Liu, F., Wen, X., Tian, X., Zhang, C., 2023. Do behavioural interventions enhance waste recycling practices? Evidence from an extended meta-analysis. *Journ. Clean. Prod. 385*, 135695. https://doi.org/10.1016/j.jclepro.2022.135695.

Yakob, H., Abd Rauf, N. R. A , Abdullah, Y. A. . and Hoon Leh, O. L.. (2020) "Factors that ontribute to Domestic Waste Recycling: reliminary Survey", *Environment-Behaviour Proceedings Journal*, 5(15), pp. 415-422. https://doi: 10.21834/ebpj.v5i15.2489.

Zhang, S., Mu, D., Liu, P., 2022. Impact of charging and reward-penalty policies on household recycling: A case study in China. Resour. Cons. Recy. 185, 106462. doi:10.1016/j.resconrec.2022.106462.

Supplementary C: Mixed Methods Limitations

The research utilised mixed methods to collect and analyse data, therefore it is important to highlight its limitations and how the limitations were mitigated. The table below outlines the limitations encountered during the research and how they were mitigated.

Limitation	Mitigation
Difficulties in generalising outcome	Triangulating and integrating results from multiple sources (residents' interview, recycling staff interviews, and resident self-completed survey) allows data to be streamlined by focusing generalisation on the commonalities between the 3 data sources. The increase in the recycling rate after implementing the SRI provides the external validity for the research results.
Sampling Limitation	Strategic sampling was adopted by using purposeful sampling for the qualitative data collection to select participants who can provide in depth and detailed information about their lived experience.
Large data volume was accumulated from the mixed methods	Computational tools were used to handle large data volume. In addition, data from the large volume of datasets were sieved to extract important and relevant data that matches research objectives and goals.
Difficulties in data integration	The design of the integration stage (triangulation) before data collection facilitates thoughtful considerations at early-stage allowing reflexivity to play an important role in being objective (to remove bias) which then guided thoughtful integration to improve rigor.

Supplementary D: Residents In-Depth Interview Guides (Phase 1)

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. In general, what do you understand to be recycling?
7. What do you understand by the term “contamination” in relation to rubbish and mixed recycling?
8. How consistent are you in carrying out your recycling habit? Please explain.
9. Is there enough space for internal bins storage for segregated rubbish and recycling within your flat or house?
10. Is there enough external bin storage for segregated rubbish and recycling?
11. The chute does it get blocked sometimes or blocked with a cardboard.
12. So, when that happens, what do you do with the rubbish.
13. If these external recycling bins are already filled to the top, when you accessed them, what do you do with your recyclable materials?
14. Please could you identify any barriers to recycle properly or to put recyclable materials in segregated external bins?
15. How do you avoid or prevent contamination of the recycling bins?
16. Do you think the labels on the bins are very clear enough?
17. How does the council communicate with you about recycling?
18. Do you think these communication methods are effective and why?
19. How do you want to be contacted by the council to encourage you to recycle correctly?
20. In your experience has anybody from the council knocked on your door to talk to you about recycling.
21. 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?

22. What is your view on incentives to drive residents to recycle more?
23. Do you think incentives will motivates you to recycle more? Maybe not you but other people because you are already motivated.
24. Do you think reduced rubbish collection frequency would help you to recycle more?
25. Tell me briefly about your recycling experience as a resident living in the City of Westminster.
26. Are there any suggestions on how the council can help you to recycle more?
27. If the council is proposing food waste collection, do you have enough storage to accommodate food waste.
28. What is behind the passion and motivation to recycle all your materials? Is it moral principle, blue planet effect or environmental harm/benefit?

Table S4: Participant's profiles for the 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

Table S5: The 9 initial themes grouped under the 3 final themes during thematic analysis of the residents' in-depth interviews (Phase 1 data)

3 Final Themes	9 Sub Themes Grouped under Final Themes
Physical Factors	Bin Capacity, Space, and Building Types
Service Factors	Food Waste, Recycling Bag, Collection Frequency, and Council Recycling Service
Political Factors	Distrust in Council Policy and National Government Legislation

Supplementary E: Residents Self-Completed Questionnaire (Phase 2)

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.

Micro-recycling centres are provided for residents to recycle unwanted materials including textiles and shoes, small electrical appliances, books and more.

19. 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. 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.

Table S6: 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

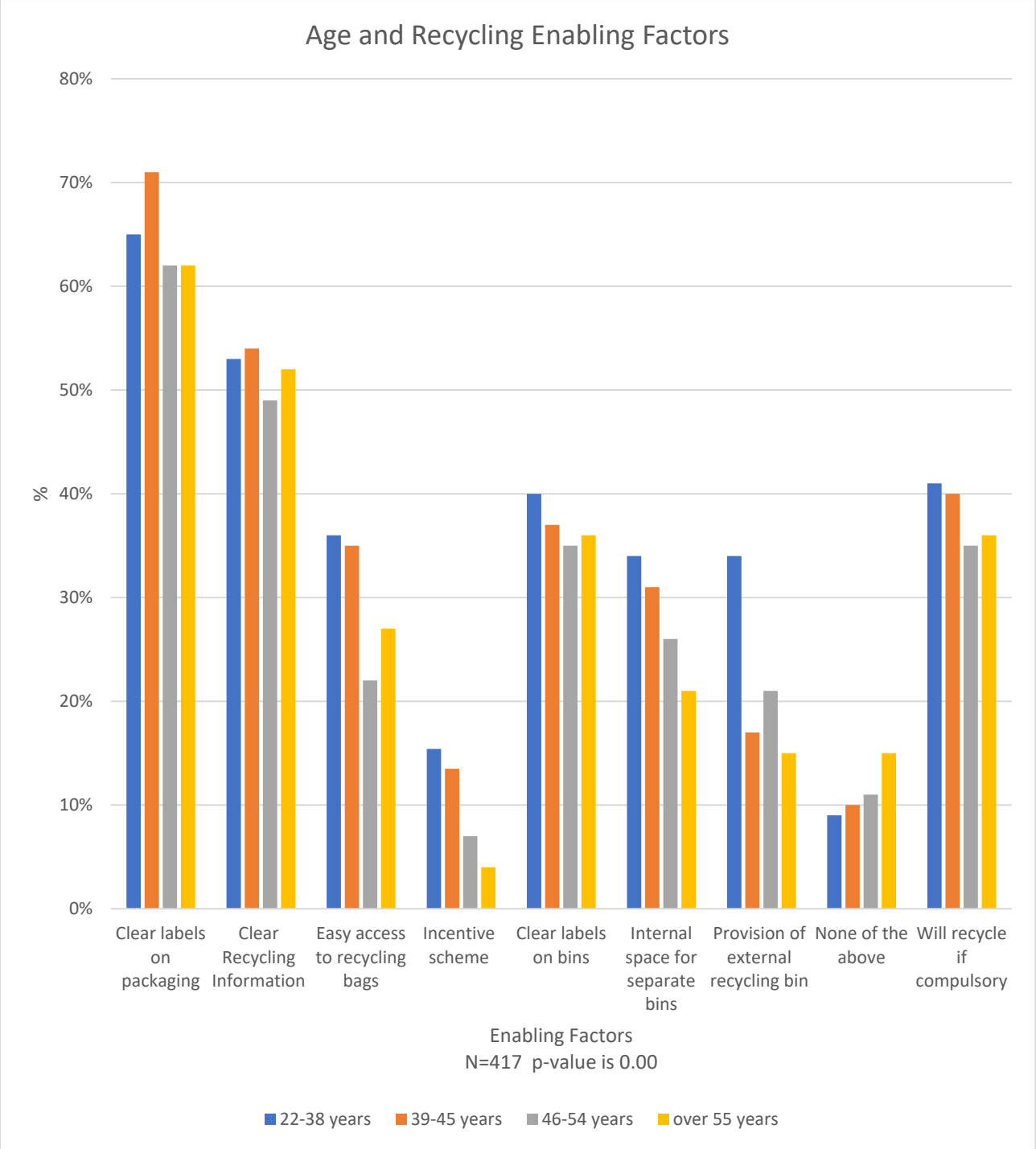

Figure S3: The result of the cross tabulation of the age variable and the recycling enabling factors variable in the borough of Westminster

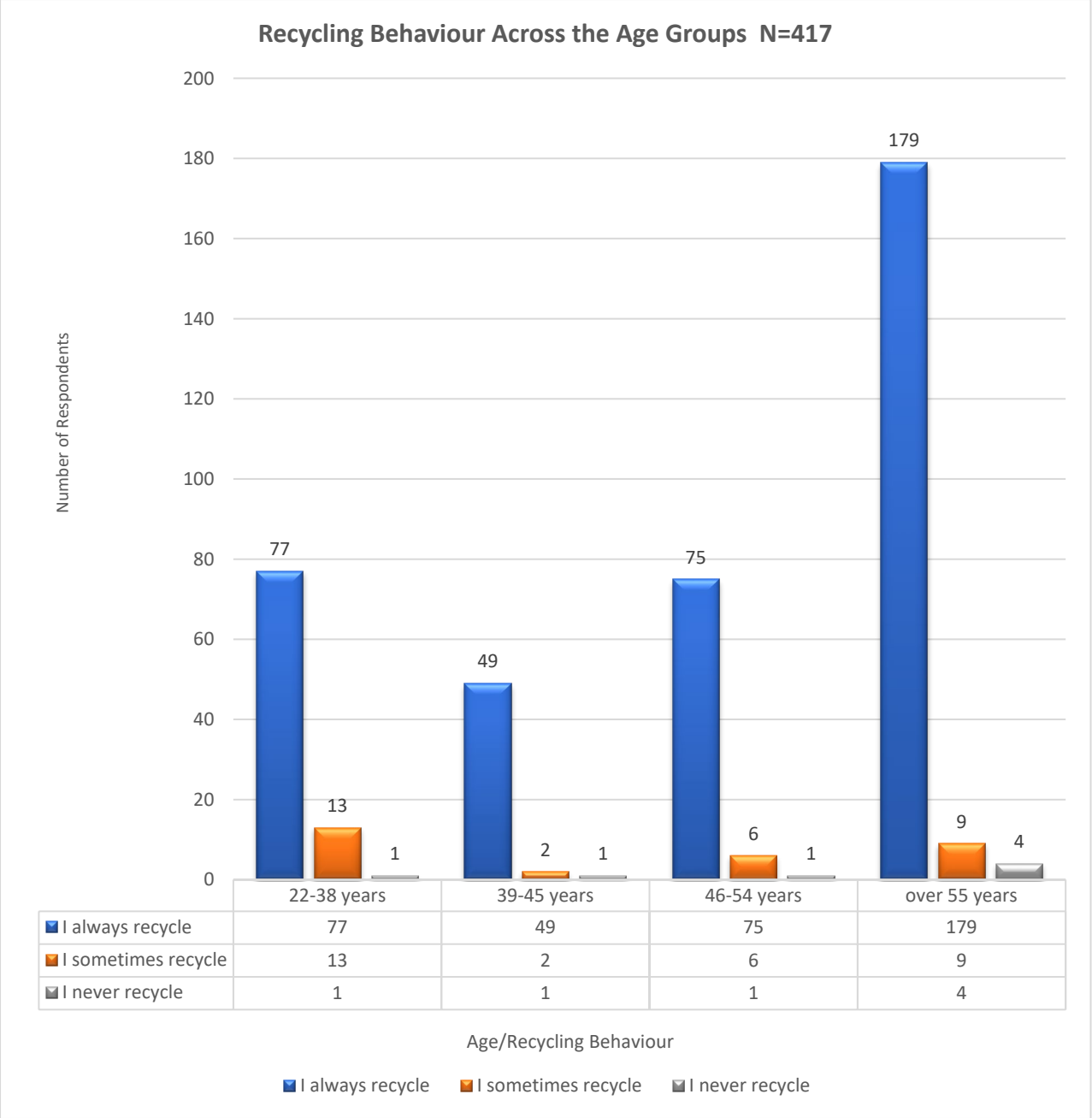

Figure S4: Indicating the number of respondents and their recycling behaviour across the age groups

Supplementary F: Council Staff In-Depth Interviews (Phase 3)

Council Innovation Team Interview Guide

- What is the current research being undertaken by your team to influence residents behavioural change or attitudes towards council policies?
- What are the challenges faced in this research?
- What are the achievements of this research?
- Does any of this research focuses on public engagement and communications?
- Does any of this research on residents recycling or environmental behaviours?
- Do you have any current research collaboration with the recycling team?
- What are the plans of the research team to bring about innovative solutions to waste storage and behavioural attitude to waste dumping?
- How would you describe the impact of the pandemic on your team research?
- How did you cope with impact?
- What are the lessons learnt from the pandemic?

Council Recycling Team Interview Guide

- 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?
- Jarno mentioned the assisted collection service for vulnerable residents, could you please explain how this work?
- What is the mechanism in place to identify new residents to the borough in order 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 feedback 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?

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 wheelchair 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?
- 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?

Table S7: Participant's profiles for the 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.

Table S8: The 7 initial themes grouped under the 3 final themes during thematic analysis of the staff in-depth interviews (Phase 3 data)

Final 3 Themes	7 Initial Themes Grouped under Final Themes
Communication and Engagement	Communication/Engagement Strategy, Transient Population
Service	Physical Constraints, Recycling Collection, Recycling Bags
Legislation	Political Agenda, Recycling Rate Calculation

Supplementary G: Sustainable Recycling Indicators Categories

The SRI enabling factors are defined as available, superficially available, or not available depending on their availability or effectiveness in facilitating recycling output. The different outputs are then categorised into three divisions from A to C.

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 output will be medium (Category B). Similarly, if all the enabling factors are red, the recycling output will be low (Category C). These are the three basic categories.

Table S10 shows the different categories description and Table S11 indicates the definition of the availability and the effectiveness of the enabling factors. These tables can be used as references to allocate the category in the indicator against recycling output or rate.

Table S9: The different sustainable recycling indicator categories from A to C and their descriptions

SRI Categories	Description
Category A	Category A has a high recycling rate because all of the enabling factors are green, which makes them to be available and effective. The recycling rate will be high and greater than 60%.
Category B	Category B has a medium recycling rate but not all the enabling factors are available, which makes the enabling factors to be somehow available or effective and yellow. The recycling rate will be in the range of 40% to 59%.
Category C	Category C has a low recycling rate where some of the enabling factors are not available or effective and red. The recycling rate will be less than 39%.

Table S10: Definition of availability and effectiveness of each enabling factors within the sustainable recycling indicator

Definition of Availability and Effectiveness of Enabling Factors	Available/Effective	Superficially Available/Superficially Effective	Not Available/Not Effective
Education and Environmental Awareness	This enabling is effective or available if most of the residents are highly educated or have high degree of environmental awareness	This enabling factor is superficially 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 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 superficially 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
Adequate Internal Storage to Segregate Waste into three Streams	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 superficially 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
Adequate External Recycling Storage outside Properties	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 superficially 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 superficially 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
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 superficially 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
Increased Frequency for Recycling Collection	This enabling factor is available, if the mixed recycling materials are collected more than twice a week	This enabling factor is superficially 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

Supplementary H : Type of Residence and Micro Recycling Centres Proximity

The participants for the self-completed questionnaire were asked “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.

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 S9 indicates almost the same usage between inhabitants of houses and flatted properties with houses (with sharers) having the highest usage of the MRC (59%).

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.

Table S11: The result of the cross tabulate-n of the type of residence variable and micro recycling centres (MRC) proximity variable in the borough of Westminster

Do you have an on-street micro-recycling centre close to your home?					
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	0.04				