

# **Contributions to the SDGs through social and eco entrepreneurship. New mindsets for sustainable solutions.**

Chris J Moon,  
Middlesex University.  
c.moon@mdx.ac.uk

## **Abstract**

New mindsets and innovative thinking (ABIS, 2017; Moon, 2013, 2014, 2016) are needed to deliver on everything from good health and well-being to affordable and clean energy. This paper reviews the latest trends to tackling pressing social and environmental problems by examining a sample of 100 projects across the globe (Sustainia, 2016). The projects are mapped against the UN SDGs and evaluated on their 'innovation' and scalability. 25 projects related to 'circular economy' solutions are selected for more in-depth analysis. The projects cover a range of applications including Buildings, Food, Energy, Transportation, Resources and Education. The key research question is: what strategic policy support is needed for enterprise & entrepreneurship education to develop the necessary multi collaborative and cross disciplinary mind-sets and skills that such projects require? Reference is made to global risks and sustainability solutions, skills needed for the green economy, and implications for enterprise development and entrepreneurship education. Findings reveal the need for new measures of eco and social mindset that will support the development of the creative and innovative solutions necessary for tackling the UN SDGs.

**Key words: Entrepreneurship, Education, Innovation, Sustainability, UN SDGs, UN HESI, mindset.**

**The business contribution to sustainable development through to 2030 will depend significantly on the qualities and vision of...leaders committed to achieving the UN SDGs, COP21 Paris climate targets, circular economy transitions, and more. Of equal importance, new capabilities, competences and mindsets will be needed across organizations to drive internal transformation and deliver external impact and value.**

**(ABIS, 2017)**

## **Introduction**

In September 2015, world leaders agreed the 17 Sustainable Development Goals (UN SDGs, 2016) that are heralded as one of the chief global tools for ending poverty, fighting injustice and tackling climate change. According to Kingo (Sustainia100, 2016), Executive Director UN Global Compact, cities and governments around the world have been embracing this new agenda; and businesses in particular have unprecedented opportunities to find new markets. Three research questions are posed: (1) How are businesses gearing up to meet these opportunities? (2) Are the UN SDGs inspiring sustainable innovation projects? (3) What are the practical implications for enterprise development & entrepreneurship education?

## **Methodology**

The data set used for this analysis is taken from Sustainia100 (2014, 2015, 2016). Several thousand projects have been submitted and reviewed by experts<sup>1</sup> and overall short-lists of 100 per year produced of the most innovative and inspiring projects across the globe. Evaluation criteria for short-listing the projects were: the solution is readily available; scalable; has positive environmental impact; is financially viable; and will improve quality of life. This paper will review key trends identified across the three years; review the latest 100 projects submitted for 2016 by sector; select 25 eco and social projects for more in-depth analysis; and discuss implications of the key trends and selected projects for enterprise development and entrepreneurship education today. Table 1 below provides a summary of the key trends for projects submitted across three years and provides a snapshot of which global issues have been receiving the most attention from the 'experts'.

[Insert table 1]

## **Key trends 2014**

According to Sustainia100 (2014), 25 solutions embodied the circular economy making this the top trend. Solutions appeared in the fashion and resources sectors in particular; with harmful materials switched for less harmful materials; and use of waste to create new products. Table 2 produced by the author of this paper identifies example short-listed solutions by key trend and sector.

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<sup>1</sup> 1. Sustainia is based in Copenhagen, Denmark, and is part of Monday Morning, Scandinavia's largest independent innovation house. Sustainia describes itself as a world leader in navigating the new market opportunities for the Sustainable Development Goals; and its mission is to innovate the business models of the future. The Sustainia100 Advisory Board 2014 consisted of 21 experts from 11 international research organisations including: Ellen MacArthur Foundation; EPEA Internationale; European Environment Agency; International Federation for Housing and Planning; Natural Resources Defence Council; Nordic Fashion Council; Norwegian University of Life Sciences; United Nations World Food Programme; University of California, Berkeley; World Resources Institute; World Wildlife Foundation. The Advisory Board for 2015 also included: Acumen Fund; Blood Orange Consulting; Climate-KIK; Copenhagen Institute on Risk & Sustainability; Cornell University; Fashion Institute of Technology; Federal University of Parana; Yale University. The Advisory Board for 2016 also included: C40 Cities Climate Leadership Group; Indian Institute of Science; Kytabu.

16 solutions addressed water scarcity across the globe. This includes producing products with less water used in the process; and also recycling water post-production to minimise loss. 14 solutions represented improvements to supply chains including removing conflict materials from mobile phones; and partnering with fair trade organisations to improve labour conditions. 13 solutions depict innovative business models such as leasing services rather than owning products. 13 solutions focussed on data analytics from use of Big Data in the energy industry to smart lighting, smart parking, and smart meters. 12 solutions feature smart building solutions including better use of solar panels and dynamic windows that dim glass.

[Insert table 2]

### **Key trends 2015**

According to Sustainia100 (2015), 23 solutions involved business at the base of the pyramid i.e. companies and social enterprises focussing on new market-based approaches to meeting the needs of the poor. Table 3 lists example short-listed solutions by key trend and sector. 21 solutions focussed on creating value from local resources including redistributing unexpired pharmaceuticals; and sharing of 3-D printers. 20 solutions focussed on climate resilience such as stronger buildings in developing countries and innovative disaster relief techniques. 19 solutions focused on incentivising the circular economy such as leasing out children's clothing and discounts for taking back worn out clothing. Additional insights have been gained from solutions involving digital mapping; and providing access to services rather than ownership.

[Insert table 3]

### **Key trends 2016**

According to Sustainia100 (2016), key trends included Cities as health promoters; such as traffic lights that prioritise cyclists and buses. Another key trend was making profit from unlikely materials; such as curing concrete with CO<sub>2</sub> rather than water; or 3-D printed shoes from abandoned fishing nets. Another key trend concerned disrupting the electrical grid such as deploying battery systems for solar power storage; and 'requiring' new buildings to have green roofs or solar panels. Another key trend is People-Powered Data for better infrastructure; such as using mobile phone technology to improve bus and cycle networks. Table 4 lists example short-listed solutions by trend or sector.

[Insert table 4]

Significant to the reporting of the 2016 solutions was the mapping of the UN SDGs against the short-listed projects. It is too early to say what direct impact the introduction of the UN SDGs has had on the overall number or quality of further innovative solutions submitted. Nevertheless, the fact that the UN SDGs are actively being used to map the Sustainia100 projects submitted in 2016 is a positive indication that they can be used to promote innovative solutions around the 17 goals; and serve as a further catalyst to inspire businesses, entrepreneurs and educators.

In fact, Kingo (Sustainia100, 2016:7), in reference to the SDGs, concludes:

From now until 2030 they will act as a lighthouse, helping businesses and societies navigate the journey toward inclusive and sustainable development.

In fact, at the most recent ABIS (2017) colloquium on academic-business partnerships for the SDGs BASF revealed that they are now actively using all 17 SDGs in their planning and operations. And HEIs such as Ashridge Hult Business School now report against all 17 SDGs.

### **Circular economy solutions**

Taking one example of the key trends identified by the Sustainia100 experts (2014), the circular economy trend demonstrates how concepts are borne out in practice. Table 5 provides a description of the solutions.

[Insert table 5]

The two sectors with the highest number of innovative solutions identified by the Sustainia100 (2014) experts were the Resources sector with 6 solutions and the Fashion sector with 6 solutions. IT, Health and Cities had 3 solutions each; Education with 2 solutions; and Buildings and Food with 1 solution each. Examples from the Resources sector include: Biodegradable Plastic from Waste Materials. This solution creates plastic through bacterial fermentation of by-products from sugar beet and cane production. The first product made from the new plastic is a lamp designed by Philippe Starck. Examples from the Fashion sector include Mud Jeans. Jeans are leased for a year then either kept, switched for a new pair, or sent back for re-use or recycling. The company creates clothing with far less water, and without harmful chemicals, and respecting workers well-being.

Ultimately, the aim of such approaches is to demonstrate that even traditional industries can transform to a circular economy (Sustainia100, 2014). The trend has continued but with Sustainia100 (2015) the emphasis turned towards solutions that 'incentivise' circularity. Thus 19 solutions were identified that exemplify how businesses and consumers are reacting to clear economic incentives to adopt more circular consumption patterns. For example, Vigga saves parents' money by leasing out children's clothing before exchanging them for larger sizes as the child grows. Other solutions include: Circular Model for Air Filter Reuse; and Circular Workwear Production. According to Sustainia100 (2015) these solutions are incentivising circularity in 38 countries across six continents.

With Sustainia100 (2016), the circular economy trend continued with the use of CO<sub>2</sub> as a feedstock for biofuel production; the production of 3D-printed shoes and floor tiles from abandoned fishing nets; flour created from discarded coffee cherry fruits; and concrete made from CO<sub>2</sub>. The challenge has been to tackle global problems; and such projects show how industry and organisations can collaborate to combat issues such as ocean plastic pollution; and, with the sequestering of CO<sub>2</sub> into bricks, reducing CO<sub>2</sub> emissions in concrete by up to 70% (Sustainia100, 2016).

By mapping the solutions onto the UN SDGs there is recognition of how multiple actors can work together to achieve targets that address global issues but also provide developing economies opportunities to innovate and develop new markets. As Kingo (Sustainia100, 2016:7) states:

There are already countless companies and organisations out there proving that through new mindsets and innovative thinking businesses can deliver on everything from good health and well-being and affordable and clean energy, to improved infrastructure and sustainable urban development, all while delivering on their bottom line.

Thus, businesses have the opportunity to remain viable and tackle social and environmental problems at the same time. The UN SDGs will not be reached overnight but the goals do provide a framework to recognise the progress of enterprise towards their achievement.

## Enterprise & Entrepreneurship Opportunities 2017-2030.

DNV GL (2017) in partnership with the Global Compact and Sustainia have identified global opportunities for enterprise arising from key sustainability challenges. The survey of 5,499 managers working in companies of 100-200 employees was conducted by YouGov using CAWI (Computer-assisted web interviews). The findings have been displayed in a 'wheel of SDG fortune' [author description] as shown in Fig. 1. The wheel is based on 15 key risks that need addressing including: extreme weather; lack of fresh water; accelerating transport emissions; global food crisis; loss of ocean biodiversity; cities disrupted by climate change; rising inequality; and soil depletion. From the 15 key risks (centre circle), 45 corresponding opportunities are identified by experts and a global survey of 5,500 leaders.

[Insert Fig. 1]

This 'map' of tomorrow's sustainable markets demonstrates the vast array of opportunities there are to innovate and develop solutions. For the purpose of this paper the 5 global risks for 2017 and corresponding 15 global opportunities are listed in table 6.

[Insert table 6]

According to DNV GL (2017) the opportunities are not single business solutions but have the potential to create value for societies and the planet as they are based on creating systemic change via multi-stakeholder collaboration. However, there still needs to be a strong business case for larger companies to pursue the opportunities. This 'opportunity business case' is represented in Fig. 2.

[Insert Fig. 2]

Thus, survey respondents rated the opportunities on the strength of the business case to 'pursue' each opportunity and their corresponding 'benefit' to society. For example, housing refugees, upgrading communities with informal housing and soil depletion were regarded by business leaders as weaker business opportunities. This presents an opportunity for entrepreneurs to tackle complex societal problems in more agile and disruptive ways.

However, the context is important. For example, in Sub Saharan Africa 'Clever Codes Disrupt Inequality' and 'Business of Power' are the top-ranking opportunities. Thus, entrepreneurs can go where larger businesses are perhaps unwilling to go; but also disrupt the market where larger business is already operating. Various opportunities thus exist for smaller enterprise and entrepreneurs to develop more decentralised services e.g. in energy, education and finance.

Moon et al (2016) report how Rumie is an example of where a social enterprise has disrupted mainstream education in seven developing countries by providing free tablets, to underprivileged pupils, loaded with eduware; the results demonstrating that users improve their reading, writing and math skills more than conventional methods of teaching. Rumie, a Canadian not for profit, was awarded Google global impact winner 2017. The stage is thus set for disruptive technologies to further impact education and other sectors.

Fig. 3 shows how projects focussing on refugees, low-income communities, micro power generation, are now within the world of opportunities for entrepreneurs with the mindset to tackle societal and environmental problems. Examples of such disruption include: ReDI School of Digital Integration helping refugees learn coding skills; BRCK Education which has developed a digital education tool-box,

the Kio Kit, for low-income communities in Africa; and WarChild which has developed a tablet based e-learning tool for children in conflict zones.

[Insert Fig. 3]

Fig. 4 identifies the top six SDGs with the most global potential for business as: decent work and economic growth; good health and well-being; industry, innovation and infrastructure; life on land; affordable and clean energy; and quality education. However, all the SDGs offer the opportunity to innovate and provide solutions that are readily available, scalable, financially viable, with positive environmental impact and improving quality of life. This has been demonstrated by Sustainia (2016) solutions.

[Insert Fig. 4]

Where Technology and Sustainability Risk intersect there are also opportunities to create and develop new markets for goods and services. Thus Health, Food, Water and Energy all intersect with Technology and this creates new ways of looking at problems in each domain. As DNV GL (2017:106) describe: The Internet of People is providing new opportunities to provide healthcare to low-income communities via mobile technology; real-time weather data is assisting small scale farmers; smart water tech is preventing disruptions to water supplies; decentralised energy is disrupting conventional utility supply. These interconnections are defining new business models and setting new trends. As DNV (2017: 111) conclude:

This interconnectedness will drive new markets, moving us ever closer to reaching the SDGs and proving that what is good for the planet is also good for business.

Questions remains though, how well are we preparing business leaders and entrepreneurs for the above challenges? Have they the mindset to tackle complex economic, social and environmental problems facing the planet? Have they the collaborative skills required? What is the current education industry doing to prepare individuals for achieving the UN SDGs?

### **Education of tomorrow's entrepreneurs**

In a global study on Higher Education for Sustainable Development (Mader & Rammel, 2014), 425 higher education stakeholders from 101 countries responded and reported about their achievements and challenges. 45% of respondents said that they are inspired by policies to integrate sustainability into their institution. However, Moon et al (2018) report that most HEIs have only signed up to SDG#4 Education; and some SDGs e.g. SDG #1 No Poverty, have not been signed up to by any HEI in a sample of 300+.

Kingo (Executive Director UN Global Compact, Sustainia100, 2016) argues that businesses are at the forefront of helping to shape the new technologies, solutions, and innovative business models needed to achieve the SDGs. However, key questions are raised: to what extent are businesses geared up to these challenges? Have they the mindsets and skills needed to focus on the solutions required? And are HEIs helping to develop such skills?

Moon (2013) identified the skills needed in the green economy and the eco entrepreneurial mindset required. For example, Table 7 lists some of the skills needed in the green economy. And the mindset of the ecopreneur differs from traditional entrepreneurs by being more compassionate and empathetic (Moon, 2013). Nevertheless, relatively few HEIs appear to be gearing themselves up for this challenge. This despite QAA (2012) stating that sustainability is core to the entrepreneurial

mindset (see Moon, 2014) and TEF (2017) identifying that graduates should be prepared to make a 'strong' contribution to society, economy and the environment.

[Insert table 7]

### **The UN Higher Education Sustainability Initiative**

Over 300 organisations have committed to the UN Higher Education Sustainability Initiative (HESI, 2016); and as these signatories are required to make SMART commitments towards achieving the UN SDGs then the UN SDGs can hardly be described as just a marketing tool. However, there appear to be few dedicated courses on eco-innovation or eco-entrepreneurship, green economy or sustainable business. And many HEIs operate with silos without the necessary cross disciplinary collaboration necessary to tackle complex societal and environmental problems.

There are exceptions. For example, in 2015 Hult International Business School and Ashridge Business School operationally merged to form one global business school; and more recently Ashridge/Hult took the strategic decision to set goals based on all 17 UN SDGs (Ashridge/Hult, 2016). In fact, all research projects seeking funding through the Hult International Business School Research Fund are asked to articulate the contribution they make to one or more of the 17 SDGs.

Thus, it appears that HEIs are willing to embrace the sustainability agenda, in general, but many might lack the capacity to support the UN SDGs throughout their strategy and operations. The European Commission funded project 'University Educators for Sustainable Development' (UE4SD, 2014) revealed that among 33 European countries there is a big lack of professional training programs in education for sustainable development (ESD). Even though 16 countries report about national strategies or action plans on sustainable development or ESD only seven countries report about initiatives for professional ESD training. Consequently, there is a big gap between what is told in national or regional strategies and what is done to empower people to act accordingly.

The Mader and Rammel (2014) study concluded that: to achieve related goals of drafted UN SDGs, HEIs, and higher education policy needs to take action to change not only single curricula, research programs or waste systems within institutions but enable a whole of institution and system-wide transformation in collaboration with practice. And that this transformation would be enhanced by the following actions:

- Establishing transdisciplinary settings for research and education
- Aiming at capacity building and training to enable individual and collective leadership for sustainability in higher education
- Initiating the assessment of global, regional and local challenges so to link global challenges to regional context
- Establishing sustainability as base line for higher education policies at national, regional and global level.
- Applying an whole institution approach that reflects people's needs and competences
- Inspiring transformations at the interface of education, research, policy and practice.
- Supporting a stronger focus on transformative education and new ways of teaching and learning.

Thus, 'greening the university' requires much more than simply bolting on new courses on sustainability. The International Association of Research based Universities (IARU, 2016) advocate campus wide operations; transport; communication; buildings; laboratories; employee and student

engagement; and green purchasing. Universities are thus catalysts for a sustainable society and as such there needs to be a whole organisation ethos, commitment and approach. The UN SDGs can provide a framework to help achieve this.

Further, the author of this paper has conducted research (Moon, 2016) recognising that business students can be 'cynical' about the environment and studying green business. In a survey of 300 business students the majority were found to be cynical; the second largest group were positive; and the remaining students were either 'instrumental' or 'complacent' (Fig.5). These results indicate that educators need to have different strategies for changing the attitudes and behaviours of such students if they are to succeed in developing the 'compassion' and 'empathy' the author has found to typify social and eco entrepreneurs (Moon, 2013).

[Insert Fig. 5]

## **Conclusions**

The SDGs are heralded by the UN as a key mechanism for bringing about the changes necessary for poverty, injustice and climate change to be 'tackled' by 2030. Progress towards achieving the SDGs is identified by UN ECOSOC (2016) which indicates that there is a great deal to achieve. And governments across the globe cannot afford to be complacent in this regard; especially as regard to supporting the development of the necessary knowledge and skills to tackle such problems.

This chapter has reviewed a large sample of innovative solutions to global and local problems that go some way to tackling the issues identified in the UN SDGs. The chapter has also recognised, in a sample of 25 eco and social projects, the imperative for phasing out petroleum based products and the trend towards bio-based products; the changing nature of ownership and the need for affordable solutions; the value of open sourcing and making sustainable options easier for consumers to use.

The review clearly shows that trends and solutions are transdisciplinary and impact across multiple sectors. HEIs need to fundamentally review their approach to education & research, policy and practice in this regard. This supports the call of Mader and Rammel (2014) for the transformation of Higher Education and Society through transdisciplinary approaches.

The author of this chapter contends that the transformation of Higher Education described above requires no less than a reformation of Higher Education Institutions. HEIs that do not set goals based on the SDGs are unlikely to be able to transform the out-dated and institutionalised practices that have prevented them from fully preparing students to work in the green economy and for sustainable development in general; nor to produce the innovative solutions needed to tackle the goals the UN SDGs identify in particular.

Tackling pressing global problems of climate change requires creative thinking but also collaboration. The issues are simply too complex to leave to chance. The mindset of eco and social entrepreneurs differs from traditional entrepreneurs in two important aspects: empathy and compassion. This aspect places them at the heart of tackling the economic, social and environmental issues identified with the UN SDGs. HEIs need to adapt and change to support teaching, research and practice that recognises and rewards eco and social entrepreneurship much more significantly than at present.

Educators may also need to adopt different strategies to help transform student attitudes and achieve engagement (Moon, 2016). 'Cynical' students can pose the greatest challenge but through a series of carefully designed pedagogical interventions such as highlighting the importance of



business ethics and sustainability, these students have the most to gain. 'Instrumental' students can be self-oriented and though prepared to study green issues their motivation is not based on compassion nor empathy; circular economy tools such as Life Cycle Analyses can help these students recognise the value of such approaches. This 'values' based education can be used by educators to encourage attitude change in this regard. And 'complacent' students can be involved in practical activities to develop their commitment.

Fig. 6 provides a model for this transformation; and The UN SDGs can be used as a framework to support all four approaches, with skilled educators able to design and construct new pedagogical experiences to enable this in ever more creative and innovative ways. They should certainly be recognised for doing so.

[Insert Fig. 6]

### **Biographical note**

Chris Moon is a multiple award winning social and eco-entrepreneur. Finalist Innovation & Entrepreneurship Teaching Excellence Awards 2015. Judge, Innovation & Entrepreneurship Teaching Excellence Awards 2016, 2017. Finalist UK's largest ever business development competition. Founder of several eco organisations, MD & CEO. Founder of CSR Global; and partnering with Rumie in Africa. Consulted to Pfizer, BT, Reuters, Canary Wharf Group, ACPO, NHS; and numerous SMEs. Formerly Head of Sustainability at two companies. Certified and accredited CSR consultant & Social Auditor. Formerly Manager, Ethics & Responsible Business Practices, global company. Senior Lecturer, Eco-entrepreneurship, Department of Management, Leadership & Organisations, Middlesex University. Published 60+ research papers and an acclaimed book for The Economist. Fellow of the Royal Society for the encouragement of the Arts, Manufactures & Commerce. Fellow of the Higher Education Academy.

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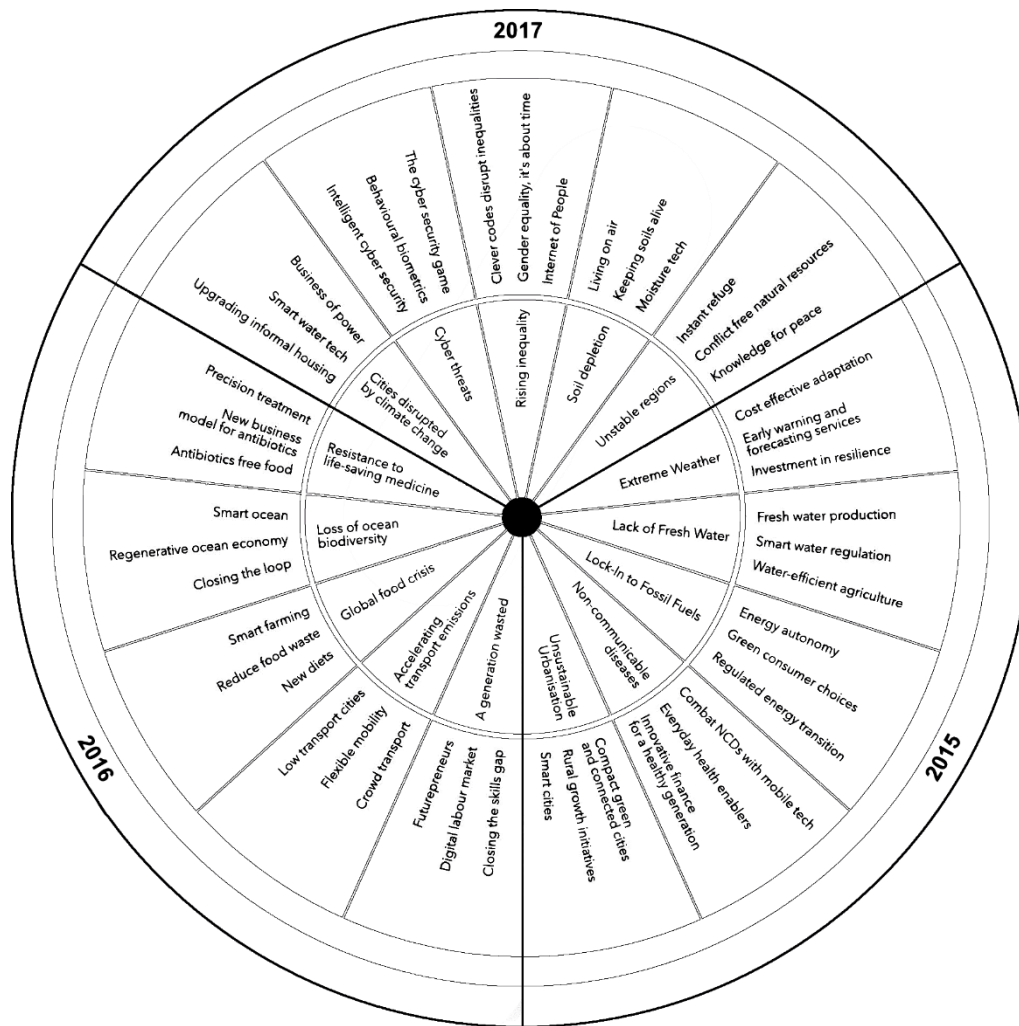


Fig. 1. Risks and Opportunities 2015-2017, DNV GL.

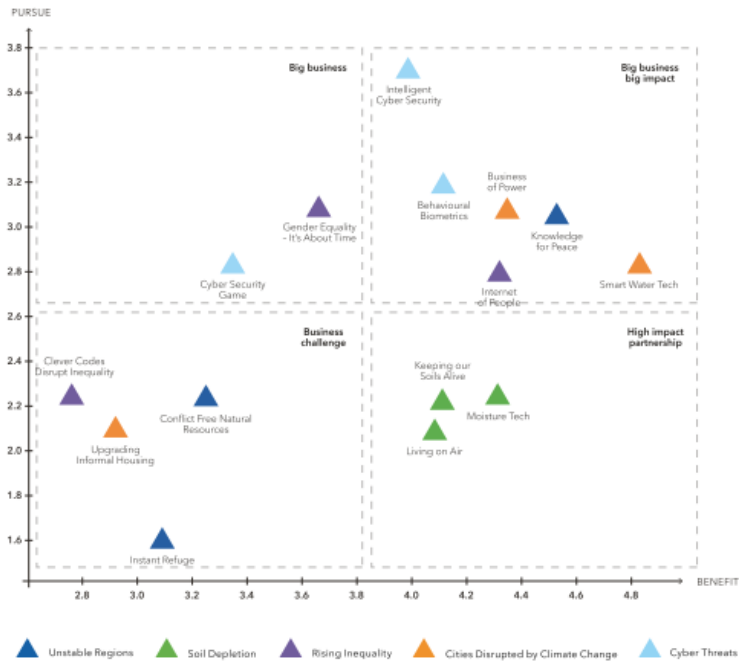


Fig. 2. Opportunity Business Case, DNV GL, 2017.

**OPPORTUNITIES FOR ALL**

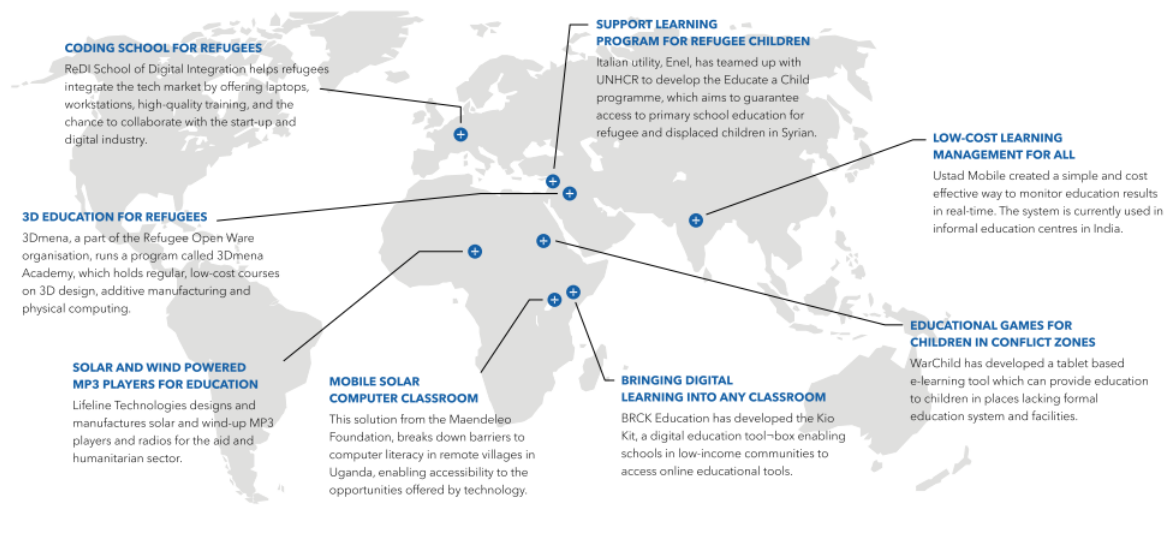


Fig. 3. Opportunities for all, DNV GL, 2017.

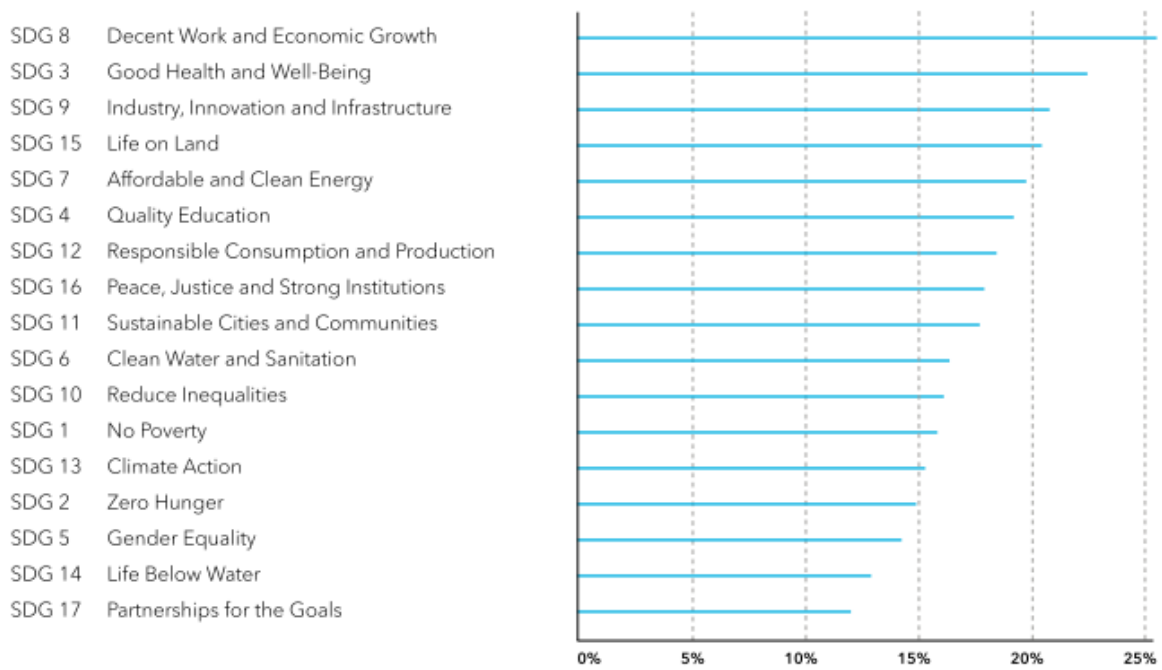


Fig. 4. Rating of SDGs as the most potential for business, DNV GL, 2017.

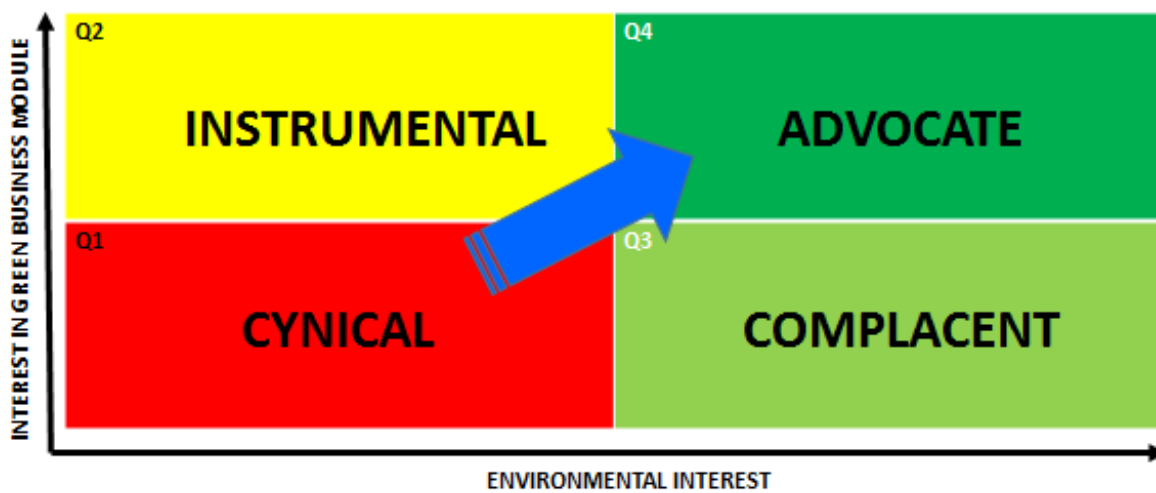


Fig.5. Challenges to transforming attitudes and achieving engagement, Moon, 2016.

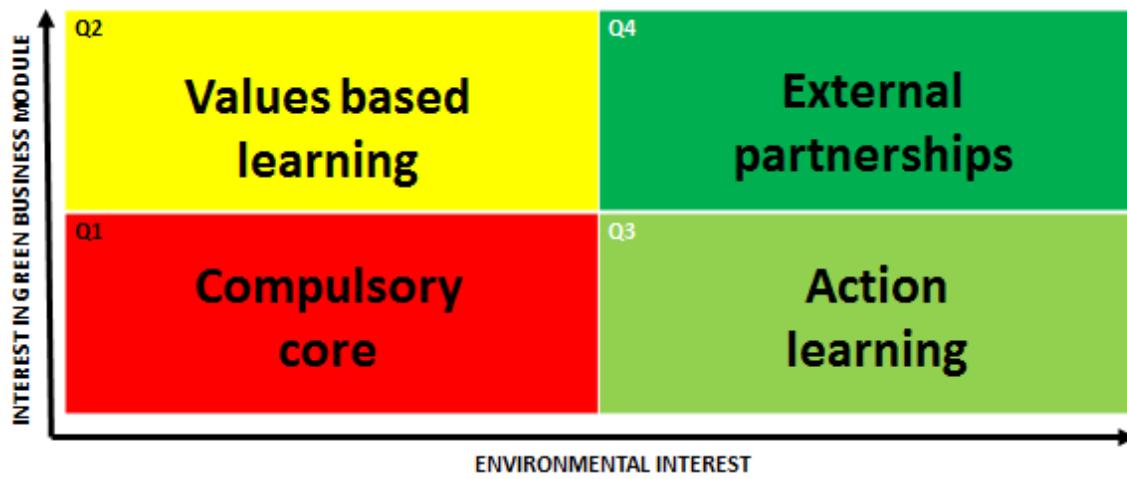


Fig.6. Model for transforming attitudes and achieving engagement, Moon, 2016.

Ten sectors	Key trends 2014	Key trends 2015	Key trends 2016
Buildings	More efficient buildings	Climate resilience; Creating value from local resources	
Food	Water efficiency	Creating value from local resources	
Fashion	Responsible Supply Chains	Access over ownership	Making profit from unlikely materials
Transportation		Access over ownership	
IT		Digital mapping	People powered data for better infrastructure
Education		Community action	
Energy			Affordable and clean energy
Health		Business at the base of the pyramid	Cities as health promoters
Cities	Data analytics; Rethinking consumption		Cities as health promoters
Resources	Circular economy	Incentivising circularity	

Table 1. Key Sustainia100 key trends 2014-2016

Key trend and sector	Example solutions
<b>Circular economy</b>	
Resources	Carbon negative plastic Biodegradable Plastic from waste materials
Fashion	Leasing Jeans for a circular fashion industry
IT	Automated e-waste Recycling Kiosk
Health	Carpets that clean the air for better indoor climates
<b>Water scarcity</b>	
Fashion	Replacing cotton with low impact flax fibre.
Food	Growing Trees in deserts with minimal water use Drip Irrigation maximises crop yields for smallholder farmers
IT	Smart water leak detection for agriculture
Resources	Shower system recycles and cleans water
<b>Supply chain</b>	
IT	The ethical smartphone
Fashion	Water recycling in denim production Transparency and real-time data for buyers
Resources	Construction products made from natural waste
Transportation	Refrigerated Shipping cuts energy consumption and food waste
<b>Rethinking consumption</b>	
Transportation	Ridesharing for people powered transportation
Cities	Mobilising behaviour change for a zero-waste city Providing incentives for recycling in low-income communities
Fashion	Global take-back system for textiles
Resources	Biodegradable diapers (nappies) reducing waste
<b>Data analytics</b>	
Cities	Citywide parking sensors for lowering congestion Communication platform for integrating Renewable Energy
IT	Software combatting energy inefficiency in buildings
Energy	Saving Energy through Data and Cloud software
Transportation	IT system for fuel-efficient railways
<b>Efficient buildings</b>	
Cities	Energy savings finance the switch to LED lighting
Health	Designing hospitals to maximise daylight
Buildings	Mirror enhanced skylight with no upfront costs Dynamic windows dim glass and save energy Refurbishing to create energy positive buildings

Table 2. Sustainia100 solutions by key trend and sector 2014.

Key trend and sector	Example solutions
<b>Business at the Base of the Pyramid</b>	
Health	Solar powered hearing aids with open sourced design
	Cooking with ingots to combat iron deficiency
Energy	Micro-Financed Off-Grid Solar Power
Food	Micro-Insurance for protecting smallholders
	Solar powered drip irrigation for smallholders
IT	Affordable Mobile Networks for Remote Areas
	Voice and SMS-based agricultural tips to farmers
Education	Improving Livelihoods through Entrepreneurship
	Mobile solar computer classrooms
Resources	Turning plastic waste into a currency
<b>Incentivising Circularity</b>	
Resources	Entirely plant-based beverage carton
	Reusing waste paint
Fashion	Yarn from the world's waste streams
	Circular workwear production
IT	Climate positive data-centre.
Energy	Algae based fuel from waste CO <sub>2</sub>
<b>Community Action</b>	
Education	Learning to value resources by swapping toys
IT	Creating access to 3-D printers through sharing
Health	Peer to peer redistribution of surplus medication
Cities	Reducing energy consumption with cool rooftops
<b>Climate Resilience</b>	
Buildings	Durable temporary homes for refugees
IT	Drones for efficient crop management
Cities	Fighting floods with mobile barriers
<b>Creating Value from Local Resources</b>	
Food	Vertical urban farming with closed-loop irrigation
Cities	District cooling system with seawater
<b>Additional insights</b>	
Access over Ownership	Peer-to-peer bicycle-sharing platform
	Leasing Organic kids' wear
Digital mapping	DIY monitoring for environmental accountability

Table 3. Sustainia100 solutions by key trend and sector 2015.

Key trend or sector	Example solutions
Smart buildings	Intelligent building management systems automatically optimises controls to save energy
	Prefabricated apartments and multi-story blocks made with environmentally friendly materials
	Growing bricks with bacteria
	Using CO <sub>2</sub> to make concrete
	Cement-free mortar
Smart food	Affordable Solar-Powered cold storage
	Selling restaurant leftovers cheap
	From coffee waste to superfood
	Low cost smart greenhouses
	Beef-flavoured plant-based burgers
	Cooking food made from agricultural waste
Slow fashion	Sweatshirt guaranteed to last 30 years
	3D-printed shoe made from plastic waste



	Leather alternative made from pineapple leaves
	Smart platform for leasing clothes
	Turning worn-out cotton into quality fibres
Eco-transportation	Using mobile phones to map informal transit
	Bike-sharing for low income neighbourhoods
	Smart traffic signals to prioritise bikes and buses
	Creating an urban network for electric scooters
Smart IT	Intelligent indoor farming platform
	Heating homes with computing power
	Using street view cars to map air pollution
	Harnessing energy from radio waves
	App for remote eye care diagnosis
	Mobile kit to diagnose lung diseases
Education	Digital platform sparks supply chain learning
	Clean-tech micro businesses empower women
	Bringing digital learning into any classroom
	Smart home teaches sustainable living
	Empowering Youth through food education
	Zero-waste school cafeterias
	Practical training and mentors spark entrepreneurship
	Parental work-exchange funds schools
	Women's coding school bridges gender gap
Energy	Smart batteries reducing power consumption
	Pay-as-you-go solar energy to off-grid households
	Low-cost batteries from abundant resources
	Real-time electricity demand reduction
	Crowdfunded solar investments for the global south
	Pooling properties to finance energy upgrades
	Solar storage community platform
	Efficient, flexible, thin-film solar cells
	On-site system converts organic waste into biogas
	Biofuel made from waste CO <sub>2</sub> and sunlight
Health	Solar-powered toilet treats and recycles wastewater
	SMS-driven toolkit improves maternal and child health
	Toilet service offers sanitation and clean fuel
	SMS verification identifies counterfeit drugs
	Sharing Marketplace for healthcare organisations
	Clean water through solar-powered ATMs
	App provides urban air quality forecast
	Eco-friendly sanitary pads for African girls.
	Affordable health insurance via SMS
	Smart cane detects raised objects
Cities	IT-enabled service delivery in informal settlements
	Legislation requires green roofs, solar panels
	Green belt limits sprawl and boosts food security
	Embracing water in a delta city
	Real-time monitoring for electric buses
	Using communities to bolster health
	Sharing resources to solve urban challenges
	Rescued healthy groceries feed the food insecure
	Formalising urban recyclers

	Personalised platform streamlines city services
Resources	Algae-based 3D-printing feedstock
	Solid waste management in refugee camps
	Vertical ocean farming creates healthy ecosystems
	Shower head optimises water usage
	Using larvae to convert food waste into animal feed
	Producing plastic foam from waste CO <sub>2</sub>
	Water-saving pumps made from recycled materials
	Making carpet tile from old fishing nets
	Solar-powered water purification
	Circular model for office inventory

Table 4: Sustainia100 solutions by key trend and sector 2016.

Sector	Circular economy solutions (25 examples)
Resources	Carbon-negative Plastic
	Biodegradable Plastic from Waste Materials
	Construction Products made from Recycled Waste
	Shower System Recycles and Cleans Water
	Paper Made from Banana Plants and Old Textbooks
	Water Treatment Plant Producing Renewable Energy
Fashion	Leasing jeans for a Circular Fashion Industry
	Global Take-Back System for Textiles
	Perpetual Recycling Makes Used Polyester New Again
	Turning Food Waste into Exotic Leather
	Used Clothing as a Currency for Development
	Recycled Plastic Bottles Reinvent Sustainable Fashion
IT	Automated e-Waste Recycling Kiosk
	Recyclable Computers Slash Use of Energy and Materials
	The Ethical Smartphone
Health	Carpets that Clean the Air for Better Indoor Climates
	Menstrual Pads Made from Banana Fibre
	Open Source Software for 3D-Printed Prosthetics
Cities	City Drives Innovation for Liquefied Biogas
	Providing Incentives for Recycling in Low-Income Communities
	Waterless Toilets for Slums
Education	Recycling Books for Literacy Worldwide
	Collaborative Innovation for an Open Source Economy
Buildings	Insulating Building Blocks from Recyclable Materials
Food	Reusing Food Waste as Energy and Fertiliser

Table 5. Sustainia100, Circular Economy solutions by sector

Global Risk 2017	Global Opportunity
Cities disrupted by climate change	Upgrading informal housing
	Smart water tech
	Business of power
Cyber threats	Intelligent cyber security
	Behavioural biometrics
	The cyber security game

Rising inequality	Clever codes disrupt inequalities
	Gender equality.
	Internet of People
Soil depletion	Living on air
	Keeping soils alive
	Moisture tech
Unstable regions	Instant refuge
	Conflict free natural resources
	Knowledge for peace

Table 6. Risks and Opportunities DNV GL, 2017.

<b>Generic skills</b>	<b>Specific skills</b>
Resource efficiency	Resource efficient business models Carbon and natural environment accounting Eco design and production Eco project management
Low carbon	Sustainable engineering and renewables including wind solar and marine Technicians for retro-fitting premises with energy efficiency measures Operators to reduce vehicle emissions, building emissions, water consumption.
Climate resilience	Modelling and projections of climate change Risk Management
Skills to manage natural assets	Accounting for natural environment Environmental Impact Assessments Environmental legislation targets Ecosystem design and management Land use planning
<b>Sector specific skills</b>	<b>Example skills</b>
All sectors	Lifecycle analysis/costing, risk analysis and management Sustainable/carbon procurement
Construction	Sustainable Architecture, CAD eco design and build, BREEAM, Green Deal, insulation and thermal performance.
Building Services Engineering, Property Management	Energy Performance of Buildings, smart metering, renewables
Chemicals and pharma, oil and gas	Green chemicals, biofuels, additives, etc.
Food and drink manufacturing	Sustainable farming and food /drink production
Renewables	Sustainable engineering
Transport	Eco-designers, sustainable engineering, freight logistics, SAFED, green purchasing, alternative fuels
Biomass/biofuel/anaerobic digestion	Green chemical and process engineers
Carbon Capture & Storage	Sustainable engineering
Waste & Water	Resource efficiency engineers and technicians
Energy supply and utilities	Energy conservation and management, micro generation, geologists and engineers concerned about the environment
Automotive Industry	Ultra-Low Carbon Vehicle design, hybrid/electric, etc.
Land management	Sustainable land use, flood risk
Other	FE & HE sustainability and eco lecturers, trainers, etc. Eco-school assessors; sustainability teachers.

Table 7. Skills needed in the green economy, (Moon, 2013).