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Retrofitting in the private residential and commercial property sectors – survey findings

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1. Overview

This paper summarises selected results from an online survey which was designed to receive responses from a broad spectrum of participants on:

- the current barriers and triggers to retrofitting in the private residential and commercial property sectors,
- their insights into the emerging retrofit technologies in the energy, water and waste sectors up to 2050 and across different scales: building, neighbourhood and city regional scale, which will help underpin the scenario-based workshops being conducted, and contribute to 'horizon scanning'[1] of new and emerging technologies.
- the key driving forces and uncertainties that could influence the future of retrofitting.

The survey considered the social (behavioural), technological, economic, environmental and political factors that shape current and future retrofitting activities.

The survey was conducted from June to August, 2011. Survey Monkey was used to frame the survey and respondents were contacted using a variety of 'crowd sourcing' media such as Building4change, Technology Strategy Board (TSB) Modern Built Environment Knowledge Transfer Network (MBE KTN), Confederation of British Industry (CBI) Low carbon business update newsletters, LinkedIn sustainability groups and Waste and Resources Action Programme (WRAP) Halving Waste to Landfill commitment group, in parallel with personal invites.

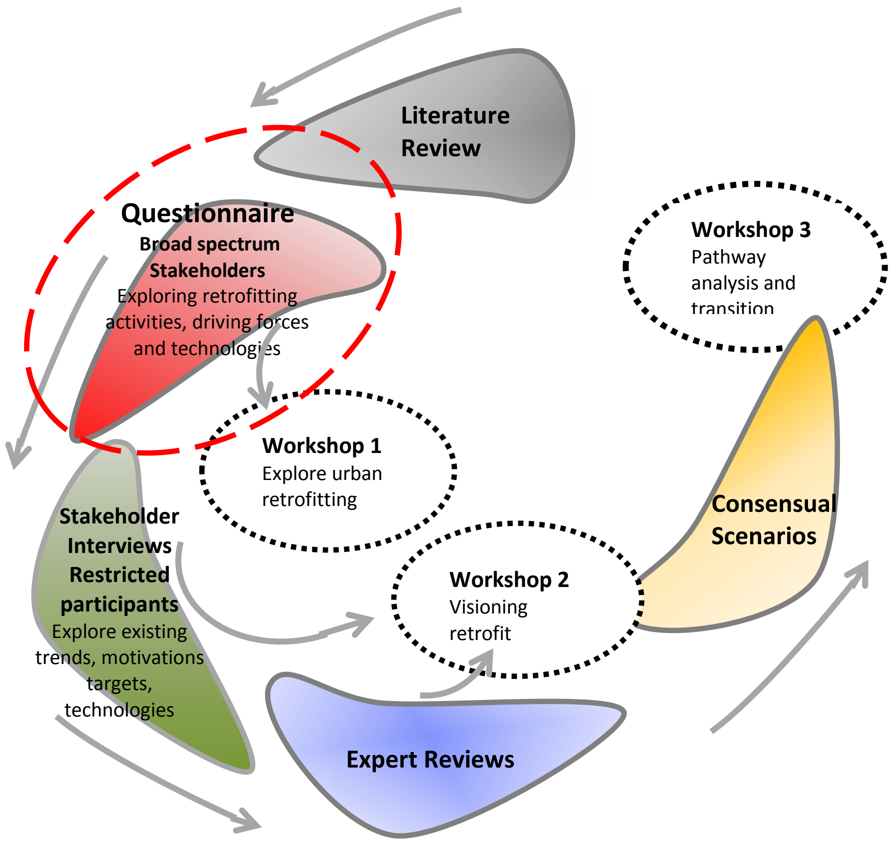
2. Introduction

This survey is part of the EPSRC RETROFIT 2050 research project focusing on how we re-engineer our cities in response to climate change challenges. The Retrofit 2050 project brings together an interdisciplinary team of leading academics from the Oxford Institute of Sustainable Development (OISD) at Oxford Brookes University, the Welsh School of Architecture (Cardiff University) Salford and Cambridge Universities.

These summary findings form part of the Urban Foresight Laboratory (2020-2050) work package 2 led by OISD at Oxford Brookes University (Figure 1) and are designed to underpin the scenario workshops. The focus of the first workshop on October 6, 2011 was to explore the meaning of urban retrofitting, drivers of change and how current 'niche' activities and 'regime' practices might develop future transitions.

[1] *"The systematic examination of potential threats, opportunities and likely developments including but not restricted to those at the margins of current thinking and planning. Horizon scanning may explore novel and unexpected issues as well as persistent problems or trends." (*Nicholson, A, (2008), *Horizon Scanning,* Office of Science and Innovation)

Figure 1: Work package 2 (OISD): Workshop based consensus building with supporting on line surveys and interviews.

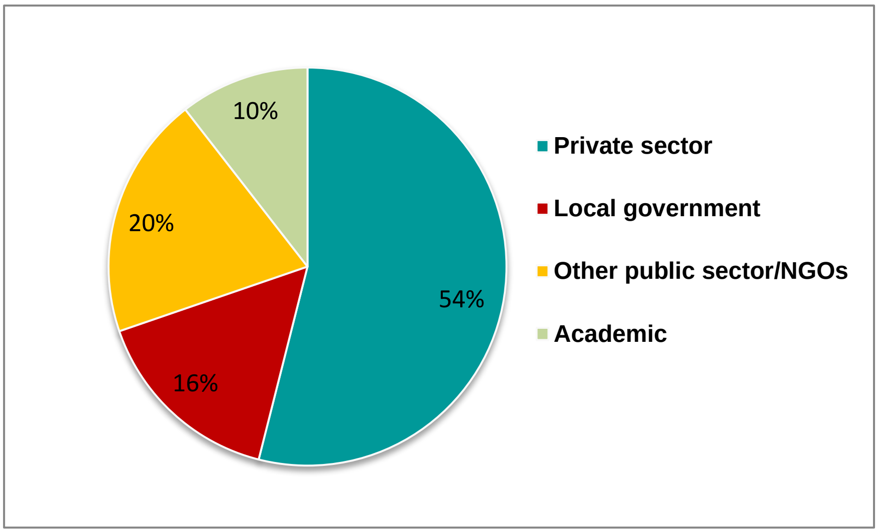


The survey went live on the 21 June 2011 and closed on the 15 August 2011. The link was published in a number of sustainable built environment e-newsletters and business networks. The following analysis presents the key findings.

3. Questionnaire responses by sector

The majority of responses were submitted from the private sector, as shown in Figure 2. Within this sector responses came from individuals working in a diverse range of disciplines geographically spread across the UK. Response rates varied across individual questions. However, at least seventy respondents completed at least half of the survey questions.

Figure 2: Responses by sector



4. Key barriers to rolling out the retrofit agenda in the private sector

Key finding: Process-based factors and strategic factors are relatively more important than technology-based factors in hindering progress on retrofit

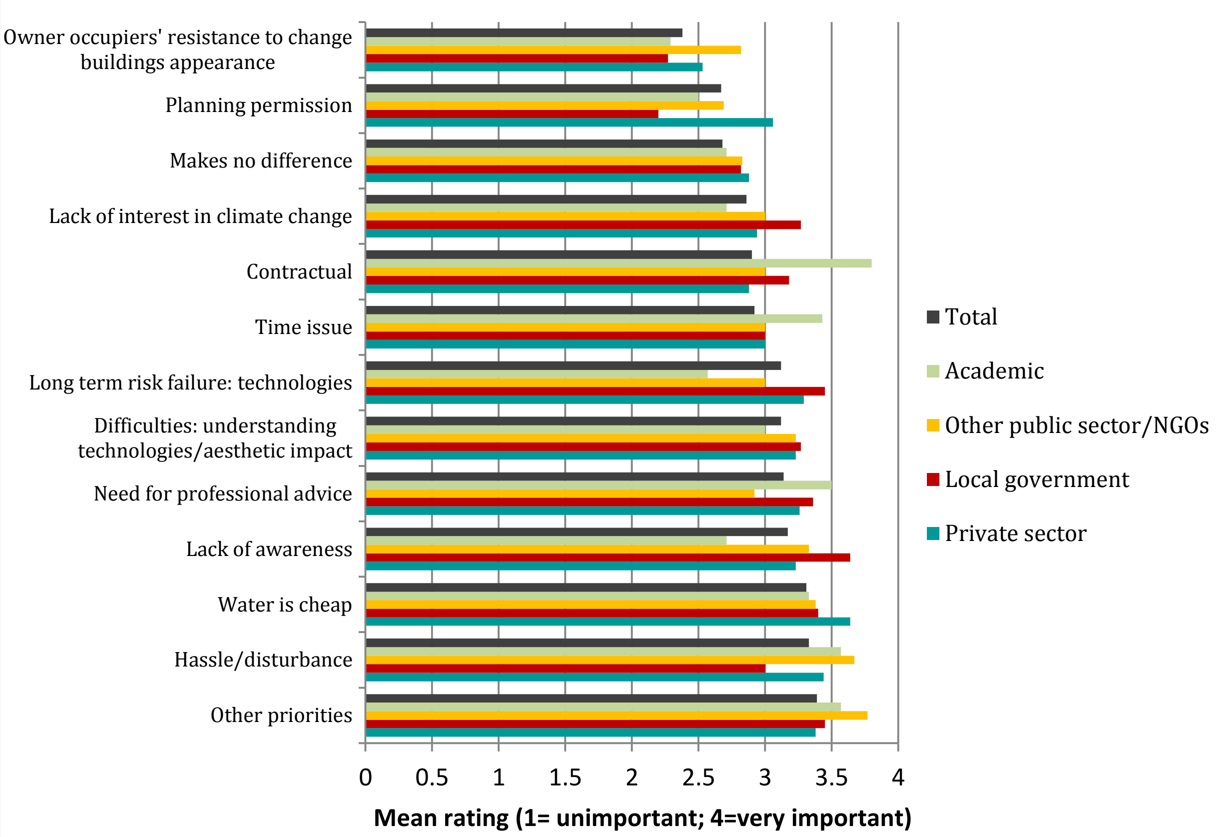
When ranking a given set of key barriers to rolling out the retrofit agenda respondents selected '**other priorities'** as the most important barrier, followed by '**hassle and disturbance'** as a key issue for occupiers. This reflects the fact that the retrofitting agenda is still not a high priority in many sectors, and that the inconvenience and disturbance of retrofitting properties for owner occupiers or occupiers is still perceived as a key barrier. Retrofitting for new water infrastructure is clearly also seen as not being cost-effective because of the low costs of water. Technological factors were seen as relatively less important[2]. Figure 3 suggests that local government representatives still consider lack of awareness as an important barrier to retrofitting and the academic group of respondents considered 'contractual procedures' and 'time' as being important barriers.

Additional barriers suggested by respondents:

- *'Problem of the lack of incentives for tenants to adopt efficient systems and methods' (private sector)*
- *'Balancing costs/benefits between landlord and tenant' (NGO)*
- *'There are no retrofit standards' (NGO)*
- *'Retrofits generally occur as a function of necessity e.g. boiler breaks down' (academic sector)*

[2] These findings tend to confirm recent research, based on a survey of commercial developers, by Skanska (2011) which found that there are key retrofit challenges still to be overcome. 71 per cent said projects are hard to get right because an integrated and planned approach is needed from the outset, while 61 per cent said the planning system needed to be changed to make the most of green technologies (source: http://www.building4change.com/page.jsp?id=692). In the OISD online survey, planning was relatively less important although the private sector considered it to be relatively more important than other groups.

Figure 3: Barriers to rolling out the retrofit agenda in the private sector



5. Key triggers to rolling out the retrofit agenda

Key finding: Financial factors are currently driving the retrofit agenda

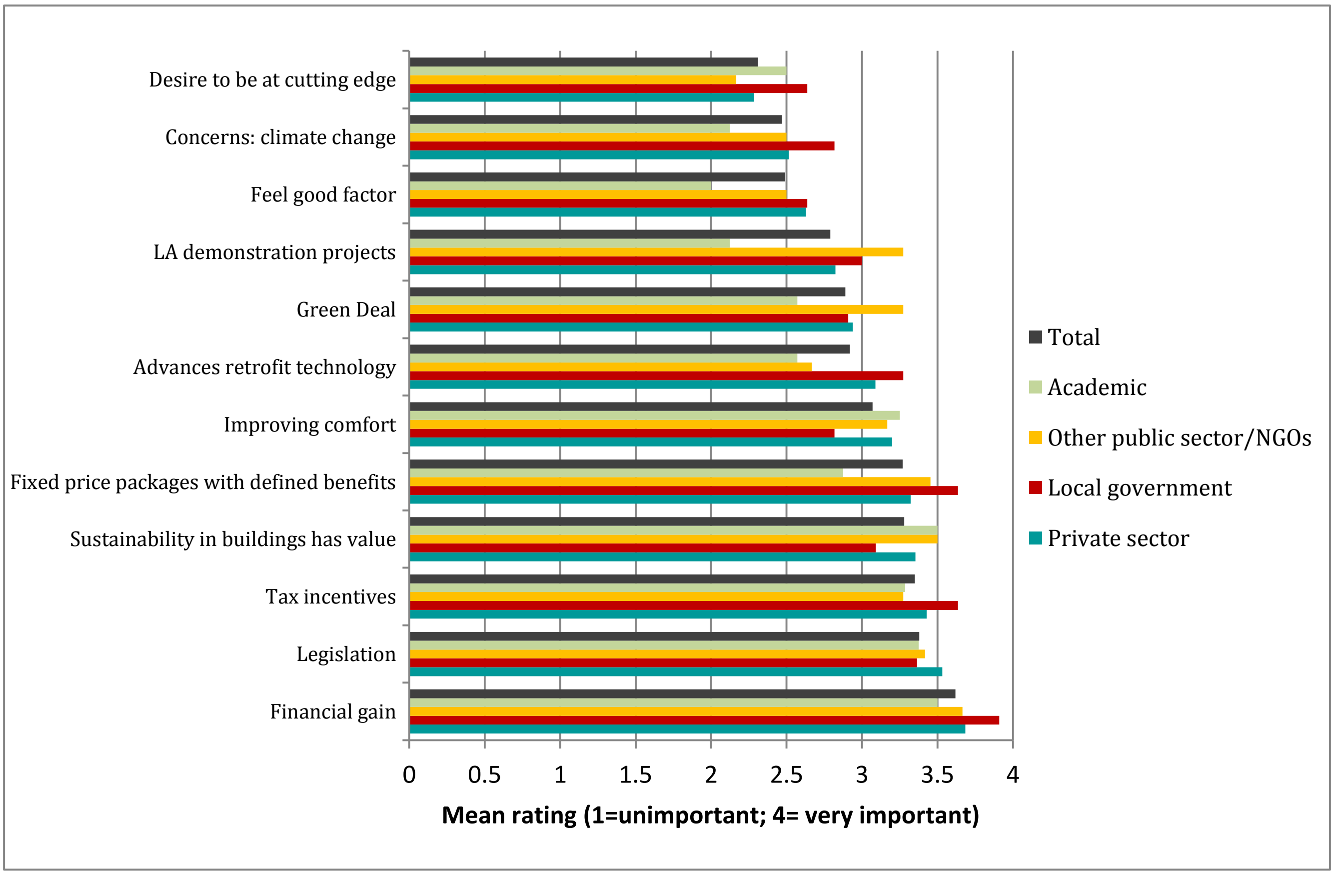
The majority of respondents considered the key trigger to advance the retrofit agenda would be in achieving **financial gain** from undertaking retrofit measures. This was followed closely by the belief that both **legislation and tax incentives** would make a difference to take up e.g. increased importance given to EPCs and more widespread council tax rebates. Again the relationship between a building's value and its sustainability was seen as a major driver. Behavioural factors and concerns about climate change were rated as less important (Figure 4). The Green Deal is seen as relatively less important currently, although public sector respondents perceived this factor as more important than other groups[3].

[3] In a related survey of the top 60 UK cities (local authority respondents), OISD found that a large majority (68%) of respondents felt the Green Deal would have a positive impact on the low carbon agenda. No respondents felt it would have a negative impact. However, there was uncertainty expressed over the impact of the Green Deal, although the potential benefits for retrofit programmes were recognised. The full results of this work, which is funded by RICS, and which analyses UK cities' strategies and plans to progress to a low carbon future, will be published in Spring 2012.

Other comments from respondents:

- *'Payback times are an issue' (private sector)*
- *'Better general publicity of demonstration projects' (academic)*
- *'The marketing of retrofit technologies such that they are intertwined with the tri-play that communication companies offer - this is a huge market yet to be explored by the big-6 and retailers alike' (academic)*
- *'Energy providers are a key trigger in my opinion' (academic)*
- *'Investment in setting up and maintaining green community groups (academic)*

Figure 4: Key triggers to rolling out the retrofit agenda in the private sector



6. Key ENERGY TECHNOLOGIES which will be viable for retrofitting cities up to 2050 at building, neighbourhood and city regional scale.

Table 1 summarises the key findings on technologies relating to the **building fabric** and Table 2 gives a more detailed account of individual responses. Not all respondents focused on technologies and some responses covered policy and management issues therefore we have widened our scope to include these responses in the results.

Table 1: Key findings

Building Fabric	
Building Scale	Focus on materials, especially thinner high performance insulation
Neighbourhood Scale	Focus on improved planning of buildings and detailing
City Regional Scale	Improved regulation to make changes and green infrastructure to regulate temperatures

Table 2: BUILDING FABRIC: Energy technologies, policies viable for retrofitting up to 2050 across spatial scales.

Building Fabric	Building Scale	Neighbourhood Scale	City Regional Scale
Operational energy reduction	Improved insulation especially thinner high performance products	Improved thermal insulation and detailing of external walls and terraces. External cladding of whole blocks of housing even if dwellings are mixed tenure.	Regulation and policy to encourage update and change in materials used. Improved insulation
	Green roofs and walls to maintain ambient temperatures	Improved green infrastructure, natural shading	Increased use of green infrastructure to regulate the temperature of cities
	High performance windows, controllable optical films. Shading systems		
	Controllable optical films for windows		
Construction and delivery energy use	Low embodied energy materials		
Design	Modular construction reducing waste and improving efficiencies	Building layouts that minimise energy demand. Location consideration e.g. windows exposed to winds	
Storage	Phase change materials	Heat capture and storage materials	

Building Services:

Table 3 summarises the key findings on technologies relating to the **building services** and Table 4 gives a more detailed account of individual responses.

Table 3: Key findings

Building Services	
Building Scale	PVs
Neighbourhood Scale	Responses shift to a longer term perspective focusing on community district heating with various options for powering including waste and microgeneration
City Regional Scale	Large scale waste to energy heat and steam systems, CHP ,PVS and LED lighting in buildings and streets

Table 4: BUILDING SERVICES: Energy technologies, policies viable for retrofitting up to 2050 across spatial scales.

Building services	**Building Scale**	**Neighbourhood Scale**	**City Regional Scale**
Production	PVs	Enhanced use of roofs for solar thermal and PV	PVs, large scale solar farms and wind turbines
	Ground source heat pumps	Community Heat Schemes powered by pelletised refuse, (AD) Anaerobic Digestion or microgeneration and CHP. Energy networks linked to hydrogen storage	Large scale waste to energy heat and steam systems. Wide scale district heating schemes and CHP.
Design and management	Greater efficiency of plant/equipment, better systems and controls(more intuitive)	Trusted, inexpensive monitoring and management technologies	Smart grid technology
	Solar thermal		
Demand reduction	LED lighting		LED lighting in buildings and streets
Management	Smart meters		
	Micro CHP		
Policy		Partnerships between utility companies/local communities/individuals	Policy and regulation to encourage uptake of district heating

7. Key WATER TECHNOLOGIES which will be viable for retrofitting cities up to 2050 at building, neighbourhood and city regional scale.

Table 5: Key findings

Water	
Building Scale	Low water demand fixtures, fittings and appliances as standard
Neighbourhood Scale	SUDS, rainwater harvesting and grey water harvesting
City Regional Scale	SUDS, rainwater harvesting and grey water harvesting

Table 6: WATER: Energy technologies, policies viable for retrofitting up to 2050 across spatial scales.

Water	Building Scale	Neighbourhood Scale	City Regional Scale
	Low water demand fixtures, fittings and appliances as standard	SUDS	SUDS
	Rain water harvesting and storage	Large scale rainwater harvesting	Rain water harvesting
	Non water appliances for washing clothes, dishes, and waterless urinals	Grey water harvesting	Grey water harvesting
	Water meters Efficient plant coupled with smart metering		Greater use of water leak detection technologies by utility companies. Water meters
	Green roofs	Green roofs	
	Recycling systems within buildings	Black water treatment	Water resource management planning
Water to energy		Micro hydro	Waste water to heat
		Using water bodies as a heat source or sink	Harness kinetic energy from mains/sewer water movement
Policy	Grant initiatives for uptake of domestic and grey water harvesting		Legislation and incentives for water reduction

8. Key WASTE TECHNOLOGIES which will be viable for retrofitting cities up to 2050 at building, neighbourhood and city regional scale.

Table 7: Key findings

Waste	
Building Scale	Interest in improving the storage space for waste within buildings. Also increasing the collection of food waste, incentivising home composting, and enhanced recycling to reduce waste going through waste stream.
Neighbourhood Scale	Energy from waste; in particular, anaerobic digestion. Still a focus on neighbourhood composting, neighbourhood waste to cash schemes, and improved recycling
City Regional Scale	Energy from waste into district heating and national grid. Anaerobic digestion/biomass gasification/advanced thermal conversion

Table 8: WASTE: Energy technologies, policies for retrofitting up to 2050 across spatial scales.

Waste	Building Scale	Neighbourhood Scale	City Regional Scale
Building Design	Improved storage for kitchen/organic waste (building design retrofit)	Improved storage to segregate waste without hassle. Automated pneumatic waste collection	
Energy production	Anaerobic digestion. Home compost to generate micro energy.	Energy from waste. Anaerobic digestion	Energy from waste into district heating and national grid. Anaerobic digestion/biomass gasification/advanced thermal conversion
Policy and Management	Food waste collection and composting systems.	Neighbourhood composting collections/initiatives	
	Recycling equipment for all waste streams, plastics, packaging and batteries	More recycling facilities	Greater recycling of commercial and industrial waste.
	Easier and improved recycling schemes		
	Additional legislation to increase recycling uptake	'Waste metering' especially for companies in order to highlight amount of waste thrown away	Recycled Polyethylene terephthalate (PET) bottle textile plants in every city region
Incentives	Incentives for home composting.	Revenue generated from recycled neighbourhood waste reinvested into communities	
Resource efficiency			Reduction of consumer/retail waste generation, simplified packaging options for closed loop recycling.
			New advancements in recycling electronic waste (and designing greener electronics) to be more sustainable

9. Main Infrastructure and Technology differences between UK cities in 2050 compared with today

Responses to the differences between today and 2050 were focused predominately around energy supply (Table 9). Responses in this group varied between, on the one hand a total reliance on electricity as the primary distribution, and on the other, electricity as a limited national resource. There was agreement that there would be a reduced dependancy on natural gas and suggestions that this may be replaced by synthetic gas.

Table 9: Key findings: Infrastructure and technology differences between now and 2050.

		Responses	
Social		Emerging technologies will be seen as essential for homeowners, cheap and effective.	
Technological	Energy Supply		Alternative perspective
		PV, Wind and Hydrogen(rather than natural gas)	
		Reliance on electricity as primary distribution.	Limited national electricity resource – possible use of synthetic gas.
		Reduced dependency on gas	Limited or no gas/oil
		Gas grid will be fed by renewable gas from a variety of sources	
		Waste to energy centres	
	Scale	Decentralised power generation and an increase in micro energy	
		Decentralised treatment/recycling of water and waste	
	Energy networks	District Heating	
	Design	Complete carbon zero development	
		Easier to use technologies	
		PV panels integrated into variety of surfaces	
	Management and Monitoring	Finely tuned grid monitoring and management	
		Monitoring and tracking of material and waste	
Transport		More electric and LPG vehicles	
		Energy neutral travel	
		Efficient and cheap public transport	
		Improved pedestrian and cycle routes	
Green Infrastructure	Greening Cities	Greened urban areas, green roofs, walls, food production, SUDs.	
Co-ordination		Integrated approach to infrastructure management	
Information and Communications Technology		Networks, Human Area Networking (HAN) and Wide Area Networking (WAN). Smart grids and networks interacting to drive out greater efficiencies.	
		Building Management Systems (BMS) to manage micro-areas rather than whole building systems	
Economics	Procurement	All aspects of waste and recovery utilised on an energy rather than cost basis	

10. Additional comments about retrofitting cities to 2050 and the scale and challenge of technological change required?

When asked to add in any other comments respondents focused less on technological factors and more on the need for better co-ordination, governance and greater community involvement (Table 10). This links in with the findings in section 5 on the key barriers to retrofit, where tackling strategic and process-based factors were found to be more important than technological factors.

Table 10: Additional comments about the scale and challenge of technological change required.

Co-ordination/governance	*More focus on a joined up approach*
	Transition and governance are key factors
	Policy makers need to look beyond elected terms
	With enough funding, strong legislation and political will we could do this tomorrow.
	Building authorities and industry slow to develop legal and economic framework for technologies
	Finding the "right"/ best/most economic balance between individual, local and city-wide solutions is a major challenge.
Community Involvement	*Community involvement brings greater resilience*
	Community action can break resistance to new technologies and facilitate wider uptake
Economics/markets	*It's less about technology and more about aligning policy and market to deliver.*
Technology	*Change could be made by using existing technology more effectively*
Organisational/Management	*Logistics is key. Where do people go during the works, how many vehicle movements to retrofit a street?*
Design	*Making retrofit a desirable place to be, this includes transport and the public realm*
	Flexibility and resilience in the design of infrastructure of cities to allow change
User behaviour	*This is a key driver and has to change*
Costs/payback	*Persuading people that costs of PV's, LED's will fall as with computers, phones.*
	Not currently sustainable – cost versus benefit
	Costs are high and hard to address

11. 'Driving forces' for the future – respondents asked to rate predetermined examples

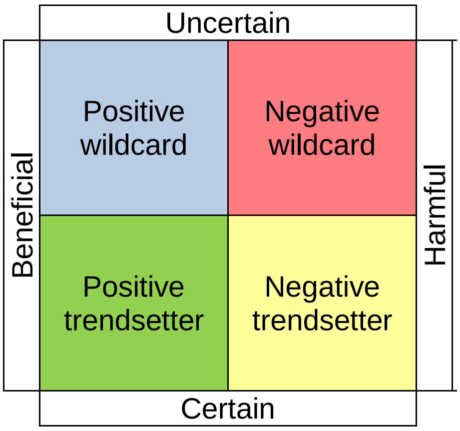
Key finding: Energy and water prices are no longer seen as uncertain because there is an acceptance that the costs will rise.

Respondents were given pre-determined examples of driving forces that could influence the success or failure of taking up the challenge to retrofit in the future to 2050. These driving forces were defined as the external factors that could influence change in the local environment e.g. energy prices, global agreements on cuts in GHG emissions, or changed values/behaviours that support climate change and carbon reduction.

Respondents were asked to rate these forces in terms of the degree of impact on a scale of -2 to +2 (where -2 is harmful, 0 is neutral, and +2 is beneficial) and degree of uncertainty (where -2 is very uncertain, 0 is neutral and +2 is very certain).

The responses were placed into four main impact and uncertainty groupings. These groupings were based on the scenario planning work by Ratcliffe and McIntosh (2001)[4] .

Figure 5: Groupings adapted from Ratcliffe and Mcintosh[1]



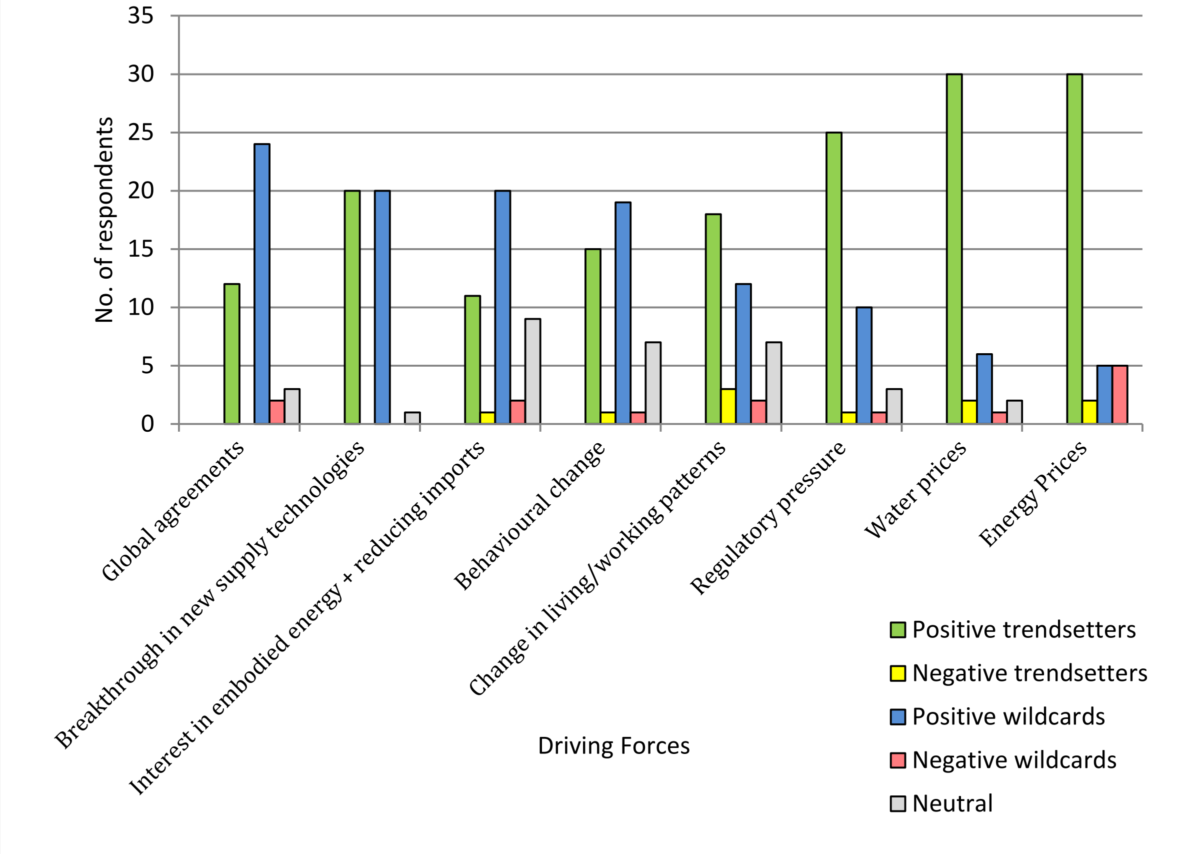
Positive trendsetters (Low uncertainty and beneficial impact)
Negative trendsetters (Low uncertainty and harmful impact)
Positive wildcards (High uncertainty and beneficial impact)
Negative wildcards (High uncertainty and harmful impact)

Positive wildcards and positive trendsetters dominate in the responses, indicating that the pre-determined examples were seen by respondents as predominantly 'beneficial' in terms of impact on the path to a low carbon future (see Figure 6). In terms of uncertainty the results are interesting in that energy and water prices are not seen as 'uncertain' drivers; rather, they could be considered as being important in shaping the future, but no longer 'unpredictable'. In other words, the relative certainty of increasing water and energy prices could help move us to a low carbon future[5]. Whereas respondents believed that global agreements on cuts in GHG emissions, breakthroughs in new supply technologies and behavioural change were forces/drivers in the future that were still surrounded by a high degree of uncertainty.

[4] Ratcliffe, J. and McIntosh, A (2001) *Global Real Estate Scenarios*, Futures Academy for King Sturge

[5] This view is not seen as being in contradiction of respondents views on water prices in Section 4. Water costs may not be a barrier now but if we look to 2050, respondents were suggesting water cost will inevitably rise.

Figure 6: Driving forces: Number of ratings grouped by impact and uncertainty



12. Driving forces for the future – examples given by respondents.

Following the rating of the predetermined examples respondents were asked to provide their own examples of driving forces that might influence change in the local environment. Respondents submitted over 110 potential driving forces. The responses were assigned to one of five (social, technological, economic, environmental and infrastructure, political) categories, clustered into related themes, and then placed into one of the four impact and uncertainty groupings as identified in Section 12, Figure 5.

Table 11 gives a summary of the findings showing groupings with ≥ 2 responses. Behaviours and attitudes, as a driving force for the future, dominated the responses in the social category, and this was closely followed by legislation and standards, under the heading of political. The majority of these respondents considered that a shift in current social norms was fairly certain and the introduction of additional legislation to drive retrofit could be expected.

Respondents considered improvements in efficiencies of technologies and availability of simpler technological solutions to be more certain but the delivery and availability of new technologies could not be guaranteed. Higher taxation on carbon use could not be assured although it was considered beneficial.

Peak oil was seen as a certainty but the impacts of climate change were believed to be a negative wildcard, both harmful and uncertain.

Table 11: Summary of 'key driving forces' from respondents

	Key driving forces		Number of responses: Positive trend setters	Negative trend setters	Positive wildcards	Negative wildcards
		Uncertainty	Low	Low	High	High
		Impact	Beneficial	Harmful	Beneficial	Harmful
Social						
Social	Behaviour/attitudes/values		7		4	
Social	Population growth			2		
Technological	Improved efficiency and reliability of technologies		2			
Technological	Availability of simper technological solutions		2			
Technological	Local energy generation and designs reflecting locality		2			
Technological	Development/availability of new technologies				2	
Economic	Localism: use of local labour/materials/food		4			
Economic	Higher cost of energy		3	2		
Economic	Investment funding for energy efficiency		3			
Economic	Shifts in economic power markets		2			
Env.	Peak oil		2			
Env.	Climate change impacts					2
Political	Legislation and standards		6		3	
Political	Financial incentives		5		2	
Political	Carbon tax/trading				4	
Political	Political will				3	
Political	Demonstration projects		2			
Political	Education/skills training		2			
Political	Awareness campaigns/greater understanding of technologies				2	