Retrofit 2050: Critical Challenges for Urban Transitions

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Scaling up retrofit presents a number of critical challenges for the transition to urban sustainability. Drawing together insights from the EPSRC Retrofit 2050 project this briefing sets out key success factors that need to be in place to deliver sustainable futures for UK cities.

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Introduction

In recent years, the need to re-engineer existing buildings and urban infrastructure has gained increasing prominence. Although cities are seen as the source of many of our most pressing environmental and resource depletion problems, the creativity and innovative potential of cities may also provide their solutions. Moreover, in the UK, as with many parts of Europe and the US, the critical challenge is not so much how to build new smart cities or eco-towns, but how best to deal with our ageing building stock and urban infrastructure. In the UK, for example, the built environment is currently responsible for over two thirds of our total carbon emissions, less than 1-2% of total building stock each year is new build, and some 70% of total 2010 building stock will still be in use in 2050.

Indeed there is now widespread agreement over the need for significant reductions in the energy we consume in our major towns and cities if we are collectively to have any chance of meeting the Climate Change Act 2008 and its related 80% emissions reduction target for 2050.

From a technical perspective at least there is an increasing understanding of what technological changes could deliver in terms of radically reducing carbon emissions from both our existing stock of domestic and commercial buildings and the broader urban infrastructures of which our cities are composed, and at what cost. Moreover, the potential economic, societal and health benefits of these energy efficiency and carbon reduction measures are attractive and well understood. National and local government and commercial and civil society organisations alike all highlight the contribution which urban retrofit programmes can make to job creation, quality of life, fuel poverty and energy security, etc.

Despite this apparent consensus about 'why' government should prioritise policy frameworks to accelerate urban retrofit and a developing knowledge base about 'what' needs to be done in particular cities and communities, the critical question remains '***how' do we collectively organise urban retrofit activities at scale to deliver significant environmental, social and economic benefits?***

Indeed this problem has only become more pressing in light of the difficulties experienced in implementing the government's Green Deal and ECO schemes.

Over the last three and a half years the Retrofit 2050 project has therefore sought to address this question through processes of comparative case study analysis; reviews of potentially disruptive technology and policy innovation; national and regional back-casting workshops; and modelling of the built environment across multiple scales.

Our research reveals both multiple and competing long-term visions of what a sustainable 'retrofit' city should look like and quite radically differing framings of the urban retrofit agenda amongst many of the current actors involved. That is, if we understand the problem in terms of a longer-term process of transition to urban sustainability, there is currently little consensus about either where we should be heading or how we should get there.

But scaling up urban retrofit activities implies a coordinated and strategic approach, reconciling multiple stakeholders and social interests (e.g. policy-makers, owners, occupiers, developers, financiers, contractors and utilities), where the aim must be to foster new forms of governance, which move beyond short-term policy and political cycles, capable of delivering systemic change over the next 10 – 20 years and beyond to 2050.

Critical factors for successful transition

An understanding of the critical challenges in scaling up urban retrofit suggests that cities will need to ensure the following eight elements are in place in order to deliver sustainable futures for UK cities.

1. An inclusive urban retrofit agenda

Extensive in-depth interviews with a broad range of actors (local government officers, civil servants, private sector companies, community groups and charities) currently engaged in retrofit activities in different parts of the UK (Cardiff, Manchester, London and other core cities) reveal quite different motivations and framings of the retrofit agenda in different governance contexts and amongst different social interests.

So for example the dominant national (UK) policy framing, as exemplified by the Green Deal, views retrofit in primarily economic terms as a process of market making, addressing the market failures which inhibit households and businesses from investing in otherwise cost effective energy efficiency measures.

At a city-regional scale we can characterise the translation of this top-down ***economic framing*** as one of ***retrofitting on Greater Manchester***, where regional political and business interests have sought to achieve 'first mover' advantage and position Greater Manchester as a leader in an emerging UK retrofit market. Hence, the development of a retrofit agenda is seen as a way to attract private investment to the city-region.

By contrast in the ***Cardiff/SE Wales*** city region a ***social rationale*** for retrofit plays a much more pronounced role, with the Welsh Government's (WG) framing of retrofit as a delivery mechanism for implementing its over-arching commitment to sustainable development. Here the WG's retrofit agenda is enacted in partnership ***with the city,*** local authorities, social housing providers and wider social interests through an emerging process within the city-region that ranges from planned and responsive maintenance programmes to targeted energy efficiency improvements and major refurbishment programmes. It focuses on area-based solutions that seek to regenerate deprived areas, reduce fuel poverty and establish a demand for greener technologies that will create local jobs.

What does 'Retrofit' mean?

To retrofit literally implies providing something with a component or feature not fitted during manufacture or adding something that it did not have when first constructed. The term has been used in the built environment to describe substantial physical changes at building level and has often been used interchangeably with terms such as 'refurbishment', 'conversion' or 'refit'. But at an urban or city scale retrofit means something much larger and more comprehensive, more integrated; underpinned by sustainable financing and with a clearly defined set of goals and metrics. The Retrofit 2050 project therefore defines *sustainable urban retrofitting as the directed alteration of the fabric, form or systems that comprise the built environment to improve energy, water and waste efficiencies*.

Finally, in our case studies in Manchester and other core UK cities (e.g. Bristol, Birmingham, etc) we find a diverse range of bottom-up initiatives where retrofitting is grounded ***in the city***. Whilst often seeking to access resources from the dominate policy frameworks, these grass-roots initiatives construct contextually rich retrofit rationales interweaving individual motivations and beliefs around the environment and quality of life and particular constructions of local community interest.

Moreover, looking beyond each of these - ***economic, social and contextual*** – rationalities, we must also consider how retrofit is constructed and embedded within the routines of everyday life and the ways in which specific moments (e.g. having children, moving house, building an extension, fitting a new kitchen or bathroom, etc.) produce a new context for considering retrofit activities.

An inclusive urban retrofit agenda must seek to reflexively reconcile each of these competing framings through consultation, experimentation and consensus building to find solutions which work in specific local contexts.

2. Compelling retrofit city visions

Visions of the city – both utopic and dystopic in nature – have long played a central role in the development of our urban civilisation. Many utopic city futures often envisage the creation of an ideal city from the ground up and tell us little about how to remake our existing cities.

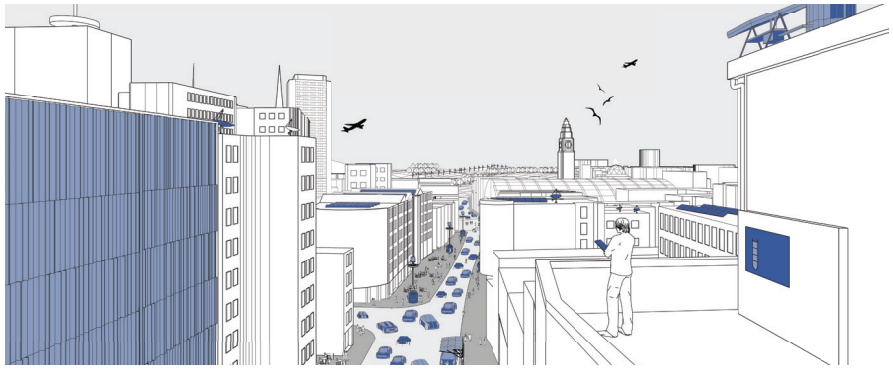
Now more than ever, however, our cities need to envision and strive for a more sustainable future. Such visions help people to make sense of the future, and determine what sort of future we want. They promote discussion and debate and allow us to see how we can mobilise, deploy, and manage resources to achieve a desired future.

The Retrofit 2050 research has shown how we can imagine a range of distinctive retrofit city futures: a 'compact city' of intensive and efficient urban living; a 'smart city' hub within a highly networked, competitive society; or a 'self-reliant' green city in harmony with nature, with each of these visions having different implications for people, technology, and governance structures (see Retrofit 2050 City Futures, page 4).

The important point here is that the Retrofit 2050 futures are not intended as self-contained predictions. Rather, they draw attention to the competing pressures and dynamics capable of shaping the evolution of cities. For example, much of the change in the self-reliant green city is predicated on significant change in the way social values and institutions operate; much of the smart-networked city vision is concerned with overlaying new technologies onto existing infrastructures.

Of course, every city is to some extent unique. When considering the future of real cities we need to consider not just their natural and built environments, but also their particular economic, social, political and demographic structures. It is also necessary to recognise the diversity of values and interests that will shape different expectations of the future within any individual city. The Retrofit 2050 futures are therefore intended as a 'jumping off point', providing a tools to understand how such visions "touch down" in particular places and specific regional contexts: each with their own particular environments, infrastructure, demographic, socio-economic and governance structures (See Cardiff City Regional Futures, page 5).

Retrofit 2050 City Futures



Smart-Networked City:

A hub within a highly mobile and competitive globally networked society

Pervasive, information-rich virtual environments integrate seamlessly with the physical world. ICTs provide real time information to drive efficiencies through automation and intelligent control, and advanced market oriented solutions allow for the internalisation of environment costs. This is an open, outward looking society in which the mobility of people, goods and services remains high.

Compact City:

A site of intensive and efficient urban living

Urban land-use, buildings, services and infrastructure provision are optimised in order to create dense urban settlement forms that encourage reduced demand and more efficient use of energy and resources. Concentration in urban centres reduces pressures on the periphery. Significant efficiencies are obtained through systems integration and re-design.

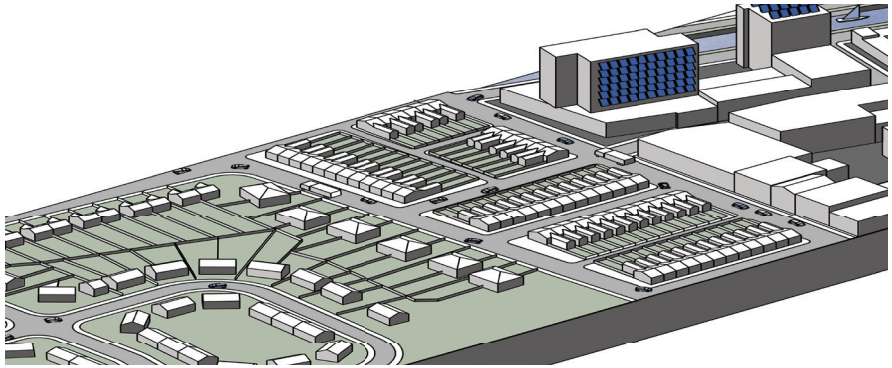
Self Reliant-Green City:

A self-reliant bio-region, living in harmony with nature

A self-replenishing, largely self-reliant system of circular metabolism, where resources are local, demand is constrained and the inputs and outputs of the city are connected (cradle to cradle). In many ways this is an inward facing society, but one conscious of its global responsibility to 'live within its limits'.

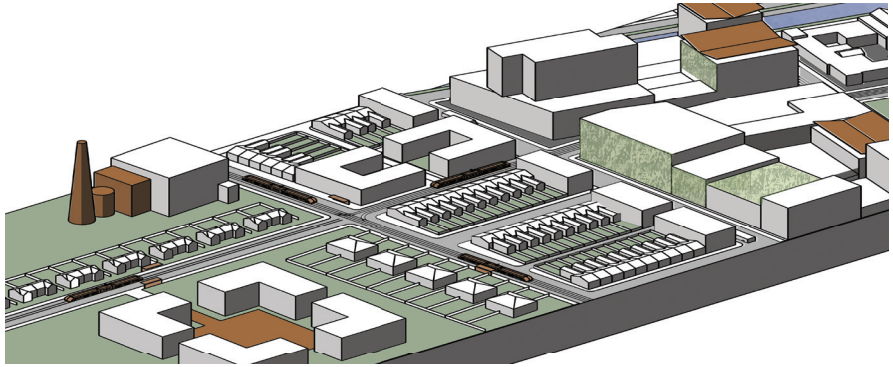
Source: Eames *at al*. 2013, Retrofit City Futures, Cardiff University

Cardiff City-Regional Futures



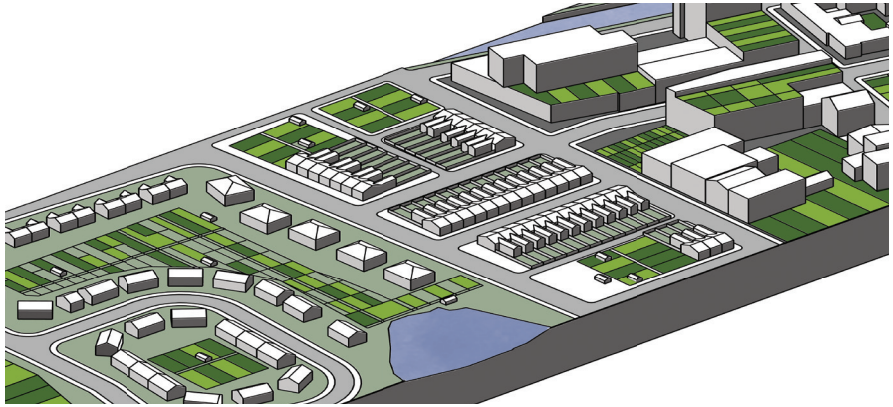
Connected Cardiff

A city-region with a vibrant economy focused on green technological solutions. Investment in the 2010s and 2020s created stronger collaboration between the knowledge sector and commerce to create business clusters that are internationally competitive. Efficiency is a key policy goal, with all utilities overseen by a single body to consider resource management issues in the face of scarcity. Economic growth has underpinned investment in high quality housing, environments and social care services.



Compact Cardiff – Wilderness Valleys

A high density city-region made up of medium rise buildings based around boulevards and parks, with previously underused spaces now more densely populated. Distinctive 'villages' within the city ensure a culturally rich region, connected by electrified rail and shared electric cars, while the rural hinterland is returned to wilderness and used for food and biomass crops. Extensive investment in the 20s, 30s and 40s included rebuilding of urban centres to mixed use development and energy, water and waste networks fit for a compact city.



Orchard Cardiff City-Region

Sustainability is at the heart of every policy decision made in the city-region, with far greater dialogue between decision makers and communities. Planning decisions are much more connected to the needs of communities; academic research is focussed on useful, practical knowledge. Half of all food eaten is produced within the city-region, with arable land in public spaces offering high employment, and hydroponics towers visible across the city. Priority is given to local energy production produced by community schemes, delivered through efficient networks.

3. Improved modelling and decision support tools

Retrofitting our current building stock and urban infrastructure is a vital part of meeting emissions reduction targets, using energy and resources in a more efficient way and creating sustainable lifestyles. However, one of the key barriers identified is a lack of appropriate modelling and decision support tools to aid long-term planning for sustainable urban retrofitting. In this respect the complexity of the built environment in cities represents a significant challenge. In recent years significant advances in 'top-down' and 'bottom-up' models have allowed the development of increasingly sophisticated simulation tools for use at building and urban scales. However, such static models can by themselves tell us relatively little about the dynamics of urban retrofit transitions.

Models and tools that engage with users and allow them to explore the potential retrofit futures are essential to expand our understanding of the potential emission reductions. Many current models constrain the users to the 'standard' scenarios for future energy usage, where land use change is limited to new build, growth is the only model and societal change is limited to population increase. These restrictions, whilst praiseworthy, fundamentally limit the 'thinking space' for the user. Approaches based on group modelling and systems dynamics techniques engage with users early enough in the tool development to allow the resulting tools and data collection requirements to cover the scope of the potential visions of 2050.

Modelling techniques are only as good as the data that is input into them, the more detailed the model the more data is required. With the emergence of data rich cities the process is now turning from data scarcity to data overload. The models developed by the team will benefit from the increased data produced by the urban environment, and also due to the inclusive user nature of their creation, allow the data to be focussed for efficient use. The creation of data sets such as the Energy Performance Certificate register have allowed the exploration of retrofit practices in conjunction with the raw data required to simulate the urban built environment at a greater detail than ever before.

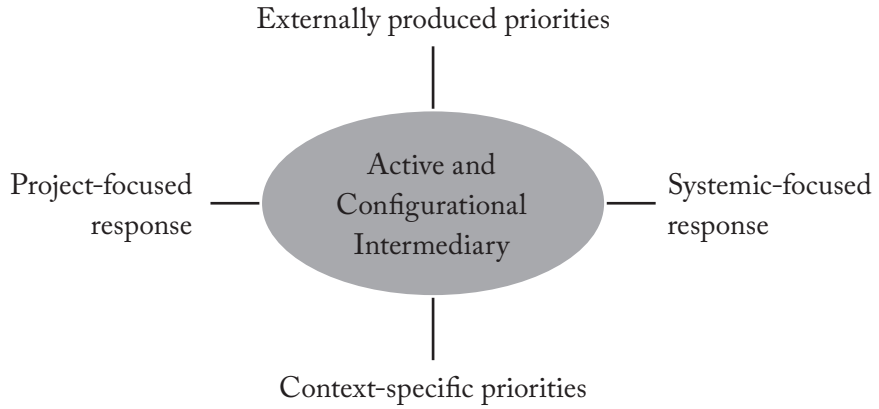
4. Institutional capacity, planning and governance

There has frequently been a failure to develop city scale governance and planning systems that are adaptive and flexible enough to cope with disruptions and uncertainty over what is a relatively long time scale, to 2050. Often beset by expediency issues, these systems have failed to address longer term systemic problems and there is often a disconnection between relatively short term planning horizons and longer term environmental ambitions and targets. For example, climate change action at an urban level happens through a combination of local regulations, urban services, programme administration, city purchasing, property management and consultation and dialogue with local stakeholders. Change may also be relatively easier to instil where the public sector plays an important role in a city. Urban policies also require better 'joining up': for example, spatial planning policies that promote higher densities and better mixing of uses can help create more sustainable transport options.

Often, integrated thinking across built environment professions has not occurred. This is important to recognise operationally at a building project level, and through individual and group actions also plays out at city level. There is a tendency to approach issues with a silo mentality, with planners, designers and architects taking different views of how to achieve the end result. Frequently projects are fast tracked and the true virtues of sustainability are missed. Moreover, in design terms, the details of sustainability are lost

on senior decision-makers through lack of clarity. Finally, there is too much focus on capital costs instead of whole life costs, and knowledge transfer and best practice are neglected. However, the built environment offers high level opportunities for market growth and jobs creation, as adaptation requirements drive change. These opportunities, which are largely based around retrofitting and new buildings, are expected to feed through in the short term and beyond. In the US alone it is estimated that large-scale retrofitting could yield US$1 trillion of energy savings and create 3.3 million new 'job years'[1]. The commercial property retrofit regime is a case in point. Here, fragmentation, complexity and conservatism in decision-making work against scaled up retrofit responses, for example. This may also mean that stronger, mandatory polices are needed nationally to help underpin retrofit, such as in the case of commercial property, mandatory Display Energy Certificates.

Figure 1. Active and configurational intermediary



1 One job year is one job for one year.

There are also substantial challenges around mobilising large scale urban retrofit actions because a low carbon urban future requires a long-term, systemic response, tying this into economic growth (or 'boosterism'), and creating an integrated set of social and community responses. These activities encompass a range of city-regional actors, multiple issues, scales and associated factors. Therefore an 'aggregating body' (or active and configurational intermediary), which brings together other key stakeholders and institutions for the purpose of scaling up retrofit responses, would act as a focal point for integrating priorities and responses at city level (figure 1).

5. Access to 'green' finance

Achieving viable city scale retrofit programmes will be challenging. Cities could, over a longer timescale, develop a combination of fiscal instruments and incentives together with financing mechanisms to achieve sustainability goals, but there are a number of challenges to implementing policy at city level and above. For example, building performance standards vary internationally and there is often a 'disconnect' between owners and operators in buildings. Moreover, existing buildings tend not to capture the imagination in the same way as new ones, and organisations often do not set ambitious targets for refurbishments because they do not recognise that inspired or innovative solutions are required. In commercial property, for example, energy retrofit projects may be competing for capital with other corporate projects which have a higher priority. In the UK, the Green Investment Bank (GIB) has been established (www.greeninvestmentbank.com); and in the same way that the German bank KfW has established a strong track record in financing retrofitting at scale, there is surely a greater upfront role for the GIB to help on a city scale in the UK by catalysing low-carbon investment and creating green jobs.

6. Effective partnerships

Well-constructed public and private partnerships (PPPs) can potentially offer better value for money than traditional procurement methods and can enable risk sharing at a time when public purses are constrained. At a building level, there is still a lack of research to prove that green buildings are worth more in the market than conventional buildings. However, there is emerging evidence that in some sectors, there may be a 'green' (or energy rating) premium. Establishing the business case is fundamental to getting the private sector to respond to the needs and requirements of retrofitting cities, but the presence of public sector actors is crucial to success within a framework of regime change that requires new polices and new instruments. Cities have a role to play in this through the jobs/green growth agenda. For example, New York's Greener Cities, Greater Buildings Plan is expected to create 17,800 construction-related jobs and in Freiberg, Germany, the city's old and historic buildings are being retrofitted in an ambitious plan. Finally, retrofitting or re-engineering cities should recognise that within cities, land and property ownership patterns are key to understanding how future trajectories of change will play out. This is not only because the size and configuration of land holdings affects urban morphology through new development, regeneration and refurbishment of existing land and property, but also because historically, the timing of land sales affects the nature and shape of urban development by reflecting contemporaneous architectural and planning styles.

7. Long term sharing of risks and benefits

The current dominant economic institutional and policy framings of retrofit (as with the Green Deal 'golden rule') focus on creating and internalising private value from commercially 'cost effective' measures. However, such business models inevitably focus on the 'low hanging fruit'. This is a particular issue in commercial property retrofit where payback requirements and lease length often act to disincentivise innovations in technology deployment. Retrofit for deep decarbonisation will require business models which provide for long-term sharing of risks and collective benefits, in order to recycle savings for socially necessary investments.

8. A whole systems perspective

In the shorter term much debate tends to focus on programmes for scaling up the retrofitting of individual domestic or commercial buildings. However, there are some encouraging signs that more systemic perspectives are beginning to gain purchase in relation to urban and city scale energy/heat, waste, water, transport and data systems.

In the UK there is much we can learn from international experience, particularly where the challenges to deployment of sustainable infrastructural systems are principally institutional and financial rather than technological, such is the case with urban heat networks.

The development of 'sticky' infrastructure, such as heat networks, also potentially has a key role to play in binding large commercial property interests, with their geographically diverse portfolios, more closely into individual city retrofit agendas. This can help overcome some of the problems of (i) complexity and (ii) conservatism in decision-making in the commercial sector.

In the medium to longer-term it is clear that such systems level innovation holds the potential for deep cuts in carbon emissions and radical improvements in the broader sustainability and quality of city living.

Summary: An integrated approach

Critics of the triple bottom line approach to sustainable development have argued that environmental and economic issues have frequently been pursued at the expense of social sustainability and warn of the creation of 'low carbon enclaves' that marginalise some groups at the expense of others. An integrated approach to urban retrofit that genuinely recognises the importance of environmental, economic and social sustainability within all projects at a city scale (and above and below) is therefore essential, particularly if issues such as fuel poverty are to be dealt with equitably. This means targeting investment to maximise environmental, economic and social benefits, often through area-based initiatives. It also means urban green growth strategies that promote greener public services; greener industrial production; and raising education and awareness programmes in cities to help underpin technology deployment and supporting innovative research and development.

More information on the Retrofit 2050 research project and its publications can be found at www.retrofit2050.org.uk

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About the Retrofit 2050 Project

Retrofit 2050 is a large interdisciplinary project funded under the EPSRC Sustainable Urban Environments (SUE) programme.

The academic partners comprise: the Welsh School of Architecture (WSA), Cardiff University; Sustainable Urban and Regional Futures (SURF), Salford University; University of Reading; the Oxford Institute for Sustainable Development (OISD) at Oxford Brookes University; the University of Cambridge, Department of Engineering, Centre for Sustainable Development (CSD); and the Durham Energy Institute, Durham University.

Non-academic partners include Tata Colours, Arup, BRE Wales, Cardiff, Manchester City and Neath Port Talbot Councils, the Welsh Government, Environment Agency (Wales), Core Cities, RICS and Defra.

Retrofit 2050 aims to develop the knowledge and capability to support city-regional scale retrofitting in order to promote a managed socio-technical transition in the built environment and urban infrastructure. In so doing our work brings together four important questions for cities which have all too often been treated in a disconnected way: (i) "what" is to be done to the city? (ii) 'who' is involved in this process? (iii) 'why' will change take place? and "how" will it be implemented? That is, it seeks to bring together an understanding of future technological options and possibilities with the behavioural, political and wider institutional and governance challenges involved.

For further information about the Retrofit 2050 project please visit **www.retrofit2050.org.uk**

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