Towards Energy Efficient Homes: A Review of Retrofitting Policies in the UK

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Abstract

The Climate Change Act committed the UK to reduce GHG emissions by at least 80 percent in 2050. This ambitious target requires millions of homes to be retrofitted and, in response, the Government has implemented multiple retrofit *policies and funding mechanisms, including supplier obligations. This study reviews retrofit policies and compares the objectives and the carbon/energy savings achieved. The review focuses specifically on the 4 iterations of the supplier obligations that have been implemented since 1994. It finds that the supplier obligations have had similar objectives and followed similar trends in the retrofit measures installed. The study further identified the benefits and challenges of the Suppliers' Obligations. The paper concludes by discussing lessons learned for the design of future policies and implementation strategies to improve the energy efficiency of homes in the UK to achieve net zero by 2050.*

Keywords: Retrofitting, Climate Change, Supplier Obligations, Net Zero Target.

1.0 INTRODUCTION

Energy is considered an essential tool for growth and economic development (Stern, 2019, Akpan and Akpan, 2012). Consequently, there has been a surge in demand globally. Notably, the UK and other advanced economies are positioned among the most energy-intensive economies (Akhmat et al., 2014) due to the necessity of higher energy inputs for the daily operations of sectors such as transportation, housing, agriculture, and manufacturing, etc. This increasing demand brings about various economic, social, and environmental concerns including but not limited to greenhouse gas (GHG) emissions (Owusu and Asumadu-Sarkodie, 2016), increase in energy bills, and security threats (Barnett, 2003) etc. Consequently, the UK has made commitments to reduce GHG emissions through legislative measures, the Climate Change Act which was enacted in 2008. (Raybould et al., 2020).

It is a widely accepted view that most buildings in Europe were constructed between 1850 and 1960, a period in which energy efficiency was not considered much. These old and historic buildings are energy inefficient as the housing sector has been marked as one of the most challenging sectors to meet the Net Zero emissions target by 2050 in the UK. Thus, retrofitting has been considered a viable solution and the best strategy to decarbonize homes and reduce energy consumption (Jafari and Valentin, 2017, Ma et al., 2012) to achieve a balance among reducing energy consumption, improving long-term building performance and satisfying building functionality. The UK government, championing net zero emissions, has supported home retrofitting through policies, programs, grants, and funding mechanisms, including suppliers' obligations. It became the pioneer country in Europe to introduce obligations on energy suppliers, also known as Suppliers' Obligations (SOs), in 1994 (Rosenow, 2012). These policies set out actions that mandate energy suppliers to cut emissions, increase efficiency, and help lower the amount spent on energy. These obligations have been changed and improved over time, driven by factors such as rising energy prices, increasing fuel poverty, government or institutional change, etc. (Rosenow, 2012).

Technically, achieving net zero target in the housing sector is feasible through strategic building retrofitting schemes. However, there are claims that the purpose of the policies is being defeated. This study aims to review the supplier obligations and similar schemes deployed by the UK government. Thus, the following objectives were used to achieve the aim of the study; to identify the supplier obligations in the UK since the liberalization of the energy sector; to identify the objective of the SOs; to evaluate the effectiveness of the supplier obligations and to examine the impacts and benefits of the supplier obligations, towards attaining energy efficiency to guide the future direction of home retrofitting.

The paper presents a brief history of the supplier obligations and the changes over time. Second, trends in the supplier obligations are presented ranging from the objectives, retrofit measures installed, carbon/energy savings, etc. Lastly, the paper discusses the impacts, benefits, and challenges while highlighting the lessons learned to guide the design and implementation of future policies.

1.1 HISTORY OF THE SUPPLIER OBLIGATIONS IN THE UK

The deregulation of the energy sector in the 1990s made energy suppliers to be obliged to execute programs to enhance the energy performance of the homes of their vulnerable customers (Mallaburn and Eyre, 2014). The basis of the obligations involves installing retrofit measures in building fabrics, or energy-efficient systems to reduce fuel bills on one hand and carbon emissions on the other hand. Initially, the obligations of the energy suppliers were at a low level. They have developed into the principal instruments used for energy efficiency in the housing sector in the past 30 years.

Going forward, the Department of Energy and Climate Change (DECC) now the Department of Business, Energy and Industrial Strategy (BEIS) set the target and was administered by the Office of Gas and Electricity Markets (OFGEM). Literature shows that different energy companies have different approaches to delivering the target. First, third-party contractors install energy-saving measures (e.g., loft insulation, cavity wall insulation, etc.) in homes. Second, others choose to deliver their obligation by engaging agents such as Local Authorities, supermarkets, and other retail stores. Lastly, energy suppliers may choose to deliver the obligation directly through a subsidiary business of their own and execute the installation of the retrofit measure in-house (Rosenow, 2012).

The first obligation, also known as Energy Efficiency Standards of Performance (EESoP), was operated in three phases. EESoP 1 operated from 1994 to 1998, succeeded by EESoP 2 and EESoP 3 which ran from 1998 to 2000 and 2000 to 2002 respectively. EESoP 1 and EESoP 2 placed obligations on electricity suppliers only while the obligation was extended to gas suppliers during EESoP 3. Thereafter, the Energy Efficiency Commitment (EEC) was in place from 2002 to 2008 with 2 phases. EEC 1 ran from 2002 to 2005 and EEC 2 operated from 2005 to 2008. EEC 2 was renamed and substituted in 2008 to Carbon Emission Reduction Target (CERT) and ran till 2011, though extended till 2012. Similarly, the Community Energy Saving Programme (CESP) ran alongside CERT from 2008 to 2012.

Energy Company Obligation (ECO) which was introduced in 2013 is expected to run till 2026 in four phases. The ECO1 scheme ran between 2013 and 2015 while the ECO2 scheme ran from 2015 to 2018 after being extended in 2017 and referred to as ECO2t. The ECO3 scheme ran from 2018 to 2022. The obligations were on energy suppliers (medium and large) to deliver efficiency measures to domestic customers considered to be in fuel poverty.

In addition to the supplier obligations are warm front and green deal which are two distinct schemes in the form of interventions made available to households to support energy efficiency through retrofit (NAO, 2016 n.d.). The Warm Front was launched in 2000 and operated till 2013, it subsequently became a focus initiative to tackle fuel poverty in England at the time.

The Green Deal on the other hand was launched in 2013 and is primarily a finance mechanism, that provides up-front loans for energy efficiency measures (Mallaburn and Eyre, 2014). This loan is then repaid through the energy savings on the bill and is therefore known as Green Deal Finance.

2.0 METHODOLOGY

A systematic literature review was initially considered for the study. Thus, an identification (i.e. database search), the first step of the systematic literature review, was performed. The search was carried out using the query string TITLE-ABS-KEY ((thermal AND retrofit* AND polic* AND in AND the AND UK)) AND (LIMIT-TO (DOCTYPE, "ar") which returned just 26 documents. The only criteria added to the search was the limitation to journal articles because most conference articles may not provide the detailed information required. On selecting the documents for review, initial screening of the titles and abstracts of these 26 documents suggested that the necessary information was not presented and therefore was all discarded. This suggested that little or no works have been reported in the subject area which may be as a result of the fact that government policies and similar documents are presented in grey form.

Thus, the study resulted in finding the policy documents and similar grey literature on the UK website. The method therefore adopted in the study is likened to a review of the policy documents, proposals, amendments, evaluation studies reports, or a combination of these in some cases, etc as suggested by Cardno, (2019) that analysis of policy documents is an established and appealing qualitative research method. These grey documents were published through evaluation research, conducted by a third party on behalf of OFGEM at the end of the obligations or while the obligations were still running. For instance, the review of EESoP was carried out after the obligation in 2002 (OFGEM and EST, 2003.). The following section summarizes the findings of the review.

3.0 RESULTS

This section presents the details of the findings of the review to give the reader a good overview of the trends of supplier obligations. This includes the objectives of the obligations, retrofit measures installed and the carbon/energy savings achieved.

3.1 Objective of the Supplier Obligations

Policies are essential tools used by governments to drive change in many sectors. Change in policy framework may be driven by the emergence or the persistence of the crisis being addressed (Campbell, 2004). The objective of the supplier obligations as shown in Figure 1 below is centered around the alleviation of fuel poverty and the reduction of carbon emissions. These objectives were achieved through the installation of lofts, cavity wall insulation, internal and external wall insulation, heating systems, etc, which improved the performance of the buildings. These were implemented through legislation that provides the Department for Business, Energy, and Industrial Strategy (BEIS) with the power to set energy efficiency targets for companies with more than 50,000 customers. Whilst progress has been made in the schemes through the delivery of the objectives, there are concerns that the coverage of the supplier obligation has not been consistent.

The earlier obligations were targeted at fuel poverty alleviation, subsequent energy efficiency programs were oriented to focus on carbon emission reductions in line with climate change mitigation goals. The obligations starting with the Carbon Emission Reduction Target (2008-2012), further raised the obligations' objectives, and was complemented by the Community Energy Saving Programme (2009-2012) which focused more on communities and vulnerable households.

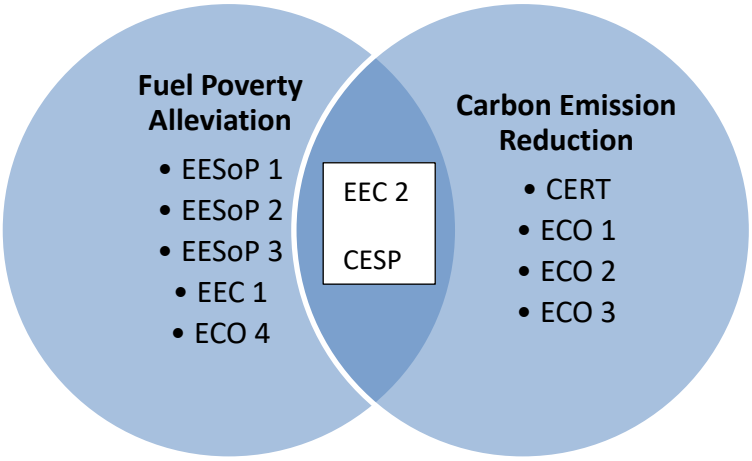

Figure 1: Objectives of Supplier Obligations

3.2 Retrofit Measures Installed and Process

The retrofit measures installed range from loft insulation, cavity wall insulation, heating system upgrades, and energy-efficient appliances etc. These measures have been generally categorized as demand-side and supply-side management measures (Ma et al., 2012). The same trends were observed in the measures installed in the household by the suppliers or their representatives engaged to deliver the retrofit measures. As presented in Table 1, the measures installed from the inception of EESoP till the most recent ECO increased from simple fabric only to a whole-house approach and deep retrofit. However, the uptake of the deep retrofit measures is low and is linked to the initial high cost of installations of deep retrofit measures. Moreover, homeowners feel that the tenants benefit more from the energy improvement of the building and thus feel reluctant to take energy retrofit measures. Earlier obligations saw more of installation of measure such as Compact Fluorescent Lamps (CFL), lofts, and cavity wall insulations. However, subsequent obligations starting with CERT, CESP, and ECO focus on hard-to-treat homes or whole-house approach to retrofitting. In particular, CERT and ECO focused on solid wall insulations.

Eligible households were identified based on factors such as income level, property type, and energy efficiency ratings of the property. Thereafter, qualified assessors conduct energy efficiency assessments to determine the most suitable retrofit measures for the property. Accredited contractors install retrofit measures by industry standards and regulations provided in Publicly Available Specification (PAS). PAS 2030, first introduced in 2013 is a Publicly Available Specification for the installation of energy efficiency measures in existing

buildings for energy efficiency schemes. The PAS was used for the ECO schemes, there is no evidence for the specifications used during the schemes before it. Installers were required to use either PAS 2030:2017 or PAS 2030:2019 and PAS 2035:2019 for the design and installation. However, quality control measures were put in place to ensure that installed measures meet specified performance criteria.

Table 1: Retrofit Measures Installed During Suppliers' Obligations

Scheme	Operating Period	Measures Installed
EESoP 1, 2 & 3	1994 – 2002	Compact Fluorescent Lamps (CFL), cavity wall, loft and tank insulation, and cold appliances
EEC 1 & 2	2002 – 2008	CFLs, cavity wall, loft and tank insulation, and cold appliances
CERT	2008 – 2012	Loft insulation, cavity wall insulation, solid wall insulation, Fuel Switching, CFLs
CESP	2009 – 2012	Solid wall insulation, Loft insulation, Cavity wall insulation, Glazing Fuel Switching, Boiler replacement.
ECO 1,2 &3	2013 – 2022	Boilers, Cavity Wall Insulation (CWI), Loft insulation, Solid Wall Insulation (SWI)

3.3 Energy/Carbon Saving

Although, the savings achieved are lower than the officially estimated by the policymakers (Galvin and Sunikka-Blank, 2013) in most of the cases. This study found that the savings achieved during the supplier obligations were not consistent (i.e., not measured in the same units). Earlier obligations (EESoP and EEC) were measured in units of energy saved while CERT, CESP, and ECO were measured in carbon savings. However, there is evidence for the conversion from one unit to the other in Rosenow (2012). Evaluation reports have it that most of the supplier obligations were able to meet and surpass the target set, demonstrating the success of the policies and value for money spent.

The policies led to substantial energy/carbon savings by improving the thermal efficiency of buildings and upgrading outdated heating systems. Enhanced cavity wall insulation, solid wall insulation, loft insulation, energy-efficient heating and cooling systems, and smart technologies etc. reduce energy consumption, lower utility bills for households, particularly the fuel poor and vulnerable households. This observation is in agreement with the of (Shorrock 2003 n.d.) which reported that energy efficiency improvements reduce carbon emissions from the housing sector. The report equally emphasized the importance of continuing efforts to improve the energy efficiency of households in the United Kingdom. This

should be continuously sustained till the ultimate net zero target of the year 2050 is perceived to be on track.

4.0 IMPACTS AND BENEFITS OF THE RETROFIT POLICIES

There are fears that the net zero target of the year 2050 would not be met in the UK (Miu et al., 2018). This study found that the uptake of retrofit measures reduced as the obligations expanded to whole house approach and treatment homes. Rosenow and Eyre, (2013) found similarly that the Green Deal Impact Assessment showed a negative contribution to carbon savings. However, supplier obligations have played a pivotal role in addressing the pressing challenges of energy inefficiency, carbon emissions, and climate change in the UK. This section explores the impacts and benefits of the policies, highlighting their significance in enhancing energy efficiency, fostering sustainability, and promoting socio-economic development.

4.1 Economic Stimulus and Job Creation:

The implementation of retrofit policies generates economic activity and job opportunities across various sectors. In complying with the obligations, market actors, supply chain, and administrative bodies are directly involved (Bertoldi et al., 2013). Jobs are created within companies under the obligation (energy distributors or suppliers as the case may be), retrofit assessors, retrofit measure installers, construction industry players, other eligible bodies and companies under the obligation, and energy users on whose premises projects are implemented.

Similarly, building retrofit projects stimulate demand for materials, labour, and skilled professionals. Local contractors, engineers, architects, and manufacturers benefit from increased business opportunities, fostering economic growth and resilience. Furthermore, the expansion of the green economy through retrofit initiatives cultivates innovation, drives technological advancements, and enhances competitiveness in global markets as was the case in the Warm Front.

4.2 Improved Indoor Comfort and Health:

Retrofitting buildings not only enhances energy efficiency but also improves indoor comfort and occupant well-being. Installation of insulation, ventilation systems, and thermal controls create healthier indoor environments by regulating temperature, humidity, and air quality. Adequate thermal comfort reduces the risk of cold-related illnesses and respiratory conditions, particularly among vulnerable populations (Ormandy and Ezratty, 2016). Additionally, by reducing exposure to indoor pollutants and allergens, retrofit policies contribute to better overall health outcomes and quality of life for occupants (Ahrentzen et al., 2016). During the Warm Front scheme, for instance, residents reported greater thermal comfort after retrofitting (Gilbertson and Green, 2008 n.d.). Overall, the installation of retrofit measures has a positive impact on mental health, alleviation of respiratory problems, and reduction of deaths in older people. Especially, there are reports of mental alertness,

emotional balance, and fewer symptoms for chronic illnesses (Gilbertson et al., 2006). However, there is similar evidence that householders in old homes particularly those built pre-1930 remained dissatisfied with the heating system despite major improvements (Critchley et al., 2007). Ultimately, the policies have contributed immensely to the improvement of the health status of the households.

4.3 Social Equity and Affordable Housing: In the United Kingdom, social equity and affordable housing remain important aspects of public policy and societal well-being (Hilber and Schöni, 2022). With the growing emphasis on corporate social responsibility and sustainable development, supplier obligations emerged and have been used as a potent tool to address rising energy challenges in the UK which has a direct impact on people's way of living. Through supplier obligations, disparities in housing quality and energy affordability, particularly for low-income households and marginalized communities are reduced (Bouzarovski et al., 2022). Targeted programs and incentives ensure access to energy-saving measures and financial assistance for those in need as seen in the Warm Front Scheme, Green Deal as well as the supplier obligations. By improving the energy efficiency of affordable housing units, retrofit policies alleviate energy poverty, reduce utility burdens, and enhance housing affordability. Furthermore, investments in energy retrofits contribute to the preservation and revitalization of existing housing stock, promoting inclusive and sustainable urban development. The policies foster social equity by contributing positively to the communities through employment, local charities, and investing in community development projects.

4.4 Environmental Sustainability: The primary benefits of retrofitting and low-carbon initiatives are the mitigation of carbon emissions and the transition toward a low-carbon economy (Damert et al., 2018) offered through the reduction of operational carbon in households. Furthermore, the UK government's commitment to achieving net-zero emissions by 2050 has intensified the focus on carbon reduction initiatives. Thus, supplier obligations have played a crucial role in transitioning towards a low-carbon and sustainable built environment. By reducing energy consumption and carbon emissions from buildings, these policies contribute to broader sustainability objectives, including resource conservation, climate resilience, and ecosystem protection. Retrofitting existing buildings also minimizes the environmental footprint associated with embodied carbon through new construction and reducing construction-related waste. Moreover, by promoting energy efficiency and renewable energy integration, retrofit policies support the transition to a resilient and decentralized energy system.

5.0 CHALLENGES AND FUTURE DIRECTIONS

Supplier obligations play important roles in shaping the environment, social well-being, and economy of the UK. However, implementation faces some challenges, ranging from complexities to enforcement, and public awareness. This section provides an examination of

the challenges associated with the retrofit policies in the UK, along with potential strategies to address them.

First, customer awareness of the importance of the retrofit measures to be installed was low. According to DECC, (2014 n.d.), about 29% of households that received installations did not know who had funded/ part-funded their energy efficiency installation during ECO. Some other households, about 40%, attributed their installation to the government, while up to 12% explicitly identified energy suppliers as the financiers of their energy efficiency installation(s). Thus, it is adequate to conclude that major households lack awareness of the various schemes being operated.

Monitoring, evaluation, and review were not built into the design and delivery of the obligations except for CERT and CESP in which cases, were not systematically designed from the start. Thus, OFGEM relies on the data given by the energy suppliers for the evaluation of the obligation. The monitoring in EESoP for example did not have an adequate sample for analysis of non-disadvantage customers in gas-heated homes. Monitoring will allow for the necessary review of delivery, and possible amendments of the policy, including an expansion of the obligations when necessary. However, it may be challenging to ensure the monitoring of the supplier obligations with the diverse nature of businesses, supply chains, and geographical differences. To address this challenge, policy review and monitoring should be part of the design of the obligation in line with the opinion of Ipsos MORI et al, (2014 n.d.). The policymakers could equally strengthen regulatory oversight through targeted reviews, inspections, audits, and more strict penalties for non-compliance. Data on household energy use could be kept after the installation of measures to measure value for money and the amount of energy bill savings. Similarly, adequate funding and personnel should be allocated to OFGEM to invest more in capacity-building initiatives, training programs, and technology upgrades that can enhance efficiency and effectiveness.

Furthermore, other challenges include supply chain, poor retrofit design, and workmanship in ensuring compliance and standard installation as the business operates across multiple jurisdictions: sourcing materials and components from diverse suppliers with varying social and environmental standards. A retrofit failure was for instance reported during the Community Energy Saving Programme (CESP) in Preston where about 390 homes were affected. Therefore, incentivizing collaboration between public and private sectors through public-private partnerships, industry alliances, and sector-specific initiatives can leverage complementary resources and expertise to address common challenges collectively.

6.0 CONCLUSION

Based on the review and analysis of the suppliers' obligations and other schemes in 1994, the following conclusions and lessons can be drawn from the review.

- Obligations were initially aimed at fuel poverty alleviation before being used as a major tool for cutting down carbon emissions. The obligations follow the same trend

in the design modalities, energy, or CO2 to be saved annually or lifetime saving, targeted groups, obliged parties, sectoral and energy coverage, etc.

- The obligations on the energy suppliers increased over subsequent obligations. Future policies should however be on deep retrofitting techniques and the obligations should be meted on the buildings, as against the energy companies, and customers.
- Earlier obligations focused on simple and easy-to-treat homes through installations of measures ranging from cavity wall insulation, loft insulation, lighting, etc. CERT, CESP, and ECO are targeted at solid wall insulations and hard-to-treat homes following the success of EESoP and EEC.
- Third parties have usually been engaged to carry out the policy evaluation. This is rather an extra cost for the delivery of the schemes.
- There is a need for a holistic approach to retrofitting that considers the structural integrity and moisture risk of retrofitting homes. There have been claims that increasing levels of insulation increases moisture risks.

Therefore, this study suggests that further research be carried out to establish the challenges faced with implementing supplier obligations. The author intends to publish a full paper on the subject.

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