# Accelerating NetZero: introducing a novel financial approach and new narratives for retrofit

Marina Topouzi
Environmental Change Institute
University of Oxford
South Parks Road, Oxford, OX1 3QY, UK
England, United Kingdom
marina.topouzi@ouce.ox.ac.uk

Yekatherina Bobrova
Environmental Change Institute
University of Oxford
South Parks Road, Oxford, OX1 3QY, UK
England, United Kingdom
yekatherina.bobrova@ouce.ox.ac.uk

Peter Mallaburn
Energy Institute
University College London
14 Upper Woburn Place, London WC1H 0NN, UK
England, United Kingdom
peter.mallaburn@ucl.ac.uk

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## Abstract

Retrofitting owner-occupied housing in the UK and across Europe remains an enormous challenge in meeting net zero targets. Successful energy retrofit policies require the alignment of diverse stakeholder interests, supply chain skills and capacity and energy performance standards. However, current policies often lack explicit strategies for aligning and capturing the value of successful retrofit for stakeholders, resulting in limited effectiveness of recent financial retrofit schemes. Previous work by the authors identified this aspect in the retrofit policy environment as an urgent call for a fundamental change in the way schemes are designed and rolled out. In this paper, we present the findings from the feasibility stage of a Retrofit Salary Finance (RSF) scheme, a novel fiscal policy approach that leverages the post-Covid trend of hybrid working to promote retrofit home improvements in owner-occupied houses. The insights were collected through engagement activities (i.e. surveys, workshops, and one-on-one conversations) with key representatives from central and local government, the construction sector, lenders, employers and homeowners. The findings were analysed through the lens of cognitive framing and systems thinking with casual loop relationships. This looked at the scheme's value and barriers for different stakeholder groups to construct narratives that effectively promote retrofit by resonating with their diverse cognitive frames. The findings emphasise the importance of focusing on shared value and implementing management practices using existing mechanisms. The novelty of the scheme is perceived as an opportunity not only to address immediate retrofitting needs but also to contribute and catalyse broader environmental and socio-economic objectives, aligning with both local and national strategies. The paper contributes to policy design and implementation, allowing the adaptation of the Retrofit Salary Finance scheme to different contexts or countries.

## Introduction

In the UK and across Europe, owner-occupied houses represent 64 % (GOV.UK 2021) and 70 % (Commission 2021) respectively of the total housing stock. Recognising the challenge, a variety of retrofit policy options have been used to encourage low-carbon retrofit. The EU has 2050 climate neutral target (European Commission 2020) and similarly the UK to achieve net-zero emissions (UK Government 2019). Under the Energy Efficiency Directive, member states are required to create national building renovation strategies and plans. While different Member States employ a mix of policies, including information provision, mandatory benchmarking, provision of financial support and minimum standards for new buildings (Rosenow and Eyre 2016), the UK at present does not seem to have the necessary mix to meet its net zero target goal (CCC 2018).

In 2020, the average annual energy renovation rate across the EU was as low as 1 % (European Commission 2023). Deep retrofits that reduce energy consumption by at least 60 % were undertaken in only 0.2 % of the EU stock while in some regions low carbon retrofit rate was virtually absent (BPIE 2021). The *Renovation Wave for Europe* strategy aims to significantly increase the renovation rate, by setting out seven key principles: prioritis-

ing and supporting investment, digitalisation, creating employment and retrofit market and supply chain growth (European Commission 2020). EU Member States currently deploy various fiscal instruments mostly in the form of grants or subsidies, followed by soft loans and tax incentives. Good practice initiatives such as the French Energy Transition Tax Credit[1], the Dutch Energy Investment Tax Deduction[2], the Estonian Kredex Credit and Export Guarantee Fund[3] and the KfW Energy Efficient Refurbishment Programme[4] among others, were assessed in terms of quantifiable impacts, including energy and cost savings, overall effectiveness, sustainability, continuity of support, scalability/replicability and impact on hard-to-reach groups (Economidou, Todeschi et al. 2019). Many of these instruments are designed to work in synergy with existing or new policy packages.

In the UK privately owned residential sector accounts for approximately 15 % of the overall national emissions and is also one of the most difficult sectors to tackle (Innovate UK 2017). There is a notable policy gap in retrofit initiatives, particularly for middle-income 'able-to-pay' groups who have the financial capacity to invest but lack of market support for the retrofit process, such as a lack of access to quality assured retrofit services at all stages in the process from evaluation and planning to delivery and aftercare (CitizensAdvice 2023). Despite government and non-governmental programs and policies, homeowners continue to face obstacles related to finance, supply chain capacity, skills, and comprehensive customer support throughout and beyond the retrofit process (BSI 2019, Topouzi, Fawcett et al. 2019, Construction Leadership Council 2020, UKGBC 2021).

In the UK policies primarily focus on single measures such as stand-alone financial incentives to overcome the high upfront costs of net zero measures. These schemes lack a holistic view of the retrofit process. For example, in the Great British Insulation Scheme, subsidies for insulation cannot be blended with funding from other government programmes. This means that any measures outside of the scheme delivered to the same property would have to be installed separately (Ofgem 2024). The heat pump roll out (BEIS 2022) suffers similar problems, missing out on opportunities for more holistic retrofit planning and co-ordination. Opportunities to employ a policy mix approach to achieve ambitious renovation goals are lagging behind and often fail to account for changes in the context of housing energy efficiency.

Simultaneously, changes in the context of housing energy efficiency have emerged, including the 'new normal' post-pandemic, where shifts in working arrangements and the usability of buildings have led to increased remote or hybrid teleworking patterns, replacing traditional office spaces with home offices. This shift towards 'smart' or 'flexible' working has implications for carbon inequality, inclusivity, building suitability, and energy resilience in employees' homes to accommodate increased working activities and associated costs. It also presents new opportunities for changes in businesses, workforce dynamics, and energy efficiency. In the latest consultation on flexible ways of employment after Covid, the UK government acknowledges considerable benefits for both employers and employees (BEIS 2021), while the demand for hybrid working remains high (Office for National Statistics 2023).

In 2021, the CREDS team at the University of Oxford and UCL started exploring an innovative concept for a financial retrofit incentive known as Retrofit Salary Finance (RSF)[5]. The following section provides the background and rationale for the Retrofit Salary Finance concept, introducing the conceptual framework for the scheme's design. Initial insights from the first stage of the feasibility study, discussing the value and challenges of an RSF scheme for various stakeholder groups, exploring their perspectives, and considering aspects related to its potential piloting and implementation.

#### RETROFIT SALARY FINANCE AS A CATALYST

As mentioned above, retrofitting the owner-occupied sector remains an enormous challenge on both national and international levels. Companies adopting flexible working arrangements and allowing employees to work from home also have a responsibility to ensure their staff are working in a safe, comfortable, and energy-efficient environment. The benefits of retrofitting become even more compelling when viewed through the lens of extended periods of remote work post-Covid and the energy price crisis in the EU.

The Retrofit Salary Finance approach recognises the significant opportunity in home working to increase homeowners' awareness and adoption of retrofitting to enhance their home offices. This scheme is designed for a specific subgroup of salaried 'able-to-pay' homeowners, and is based on established salary sacrifice schemes in the UK for cycles, electric cars and childcare. Evidence has shown that 'able-to-pay' doesn't necessarily translate to 'able-to-retrofit' without incentives and support in the customer's retrofit journey (BEIS 2021). To address this RSF views homeowners working from home as employees. The aim is to invest in a comprehensive whole-house retrofit improve-

1. The tax credit covers a range of energy-efficient investments such as boilers with high energy efficiency rates, thermal insulation works, heating regulation devices, heat pumps, and charging points for electric vehicles Schneller, A. and C. Hennig (2017). *The Energy Transition Tax Credit (CITE) in France*.

2. The Dutch Energy Investment Tax Deduction, known as the Energy Investment Allowance (EIA), offers tax benefits to companies investing in energy-efficient technologies and sustainable energy. This means that companies pay less tax when they invest in energy-efficient technologies, resulting in an average tax reduction of 10 % and lower energy bills, Ruijs, A. and H. R. J. Vollebergh (2013). "Lessons from 15 Years of Experience with the Dutch Tax Allowance for Energy Investments for Firms."

3. The Estonian Credit and Export Guarantee Fund, known as KredEx, was established in 2001 that serves as a guarantee fund to support the development of Small and Medium-sized Enterprises (SMEs) in EstoniaGlobal, T. F. (2024). KredEx | Export Credit Agency (ECA) in Estonia. Available at: https://www.tradefinanceglobal.com/export-finance/export-credit-agencies-eca/kredex-export-credit-agency-eca-in-estonia/. Accessed on March 6, 2024.

4. The KfW Energy Efficient Refurbishment Programme, operated by the KfW promotional bank in Germany, provides low-interest loans of up to €50,000 with a 10-year maturity at fixed rates to support energy-efficient renovation projects in buildings. The program promotes various Efficiency House Standards, incentivising energy-efficient refurbishments through grants and bonuses. These incentives include a 7.5 % repayment bonus for individual measures and investment grants for self-funded renovations. Recent enhancements include increased grants for KfW Efficiency Houses and a higher maximum loan amount of €100,000, contributing to sustainable building practices and reduced energy consumption in Germany. European Commission (2020). Finance for Energy Efficiency. Available at: https://energy.ec.europa.eu/system/files/2020-10/003_dominik_bach_0.pdf. Accessed on: March 9, 2024.

5. The term "Retrofit Salary Finance," known in the UK as "Retrofit Salary Sacrifice," was originally coined by the authors to describe the same financial concept. In prior publications and discussions, we used "Retrofit Salary Sacrifice" to align with existing UK schemes that enable employers to provide in-kind benefits to employees. However, feedback from international panels and various activities, such as sessions at previous eceee summer schools, emphasised that the term "sacrifice" conveys a negative connotation. This is the reason for opting to use RSF in this context.

ment service covering assessment, retrofit planning, works, and (or) repair and maintenance. The cost is covered through gross salary contributions (Topouzi, Mallaburn et al. 2022).

Recognizing the shortcomings of previous policies in the building sector discussed above, the scheme is not proposed as a standalone initiative but as part of a comprehensive policy mix, drawing on the success of similar EU scheme approaches. It identifies policy connections and extends boundaries to align with other 'green' public or private lending mechanisms.

The model design facilitates adaptation using existing mechanisms of salary in-kind benefit schemes successful in other sectors to reduce risks and manage administrative burdens. Like other similar UK schemes, the RSF operates as a 'salary sacrifice' employee benefit. The employee gives up part of their salary in exchange for a benefit – in this instance the benefit is for a retrofit service from evaluation to planning and actual retrofit works, aftercare repair and maintenance improvements. The salary sacrifice is taken from gross salary (before tax) which means that the employee will pay less Income Tax and National Insurance (NI) and that the employer will reduce their National Insurance Contributions (NICs) bill. Table 1, illustrates three examples of using the RSF for different application, employee tax payers cost rates and length of payback process.

Central to the RSF business model is to leverage existing retrofit services (One-Stop Shops – OSS), retrofit standards and accredited installers to ensure quality assurance and price control of suppliers (Topouzi, Mallaburn et al. 2022, Topouzi, Mallaburn et al. 2023). Central to its design is also the emphasis on the customer journey, built on a 'retrofit service' that integrates green finance, project management, and building condition and operation assessment. This alignment of interests overcomes a significant deployment barrier while instilling confidence in public and private lenders to provide the bulk of the project's financing. It allows employers to enhance their sustainability credentials with clients and investors, while also supporting employers in maintaining their reputation by addressing the challenges of remote work.

The new work-from-home patterns within the RSF scheme focuses on the able-to-pay market where demand is likely to be the highest, i.e., employed owner-occupiers with capital reserves and the lowest lending risk due to the best loan-to-value ratio. These homeowners are also the most 'able-to-accommodate' working from home, possessing available space for home office facilities and energy-efficient retrofit technologies (e.g., a garden suitable for a ground source heat pump). The RSF design aims to make capacity-building a central feature, allowing for the exploration and support of the demand/supply relationship by establishing an expert service to assess, advise, and plan the best retrofit solutions for each home-office property (Topouzi, Mallaburn et al. 2023).

#### TESTING THE RETROFIT SALARY FINANCE SCHEME

Flexible governance is crucial for addressing significant societal and environmental changes. It suggests a decentralised structure of decision-making that breaks down a large, complex policy problem into many smaller, more manageable problems, facilitating adaptation of what has worked anywhere to similar circumstances elsewhere (Brunner and Lynch 2017).

The concept of the RSF was revisited and reframed by the first author, while expertise from others within CREDS, particularly in finance, policy, and energy demand flexibility, contributed to the development of various stages of the concept (Topouzi, Mallaburn et al. 2023). As shown in Figure 1, Topouzi, Mallaburn et al. (2022) embarked on creating a new narrative for the RSF scheme, developing and testing the concept with various audiences in the UK and internationally. They engaged with stakeholders from local and central government, the retrofit supply chain (manufacturers and installers), energy companies, retail banks, employees, and employers. Throughout this period, these stakeholders contributed to the development of the RSF business model and, crucially, helped us understand why a successful RSF scheme would be of value to them. Additionally, extra funding from a stakeholder engagement fellowship in 2023 allowed us to begin feasibility testing, i.e. how a scheme would work in practice, and findings from this phase of the study are discussed in the following sections.

Feasibility testing of the RSF involved the identification and involvement of relevant actors, of which role was crucial for

**Table 1. Examples of Retrofit Salary Finance application – Cost, time and Tax deduction of retrofit measures using the scheme.**

| Examples of application | Capital cost band £ | Cost of measure (£) | Total gross cost/Monthly gross salary reduction | Term (months) | Total lower rate (20 %) tax payer cost/ NI rate based upon 13.25 % | | Total higher rate (40 %) tax payer cost/ NI rate based upon 3.25 % | | Disruption band (measures examples) | Additional funds |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Total salary sacrifice | Monthly net salary reduction | Total salary sacrifice | Monthly net salary reduction | | |
| Home assessment & Whole House planning | Up to £100 | £100 -£500 | (£100)/£8.33 | 12 | £66.75 | £5.56 | £56.75 | £4.73 | Low | No |
| | £100–£1,000 | | (£500)/£41.67 | | £333.75 | £27.81 | £283.75 | £23.65 | | No |
| Ex wall insulation (U=0.3) | Over £10,000 | £6,200 | £258.33 | 24 | £4,138.50 | £172.44 | £3,518.50 | £146.60 | Low | Yes |
| Heat-pumps | | £7,000–£10,000 | (£10,000)/£416.67 | 24 | £6,675.00 | £278.13 | £5,675.00 | £236.46 | Low | Yes (BUS) up to £5,000 |

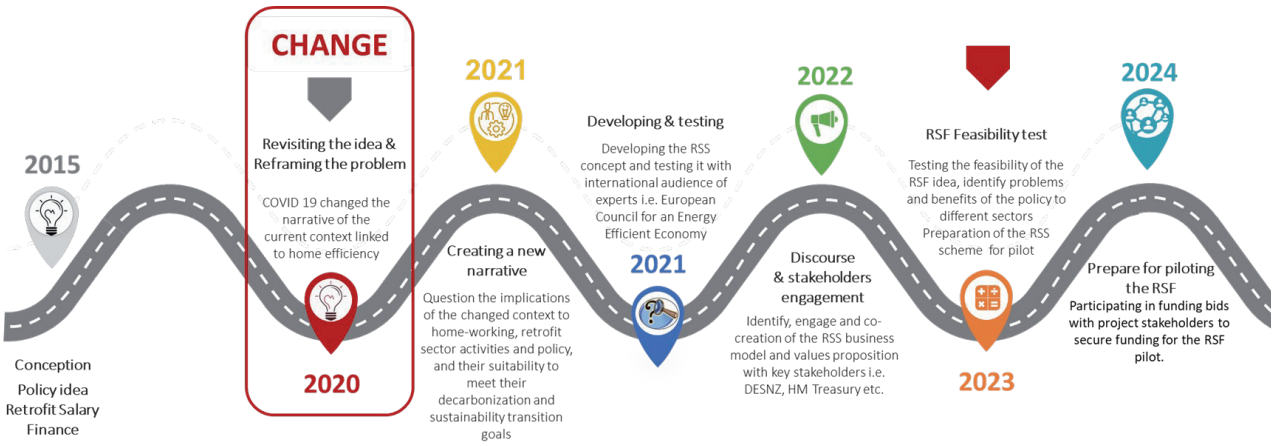



*Figure 1. Timeline of developing the Retrofit Salary Finance idea from conception to feasibility test.*

**Table 2. Approaches to Data Collection and types of data for the feasibility testing stage.**

| Data Collection activities | Sources |
|---|---|
| **Online survey** | Open and closed-ended questions to 5 key stakeholder groups (n=71 in total): i. employees-homeowners (n=50); ii. employers/companies (n=2); iii. Government and local authorities (n=9); iv. construction sector (n=9); v. banks/lenders (n=1). |
| **Half-day online workshop** | With representatives from 4 key stakeholder group(n=18 in total, i. employers/companies (n=2); ii. Government and local authorities (n=6); iii. construction sector (n=5); iv. banks/lenders (n=5) explored aspects related to value and implemetnation of the RSS. |
| **One-on-one conversations and meetings** | From 2021 to 2023 continoues engagement with key stakeholders from academia, bussiness and government i.e. DESNZ, HM Treasury, CosyHomes Oxfordshire, Oxofrd City Coulcil etc (n=45), reviewing, and co-creating the RSS business model and values proposition. |

the success of the RSF pilot scheme (Figure 1). Key actors were identified in previous stages from five stakeholder groups in the UK (n=71 in total) including employees-homeowners; employers/companies; government and local authorities; the construction sector; and banks/lenders (Table 2). Employing diverse data collection methods, including individual conversations, surveys, and a half-day workshop, the study aimed to assess the potential of an RSF scheme for different groups, and explore its feasibility for piloting and implementation. This involved testing the hypothesis of qualitative benefits to understand the value distribution within the retrofit salary finance model, the required investment from various stakeholders, and strategies for scaling up the RSF business model (Topouzi, Mallaburn et al. 2022, Topouzi, Mallaburn et al. 2023).

An outline of the key areas explored in these activities includes i. where value will be delivered by RSF and to which sectors and stakeholders; ii. what additional benefits are associated with these value streams; iii. how these benefits compare with alternative interventions. Barriers or risks and how to overcome them were also systematically addressed and identified.

In the methods used for data collection and analysis, the concept of a *cognitive frame* was employed to: (i) communicate the change to different retrofit actors and (ii) understand and shape how various actor decisions can influence the success of the RSF scheme. A *cognitive frame* is a pattern of thought or behaviour, through which people organise information to make the interaction with the environment more efficient (Miller 2010). This approach enhances sensitivity among diverse actors, their respective sectors, and their social environments, facilitating adaptability to environmental and social changes. As van Assche, Valentinov et al. (2022, p. 14, as cited invan Assche, Valentinov et al.) argues, 'the growing systemic complexity entails an increasing risk that systems develop insensitivity to the environmental conditions on which they critically depend. (C)ognitive frames are those background understandings needed for making sense of things that happen around us' (Andor, 2010, p. 158, as in Sullivan (2023). We use the concept of a 'cognitive frame' (Scheufele 2004) to make explicit the different ways in which various actors, such as homeowners, employers and institutions will make sense of the RSF scheme and how to use the scheme to coordinate and align their various interests.

### Cognitive Frame to Communicate Change

In the context of home energy efficiency, the concept of 'change' has been examined from a holistic perspective, ranging from the broader systemic level to the more individual one. Figure 1 shows, that different aspects of the 'real world' linked to the efficiency of the building stock have changed. However, these changes do not necessarily indicate that the cognitive frameworks of stakeholders have been similarly updated. There are many possible issues here to consider: comfort and increased fuel costs due to extreme temperatures; geopolitical shifts, such as the conflict in Ukraine, energy security considerations. There are changes within the

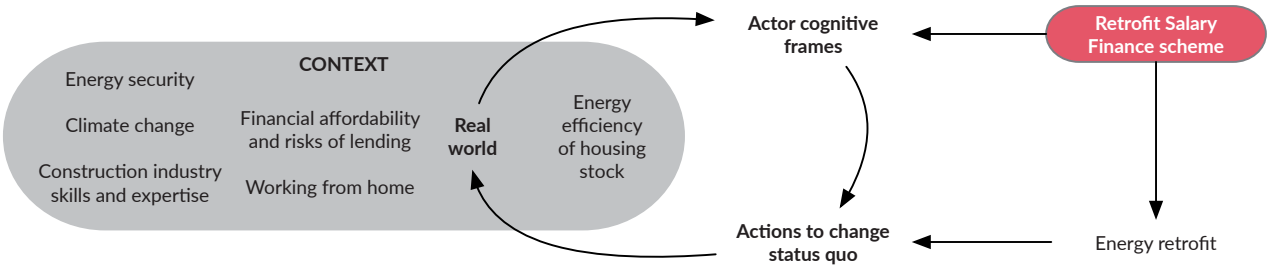



*Figure 2. Changes in the context of home efficiency: a cognitive frame to a common narrative (adapted from Topouzi, Mallaburn et al. (2023).*

construction industry and the broader 'change of culture' within the sector to achieve retrofit goals with speed, scale, and quality, new services like One-Stop Shops (OSS), as well as the evolution of retrofit supply chain. Similarly, financial changes and lending risks such as the increase in interest rates and the availability of less flexible and attractive products for homeowners. Finally, changes in working patterns, particularly the increase in hybrid working, introduce further dynamics into this multifaceted context of energy home efficiency.

As in Figure 2, changes in the external environment (the real world) shape our cognitive frameworks, which subsequently drive the actions taken by stakeholders to adapt the world to their needs. In this evolving context, the Retrofit Salary Finance (RSF) scheme offers both a solution – energy retrofitting – and a means to update actor cognitive frameworks to create a shared narrative for communicating the evolving landscape of home energy efficiency. This narrative helps various stakeholders identify their roles and activities within this changing context, as well as the effects of RSF in relation to these roles.

These changes in the present context of home efficiency are also closely associated with four key barriers in retrofitting. These include policy consistency, regulations, and standards; awareness and trust in the retrofitting process; supply chain capacity and skills related to climate change, building performance, and 'culture change' within the construction sector; and financial barriers and incentives linked to lending risks. These four key barriers in the domestic retrofit landscape, are used in the thematic analysis here to organise the perceived shared value from the Retrofit Salary Finance scheme to five key groups of actors. The barriers also underscore the complexity often associated with such schemes, stemming from a narrow focus on a single aspect of the system, rather than recognising the multifaceted nature of the problem at different levels. High-level policy design, while detailed, can be inflexible and incapable of adapting to local-level and sector-specific demands (Bizikova, Swanson et al. 2018).

### Cognitive Frames of Shared Value

This section discusses the findings on RSF's shared value derived from data collected during various activities with five groups of stakeholders. It explores the common elements in the cognitive frames across these groups of actors and highlights the areas of greatest value that have the potential to tackle current retrofit barriers and impact the success of the retrofit salary finance scheme.

Although cognitive frames appear to have common elements across these groups, shared values can take on different meanings for various stakeholders. Figure 3, illustrates areas of greatest value for all actors, where their motivations and decisions can influence the success of the Retrofit Salary Finance scheme, ranging from broader concerns such as (1) carbon reduction and environmental goals to more role-specific factors like (2) enhanced reputation and value proposition, as well as (3) convenience, clarity, and ease. Other areas identified include (4) access to finance and affordability benefits; (5) wider economic and socio-economic benefits; (6) market stimulation and engagement; (7) policy alignment and continuation; (8) quality assurance; and (9) trust and risk management. The shared value and co-benefits arising from Retrofit Salary Finance often serve as common motivations for scheme uptake and can help address specific retrofit barriers discussed in more detail in the following sections.

Recognizing the complexity of the system, it is crucial to understand that the four identified themes for barriers and the nine themes for shared values among various actors are not isolated drivers and barriers. Instead, there exists a network of looped causality where each element influences everything else. To enhance our analysis and effectively illustrate the interplay between shared value and risk variables within the overall approach, we employ systems thinking approach to visualise relations using a Causal Loop Diagram (CLD). These connections show the dynamic causal relationships among shared variables depicting drivers and barriers of the scheme, whether they reinforce or balance one another. This representation aims to deepen our understanding of actors' cognitive frameworks and their impact on the adoption of management practices to navigate changes over time.

The CLD illustrated in Figure 4[6], two balancing loops try to get us to the goal of domestic energy retrofit and six reinforcing loops can amplify the effect of the RSF either as in a virtuous or a vicious cycle. The first balancing loop (B1) shows how *carbon reduction and environmental goals* are achieved through

6. In Figure 4, arrows depict the relationships between two variables, with positive and negative signs indicating their mutual influence Sterman, J. D. ( 2000). "Business dynamics: Systems thinking and modeling for a complex world." ***Boston, USA: Irwin/McGraw-Hill***. A positive sign signifies that a change in one variable leads to a corresponding change in the affected variable. Conversely, a negative sign indicates that a change in one variable results in an opposite change in the affected variable. In CLDs, loop polarity is categorized as either reinforcing (R) or balancing (B), depending on whether the net effect within the loop the initial condition is amplified or balanced.

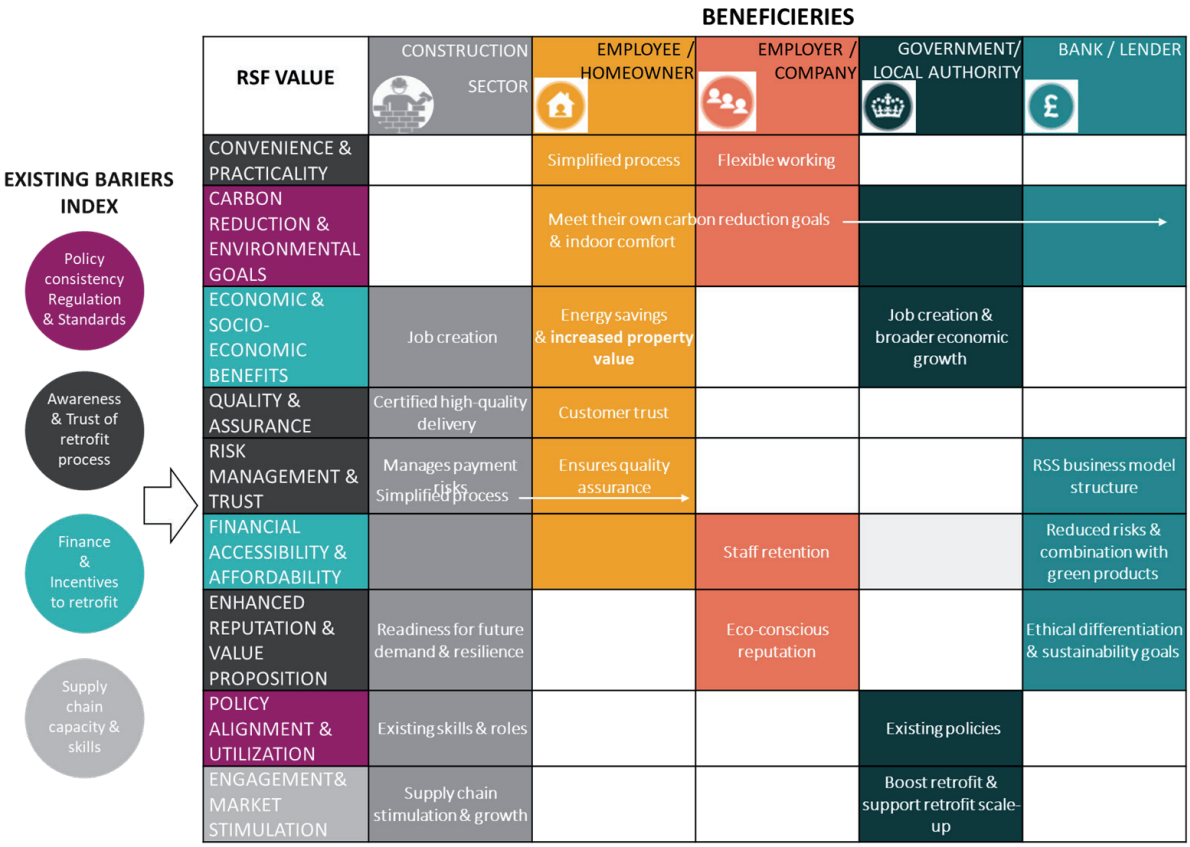



*Figure 3. The shared value of the Retrofit Salary Finance scheme is represented across the five actors and colour-coded within the existing barriers in retrofit (adapted from Topouzi, Mallaburn et al. (2023).*

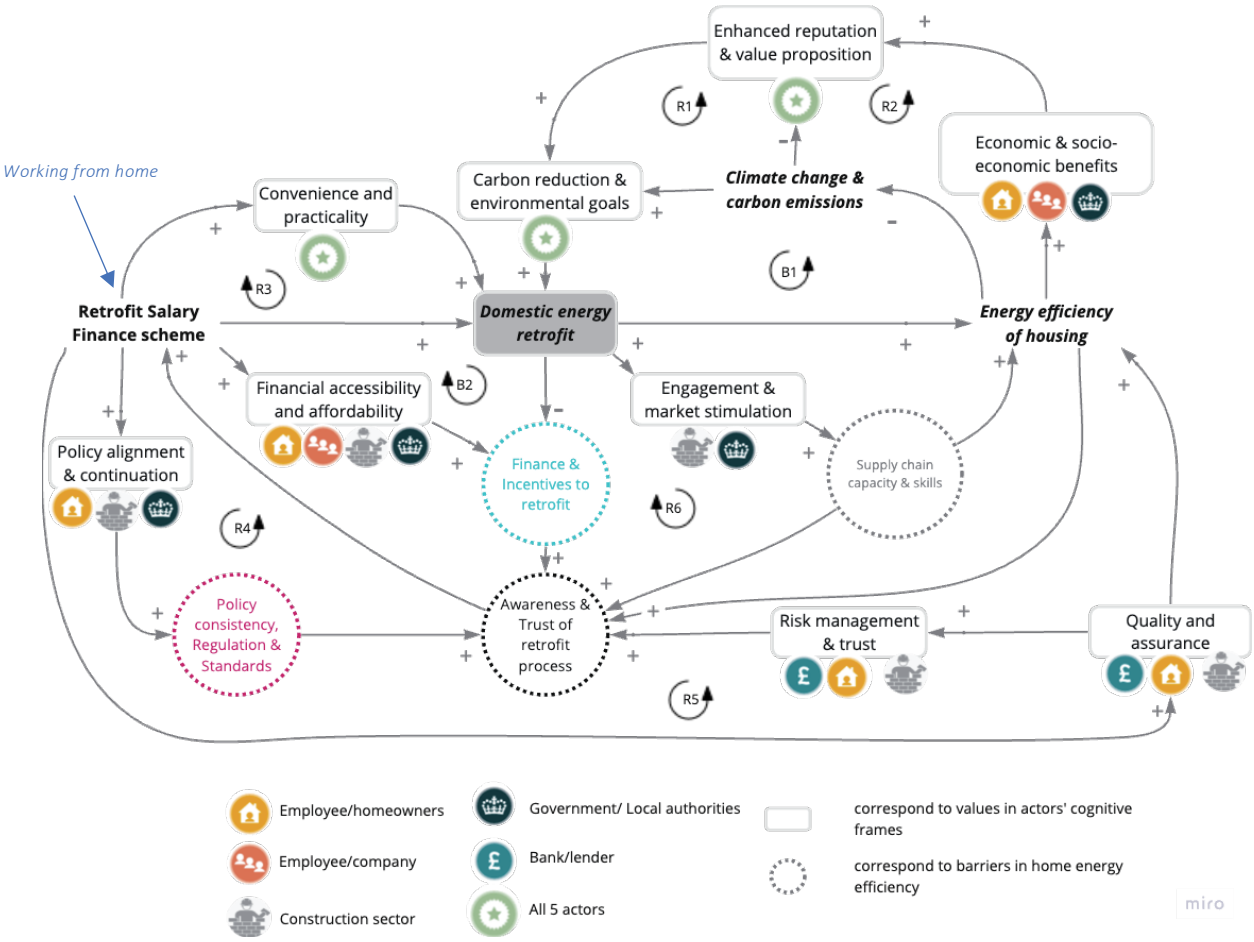



*Figure 4. Causal Loop Diagram (CLD) of actors shared cognitive frames regarding RSF scheme.*

*domestic energy retrofit and the subsequent energy efficiency of housing*. This goal depicted by the loop can be amplified through *enhanced reputation and value proposition* (R1) and wider *economic and socio-economic benefits* (R2). If retrofit is successful, the amplification inherent in the loops works in the desired direction, increasing reputation of the companies involved and delivering greater benefits to the population. However, if retrofit is unsuccessful, the amplification works in undesired direction, damaging the reputation and bringing harm to the population.

The second balancing loop (B2) shows how RSF scheme unlocks financial accessibility and affordability, providing *financial incentive to retrofit*, which builds *trust in the retrofit process* resulting in further implementation of the scheme. Eventually the dynamics are balanced out via diminishing return on investment as more measures are implemented. The RSF scheme also feeds into other causal relations, which can amplify the dynamics of implementing *domestic energy retrofit* in a desired or undesired direction. The RSF scheme is designed to provide *convenience and practicality* (R3), thus increasing domestic energy retrofit and the overall trust in the *retrofit process*. However, if not managed and delivered properly, it could have an opposite effect, resulting in increased complexity and implementation burden, resulting in further erosion of *trust* in the effectiveness of *energy retrofit process*. The RSF scheme builds on previous successful salary sacrifice schemes, and thus provides *policy alignment and continuation* (R4) and ultimately *policy consistency*. However, again, if not implemented correctly, it could fail to build such alignment and consistency. The RSF scheme intends to build in mechanisms for *quality and assurance* (R5), thus contributing to the increase of *energy efficiency of housing*. Again, if the mechanisms are poorly implemented, the dynamics switch to a vicious cycle with deteriorating *quality* and no improvements in *energy efficiency of housing*. Finally, if RSF scheme is successful in triggering domestic energy retrofit, it will result in *engagement and market stimulation* (R6), ultimately contributing to building *supply chain capacity and skills*.

## Synthesis and Discussion

The Casual Loop Diagram demonstrated loops and connections between actors' cognitive frames, emphasising the relationships of existing mechanisms within RSF and how they craft narratives and feedback loops that effectively promote home retrofit. The following discussion provides more detail on actors' cognitive frames and how they align with the current retrofit barrier narratives related to policy, the retrofit process, finance, and skills.

*Policy Consistency, Regulation and Standards*

In the broader high-level policy, stakeholders' cognitive frames of shared value are related to *carbon reduction and environmental goals*, as well as the principles of *policy alignment and continuity*. Homeowners and employees, in addition to achieving carbon reduction and personal environmental objectives, perceive the RSF as a means to reduce energy consumption and lower energy bills in their homes/home offices. Other stakeholders (government, construction sector and lenders) perceive the RSF as a tool not only to fulfil national net-zero goals but also to attain sector-specific carbon reduction targets, tailored to their respective sectors or organizations. The RSF is widely acknowledged within the five actors' groups as a consistent policy leverage for the construction sector and supply chain, as it aligns with and promotes established retrofit standards, retrofit services, and roles related to both retrofit and repair and maintenance. For actors from central and local government, the RSF combines and promote the adoption of existing policies, effectively addressing policy gaps such as income thresholds (with no current policy for retrofit in the UK supporting incomes above £31,000), comprehensive whole-house retrofit assessments and planning, and repair and maintenance for the already retrofitted and new stock. At the individual homeowner level, the *consistency and continuation* of a policy are closely tied to trust, stemming from the successful application of mechanisms proven effective in other sectors (bicycle schemes and EVs). Both homeowners and the construction sector perceive the scope of the scheme as supporting comprehensive retrofit projects rather than focusing solely on individual technological interventions.

*Finance and Incentives to Retrofit*

In terms of co-benefits, *access to finance and affordability* through the RSF appeared to vary among different stakeholders. Homeowners view the scheme as a solution to a significant barrier, providing access to funding for retrofit projects, encompassing both capital costs and the associated expenses. They see value in terms of cost-effectiveness through tax savings. For the government, the RSF is viewed as a mechanism that facilitates support for energy retrofit without imposing a financial burden on HM Treasury, compared to stand-alone subsidy-led programs. Meanwhile, the construction sector sees increased accessibility to funding for retrofit projects as an opportunity to attract and financially incentivise more potential clients who can afford energy retrofit work. Additionally, homeowners anticipate additional long-term benefits, such as savings on energy bills in their home /home office through reduced energy consumption after retrofitting. Employers recognise affordability benefits in terms of staff retention, stemming from a supportive employee culture that enhances the company's reputation.

Actors from the government (central and local authorities) and homeowners share a common appreciation of the RSF's *wider economic and socio-economic benefits*, particularly in relation to fuel prices and energy security. Resilience and future-proofing of the building stock are also perceived by both parties as means to address co-benefits related to household health, well-being, and comfort. For employers, the RSF is seen as a way to increase employee productivity due to improved home office conditions, thus mitigating the challenges posed by additional activities and responsibilities.

*Awareness and Trust to Retrofit Process*

Value related to *enhanced reputation and value proposition* varies in meaning between different actors from individual to collective. Homeowners can demonstrate their support for wider environmental values, including equality towards future generations. Employers are perceived to be providing a supportive company culture and helping staff retention by provide a safe environment for home office and flexible working. For actors like government, supply chain and lenders, the RSF perceived value is expressed in terms of corporate environmental identity to support the construction sector, enhance its reputation in energy retrofit and prepare for future demands. While for lenders it is also a means

to stimulate demand for green lending products and demonstrate their commitment to sustainable investing targets.

One of the key values associated with the scheme's design is its *convenience, clarity, and ease* of use. Employees have found the RSF process to be straightforward and transparent, supporting a customer-centred mechanism that streamlines administration and planning while simplifying the payment process through direct deductions from salaries, which builds on the precedents set by similar schemes. Clarity regarding roles and responsibilities, including procedures from assessment to delivery of works, is another aspect that emerged as shared value to *quality assurance, trust, and risk management* across all stakeholders (employers, employees, the construction sector, government, and lenders). For homeowners, the construction sector, and lenders, this clarity is seen as a means to ensure the quality assurance of retrofit work through skills accreditation, thereby ensuring high-quality delivery. Homeowners and lenders find their risks mitigated through the involvement of employers and HMRC as intermediaries, while for the construction sector, de-risking the process is associated with construction quality assurance and the payment mechanisms for the work.

*Supply Chain Capacity and Skills*

Trust is a crucial element of value in RSF that supports market stimulation and engagement. In the construction sector, this translates into the stimulation of retrofit demand, resulting in supply chain growth with consistent workloads. This, in turn, contributes to upskilling and enhances supply chain capacity, particularly at the local level. Similarly, for the government and local authorities, there is a shared value in terms of job creation and positive contributions to the broader economy when implementing a place-based approach for small-scale, local pilot projects, leveraging existing retrofit supply chain infrastructure.

## Conclusions

We have highlighted how the RSF concept works to enhance the delivery of shared value among various retrofit actor. Targeting the work-from-home homeowner provides an alternative approach to addressing existing barriers that are more challenging to tackle for this specific income group, as they may not adequately address specific changes related to home energy efficiency. Taking a wider system-level perspective, the causal loop diagram reveals the interconnections between the actors, their perspective of retrofit and the value and risk they associate with it. It crucially shows policy designers how value and risk are connected, and that risks can turn into value and vice versa depending on the perspective of the actor and the external influences acting of the sector. For example, supply chain capacity currently acts as a potent barrier, putting off the homeowners and affecting other values such as trust and quality. However, if the RSF accelerated the demand for retrofit from homeowners the supply chain, if properly supported, will react by upskilling and training more installers, and driving up the quality of the work and contributing to wider multiple benefits such as job creation. Similar positive feedback can be identified with employers, who are publicly seen as supportive and sustainable and enhances employee retention and welfare.

The RSF design's conceptual aspects enable adaptation to diverse contexts where retrofit mechanisms and services are pivotal in generating demand and bolstering existing mechanisms. Successful RSF implementation demands meticulous attention, including defining roles, effective cash flow management, and robust risk mitigation by various stakeholders involved in the process. Well-defined governance structures are essential, emphasising detail-oriented planning at the local and national levels. Catalysing the supply chain, streamlining cash flow, and refining roles and responsibilities require new narratives that understand specific changes. To ultimately facilitate retrofitting and prepare for future demand in the repair and maintenance improvement sector, innovative financial ideas and decentralized decision-making are essential in overcoming community adaptation to inherent complexities.

Retrofit initiatives pose significant challenges due to their inherently social nature. However, governmental approaches often frame retrofitting primarily as technological and financial problem, leading to systematic failures in implementation. The RSF provides a structured approach to transcend this misconception. It emphasises a holistic understanding of retrofitting challenges, empowering central and local governments to navigate complexities effectively. By aligning policies with market dynamics through RSF, multi-level governance can leverage market forces to support successful implementation.

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