Best Practice in European Public Support Schemes for Energy Efficiency

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Contents

Executive Summary

In this report, we examine a sample of five specific energy efficient renovation public support schemes, each from five different jurisdictions, that were either implemented or are currently being implemented (as of November 2022, the time this report was written). These include the KfW Energy Efficiency (Germany), the Green Deal (UK), the KredEx Revolving Fund (Estonia), Superbonus 110% (Italy) and PAREER II (Spain). Our aim is to identify and describe best policy practices that European policymakers and stakeholders can potentially replicate whilst defining and eventually executing similar programmes in the future.

In the first part of this report, we set the basic frame of the report, building on two Reports in this series[1], and look at the themes that are common to all programmes, namely their energy efficiency goals and background, implementation barriers these programmes and their impact and replicability. In the ensuing section, we delve into the specific traits of each scheme, using the previously defined methodological background.

In the last section, we include a Main Findings section, where we outline the factors that made some of these programmes excel and ultimately deliver positive EE outcomes, as well as learning experiences from less successful implementations.

[1] This group includes *Technical Report on relevant public support actions in relation to EEM EE policies in selected EEMM Database* (delivered in October 2022) and *Support Actions and Regulatory Instruments, an overview among selected European Countries* (delivered in November 2022).

Review of policies implemented across international energy efficiency schemes.

This paper reviews policies that have been applied across international energy efficiency ('EE') schemes, together with feedback received from several private sector market participants, alongside their views, to identify best practices in public sector actions that concern the energy efficiency of buildings.

Introduction – EEMI and the EE Schemes in Europe

The Energy Efficient Mortgages Initiative[2], or EEMI, is intended to design and deliver a market in energy efficient mortgages (EEM) as a stand-alone private sector financing mechanism. However, over time, it has become clear that a policy and consensus building framework among public institutions and markets is also critical to mobilise and effectively channel finance to energy efficiency investments. Coordination is required between multiple stakeholders (policy makers, regulators, banks, long-term investors and public financial institutions) in order to secure financing efficiencies and benefit from leverage effects.

In order deliver the multiple benefits of energy efficiency (EE) to European, national and local economies, EE investments must increase, regardless of the sources. Indeed, EE financing is a tool –in other words, a means to an end- that, if adequately deployed, can rapidly accelerate the growth of new, sustainable business models, facilitating the up-scaling of energy efficiency mortgage markets. The collaborative EEMI framework offers a flexible architecture to continue the joint development and exchange of EE policies, investment and financing tools and best practices to enhance capital flows to and scale-up EEM.

An efficient combination of EEM and public support schemes at both national and local level, as some of the programmes outlined here show, can be particularly effective, especially in markets where investment in energy efficiency and the residential real estate sector are currently negligible. Public financial institution programmes can work in a complimentary fashion to EEM and the market, rather than creating confusion or distortion of already established market practices. Moreover, public funds, tax breaks or grants can be used in recognition of wider social and economic benefits (employment, economic growth, affordable housing, and energy security, to name a few) and can take various forms, such as:

- public support or grants for verifiable energy improvements and savings which could be easily coupled to EEM eligibility criteria in terms of a single, streamlined application and approval process;
- support of independent energy (or technical) assessments which deliver trust and confidence into the origination of EEMs for both borrowers and lending institutions/investors;
- deployment of technical and project development assistance;
- participation in capacity building through training programmes to upskill market actors;

[2] For further information, the EMF-ECBC Energy Efficient Mortgages Initiative brings together the EU-funded Energy Efficient Mortgages Action Plan (EeMAP) and Energy Efficient Data Portal & Protocol (EeDaPP) Initiatives, with a view to delivering an integrated market EEM market. The Initiative is based on based on the realisation that: (i) banks, in financing the purchase of homes, can play a game-changing role in supporting the EU's energy savings targets, by bringing EE into the conversation between banks and consumers by means of a standardised approach to the financing of EE buildings/renovation, and (ii) it is essential to gather and access large-scale data relating to energy efficient mortgage assets (loan-by-loan) for the purpose of risk analysis by way of an accompanying data protocol and portal. Further information can be found on the official EEMI webpage, available here: https://energyefficientmortgages.eu/

- opportunities to lever retail distribution channels and build capacity and investment activities among local partner financial institutions, taking into consideration countries' national circumstances and priorities;
- effective implementation of existing energy efficiency legislation and effective local enforcement procedures, e.g. NZEB standards, EPC regimes, privacy, ownership and accessibility of energy data.

As part of an ample range of actions support Europe's efforts to build a broad and coherent financial environment that effectively supports global sustainable growth, the EEMI sets out, by means of this paper, to examine specific public sector actions that seek to establish and/or further expand EE upgrades, renovation and retrofitting different European jurisdictions. More particularly, from a methodological standpoint, the goal of this report is to firstly identify best practices in the design and execution of EE support schemes at national levels. Our commentary, however, shall also include references to potential shortcomings of these actions, since they can serve a "learning experiences," building toward a more robust groundwork for future EE actions. Thus, we will examine not only the most meaningful and positive aspects of the programmes, including their overall impact, but also the barriers and difficulties the schemes have endured during their lifetime.

This report furthermore provides supporting rationale and evidence on these programmes, shedding light on the particularities of each model and the outcomes of their implementation.

Such endeavour builds upon the work done in previous Reports[3] in this series and it is intended to provide relevant stakeholders and authorities with guidance on best EE practices, which would help them to prioritise between different government support actions, and ultimately deploy the most effective policy options.

At the time of writing of this report (November 2022), our colleagues at Ca Foscari University Venice have identified 283 relevant EE public support programmes in place in Europe, distributed across 17 different countries[4]. Given the wide range of approaches to the issue of energy efficiency, each with their own national nuances, this report will consider a sample of five (5) programmes that could help illustrate this diversity.

The public support schemes chosen for the purpose of this study are:

- KFW Energy Efficiency Scheme (Germany)
- KREDEX (Estonia)
- Superbonus 110% Fiscal Scheme (Italy)
- PAREER II (Spain)
- UK Green Deal

These programmes were chosen for several reasons. First and foremost, these provide an up-to-date perspective as to current EE renovation trends in Europe, shedding light on the specific practices and goals that both credit institutions and public authorities can potentially emulate in their markets and/or jurisdictions. Secondly, most of these have a proven track record, as it will be shown in the relevant section, as they had a clear impact on mortgage and housing markets, aiding stakeholders to tailor, introduce and gradually develop EE solutions in their countries. Additionally, and further completing the previous point, the public support schemes considered here also provide clear indications about the constraints and drawbacks linked to their design and implementation. Moreover, most of these programmes were put forward in countries where extensive and

[3] As indicated in Footnote 1.

[4] The report entitled "Support Actions and Regulatory Instruments, an overview among selected European Countries" includes a non-exhaustive sample containing the indicated number of finished and ongoing programmes, all implemented across a select range of European countries. The sample was used to understand the distribution of EE programmes, determining which types were more predominant and which sustainability objectives they were designed for.

comprehensive efforts are already underway to ensure that consumers, builders, lenders and public institutions can cooperate and contribute altogether to shaping national green mortgage markets. A prime example of such efforts is the *EEMI National Market Hubs*, which span over 10 countries in Europe, and enable all market actors to research and discuss the most pressing issues that concern EE and overall sustainability of residential and commercial buildings[5].

Lastly, these programmes have been the subject of objective review by the European Commission. Indeed, the European Construction Sector Observatory (ECSO) has published a collection of reports examining a series of individual schemes designed to deliver on Thematic objectives 1 (investment support), 3 (improvement of resource efficiency and/or environmental performances) and 4 (strengthening of the internal market for construction)[6], which are aligned with the object of study of this paper. This means that many of the programmes chosen here have gone through a degree of scrutiny, which will be considered in our observations and commentary.

A particular note about Estonia's KREDEX is warranted. Indeed, despite being somewhat of an outlying country in the EEMI environment and the programme's absence in the previous Reports in this series (to recall, the scheme concluded before the previous Reports' timeframes), Estonia has taken significant steps towards the uptake of EE solutions, arguably more decidedly than other EU countries. As such, it was considered sensible, from a critical perspective, to include Estonia in our public scheme sample. Furthermore, as will be shown here, KREDEX has had a striking effect at market level, facilitating costumer access to EE upgrades and improvements through a combination of financial instruments and the close cooperation of different stakeholders directly involved in renovation work. All in all, a clear example of practical public EE policy.

The input used to carry out this policy review was primarily grey literature, e.g. from government departments, agency reports, consultancy reports, working papers, including the ECSO fact sheets. Discussions with energy efficiency market participants were also taken into account, in the context of the abovementioned EEMI.

Common themes from international energy efficiency schemes – setting the stage

To start off, by *public support actions* or *schemes*, we refer to, as indicated in *Support Actions and Regulatory Instruments, an overview among selected European Countries*, cited in a previous section, individual financial policies, fiscal policies or market-based instruments, or a combination of these, employed by public bodies to encourage EE improvements by lowering households' upfront upgrade costs[7]. These include, but are not limited to, grants, subsidies or soft loans.

We provide here an overview of the common themes that will be considered in this paper, namely: the specific EE goals and interventions, financial features, implementation barriers and the replicability potential. Identifying these key features will not only help characterise EE support schemes we will focus on, but also pinpoint the elements that can be replicated across different jurisdictions or used to enhance similar programmes. Both will help draw, as is the goal of this report, important lessons on how to design public support programmes in a way that they perform efficiently and effectively, make best use of government resources, and reproduce the success of policies used and evidenced elsewhere.

[5] As of November 2022, there are active national hubs in Belgium, Germany, Hungary, Italy, the Netherlands, Spain, the UK and in the Nordic region (which includes Denmark, Sweden and Finland). Specific projects are being developed locally to further facilitate the uptake of EE solutions in these jurisdictions, in line with the EEMI's goals. More information can be found on the EEMI webpage, as per Footnote 2.

[6] European Commission – Internal Market, Industry, Entrepreneurship and SMEs: Objectives of the European construction observatory, Source: https://single-market-economy.ec.europa.eu/sectors/construction/observatory/objectives_en

[7] Trotta G., Spangenberg, J. & Lorek, S. (2018) Energy efficiency in the residential sector: identification of promising policy instruments and private initiatives among selected European countries. Energy Efficiency 11, 2111–2135.

EE goals and interventions – background information

- EE schemes across Europe have implemented some form of legislation for progressive levels of mandatory energy efficiency works to be undertaken, as the papers linked to this one show. Regulations and standards are typically framed within the context of national climate and/or targets and include roadmaps and milestones. These indications are intended to help stakeholders better allocate resources and policymakers decide on the duration and continuity of a scheme. For instance, given that building renovations are at the core of these schemes, energy performance targets appear to require the building stock (public and residential dwellings) to be improved/upgraded to a specific energy performance level in a certain number of years.

- The timing and the approach to renovation funding is also relevant, since the interventions that we will focus on are typically limited and are expected to have a long-term impact, not only on the dwelling that is being upgraded but also on high-level energy indicators.

- The types of specific technical interventions that are funded, such as insulation or the installation of new heating sources, to name a couple of examples, is another fundamental part of the scheme.

Other characteristics that can be considered are:

- The accessibility and transparency of the programmes (for instance, if the scheme encourages participation by potential costumers whilst limiting the administrative burden)

- The participation of trusted intermediaries for the successful delivery of energy efficiency programmes. Similarly, stakeholder engagement can prove crucial, as strategic partnership can help potentially drive EE renovations or upgrades.

- Lastly, public consultation and communication, which make the programmes better known, potentially expanding the interest in EE household improvements and renovations and ultimately help build confidence in these interventions.

Financial Features

- **Attractive financial support:** EE support should have a clear and effective financial proposition to achieve sufficient EE uptake. This can take the form of loans (with low interest rates) and grants, or a combination thereof. Loans can moreover be implemented alongside potential grant schemes where required.

- **Fiscal Incentives:** tax breaks, incentives, dis-incentives, as well as rebates have been widely used in various forms across energy efficiency schemes. VAT reductions on renovation and refurbishment of residential buildings, as well as equipment and material costs, can also be considered within the scope.

Barriers

As the name suggests, barriers are obstacles, whether technical or practical, that hinder the effectiveness of a support scheme and prevent it from delivering the expected outcomes. Some of the most barriers that we expect to find are:

- **Budgetary constraints:** Programmes that depend on annual budgets (e.g. as part of the national public budget, decentralised/regional stimulus programmes or utility funding programmes) often suffer from the limited funds allocated to them. Once the funds are exhausted this can lead to a start-stop cycle with significant impacts on industry.

- **Lack of long-term certainty:** Long-term investments into the energy efficiency industry require long-term certainty. Programmes that are at risk of being affected by funding cuts or even terminated before completion do not bolster investors' confidence. Similarly, programmes that depend on a set target of energy savings to be reached (such as EEOs) can suffer from frequent changes to the target which has repercussions for the industry as well.

- **Lack of buy-in from stakeholders**: Particularly in the early stages of a new programme scepticism and lack of buy in from stakeholders appears to severely limit the uptake of a programme.

- **Incomplete information**: can lead to risk aversion, where savings are underestimated and installation costs overstated, creating a cost-savings gap.

- **Supply chain constraints:** If a programme increases the levels of activity in the market for energy efficiency retrofits very quickly, this could lead to supply-side capacity constraints.

- **Complex application procedures:** If the application process is burdensome and not transparent, demand for support from the programme is likely to be limited or at least remain below its potential.

Other potential barriers that EE support schemes can encounter are:

- **Limited potential for low-cost measures:** As uptake on schemes increases, the potential for low-cost measures gets depleted. This means that the finance model requires adjustments allowing for more capital-intensive measures to be supported.

- **Complex administrative procedures:** In addition to the application procedures from the perspective of the applicant there can be tedious and complex administrative procedures for the other stakeholders involved.

- **Comparatively high costs of contribution from consumer**

Impact & Replicability

Impact-wise, our main focus will be to ascertain if the schemes examined here have produced the expected results, bearing in mind its goals and means. There is a wide range of indicators that can be used to determine this, in view of the different criteria used to measure how a given programme progresses. A successful scheme will most probably meet the metrics and thresholds established beforehand.

Replicability, more than an item subject to examination, will be, for the purpose of this report, an assessment as to whether a programme is successful enough —i.e., it has a comparatively solid or consistent framework, is implemented according to clear guidelines and has managed to deliver either the expected or overall positive EE outcomes, relative to its original goals— and could eventually be executed, without or without a degree of adaptation, in jurisdictions different than the one of inception.

These two aspects will, in concert, shed light on whether a scheme can be considered "good practice", a benchmark policymakers and stakeholders can try to follow as they put forward specific actions relating to national EE roadmaps and agendas.

Case Studies – Key EE Programmes in the European Union

The following section provides granular information and commentary on the five selected schemes from Europe, their methodology to developing their energy efficiency programme and key learnings that were obtained from the schemes. The schemes selected are highlighted below, with an overview of components and why they may be of particular use for stakeholders in the field of energy efficiency.

Public Support Scheme	Period	Country	Key Information	Objective(s)
KfW Renovation Scheme	2015	Germany	• A long established and highly successful scheme • Encouragement of 'deep' renovation. • Large fossil fuel component to energy mix • Interesting flexible loan scheme	Facilitate EE renovations for homeowner Improvement of the building stock Mobilise private investment towards EE projects
KredEx & Renovation Loan and Grant Scheme for Apartment Buildings	2009-2014 & 2015-2020	Estonia	• Use of revolving loan fund combining loans and grants • State and EU sponsored funding	EE renovations for homeowner
Green Deal	June 2014 - September 2015	United Kingdom	• Loan-based funding for homeowners • "Pay as you save" loan scheme	Improve the UK's building stock overall energy performance (i.e, reduce CO2 emissions of British residential dwellings)
Superbonus 110% Fiscal Scheme	June 2020 - December 2023 (*exceptions apply*)	Italy	• Ongoing fiscal incentive programme • Helps finance specific interventions on private properties (targeted approach)	Tax relief scheme to incentivize EE and structural renovations or improvements to private properties Contribute to Italy's climate agenda and energy policies
PAREER II	2020	Spain	• Government-led grants and subsidy programme • Designed to support energy efficiency improvements in existing buildings	Fund renovations that help reduce CO2 emissions or final energy consumptions for legally registered buildings constructed prior to 2007

KfW Energy Efficiency Scheme – Germany

1) Key features of the programme

Germany's long-term energy and climate goals include achieving a climate-neutral building stock by 2050, which, in turn, is an intricate part of the country's more wide-ranging *Energiewende* or energy transition[8]. To accomplish this, the German government has sought to improve the funding of EE measures. The EE financing "pillar" was moreover accompanied by two other pillars, namely regulatory changes and information campaigns[9]. EE measures were also accompanied by standalone,

[8] Federal Ministry for Economic Affairs and Energy (2020): Germany's Energy Efficiency Strategy 2050. Source: https://www.energypartnership.cn/fileadmin/user_upload/china/media_elements/Documents/200407_BMWi_Dossier_Energy_Efficiency_Strategy_2050.pdf

[9] Heinrich Böll Stiftung Tel Aviv (2022) Energy efficiency in Germany - What is at stake? Source: https://il.boell.org/en/2022/04/04/energy-efficiency-germany-whatstake#:~:text=Regarding%20energy%20savings%20and%20energy,transport%20and%20the%20building%20sector.

yet mutually supportive initiatives, such as programmes to facilitate the development of renewable energy capabilities or measures fostering industrial competitiveness by way of energy savings, to name but a few.

In this context, the KfW Development Bank, a credit institution owned by the Federal Government and the federal states, began allocating resources to the promotion and financing of energy-efficient refurbishment of residential property across the country[10]. The means used for this purpose include a combination of low interest rate loans and subsidies. Additionally, the development bank has contributed to the the construction of new buildings with a low energy requirement.

The EE support programme set up by KfW, entitled *Energy Efficiency Refurbishment*, targets the overall building section, offering long-term, low-interest loans for comprehensive refurbishment of dwelling, as long as these modifications are aimed at saving energy and reducing CO2 emissions in existing residential buildings[11].

2) Financial features and implementation – How it works

Despite it being a state-owned credit entity, KfW is essentially funded by way of capital markets, benefitting from both a AAA credit rating among investors and a 100%-guarantee from the German government, its majority shareholder. Another distinguishing aspect of KfW is that it solely relies on partnerships with private banks and insurance companies to distribute its financial products (that is, provide funding), since the institution does not have retail branches of its own. This is further underpinned by the fact that KfW support to banks is generally ample. Against this background, private banks are responsible for evaluating borrower risks before issuing loans or granting any financial product to potential clients, in view of their proximity to customers, while credit risks are distributed across different institutions, in the context of a nationally defined financial scheme. Clients in turn enjoy access to funding programmes, supported by a state-owned institution, that are transparent and have clearly defined conditions[12].

As to KfW's building refurbishment programme, it is designed as a promotional scheme offering long-term, favourable interest rates for the particular purpose of increasing the energy performance of buildings and decreasing greenhouse gas emissions. As of 2015, borrowers can obtain a repayment bonus of up to 22.5%, depending on the Energy Efficiency Standard of the dwelling[13].

Additionally, beneficiaries have a right to a grant for construction planning and supervision from an independent party (covering 50% of the cost, up to EUR 4,000), should funding be approved.

3) Barriers

KfW has a proven track record and has been delivering consistently. However, despite the apparent robustness of the programme and the underlying framework, this institution faces two main, closely intertwined barriers: ensuring long-term consumer access to renovation-related funding and effectively contributing to the overhaul of the German housing stock. Indeed, Germany's residential housing stock, according to the latest available data[14], is mainly made up of dwellings built between 1946 and 1981, which represent altogether 46.5% of the total national structure, and houses built

[10] About KfW – Source: https://www.kfw.de/About-KfW/#:~:text=KfW%20is%20one%20of%20the,107%20billion%20in%202021%20alone.

[11] KfW (2015): KfW 'Energy-Efficient Refurbishment' programme becomes even more attractive. Source: https://www.kfw.de/About-KfW/Newsroom/Latest-News/Pressemitteilungen-Details_254272.html

[12] Loans are encouraged by means of a repayment bonuses, which is higher than the grant option, and through subsidising the low interest loan (currently 0.75%) with a maturity of up to 30 years. This includes up to 5 repayment-free start-up years and a fixed-interest period of up to 10 years. The loan can cover up to 100% of eligible costs, to a maximum of EUR 100,000 per housing unit for a KfW Efficiency House, and up to EUR 50,000 for individual measures.

[13] KfW (2015): KfW 'Energy-Efficient Refurbishment' programme becomes even more attractive. Source: https://www.kfw.de/About-KfW/Newsroom/Latest-News/Pressemitteilungen-Details_254272.html

[14] EMF Hypostat 2022 (page 40) & Eurostat Population and Housing Censuses (data from 2011).

before 1919 (14% of the share) and between 1919 and 1945 (10%). In view of this fundamental economic challenge, for it to remain an instrumental catalyst of EE improvements and upgrades, the German development bank will likely have to take into account the diverse EE needs in its jurisdiction, particularly when it comes to improving the energy performance of residential buildings constructed before or during the first half of the XX century and in line with the desired energy performance scores. This would not only test the effectiveness of the KfW led EE schemes, but also measure the actual reach of this institution in the field of EE renovations.

4) Impact and potential replicability

According to the Buildings Performance Institute of Europe (BPIE)[15], KfW is clearly poised as a "best practice" example, delivering a high leverage of private investment from public funds. The programme had significant strongpoints that came to bear during its lifetime.

Regarding the programme's budget, the average total endowment for KfW building sector schemes was EUR 1.8 bn between 2012 and 2014, one of the largest dedicated to this type of interventions. The resources used during each exercise were scrutinised by independent experts, financed by both the German federal government and KfW proper.

The second aspect that stands out is the flexibility of the KfW programmes, as well as the awareness work done to encourage new clients to undertake EE renovations of their properties. It is also a prudent programme, as not all clients will ultimately meet the requirements established to receive support funding.

All in all, KfW's approach to EE renovations and upgrades is clearly embedded in and reminiscent of Germany's wide-ranging strategy to make the country's residential building more energy efficient and environmentally sustainable. Granted, some specific measures might not easily translate into other jurisdictions, yet these can serve as potential benchmark for policymakers involved in designing energy efficient support schemes elsewhere.

As the KfW shows, there is a clear and enforceable framework in place, with granular information as to the type of interventions that can be backed financially. This not only helps establish a precedent, which serves as a sort of legal safeguard, but also generates new incentives to draw potential customers in, offering favourable repayable loans or grants linked to performance objectives. Moreover, the addition of qualified expert council and technical support aid in delivering a more favourable experience for costumers. Lastly, concerning the energy-saving side of the narrative, the requirements established by the KfW scheme are measurable and do in fact contribute to the improvement of a given residential building's energy performance, ultimately helping to reduce overall CO2 emissions. Environmental and sustainability related improvements are furthermore gradual but steady, thanks to the "whole house approach" to energy saving, and provide both homeowners and builders involved in the renovation a clearer roadmap as to the EE improvements to be carried out.

[15] BPIE (2015): Renovation in Practice. Best Practice Examples of voluntary and mandatory initialise across Europe – Summary Version. Source: https://www.bpie.eu/wp-content/uploads/2016/04/BPIE_executive_briefing-Renovation_in_practice2015.pdf

KredEx Revolving Fund – Estonia

1) Key features of the programme

The KredEx Revolving Fund, or simply KredEx Fund, is a revolving energy efficiency fund established in 2009 as part of the government-owned, non-profit financial institution KredEx Foundation (merged as of 2021 into the Estonian Business and Innovation Agency)[16]. In addition to the Estonian Ministry of Economic Affairs and Communications, the Fund is also supported by a diversity of institutions, most notably the European Regional Development Fund (ERDF) and the Council of Europe Development Bank (CEB).

From a practical standpoint, KredEx provides a revolving finance[17] support scheme linked to a wide-ranging energy efficiency strategy, including the improvement of energy savings and the reduction of energy consumption of Estonian houses, particularly those of low quality and low energy efficiency, according to the EU-sponsored Citynvest Project[18]. It combines loans and grants for this purpose, as well as loan guarantees. Its main target is multi-family apartment building owners and housing associations. The Fund also manages EE grants on behalf of the Estonian authorities, both national and local.

The KredEx programme is moreover part of the Estonian governments plan to align national energy efficiency measures with European climate policies and energy package, and is also closely linked to the European Regional Development Fund, which provides financing for sustainable urban development.

The basis of the scheme relates to two structural concerns surrounding the Estonian building stock. In 2009, the year KredEx was launched, the combined building stock of Estonia represented 50% of the overall final energy consumption (the EU average was 37.5%). In addition, approximately 60% of Estonian families lived in apartment buildings built between 1961 and 1990 (30% before 1960)[19].

These two factors were indicative of poorly performing building stock, which needed to be addressed by authorities. The pre-2009 legal framework also contributed to the state of Estonian housing, as were no legal obligations to insulate buildings or to provide efficient technical systems such as heating in buildings. As a result, Estonian buildings are wasteful in terms of energy use, having an average heating energy demand of around 200-400 kWh/m2 per annum[20].

This poor energy efficiency, combined with the fact that the majority of the population lives in Estonia's urban areas, with three out of four people residing in apartment blocks, led to the Estonian Government establishing the KredEx Foundation and the subsequent KredEx fund.

2) Financial features and implementation – How it works

Originally based on grants, in 2009, KredEx renovation finance changed its structure to a revolving loan fund. KredEx manages the revolving fund, the first of its kind to use EU Structural Funds to provide

[16] KredEX (2021): Who we are. Source: https://kredex.ee/en/who-we-are/sa-kredex

[17] According to Investopedia, "*[r]evolving credit is an agreement that permits an account holder to borrow money repeatedly up to a set dollar limit while repaying a portion of the current balance due in regular payments. Each payment, minus the interest and fees charged, replenishes the amount available to the account holder*". Source: https://www.investopedia.com/terms/r/revolvingcredit.asp

[18] Citynvest (2015): KredEx Revolving Fund for energy efficiency in apartment buildingshttp://citynvest.eu/content/kredex-revolving-fund-energy-efficiency-apartment-buildings

[19] EMF Hypostat 2022 (page 40) & Eurostat Population and Housing Censuses (data from 2011).

[20] BPIE (2015): Renovation in Practice: Best Practice Examples of Voluntary and Mandatory Initiatives across Europe. Source: http://bpie.eu/wp-content/uploads/2015/12/Renovation-in-practice_08.pdf

low-interest loans to housing associations and municipalities through organisations such as the European Investment Bank.

This funding mechanism provides the housing sector with an opportunity to reuse funds going into the scheme to further renovate the building stock.

KredEx coordinate various operational aspects of the fund, as follows: The Ministry of Economic Affairs and Communications steer project progress, while commercial banks take on lenders' risks through checking borrower eligibility, repaying the loan to the bank and checking compliance. In the meantime, housing associations organise apartment owners, managing the project proposal, reporting to banks and collecting loan repayments. Finally, apartment owners making a collective agreement to undertake the block renovation.

KredEx's model is a holistic package that combines incentives and limitation, in an effort to favour the uptake of EE upgrades across the Estonian market. This includes awareness-raising campaigns and training days for members of housing associations and energy auditors.

Regarding the specific requirements of the loan scheme, the basic condition to be met is that an apartment block to be renovated must have been built before 1993. Beneficiaries would then follow a mandatory 5-step process, according to the BPIE report previously cited and ECSO[21]:

1. Carry out an energy audit at the start of the application process (undertaken by a licensed, accredited and independent auditing company). The energy auditor takes measurements, collects data, provides a technical overview of the state of the building to identify the baseline energy consumption and proposes energy efficiency refurbishment measures that will lead to reductions in energy consumption of at least 20%.
2. The measures recommended by the audit are then used in the building design documents.
3. A tender is written for the renovation of the building.
4. The housing association applies will apply for the loans and grants from the banks to the buildings.
5. The winning contractor completes the renovation that is supported by the loan and grant payments.

The technical aspects of each project differ depending on the needs of the building and the results of the audit. Normally, the improvement works will consist of: Thermal insulation of the roof, walls/façade, cellar/roof ceiling; New windows and external doors; New or renovated heating system; New or renovated ventilation system; or Installation of renewable energy devices.

To ensure specific EE renovations have successfully reduced energy consumption, the prime goal of the whole scheme, KredEx requires regular reporting of monitored and verified energy data. The requirement demands annually metered energy consumption data for heat and hot water in kWh/yr. By checking invoices from heating companies, KredEx carries out spot checks on around 5% of the beneficiaries.

From a financial standpoint, the revolving fund has a total capital of EU 72 mn, financed by the European Regional Development Fund (with a contribution of EUR 17 mn of ERDF equity), the Council of Europe Development Bank (by way of a EUR 28.8 mn loan), the State (loan of EUR 16 mn) and the KredEx Fund proper (EUR 10 mn investment). The structural fund contribution allows for interest rates to be lowered and this enables KredEx to provide final recipients with preferential loans.

[21] BPIE (2015): Renovation in Practice: Best Practice Examples of Voluntary and Mandatory Initiatives across Europe. Source: http://bpie.eu/wp-content/uploads/2015/12/Renovation-in-practice_08.pdf & European Construction Sector Observatory (2017): *Policy measure fact sheet - Estonia-Renovation Loan and Grant Scheme for Apartment Buildings*.

The funding procedure generally works as follows, according to BPIE and ECSO (cited previously):

Apartment/building associations and communities of apartments can apply for the loans, providing the building contains at least 3 apartments.

- Following a mandatory energy audit, loans can be used to finance measures that lead to an improvement in energy efficiency of at least 20% for buildings up to 2,000 m2 or at least 30% improvement for larger buildings.
- Loans are paid back through the energy savings.
- The minimum loan is EUR 6,400 per apartment.
- The loan maturity period is up to 20 years.
- Average interest rates in 2012 were between 3.5% and 4%, fixed for 10 years.
- At least 15% of the total awarded loan must be co-financed by the final recipients. The KredEx grant can be combined with the loan. The grant rate depends on the expected energy savings:
    - 15% grant if saving 20-30%, achieving energy label E and energy consumption < 250 kWh/m²a;
    - 25% grant if saving 40%, achieving energy label D and energy consumption < 200 kWh/m²a;
    - 35% grant if saving 50%, achieving energy label C and energy consumption < 150 kWh/m²a.

3) Barriers

Despite its generally consistent design and clear implementation guidelines, KredEx has three key limitations to consider, based on the European construction sector observatory analysis[22]:

- Firstly, some technical aspects of the scheme would require a careful revision, for instance, when considering the features of a building under renovation, or as regards the technical advice provided to applicants.

- Continuity is, furthermore, is not hardwired into the KredEx programme, since it is devised as a "stop-start" scheme (i.e., there are no follow-up actions once the intervention is complete). Therefore, in order to build on the momentum generated by previously funded actions, follow-up programmes can extend the reach and generate more favourable outcomes for the housing stock.

- Lastly, despite the efficient combination of loans and grant funding, which further expand financing opportunities, KredEx relied heavily on EU funds, a source of funding that can vary greatly across European jurisdictions.

4) Impact and potential for replicability

The programme used a relatively complex funding mechanism, which in turn required an equally intricate governance and management arrangement. Such framework had to ensure a degree of flexibility as well, in order for the programme to cover all the funding and operational parameters established by the relevant authorities.

Given that EE renovations need large investments, the challenge with KredEx lied in creating useful incentives to mobilise both capital and customers, especially if we consider that home renovations within individual apartments can vary significantly and, broadly considered, can be expensive. In this

[22] European Construction Sector Observatory (2017): *Policy measure fact sheet - Estonia-Renovation Loan and Grant Scheme for Apartment Buildings*.

case, as KredEx showed, a grant scheme can be instrumental in stimulating homeowner demand for EE-related home upgrades.
Another aspect in which Kredx can set a practical example is in managing administrative costs, as they are "outsourced" to private banks, thereby allowing the fund to focus on supporting EE solutions across the country.

Lastly, Kredex is built on the need to address structural challenges pertaining to the Estonian Kredex building stock, which have sufficient scientific backing and make for a more targeted approach.

Superbonus 110% Fiscal Scheme – Italy

1) Key features of the programme

The Italian Superbonus, first established in June 2020 by the Italian national government, is an ongoing fiscal incentive programme that comprises two separate arrangements or sub-schemes: the so-called Super Eco-bonus, aimed at supporting EE-related building improvements, and the Super Sismabonus, which focuses on improvements pertaining to the structural safety of buildings in the context of high seismic activity.

The broader fiscal scheme was designed to relaunch the national construction section, following a decade-long period of sectoral underperformance, and meet Italy's climate goals, in accordance with the country's Integrated National Energy and Climate Plan. More particularly, the Superbonus was devised, according to ECSO and the European Commission[23], as a tax relief scheme that would enable homeowners, as well as civil society organisations and social housing institutions, to commission EE and structural renovations or improvements to their property. The Italian public administration would cover 110% of the costs of all interventions.

Overall, the programme is an advantageous and comprehensive fiscal plan that seeks to prompt wide-ranging changes in the Italian economy through a combination of individual interventions, which can lead to potentially positive knock-off effects. Therefore, in addition to restarting a traditional business sector -especially one that represents more than 18% of Italy's gross value added[24], that of real estate construction-, this programme can ultimately lead to a more robust, sustainable and potentially innovative housing stock, far removed from its current state.

2) Financial Features and Implementation – How it works

As a tax incentive, the Superbonus seeks to encourage homeowner and other relevant actors to improve specific aspects of their residential buildings, thereby supporting modification that help adapt buildings to better EE standards. The programme is comprehensive in terms of eligible interventions, yet some exceptions apply. Among the main EE interventions, the Superbonus covers renovations on the thermal insulation of buildings, as well as the replacement of heating and air conditioning equipment. Additional interventions include, among others, the installation of EE solutions -such as domestic automation systems, solar shields or heat pumps, to name a few-, photovoltaic systems, and/or electric vehicle infrastructure.

To be eligible, the interventions must improve the energy performance of a given building or property by at least two classes. This must later be certified by independent technicians and supervisory bodies.

As per the underlying legislation, Italian homeowners can choose between three different methods to finance their EE improvements.

- Firstly, they can bear the full costs of the interventions and obtain a 110% tax deduction.

[23] European Construction Sector Observatory: Policy Fact Sheet – Italy, Superbonus 110%, November 2021.
[24] Source: Eurostat

- Obtain a tax credit to third parties, as a form of liquidity.

- Opt for an invoice discount of up to 100% of the total invoice amount[25].

The application process for the Superbonus is divided into two tracks, one for each of the sub-schemes. Regarding the Eco-bonus, applying homeowners must ensure that the interventions are eligible under the Superbonus framework (i.e., upgrade the property by two steps on the energy performance scale of reference). EE renovations are furthermore scrutinised to ensure that they are completed correctly, and the costs are adequate. Official certification is provided to ascertain the compliance of the finished interventions, namely by the ENEA national agency.

3) Barriers

When referring to the programme's shortcoming, some aspects have room for improvement:

- Firstly, the objectives of the programme are not fully clear. Financing individual renovation projects aimed at either improving buildings EE rating or making these more structurally stable. These can constitute independent goals or can contribute to achieve other policy objectives. However, the Superbonus comprises both local and wider-ranging goals in its framework, which can make the programme more complex and perhaps less practical.

- There is an administrative overburden in the shape of red tape, which can slowdown the completion of several renovation works, thus hindering the programme's impact.

- At the time of writing (mid 2022), the implementation of the Superbonus faces significant supply-side challenges, namely the availability of construction material or a qualified workforce, which have led to price increases in construction projects and/or to noticeable delays.

- Lastly, the level of public expenditure can be significant for public authorities and can potentially deteriorate Italian public finances. There are, therefore, question as to whether and how to extend the programme, despite its relative success.

4) Impact and potential replicability

Even though the programme is still ongoing, its impact can be considered positive to a large extent. Firstly, it has helped restart the Italian construction sector to a certain degree, thus achieving one of the policy goals initially set out. Furthermore, it is a programme with an environmental angle, in that it seeks to transform the construction activity, reducing its carbon footprint, and make the Italian dwelling stock more sustainable through the renovation and/or rehabilitation of existing buildings, particularly residential dwellings.

Overall, the programme has been able to mobilise significant resources to finance different specific interventions which, as a whole, can render positive economic and environmental knock-off effects. It also involves individuals and households in the endeavour, prompting a demand for sustainable solutions that can help families save in energy costs.

This scheme, in spite of its barriers, can serve as a pilot tax incentive plan to kickstart EE projects in another jurisdiction and can be adapted to meet the specific situation of different national/regional scenarios. However, the outcomes of this programme will only be known once it run its full course, and its impact properly assessed.

[25] Under this option, the contracted firms receive a tax credit equal to 110% of the discount applied. The renovations can thus be commission without expenditure on the part of the homeowner.

PAREER II Programme – Spain

1) Key features of the programme

Launched in February 2018, PAREER II was a government-led grants and funding programme designed to support energy efficiency improvements in existing buildings, mainly residential, across Spain. Building renovations are at the core of the government's strategy to fulfil European climate and sustainability goals, especially considering the particular aspects of the national building stock. Multi-family buildings, i.e. apartment buildings, represent more than two thirds of the country's residential building stock most of which were built between 1970 and the 2000s[26]. Furthermore, the country's building sector amounts to more than 30% of total energy consumption, making it one of the most environmentally meaningful sectors of the economy. The importance of these two factors is further underpinned by the transposition of the EU Energy Efficiency Directive, which requires Member States to reduce final energy consumption, promote the use of renewable energy sources and, ultimately, contribute to the reduction of CO2 emissions across a variety of sectors, including but not limited to construction and real estate.

The programme was implemented by the Institute for Diversification and Energy Savings, a public body dependent on the Ministry of Energy, which manages a diversity of building renovation support schemes, many of which work towards improving energy efficiency standards. PAREER II in particular is devised as a sort of "continuation programme", building on the experience (and success) of the PAREER-CRECER plan of 2013-2016. Its purpose, as that of its predecessor programme, was to further encourage and financially support energy efficiency and/or renewable energy refurbishments in existing dwellings, regardless of their use or legal status of their owners.

The programme ran until December 2018 and had an initial endowment of EUR 125.6 mn, which grew to EUR 204 mn by the end of its life cycle. As it will be explained below, the scheme foresaw the use of basic grants to cover between 20% and 30% of total eligible costs. On top of the former instrument, the scheme included an "add-on" grant for specific buildings and the option for potential beneficiaries to receive a loan for the 60%-70% of total eligible costs. Overall, the programme was successful, in view of the high demand and the application rate, and had an apparently positive impact on the energy rating of targeted buildings. However, there were significant limitations in terms of design and budget to bear, similar to those that have been described in this paper.

2) Financial Features and Implementation – How it works[27]

PAREER II can be categorised as a public grant or subsidy scheme. However, access to this specific source of funding was conditional on the renovations reducing CO2 emissions or final energy consumptions for legally registered buildings constructed prior to 2007. The types of interventions eligible for funding was therefore limited to fixed number of specific works, namely:

a) Improvements relating to the energy efficiency of the thermal envelope of a given building
b) Improvements focusing on the energy efficiency of thermal and lighting installations
c) The installation of solar-thermal solutions[28]
d) Installation of geothermal energy options

In terms of beneficiaries, access to funding was limited to five specific groups:

[26] EMF Hypostat 2022 (page 40) & Eurostat Population and Housing Censuses (data from 2011).
[27] Analysis based on European Construction Sector Observatory Policy Fact Sheet – Spain, PAREER II Programme, January 2022.
[28] To note, options "c" and "d" are considered as means to move away from conventional, carbon-centred energy sources.

a) Owners of an existing building
b) Community of owners or a group of communities of owners ("horizontal property"[29]) for residential building used specifically for residential purposes
c) Group of building owners that have not been granted the title of horizontal property
d) Building operators, lessees, or concessionaries
e) Energy service companies

The total endowment of the programme was EUR 204 mn, funded by Spain's National Energy Efficiency Fund, with a co-financing option from the European Regional Development Fund, by way of the 2014-2020 *Programa Operativo de Crecimiento Sostenible* (Operational Programme for Sustainable Growth), a region-focussed growth and development plan that strives to support competitiveness and sustainability across various sectors of the economy. The programme, as mentioned above, was opened for applications on 3 February 2018 and was due to finished by 31 December 2018 at the latest, unless the budget was used up at a prior date.

Applications were mainly conducted and managed through digital means, with the necessary technical verification by public bodies.

The main financial instruments employed by this programme were, as indicated above, non-repayable grants with a repayable loan added in as a complementary tool. There are, however, different types of grants considered in the programme. The basic, without consideration grant included 4 different loan funding rates, was either 20% or 30% of the value of the relevant intervention. In terms of the loan assigned to each type of grant, the total covered value was either 60% or 70%. Overall, the scheme covered up to 90% of the intervention. Policymakers planned an additional grant, which was meant as an "extra layer" complementing the both the basic grant and the repayable loan. This grant was conditional to three specific criteria: social actions (i.e., actions in buildings under the public protection scheme or located in areas under urban renewal), energy efficiency (actions aimed at achieving a building's energy rating of A or B, reduction of the CO2 emissions, or an increase by two grades of the energy rating) a combination of the two different, eligible interventions.

Regarding the loans, refund conditions were flexible and generally favourable, as recipients had a 0.0% interest rate, the loan could be repaid in a period of 12 years (included a one-year grace period), and the granting authorities accepted a set of accessible guarantees (bank guarantees, insurance contracts or cash deposits) that represented 20% of the loan amount.

Granting conditions were, however, comparatively more demanding. Firstly, no project could be undertaken before the scheme came into force, establishing a clear cut-off date for eligible interventions. Additionally, the cost of the project had to be higher than EUR 30,000, yet lower than EUR 4 mn, thereby setting a legally binding range in terms of costs. Lastly, as anticipated in the initial commentary as to the PAREER II, the interventions against which grants and loans were issued had to have a measurable positive impact on the overall energy performance of buildings. Namely, it was required that the energy performance rating rose by at least one grade on the CO2 emissions scale (*kg CO2 per m2 per year*). The provisions also included a clear exclusion clause, which affected newly built buildings, the extension or expansion surface-wise of new and existing buildings, interventions relating to the change of use, and actions related to buildings use non-residential purposes (particularly, industrial, agricultural, and defence-related processes). As a final condition to bear, supported interventions (that is, those that ultimately received funding under PAREER II) must have been implemented within a period of 24 months starting from the issuance of the grant award notice.

[29] Under Spanish law, particularly the framework established by Horizontal Ownership Act from 1960, last updated in 2019, units contained in a given building can be owned and sold separately (i.e., constituting apartment units). This furthermore grants the owners of said units to a common right to a common area of the property. There are, however, regional differences that may apply.

3) Barriers

The programme, as it will be explained here, was a demand-side success -considering the number of successful application- and its implementation was efficient in targeting buildings that required the most significant improvements. However, there were three key aspects that might have undermined its overall impact and transferability to other jurisdictions.

One of such aspects was the list of beneficiaries. The scheme considered that energy service companies and building-owning public bodies had a legitimate interest in gaining access to funding for energy efficient refurbishments, and thus are part of the list of eligible parties. This means that public funds were channelled by way of no-consideration grants to private, for-profit companies involved in activities such as retrofitting, energy savings and conservation, power generation or energy supply, to name a few. They do not necessarily own or use the residential property being refurbished, although they might provide services to said dwelling. This can be detrimental for homeowners, as grant-giving to companies can contribute to an increase in the price of energy services provided by these companies, thereby distorting the market, especially considering that these grants are not linked to the specific provision of a service but rather the conditioned improvement of a residential dwelling. Moreover, the fact that public bodies can apply for a renovation grants and loans from the government further highlights the technical shortfalls of the programme, especially in terms of the use of funds.

A second barrier or limitation to consider relates to the type of buildings covered by the programme. One crucial type missing from the framework are the individual dwellings located in apartment buildings. It is worth recalling that more than two thirds of Spain's building stock is made up of multi-family dwellings, which include apartment units.

Lastly, as in other programmes, the budget allocated to this programme proved to be insufficient, in sharp contrast with the demand for funding. Increases were required to meet the budgetary limitations and absorb excess demand (albeit not fully).

4) Impact and potential replicability

The programme was successful across different metrics. According to ECSO and the Spanish government[30], a total of 1,564 grant application were submitted under this scheme, amounting to a combined project cost of EUR 443.8 mn. 35% of the funding (approximately EUR 155 mn) was requested by way of grants, while 33.5% (around EUR 149 mn) was requested in loans.

A total of 1,189 applications were awarded as of January 2022, for a total cost of EUR 379.7 mn. In terms of effectively awarded funding, grant was EUR 115 mn, while loans covered EUR 86.5 mn of the cost. Total awarded grants and loans, considered altogether, thus covered about 53% of the total approved costs by the programme, with grants playing a more prominent role, as values suggest.

The main beneficiaries were the community of owners, described above, which represented about 98% of all approved applicants.

The type of interventions supports by the PAPEER II were mainly residential building renovation works, with thermal envelope renovations accounting for almost 98% of total grant funding. The rest of

[30] IDAE (2021*): Annual Report 2019*. Source: https://www.idae.es/sites/default/files/documentos/publicaciones_idae/IDAE_Memoria%20Anual%202019.pdf (in Spanish).

funding involved thermal and lighting installations, the replacement of fossil-intensive energy means with sustainable (solar thermal or geothermal) sources.

As regards to the energy performance of buildings, all the approved applications met the energy performance improvement requirement –to recall, a dwelling must move up 1 grade or class on the scale–, while more than 33% of these led to improvements of two grades or better[31]. Furthermore, almost 25% of the financed projects achieved an improvement from G, the lowest threshold, to the E mid-level rating. It is worth noting that most of these improvements took place in buildings that with an initial energy class lower than E (i.e., either class F or G).

In view of the success of this programme, and the preceding PAREER-CRECE scheme, a continuation programme called PREE –Existing Building Rehabilitation Programme– was approved by the government in 2020 with a total budget of EUR 402 mn. It is linked to both the NextGeneration EU framework and Spain's National Recovery and Resilience Plan and builds on the experience and achievements of the preceding schemes.

The success of this programmes is mainly due to its targeted nature, as it is based on specific, clearly defined interventions, and the list of requirements, which were known to all relevant parties in advance. Perhaps the only limitations to its potential replicability beyond Spanish borders would be the application process and the limited budget, two recurring issues in several renovation support schemes, as well as the exclusion of individual dwellings of apartments, which make up a substantial part of the Spanish building stock.

Green Deal – UK

1) Key features of the programme

In December 2013 the UK Government Department of Energy & Climate Change[32] ('DECC' or 'the Department') launched the Green Deal, a 'pay-as-you-save' scheme, wherein homeowners take out loans to pay for energy efficiency improvements or upgrades and are repaid over time from the savings stemming from these measures. It was put forward by the British government in concert with three other energy efficiency support schemes, namely: a) the *Green Deal Home Improvement Fund*, a GBP 200 mn euro voucher scheme to encourage homeowners in England and Wales to make energy saving home improvements and offset some of the installation costs, *Green Deal Communities Scheme*, funding local authorities to support households at a local community level, and the *Energy Company Obligation*, a government-led scheme that binds larger private supplier, requiring them requiring them to provide energy efficiency solutions in British domestic premises.

As to its specific goals, the British government implemented the Green Deal as means to improve the energy performance of Britain's housing stock and, in doing so, mobilise private investment towards energy efficient technologies or solutions. No technical description or indicators were established to assess the overall progress of the Green, although CO2 emissions were widely used by the government as a marker to determine the impact of the different energy efficiency support programmes[33].

[31] According to the ECSO, 34.5% of the applications led to improvements of at least two grades, while 2.3% achieved an improvement of three or more.

[32] For further information, the Department is a group of energy companies and organisations intending to be Green Deal providers established the Green Deal Finance Company (the finance company) in 2012. This not-for-profit company provided finance to Green Deal providers, which agreed loans with consumers. The Department was reliant on the finance company for achieving its aims for the scheme as it wanted the private sector to provide finance for Green Deal loans. Along with private investors, the Department provided a 'stakeholder' loan to the finance company to cover its early costs.

[33] Thorpe, D.: *Why the UK Green Deal failed and why it needs a replacement*, Energy Post, 18 April 2016. Source: https://energypost.eu/uk-green-deal-failed-needs-replacement/; and Rosenow, J. & Eyre, N. (2016): *A post mortem of the Green Deal: Austerity, Energy Efficiency, and Failure in British Energy Policy*, Energy Research & Social Science. Source: http://www.janrosenow.com/uploads/4/7/1/2/4712328/eers_paper.pdf

According to the National Audit Office (NAO), the Green Deal cost approximately GBP 240 mn, including grants[34]. It was designed as no-cost solution for British homeowners, with a view to stimulating demand for renovations and generation significant energy savings in individual household. However, the programme had noticeable shortcomings, particularly the conditions for accessing each loan, as it will be explained here, and it ultimately failed at persuading costumers to committing to energy efficiency improvements.

2) Financial features and implementation – How it works

Home improvement financing under the Green Deal programme relied on a combination of tools. The installations of EE technologies and upgrades in British residential properties were finance by way of government-sponsored loans with an interest rate. Costumer would then repay the borrowed amounts through the energy bills, the so-called "Golden Rule" of Green Deal finance. This means that finance was linked to the property and the amount borrowed was ultimately reimbursed through charges on the electricity bill. An advisory service would also be in place to increase homeowners' trust in the supply chain for home improvements.

The yearly interest rates on the Green Deal loans varied between 7% and 10%, comparatively higher than other market level options.

Demand for Green Deal loans, in view of the financing conditions, was overall modest. By end December 2015, according to the NAO's evaluation[35], 14,000 households took a Green Deal loan, with a total of 20,000 individual improvements carried out.

3) Barriers

Several barriers plagued the UK Green Deal during its lifetime, many of which derive from its original design.

In this vein, the first barrier that fundamentally hindered the efficiency of the programme is that it lacked clear success guidelines, which prevented policymakers from monitoring the progress of its implementation and, more importantly, react to warning signs. This is further underpinned by the fact that the Green Deal did not include a CO2 emission reduction threshold, making it difficult to evaluate to cost-effectiveness of the loans relative to the governments overarching climate goals.

Furthermore, the Green Deal was not tested with consumers before implementing the scheme. There were concerns that its design would not generate demand, and was an issue highlighted by stakeholders that responded to the Department's consultations in 2011 and 2012 and a subsequent external report on consumer uptake forecast. Ultimately, the market-led design proposed by the Department meant the financial risk to government of the scheme not working was acceptably small.

Additionally, the loan application process is quite complex, encompassing several parties in the arrangement. Of the consumers who applied for finance plans, only 50% completed the process of arranging a loan. Even though the Department simplified the loan application process, the changes were not sufficient to incentivise demand. Moreover, as stated previously in this paper, the loans that were ultimately granted had a comparatively high interest rate, which likely pushed potential customers away from EE loan, in sharp contrast with the original goals of the scheme.

[34] National Audit Office: Green Deal and Energy Company Obligation. Press Release, 14 April 2016. Source: https://www.nao.org.uk/press-releases/green-deal-and-energy-company-obligation/

[35] National Audit Office (2016): Green Deal and Energy Company Obligation Report. Executive Summary. Source: https://www.nao.org.uk/wp-content/uploads/2016/04/Green-Deal-and-Energy-Company-Obligation-Summary.pdf

4) Impact and potential for replicability

Considered altogether, the Green Deal is perhaps the least successful programme of considered here, making it the least but nonetheless a source of important lessons for future programmes.

A fundamental reason for the scheme being unsuccessful resulted from the fact that its design and implementation did not incentivise people to pay for energy efficient improvements in their residences. As a consequence, projected volumes of homeowners undertaking energy efficiency measures was far lower than expected, and consequently anticipated demand for Green Deal loans was far lower than what was actually observed. Committed third party investment had been secured based on this projected 'latent' demand, and so significant facility commitment fees were incurred for financing that never materialised.

The NAO produced a report[36] on the findings from this scheme, together with recommendations for future improvements that should be considered elsewhere for other future EE schemes. These include the following:

- Firstly, a given EE programme or initiative should be clear about its purpose from the outset, setting realistic priorities and clear success criteria, developed with stakeholders, including other government departments. Further, a programme needs to develop goals based on evidence. It should also plan what to do in the event of underperformance, such as reducing the scope of the programme while minimising the impact on outcomes.

- The delivery of outcomes should also be taken into consideration. In terms of energy-efficiency schemes this means, in particular, testing designs with consumers to ensure policies have the desired impact on behaviours, and being realistic about the motivations of energy companies in fulfilling their obligations.

- A programmes progress should also be tracked on a regular basis and using clear metrics, as this can help evaluate if its cost-effective and address potential shortcomings.

- To achieve its objectives, DECC should have ensured that the Green Deal was a sufficiently attractive proposition to generate consumer demand. This would have required it to have insight into the behaviours of the target groups for the scheme, and to design it according to their motivations. Predicting behaviours can be difficult, so policies that rely on consumer behaviours normally require testing and adjustments before they are fully implemented, for example by running pilots.

- DECC based its design on a 2011 consumer survey, focus groups, a stakeholder consultation and lessons from previous locally run 'pay-as-you-save' schemes. However, the Department did not fully integrate this evidence into the design and implementation of the Green Deal

- The measures that were popular in previous local 'pay-as-you-save' schemes, such as double glazing, generally did not qualify under the Green Deal's 'golden rule', which stipulated that repayments must be offset by lower energy bills.

- Consumer research showed people were interested in benefits other than financial savings, such as a warmer home. In contrast, the Department's early marketing for the scheme focused on the financial benefits for households.

[36] National Audit Office (2016): Green Deal and Energy Company Obligation – Report by the Comptroller and Auditor General, 14 April 2016. Source: https://www.nao.org.uk/wp-content/uploads/2016/04/Green-Deal-and-Energy-Company-Obligation.pdf

- Green Deal loans were offered with interest rates ranging from 7% to 10%, whereas in local 'pay-as-you-save' schemes, consumers were attracted by offers of interest-free finance.

In addition to the previous list, further lessons can be drawn from the Green Deal. Firstly, programmes like the Green Deal require a long-term objective and must be linked to tangible goals, most notably increasing household energy efficiency. Such an approach would be further supported if the EE goals were based on consumer and supplier needs and expectation, an element that was otherwise lacking. Secondly, together with the finance conditions, which could have hampered consumer demand, the Green Deal did not provide sufficient information about costs and certainly did not make a strong, persuasive case in favour of EE solution, as other programmes here have done. Lastly, the scheme did not mobilise private finance the same way as other European scheme have, an aspect that limited the scope and reach of the Green Deal, making it a least competitive option in the market.

All in all, the replicability of the Green Deal is not encouraged, given the technical and practical shortcomings described here. It does, however, constitute a strong "educational experience" that sheds light on some of the basic elements an effective EE programme should include, particularly from a design or conceptual standpoint.

Main Findings

The programmes analysed are, in their own right, useful examples for policymakers and stakeholders who, in the future, might be involved in designing public support schemes to bolster EE renovations in their jurisdictions. Indeed, whether through their merits or shortcomings, we can draw important lessons from them, which we will comment on in this section:

- **Targeted programmes are generally more effective**

When it comes to supporting energy efficient renovations, a goal-oriented approach can prove more effective than catch-all, largescale renovation schemes. As KredEx and PAREER II demonstrate, financing particular interventions in a given property can have a clear, measurable positive impact on the energy performance of a building, thereby ensuring a cost-effective use of resources. This is furthermore relevant if we consider that, in most cases, as it will be explained in the following point, financial resources are normally scarce, so there is a need to ensure that the funds allocated to renovations, however limited, bear a real impact.

- **More budget, but with conditions**

The fact that these programmes have a limited budget, both in terms of endowment and lifespan, is a consistent drawback, in that overall demand for EE renovations and upgrades is never fully satisfied. However, this does not necessarily represent an unsurmountable negative aspect. Indeed, most of the programmes shown here saw their budgets exhausted shortly after they were launched, indicating that there is tangible demand for this kind of initiatives. It could certainly be argued that a broader budget for EE interventions would be help meet the customers, yet this cannot be the sole solution. A broader endowment would mean additional resources are allocated to a specific goal, yet, as indicated above, funds could be used more efficiently if they pursue certain goals. This has a two-tier reading: firstly, it means that access to funds, whether through grants or loans, should be conditional on meeting technical requirements; lastly, funds that are ultimately granted should be used to offset the costs of EE improvements and upgrades. All in all, policymakers should not work toward expanding funds to *douse* EE demand. Instead, these should be linked to objective criteria as to the profile of potential customers and the type of renovation that should be encouraged, bearing in mind the overarching goals of the scheme.

- **Private-public partnerships go a long way**

Another factor to consider is private funding. As KFW shows, involving private institutions not only provides new funding opportunities for both the responsible body behind the programme and costumers, but also the reach of the programme, by allowing potential partners to assess the suitability of applicants and ultimately allocate funds to interventions that are technically more meaningful to support. This option helps streamline the whole funding process, making it possible to deliver EE solutions in a timely fashion and taking into account costumer needs. The value of becomes ever clearer if we consider EE initiatives such as EEMI, refer to in the introductory section of this report, is a prime example of how an ecosystem composed of private credit institutions and public bodies can provide borrowers and homeowners with tailored, targeted and sound EE solutions. Indeed, such an enterprise would help authorities attain their sustainability goals, but it would ultimately help customers and citizens overall live in cleaner, more economically viable homes.

- **Measure progress**

Measuring progress during the implementation phase is key. This aspect is generally overlooked across the different schemes evaluated here, although the individual outcomes of each intervention can help gauge if these can deliver at a micro level. Nevertheless, besides a post-implementation analysis,

which remains a sensible option in all cases, it could be appropriate to consider intermediate assessments mechanisms to determine if a programme is being effective or if it is encountering problems to reach potential users. This could enable policymakers to make mid-term adjustments to the framework or, at least, shed light on the most pressing challenges the programme has encountered during its lifetime. Seemingly, intermediate metrics can serve as an educational path.

- **Step by step, the issue of continuity**

Perhaps a common barrier that remains in place in all the programmes is the fact that they conclude without necessarily ensuring a degree of continuity in the interventions. That is, the schemes deliver a series of results, depending on the make-up of the initiative, but the core issue, an aged, energy inefficient building stock remains. Granted, some of the programmes here have had follow-up iterations (PAREER II) or have remained active over a long period of time (KFW), and these certainly are good replicable practices. However, there can be changes in terms of goals and priorities, which can likely modify the course of the initiatives. In view of this, it would be reasonable to consider designing longer-term programmes, with a clear EE renovation roadmap that involves the building stock. It should, of course, be in line with the EU's long term climate goals, but the horizon proposed here should be one built on the ideas of practicality and gradual gains.

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ANNEX I – Source: NAO