4RinEU

Reliable models for deep renovation

D4.5
WP4

Regional adaptable financial instruments

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 723829

Foreword

Despite the low energy performances of the European building stock, the yearly renovation rate and the choice to perform a building deep renovation is strongly affected by uncertainties in terms of costs and benefits in the life cycle.

The project 4RinEU faces these challenges, offering technology solutions and strategies to encourage the existing building stock transformation, fostering the use of renewable energies, and providing reliable business models to support a deep renovation.

4RinEU project minimizes failures in design and implementation, manages different stages of the deep renovation process - from the preliminary audit up to the end-of-life - and provides information on energy, comfort, users' impact, and investment performance.

The 4RinEU deep renovation strategy is based on 3 pillars:

- *technologies* - driven by robustness - to decrease net primary energy use (60 to 70% compared to pre-renovation), allowing a reduction of life cycle costs over 30 years (15% compared to a typical renovation);
- *methodologies* - driven by usability - to support the design and implementation of the technologies, encouraging all stakeholders' involvement and ensuring the reduction of the renovation time;
- *business models* - driven by reliability - to enhance the level of confidence of deep renovation investors, increasing the EU building stock transformation rate.

4RinEU technologies, tools and procedures are expected to generate significant impacts: energy savings, reduction of renovation time, improvement of occupants IEQ conditions, optimization of RES use, acceleration of EU residential building renovation rate. This will bring a revitalization of the EU construction sectors, making renovation easier, quicker, and more sustainable.

4RinEU is a project funded by the European Commission under the Horizon 2020 Programme and runs for from 2016 to 2020 (extended to 2021).

The 4RinEU consortium is pleased to present this report which is one of the deliverables from the project work.

Principal Authors

Kari Thunshelle, Michael Klinski (SINTEF; framework, editing and co-ordination)

Contributors

Federico Noris, Marco Pietrobon (R2M)
Christoffer Venås, Synne K. Lien (SINTEF)
Vera Lukina, Helene Moen (Boligbygg)
Chiel Boonstra (Trecodome)
Wim Bakker, Judith Tillie (Woonzorg)
Toni Herena, Jordi Pascual Pellicer, Clara Ferrer (AIGUASOL)
Inés Fàbregas (AHC)

Document details

Deliverable No: D4.5
Dissemination level: Public
Work Package: WP4
Lead beneficiary: SINTEF
Date of publication: 31/03/2020
Version: Final version

Project information

Title: Robust and Reliable technology concepts and business models for triggering deep Renovation and residential Buildings in EU (4RinEU)
EC Grant Agreement Number: No 723829
Duration: October 2016 until September 2020 (48 months), extended to June 2021
Coordinator: EURAC (IT)
Project Partners: SINTEF (NO), ADERMA (IT), TRECODOME (NL), AIGUASOL (ES), G&M (DE), THERMICS (IT), IES (UK), ACCIONA (ES), BOLIGBYGG (NO), WOONZORG (NL), AHC (ES), R2M (IT).

Disclaimer

Table of contents

Contents

Executive Summary

The current report gives a comprehensive summary of available financial instruments that support deep renovation of existing residential buildings on the European level, with in-depth insights to available instruments in Norway, Netherlands, Spain, Poland, Hungary and the UK and Ireland. It gives a good snapshot of the current state of the funding schemes for deep renovation of buildings in these European countries.

In the countries where the 4RinEU research project had ongoing demonstration pilots, the relevance of the financial instruments in regard of the demos was found to be low. Many of the financial instruments investigated in the current report are not applicable for the demonstration pilots, as the pilots already are receiving funds for the research project, making them not eligible for other additional state funds (as of the EEA agreement). However, relevant funding opportunities for renovation of residential buildings in general is identified in all countries. In several countries, like for Norway and Netherlands, the funding schemes are existent, but still does not have large enough (economic) impact to change decisions in favour of more deep renovation (in front of new construction or single/simple renovation measures). In Hungary, the subsidy of electricity (to keep the end-user energy bill low) was found as a main barrier towards renovation.

Currently, most instruments in the investigated countries are related to aids and subsidies, rather than other less-custodial financial mechanisms. Such (public) aids and subsidies are in constant development and changing regularly. In Poland (as in Norway and Spain), financing is mainly funded by public entities as directly (subsidies) or by using private entities as banks (loans). Most of the available support in Poland is available for both private and public building owners. In Norway these are mostly directed towards the larger share of owner-occupied private housing (around 80% of total). In the UK as well support schemes are most available for houseowners, especially for single family houses (and to some degree landlords of these). Few of the investigated instruments are directed towards the improvement of housing for the low-income segment. Important initiatives like Energiesprong, that have activities in the investigated countries Netherlands and UK, focus on boosting and supporting deep renovations, starting with the social housing sector.

In the UK and in Ireland, as in Norway and the Netherlands, there is a fairly large variety of schemes available, but they are typically directed towards single renovation measures compared to deep renovation. Other instruments than aids and subsidies, like taxation that favours reuse, differentiation in fees for planning applications for rehabilitation versus new construction or other legal instruments can potentially strongly affect these decisions – to get the shift towards deep

renovation that is needed. However, as the scope of this work has been to map the existing instruments, and most of these are found to be funding schemes (subsidies and loans), further work should focus on exploring the potential impact from other financial instruments that can increase the rate of deep renovation of buildings.

1 Introduction

In addition to the identification of needs and opportunities for deep building renovation, there is always the issue of how to finance the renovation work. Financing issues, in turn, have a close connection to the technical assessment regarding which solutions should deliver the expected benefits and make the most sense from an engineering point of view. Different technical options have different expected Capital Expenditure (CAPEX), Operational Expenditure (OPEX) and Net Present Value (NPV) that should be evaluated. To identify the most appropriate financial strategy, several aspects should be considered, including the following:

- **Financial resource availability**. The availability or lack of financial in-house resources should determine if financing the work fully with in-house resources is even an option. This should be in line with financial planning and forecast of an organisation that may have a rotating fund for regular maintenance that could be coupled with deep renovation
- **Available technical/financial offers**. Some companies provide interesting opportunities to be considered that for instance would allow to refurbish a larger share of the building stock (in case of real estate) or be used for other competing demands. Additionally, energy service companies (ESCo) often provides attractive opportunities to obtain technical assistance, financial resources and share the risk with a partner with vested interest
- **Presence of incentives and support.** Regardless of whether in-house resources are used or collaboration with external parties is considered, the incentives and instruments available should be evaluated and leveraged to reduce CAPEX, reduce risk and improve cashflow among others.
- **Economic trends and assessment of financial metrics/ key performance indicators (KPI)**. When evaluating different investment options, economic indicators should be used as base for the decision. There are several different ways to measure investment performance, although some are more popular than others. These include Return on Investment (ROI) and Internal rate of return (IRR). Additionally, oil, gas and electricity price volatility should be considered adding uncertainty.

2 Financial Instruments for Energy Efficiency Investment in Buildings

Currently, there are several financial instruments, mechanisms and schemes to support the implementation of Energy Efficiency actions in buildings. This framework of solutions, should encourage uptake of energy efficiency retrofits, supporting in overcoming one of the main barriers: financing the renovation. Some of these financial solutions are widely common, and therefore available nearly everywhere, while others are country specific. The following sections provide an overview of possibilities and give insights into where their application could make sense.

2.1 Overview of potential financial instruments

The table below, taken from the comprehensive EEFIG report [1], provides an overview of available financial instruments. Excluding, since it is not the focus on this report, the first column ''Commercial'', the others target applicable residential segments. The financial mechanisms available to support energy-efficiency investments are different based on the type of owners and whether the owner lives or rents out the unit. However, similarity and therefore classification of instruments is possible.

Mature Financial Instruments	Commercial	Public	Public Rental	Private Rental	Owner Occupied
Dedicated Credit Lines	3	2	3	3	3
Energy Performance Contracting (Undertaken by Private Sector)	3	3	3	1	1
Risk-Sharing Facilities	2	1	2	2	2
Direct and Equity Investments in Real Estate and Infrastructure Funds	2	1	1	2	0
Subordinated Loan	1	1	1	1	1
Covered Bonds	1	1	1	0	0
Leasing	0	1	0	0	0
Emerging Financial Instruments	**Commercial**	**Public**	**Public Rental**	**Private Rental**	**Owner Occupied**
On-Bill Repayment	2	1	2	3	3
On-Tax Finance (PACE)	2	1	1	2	3
Energy Efficiency Investment Funds	3	2	2	1	1
Energy Services Agreement	3	3	2	1	1
Public ESCOS for Deep Renovation of Housing	0	0	3	2	2
Factoring Fund for Energy Performance Contracts	2	2	1	1	0
Public ESCOS for Deep Renovation of Public Buildings	0	3	3	0	0
Green Bonds	2	1	0	0	0
Citizens Financing	0	0	0	1	2

Figure 1. Overview of Financial instruments for energy efficiency investments in buildings. Score of 3 is mature, 1 marginally useful, while 0 is not applicable.

2.1.1 Mature financial instruments

EEFIG identified a total of 16 financial instruments with different levels of maturity and readiness. The most mature are:

- **Dedicated Credit Lines**. These are ad-hoc financial lending instruments for energy efficiency, which can be loans, guarantees and grants, at times backed by public financial institutions. Sometimes the lending institutions already define the specific sector/target and provide simplified standardised procedure to access the credit (e.g., eligible materials and measures, minimum performance levels). Examples are KFW in Germany and KredEx in Estonia: the public German bank institution KFW [2] offers financial support in a program called "KfW Efficiency House" in form of grants and loans for building energy retrofits, the support amount varies between 40% and 20%, depending on the energy performance level achieved in the considered renovation project, it can support both deep renovations both single energy efficiency measures (e.g. thermal insulation of walls, roof and floor space, replacement of windows and exterior doors, ventilation system, interventions on heat distribution of heating systems).
- **Energy Performance Contracting (EPC)**. It is a contractual arrangement between a host beneficiary and the provider of an energy efficiency improvement measure, verified and monitored during the whole term of the contract. It is one of the main instruments used by Energy Service Companies (ESCOs). The EPC provides offer guarantee savings, know-how and turnkey contracts.
- **Risk-Sharing facilities**. They reduce the risks for banks and equity investors by covering part of the risk of payment default. They have the advantage to remove some of the uncertainty and risks therefore favouring greater private instruments to be deployed.
- **Direct investment in Real Estate and Infrastructure Funds**. This is not a financing instrument per se, but a realisation that if real estate managers better value buildings with improved energy performance, there could be a market of self-financed actions on the assurance that investors and buyers would share that vision and be willing to recognise the investment sum.
- **Subordinated loans, covered bonds and leasing.** Subordinated loans sit between a direct credit line and grant; they are junior ranked compared to other senior debt. They are commonly used instruments in general, but rarely used to finance energy efficiency in buildings. Covered bonds are corporate bonds backed by pool of assets and are used as collateral to secure the cash for the bond. They could be used to refinance other investments; leasing, finally, is how a host obtains the use of machinery or a highly efficient equipment. Ownership stays in the hand of the lessor, while the business has the actual right to use the equipment. Leasing approach is used mainly for equipment, I can be used also for photovoltaic systems.

Other financial instruments, mainly funded by public sources, are the following ones.

- **Tax incentives** (tax reductions and tax credits). In this case part of the costs for eligible energy efficiency and renovation interventions are repaid to the beneficiary, who bore the expenditures, with reduction or credit in his taxation. Generally, legislation can foresee this in the main tax in place for single person or single company in the considered country.
- **Grants from public funds**. These are grants for private and public subjects, that allow to cover a percentage of the costs occurred for eligible energy efficiency and renovation interventions

2.1.2 Emerging financial instruments

Besides the financial schemes described above, other emerging instruments include the following.

- **On-bill repayment and tax finance (PACE - Property Assessed Clean Energy).** It is a mechanism to repay energy efficiency investments within utility or tax bill and recovered through the existing payment collection infrastructure. Due to the existing payment relationship, customers have a consolidated credit history and a therefore associated risk. PACE scheme is a subset of this that has been gaining popularity in the USA. Basically, a loan is given to a building owner, but it is attached to a property and reimbursed through local taxes by occupant increasing therefore their creditworthiness. If the building is sold, the loan can be reimbursed or transferred to the new owner. If it is rented, it is the tenant who pays the tax and benefits from the savings, and the change of tenant has no impact on the repayments. Financing can be private or public.
- **Energy Efficiency investment funds and Energy Service agreements (ESCOs).** These instruments are dedicated to investing only in energy efficiency projects seeking a return based on savings achieved. Some of these Socially Responsible Investment (SRI) funds have partnered with governments. Energy service agreements (ESA) are a contract between a third-party investor and an asset owner to deliver energy savings as a service; it is an evolution of the traditional shared-savings model provided via EPC but structured more like Power Purchase Agreement (PPA). Basically, the investor invests into energy efficiency opportunities and operates the energy equipment to provide services to the asset owner who in exchange agrees to pay their historical utility bills to the investor.
- **Public ESCOs for Deep Renovation.** A special purpose company that manages energy efficiency investment and delivers guaranteed savings to a host and counterpart to an EPC set up with public funds. These ESCOs aggregate credit lines and other incentives.
- **Green bonds and citizen financing.** Financial instruments that finance projects and activities promoting climate and environmental sustainability outcomes. These bonds can be issued by corporations or by banks, or in other cases can be

started by the initiative of public institutions like municipalities, regional or national governments. Municipal bonds generally aim to finance specific projects, like school renovations or transport infrastructures.

The financial schemes described above can be used also in **combination**, two or more together: for examples tax incentives with preferential loans, or tax incentives with EPC and ESCO schemes. Loans with advantageous interest rates can be refund by households and landlords also thanks to the possible savings in energy bills achieved after the renovation.

Proper financial schemes, adopted as single solution or in combination, can produce relevant **leverage effect** in stimulating private investment, also using part of public money.

An example is the zero-interest eco-loans in place in France, which is an interest-free loan for energy renovation interventions in buildings. The amount of a single loan can be up to 30 000 € with a duration up to 15 years. The public entities involved cover the costs related to the interests and to the administrative expenditures. About 20 banks in the French market participated to this program. In 2015, the total amount invested related to this scheme was about € 480 million, with an average loan value of about 17 000 € per project. The total government spending was about € 40 million, including operation of the scheme and interest payments. Thus, this scheme stimulated 12 € of private investments for every 1 € of public support.

Another example is the Green Funding Scheme ("*Regeling Groenprojecten*") in the Netherlands, which makes available about € 800 million annually for environmentally sustainable project, including energy renovation of buildings. This investment fund offers interest rate below the market level, but investors are encouraged to participate and invest money there thanks to proper tax incentives related to this investment amount. Thanks to this fund low interest loans are made available for energy renovation of buildings. It was estimated that this scheme stimulated about 80 € of private investment for every 1 € of public funding.

2.1.3 Appropriateness of instruments for 4RinEU solutions

Generally, the financial instruments presented in this chapter can be applied both for single energy efficiency measures and for deep renovations. However, in some cases, they are available only for **deep and integrated interventions**, and anyway the percentage of refunded costs or the maximum amount of funding increase with the level of the energy performance or with the achieved energy savings (e.g. deeper renovations, higher level of energy performance, higher energy

certification label). For these reasons, the **4RinEU solutions** can be more suitable to reach higher level of funding or better conditions in financial schemes, since they integrate several and comprehensive functions and they can allow to achieve higher energy performance levels. For example, the prefabricated multifunctional facades developed in the 4RinEU project, which can integrated in one solution, includes all or part of these aspects: thermal insulation of opaque and transparent building envelope surfaces, details and solutions for airtightness, devices and components for mechanical ventilation, solar shading, RES systems. This represents a comprehensive package to achieve higher energy saving through renovation, and so higher support from the available financing scheme.

Furthermore, the 4RinEU solutions can allow higher quality checks and assurance, thanks to off-site prefabrication, to an overall methodology and the tools supporting the decision making, made available from the project. This can also help to control and reduce risks associated to renovation interventions (delays in completions, lack of quality, lack of performances) giving better conditions for some financial schemes, like preferential loans and EPC.

Since one of the main focus sectors of the 4RinEU project is multi-families residential buildings, owned by private or public organizations, and particularly the social housing sector, about the opportunities to fund energy retrofitting intervention we can consider also the drivers here below.

A problem, that occurs to low-income people and families, is the so called fuel poverty or **energy poverty** [4], which can be exemplified by three main issues: (i) inability to keep homes adequately warm, (ii) living in a dwelling with bad or dangerous construction components (e.g. a leaking roof, rot windows and damp walls or ceilings), (iii) and arrears on payment of utility bills.

Particularly in social housing buildings, in some cases, tenants can pay higher amount for energy bills than for renting the dwelling. This is because occupant incomes can be low, and the renting fees balanced accordingly, but the energy bills are expansive since depend on the poor building energy performance. In these cases, it is possible that the tenants cannot manage to pay the bills or that they pay with delays, leaving the public or private bodies owning the buildings to bear the costs. So, energy costs must be partially covered by the budget of the public or private organization that owns the apartments. Improving the energy performance of buildings allows to reduce the costs due to energy bills, reducing the phenomenon of arrears in utility bills, thus allowing building owners to repay the investments made for renovations or to make available part of the budget for this. Analysis on financial sources from savings could mobilise investments in renovations.

These direct financial advantages related to buildings renovations in social housing sector are coupled to undirect ones and to social advantages like health issues due to cold homes, better indoor thermal comfort, Job creation, social inclusion (e.g. by renovated poor districts), reduction of CO_2 emissions.

When multi-family residential buildings are owned by social housing organizations or by real estate actors, they can be grouped in large buildings stocks including thousands of residential units. For example, this is the case of the housing organization participating as partners to the 4RinEU project.
With large assets of buildings, it could be profitable to apply certain forms of **aggregation of renovation projects**, to benefit from economies of scale [5]. Organizations owning or managing large buildings stocks could plan renovation interventions on a large amount of buildings and according medium and long periods. This can be difficult, since requires proper budget and economic and financial plan and adequate technical and administrative capacities in the owning organizations. But it could be possible with legal instrument like **framework agreements** and related tenders for this.

The 4RinEU solutions and methodologies can be suitable for this kind of frameworks, thanks to features related to prefabrication and industrialization of the renovation interventions and thanks to a comprehensive set of solutions and methods.

Often, financial instruments foresee that funding or repayment happen in a certain time period in future with instalments, as for example loans or in different way with EPC schemes, or with part of the funding amount in the taxation cycle, for example for the next 5 or 10 years. This lasting in time allows to assess interventions costs through life cycle cost and **global cost analysis**. These can be also useful to evaluate repayments on long periods and considering evaluation and **monetisation of multiple benefits** from deep renovations, consisting in costs savings not only for energy but also in other undirect relevant issues, like environmental sustainability and atmospheric emission reduction, better health and comfort conditions for occupants, job creation, etc.. These could be relevant also when the considered buildings or buildings stocks are owned by public entities, which deal also with societal issues and related expenditures.

2.2 EU funding opportunities

At European level, the European Investment bank (EIB) has a series of instruments that target sustainability. However, these are often of significant size (>25-50M€), so they are more intended as city-wide initiatives rather than isolated ones;

however, once the city has applied and received the loan it can then distribute to individual projects.

- EIB acts also via the **European Fund for Strategic Investments (EFSI)** and the associated investment platform that basically can pool public and private financing for investment in a portfolio of projects with a given thematic and/or geographic focus.
- The European Commission and the EIB have created the **European Investment Advisory Hub (EIAH)** [6] that serves as a single access point to a wide range of services and assistance. This includes the **Joint Assistance to Support Projects in European Regions (JASPER)** [7]
- Another common option is the **European Local ENergy Assistance (ELENA)** [8] program that specifically targets energy efficiency. ELENA provides technical support to local and regional authorities to prepare, implement and finance investment to enhance energy efficiency. ELENA is managed by the European Investments Bank. ELENA covers up to the 90% of the costs for the technical assistance and it require a leverage effect of 1:20 (1:10 for transportations) between the funding for assistance and the total invested amount in the considered project, which should be greater than € 30 million.
- **Joint European Support for Sustainable Investment in City Areas (JESSICA)** [9] give funds to support the use of EU structural funds. It foresees support also for projects in the field of energy retrofits of public buildings and social housing.
- **European Regional Development Fund (ERDF)** aims to strengthen economic and social cohesion in the European Union by correcting imbalances between its regions. Among the different pillars, there is typically something about Low-Carbon Economy and Resource Efficiency. It foresees support also for projects in the field of energy retrofits of public buildings and social housing. Generally, they are distributed according proper regional or national plans, developed by each Member State.
- **Project development assistance (PDA - Horizon 2020)** supports public and private organizations to develop projects investing in energy efficiency in the sectors of buildings, industry, services, urban transports, infrastructures (e.g. public lighting, water and sewerage grids). The PDA programs finance support for € 0,5-1,5 million in order to develop and applied projects investing an overall amount of € 7,5-50 million. It is requested that the leverage effect between PDA funding and the total amount of the investments is at least 1:15.

Exemplary H2020 project – effective combination of financing tools

H2020 EnerSHIFT project

An interesting example of profitable combination of different above-mentioned financial instruments is the **EnerSHIFT projects**, focusing of energy renovation of a good number of social housing buildings in Liguria region in Italy. EnerSHIFT is a project of typology Coordination and Support Action funded by the European Commission in the framework of the program Horizon 2020 - Project Development Assistance. The budget, funding at 100% by the European Commission in the EnerSHIFT project, has been of about € 970 000, that project consortium used for technical, administrative and legal assistance in order to develop tenders and to started renovation works in **76 social housing buildings (about 3 000 apartments) in about 15 municipalities** of Liguria region, for a total investment of about € 14,5 million. So, the ratio between the funds from the EnerSHIFT Horizon2020 project and the total investment for renovations is about 1:15. The foreseen energy retrofit interventions are about boilers replacements and building envelope renovation, with energy savings at least of 45%. In order to cover the investments of € 14,5 million the public organizations involved combined 3 different financial schemes: (i) European regional Development Fund (ERDF), (ii) energy performance contracts (EPC) with ESCOs, (iii) public subsidies from national state called "Conto Termico". At the end, for constraints in use of the ERDF, 2 different public tenders for renovation works have been published. The first one according EPC schemes for ESCOs, for a total amount of about € 21 million (VAT excluded) including renovation works, heating systems managements services and energy carriers delivering for the next 12-13 years. In addition, the second tender with a total amount of about € 6,2 million, covered with about € 3,5 million from ERDF and 2,7 for the public organization owning the social housing stock in Liguria. This second tender covered renovation works without other ESCO services.

The EnerSHIFT project duration has been of 48 months from February 2016 to January 2020, and it prepared the renovation works that started during 2019.

H2020 LEMON - Less Energy More OpportuNities

LEMON - Less Energy More OpportuNities, funded in the Horizon2020 program, supports renovation works for 622 apartments in social housing buildings in Emilia Romagna region in Italy, for a total amount of about € 15 million. They combined EPC schemes with ESCOs, European regional development fund (ERDF - POR-FESR in the figure 2), and public subsidies from national state (GSE - Conto Termico in the figure 2), according the exemplifying scheme in the figure here below (source: www.progettolemon.it, www.lemon-project.eu).

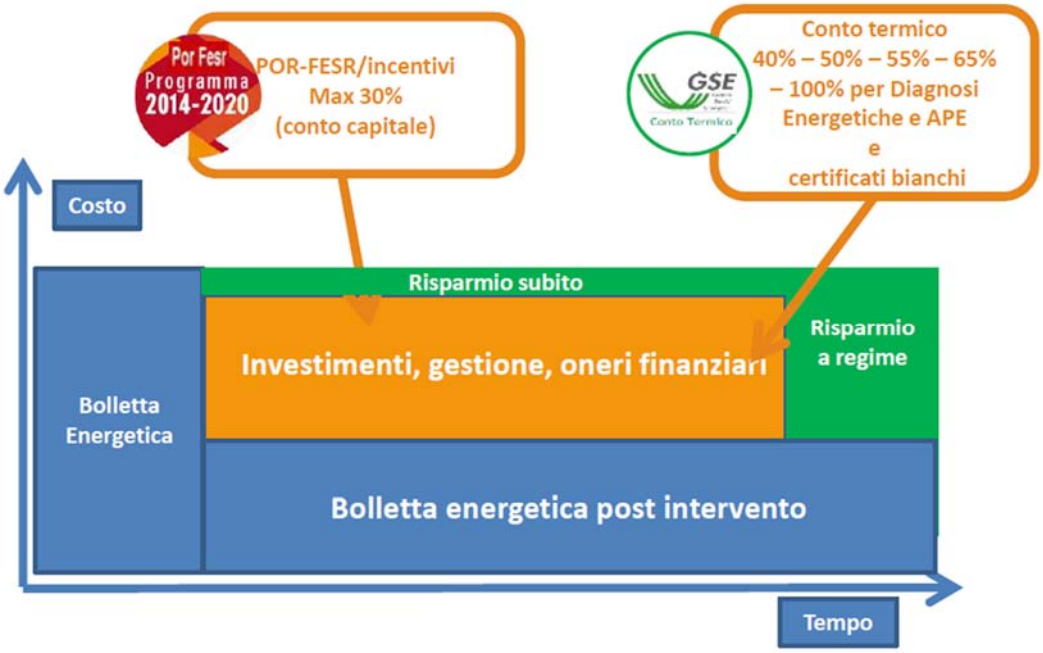

Figure 2. Example of financial schemes for energy renovation of social housing, combining EPC with ESCO, European Regional Development funds (POR-FESR in Italian) and national public subsidies (GSE-Conto Termico) - source: LEMON project.

2.3 Solutions for matching demand (renovation) and supply (investors)

There are then a series of initiatives that aim at facilitating the matching between demand and supply. These are mainly intended as meeting point that should provide know-how to building owners seeking finances and confidence to investors when assessing and evaluating an investment opportunity. Among others we cite:

- **Energy Efficient Mortgage Initiative (EEMAP)** [10] aims to design and delivery of an ''energy efficient mortgage'' which intends to incentivise and channel private capital into energy efficiency investments.
- **Sustainable Energy Investment (SEI) Forum** [11] aims to work with national stakeholders in order to boost large-scale investment and financing for sustainable energy. SEI Forums builds on the works of EEFIG. SEI forum organises a series of events across the EU in order to showcase best practices
- **Sustainable Energy Asset Evaluation and Optimisation (SEAF)** [12] enables investment in small to medium sized projects in Sustainable Energy Assets (SEA) such as Demand Response, Energy Efficiency and Distributed Renewable Generation through a holistic online platform, eQuad [13], designed to function across Europe.

- **Investor Confidence Project (ICP) [14]** defines a clear roadmap to support reliable Investor Ready Energy Efficiency via established protocols that provide confidence to the investors.
- **Private Finance for Energy Efficiency (PF4EE) instrument** - The instrument focuses on projects which support the implementation of National Energy Efficiency Action Plans or other energy efficiency programs of EU Member States. The instrument provides credit risk protection, long-term financing from EIB Loan for Energy Efficiency, expert support services for the financial intermediaries.
- **EnergieSprong** [15] is an initiative that promotes the whole house refurbishment with funding support. The initiative aggregates mass demand for high quality retrofits (and new built houses) in a market and creates the right financing and regulatory conditions in parallel. Solution providers can go into a quick and transformative innovation process to deliver against this new standard.

References

[1] Energy Efficiency Financial Institutions Group. *Energy Efficiency – the first fuel for the EU Economy. European Union*, 2015. See: http://www.eefig.com/index.php/the-eefig-report. The report is also available in French, German, Italian, Polish and Spanish, see https://ec.europa.eu/energy/en/news/new-report-boosting-finance-energy-efficiency-investments-buildings-industry-and-smes.

[2] KFW, n.d. See: https://www.kfw.de/inlandsfoerderung/Privatpersonen/Bestandsimmobilie/

[3] BPIE. *Attracting investment in building renovation*, 2017. See: http://bpie.eu/publication/attracting-investment-in-building-renovation/

[4] BPIE, ROCKWOOL, EIT Climate-KI. *Upscaling urban regeneration - European frontrunner cases are leading the way*, 2018.

[5] BPIE. Reducing energy poverty with national renovation strategies: a unique opportunity, 2016. See: http://bpie.eu/publication/reducing-energy-poverty-with-national-renovation-strategies-a-unique-opportunity/.

[6] http://eiah.eib.org/

[7] http://www.eib.org/products/advising/jaspers/index.htm

[8] http://www.eib.org/products/advising/elena/index.htm

[9] https://www.eib.org/en/products/blending/jessica/index.htm

[10] http://energyefficientmortgages.eu/

[11] https://ec.europa.eu/energy/en/financing-energy-efficiency/sustainable-energy-investment-forums

[12] https://www.seaf-h2020.eu/

[13] https://www.eu.jouleassets.com/about-equad/

[14] http://www.eeperformance.org/

[15] http://energiesprong.eu/

3 Instruments, Approaches and Drivers in Demo-Case Countries – Norway

Single-family homes are very predominant in Norway, especially in the decades of building construction after the second world war. Nearly 80 percent of the Norwegian population live in detached or semi-detached houses (SDH), most of them in single-family homes (SFH). However, after the turn of the century, the share of dwellings in apartment buildings is turning higher, with a higher increase in dwelling units than for SFH/SDH, but still apartment buildings increase less in the total floor occupied space. Traditionally, nearly 80 percent of all dwelling units are owner-occupied, almost 15 percent of them through membership in a housing cooperative [16]. Compared to other countries, the share of tenants in rented apartments is small, but has increased during the last decades. Most of these rented apartments are individually owned by a single private owner, while apartment blocks, owned by a professional company, are quite uncommon.

Only 5 % of the Norwegian housing stock is publicly owned [17]. These dwellings are dedicated to disadvantaged persons that are not capable of finding housing on their own or without the help of others. There must be financial, health or social conditions that makes resident eligible. Low income is generally not enough to get municipal housing. Approximately 50 % of all publicly owned housing in Norway is wheelchair accessible.

Especially for apartment blocks, there are many different construction types in the earlier decades. Moreover, many of these older construction types have façades where insulation could not be added in an easy way, or they already have been renovated. There is a large potential for façade renovation of apartment buildings from the 1960s and 70s, because it is a segment of the building stock that needs maintenance today – and where this should be performed in line with sustainability and energy efficiency targets. The potential in prefabricated elements lies in the easy integration with the existing building, as well as potentially less resource use and construction time.

3.1 Available financial instruments in Norway

Enova, a government-owned energy enterprise, offers guidance support and investment support for new energy efficient buildings and ambitious major renovations in Norway. Enova is owned by the Ministry of Climate and Environment and was established in 2001 with the objective to contribute to greenhouse gas emission reductions, contribute to the development new technologies related to energy use in buildings, and to strengthen the security of

energy supply. This is achieved through support schemes for both public and private stakeholders. Enova offers subsidies for energy consulting and conditions surveys of the energy efficiency potential in existing buildings. The support is offered for both large- and small-scale projects. Most of the support schemes have a large focus on innovation as well as energy efficiency and sustainability. Enova supplies grants for projects that aim to increase the energy efficiency of new and existing buildings in order to reduce risks so that more innovative projects (usually more expansive) can be implemented.
Enova invest more than NOK 2 Billion (app. 0,2 Billion €) of public resources in green solutions each year. The amount of contributions made to a project will depend on the risk and varies from project to project. Both private housing cooperatives and public owned multifamily buildings are defined as 'private companies' when applying for grants from Enova and cannot apply for the same programs as single-family building owners. Applicable programs for private and public multifamily buildings from Enova includes:

- Introduction of new technology in buildings
- Commercial testing of innovative building technology
- Best available technology in existing buildings
- Comprehensive mapping of buildings
- Innovative solutions in the energy service market for buildings
- Concept study for innovative energy and climate solutions in buildings, areas and energy systems
- Heat centrals
- Large-scale demonstration of the future energy system

Husbanken, The Norwegian State Housing Bank, is the main agency implementing Norwegian social housing policy on the national level, and provides loans, grants and guidance as well as initiates new development and research [18]. Loans issued by Husbanken have lower interest rates than mortgages from the average commercial bank. The criteria for recieving financing from Husbanken changed in 2005, to promote sustainable development, accessibility for all, and architectural quality, as
well as to allow easier access for owner-occupied housing for disadvantaged groups and young people. The public bank currently offers basic loans for new housing projects and a range of other financial instruments through an application procedure in the local municipality, where eligible persons can apply for start-up loans, housing allowance and grants.
Husbanken also offers grants for conducting condition surveys on existing residential buildings, for mapping the need for repairs/renovation with a focus on universal design and/or energy efficiency. The Norwegian State Housing Banks loans aims at promoting universal design and environmentally sustainable solutions in new and existing buildings, often at higher requirements than the

minimum requirements in the national regulations. It is also designed to provide financing for rural districts where it is difficult to obtain mortgages at normal rates. Municipalities and landlords providing social rental housing may also be eligible for loans from Husbanken [20].

Both Enova SF and Husbanken have support schemes for public and private buildings. In addition to these national schemes, there is also a municipal scheme for energy efficiency and sustainability in Oslo (municipality) that is quite substantial. Green Loans, EPC-contracts and other support schemes are available for from different providers for public and private owned dwellings.

Financial mechanisms for the implementation of RES-technologies at building level have been introduced through subsidy and loan options for investments and through "Plusskundeordningen". "Plusskundeordningen" is the regulation of electricity customers that produce more electricity than the buildings' demand for some hours of the year that must be fed into the grid, but where the power fed into the grid does not at any point exceed 100 kW. These "prosumers" do not pay feed-in-tariffs for exporting electricity to the grid.

3.1.1 Instruments available for public owned residential buildings

Municipality-owned dwellings in Norway are only available for people with financial, health and/or social conditions that make them unable to find a place to live without the help of others. Private owned and public owned residential multifamily buildings can apply for the same support schemes from ENOVA for retrofitting and energy upgrading.

Husbanken offers the widest range of different support schemes such as housing support, loans and grants support to municipalities in their efforts to help those disadvantaged in the housing market, and have several programs available for public owned residential buildings, such as investment grant for residential care buildings and nursing homes, focuses on buildings built for people with need for 24/7 health and care services, which include the elderly, people with disability, mental disorders and people that suffer from addictions. Up to 50 % of the construction cost can be given in grants per dwelling unit. Husbanken also offers grants for rental dwellings for the disadvantaged, to contribute to the establishment of more fitting rental dwellings for this group. The grant varies from municipality to municipality. Municipalities can however not apply for loans for retrofitting existing dwellings with the sole purpose of making existing dwellings more energy efficient [21].

Kommunalbanken is a local government funding agency owned by The Ministry of Local Government and Regional Development that is the main provider of loans for municipalities and local governments in Norway. The loans have low interest rates and can be used for development in the municipalities. Kommunalbanken can grant Green Loans for climate and environmental investments with 0,1 percentage points discount on current commercial margins. These loans can finance projects that results in higher energy efficiency or reduced greenhouse gas (GHG) emissions or contribute to local adaption to climate change.

Green loans can be used for construction of new and energy efficient buildings or retrofitting existing buildings. The requirement for receiving green loans for retrofitting and renovation is to reduce the estimated energy demand by 30 % and using materials with low LCA-emissions, but it is also possible to apply for other measures such as installing energy storage in a building or installing renewable energy [21].

Since 2016, municipalities have been able to apply for the **'Klimasats'** support scheme [22]. Municipalities can apply for grants from 'Klimasats' for implementing measures that reduce GHG emissions in several different topics. Measures that ensures more climate friendly buildings in the municipalities is one important topic. Applications must have political support within the municipality, and innovative project with high emission reduction potential is prioritised.

Several contractors offer Energy Performance Contracting (EPC) for retrofitting of buildings. EPCs are contracts between the building owner and the contractor where the contractor guarantees for the energy performance (energy consumption) of the building in parts of the operation period of the building (after time of upgrade).

3.1.2 Instruments available for private owned multi-family buildings

Many private owned banks offer Green loans for private dwelling owners. Owners can be eligible for Green Loans when buying buildings with high energy efficiency or if they are planning upgrading of their existing dwelling to a high energy standard. In order to receive the loans, the applicants must document the energy standard of the building before and after the upgrade, and the energy standard must reach the requirements for energy label 'A' or 'B' or be BREEAM-certified [23].

Private owners of buildings classified as cultural heritage and cultural heritage can apply for funding from The National Trust of Norway (*Fortidsminneforeningen*) or Norwegian state heritage funding institution (*Kulturminnefondet*). These

institutions have a goal to promote efforts to preserve cultural heritage and offers funding for restoration of cultural heritage buildings.

Furthermore, several municipalities – like Oslo – provide their own support scheme and/or they offer a discount for the building permit fee in case of low energy or Passive House projects. In Oslo, private owners can apply for investment support for energy saving measures in residential buildings, such as insultation of the building body, upgrading the building's heating system or installing local energy production.
The applicable programs in Oslo municipality are the following:

- Energy improvements in residential buildings and non-residential buildings [24]
- Grant for district heating or heat pump in residential buildings
- Grant for charging infrastructure in residential buildings
- Grant for replacing old woodstoves

There are also some other municipalities in Norway that give other grants, but Oslo is believed to have the most comprehensive list of programs. Several municipalities have grants for replacing old woodstoves.

Table 1, Overview of main schemes in Norway

Name of scheme / instrument	**Level of financing**	**Source of funds**	**Target groups**
Enova programs	National	Public	Private housing market (mainly single owners, also housing cooperatives)
Husbanken support schemes	National	Public	Private housing market (loans) Publicly owned (social) housing (loans and grants)
Kommunalbanken loans	National	Public	Municipalities (loans)
Climate and energy fund of Oslo	Local	Public	Privately owned residential buildings with max. 4 dwellings
Fortidsminneforeningen and *Kulturminnefondet*	National	Public	Historical / cultural heritage buildings only
Green loans from private banks	*	Private	Private dwelling owners
Klimasats	National	Public	Municipalities. **

* Dependent on the bank (local/national).
** Not specifically directed to buildings, but innovative projects that reduce GHG emissions within different topics.

3.2 Drivers and approaches in the Norwegian demo-case

The Norwegian demo-case is a small public owned multi-family building built in 1974 and has never been renovated. The building consists of two floors with a total of 8 dwellings with an average area of 46 m^2 and are located in Haugerud in Oslo. The building is owned by Boligbygg. Boligbygg Oslo KF (BBY) is a municipal enterprise that owns, operates, and manages all rental housing units owned by the Oslo municipality. They administer over 11,000 homes, with more than 25,000 occupants.

The demo building is **100 % publicly owned by the city of Oslo**. Within 4RinEU project, the building was renovated using prefabricated façade elements with integrated photovoltaic and ventilation ducts. These were installed outside of the existing facade, resulting in minor work on the building itself. The renovation was funded by Oslo Municipality, and the tenants lived in the dwellings during the entire renovation.

3.2.1 Drivers for energy efficiency investments in the demo-case

In the demo-case, the followings were identified as important drivers towards the renovation. They are elaborated in the D5.2 and D5.3 in the 4RinEUproject. In particular, the political drivers were:

- Paris 2015 and the 2018 IPCC report stress the urgency to act on climate change in all sectors.
- The **City of Oslo** is one of the cities in the world with highest ambitions when it comes to climate action. The target is to **reduce climate gas emissions with 95 % by 2030** [25]. The municipal strategies clearly state that all subsidiary companies within the municipal group have to contribute in achieving the target.
- The municipality of Oslo has high ambitions for their new projects, and has a target that new and renovated buildings in Oslo shall be built as plus-energy buildings, with the installation of renewable energy sources (RES.) [26]. When renovating municipality owned dwellings, the minimum target for energy label is set to B [27].

The following social and financial drivers are identified:

- The demo-case building had a high need for maintenance and was on top of that list. The poor quality of the building stock in the demo-case building might be the biggest driver for renovation. The City of Oslo has a goal to close the gap of the generally high maintenance need of the municipal properties, making the current project on top of Boligbygg's list.
- For Boligbygg, the main aim of the project was to test a solution that **minimized inconvenience to residents**. The tested solutions in the demo-

case enabled the **tenants to live within the apartment during the deep renovation process**. This is both socially important as the inconvenience for the tenants is minimized, and Boligbygg saves the cost of needing to provide temporary housing for the residents.

- The tenants pay a fixed leasing price and the energy cost. The renovation completed in completed in the 4RinEU project has reduced the energy cost for the tenants. Replacing old technical installations with newer ones can reduce the need for maintenance over time, which is a long-term financial driver for Boligbygg.

3.2.2 Structural or planning approaches which reduce the amount of investment or facilitate the repayment

The selection of the design team for prefabricated façade elements with integrated technology took a lot of time and energy. This was to make sure that everyone was on board with the ambitions of the project, and to find the most relevant experts within the given areas. A close collaboration with the manufacturer was crucial to achieve the wanted result. The same company was used for both the production of elements and subcontracting the mounting work – this reduced coordination risk of conflicts. The company also involved as an integral part of the research project team, and the full details of the renovation were not decided in the procurement process but was developed by the consortium. This innovative procurement and planning approach proved to be valuable.

The project used a BIM model approach for design and construction – applied in scanning and to timber cut. The design team has stated that this planning approach was a crucial point of success, both for the cooperation between the experts in the planning and to achieve the level of detail needed to produce elements with minimal adjustments on site.

The ventilation solution was optimized to the apartment layout, some of the ducts are integrated in the façade elements, while others are built in the staircases.

3.2.3 Financial approaches

The demo-case was initiated by Boligbygg and was fully financed through the municipal budget. Municipality owned corporations and enterprises (such as Boligbygg Oslo KF) can not apply for loans through Kommunalbanken directly – only municipalities can apply but allocate the funding through the budgets. The funding of the renovation of the Norwegian demo-case was allocated from the municipal budget directly. Boligbygg as a subsidiary company under the Oslo municipality that uses investment budget for this project, which is an internal

municipality loan. This is the way that Boligbygg can get loan for these kinds of projects.

3.3 Discussion: Appropriateness of approaches and instruments in Norway

Oslo municipality calculates emissions from electricity and district heating as zero, thus the renovation does not affect the calculated GHG emissions of the energy use. In Oslo Municipality, there is a minor political push and budget allocations for these kinds of measures compared to larger initiatives on emission-free transport and construction sites. It could be argued that the saved energy in these kinds of projects can be used for other purposes, like increasing the electrification of construction sites within the city borders, thus giving a push for more rehabilitation of the municipally owned residential buildings. Boligbygg must also meet their annual budget goals exactly, and this can lead to less desirable approach such as simple measures instead of larger façade renovations. Longer budget periods would allow the flexibility of more time to plan comprehensively.

Norwegian schemes are directed towards innovative measures or replacement of energy sources towards low-emission systems. The largest source of funding, the Enova funds, does not longer support measures that are profitable – meaning that cost-efficient energy efficiency measures will not receive funding. The current project is innovative, so there would be some possibilities for funding through the Enova schemes. However, when the tested solution soon becomes commercially viable ("off-the-shelf"), the options of funding of the tested solution might be few. Even though the solution could be profitable in the long-term perspective, the short-term economic focus of Norwegian apartment owners is a barrier for energy upgrade in housing cooperatives [28]: "Even if the investments are well grounded economically, the residents' fear of increased association fees (monthly costs) often stops the process, and leads to building degradation in the long run". Oslo municipality does however offer support for energy upgrading in private homes. Still, Grini and Oksvold [29] states that more targeted information for dwelling owners about the benefits of upgrade is needed, recommending Enova to develop a program that supports and fit to the decision processes of the privately owned housing cooperatives in Norway. The instruments today are not coordinated in a way that is close to fulfilling the potential of energy savings (of 1,5 TWh in total) for Norway in 2030. Rehabilitation rates need to approximately be doubled for this potential to be reached, and all rehabilitation project would then need to take energy measures into consideration (which is not the situation currently). The Office of the Auditor General (OAG) had an investigation of the governmental work on energy efficiency in buildings in 2015, criticising the available instruments

for energy efficiency in existing buildings, stating that the financial instruments had only minor effects [30]. The follow-up from OAG in 2019 pointed to several improvements after the changes in the Enova funds in 2017, and that the support towards the existing building sector had grown. Further developments are however needed to support and encourage the privately-owned residential sector in reaching higher energy efficiencies and higher renovation rates.

3.3.1 Available financial instruments – but not applied in 4RinEU project

Many of the support schemes from chapter 3.1 could have been used in the demo-case, had it not been for the limits on state aid rules.
The national support schemes are covered by state aid rules depicting how much of the additional costs that can be covered by the state. Since the project already is receiving funds for the 4RinEU project it will not be eligible for other additional state funds. This is stated in the EEA agreement.

Some of the programs from Enova mentioned in subchapter 3.1.2 could have been applicable. These include:

- Introduction of new technology in buildings
- Commercial testing of innovative building technology
- Best available technology in existing buildings.

Boligbygg has some experience with Energy Performance Contracting (EPC) from ongoing projects. The ESCO use the stream of income from the cost savings or the renewable energy produced to repay the costs of the project (including the costs of the investment). The company will not receive its payment unless the project delivers energy savings as expected. However, if the residents themselves have no incitement for saving energy, the profit for an ESCO might be uncertain. As Boligbygg is testing EPC contract in a large scale in other projects, with 370 000 m^2 in 102 buildings included, it was not seen as relevant in the current project, that focuses on the cost-efficiency in the construction part of the rehabilitation project.

3.3.2 Desirable approaches – not available in the project

Enova does not provide support for single measures on the building envelope that are considered commercially viable (such as insulation of existing buildings and replacing windows) for private and public multifamily buildings, but can support energy initiatives in a market introduction - when demand is low, and prices are high. The goal is to stimulate sale and reducing the prices of new and innovative solutions. Private and public owners of multifamily buildings cannot receive support for regular PV-panels as this is considered commercially viable. Support from Enova is larger for more innovative projects in the early phase of a new technology. The support may be smaller once the innovative technologies have

already been applied in previous projects, although there may still be a risk related to the early adaptation of the technology the second time a technology is being adopted in a new project. Enovas programs are directed toward private owners or housing cooperatives, and not municipally owned buildings.
Municipalities and property-owners providing social rental housing may use the basic loan scheme from Husbanken to finance their projects. Most programs from Husbanken offer loans for new buildings. There are less programs for the renovation of existing public buildings to high energy efficiency standards.

3.4 Summary: Applicable financial instruments in Norway

The most relevant instruments identified for the deep renovation measures considered in the 4RinEU project:

- Enova subsidy programs (private owners or housing cooperatives)
  - Introduction of new technology in buildings
  - Commercial testing of innovative building technology
  - Best available technology in existing buildings.
- Climate and energy fund of Oslo (privately owned residential buildings with max. 4 dwellings)
  - Energy improvements in residential buildings and non-residential buildings
- Husbanken loan (not for municipalities, energy upgrade in addition to accessibility measures)
  - Loan for upgrade of existing residential housing
- EPC contracting (for municipally owned housing)

The Norwegian demo-case is a small public owned multi-family building built in 1974 and has never been renovated. Many of the beforementioned support schemes linked to buildings could have been used in this project, had it not been for the limits on state aid rules. Since the project already is receiving funds for the 4RinEU project it will not be eligible for other additional state funds. This is stated in the EEA agreement.

Norwegian schemes for multifamily buildings are directed towards innovative measures or replacement of energy sources towards low-emission systems. The current project is innovative, however, when the tested solution soon becomes commercially viable ("off-the-shelf"), the options of funding of the tested solution might be few. Even though the solution could be profitable in the long-term perspective, the short-term economic focus of Norwegian apartment owners is a barrier for energy upgrade in housing cooperatives. The instruments today are not

coordinated in a way that is close to fulfilling the potential of energy savings reach the required renovation rates. Further developments are however needed to support and encourage the privately-owned residential sector in reaching higher energy efficiencies and higher renovation rates.

What does Boligbygg see as the most important economic benefit from the new innovative renovation method?

- The solution of renovation by prefabricated façade elements enabled the residents to stay in their apartment during the construction work. This did not only minimise the inconvenience for residents during renovation. It also represents an economic benefit for us, since Boligbygg saves the large costs of providing temporary housing for the residents. In addition, the period of construction work was shorter.

References

[16] https://www.ssb.no/bygg-bolig-og-eiendom/statistikker/boforhold/aar

[17] https://www.ssb.no/bygg-bolig-og-eiendom/statistikker/kombolig_kostra

[18] https://husbanken.no/english/about-the-housing-bank/the-housing-banks-role/

[19] https://husbanken.no/english/basic-loan/

[20] *Veileder for lån fra Husbanken §2-5*: https://nedlasting.husbanken.no/Filer/7b18.pdf

[21] https://www.kbn.com/globalassets/dokumenter/gronne-lan/grontlaneprogram_kriteriesett.pdf

[22] https://www.miljodirektoratet.no/klimasats

[23] https://www.smartepenger.no/95-lan/3408-gronne-boliglan

[24] https://www.oslo.kommune.no/tilskudd-legater-og-stipend/energiforbedring-i-boliger/

[25] *Climate and Energy Strategy for Oslo, Adopted by the City Council in Oslo 22.06.2016 (Proposition 195/16).* See: https://www.klimaoslo.no/wp-content/uploads/sites/88/2018/06/Climate-and-Energy-Strategy-2016-English.pdf

[26] *Plattform for byrådssamarbeid mellom Arbeiderpartiet, Miljøpartiet De Grønne og Sosialistisk Venstreparti i Oslo 2015-2019*. See: https://www.sv.no/oslo/wp-content/uploads/sites/2/2015/10/Byraadserklaering-web.pdf

[27] https://www.oslo.kommune.no/for-vare-leverandorer/standard-kravspesifikasjoner/

[28] Hauge, Å.L., Thomsen, J. & Löfström, E. *How to get residents/owners in housing cooperatives to agree on sustainable renovation,I* 2013. Energy Efficiency 6, 315–328 (2013). https://doi.org/10.1007/s12053-012-9175-5

[29] Grini, G. and Oksvold I. *Virkemidler for energieffektivisering i borettslag/sameier*, 2018. See: https://www.nbbl.no/media/4644/2018-02-12_gehor_rapporten.pdf

[30] Riksrevisjonen. *Undersøkelse av myndighetenes arbeid med energieffektivitet i bygg*, 2015. See: https://www.riksrevisjonen.no/rapporter-mappe/no-2015-2016/Myndighetenes-arbeid-med-energieffektivitet-i-bygg/

4 Instruments, Approaches and Drivers in Demo-Case Countries – The Netherlands

In the Netherlands, around 40 % of the housing stock is rental, the rest is owner-occupied, and the majority of the rental stock is owned by social housing associations. Though the associations have been privatised in the 1990s, the sector is heavily regulated by the central government. Rent levels have been maximised, so that low income tenants can afford a house, and receive additional financial support for the renting, depending on their income. The valuation of property is regulated, and the building energy performance certificate partly defines the maximum allowed rent level.

4.1 Available financial instruments in the Netherlands

The central government charges specific taxes to the social housing sector, based on the property valuation. At the same time subsidies for energy renovation are available based on the improved building energy performance certificate after renovation. In future the government subsidy for energy renovation will be paid as a tax reduction on this specific tax for housing associations. Also, the level of service costs, and the charges for (district) heating are regulated. The costs for district heating should be equal to the costs of heating with individual gas boilers – the most common way of heating. The costs of gas and electricity are being regulated by the government by adding 50 – 100 % energy tax on top of trade prices.

The government supports investments in renewable energy by providing subsidies for every kWh renewable energy produced. PV for rental housing is subsidized through the energy subsidy, and through the net-metering regulation which waves energy taxes for every kWh compensated with own PV generation.

Currently new financing mechanisms are being developed for owner-occupiers by introducing a building related loan for energy investments. This differs from a normal loan which is provided to a person.

Taxation measures

The Dutch government charges energy tax and an additional renewable energy tax on every unit of gas and electricity sold. In future the energy and renewable energy tax will increase, especially on natural gas, while the energy tax on electricity shall reduce.

Renewable energy generated behind the meter nowadays can be sold at the same price as it must be purchased from an energy provider. Energy tax is waved for any kWh of renewable energy sold to the grid. This concept of net-metering will be in place until 2023 and be replaced with a smaller subsidy on every kWh renewable energy sold to the grid.

For those who cannot install their own renewable energy technology behind the meter, it is possible to join community-based initiatives in communal PV systems, and profit from some energy tax reduction on generated kWh renewable energy.

4.1.1 Instruments available for public owned residential buildings

- **STEP-subsidy** (now ended) [31].
  This subsidy is an instrument only for not-for-profit housing companies in the Netherlands. Briefly we can explain this subsidy as a stimulation to improve the energy label of a dwelling with at least two steps (where G is worst and A++ best). The fixed budget for 2018 has been reached and for 2019 the government ceased this instrument.
  The projected future financial incentive for not-for-profit housing companies is a reduction of a levy for these companies when certain investments in sustainability have been made.
- **Reduction of Social Housing Tax** [32]
  The Reduction of Social Housing Tax is structured along the lines of the previous STEP subsidy. In this case, the tax obligation for social housing providers is reduced if a number of energy label steps has been achieved. The budget for this tax reduction is smaller than the previous STEP subsidy: the two years budget was used in less than a half year. Therefore, many applications cannot be awarded unless additional budget comes available.
- **EPV (EPC) Energy Performance Compensation** [33]
  This is an instrument for owners of rental housing in general, both public as private owned, new constructed as well as renovated houses. It concerns a certain supplement that the owner may charge on top of the monthly rent. There are two requirements: the level of insulation of the house and the level of renewable energy generation of the house. When both apply, the owner can add between € 1,05 and € 1,45 per m^2 floor area on the rent. For instance, for a house of 100 m^2 the owner can raise the monthly rent between € 105 and € 145. The owner must proof both requirements by yearly monitoring and reporting.
  Due to the current net-metering arrangements, this scheme is attractive for end-users, whilst the housing companies have extra income. When the net-metering ends in 2023, the system will be less obvious and less attractive to tenants. The level of the requirements demands such an investment and the administrative requirements are so strict that Woonzorg hasn't used this instrument (until) now.
- **WWS Woning Waardering Systeem (HVS Housing Valuation System)** [34]
  This also is an instrument for owners of rental housing in general, both public as private owned, new constructed as well as renovated houses. There are specific restrictions for social housing.
  In the Netherlands, the definition of renting levels of social housing is not free, on the contrary there are strict regulations. One of the criteria of the HVS is the energy performance of the house. This is determined by the energy label, again. It is a system with points, so the bottom is label G with 0 points and the top is A++ with 40 points. 1 point represents about € 6 or € 7, so with 40 points an owner can raise the monthly rent with € 240 to € 280. This is theoretical, there are other restrictions. For example, social housing never exceeds a monthly rent of € 713.
  Only costs concerning non-movable property can be charged via the HVS system.

- **Charging of sustainability investments by service fee** (NL: Verrekening via servicekosten) [35]
  In the Netherlands, housing associations may charge the investments made for sustainability via a monthly service fee. It concerns both capital and exploitation costs. In this way housing associations can earn back their investments in movable property. One of the most applied technologies exploiting this mechanism is the installation of a PV system. This is an instrument both for public as for private housing owners.
- **SDE subsidy** [36]
  An instrument independent of owner situation, this subsidy is not for consumers. It is only for non-private owners. When investing in one or more of six determined technologies a company can use the SDE subsidy (SSE Subsidy Sustainable Energy).
  This is an exploitation subsidy. This enables a guaranteed contribution during 15 years per generated kWh renewable energy.
  It concerns investments in one or more of the following techniques: bio-mass, wind energy both on land and offshore, geothermal energy, hydro energy and solar energy.
- **ISDE** [37]
  Investment subsidy for renewable energy technologies. Building owners can apply for subsidies for renewable energy technologies, such as solar thermal systems, heat pumps, wood pellet burners etc.

4.1.2 Instruments available for private owned multi-family buildings

- **EPV (EPC) Energy Performance Compensation**
  - This is an instrument for owners of rental housing in general, both public as private owned, new constructed as well as renovated houses. It has already been described in Section **4.1.1.**
- **WWS Woning Waardering Systeem** (HVS House Valuation System)
  This also is an instrument for owners of rental housing in general, both public as private owned, new constructed as well as renovated houses, but restricted to social housing. **See 4.1.1.**
- **Charging of sustainability investments by service fee** (NL: Verrekening via servicekosten). **See 4.1.1.**
- **SDE subsidy**
  An instrument independent of owner situation, this subsidy is not for consumers. **See 4.1.1.**
- **ISDE**
  Investment subsidy for renewable energy technologies. Building owners can apply for subsidies for renewable energy technologies, such as solar thermal systems, heat pumps, wood pellet burners etc.
- **Subsidies for associations of apartment owners** [38]
  There is a specific subsidy for energy advice and investment in insulation and energy efficiency measures for associations of apartment owners.
  Loans for investment in energy efficiency and renewables are available, initially only at 15 years span. Recently also 30 years loans are possible under the same mechanism.

4.2 Drivers and approaches in the Dutch demo-case

Social housing organisations and the government have made voluntary, agreements to achieve certain energy label steps by 2020, to the extent that the average energy label is label B. This has resulted in programs to achieve energy label B and A. The standard renovation in the Dutch demo case is a good example of the current state of the art of energy renovation in the Dutch market.

4.2.1 Drivers for energy efficiency investments in the demo-case

Drivers to enhance investments in sustainability:

- General drivers
  - *Social drivers*
    More and more residents of Woonzorg ask about their investments in sustainability. They are usually driven by two aspect: financial and societal. Financial because they expect that these investments will decrease their energy costs, a legitimate expectation. Societal because they feel the urge to reduce CO2-emission in favour of the new generations.
  - *Authorities, local and national*
    Both local as national authorities ask Woonzorg as a semi-public organisation what actions to take concerning sustainability. Woonzorg is represented in about 180 municipalities around in the Netherlands and make agreements with the municipalities yearly on a variety of aspects, such as rent policy, but sustainability policy is becoming an increasingly more important part of this.
  - *Market value, return on investment*
    Investments in residential buildings increases the market value of the building stock. This is a limited measure, because a certain market can only handle a restricted value increase. An investment higher than a local market is not profitable. Calculations of Woonzorg shows that investments in residential buildings increases the market value around by 50%.
    Also, the RoI is part of the considerations, in projects Woonzorg has invested in, RoI figures are within the aimed criteria.
  - When major investments are involved it may help to extend the economic lifetime of the building and thus generate rental income over a longer period than originally anticipated. This principle generates investment potential in sustainability measures.
  - *Asset management risks*
    There is a long-term risk in not investing in sustainability. As an example, Woonzorg has concluded that not participating in decreasing CO2-emissions of their building stock gives a risk in devaluation of it in the future.
- *Specific drivers for the demo case SOEST*
  - For the Soest demo case all general drivers apply.
  - At the moment (March 2020), the process of procurement is taking place. After the contractor is selected and the final investment level is determined we will make calculations where HVS (House Valuation

System), service fee, market value and return on investment will be applied.

4.2.2 Structural or planning approaches which reduce the amount of investment or facilitate the repayment

- General
  - Procurement process. Woonzorg has developed an approach for procurement where we tender 5 to 10 buildings at one time, to offer the contractor a larger volume. The contractor may plan the construction works these buildings sequential, which offers him or her continuity and less failure costs.
  - Synergy with maintenance. Woonzorg planned the order of buildings to refurbish by selecting the year where maintenance on the 'skin', i.e. facades and roof, or major systems is planned. This enabled utilization of equipment such as scaffolding more efficiently.
- Soest demo case
  - In the Soest demo case these approaches were not applied because it makes part of the 4RinEU program where other drivers are formulated already (Robust, Replicable, Reliable).
  - The demo case also aims at a much lower heat demand, than necessary to a achieve Energy label B and A under the Dutch definitions of the Energy label. Therefore, the performance of the demo case is still exceptional in the Dutch market.
  - In the planning approach experienced partners have been chosen to be able to demonstrate a cost-effective way to achieve a better performance than typically achieved.

4.2.3 Financial approaches

- Apart from the financial instruments described in 4.1.2 we don't apply other financial approaches at this moment.
- Since two months we employed a purchaging officer. One of his tasks is to investigate possibilities such as ESCo's, leasing sustainable systems instead of buying, use of other fiscal instruments.

4.3 Discussion: Appropriateness of approaches and instruments in the Netherlands

Most financial instruments in the Dutch market focus on energy supply technologies. Even though energy saving measures are part of the energy performance building certificate, the impact of solar PV generation dominates the outcome of the calculation. Therefore, with exceptions, the Dutch market focuses on standard insulation measures combined with PV panels on the roof.
The calculation algorithms of the building energy certificate determine the preferences of decision makers, because the building energy certificate discloses regulated property values, rent levels and subsidies.

As of 2020 the building energy certificate will also relate the net energy demand of buildings as a separate parameter. This will support the application of 4RinEU technologies, which help reduce the net energy demand.
The current domination of PV in the building energy certificate combined with net metering of PV generations results in a lack of financial incentives to address load shifting or energy storage.
The new proposals for financing mechanisms are promising, because the current subsidy mechanisms often result in a stop and go market.
Most subsidies have a short political life span, which results in technological preferences which last for 3 – 4 years, It would be useful if financial mechanisms have a longer life span, so that a mature energy market for energy saving and energy supply technologies can develop. There is also a need to modify energy taxes into a CO2 related tax system, to ensure a predictable and long-term influence on decision makers.

4.3.1 Available financial instruments – discarded in the project

Woonzorg in most cases uses either own capital or cheap loans which are available to the social housing sector. In addition, in many projects the STEP subsidy for social houses has been used. Just exceptionally the STEP subsidy has not been used for the project Marienheuvel and Marienhorst, even though the project does meet the requirements of achieving several Energy Label improvement steps. The project did not make use of heat pump technology or solar thermal, for which product related ISDE subsidy could have been used.

4.3.2 Desirable approaches – not available in the project

It would be desirable to have financial instruments which focus on very low energy performance. The current labelling method scores energy label A and B at relatively modest energy performances. Therefore, the system does not acknowledge the value of better performances, unless through the use of renewable energy systems. The financial approaches either only support renewable energy systems, or in combination with a good energy performance. Stimulation of good energy performance on its own rights is missing.

4.4 Summary: Applicable financial instruments in the Netherlands

Most subsidies have a short political life span, which results in technological preferences which last for 3 – 4 years. It would be useful if financial mechanisms have a longer life span, so that a mature energy market for energy saving and energy supply technologies can develop. There is also a need to modify energy taxes into a CO2 related tax system, to ensure a predictable and long-term influence on decision makers. It could also replace the need of subsidies.
The social housing sector has proper access to financial sources through national mechanisms, but other sectors would benefit from access to affordable financial sources. There should be more focus on long term asset management-based finance mechanisms. The investment levels are not only environmentally but also economically viable when they are part of a long-term exploitation and income streams.

Concluding remarks from this chapter:

- Most financial instruments in the Dutch market focus on energy supply technologies.
- Even though energy saving measures are part of the energy performance building certificate, the impact of solar PV generation dominates the outcome of the calculation.
- Therefore, with exceptions, the Dutch renovation market focuses on standard insulation measures combined with PV panels on the roof.
- The EnergieSprong concept using the Energy Performance Compensation has a limited uptake. In 2019, 6000 houses have been renovated instead of the targeted 111,000 units for 2020.
- Most subsidies have a short political life span, which results in technological preferences which last for 3 – 4 years.

The social housing sector has proper access to financial sources through national mechanisms, but also other sectors can benefit from access to affordable financial sources.

In the Netherlands, there should be more focus on long term asset management-based finance mechanisms and independence of subsidy schemes, so that a mature market for deep renovation can develop.

References

[31] https://www.rvo.nl/subsidie-en-financieringswijzer/stimuleringsregeling-energieprestatie-huursector-step
[32] https://www.rijksoverheid.nl/onderwerpen/huurwoning/verhuurderheffing
[33] https://wetten.overheid.nl/BWBR0038456/2019-07-01
[34] https://www.rijksoverheid.nl/documenten/publicaties/2019/03/27/hoe-tel-ik-tot-1-juli-2020-de-punten-van-mijn-zelfstandige-huurwoning
[35] https://www.huurcommissie.nl/faq/servicekosten-en-nutsvoorzieningen/welke-kostenposten-vallen-onder-servicekosten
[36] https://www.rvo.nl/subsidie-en-financieringswijzer/stimulering-duurzame-energieproductie-sde
[37] https://www.rvo.nl/subsidie-en-financieringswijzer/isde
[38] https://www.energiebespaarlening.nl

5 Instruments, Approaches and Drivers in Demo-Case Countries – Spain

In Spain, the E.P.E. Institute for the Diversification and Saving of Energy (IDAE) is an important public actor in the work of fulfilling Spanish objectives and commitments regarding improvements in energy efficiency, renewable energy and other low carbon cost technologies. This constitutes the strategic framework of its activities. To this end, the IDAE carries out promotional and training activities, technical consulting, development of specific programs and financing of technical projects, which are innovative and replicable. Likewise, the Institute leads active international engagement within the framework of various European Programs and co-operation with third countries.

Another important actor is the European project EnerInvest. The aim of EnerInvest is to become a National Platform of reference, a meeting point between relevant stakeholders and a consulting platform, by offering technical, legal and financial solutions to sustainable energy projects (SEP) promoted at the national level by both the public and private sectors. Both these actors are relevant for the reader searching for updated information on current financial instruments, as they were in the work on this chapter.

5.1 Available financial instruments in Spain

In Spain, at country level, the main instruments to improve energy efficiency are related to aids and subsidies, above financial mechanisms. The following instruments are available both for public and private owners:

- **Support:** All type of mechanisms provided, mainly, by the national government to indirectly offset the costs of operation and management of the activities related to retrofitting actions.
  These one's include mainly direct payments, loans guarantee, and special tax reductions so, the company or the private owner could use the saved money to compensate the costs of the operation and management. At local level, this mechanism is usually implemented by reducing the annual property taxes. It should be mentioned too that, for any kind of retrofitting actions, no matter if they're specifically energy efficient or not, the VAT tax is reduced up to 10 %, instead of 21 % that should be paid for new constructions. This VAT reduction is always discounted directly to the owner payments to the construction company, which means that rarely the ESCO companies can access to these favorable conditions.
- **Grants:** All kind of mechanisms in which a direct budget is transferred from the government (usually direct or indirectly the national one) to the end-users nominally.
  Public administrations grant a percentage of the total investment of a set of projects defined in a public call, which is access-based on competitive contest.

Both the bases and the call for subsidies, as well as their amendments, are made public, through the official reference bulletins for each administration. For energy efficient retrofit actions, the impartment and the amount of these subsidies are directly linked to the kind of actions (passive refurbishment, HVAC substitution and/or renewable systems implementation), are evaluated through the improvement of the qualification on the mandatory building certification processes, and are paid against receipted invoice. Due the ERDF funds origin and its rules, the maximum total amount to be perceived from a unique entity it's about 300.000 €, which again, limits the activities of ESCO companies. The main risk is that the implemented action must achieve a certain result and, if not, the subsidy is finally not granted.

Beyond the national directly granted one's, the mechanisms of some of these subsidies are usually shared with the funds of the Regional Governments, and the provincial or local funds, sometime provided by its own, but mostly as a channel to distribute the national or European one's.
The main national Program for finance the energy renovation in buildings is the **PAREER-II**. It's budget of 203,6 M€ is distributed in subsidies and repayable loans. The eligible cost must be between 30,000 € and 4 M€ and the measures financed are the installation of renewal energy production (solar thermal and geothermal), the improvements in the thermal envelope (up to the 30 % of the total amount), and the improvements in thermal installations and in lightning (up to the 20 % of the total amount). The PAREER program will continue under the name of PAREER-CRECE due it is considered as a successful action by the national government.

5.1.1 Instruments available for public owned residential buildings

No specific financial instruments have been identified in addition to those described above (grants and subsidies). Even though, there exist the program FEDER-POPE 2014-2020 (from ERDF), specifically oriented to public owned residential buildings, financing energy renovation in existing buildings or infrastructures of the Public Administrations in Spain. The general budget amount is about 95.181.546,36 €, from which up to 5,9 % of this budget (5.659.125 €) is distributed in Catalonia, for co-financing up to 50 % of the costs of the renovation projects.

5.1.2 Instruments available for private owned multi-family buildings

In addition to the most common one's above-mentioned, there exist other financial instruments in Spain that can be used by private building owners:

- **Credit Lines.** There are *Conventional loans* -from private banks or public entities- without a specific objective, or the *Dedicated Credit Lines*, ad-hoc financial lending instruments for energy efficiency or renewable energy – as already mentioned in chapter 2. The more interesting feature of these *Dedicated credit lines* is that the interest rates of these loans are generally lower than comparable conventional loans, and, payback time is the same that the return period on investment. To obtain these specific loans it is necessary to achieve a minimum level of energy savings, to be demonstrated via the qualification achieved in the mandatory building energetic certification, or, in a

few cases, after the implementation of the actions through the verification of the energy bills. At national level, this kind of mechanisms is still incipient with only a few private entities offering them.
Triodos bank [41] was the pioneer at Spanish level by offering credit lines and mortgages with an interest rate directly linked to the building certification level. Recently, Triodos bank and Green Building Challenge Spain (GBCs) signed an agreement to jointly collaborate in the Energy Efficient Mortgage Initiative European project (EeMAP [43]) in order to develop such kind of initiatives. On the other hand, there is the already mentioned, public Program PAREER-II, that offers repayable loans with the following conditions:

- Interest Rate: Euribor + 0,0 %.
- Maximum repayment term: 12 years (including an optional 1-year grace period).
- Guarantees: Bank guarantee, bond insurance contract, or cash deposit in favor of the IDAE in the General Deposit Fund of the Ministry of Economy, Industry and Competitiveness, amounting to 20 % of the amount of the loan.

- **Equity.** Itis a financial instrument that offers loans for a project with the possibility of becoming partner of the project. Security is different, as compared with traditional loans, as the financial entity controls the business interests and has an active involvement in the management activity. This type of financing instrument is focused on technologic start-ups and new businesses of the *innovation* sector; that means that, specifically, these mechanisms are more related to new products or solutions to be putted on the market, rather than retrofitting activities as a whole. The first Spanish fund in this sense, is the SC Energy Efficiency Fund, from SUMA CAPITAL [43]. This fund finance projects classified as Energy efficient in residential, industry or services but often, and due to its characteristics on the minimum investment requirements and high return rates, are not a realistic mechanism for residential buildings.
- **EPC.** The Energy service contracts generate a future cash flow from savings in energy costs, which can be used to re-finance energy efficiency investments. This means that they are a form of funding that allows them to invest in energy updates to get cost reductions. These contracts provide improvements in the infrastructure of consumers who lack:
  - Energy Engineering Skills
  - Time to manage projects
  - Financing
  - Understanding Risk
  - Technology information
  - Labor

  Energy service contracts can be of three types:
  1. *Shared savings Model* (*SSM*): Cost savings are shared for a predetermined time according to the preset percentage.
  2. *Guaranteed savings Model* (*GSM*): The contracting company guarantees a minimum level of energy savings and the customer assumes no responsibility for the possible risks.
  3. *Shared and Guaranteed Savings Model*: Is a mix of SSM and GSM contracts.

Some companies that offer these Energy services contracts are Geinsema [44], Prodiel [45] and Enertika [46].

- **Operating lease** It's a financial mechanism between the loan and the Energy Performance Contracting (EPC). The Energy Service Company (ESCO) signs an agreement with a financial entity to study and implement a SEP (Sustainable Energy Projects) with an EPC in an operating lease modality. The financial entity provides liquidity, and the ESCO carry out – together with other associated groups – other parts of the project, as the technical one. In this case, the final client uses the active in exchange for a fixed monthly payment. When the agreement ends, the lease transfers ownership of the asset to the lessee considering the residual value. In Spain, the financial entity KIPLAI [47] offers this mechanism, that in the residential sector can be applied mainly for energy renewal projects and for the renovation of the electric equipment's.

- **Bonds.** Financial instruments of public or private debt, where the issuer agrees to return the principal capital together with the interest. In recent years, green bonds have emerged. These are similar to conventional bonds but, in this case, they are required to be used to implement sustainable energy actions. Energy savings must be important because a minimum level must be reached to preserve the amount financed. In case of non-payment, the investor appeals against the issuer and against the subsidiary warranty. In addition, the asset set is dynamic, which means that non-profitable assets are replaced.

- **Forfaiting.** The peculiarity of this mechanism is that the energy services company transfers the collection rights that the beneficiary will pay in accordance with the contract signed (for the development and implementation of the contracted project) to the financial institution. The financial institution buys the payment rights by paying an amount to the seller in exchange for receiving monthly payments. The ESE does not acquire debt which is an advantage because increasing the debt level could hinder their progress. In Spain, the European Energy Efficiency Fund has financed energy renovation projects, through this mechanism.

- **Crowdfunding (citizen financing).** It is a financing practice that consists of collecting money from a large number of private investors, without a bank as an intermediary neither other financial institutions. Usually, the financing through crowdfunding is done on an Internet platform that offers this type of financial Service (fintech). However, the collective funding can also be made through a model of purchase of shares or through cooperatives. There are several financing alternatives through crowdfunding, **crowdlending,** it is the more directly applicable to the financing of energy renewal projects in existing buildings. Investors receive an interest in the amount invested, currently greater than the interest offered by most of bank deposits, although the risk is also higher. Some examples of this Internet Platform are ECrowd or Fundeen. Those entities ask for an amount and returns it on a date established with a specific interest. In addition, the bonds give access to financing for sustainable

energy projects, which make it possible to control that sustainable standards are reach.

5.2 Drivers and approaches in the Spanish demo-case

The Spanish demo case is a building constructed and belonging to the Regional agency Institut Català del Sòl (INCASOL) but managed by AHC. As a manager, the AHC must maintain the buildings at optimum conditions, including corrective and preventive maintenance but global retrofitting actions when needed. Nevertheless, the AHC is conditioned by two main factors: i) most of the end-users of the buildings in its charge suffer from energy poverty situations and, ii) the AHC have not a specific budget allocated for building refurbishment, but to general maintenance which, in some cases, means building renovation actions.

5.2.1 Drivers for energy efficiency investments in the demo-case

There are no political targets or budgetary allotment to specifically promote energy efficiency investment in the AHC stock of houses. Nevertheless, as a public agency, AHC has to become an example, in order to enhance the energetic renovation in the private properties. Because of that, the AHC tries to implement energy efficient solutions when retrofits its buildings.
At the other hand, another powerful reason why the Agency do the energy efficient renovation in some of its buildings, including the demo-case one, is the serious social situation of fuel poverty of most of their tenants, which makes necessary to seek solutions to reduce energy consumption.
Although the building is quite new (2003), its envelope is not enough insulated for the weather conditions of Bellpuig and, from the air-leakage tests, probably a poor execution process has result in some obvious pathologies. Additionally, the energy system of this demo-case uses electricity from the net to the lighting, the heating and the cooking. Only the DHW combines electricity consumption with Solar Thermal Panels. The insufficient insulation and sealing of the apartments and the electrical dependence causes high electricity invoices or, often and due to poverty reasons, discomfort situations during the occupancy periods. Some time ago, the AHC's tenants of the building started to renounce to the apartments and it seems that the main cause was that high electricity invoices added to the apartment's rent become unaffordable for them. In 2015, AHC had to reduce the rent of the apartments more than 50% of the initial one, as a solution to avoid having the building empty, whilst a more definitive solution has been implemented, as the renovation actions one.

5.2.2 Structural or planning approaches which reduce the amount of investment or facilitate the repayment

In the Spanish demo-case of Bellpuig, the invest for the renovation is assumed by AHC, without any cost for the tenants. AHC has planned to reduce the amount of investment by: creating synergies between the 4RinEU project and the actions of maintenance. Therefore, part of the investment is obtained from EC and the other part from our internal annual budget previewed for maintenance

To facilitate the repayment of the works it is also previewed that:

- The installation of PV panels for energy production on-site, will minimize the energy consumption of the building, both tenant's apartments and common areas). AHC, do not assume the energy invoices of the apartments, but it assumes the energy expenses of common areas, so to reduce them economically benefits de Agency.
- Due to the reduction of the high energy invoices of the apartments, the Agency will also study the possibility of increasing the rent of the apartments, in order to be more like the initially rent planned.

5.2.3 Financial approaches

At this moment no National or Regional financing instrument seems applicable in this demo-case. Neither at the local level AHC will obtain any direct financial aid. However, it is expected that the owner of the demo-building (INCASOL) will obtain a reduction of the annual property tax. Both, AHC and INCASOL are public agencies who depend on the Secretary of Urban Habit and Territory from the Regional Government of Catalonia. AHC needs INCASOL approval to do energy renovations as the one previewed in Bellpuig demo-case. In this sense, the reduction in the annual tax property, can facilitate to obtain INCASOL agreement for the refurbishment.
The discount in the Annual Property Tax will depend on the level of improvement that the building will achieve in the Energy Certification:

-Type A: up to 20 %
-Type B: Up to 16 %
-Type C: Up to 12 %
-Type D: Up to 8 %
-Type E: Up to 4 %

5.3 Discussion: Appropriateness of approaches and instruments in Spain

5.3.1 Available financial instruments – discarded in the project

Some financial instruments mentioned as specific for private owners, could have been applied in these demo-case. For example, the EPC could be especially interesting as financial mechanism. Nevertheless, the complex process for subcontracting services in public organism and the fact that AHC does not assume the energy invoices of the apartments, make not viable this instrument for financing the renovation of the Agency's dwellings, at least by the moment.

5.3.2 Desirable approaches – not available in the project

For a public agency as AHC, grants are the main financial instrument (see chapter 5.1), though in these demo-case the subsidies of the PAREER II Program or of the FEDER-POPE 2014-2020 cannot be applied, although are specific for finance energy renovation in buildings.

The main raison is that the energy renovation project is already partially financed by the Horizon2020 Program. The PAREER II and the FEDER-POPE 2014-20120 programs are compatible with other financing instruments, if the beneficiary is not a profit-making entity. In Bellpuig case, the owner of the building is INCASOL, a public entity, but with profit-making, so the renovation cannot receive this national financial aid.

5.4 Summary: Applicable financial instruments in Spain

As it has been introduced, for the Spanish building retrofit market most of the financial mechanism are related to aids and subsidies, rather than other less-custodial financial mechanisms.
That is, for the building retrofit sector at Spanish level, most of the financial mechanisms are mainly included in the:

- **FEDER-POPE 2014-2020 program** [48] (for buildings refurbishment only Public Administrations owned)
- **PAREER-II program** [49] (subsidies and repayable loans for non-profit public bodies and private stakeholders).

There are two indirect mechanisms to be noted:

- **VAT reduction for deep retrofitting actions** [50] (from the regular 21 % to the 10 % for these initiatives, and regardless the actions are energy efficient or not).
- **Local aids related to the reduction of the property taxes** (only for energy efficient actions), with an example case of Barcelona City Council in [51].

Finally, in a punctual way and at local or regional levels, some support exists for the implementation of RES systems (for the global or its parts) at building level, despite of the current Spanish legislation (the so-called “tax to the sun”), with an example case (for electric batteries implementation) from the Catalan region in [52].

Nevertheless, other private or PPP financial mechanisms are rare at the Spanish residential market, probably due to:

- **The lower maturity of the market**, both from the financial institutions' side and from the end-user's side.
- **The higher return rates expected for the financial institutions**, which prefer to invest in more profitable energy business, rather than the building retrofit one’s (specially, in the residential sector with low incomes in most of the cases).
- **The lack of specific legislation and regulations** which promotes some models, specially the ESCO one’s.

Some of these issues are pointed and planned to be overcame in the main directives of the Spanish government [53], but nowadays are still not solved.

For the specific case of the Spanish demo-case, and moreover the EU funds from the 4RinEU project:

- **No other financial instruments are planned to be used** for, due the nature of the legal owner (INCASOL, as a public entity with profit-making) which impedes to perceive any of the existing public financial mechanisms at national level.
- **Either at local level, there are no specific mechanisms to be applied**.

Specifically related to RES systems implementations and considering that the building already has a solar thermal system, only aids to electric batteries would be asked for, but the 4RinEU planned PV scheme will not use them.

References

[39] IDEA webpage. See: http://www.idae.es
[40] EnerInvest webpage. See: https://www.enerinvest.es/en/
[41] https://www.triodos.es/es/particulares/ahorro/hipoteca-triodos/
[42] http://energyefficientmortgages.eu
[43] http://sumacapital.com/
[44] http://www.geinsema.com/
[45] http://prodiel.com/
[46] http://www.enertika.com/
[47] http://www.kiplai.com/
[48] http://www.seat.mpr.gob.es/portal/areas/politica_local/coop_econom_local_estado_fondos_europeos/fondos_europeos/2014-2020-FEDER/normativaFEDER_14-20.html
[49] http://www.idae.es/en/node/12955
[50] https://www.agenciatributaria.es/AEAT.internet/Inicio/_Segmentos_/Ciudadanos/Vivienda/Obras_en_viviendas/IVA/Tipos_reducidos_en_obras_en_viviendas.shtml
[51] See, as an example, the case of Barcelona City Council; https://w30.bcn.cat/APPS/portaltramits/portal/channel/default.html?&stpid=19970000413&style=ciudadano&language=es
[52] http://icaen.gencat.cat/ca/energia/ajuts/icaen-sistemes-demmagatzematge-denergia-electrica-amb-bateries-associats-a-installacions-fotovoltaiques-dautoconsum/
[53] ERESEE. *Long-term strategy for the energetic retrofit of the Spanish building sector*, 2017. See: https://www.fomento.gob.es/el-ministerio/planes-estrategicos/estrategia-a-largo-plazo-para-la-rehabilitacion-energetica-en-el-sector-de-la-edificacion-en-espana

6 Financial Instruments in Early Adopter Countries – Poland

The total number of building stock is about 4.772.728 buildings, from which the 85% was constructed before 1988, and the multifamily housing stock constructed during 1944-1988 is around 400.000 dwellings [53]. Most of these residential houses use high carbon emissions energy sources to cover their heat demands.
50 % of the population (around 19.5 million people) live in single-family buildings. This type of dwelling is more common among people from villages and small towns, with lower income and in the less affluent regions of the country [54].
The ownership structure of dwellings in Poland is distributed in 47% private, 27% cooperatives, 11 % private in Homeowners Associations (HOAs), 10% municipal, 3% enterprises and 2% to others [55].
The average economic figures for the residential sector are defined by a household's disposable income of 800 euro/month, a dwelling rental cost about the 20% of household's expenditures, and an energy bill about the 10 % of it [53]. The average cost of the thermal modernisation of 50% of all single family and multi-family houses, as well as non-residential buildings will, depending on the adopted variant, range from PLN 270 to 470 billion [56].
In the recent years, some public and public-private financial initiatives have been introduced to improve the building sector at different levels: integral renovation actions, HVAC systems replacements and RES generation.

6.1 Available financial instruments in Poland

In general, it could be said that most of the existing financial mechanisms for building renovation actions are mainly structured through public funds and implemented both, directly to the owners (mainly subsidies) or through Banks and other financial institutes (usually by means of oriented loans).

Basically, from the most typical EU countries financial mechanisms, Poland one's are mainly based on:

- direct grant to the building's owners or owners of dwellings,
- commercial loan extended to the building's owner softened by the grant related with energy saving result of renovation,
- mixed schemes of direct subsidies and soft loans, including revolving funds (EU JESSICA [57]).

Other financial mechanisms, as special guarantee schemes or energy performance contracting, are quite unusual in the Polish market and, often focused in tertiary sector buildings (i.e. buildings for the tertiary economic sector).

On the other hand, there are no significant differences on public or private financial mechanisms for residential sector, and only for tertiary sector buildings, specific mechanisms are implemented for public sector [58]. The only relevant exception is the program introduced by the BGK Bank [59], under an agreement with the European Investment Bank, as it's explained in subchapter 6.1.11.

In recent years, most of the investment funds come from the Joint European Support for Sustainable Investment in City Areas (is an initiative of the European Commission developed in co-operation with the European Investment Bank (EIB) and the Council of Europe Development Bank (CEB). Contributions from the European Regional Development Fund (ERDF) are allocated to Urban Development Funds (UDFs) which invest them in public-private partnerships or other projects included in an integrated plan for sustainable urban development. These investments can take the form of equity, loans and/or guarantees. Alternatively, managing authorities can decide to channel funds to UDFs using Holding Funds (HFs) which are set up to invest in several UDFs. This is not compulsory but does offer the advantage of enabling managing authorities to delegate some of the tasks required to implement JESSICA to expert professionals.
In Poland, these funds are partially implemented through national or local Banks and other financial institutes, by means of oriented loans, as the BGK Bank, or the WFOSiGW Bank [60]. Also, some public entities, as the Polish National Energy Conservation Agency (KAPE) [61] or the National Energy Conservation Agency (NAPE) [53], are in charge of these programs, through the definition of its access conditions or their verification.
The main financial instrument for energy efficient retrofitting of buildings, launched by the central government, is the Thermo-Refurbishment Fund [62]. The National Economy Bank created the Thermal Modernization and Refurbishment Fund. The Fund is a nationwide initiative targeting housing cooperatives, housing communities, private individuals and local governments. Its main goal is providing financial aid for investors engaged in thermo modernization and renovation initiatives as well as providing financial indemnifications for residential building owners. The Fund offers three types of assistance, namely: i) thermo modernization incentive, ii) renovation incentive, and iii) indemnification incentive. The amount of the funding received is equivalent to 20% of the loan used for the realization of the intervention from personal funds. The precondition is to achieve at least 25% energy savings through the interventions in order to be financed (confirmed by energy auditor).

Thermomodernisation project	Type of savings	Savings achieved
modernization of heating system in building, exclusively	reduction of annual energy demand	at least 10%
comprehensive modernization	reduction of annual energy demand	at least 25% or at least 15% when the heating system was modernized after 1985
modernization of local heat source and district heating networks	reduction of annual energy losses	at least 20%
connection to district heating network due to liquidation of local sources	reduction of annual heat costs	at least 20%
conversion of conventional energy sources into renewable (unconventional) ones and installation of co-generation	-	-
renovation of building constructed before 1961	reduction of annual energy demand	at least 10%

Figure 3. Detailed conditions of the state aid to refurbishment of buildings. Source: NAPE

The National Economy Bank (BGK) implements the program and in particular, a special division was created, which has signed contracts with several Commercial Banks spread on the territory. These banks forwarded numerous applications for the thermo-modernization incentive from investors to the National Economy Bank, facilitating the cooperation between local and national members of the program.

The program was launched in 1998 for a 10-year period and was extended in 2008. In the years of 1999-2015, approximately 38,000 thermo-modernization incentives were awarded, which at the end of 2015 produced annual savings in energy costs in the amount of approximately 900 million PLN. The significance of financial savings, attained through the thermo modernization initiatives supported by the Fund, influenced the decisions of numerous investors who have not benefited from the financial support within the framework of good practice. It has largely contributed to the increase the public awareness on this matter and the willingness to engage in similar projects. In this period, the 40% of the cases are implemented in HOAs properties, another 40% to cooperatives, 7% to private family houses, and 1% to others. The activity of the Fund continues to this date and is a crucial element of Poland's environmental initiatives.

Moreover, at level building integral renovation, it should be mentioned that in 2015 was introduced a specific program to establish mechanisms to finance single-family houses, as they are a relevant part of the overall building sector [63]. The program, scheduled for implementation between 2015 and 2023, has a proposed budget for the pilot phase (2015-2020) of PLN 400 million (including 120 million for subsidies) providing for the possibility to conclude subsidised loan agreements until 2017. Beneficiaries of the program include natural persons, local government units and non-governmental organisations (such as foundations, associations, churches, religious groups) having the ownership of single-family residential buildings.

At the other hand, in the recent years some further specific financial mechanisms have been introduced to facilitate the implementation of RES technologies at building level [64]. Specifically:

- For implementing **thermal RES**, the supported schemes are:
  - *Subsidies*. There are three grant schemes for heat from renewable energy sources [65]. A state-owned bank, the other two by the National Fund for Environmental Protection and Water Management, launched one. The former and one of the latter support refurbishments works, which, among others, may include the installation of RES technologies for heat generation. The second grant program from National Fund supports the purchase and installation of solar collectors.
  - *Loan*. The National Fund for Environmental Protection and Water Management grants low interest loans to support the purchase and installation of RES installations [66].
- For implementing electrical RES, the supported schemes are:
  - *Tenders* (auctions). Currently, the main incentives for renewable energy use in Poland are tenders [67]. Nevertheless, these mechanisms, available for all the RES technologies, are more focussed to big size installations and for declared energy producers.
  - *Quota system* (renewable portfolio standards) [68]. Until 2016, the main support scheme was a quota system in terms of a quota obligation, which was combined with a certificate-trading scheme. The Energy Law obliged electricity generators and suppliers that provide electricity to customers in Poland to fulfil a specified quota of certificates of origin / green certificates. These certificates were awarded to the producers of electricity from renewable sources. Currently, the installations that started to produce energy before the new law came into force can choose between both systems.
  - *Support scheme for prosumers*. The owners of micro-installations (with capacity up to 40 kW) are allowed to exchange the surplus of energy produced under favourable conditions for gaps in energy production in the future in relation 1 to 0,8 (in the case of micro-installations with capacity up to 10 kW) or 1 to 0,7 (in the case of micro-installations with capacity above 10 kW) [69].
  - *Tax incentives*. Producers of electricity from renewable sources are exempt from the tax on the sale and consumption of electricity [70].
  - *Loan*. The National Fund for Environmental Protection and Water Management grants low interest loans to support the purchase and installation of RES installations [71].
  - *Grant*. The National Fund for Environmental Protection and Water Management (NFOŚiGW) grants low interest loans together with subsidies to support the purchase and installation of small and micro-RES installations for the needs of residential single-family or multi-family houses.

6.1.1 Instruments available for public owned residential buildings

Moreover, the above-mentioned financial mechanisms available for both, public and private owners, for the Polish residential sector there is a specific mechanism only available for public owners. In 2017, The European Investment Bank (EIB) and Bank Gospodarstwa Krajowego (BGK), the Polish development bank, have signed an agreement to set up an investment platform supporting social and affordable housing projects in different municipalities across Poland until 2021 [72].

The intention of this agreement is to support social and affordable housing investments for a total cost of some PLN 2.1bn (around € 496 M) until 2021. The projects to be financed under the investment platform concern the construction or retrofitting of social and/or affordable housing units for rental, as well as the construction of regulated affordable rent-to-buy housing. The municipal authorities and registered social and affordable housing providers, such as non-profit housing enterprises (TBS), will be the eligible beneficiaries of this investment platform. The program is based on three pillars:

- The National Program for Support of Social Housing (receiving EIB support of € 190M),
- Individual loans € 95M by ESFI, and
- BGK own funds, as intermediated loans.

There's still no relevant data related to the success of such mechanism.

6.1.2 Instruments available for private owned multi-family buildings

In addition to the above-mentioned financial mechanisms available for both public and private owners, there are no significant mechanisms available for only private owned multi-family buildings refurbishment.

6.2 Discussion: Appropriateness of approaches and instruments in Poland

From referred studies in [73], the preferred form of co-financing for thermal modernisation projects, the vast majority of owners mention cash rather than loans;

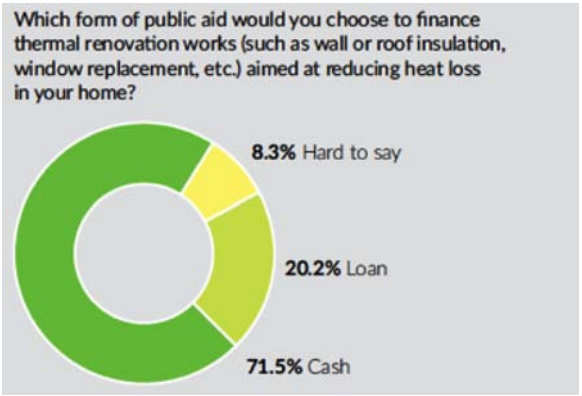

Figure 4. Preferences of the building owners on co-financing mechanisms in Poland. Source: CATI 2016; sample N=513

Moreover, and accordingly to Institute of Environmental Economics and Efficient Poland analysis, some existing barriers should be considered for Poland building refurbishment market. The analysis was mainly focused in single-family houses, most of its conclusions could be relevant too for the multi-family ones.
Specifically:

- The absence of a comprehensive financing system aligned to the needs.
- The unavailability of long-term loan for renovation projects.
- The High transaction costs.
- The low level of contractor knowledge.

As recommended by some authors [56], "*The support system for thermal modernisation should consist of two independent and separate instruments, i.e. a support system for renovation based on attractive loan facilities and a support system for energy efficiency based on subsidies, addressed to investors who cannot obtain credit*".

Considering the 4RinEU technologies and solutions, most of them could be introduced in the Polish market through existing financial mechanisms. There is no evidence on any existing program to support those specific innovative building technologies and solutions, but the existing ones at generic level. Specifically, the most indicates one's are:

- The *Thermo-Refurbishment Fund, both for private and public owners.* This program could partially support the implementation of the Prefabricated Timber-based Multifunctional Façades developed, under the comprehensive modernization section (by achieving at least a 25% reduction of the energy demands) or the renovation of buildings constructed before 1961 section (by achieving at least a 10% reduction of the energy demands) of the program. The program provides a 16% bonus to the loan extended for owners of buildings.
- *The EIB and BGK investment platform to support social and affordable housing projects available only for public owner buildings.* Although it's perceived as an appropriate mechanism to support the replication of 4RinEU renovation solutions, more information is required on the program conditions to analyse the real options.
- *Thermal rehabilitation grants, National Fund for Environmental Protection and Water Management Stork, and Efficient Heating and cooling.* These programs could support the installation of new RES based systems for heating purposes based on ST systems integration and management systems developed in 4RinEU. The programs support the purchase and installation of solar collectors and global RES installations through subsidies and loans.
- *Support scheme for prosumers, Tax incentives, National Fund for Environmental Protection and Water Management programs.* At electrical RES generation level, all these programs would promote the PV façade integration considered in the 4RinEU solutions. Different mechanisms (exchange of the surplus of energy produced under favourable conditions, exemption from the tax on the sale and consumption of electricity, or low interest loans to support the purchase and installation of RES systems), could be used for such purpose.

Local stakeholders should consider the best options in any case, and the potential combinations of these mechanisms.

6.3 Summary: Applicable financial instruments in Poland

As a synthesis, the financial instruments for residential building refurbishment or renovation in Poland are mainly funded by public entities, both directly (subsidies) or by using private entities as banks (loans). Most of these instruments are available for both, private and public building owners, except for the EIB and BGK investment platform, which is only available for public entities. From the state of the art, the most appropriate ones to support the implementation of 4RinEU technologies and solutions are:

- **The Thermo-Refurbishment Fund**, mainly for passive refurbishment but also for HVAC systems replacement.
- **The EIB and BGK investment platform**, for energy efficient actions.
- **The Thermal rehabilitation grants, National Fund for Environmental Protection and Water Management**, for the support on the implementations of ST systems.
- **The Support scheme for prosumers, Tax incentives, National Fund for Environmental Protection and Water Management programs**, for the support on the implementations of PV systems

Due to the variety of the financial instruments named above, it is possible to combine different instruments for passive (The Thermo-Refurbishment Fund) and/or active systems (EIB and BGK), and for renewable energies (National Fund for Environmental protection and water management).

References

[53] The National Energy Conservation Agency (NAPE). www.nape.pl

[54] *Institute of Environmental Economics – Efficient Poland.* Energy efficiency in Poland 2015 review. Single-family houses mechanism to support modernization, 2015.

[55] Central Statistical Office of Poland. http://stat.gov.pl/en/

[56] Instytut Ekonomii Środowiska. *Strategy for the modernization of buildings: 2050 Roadmap: Summary*, 2014. See:http://bpie.eu/wp-content/uploads/2015/10/BuildingsModernisationStrategy2050ENsummary.pdf

[57] JESSICA: Joint European Support for Sustainable Investment in City Areas http://ec.europa.eu/regional_policy/en/funding/special-support-instruments/jessica/

[58] Green Investment Scheme Poland. http://www.nfosigw.gov.pl/en/priority-programs/green-investment-scheme/. Based on grants and subsidies for the refurbishment and/or the energy efficient management of public services buildings.

[59] Bank Gospodarstwa Krajowego, The Polish development Bank. https://www.en.bgk.pl

[60] Provincial Fund for Environmental Protection and Water Management in Gdansk https://wfos.gdansk.pl

[61] The Polish National Energy Conservation Agency (KAPE). See: https://www.kape.gov.pl/page/about-us

[62] http://publenef-project.eu/wp-content/uploads/2017/04/GP37_PUBLENEF_Poland_factsheet.pdf
[63] Instytut Ekonomii Środowiska. *Strategy for the modernization of buildings: 2050 Roadmap, p. 73–76*, 2014. See: http://efektywnapolska.pl/wp-content/uploads/2015/03/Strategia_modernizacja_budynkow_mapa_drogowa_2050.pdf
[64] http://www.res-legal.eu/search-by-country/poland/
[65] Thermal rehabilitation grants. http://www.res-legal.eu/search-by-country/poland/single/s/res-hc/t/promotion/aid/subsidy-thermo-modernisation-grants/lastp/175/
[66] National Fund for Environmental Protection and Water Management: Stork. See: http://www.res-legal.eu/search-by-country/poland/single/s/res-hc/t/promotion/aid/loan-national-fund-for-environmental-protection-and-water-management-stork-1/lastp/175/ and Efficient Heating and cooling http://www.res-legal.eu/search-by-country/poland/single/s/res-hc/t/promotion/aid/loan-national-fund-for-environmental-protection-and-water-management-efficient-heating-and-c/lastp/175/
[67] http://www.res-legal.eu/search-by-country/poland/single/s/res-e/t/promotion/aid/tenders-feed-in-tariff/lastp/175/ and http://www.res-legal.eu/search-by-country/poland/single/s/res-e/t/promotion/aid/tenders-premium/lastp/175/
[68] http://www.res-legal.eu/search-by-country/poland/single/s/res-e/t/promotion/aid/quota-system-2/lastp/175/
[69] http://www.res-legal.eu/search-by-country/poland/single/s/res-e/t/promotion/aid/support-scheme-for-prosumers/lastp/175/
[70] http://www.res-legal.eu/search-by-country/poland/single/s/res-e/t/promotion/aid/tax-regulation-mechanism/lastp/175/
[71] National Fund for Environmental Protection and Water Management: Stork. http://www.res-legal.eu/search-by-country/poland/single/s/res-hc/t/promotion/aid/loan-national-fund-for-environmental-protection-and-water-management-stork-1/lastp/175/
[72] http://www.eib.org/en/infocentre/press/releases/all/2017/2017-126-eib-and-bgk-establish-investment-platform-for-social-and-affordable-housing-in-poland-under-juncker-plan.htm
[73] Institute of Environmental Economics – Efficient Poland. *Energy efficiency in Poland 2015- review. Single-family houses mechanism to support modernization*, 2015. See: https://depot.ceon.pl/bitstream/handle/123456789/13526/EE_Review_2015.pdf?sequence=1&isAllowed=y

7 Financial Instruments in Early Adopter Countries – Hungary

The current chapter for Hungary is based on reports that were available in 2018 [74, 75, 76,77]. It gives an overview of the relevant Hungarian financial instruments of Hungary and a minor discussion based on the literature study.
In 2015 the final energy consumption of Hungary was 17,3 Mtoe, and the residential sector, the largest consuming one, accounts for the 34% of total final consumption in 2015.
Energy efficiency measured by ODEX improved by more than 2% per year on average from 2000 to 2015, or 30% over the period. The main driving forces have been industry and services with an average 3,8% and 3,5% improvement per year, respectively. Transport and the residential sector got smaller gains than the average, with 1,9% and 1% per year on average, respectively. This trend can be explained by overall resource efficiency improvements especially in the private sector. Improvement in the industry and the service sector were due especially to the introduction of energy efficiency requirements and labelling affecting buildings, equipment, processes and appliances.

Hungary intends to achieve the 1,5% annual decrease of the final energy consumption with 17 alternative measures. No energy efficiency obligation scheme was introduced, and no plan to do so is on the energy policy agenda. The most important measures of the NEEAP are Operational Programs (OPs) financed by EU Funds (some of them coupled with state budget), with primary focus on energy efficiency improvement. In particular, the focus of the Environmental and Energy Efficiency Operative Program (KEHOP) is explicitly the improvement of energy efficiency at enterprises, public and residential buildings. Other OPs also have sub-programs that aim to promote energy efficiency. The OPs all target a wide range of consumer groups, with a wide range of potentially supportable projects related to energy efficiency improvement in buildings, production and processes, and renewable energy. Other programs aiming at the achievement of the national saving target include the Green Economy Financing Scheme (GEFS), financed from state budget and EU-ETS revenues. GEFS finances the 'Warmth at Homes' program, which ensures non-refundable funding for energy efficiency in the residential sector and state-owned building sector for e.g. for heating system modernization, replacement of old household appliances and complex building modernization. A new measure - the National Network of Energy Managers - was introduced in 2017 aiming to promote the support from energy advisors.

Gas has been the principal source of energy, representing the 52,5% of the final residential energy consumption in 2012, however it decreased from 1995 to 2012 of 5,9%. Other fossil fuels like coal and oil were almost disappearing, accounting together for only the 3,1% of the total energy used in 2012 in the residential sector. While heat decreased of 30,7%, electricity and wood (that were the second and the

third source of energy in 2012) increased of 8,3% and 21,6%, respectively, over the period 1995 – 2012.

In 2010, approximately 66% of energy in the residential sector was used for space heating, roughly 18% for water heating, about 10% for electricity for appliances and lighting, a small part for cooking (6%) and almost no use of air cooling.

Gas was also the main source of energy used for water heating in 2010; it represented 63.7% of the total energy share of water heating in 2010, followed by electricity (20,5%), heat (10.7%), wood (3,9%).

48.4% of the energy consumed for cooking in 2010 came from gas, 42.4% from oil and 9% from electricity.

In 2010, the average floor area of dwellings was about 77 m2, smaller than the average of the European Member States (87,4 m2).1 Energy consumption of households per permanently occupied dwellings (calculated at normal climate), was 1,48 toe/dw a bit higher than the average of the European Member States (1,44 toe/dw).

Regarding CO2 emissions the residential sector's share of total emissions (11,63 MtCO2) decreased of 38,92% from 1995 to 2012 and it was below the average of the European Union (30,2 $MtCO_2$) decreased of 4,6%, in the same period. In addition, in 2012 CO2 emissions per dwelling with climatic corrections (included electricity) were 1,92 (tCO_2/dw), far below the European average (3,74).

7.1.1 The building stock in the household sector

Typology for buildings from thermal efficiency point of view

According to Slezák et al. [74], the National Building Energy Performance Strategy of Hungary states that the residential building stock mainly consists in the following three types:

- A - Detached houses
- B - Blocks of flats built by traditional technologies; Constructed of brick, rock or of hand-laid building blocks
- C - Blocks of flats built by industrial technologies; Constructed of mid- or large-panel elements, or of cast concrete

The average age of buildings in the residential sector in Hungary is about 50 years. Although the number of licenses for new buildings shows a slight increase again, after a downturn and then stagnation period starting about 2003, the rate of replacement of buildings remains low in the country, primarily because of the lack of capital. The full representation of the different types of buildings in the building

stock, in terms of the number of buildings, as well as in terms of the number of dwellings, can be found in [74] (see figure 1.4).

The dominating basic type of building in Hungary is a detached house, both in terms of the number of buildings (circa 95%) and the number of flats (circa 60 %). Consisting of about 2.5 million flats, around 63 % of the population, equalling about 6.5 million people live in the stock of detached houses in the country.

Within this category about 25% of the buildings were built before 1945 and at the same time the representation of buildings built between 1946-1980 is close to 50%. Consequently, about 75% of the buildings in this category were built before 1980 and thus generally are without thermal insulation. At the same time, buildings built after year 2001 (and thus with higher thermal efficiency standards) in this category represent only about 8% of the stock.

Indeed, the stock of detached houses in Hungary embodies the largest energy saving potential in the residential building stock, both in terms of volume and in terms of the actual range of specific energy consumption values (kWh/m2).

Concerning the blocks of flats, about 40% of the stock is made up of small-sized buildings (consisting of 1 - 3 flats), built before 2001, by traditional technologies and about 10% of the stock are large- sized buildings (consisting of 10 or more flats), built before 1945.

Furthermore, buildings built by industrial technologies represent a considerable share in the category of blocks of flats in the country: in terms of the number of buildings, their representation is slightly above 25% and in terms of the number of flats it is about 42%. Consisting of about 0.75 million flats, about 20% of the population, equaling almost 2 million people, live in the stock of buildings built by industrial technologies in Hungary.

According to the estimates of the NBEPS, about 70% of residential homes in the country are in need of energetic refurbishment and in certain proportion of these buildings it is likely that such refurbishments are economically not viable anymore and thus it will be necessary to replace the whole building.

Ownership structures

The private ownership of residential properties (meaning less professional owners in general) is relatively high in the country, in a comparison to other EU countries: slightly above 90% of the private homes are owned by the inhabitants, compared to the EU average of about 65%. The considerable share of condominiums in the stock of blocks of flats is also an important factor in Hungary in the context of energy efficiency refurbishments, since common property many times is a hindering factor in refurbishment decisions.

7.2 Available financial instruments in Hungary

Subsidies and other financial schemes in climate and energy policy:

Operational Programs
In the 2014-2020 Multiannual Financial Framework of the EU, 760 billion HUF (2,4 billion €) can be used from EU funds to boost energy efficiency and the use of renewables via Hungary's different operational programs. This is a significant amount of investment, amounting to about € 250 per capita.
In the framework of operational programs, 100% grants are offered for the refurbishment of public buildings. No grants are offered to household energy efficiency investments, only interest-free loans. Furthermore, there is no coordination between these loans and the energy efficiency grants provided from auction revenues.
The interest-free loans aimed at enhancing the energy efficiency and the utilization of renewable energy in residential buildings are offered by the Hungarian Development Bank and represent an amount of 110 billion HUF (344 million €). This program has received only limited interest from the public.

Auction revenues
Hungary auctions around 14,5 Million EUAs in the EU ETS, which at 2018 prices will bring in about 200-250 million €in 2018 (the exact amount depends on the results of the auctions.). This is a sizeable sum, almost 50-60% of all the money spent annually on climate change under the EU's Structural and Investment Funds.
National legislation says that from 2013 onwards, 50% revenues under the EU ETS must be spent on the development of green economy. 25% of this income has to be used by the Ministry for Innovation and Technology via the Green Economy Financing Scheme (GEFS - Zöldgazdaság Finanszírozási Rendszer, ZFR), and 25% by the Ministry of Finance via the Greening the Economy Scheme (GES - Gazdasági Zöldítési Rendszer, GZR).

Between 2012 and 2015, the government had a legal obligation to report to the Parliament on the use of auction revenues. From the information from the source applied for this analysis, (Climate Strategy Institute), no such reports were submitted to the Parliament to date before the reporting obligation was abolished in 2015. In the absence of statutory reports, limited information is available on the use of auctioning revenues. In 2015 a parliamentary written response to an MP gave details on quota use. In addition, Hungary's National Reform Program provides some information on the auction revenues.

Warm homes program (Otthon Melege Program)
The aim of this program is to increase energy efficiency and the use of renewable energies in households, through grants. The support scheme is financed by income realized in the EU ETS. Between 2014 and 2017, around € 100 million were spent on grants in the framework of the Warm Homes Program. The main subsidy measures were the purchase of energy efficient electric devices like fridges, washing machines, etc., and investments in buildings, like installation of PV-panels,

heating system renovation or the change of windows for better insulation and energy efficiency.
Although the program has its benefits, experience shows that there is a significant demand for this type of grant, as the available funds run out in a few hours. This it is safe to say that the amount is inadequate and should be increased significantly, since the per capita amount of subsidy under the Warm Homes Program is about 11€ per household per year.
Another shortcoming of the program is that it is not linked to the subsidy loans provided by MFB, and thus only those people can take advantage of the program who can finance the other half of the investment on their own.

Indirect support
The Hungarian tax system supports fossil fuel use through a range of contradictory incentives. For example, road haulers can ask for excise duty refund to decrease their expenses. The level of mining fees has been reduced in recent year, thus increasing the profitability of oil and gas extraction.
Hungary fosters fossil energy use in other indirect ways as well. In general, these subsidies are not easy to be analyzed, since there are no structured data about 70% of the fiscal support instruments. The total fossil fuel subsidy was estimated to be more than € 350 million per year (in average between 2014-16).

The environmental product fee is interesting element of the Hungarian tax system and shows how ill-considered tax measures can be. The fee was originally developed to incentivize the rationalization of production and waste management of products especially harmful for the environment. Unfortunately, the conditions to get exemptions became extremely difficult to fulfill, consequently the environmental product fee became a more or less fix tax income instead of a sustainability incentive. In addition, the government decided to enlarge the list of the products on which this tax had to be applied, and eventually even solar panels got on the list of products that must pay an environmental product fee.

In 2013, as a political measure, Hungary started to cut significantly household energy prices (and raise energy prices for industrial users): the price of natural gas, electricity and heating for households dropped to levels under their actual cost, which discourages investments in buildings' efficiency and renewable energy.
There are also good incentives in the system: for example, in the Hungarian corporate tax legislation there is a positive option since 2017, which can be connected to climate change issues. If a company makes an investment of at least 100 million HUF net present value (app. 285.000 €), that is an independent environmental investment, the company can get a maximum of 80% allowance from the corporate tax it should pay.

METÁR
In 2016, Hungary has reorganized its renewable subsidy system. The new system called METÁR offers varying types of support to solar producers of various sizes. Producers with a capacity below 500 kW have a mandatory feed-in tariff of HUF 31,77/kWh (app. € 0,1). Producers between 500 kW and 1 MW receive a so-called administrative premium over the market price, determined by the government on a

case-by-case basis. Above 1 MW, subsidies are to be distributed on an auction basis.
The introduction of the new subsidy system resulted in a veritable boom of solar investment in Hungary. As installations below 500 kW could apply for a simplified funding system until January 2017, there was a rush of applications submitted to the government, with a total proposed capacity of over 2000 MW. This is more than the double of all existing solar capacity in Hungary. There is also a significant uptick in large-scale solar investment, where both large utilities and notable oligarchs with strong ties to the prime minister are involved. A new solar capacity auction is planned for the first quarter of 2019. There has been no corresponding impact on wind energy investment because (as mentioned earlier) new wind investment is currently legally impossible.

7.2.1 Instruments available for public owned residential buildings

The main financial instrument managed by the central government to promote investments aimed at furthering energy efficiency in households is a grant scheme, called the ***Warmth of the Home Program***

The ***Warmth of the Home Program*** was launched in September 2014 and there have been five sub-programs implemented focusing on the different aspects of energy efficiency in households, e.g. household appliances, facade doors and windows, heating and hot water boilers and insulation. Further sub-programs are currently under preparation.
The sources of the program funds have been the *Green Economy Financing Mechanism* (revenues from the sale of Kyoto units) and the *Specific Appropriation for Building Energetics and Energy Efficiency* of the central state budget.
Due to overwhelming interest on the part of households, all sub-program funds have been sourced out fully after announcement, either within hours, or after a few days the latest.

Sub-programs launched in autumn 2014
The replacement of large household appliances in the categories of refrigerators and freezers
The aim of this sub-program was to raise the energy efficiency of households by supporting the replacement of inefficient refrigerators and freezers to new, energy-efficient ones. The tender was targeted primarily at retired people, as well as large families and provided 50% co- financing for the purchase of new appliances, up to maximum HUF 25.000 (app. 71 €) in the case of A+ category units and respectively HUF 35.000 (app. 100) in the case of A++ and A+++ units. The criterion for the co-financing was to achieve energy savings of at least 10% per annum, or to save, at the minimum, 20 kg/year CO_2 emissions. The total available fund was HUF 500.000.000 (app. 1.430.000 €).

The modernization of heating systems (replacement of inefficient heating boilers)
The aim of this sub-program was to reduce carbon dioxide emissions and thereby also to improve the energy performance of households by supporting the replacement of inefficient heat and/or hot water boilers with high efficiency units utilizing condensing technologies.

The tender was aimed at households equipped by individual boiler units in blocks of flats including not more than four independent dwellings by providing 40% co-financing to the maximum amount of HUF 650,000 (app. 1,855 €). The total available fund was HUF 1.000.000.000 (app. 2.850.000 €).

The replacement of energetically obsolete facade doors and windows
The aim of this sub-program was to reduce carbon dioxide emissions and thereby also to improve the energy performance of households by supporting the replacement of energetically obsolete facade doors and/or windows to new ones. The aim is to meet the cost-optimal energy efficiency requirements in the national context (as per the EPBD, 2010/31/EU) and, in connection to this, but optionally, to improve the summer heat protection of buildings by the installation of shading structures (without jeopardizing winter heat absorption).
The tender was aimed at the owners of (any type of) households by providing 40% co-financing to the maximum amount of HUF 450.000 (app. 1.300 €) and respectively, in the case of shading integrated new installations HUF 520.000 (app. 1.500 €). The available program fund was HUF 1.100.000.000 (app. 3.140.000 €).

Sub-programs launched in spring/summer 2015
Support to the complex energetic renovation of blocks of flats
The aim of this sub-program was to reduce carbon dioxide emissions and thereby also to improve the energy performance of households by providing support to housing communities in blocks of flats for the energetic refurbishment of their building.
Co-financing up to maximum of 50% of the total costs was provided for complex energy refurbishment programs, including the replacement of facade doors and windows of the common areas of the buildings, the thermal insulation of the building facade, the modernization of energy infrastructure, including the improvement of the efficiency of heating and/or hot water systems as well as the integration of renewable energies. The available program fund was HUF 10.000.000.000.- (app. 28.500.000 €)
The replacement of large household appliances in the category of washing machines
The aim of this sub-program was to raise the energy efficiency of households by supporting the replacement of inefficient washing machines to new, energy-efficient ones.
The tender provided 50% co-financing for the purchase of a new appliance, up to maximum HUF 25,000 (app. 71 €) in the case of A+ category units and respectively HUF 40,000 (114 €) and HUF 45,000 (app. 128 €) in the cases of A++ and A+++ units. The criterion for the co-financing was to achieve energy savings of at least 10% per annum, or to save, at the minimum, 20 kg/year CO_2 emissions. The estimated monetary savings per households (combined energy and water savings) were up to HUF 12,000 (34 €) per year.
Due to the high level of interest the original program fund of HUF 500.000.000 (app. 1.430.000 €) was raised to HUF 2.000.000.000 (app. 5.700.000 €).

Bank loans
The availability of loans for energy efficient renovations or building varies a lot and changes regularly, mostly based on the availability of state funding/support for

energy efficiency. At the moment, due to the specific political and economic circumstances, only a very limited number and types of loans are available. For the purposes of the current paper it was not possible to conduct a complete and exhaustive overview of all loans available, but based on our internet- based review, **it appears that, when this analysis has been taken, loans are only available for blocks of flats/multi-owner apartment houses to supplement** the government funding available for their energy efficient renovation in the framework of the *Warmth of the Home* program.

Loans to supplement the funding available on a competitive basis to multi-apartment houses (with between 5-60 apartments) are available to cover the 50% own contribution required for eligible blocks of flats from the OTP Bank.

7.2.2 Instruments available for private owned multi-family buildings

Municipalities, often in cooperation with NGOs, founded several organizations to assist in their work towards more sustainable energy use, higher energy efficiency and the utilization of renewable energy sources.

- The **Alliance of Energy Efficient Municipalities** (EHÖSZ) was founded in 2007. The Alliance is an organization for municipalities (as of Dec 2015 with 20 members) in order to join forces and achieve a higher level of energy efficiency in their settlements. Among other things, the Alliance organizes events to facilitate the exchange of experience between municipalities.
- The **Alliance of Climate-Friendly Municipalities** was also founded in 2007 and has 27 member settlements from all over Hungary (as of Dec 2015). The Alliance publishes a monthly newsletter, organizes events, makes publications to facilitate the work of municipalities in the field of climate adaptation, energy efficiency and the utilization of renewable energy sources.

The Alliance also cooperates with the Hungarian Academy of Sciences to help spread good practice and support the development of local climate change, adaptation and energy strategies. An important feature of the work of the alliance is that they place **great emphasis on the involvement of the local population and communities** and suggest that all member municipalities support the founding of a local climate club. Furthermore, the Alliance published recommendations for its members which, among other issues, contains advice for employing a climate coordinator.

Support from municipalities for energy efficiency renovation

Several municipalities offer local support for the energy efficient renovation of private homes as well as apartment houses or multi-owner housing blocks. Both the amount of support available and the list of towns where the support is available vary from year to year. Although it would prove to be challenging to prepare a summary study on such initiatives by municipalities, it is worth mentioning an example.

One of the most active towns in this field is Tatabánya, a town of 65-70.000 inhabitants. Through various means, the municipality has supported the energy efficient renovation of buildings, with specific emphasis on apartment houses (or blocks of flats) since 2010. Most recently, in 2014 and 2015, the municipality

provided support for blocks of flats on a competitive basis (based on competitive calls for proposals) partly by providing interest-free loans for energy efficient renovations, partly by supplementing the support blocks of flats can receive from the central grant program, W*armth of the Home* (see section 2.3.2.). (*Tatabánya is member of EHÖSZ as well as the Alliance of Climate-Friendly Municipalities, the organizations established by municipalities and described above.)*

Initiatives and support for households by utilities
In this section we provide examples of the kind of actions and initiatives utility companies have in order to support household energy efficiency. Please note that not all utility companies were covered in this analysis, but an attempt was made to introduce the better-known campaigns and programs as well as to indicate the variety of the actions.

7.2.3. ELMU-ÉMÁSZ

ELMU has been operating in Hungary for more than a century. The Company was established in the era of the Austro-Hungarian Empire, and has pursued its activity with the original purpose to supply various groups of consumers with electricity, surviving two world wars and several governmental changes. As ELMU-ÉMÁSZ the group of companies has been operating since 2007 as one of the largest electricity providers in Hungary, serving around 2 million consumers. ELMU-ÉMÁSZ also offers a variety of incentives and programs intended to increase household energy efficiency and awareness:

- They offer **GREEN and GEO (geothermal) tariffs** - to allow households to purchase green energy.
- In the framework of the **LED Energy Saving Program** households are invited to buy premium category LED lights and pay for them in instalments. The company complements this popular program with an online energy saving calculator tool.
- ELMÜ offers i**nterest-free loans f**or households for the installation of s**olar energy systems.**
- ELMÜ also has an e**ducational program c**alled the e**nHome Green Line (***in Hungarian: enHome Zöldjárat)*, which is a roadshow-like service intended to attract and educate consumers with exciting and interesting content and information. Its main goal is to provide information on renewable energy sources for the young generation. The service is free and interactive. Schools and educational institutions are encouraged to incorporate it into their program of education.
- **Energiapersely** is an **energy saving program** for households providing tips and advice for saving energy in the home, both online and in the form of printed flyers, including a service that allows households to **borrow energy meters** from ELMÜ-ÉMÁSZ customer service offices.
- ELMÜ created the **Liveable Future Park,** a demonstration of energy efficient and renewable energy systems in the form of an open-air demonstration park that is open for visits from the public.

7.3 Discussion: Appropriateness of approaches and instruments in Hungary

The Hungarian residential building stock is dominated by owner-occupied property. Energy improvements are being stimulated by several instruments, such as subsidies and loans. The Warmth of the Home Program is the most well-known, however the available budgets were so small that the subsidies ran out of resources within days.
There are also initiatives and schemes organised by municipalities and energy companies, targeted to building block owners.
A major issue is that the government reduces end use energy prices in order to have affordable energy bills. In the long run, this does not stimulate investments in deep renovation.

7.4 Summary: Applicable financial instruments in Hungary

- The main financial instrument managed by the central government to promote investments aimed at furthering energy efficiency in households is a grant scheme, called the Warmth of the Home Program. Its budgets are much smaller than the market demand and market potential

- Municipalities, often in cooperation with NGOs, founded several organizations to assist in their work towards more sustainable energy use, higher energy efficiency and the utilization of renewable energy sources.

- Also, Energy Companies approach the market with campaigns about energy efficiency, behavioral changes and short-term investments such as LED lighting.

- A major issue is that the government reduces end use energy prices in order to have affordable energy bills. In the long run this does not stimulate investments in deep renovation.

The Hungarian residential building stock is dominated by owner occupied property. Further, the government reduces end use energy prices in order to have affordable energy bills. In the long run this does not stimulate investments in deep renovation.

References

[74] Slezák, J., et al. *"Consumers and energy efficiency—country Report for Hungary. An inventory of policies, business and civil initiatives at the national level, focusing on heating, hot water and the use of electricity*, 2015. EUFORIE-European Futures for Energy Efficiency." EUFORIE—European Futures for Energy Efficiency.

[75] István Bart, Dóra Csernus, Fanni Sáfián (Climate Strategy Institute). *ANALYSIS OF CLIMATE- ENERGY POLICIES & IMPLEMENTATION IN HUNGARY*, November 2018. Available at: http://eko-unia.org.pl/wp-content/uploads/2018/06/mini-report-1_Hungary.pdf

[76] IEA. *Energy Policies of IEA Countries: Hungary 2017 Review*, 2017. Available from: https://www.iea.org/reports/energy-policies-of-iea-countries-hungary-2017-review

[77] EEIFG report. *FINAL REPORT covering Buildings, Industry and SMEs*, February 2015, available from: https://www.unepfi.org/fileadmin/documents/EnergyEfficiency-Buildings_Industry_SMEs.pdf

8 Financial Instruments in Early Adopter Countries – UK and Ireland

At the beginning of 4RinEU, the consortium planned to include an English Early Adopter, in order to have a reference for the Atlantic geocluster. After a first phase, the consortium engaged a different Early Adopter, that is the Municipality of Limerick, in Ireland. Therefore, the following analysis reports the financial situation in UK with also a focus for Ireland.

The UK's building stock varies widely both in age and type. The UK has 27 million homes across a wide range of housing types, including a significant proportion of old buildings. Over three quarters of the UK's homes were built before 1980 and nearly one fifth are over 100 years old (Figure 5) [78]. This means that most of the domestic building stock pre-dates the introduction of energy efficiency standards within the national Building Regulations. Additionally, approximately half of the residential units have a rating of D and 25% of E, indicating significant energy saving potential as can be seen from Figure 6. Considering the buildings typologies (Figure 7), we can see that around the 30% of the residential units are in semi-detached houses. The other typologies, which are detached-houses, terraced-houses, flats, show about the same quantities, around the 20% each. Concerning the ownership typologies (Figure 8), we can see that the large part, around the 60%, of the residential units are owned occupied. It's also relevant the part of social rented buildings with a percentage around 20%.

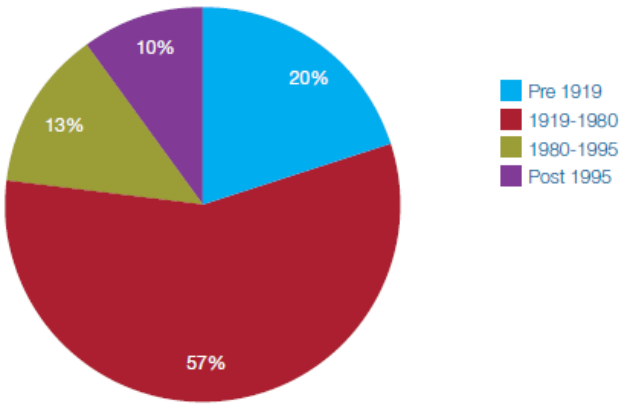

Figure 5. Percentages of residential units by construction period, in the UK (source: Department of Energy - UK Government).

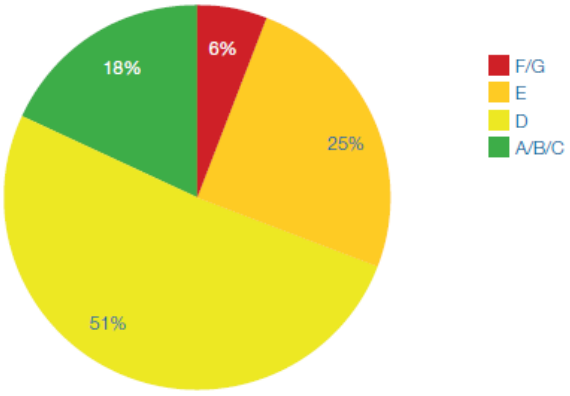

Figure 6. Percentages of residential units by construction period, in the UK (source: Department of Energy - UK Government).

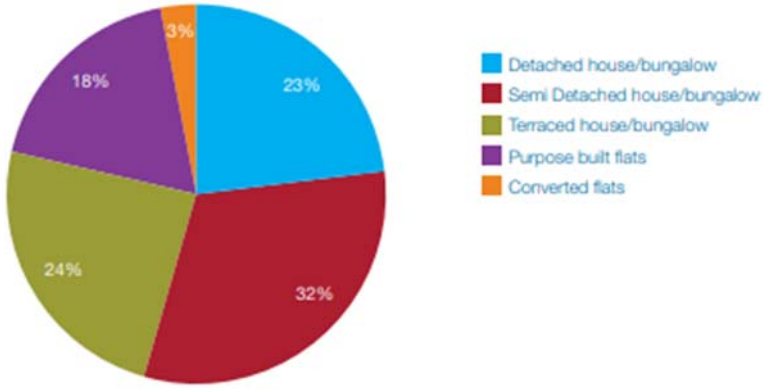

Figure 7. Percentages of residential units by building type, in the UK (source: Department of Energy - UK Government).

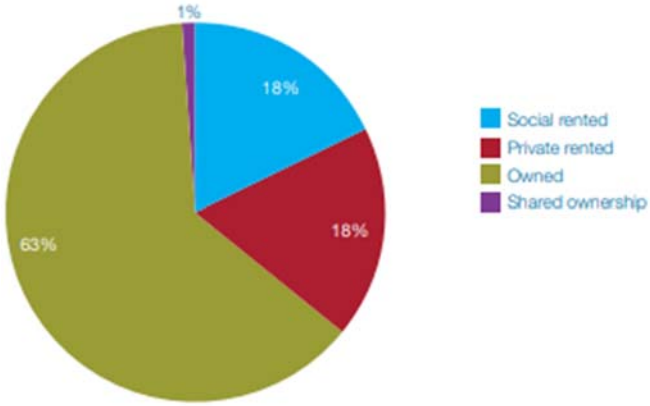

Figure 8. Percentages of residential units by ownership type, in the UK (source: Department of Energy - UK Government).

Concerning the Irish context, in general we can see that in Ireland the building stock is more recent compared to other European countries, however about one third of the current housing stock was built before 1970, as in Figure 9. This is relevant, since the first mandatory building regulations in Ireland, stating energy performance requirements, came in force during 1992 and about the 60% of the residential units was built before. The most common buildings typology in Ireland is

a detached house, with about 40% of the total building stock in this category. It is followed in order by the typologies semi-detached, terraced, and flats, as it presented in Figure 10. National report in Ireland states also that many of these detached houses are typically located in rural areas. Often, they cannot be connected to the gas grid, and are supplied by solid fuels or oil-based heating systems, producing higher demand in terms of primary energy and higher environmental impacts [79].

Finally, the Irish residential building stock shows a high degree of ownership: around two thirds of the residential dwellings are owners occupied, about half of this with mortgages or loans while the other half is owned outright.

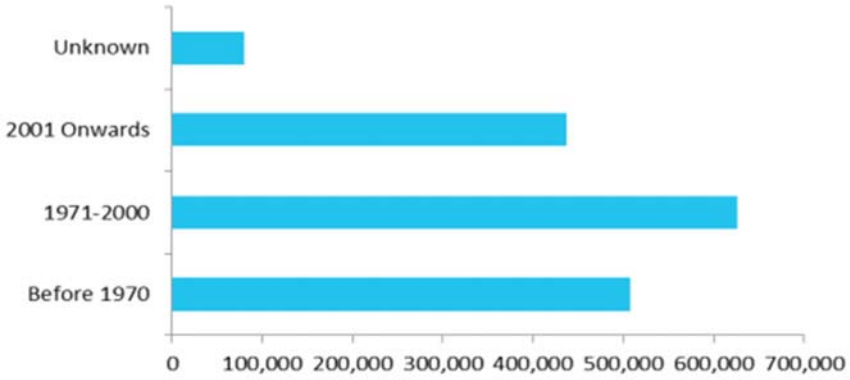

Figure 9. Number of residential buildings by construction period, in Ireland.
(source: Department of Communications, Energy and Natural Resources - Ireland Government).

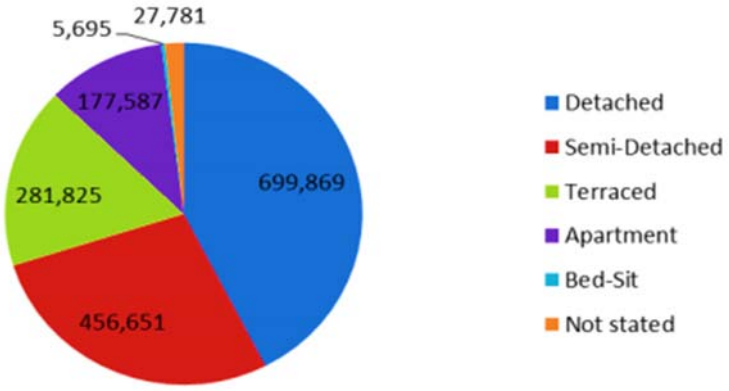

Figure 10. Number of residential buildings by building type, in Ireland.
(source: Department of Communications, Energy and Natural Resources - Ireland Government).

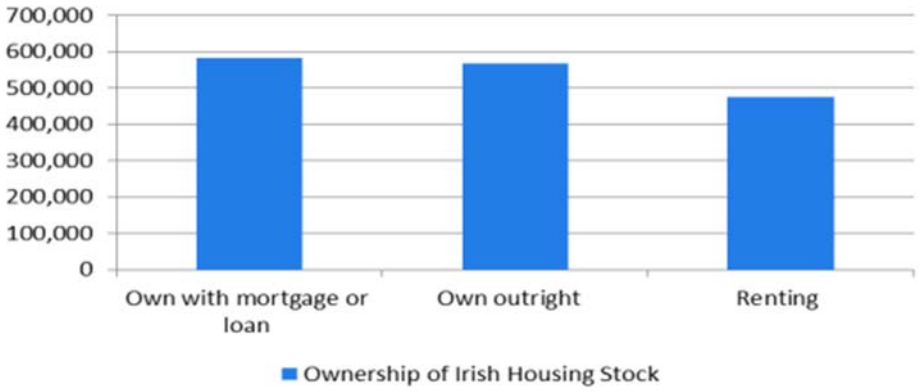

Figure 11. Number of residential buildings by ownership type, in Ireland.
(source: Department of Communications, Energy and Natural Resources - Ireland Government).

8.1 Available financial instruments in Ireland and UK

The sections below provide an overview of some of the main financial instruments characterizing the UK and in Ireland contexts. Since most instruments are applicable to both public and private housing are listed here, with specific schemes listed under public and private subchapters.
In the UK, some supporting financial mechanisms are defined at national level, some others are established respectively by regional governments of England, Wales, Scotland and Northern Ireland. Many financial schemes are also placed by city councils and municipal bodies. Hereafter an overview of the main mechanisms in place at national and regional level is presented, not entering in detail for municipalities, thus, to give the framework of opportunities and process in the Great Britain context.

Concerning UK, we can recognize the following schemes to give financial support to energy retrofit in residential buildings.

Energy Company Obligations
The scheme foresees obligations for energy company to provide financial support for interventions in homes about thermal insulation and heating systems improvements (such as cavity wall insulation, loft insulation, replacements or upgrades of boilers or other heating systems components, small photovoltaic installations, etc.). The specific supported interventions depend by each energy company. The scheme is dedicated mainly to low income and vulnerable people's house. Eligibility criteria for customers to received funded services and interventions could receive one of the established social benefits (e.g. pension credit guarantee credit element, income supports, working and child tax credit, disability living allowances, etc.).
Some energy companies cover all the costs of interventions, while other only a part of them [80]. The ECO scheme involves the main energy suppliers in the UK: only some examples are E.on, EDF, Npower. Energy suppliers fall under these obligations if their dimensions are greater than thresholds established by law in

terms of number of domestic customers and amount of energy supply to domestic customers (electricity carrier and gas carrier).
The scheme began in 2013, and during 2019 reached his third versions "ECO3" [81]. It is still dedicated to low income people, according eligibility criteria introduced above, and especially for householder of social housing property [82]. The scheme will now be exclusively targeted at fuel poor population (estimated in around 6 million in the UK). The new scheme also requires energy suppliers to cover 15% of their obligation with measures in rural areas.

Renewable Heat Incentive
The main instrument for funding RES-H sources is the Renewable Heat Incentive (RHI); the Domestic RHI is open to homeowners, private landlords, social landlords and self-builders. The Domestic Renewable Heat Incentive (RHI) is a scheme targeted at supporting domestic RES-H installations (biomass only boilers, biomass pellet stoves, air source and ground source heat pumps as well as flat plate and evacuated tube solar thermal panels) with a fixed amount per kWh foreseen to be produced, according the systems dimensions and features. The payment is provided to homeowners, private landlords, social landlords and self-builders and is payable for 7 years. The scheme supports aerothermal (air source HP with COP>2.5), hydrothermal (ground-source HP with COP>2.5), geothermal, solar thermal energy and biomass (boilers and stoves).

Smart Export Guarantee
The scheme is dedicated to photovoltaic systems and other renewable energy systems producing electricity and it foreseen that the system owners receive a certain amount of money in function of the amount of renewable electrical energy exported to the grid. The self-consumption energy is not paid by this scheme. Since 1 January 2020, large energy suppliers must provide tariffs for this and smaller energy suppliers shall do it. Suppliers are free to define different tariffs, i.e. flat ones or variables. Systems in order to be eligible must be total install capacity lower than 5 MW and lower than 50 kW from micro cogeneration heat and power.

Minimum Energy Efficiency Standards in the Private Rented Sector (MEES) and financial obligations for landlords
Concerning the private rented property, since 2015, in England and Wales, a regulation established a minimum level of energy efficiency for rented dwellings. From April 2018, landlords of privately rented residential and non-residential property must ensure that their properties reach at least an Energy Performance Certificate (EPC) rating of E before renting them. From April 2020, the regulations will apply to all private rented properties, and from April 2023 to non-residential properties. Since 2019, the Government overcame the principle of "no cost to the landlord" establishing that landlords are obliged to fund energy efficiency improvement interventions at least until a certain threshold (e.g. £ 5 000) in order to reach the EPC range E [83] for the dwelling to be rented.

ESCo and energy performance contracts

One important financial mechanism is the ESCo approach, which is not specific to UK only, applied to both public (although they have a stronger presence in public sector) and private and it is described in other sections of this document.

Energiesprong approach in the UK
Energiesprong is an originally Dutch initiative focused on energy upgrade of the housing sector. Now the initiative has spread to Netherlands, France, the UK, Germany and Northern Italy [84]. They target high energy performance levels towards zero energy and performance guarantee model. Tenants will cover costs for interventions by paying a monthly amount during a long period to the housing association, that owns the buildings and funded the initial investment for interventions. The objective is that tenants have the same monthly energy expenses than before intervention, thanks to the obtained energy savings, and the housing association can now add this new income stream to pay for the renovation. At present the Energiesprong UK initiative is on process in three social housing settlements, also supported by European funds within the research project Transition Zero in the framework of the program Horizon 2020 and within the projects E=0 and Mustbe0 in the Interreg program [85].

Building renovation grants from municipalities governing bodies
In the UK, rules and features for grants mechanisms supporting energy renovation of buildings are placed by the governing bodies in municipalities and so they differ from town to another. They are available web searching engines in order to find grants mechanisms in different municipalities [86].

Estate Regeneration Fund
This funding is available over 5 years from 2016 to 2021 and it aims to transform housing estates through the UK. A budget of £ 140 million has been set to accelerate recoverable investments boosting housing supply and improvements of the quality of life for residents [87]. The scheme is also available for housing associations registered as providers of social housing.

Green Deal Finance Company
It's a privately-owned consumer credit company, aiming to funds personal loans for energy renovation improvements of homes [88]. Refurbishment interventions are done by selected installation companies. The initiative was launched in 2012 as part of the governmental scheme Green Deal, described hereafter. At present, the Green Deal Finance Company is providing loans to over 12.500 properties, funding a variety of energy efficiency measures, like boilers, wall insulation, renewable energy systems.

Green Deal
This is a former scheme available in the UK before July 2015. We present it here as an example of one of the main schemes in place in the UK during the last years. In 2011 the UK adopted an Energy Act and one of the three main objectives was how to tackle barriers to investment in energy efficiency and specifically the problem of unaligned incentives between landlords and tenants. The Green Deal has been a financing framework for building energy efficiency renovation that provided

financing via a charge on energy bills, without any upfront costs. The Green deal was intended to encourage households to undertake energy assessments. It offered energy efficiency assessments, financing and the installation of energy efficiency measures through a network of Green Deal approved assessors, installers and providers. A wide range of measures (see the list in Figure 12) were eligible for funding. The "Green Deal" financing was tied to the building rather than the owner, so if the occupants moved out the debt was passed on to whoever lived there next. The loan was paid back through the electricity bill over a 25-year period and unlike many other building improvement initiatives was not dependent on people's income and the loans are available to everyone. The Green Deal Finance Company aimed to deliver universal low-cost financing to households for the installation of energy efficiency measures under the Green Deal. At the end the interest of homeowners for this scheme results less than expected by the governing bodies.

Heating, ventilation and air conditioning	Condensing boilers Heating controls Under-floor heating Heat recovery systems Mechanical ventilation Flue gas recovery devices
Building fabric	Cavity wall insulation Loft insulation Flat roof insulation Internal wall insulation External wall insulation Draught proofing Floor insulation Heating system insulation (cylinder, pipes) Energy efficiency glazing and doors
Lighting	Lighting fittings Lighting controls
Water heating	Innovative hot water systems Water efficient taps and showers
Microgeneration	Ground and air source heat pumps Solar thermal Solar PV Biomass boilers Micro-CHP

Figure 12. List of energy efficiency measures supported by the Green Deal scheme.

Warmer Homes Scotland

This is an example of funding scheme placed at regional level by the Scottish government [89]. It aims to give financial support to vulnerable and low-income people, making their homes warmer and more comfortable. The program has been extended till 2022. A recognized assessor visits the considered home and indicate the suitable and eligible renovation measures for each case. Eligible interventions have to be performed by approve installers. The scheme is suitable both for homeowners both for private sector tenants, who both have certain features in terms of time of occupancy or ownership of the building and of social conditions. Potential renovation measures include wall insulation, loft insulation, draught-proofing, central heating, renewables systems. The scheme makes available an interest free loan to cover part of the costs for the intervention.

National grants supporting energy bills payment
In addition to the previous mechanisms in place in the UK, there are also different series of grants helping low-income or elderly people in order to pay the energy bills for their homes [90]. These programs are called Winter Fuel Payments, Warm Home Discount, Cold Weather Payment. They do not deal with buildings renovations, but they complete the framework of financial scheme related to energy performance in residential sector of the UK.

Concerning Ireland, we can recognize the following schemes to give financial support to energy retrofit in residential buildings.

Better Energy Warmer Homes scheme
It is dedicated to low-income people, who received other welfare payments like fuel allowances, working family payment, jobseeker's allowance, domiciliary care allowance, etc. [91]. They must own their homes, for which the grant is requested, and be living in them since before 2006. Eligible interventions are selected by official technical surveyors, who visit the dwelling, and they can be of these typologies: attic insulation, draught proofing, lagging jackets, low-energy light bulbs, cavity wall insulation, energy advice activity [92].
All the costs for the selected eligible interventions are covered by the scheme and no costs occur for the homeowners.
The scheme is operated by the organization Sustainable Energy Authority of Ireland (SEAI). Renovation works must be delivered by appointed companies for the scheme. Installers must provide a 2-years guarantee for the deployed works
The scheme foresees that a sample of renovated home must be inspected after the renovation. A Building Energy Rating (BER) is carried out on all homes after the works.

Better Energy Homes scheme
It supports buildings retrofit interventions for energy efficiency measures and renewable energy systems. It is dedicated to homeowners and landlords, who can apply also for multiple properties [93]. The following measured typologies are eligible: attic insulation, wall insulation - including cavity wall, internal dry lining and external insulation, heating controls upgrade, solar thermal solutions, heat pump systems, a Building Energy Rating (BER) after the energy-saving work is carried out.
It is mandatory to have a new BER after the interventions. The scheme is operated by the organization Sustainable Energy Authority of Ireland (SEAI). Contractors for the works must be chosen within the registered contractors list, managed by SEAI, and there are also available official guidelines for contractors, gathers under the Contractor's Code of Practice [94]. In order to be eligible, the works must start after the grant under the scheme is approved by SEAI. The grant is paid after the works are completed and the homeowners paid the contractors.
The maximum amount of grants for each intervention typologies are indicated in the figure 13 below. If 3 qualifying measured are deployed and additional bonus of € 300 is recognized in the grant, and if the measured are 4 a further € 100 bonus is

foreseen. Works performed in specific offshore islands are eligible for 50% additional grant support.

Measure	Maximum grant value
Attic insulation	€400
Cavity wall insulation	€400
Wall insulation - internal dry lining - Apartment (any) or mid-terrace house - Semi-detached or end of terrace house - Detached house	 €1,600 €2,200 €2,400
Wall insulation - external - Apartment (any) or mid-terrace house - Semi-detached or end of terrace house - Detached house	 €2,750 €4,500 €6,000
Heat pump systems (available from 16 April 2018) - Air to water - Ground source to water - Exhaust air to water - Water to water - Air to air	 €3,500 €3,500 €3,500 €3,500 €600
Heating controls upgrade	€700
Solar water heating	€1,200
Bonus payment after 3rd measure	€300
Bonus payment after 4th measure	€100
A BER assessment after works are done (maximum of 1 grant payable per home)	€50

Figure 13. Eligible measures and maximum grant amounts according the Better Energy Homes scheme.

Home Renovation Incentive

It is dedicated to homeowners, landlords and local authority tenants, in form of claim tax relief on repairs, renovations or improvement work that was carried out on their main home or rental property [95]. The works must be delivered by a tax-compliant contractor and they are subject to lower VAT rate of 13,5 %. The scheme consists of a payment in the form of a tax credit at 13,5 % of the eligible expenditures occurred, on the income tax over 2 years. So, this reduces the rate of VAT to zero on qualifying work, up to a value of € 30.000. This scheme seems to be not in force anymore since 2018, but it is presented here to give the comprehensive framework of the financial supports in Ireland during the last years.

Grants for solar panels and battery systems

It funds installation of solar photovoltaic (PV) systems and/or battery energy storage in homes. It's a once-off grants and it is managed by SEAI [96]. PV panels can be installed on the roof or in the home garden. Homeowner must apply for the

scheme and have received grant approval before starting with any work. The maximum grants amount is presented in the figure 14 below.

System	Rate
Solar PV system	€900 per kWp up to a maximum of 2kWp (kWp means kilowatt-peak, which is a measure of the peak output of a solar PV system)
Solar PV and Battery energy storage system	€900 per kWp up to a maximum of 2kWp €300 per kWp for 2-4kWp Battery storage up to €600 per home

Figure 14. Eligible measures and maximum grant amounts according the related scheme in Ireland.

Deep Retrofit Grants
It dealt specifically with deep renovation for energy performance improvements. The program was launched as pilot initiative by SEAI in 2017 and is now closed. New programs and schemes dedicated to the deep renovations, are now under considerations by the Irish governing bodies [97].

Community Grants
The scheme supports energy efficiency community projects through capital funding, partnerships, and technical support. It is managed by the SEAI with yearly call. The last one closed at the end of January 2020 and the requests evaluation is now in process.

8.1.1 Instruments available for public owned residential buildings

The Carbon and Energy Fund (CEF) was originally set up as a National Health Service (NHS) initiative to provide support to any NHS operating organization. Thanks to its success, it has then been expanded and deployed also to other public buildings. The fund enables the installation of energy-saving measures and is available for any qualifying NHS Trust at no capital cost. This is done through energy service performance contracts that guarantee an agreed level of energy and carbon savings. The contracts carry the costs of the design and procurement process as well as the up-front costs of installing energy-efficient improvements. The investment is repaid throughout the life of the contract.

8.1.2 Instruments available for private owned multi-family buildings

The UK Green Investment Bank (now Green Investment Group) invest in UK projects that are both green and commercial and has a mandate to invest at least 80 % of its capital in three priorities: energy efficiency, offshore winds and waste.

8.2 Discussion: Appropriateness of approaches and instruments in Ireland and UK

A good variety of financial schemes are available in the UK and Ireland regions. They are mainly in form of grants and financial supports from energy suppliers through obligations for energy companies. They cover typical energy efficiency and renewable energy interventions.

Support to deep renovation through packages of interventions on the same buildings seems not to be very spread in these regions: although some features of the scheme in force go toward this direction and some pilot initiatives aim to deep renovations, they don't allow for relevant specific additional incentives respect then single actions. This can be seen particularly in the UK context with the adoption of energy company obligations. Deep renovations have the greater potential in energy saving and living conditions improvements in dwellings, and they are the focus of the 4RinEU methodologies and components.

Concerning the UK and Ireland, almost all the financial measures in place are for homeowners, some of them for landlord, only few for public organization or housing association owning building stocks. So, the context from point of view of the financial support seems to be more suitable for single family houses or dwellings, rather than for multi-families houses or apartments blocks. This is probably related to the features of the residential building stock in the UK and Ireland, where the great part of dwellings is in detached, semidetached, terraced houses.

The relevant issue of fuel poverty is covered by a range of different financial measures that can help low income people to improve the energy efficiency and wellbeing in their homes. This kind of support seems not be linked to the social hosing sector and to the public and private bodies who manage it.

Initiatives like Energiesprong go to this direction aiming to boost and support deep renovations starting from the social housing sectors. Goals and solutions are suitable for the 4RinEU approach, which can strengthen and complete this kind of experience.

Concerning Ireland, the Sustainable Energy Authority of Ireland (SEAI), who manage directly many of the supporting schemes in place, could represent a relevant access point to the market of renovation, thanks to the framework they manage, consisting in a network of appointed companies, list of technical surveyors, publication of specific guidelines as code of practice of contractors.

8.3 Summary: Applicable financial instruments in Ireland and UK

In summary, the UK and Ireland have old building stocks or with poor energy performance. Its progressive renovation is supported by good range of policy and financial instruments that should provide relief for investors and owners. Specifically, there are:

- The **Domestic Renewable Heat Incentive** for supporting RES-H installation (biomass boilers and stoves, air and ground source HP and solar thermal panels)
- The **Green Deal** provided financing via a charge on energy bills over 25 years, without any upfront costs for a comprehensive list of measures. It was tied to house and not the person.
- The **Energy Company Obligation** offers financial support to households in need of additional support and funds measures which could not be financed under the Green Deal
- The **Carbon and Energy Fund** targets public buildings and the measures are financed via Energy performance contracts (EPC)
- The **Green Investment Group** is a private organization that devised financial instruments that specifically invest in UK projects that are both green and commercial on three priorities: energy efficiency, offshore winds and waste.
- The **Better Energy Homes scheme** and **Better Energy Warmer Homes scheme**, which are grants covering in part or in total renovations measures in dwellings, the second one is specific for low income people, who already received other welfare supports.
- The **Grants for solar panels and battery systems** covering with grants part of the costs for installation of solar photovoltaic panels and/or battery energy storage systems for renewable electricity.

Decision-makers should select the appropriate financial supporting schemes based on the specific type of building and interventions planned among other factors.

References

[78] Department of Energy & Climate Change of the Government of the United Kingdon. *UK National Energy Efficiency Action Plan*, 2014. See: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/307993/uk_national_energy_efficiency_action_plan.pdf

[79] Department of Communications, Energy and Natural Resources of the Government of Ireland. *Better Buildings - A national renovation strategy for Ireland*, 2014. https://ec.europa.eu/energy/sites/ener/files/documents/2014_article4_en_ireland.pdf

[80] https://www.simpleenergyadvice.org.uk/pages/energy-company-obligation

[81] https://www.ofgem.gov.uk/environmental-programmes/eco/about-eco-scheme

[82] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/775333/energy-company-obligation-guidance-2018.pdf

[83] https://www.nea.org.uk/wp-content/uploads/2019/09/Fuel-poverty-monitor-high-res.pdf

[84] https://energiesprong.org/about/

[85] https://www.energiesprong.uk/

[86] https://www.simpleenergyadvice.org.uk/grants

[87] https://www.gov.uk/government/publications/estate-regeneration-fund

[88] http://www.gdfc.co.uk/

[89] https://energysavingtrust.org.uk/scotland/grants-loans/heeps/heeps-warmer-homes-scotland-scheme

[90] https://www.simpleenergyadvice.org.uk/grants

[92] https://www.citizensinformation.ie/en/housing/housing_grants_and_schemes/warmer_homes_scheme.html#l62fd2

[92] https://www.seai.ie/grants/home-energy-grants/free-upgrades-for-eligible-homes/

[93]https://www.citizensinformation.ie/en/housing/housing_grants_and_schemes/home_energy_saving_scheme.html

[94] https://www.seai.ie/grants/supports-for-contractors/BEH-Contractors-Code-of-Practice.pdf

[95]https://www.citizensinformation.ie/en/housing/housing_grants_and_schemes/home_renovation_incentive.html

[96]https://www.citizensinformation.ie/en/housing/housing_grants_and_schemes/Grants_for_solar_panels_and_battery_systems.html

[97] http://3cea.ie/deep-retrofit-program/