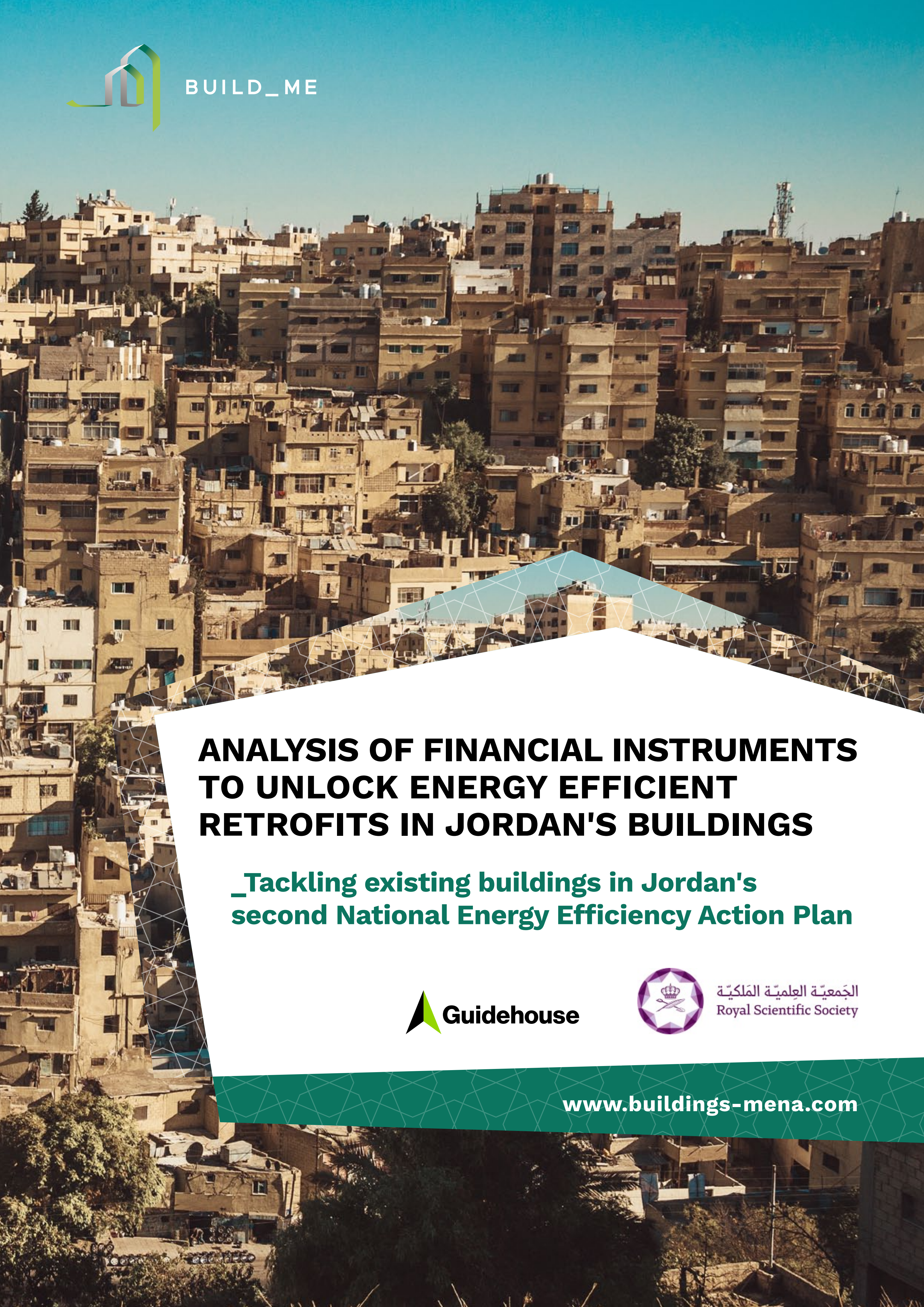

BUILD_ME

ANALYSIS OF FINANCIAL INSTRUMENTS TO UNLOCK ENERGY EFFICIENT RETROFITS IN JORDAN'S BUILDINGS

_Tackling existing buildings in Jordan's second National Energy Efficiency Action Plan

Guidehouse

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Analysis of Financial Instruments to unlock energy-efficient Retrofits in Jordan's Buildings_Tackling existing buildings in Jordan's second National Energy Efficiency Action Plan

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1. Introduction

Continuous population growth and economic developments as well as high urbanization rates increase the demand for housing in the countries of the MENA region. This results in a sharp increase in the energy demand for heating and cooling in the building sector. According to the International Energy Agency (IEA) data, the building sector accounts for around 20% of total energy consumption in the MENA Region and is expected to increase. Most buildings are constructed in a non-energy-efficient way and considering the long service life of the buildings, this will jeopardize the transition to low-carbon development paths. Therefore, the BUILD_ME project (IKI Project Accelerating 0-emission building sector ambitions in the MENA region) focuses on supporting the relevant stakeholders in shaping the path for a more energy-efficient building sector. In the previous phase (2016 - 2018), a comprehensive understanding of the barriers to invest in energy-efficient and/or renewable energy-based heating and cooling in the MENA region was developed. The implementation, upscaling, and consistency of the recommendations for action into national strategies are the guiding principles of the BUILD_ME project. Further information and insights about BUILD_ME activities can be found on the project website: https://www.buildings-mena.com/.

The building sector in Jordan is responsible for around 40% of total final energy consumption. Jordan has seen a significant growth in the building sector over the past few decades. So far, however, energy efficiency measures have only played a subordinate role in technical building equipment. In most of the new buildings, the climate-friendly design principles and materials do not often be the main criteria of the construction process. To achieve a high level of comfort in the living area, technologies with high energy consumption are used. As a result, the demand for energy imports is increasing, which in turn puts a great pressure on the Jordanian economy.

The Jordanian government has adopted several policy instruments to promote and create appropriate framework conditions for energy efficiency. To name a few of these policies, standards for household appliances are in place, the Jordanian National Building Council (JNBC) issued the Green Building Manual through, Amman municipality adopted a programme for green building incentive programme (density bonus), and the approval of instructions and procedures for Energy Service Companies (ESCOs) has been also issued. In parallel, a few financial incentive programs appeared to support this transition towards energy efficiency such as tax incentives for investments in solar water heaters, as well as for highly energy-efficient products such as efficient air conditioning systems. While the building sector may benefit from the funds available from the JREEEF, yet there is no special financing instrument that holistically supports energy efficiency in buildings.

This report endeavours to provide analysis and a clear picture of the financial instruments that may unlock energy-efficient buildings projects in Jordan. The report therefore compiles the results of research and analysis of the energy efficiency existing financial instruments in Jordan and then provides a wide range of best practices that can lead to a defined set of recommendations to be adopted in Jordan. To do so, the report starts with an introductory background about the different funding types and a description of some practical selected financial instruments. The next step is to describe the status of the available financial instruments for EE/RE measures in Jordan. That to be followed by showcasing different examples of best practices from countries in a similar phase of transition towards energy efficiency. The report continues then with the analysis of a case study from Jordan. For that purpose, a reference building of a multi-family house (MFH) has been selected to assess the cost efficiency of energy-efficient retrofit measures in Jordan. The report ends with process related and technical recommendations. Figure 1 below shows the methodology of the report.

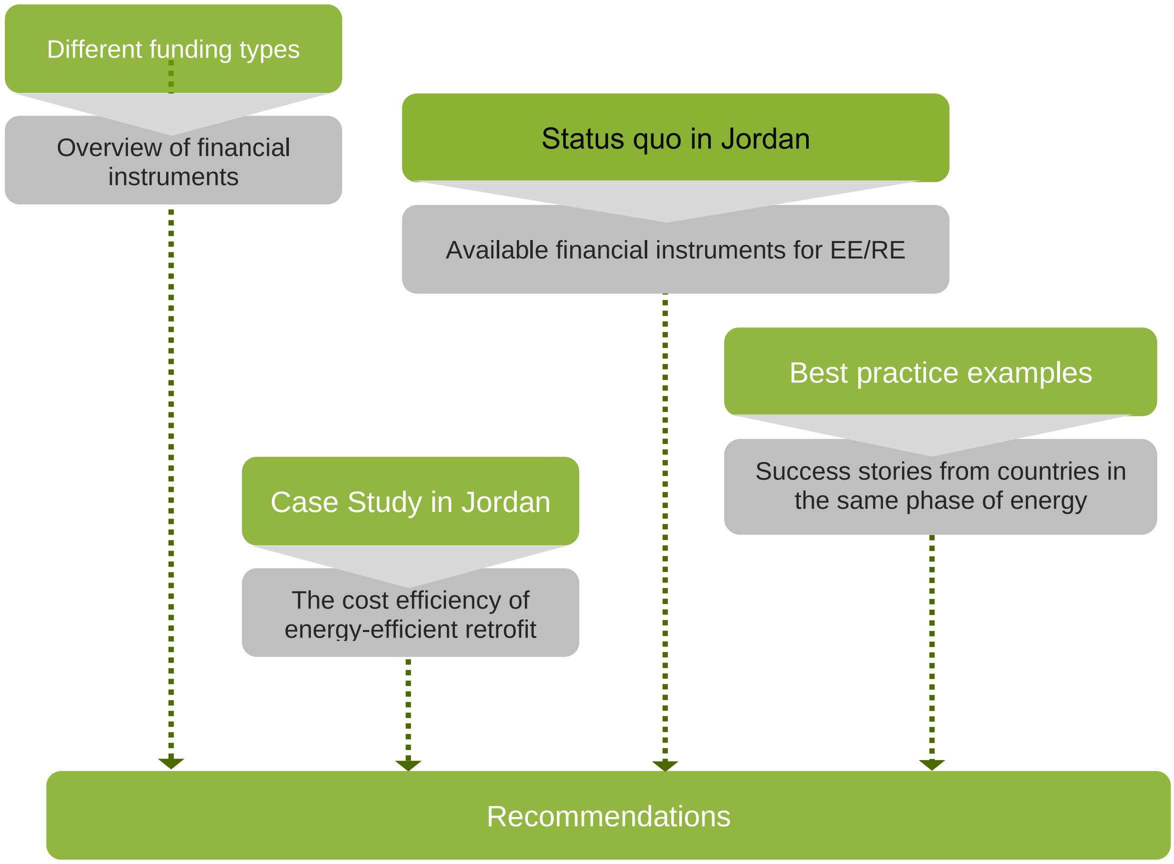


Figure 1: Methodology of the report

2. Financial instruments to stimulate energy efficiency investments in buildings

This chapter aims to take a closer look at how financial instruments are currently being used in energy efficiency projects and provides some evidence on their effectiveness to stimulate energy efficiency in the building sector. The objective of this chapter is to illustrate the variety of available financial instruments.

2.1 Overview of financial instruments

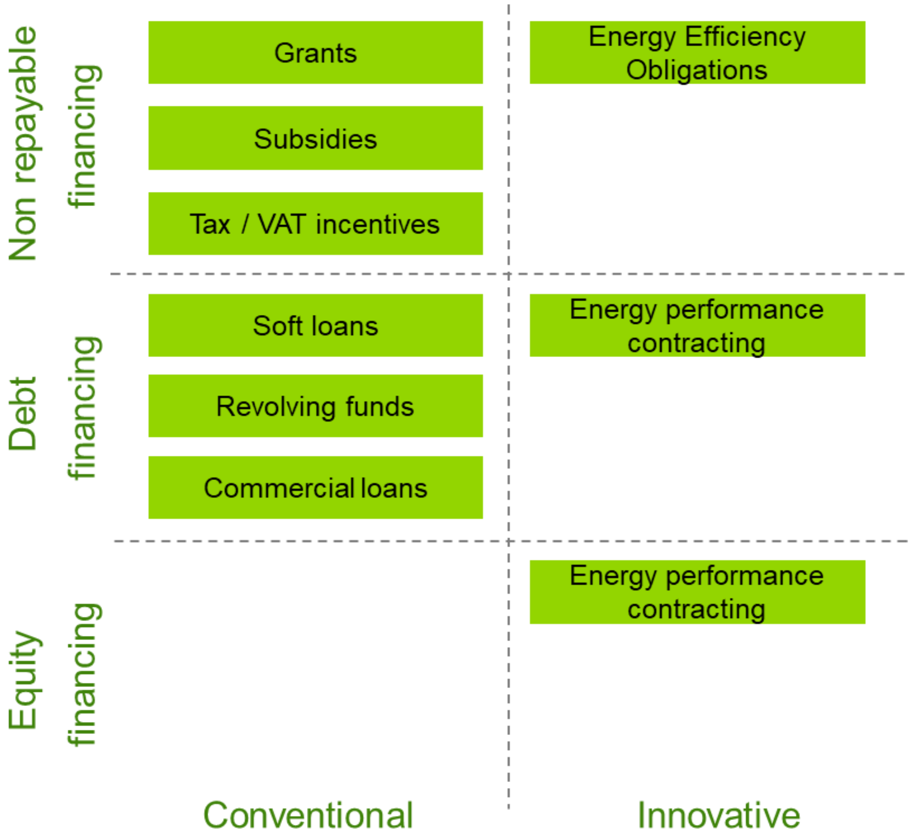


Figure 2: Overview of financial instruments

According to BPIE (2011) and JRC (2019) there is a range of financial instruments available to improve the energy performance of buildings as shown in Figure 2. The different types of financial instruments can be divided into two broad categories of conventional and innovative instruments. The conventional financial instruments that have been used since the oil crises of the 1970s include:

- Grants that are targeted at households, industrial or other energy consumers to pay for a part or all the cost of introducing energy-efficient processes – such as enhanced building insulation. Grant schemes can be useful at stimulating the market by subsidising energy efficiency investments for households and businesses, which otherwise cannot be fully supported by the market alone due to high upfront costs. They directly fill an immediate financial gap and thus enable a temporary shift in the market. They typically rely on limited resources and can, therefore, neither offer a sustainable solution nor support massive market uptake programs. Grants mainly serve as direct investment subsidies which may partially or fully cover renovation costs including acquisition of material/equipment, advice, certification and installation.

- Subsidies which allow prices to be kept low. They may be provided, for example, to manufacturers of energy-efficient equipment. Both grants or subsidies may be financed directly through the state or local authority budget or hypothecated taxes (also known as ring-fenced or ear-marked tax).

- Loan schemes to encourage energy-efficient practices can be introduced with subsidised interest rates or credit risk support. Subsidies provided by the local authority or state budget to banks offering low interest rates are a fiscal policy. Various international financial institutions and European Union (EU) governments have begun experimenting with loan schemes that offer attractive terms to customers for energy-efficient projects. In most cases, preferential or soft loans – government supported loans offered at below market interest rates – are delivered through public-private partnerships where the government provides financial support to a bank, which in turn offers a loan scheme with preferential interest rate to its customers. Typically, credit lines are extended to financial institutions as low interest rate loans by a donor or a government. The recipient institution then on-lends the funds to customers (e.g., private individuals, condominium association, commercial customers, public authorities, ESCOs, etc.) to invest in energy efficiency projects. They can be an alternative or a complementary measure to subsidies.

- Tax incentives can increase demand for energy efficiency projects by reducing the cost of the energy efficiency improvement through reduced taxes for households and businesses. They can be less costly than grant schemes and are considered a popular instrument promoting energy efficiency in certain EU countries. They may work well alongside with a taxation scheme, whereby the tax loss attributed to the tax incentive scheme is offset by revenues from taxation for energy intensive industries. The schemes are often designed with a specific technology focus, which means that they are designed to stimulate investments in specific technologies/measures rather than set overall energy performance criteria. They are effective if the tax collection rate is sufficiently high and can be useful at promoting new technologies that lack profitability at the current stage.

- Energy Supplier Obligations (often known as White Certificates) are requirements on a group of market actors in one or more sectors of the energy industry in each territory to achieve a specified energy saving target (Source: Dan Staniaszek and Eoin Lees, Determining Energy Savings for Energy Efficiency Obligation Schemes, ECEEE, 2012). Energy Efficiency Obligations (EEOs) are a market-based instrument enacted by governments to stimulate energy efficiency investments through obligations placed on energy companies. Under an Energy Efficiency Obligation scheme, energy distributors or retail energy sales companies are required to achieve a certain amount of energy savings in a pre-defined time. For example, the Energy Efficiency Directive requires member states to establish EEOs, mandating energy companies to achieve yearly energy savings of 1.5% of annual sales to final consumers.

- Energy Performance Contracting, often known as Third Party Financing or Contract Energy Management, are all terms used to cover a wide variety of contracting and financing techniques for energy efficiency and renewable energy projects (Source: Energy Charter Secretariat, Third Party Financing: Achieving its Potential, ECS, Brussels, 2003). Under an energy performance contract (EPC), an ESCO undertakes a project to deliver energy efficiency improvements in the premises of the client. It then partially or fully uses the stream of income from the cost savings to repay the costs of the project. Following the end of the contract all energy savings are transferred to the client. There are two main types of EPCs with different loan arrangements:

- Guaranteed savings: The ESCO guarantees a certain level of energy savings and in this way shields the client from any performance risk. The loan goes on the client's balance sheet and the ESCO assumes full project performance risk.
- Shared savings: The savings are split in accordance with a pre-arranged percentage between the client and the ESCO, i.e. the loan goes on the ESCO's balance sheet. The ESCO finances the project and assumes debt obligation on balance sheet. The ESCO assumes both (partial) project performance and credit risks. There is no standard split of the share of the ESCO vs. the client, as it depends on the length of the contract, payback time and underlying risks taken.

2.2 Strengths and challenges of financial instruments

After classifying the main types of financial instruments used to stimulate more energy efficiency investments in buildings, this subchapter summarizes in Table 1 the main advantages and challenges of each financial instrument type (JRC 2019).

Table 1: Strengths and challenges of financial instrument

Financial instrument	Strengths	Challenges
Grants and subsidies	• Can support initial stage of a new market/diffusion of new promising technologies and deep renovations perceived risky by investors. • To provide financial assistance to vulnerable groups or low-income households meeting political priorities such as health or social inclusion. • Can support EE projects that normally would be too small to get attention from commercial banks.	• Cannot offer massive uptake rates. • More suitable for individual interventions which may lead to energy saving "locking-in" effect. • Public budget restrictions may threaten its continuation due to high costs. • May discourage the use of other forms of financing such as commercial loans. • Can be associated with significant paperwork or bothersome application processes.
Loans	• Represents a more sustainable means of financing than grants. • Can be combined with various support mechanisms such as a revolving fund mechanism which ensures that loan funds are cycled back into the fund for more energy efficiency projects. • Can be easily implemented by banking institutions, reducing long bureaucratic processes.	• Households and other target recipients may be unwilling to take on (additional) debt. • Lack of understanding of value of EE projects by financial institutions remains a key barrier. • Acquiring a second loan (e.g., on top of existing mortgage) may be complicated. • Low credit worthiness of vulnerable groups who need support. • Small projects may not be attractive for bankers.
Tax / VAT incentives	• Can work well if the tax collection rate is sufficiently high. • Can be useful at promoting new technologies that lack profitability at current stage. • In certain cases, they can increase tax revenues to the government.	• Usually have a poor performance in an economy in recession or in transition. • Less effective if tax collection rates are low. • Can be subject to the problem of the “free rider”. • Tax savings to households and businesses typically mean reduced tax revenue to the government.

Financial instrument	Strengths	Challenges
Energy Performance Contracting	• Reduces or eliminates performance risk of energy efficiency measures. • Eliminates need for internal technical expertise and packages all services in a single contract/source of accountability. • Avoids upfront capital expenditure in case of shared model. • Incentivises ESCOs to provide optimised and state-of-the-art solutions to maximise energy savings.	• Uncertainty of baseline measurement and ex-post measurement challenges. • Difficulty to access finance by ESCOs who may become very indebted. • Not suitable for small projects due to high transaction costs. • Difficulty to promote ESCO models in markets which are not yet mature.

3. Status quo in of available financial instruments for EE/RE measures in Jordan

3.1 Jordan Renewable Energy and Energy Efficiency Fund

JREEEF was established in 2012 by the EE and RE law 13 and became operational in 2015 after the promulgation of bylaw 49 of 2015. It is established at the Ministry of Energy and Mineral Resources (MEMR) to provide necessary funding for EE and RE measures at end-user's level. It supports any programme and financial mechanism allowing RE and EE users to access financing from banks, local and international financial institutions. This includes loan interest rate subsidy, revolting funds, financial risk mitigation, credit guarantees, equity participation, subsidy to investment in innovation projects and soft investment.

The strategic plan and implementation programs are based on the strategic plan of the MEMR and the national strategy for the energy sector. JREEEF aims to support the national goals and contribute to achieving Jordan's commitments on climate change and the Paris Agreement. Therefore, JREEEF's strategic objectives include the rationalizing of energy consumption and improving energy efficiency in all sectors (MEMR strategic target 4) and developing local energy sources through the exploitation of various renewable energy sources. JREEEF, as shown in Figure 3 has a number of programs and projects that include various sectors and were implemented through several financing windows.

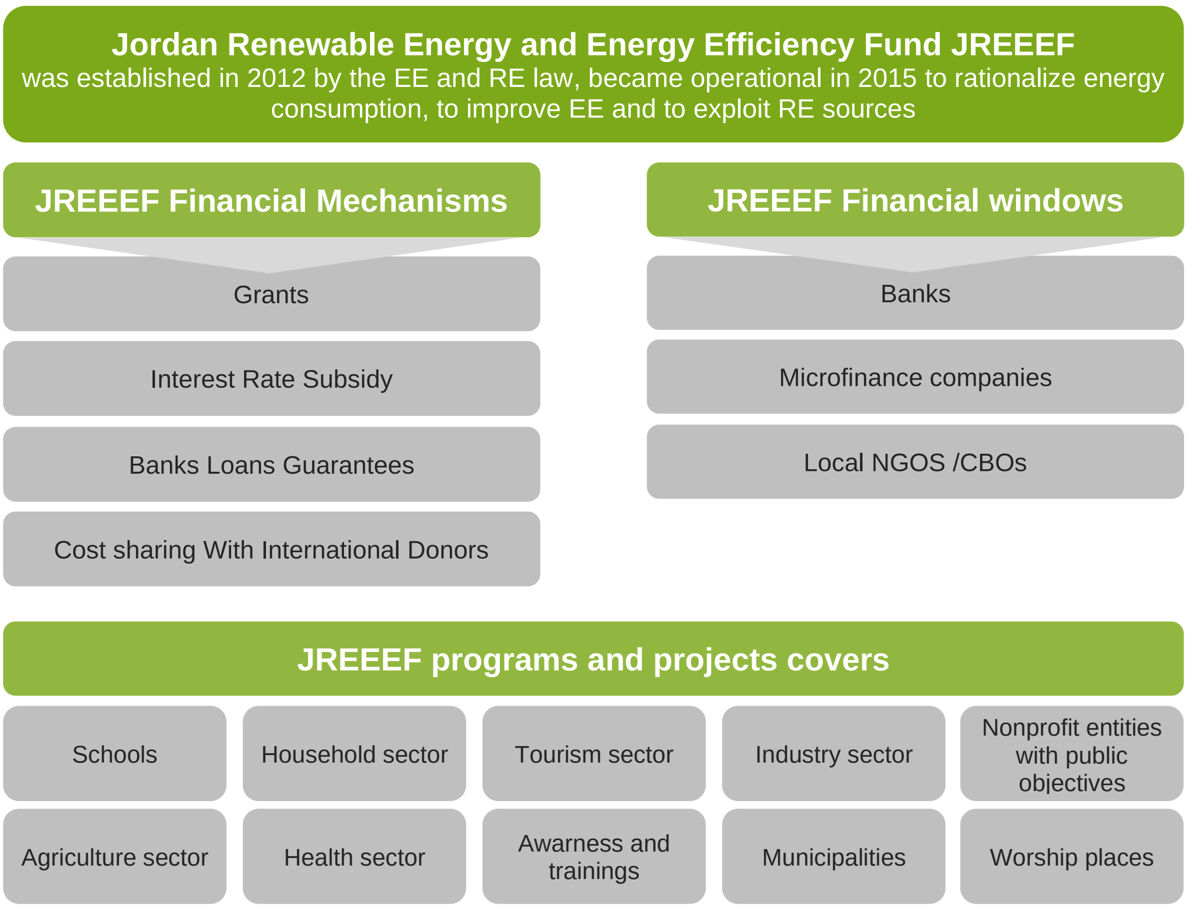


Figure 3: Overview of JREEEF

3.2 Green Economy Financing Facility (GEFF) in Jordan

The European Bank for Reconstruction and Development (EBRD) and the EU introduced a comprehensive green economy programme in Jordan to promote green investments in the private sector. The programme will support Jordan's transition to a green economy and combines commercial loans from the EBRD, concessional loans from the Green Climate Fund (GCF) and grant funding by the EU. GEFF will support businesses and households to invest in green technologies in order to increase energy efficiency and reduce emissions through the introduction of loans through local banks and microfinance institutions.

The programme provides free advisory services through a full-time project office in Amman. The office will provide training, documentation, and ongoing support to loan officers. GEFF in Jordan offers its services to industrial and commercial sectors as well as to the residential sector. The eligibility criteria of projects include several aspects such as to achieve 20% of EE improvements, to use RE sources, to reach 20% of water savings or to obtain the Certification of Green Buildings with proven performance of 20% better than the national standards. The eligibility assessment of projects includes dedicated site visits (when needed), analysis of feasible green investments and assessment of sub-projects considering cash flow and its profitability. Figure 4: below depicts the general process of GEFF to provide loans and support for EE projects.

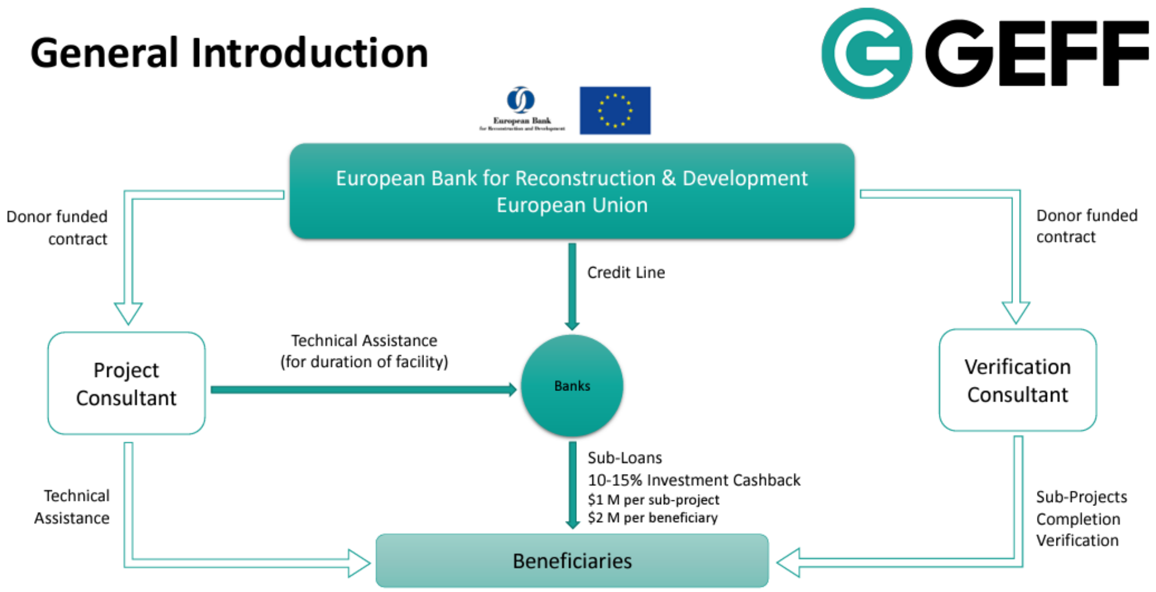


Figure 4: EBRD procedures

GEFF offers cumulative funding per borrower up to 20% of loan amount. The borrowers/applicants may ask for the fund through two channels:

a) Green technology selector: When requesting from the pre-approved equipment selected from the green technology selector database of EBRD. The loan or lease should not exceed 300,000 USD per piece of equipment.

b) Assessed projects: For complex projects requiring specific support, where applicants may be eligible for a support up to 10% of loan amount.

Projects related to the improvement of existing buildings have a performance baseline defined by the current condition of the building fabric and engineering systems which are eligible to receive support as "assessed projects" when meeting one of the following criteria:

- Green building certification e.g., LEED (silver), BREEAM (Good), EDGE standard, passive house, DGNB (bronze).
- >30% energy savings / RE sources.

- >15% energy savings against the national standards.

4. Relevant best practices to finance EE retrofits

Several different case studies were analysed. Each of these case studies present a different approach to finance energy efficiency measures. The schemes differ from each other in terms of financial instrument used, target group and EE measure etc. The analysis is based on desktop research, literature review and interviews with experts and/or stakeholders, such as implementing agencies and banks. In this way collected data is therefore a mixture between publicly available data and internal data sources. The case studies included the following programs: Tunisian Solar Programme (PROSOL), Tunisian incentive program for the thermal insulation of roofs (PROMO-ISOL), National Energy Efficiency and Renewable Energy Action (NEEREA) (Lebanon) and Latvian Baltic Energy Efficiency Facility (LABEEF) (Latvia).

To capture the entire depth of the financial schemes, the analysis presents different aspects such as the context, description, financial mechanism, impact, co-benefits and finally conclude with the key success factors and the main barriers as well. The case study template was prepared to fit better with the available data at hand. For example, it was also difficult to acquire some of the broader quantitative indicators, as no quantitative data could be collected e.g., for CO_2 savings and co-benefits. This lack of available quantitative indicators and the lack of comparability of the different financial schemes also lead the corresponding analysis to focus on success factors and barriers for financial energy efficiency schemes.

4.1 Best Practice Tunisia – PROSOL

- Summary, based on (Chiara Trabacchi, 2012) and (bigEE, 2021)
- PROSOL is an end-user financing facility which was jointly developed by the Tunisian Ministry of Industry, Energy and Small and Middle Size Enterprises (MIEPME), the National Agency for Energy Conservation of Tunisia (ANME) and the United Nations Environment Programme (UNEP).
- The programme aimed at replacing fossil energies water heaters, in particular liquid petroleum gas (LPG), which is highly subsidized by the government.
- The programme accelerated the penetration of solar water heater (SWH) in the residential sector by involving a number of local financial institutions to provide credit lines to end-users, to help them overcome the barriers of the initial costs of SWH.

4.1.1 Description of the financial instrument

The programme includes several incentives for suppliers and for residential households as end-users. The main incentives of PROSOL are described in the following table.

For Suppliers	▪ **A VAT and customs duties exemption for finished or semi-finished products and raw materials.** ▪ **A top-down and bottom-up quality assurance for all suppliers and their products to be approved and marketed within the programme framework to ensure aftersales service and improve the public image of the SWH.**

For end-users	▪ A direct public subsidy for buying a SWH of around 20%. The remaining costs of the SWH (approximately 80%), a direct simplified access to bank financing with credit recovery over 5 years to be attached to the electricity bill.

4.1.2 PROSOL financial mechanism

PROSOL financial mechanism, as shown in Figure 6:, addresses a few crucial issues such as the high cost of SWH in comparison with the LPG or electricity heaters. Furthermore, the fossil energies public subsidy hinders the development of SWH systems. Therefore, there are no easy credits for to fund the initial investment required to install SWH.

PROSOL was designed for residential housing representing an integrated solution to overcome the financial, technical and organizational barriers hindering the development of an SWH market. PROSOL is based on secure funding through a dedicated credit line managed by the Tunisian company for electricity and gas (STEG). Figure 5: below shows the nine simple steps of the procedures of PROSOL.

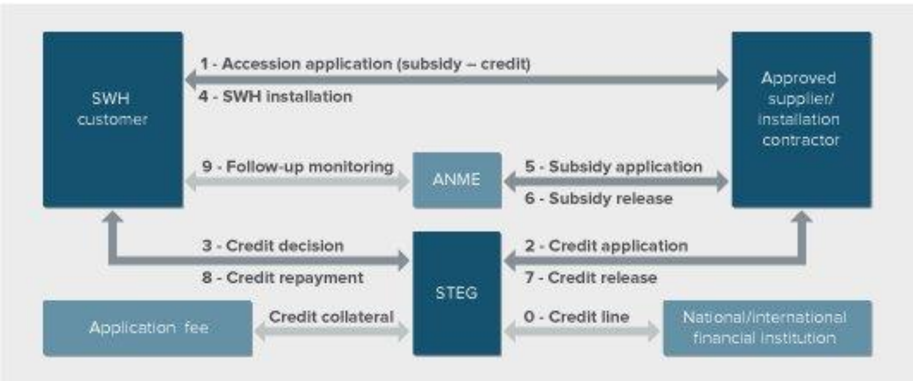


Figure 5: PROSOL procedures and steps, Source: Wuppertal Institute 2012; adapted from ECO-Ser 2011

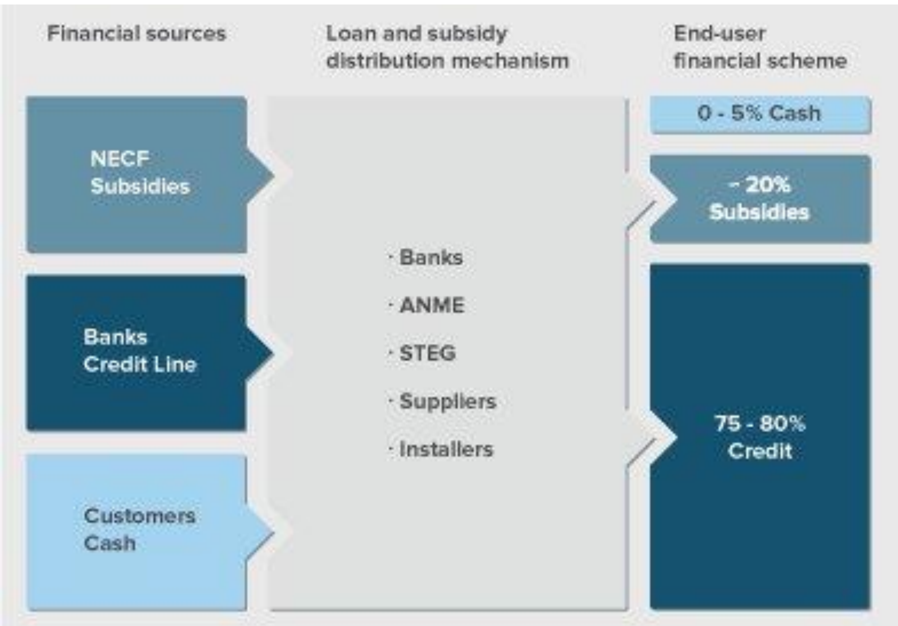


Figure 6: PROSOL financial windows, Source: Wuppertal Institute 2012; adapted from ECO-Ser 2011

4.1.3 Impact

PROSOL aimed to install 510,000 m^2 of SWH in the period between 2007 and 2011 which allows for annual energy savings of approximately 38 Ktoe and 540 Ktoe incrementally over the SWH life cycle of 15 years. Furthermore, PROSOL impact has in particular allowed for:

- In terms of collector area, it has increased fivefold compared to the previous situation, with a total installed base of about 119,000 systems.
- A net gain for the public budget was achieved. For example, between 2005-2010 the shift in consumers' demand shaved USD 15.2 million off Tunisia's fossil fuel subsidy. These savings are projected to reach USD 101 million over the lifespan of the SWHs. This in total compensated the Government's original USD 21.8 million investment.
- Reducing greenhouse gas (GHG) emissions, 251 Ktoe of avoided fossil fuel consumption and 715 Kt CO_2 emissions over the lifespan of the installed SWH.
- Contributing to the energy independence and reducing the imported amounts of LPG.

4.1.4 Co-benefits

PROSOL is implemented by the National Agency for Energy Conservation (ANME), based

on the political will to promote SWH which is revealed by the involvement of STEG in the funding of the SWH with direct support from the National Fund for Energy Management (FNME) and the tax benefits for SWH import and manufacturing. Further co-benefits are:

- PROSOL helped make SWH more attractive in comparison with fossil fuel heating systems by making SWH more affordable through reducing upfront cost requirements.
- A shift of subsidies from fossil energies to SWH allowing for a price reduction in SWHs in the medium term.
- Suppliers of SWH and the banks share efforts to achieve a win-win situation in the medium and long-term.
- PROSOL efforts to improve understanding of the value added of the technology may support more responsible and long-term investments in SWH.
- It is also estimated that about 3,000 new jobs were possibly created, although job losses observed in more conventional industries should also be taken into account.

4.1.5 Success factors and barriers

- Direct and simplified access to bank financing for the end-user with recovery over 5 years via easy payments on the electricity bill.
- The involvement of the State utility STEG as guarantor and debt enforcer, which improved domestic financial institutions trust and resulted in lowered financing costs for residential end-user.
- A proper legal framework, thanks to an incentive-based regulation under the law on energy management. Additionally, the Government passed a legislation mandating that SWHs in the residential sector are eligible for a 20% capital cost subsidy.

- International aid played a specific role to kick-start the programme by building infrastructure that addresses the needs of commercial banks, households, and the SWH industry. For example, a temporary interest rate subsidy (USD 1 million – funded via UNEP) gradually phased out after 18 months. This facility aimed to create incentives for householders to apply for favourable credit terms to purchase SWH systems, and to help banks rapidly achieve a critical mass of loans.

- Continuous awareness about the economic benefits of SWH through targeted campaigns. Parallel to that, building confidence in the technology through quality and certification measures.

- A top-down and bottom-up quality assurance system for suppliers and products. For example, the selection criteria for the PROSOL were prepared by ANME as programme manager. ANME carries out technical audits on sample installations to monitor product and installation quality.

4.1.6 Best practice Tunisia PROMO-ISOL

The population growth and the rising living standards in Tunisia resulted in an increase in the construction of buildings and accordingly, the energy demand in the building sector which is amounting to 27% of the total consumption in the country with expectation of increasing this percentage to reach 35% by 2030, thus delaying climate change mitigation efforts. To combat this situation, the NAMA Support Project (NSP) aims to increase the uptake of EE and RE measures in the building sector through the launching of the several programs including programme of PROMO-ISOL (ANME, 2021) (MMEWR, 2021).

PROMO-ISOL is a financial incentive programme for the thermal insulation of roofs in the existing and new individual housing and it provides the following support:

- Technical solutions from certified professionals, technical inceptors, and installation companies.

- Attractive financial support in a form of grants, additional grants, and concessional loans as shown in Table 2 below:

Table 2: Financial support by PROMO-ISOL

Financial incentive	Existing buildings	New buildings
Grant	8 Tunisian dinar / M^2	6 Tunisian dinar / M^2
Additional grant	6 Tunisian dinar / M^2	4 Tunisian dinar / M^2
Total	14 Tunisian dinar / M^2	10 Tunisian dinar / M^2

	Ceiling	Interest rate	Payment's period	grace period
Loan	2400 Tunisian dinar	5%	7 years	2 years

PROMO-ISOL targets to provide roof thermal insulation for 65,000 houses in all municipal areas of Tunis in the period of 2020-2024 according to Table 3:

Table 3: Provision of roof thermal insulation by PROMO-ISOL

Year 1	Year 2	Year 3	Year 4	Year 5
1,000	4,000	15,000	20,000	25,000

PROMO-ISOL financial mechanism flows works according to the following points and Figure 7::

a) Payment of the beneficiary's personal contribution to the installation company.

b) Partial payment of monitoring costs to the technical control office by the beneficiary.

c) Transfer of the loan by the bank directly to the installation company.

d) Release of the Transmission Fund Subsidy by the National Agency for Energy Control to the installation company.

e) Repayment of the loan by the beneficiary.

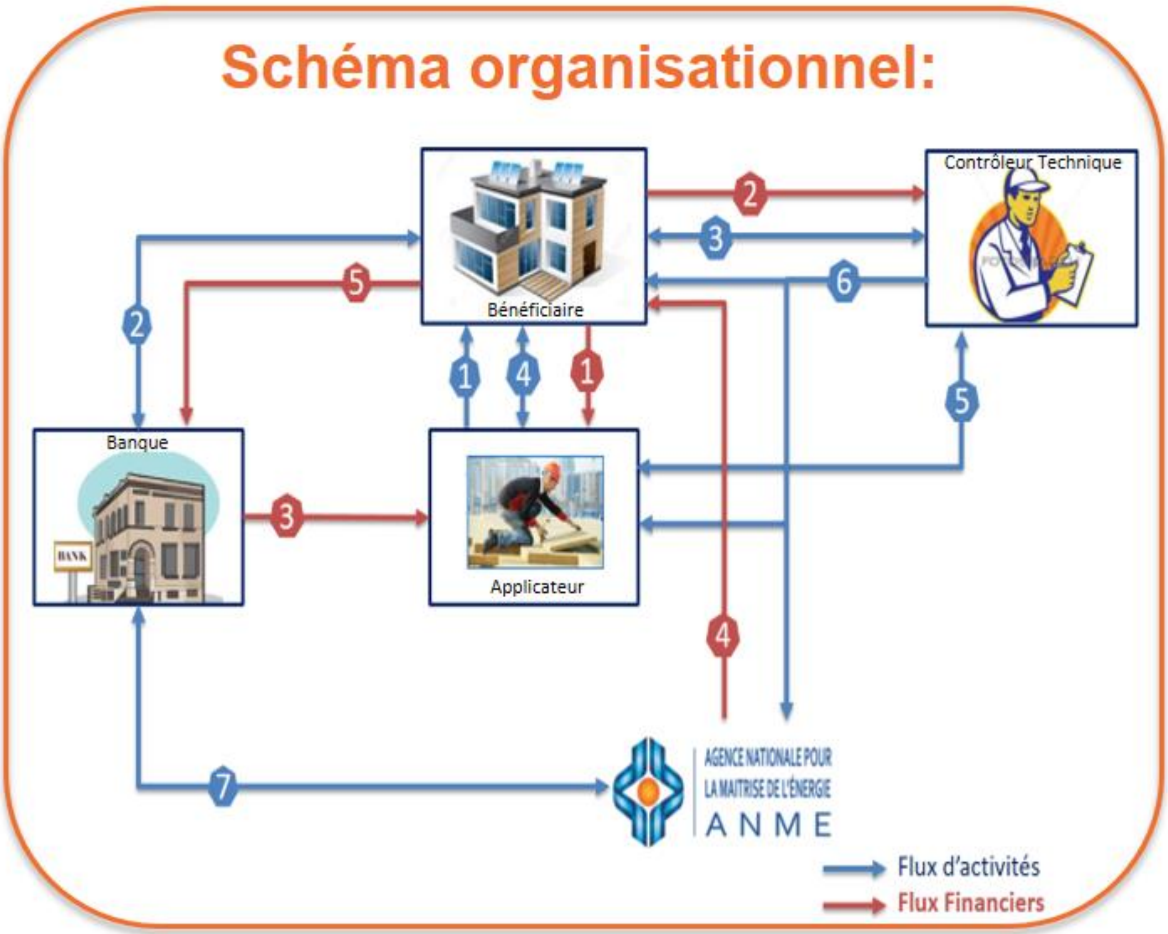


Figure 7: Organizational scheme for PROMO-ISOL

4.2 Best Practice Lebanon: NEEREA

- Summary, based on (NEEREA, 2021), (RCREEE, 2014),
- The NEEREA is a national financing mechanism which allows private sector to receive subsidized loans for EE and RE projects.
- NEEREA is active through all Lebanese commercial banks under the leadership and management of Banque du Liban/Central Bank of Lebanon (BDL). Promising concept for countries with a large stock of multi-family apartment buildings.
- Private facilities are eligible to apply for loans at a low interest rate for a maximum of 14 years including a grace period of up to six months to four years.

NEEREA was the first green financing mechanism in the Arab Region that finances renewable energy, energy efficiency projects and green buildings. Related to NEEREA, the technical support and capacity building activities are provided by the Lebanese Centre for Energy Conservation (LCEC).

NEEREA is a part of the National Energy Efficiency Action Plan (NEEAP) for Lebanon, which was approved in November 2011. NEEREA was initiated by the BDL in collaboration with the Ministry of Energy and Water (MEW), the Ministry of Finance (MoF), United Nations Development Program (UNDP), the EU, and LCEC, it was officially launched with the issuance of Circulars No. 236, 313, 318, 346 and 365 by the BDL.

Other parties and international stakeholders were involved in NEEREA such as the EU and UNDP who partnered with BDL to offer technical support, training, marketing, and awareness raising activities. The most important and effective involved stakeholders are residential, commercial, non-profit and industrial users who can benefit from long-term loans at low interest rates to finance their RE and EE projects through NEEREA.

4.2.1 Description of the financial instrument

Private, existing, and newly built facilities are eligible to apply for NEEREA loans. It has a ceiling of 10 million USD and is offered at a low interest rate for a maximum of 14 years including a grace period of up to six months to four years. The green loans are provided by Lebanese commercial banks to the private sector. With such a mechanism, NEEREA links commercial banks to private companies and builders which ensures an easy implementation and quick procedures. NEEREA process includes the following steps, as shown in Figure 8::

a. Prepare a technical report (based on templates provided by the LCEC) either by the applicant or by an appointed energy company. The technical report must include a feasibility study, financial analysis, technical analysis and the total amount of the requested loan.

b. Choose a commercial bank where to apply for the loan. Procedures are different depending on the size of the loans:

    i. Loan requests not exceeding 20,000 USD do not require a direct approval of BDL. Therefore, the report will be sent directly by the commercial banks to LCEC.

    ii. For loan exceeding 20,000 USD, the commercial bank first submits the technical report to BDL for approval and BDL forwards the report to LCEC for technical verification.

c. After LCEC verification, the report to be re-sent to the commercial bank or to BDL to review and send the results to the commercial bank.

d. The commercial bank informs the client about the result of the application.

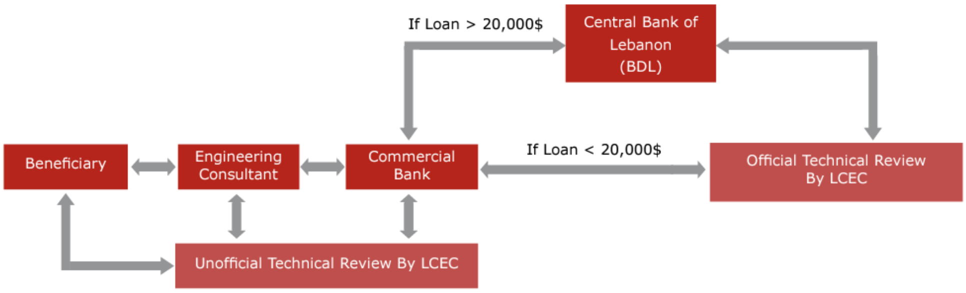


Figure 8: NEEREA procedures steps

Additionally, NEEREA provides households interest-free loans for SWH over a 5-year period. Moreover, consumers that install small RE systems can offset the cost of power drawn from the utility (Électricité du Liban, EDL) through Net Metering. The exported energy from the system is then subtracted from the imported energy and the net output is calculated and billed by the utility (EDL).

4.2.2 Financial mechanism

NEEREA loans are subsidized by BDL via two financial mechanisms as follows:

a) Exempting the lending banks from reserve requirements,

b) Granting the lending banks a special loan at 1% against NEEREA loans.

Additionally, final beneficiaries who are eligible under the Government Subsidy Program managed and subsidized by BDL too, will receive an additional subsidy of 4.5% on interest rate. Therefore, the price of a NEEREA loan will be between 0% and 1%.

4.2.3 Impact

By 2020, more than 1,000 projects were approved by the NEEREA. 76% of the projects were for solar photovoltaic while 42% of loans were for green buildings. The projects contribute to an annual saving of 73,253,210 USD. So far, NEEREA has achieved to reduce yearly energy consumption by 260,163,325 kWh and saved 281,245 tonnes of CO_2. The top three sectors supported by NEEREA are the commercial sector with 52%, the residential sector with 31% and the industrial sector with 8%.

4.2.4 Co-benefits

NEEREA has helped the national economy by reducing the burden on the Lebanese institutions and industries, as a relatively small yet less amount of energy is imported. It has also created sustainable job opportunities; 76 new energy companies recently entered the energy market with 40% more of job vacancies.

4.2.5 Success factors and barriers

- Applicants can apply by themselves with no additional costs occur for them.
- Loans provided via NEEREA are available and provided by most of the commercial banks. The loans are as well subsidised and competitive in comparison with the normal commercial loans.

- Easy process with clear procedures. Reports and requirements have been standardized using clear templates provided by LCEC.
- NEEREA covers and supports the green buildings as well. verification process includes the calculation of achieved energy savings.

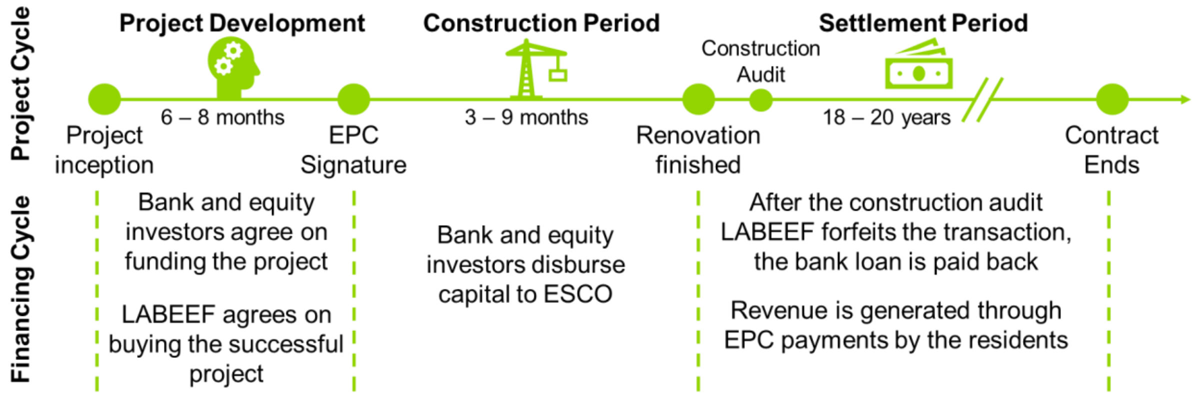
4.3 Best Practice Latvia: Latvian Baltic Energy Efficiency Facility

- Summary
- Market funded facility for enabling ESCOs to provide deep energy efficiency measures through long-term EPCs.
- The main benefit for the facility is to separate execution from funding, allowing ESCOs to accept the terms of a long-term repayment schedule while still being able to take on additional projects.
- Promising concept for countries with a large stock of multi-family apartment buildings.

4.3.1 Programme concept

The LABEEF is a private fund created in 2016 by the investment management company Funding for Future (F3). While LABEEF is responsible for the financials, the Building and Energy Conservation Bureau (ESEB) is the organisation in contact with tenants and homeowners. LABEEF, as shown in Figure 9 finances long-term payment cash-flows backed by an EPC. Energy performance contracting is a financing scheme offered by ESCOs to building owners who are in need of energy efficiency improvements but have limited financial means or technical capacities to implement such projects on their own. What makes EPC innovative is that an ESCO finances the project based on the guaranteed energy savings that will be generated in the future. The renovation can be financed by the company in form of equity or from a bank, which provides a loan to an ESCO or a combination of both. LABEEF does not finance any renovation themselves but only provides long-term financing.[1] The renovation cost is paid by the owners, e.g. the inhabitants of the apartment building, through monthly instalments linked to the achieved savings outlined in the EPC. The renovation can also be partially financed by grants and subsidies, in which case only the EPC component linked to energy savings is paid back by buildings owners.

[1] An energy performance contract is a financing structure, in which residents or house-owners pay for energy efficiency renovations conducted by their energy service company through their monthly electricity bill. It usually involves guaranteed energy efficiency gains.



Source: Guidehouse based on Stancioff, 2019

Figure 9: LABEEF Project Life Cycle

4.3.2 Financial mechanisms

LABEEF is a long-term financing vehicle, that makes it possible for ESCOs to take up projects with a long-term repayment schedule. In other words, it separates execution of a project from the funding of the project. To this end, the EBRD has provided the initial funding of EUR 4 million in 2017 (EBRD, 2017). Initial equity was provided by F3 and additional equity is planned to be collected privately. The investments into LABEEF are used to purchase the receivables linked to the corresponding EPCs. LABEEF follows a previously approved set of investment guidelines to acquire projects for financing. The facility is thus a market-based instrument, which means that no public money needs to be spent to achieve the envisaged CO_2 reductions (Jörling & Schäfer, 2018). However, the facility can be supported through grants and subsidies for energy audits and to cover some of the investment costs of the renovation, which could allow for a faster project take up. Figure 10 illustrates the financial flows during construction and settlement period, i.e. before and after LABEEF purchased a project. During the construction phase, the ESCO either uses own equity or receives a loan from a commercial bank and performs the agreed renovations. After the construction phase, LABEEF buys the receivables, the ESCO repays the bank loan if it had taken one, and the settlement period begins. Residents, through collective payments by the housing association, pay their monthly EPC bill to their facility management company, which in turn transfers the EPC receivables to their bank or directly to LABEEF. LABEEF then uses the funds to provide the 20% share to the ESCO, pay off its financiers as well as to cover the costs of the facility itself.

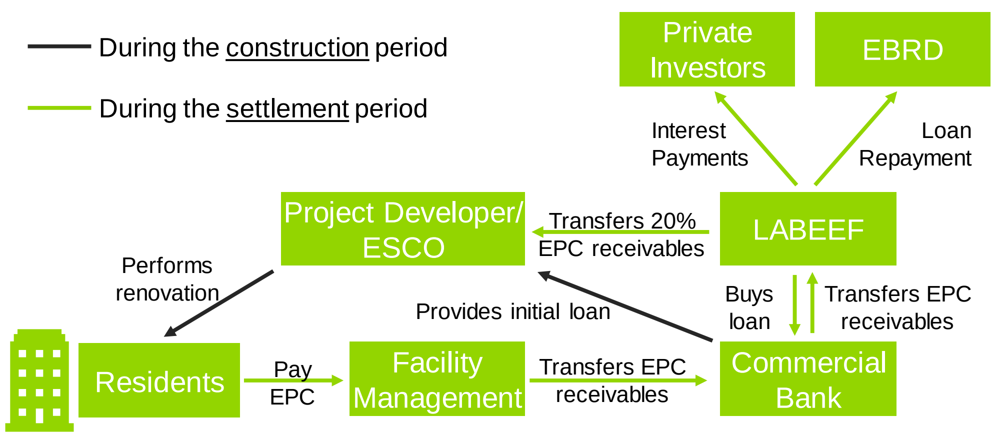


Figure 10: Financing flows during the construction and settlement period

ESCOs profit from LABEEF in the way that they have a professional funding structure with whom they do repeat business and that takes ownership of the necessary long-term receivables. ESCOs however remain responsible and liable for the maintenance of the buildings and maintain the technical risk of the project. LABEEF forfaiting the loan of the commercial bank reduces the debt burden on the balance sheet of the ESCO and makes it possible for ESCO take on another loan and renovate an additional building. ESCOs can agree to a working capital loan, which can revolve as projects are paid back and new ones developed. In that way LABEEF takes on some of the long-term credit risk of the project. During construction and implementation, the project risk is split between the ESCO and the lending commercial bank, until LABEEF forfeits the initial loan. After LABEEF acquires the remaining project receivables, it passes on at least 20% to the ESCO and uses the remainder to pay off investors. The project risk for LABEEF is further minimized through the construction audit, which is conducted following one heating season after the completion of the construction phase. This provides actual energy savings figures.

From resident's perspective the first and only action is required in the project development phase during the EPC negotiation: Residents need to collectively decide on the scope of the renovations to be performed, which will then influence the height of the monthly instalments. The EPC keeps the monthly payments constant throughout the year and thus removes usual fluctuations in payments.[2] This means that payments in winter might be lower than usual but are correspondingly higher in summer. The savings due to the lower energy demand are used to pay the renovation measures. This means that there are no additional or only very few costs for the residents occur. Additional costs are driven by residents wishes as to which other measures they would like to be implemented in the building. The annual EPC payments can be slightly higher than previous annual energy cost payments. However, the residents gain when the buildings have been deeply renovated as it not only increases their quality of life but also their property value (Stancioff, 2019). Gains through lower electricity costs only materialize after the end of the EPC.

4.3.3 Impact

Table 4 provides key performance indicators on the impact of LABEEF. Only a few indicators could be compiled, as the facility is still rather new and the number of already completed projects is still low.

Table 4: KPIs on the impact of LABEEF

Category	Indicator	Result
Economic	Total investments in energy efficiency (EUR)	EUR 1.6 million (Stancioff, Green Buildings - Scalable Financial Instrument - Delivering a European Building Energy Efficiency Facility, 2019)
	Additional investments realised	Currently each loan up to 55% financed by EBRD and the remainder is private funding
	Number of projects realised (#)	6 projects are currently being implemented with an additional 40 in the near-term pipeline.
	Return on investment	Estimated at ~10% for private investors

[2] Electricity and heating payments in Latvia vary from month to month based on actual consumption, leading to higher bills in winter than in summer.

Category	Indicator	Result
	Investment per m^2	EUR 200 – 300
Technical	Average savings in final energy consumption	57%

4.3.4 Co-benefits

The main co-benefits for inhabitants are threefold. First, they enjoy an increased property value through the renovation measures. This increase is typically around 15 – 25% of the property value (Stancioff, 2019). Second, the lifespan of the buildings is greatly increased through the renovation. Third, the quality of life is increased for the inhabitants through the newly renovated facilities and exterior, which in turn increases their desirability from a rental perspective. LABEEF's objective is to leverage private finance funding in order to achieve scale and support national governments in their building renovation plans, which are part of the long-term climate policies. Additional benefits are achieved in the removal of health hazards presented by poorly maintained buildings and in the newly created asset class for sustainable finance investors.

4.3.5 Success factors and barriers

Table 5: Success factors and barriers of LABEEF

Success factor	Barrier
• Residents do not have to take on a loan themselves and no additional costs occur for them. • Private sector funding makes the programme independent of official funds. • Separating the executing from the funding of a project, allowing ESCOs to take on additional projects. • Instalments in the EPC depend on actual savings and are relatively low due to the long contract duration (~20 years). • Representation through Ekoburojs, which advocates the interests of the residents and offers conflict mediation. • Verification of savings before LABEEF guarantees the financing holds the ESCO accountable.	• Ownership structure can make it difficult to get all residents in a project on board. • Local energy suppliers are not keen on the reduced energy demand and can lobby against changes. • The long EPC duration can make it more difficult to persuade owners to take part in the scheme. • Public sector finds it challenging to let private sector initiatives undertake projects at scale. • Limited understanding of the benefits of Energy Performance Contracting.

Source: Guidehouse based on (Stancioff, Director Funding for Future, 2020)

5. Case Study: Assessing the cost efficiency of energy-efficient retrofit measures in Jordan

This chapter analyses the implications of selected energy efficiency and renewable energy measures on an existing MFH in Jordan. The analysis focuses on energy savings and global cost savings. The MFH and its boundary conditions were researched within the development of the building typology in the framework of the BUILD_ME project, representing a typical MFH constructed between 1990 and 2010. The climate data took into account a location in Amman and the findings were calculated with the BUILD_ME Building Energy Performance (BEP) Tool.

5.1 Existing situation, non-renovated MFH

5.1.1 Boundary conditions of a representative existing multi-family house

In the following Table 6, some of the most relevant boundary conditions are shown, while a more detailed list can be found in the Annex.

Table 6: Boundary conditions of the analysed case study

General information		
Building type I	-	MFH (Multi-family house/Apartment block)
Country	-	Jordan
Age group	-	Existing building (1990 - 2010)
Reference city, representative climate	-	Amman
Geometry related parameters		
Building levels (floors)	-	4.00
Number of dwellings	-	8.00
Net floor height (Floor to ceiling)	m	3.40
Net floor area (i.e., living area)	m²	1,342.80
Roof area opaque	m²	373.00
Façade area opaque (excluding windows)	m²	1,220.72
Window area (Total = transparent + frame)	m²	165.88
Area floor slap (ground plate)	m²	373.00
Building configuration		
U-value (wall)	W/(m²K)	1.5
U-value (roof)	W/(m²K)	1.5
U-value (slab)	W/(m²K)	2.5
Window type	-	Single glass (U:5.7 | G: 0.85 | 4 mm)
G-value	-	0.85
U-value (window)	W/(m²K)	5.7
Shading variant	-	Manual Shading
Shading factor for movable sun protection elements	-	0.6
Free ventilation	1/h	0.6
Infiltration	1/h	0.15
Space heating system	-	Air conditioning system (reversible for heating; air-air heat pump)
Resulting efficiency	COP	3.8 - 3.2
Hot water generator	-	Dedicated electric heater (dedicated = only hot water generation)
Space cooling considered		Yes
System renovated?	-	Yes
Space cooling system	-	Mounted single-split | Usually, a visible smaller system mounted outside the wall or above the window just supplying one room.
Efficiency class primary AC system	-	(3) Minimum newbuild requirement
Resulting efficiency - EER	-	3.9 - 3.0

(at 35°C outside, 26°C inside)		

5.1.2 Results of an existing (non-renovated) multi-family house

The calculation of the existing MFH final energy consumption results in 111 kWh/m²a (see Figure 11 below). The biggest share is needed for space heating followed by household electricity (HH electricity) like TV, refrigerator and other appliances. Less relevant for the given boundary conditions (climate, building type and geometry) are space cooling, domestic hot water (DHW) and lighting.

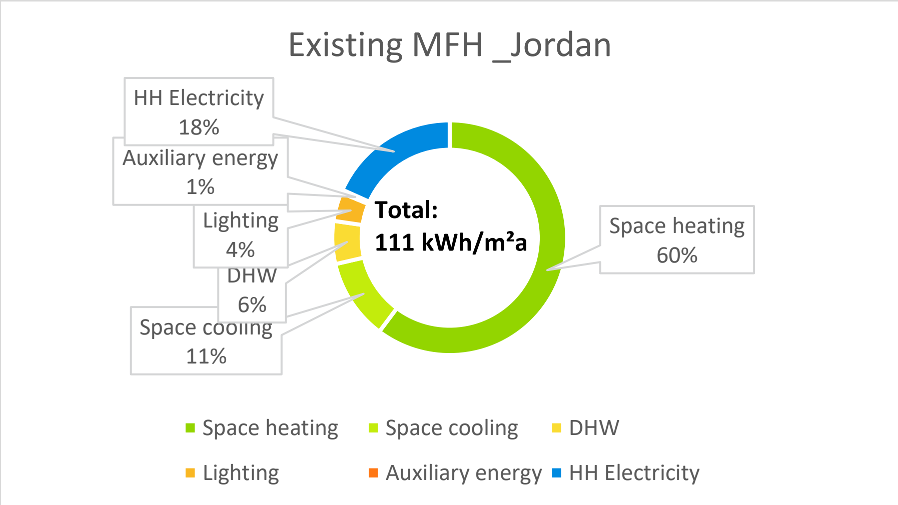


Figure 11: Final energy consumption of an existing Jordanian MFH

5.2 EE and RE measures in the case study

5.2.1 Description of measures

Technically, the best approach is to first reduce the energy demand. A general design strategy is the Trias Energetica. This Energy Triangle corresponds partly to ‘passive building’ strategies and describes a general three-step approach to sustainable energy projects, as shown in Table 7:

a. Proper design: Minimise the energy demand needed for comfortable living with insulation measures, shading, and reduction of ventilation losses.

b. RE utilisation: For the remaining energy demand, use sustainable energy sources like solar power and solar heat.

c. Efficient systems and equipment: Cover the remaining energy demand in an efficient way, for instance with efficient boilers instead of conventional ones.

Table 7: EE measures and RE measures

Measure	Description
Thermal insulation of external walls	Cavity (if available) and/or Internal thermal insulation
Thermal insulation of roof	External insulation on a flat roof
More efficient windows	Double glazing or double glazing with a Low E coating
Solar Shading	External shading elements (fixed, manual or automatic)
Efficient space heating	Condensing Boilers or highly reversible, efficient split units
Efficient air conditioning	highly efficient split units
Solar thermal systems for hot water	Solar collectors on the roof (thermo syphon)
Photovoltaics	Photovoltaic array on the roof – southwards orientated and optimally tilted

5.2.2 Analysis of EE/RE measures

We have calculated the energy and economic performance using the BUILD_ME Building Energy Performance (BEP) tool for each measure. The analysis illustrates the final energy consumption and the related global costs (for 20 years) of different efficiencies per measure. The simple pay back is also shown off as an additional economic parameter.

Envelope: Wall

The graphs in Figure 12: below express the energy demands, the different global costs and payback periods based on the variation of U-values for walls. The least energy saving is observed in variant 1 (energy demand: 77.97 kWh/(m^2a)) and the highest energy saving is observed in variant 5 (energy demand: 59.01 kWh/(m^2a)). The energy saving difference between both is considered 18.96 kWh/(m^2a). The optimum global cost is associated with variants 2 & 3 (199 Euros/m^2). There is a slight increase in global costs of variants 4 & 5. The best payback period is associated with variant 1 (1.4 years). The energy saving is increased by approximately 35% and the global costs decrease by approximately 24% between the highest and lowest cases.

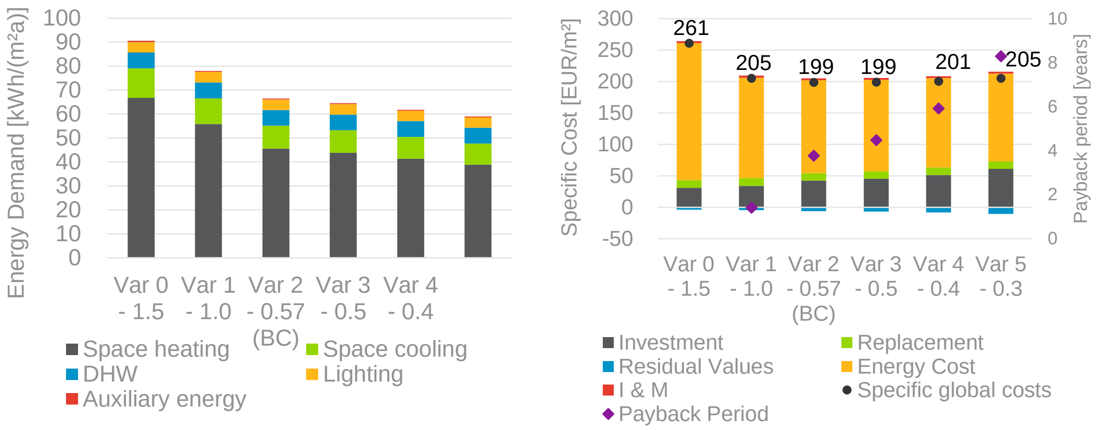


Figure 12: Wall insulation variants, energy demand, related global costs and payback periods

Envelope: Roof

Figure 13: shows the variation of energy demands, the different global costs and payback periods based on several variants of roof insulations. There is a slight gradual decrease in energy demand between variant 1 and variant 5. The highest energy saving is observed in variant 5 (energy demand: 80.86 kWh/(m^{2}a)) while the lowest energy saving is observed in variant 1 (energy demand: 86.48 kWh/(m^{2}a)). The energy saving difference between both cases is 5.62 kWh/(m^{2}a). The variation in energy saving is limited starting variant 2 till variant 5. The optimum global cost is associated with variants 2 & 3 (210 Euros/m^2). A slight increase is observed in variant 4 & 5. The best payback period is associated with variant 2 (1.5 years). The energy saving is increased by approximately 11% and the global costs decrease by approximately 20% between the highest and lowest cases.

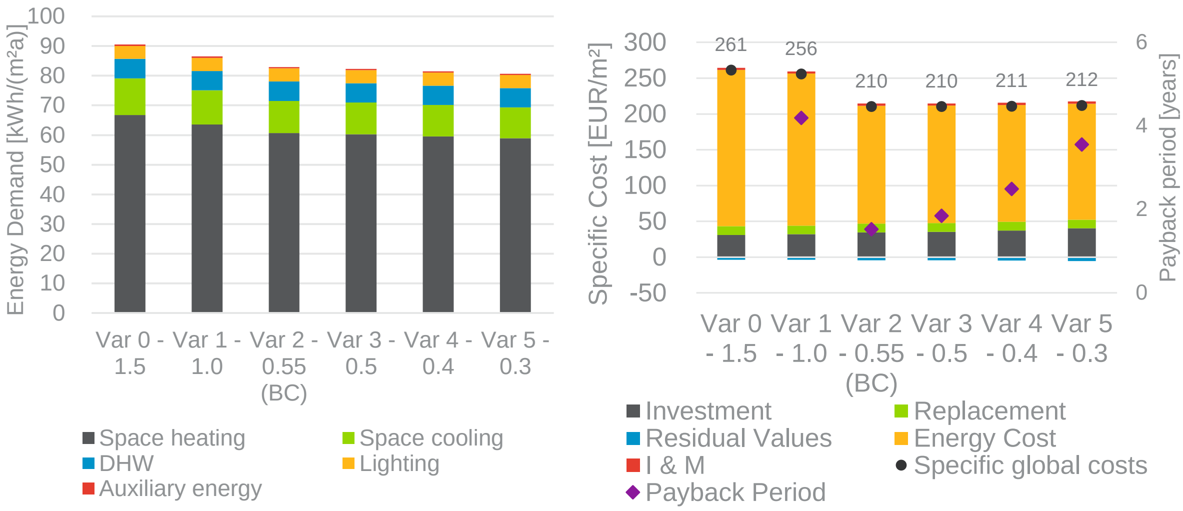


Figure 13: Roof insulation variants, energy demand, related global costs and payback periods

Envelope: Windows

Graphs within Figure 14:. convey energy demands, global costs and payback periods based on variation of window types. The highest difference in energy saving is between window (U-Value: 5.7) and window (U-Value: 1.3), while the cases of windows (U-Value: 3.0) & (U-Value: 2.4) are quite similar. The highest energy saving is observed with window (U-Value:

1.3) (energy demand: 96.9 kWh/(m²a)). The energy saving between highest and lowest cases is 13.92 kWh/(m²a). The optimum global cost is associated with window (U-Value: 1.3) (210 Euros/m²) as well as the best payback period (3.6 years). The energy saving is increased by approximately 13% and the global costs decrease by approximately 20% between the highest and lowest cases.

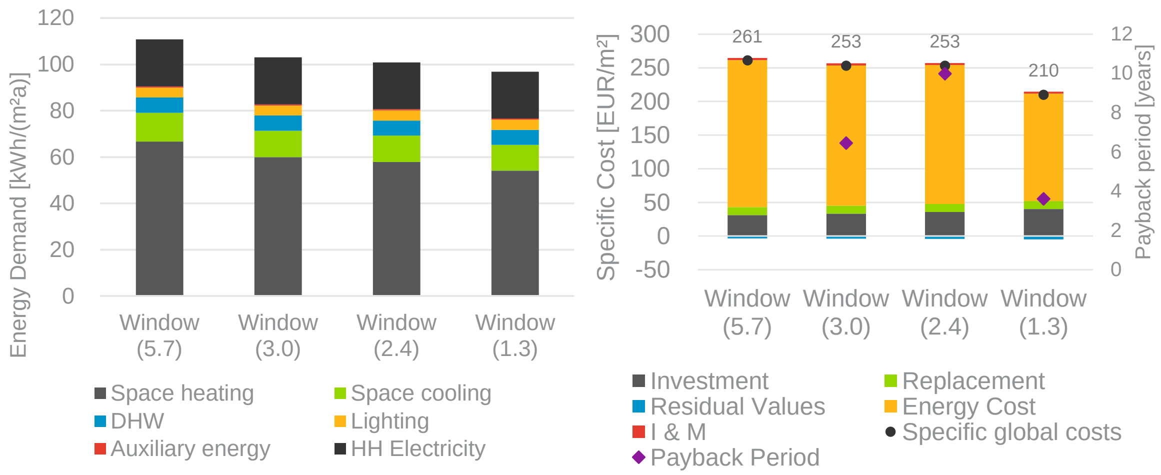


Figure 14: Windows types, energy demand, related global costs and payback periods

Shading

Graphs within Figure 15: describe energy demands, global costs and payback periods associated with different cases of shading. Manual and automatic shadings had a slight energy saving features than no or fixed shadings. The highest energy saving is associated with the case of automatic shading (energy demand: 109.41 kWh/(m²a)) while the least energy saving is associated with no shading (energy demand: 111.7 kWh/(m²a)). The energy saving difference between both is 2.29 kWh/(m²a). The optimum global cost is associated with the case of no shading (243 Euros/m²) while among the other three cases automatic shading has the best payback period (16.6 years). The energy saving is increased by approximately 2% and the global costs decrease by approximately 9% between the highest and lowest cases.

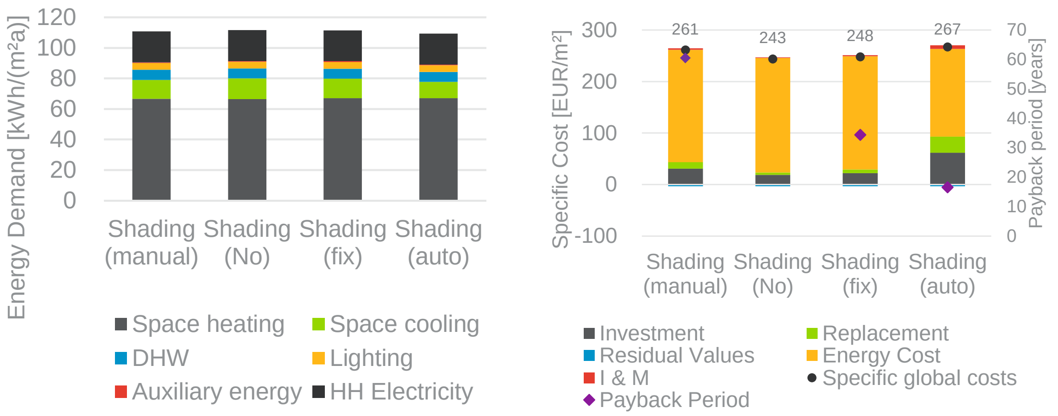


Figure 15: Shading cases, energy demand, related global costs and payback periods

Heating Ventilation Air Conditioning (HVAC): Cooling

Graphs within Figure 16: describes energy demands, global costs and payback periods associated with different cases of cooling supply. There is a slight gradual decrease in energy demand from case 3 till case 1. The highest energy saving is associated with case 1 (energy demand: 105.76 kWh/(m²a)) while the lowest with case 3 (energy demand: 110.82 kWh/(m²a)). The difference between the highest and the lowest energy saving cases is 5.06 kWh/(m²a). The optimum global cost is associated with the case 1 (206 Euros/m²) while among the other three cases, case 2 has the best payback period (0.2 years). The energy saving is increased by approximately 5% and the global costs decrease by approximately 21% between the highest and lowest cases. The variation of theoretical and real space cooling efficiencies according to different cases is shown in Table 8.

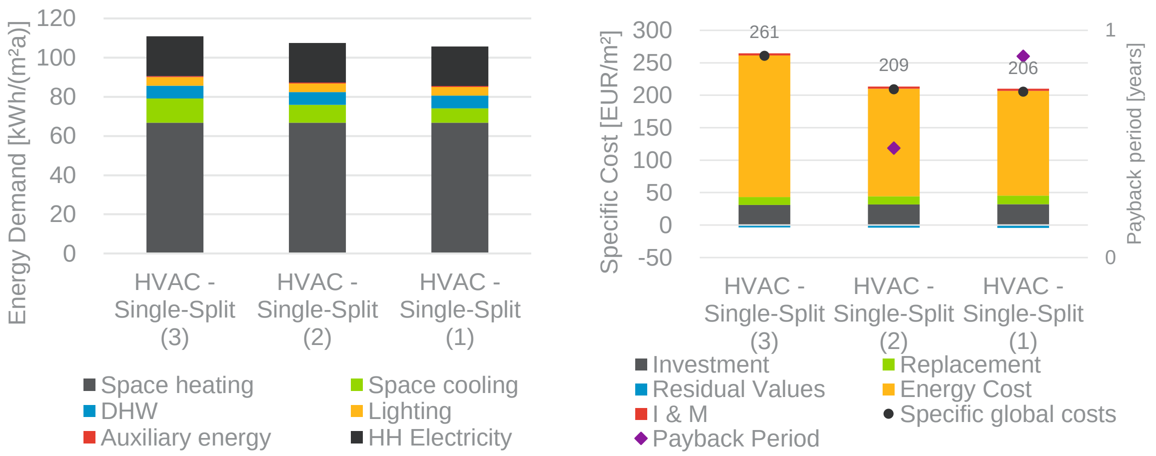


Figure 16: HVAC Cooling cases, energy demand, related global costs and payback periods

Table 8: The definition of the different cases

	HVAC - Single-Split (3)	HVAC - Single-Split (2)	HVAC - Single-Split (1)
Space cooling efficiency (ESEER)	3.9 - 3.0	4.9 - 4.0	> 5.0
Space cooling annual COP (real efficiency)	3.6	4.9	6.1

HVAC: Heating

Graphs within Figure 17: describes energy demands, global costs and payback periods associated with different cases of HVAC heating cases. There is a slight gradual decrease in energy demand from case 3 till case 1. The highest energy saving is associated with case 1 (energy demand: 107.91 kWh/(m²a)) while the lowest with case 3 (energy demand: 110.82 kWh/(m²a)). The difference between the highest and the lowest energy saving cases is 2.91 kWh/(m²a). The optimum global cost is associated with the case 1 (259 Euros/m²) while among the other three cases, case 2 has the best payback period (-3.8 years). The energy saving is increased by approximately 2.6% and the global costs decrease by approximately 1% between the highest and lowest cases. The variation of theoretical and real space heating efficiencies according to different cases is shown in Table 9.

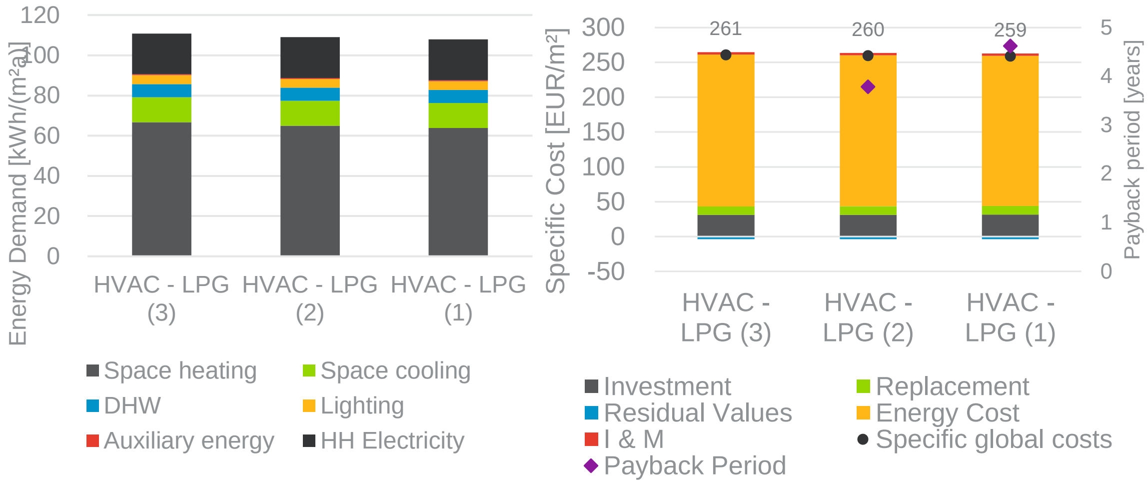


Figure 17: HVAC Heating cases, energy demand, related global costs and payback periods

Table 9: The definition of the different cases

	HVAC - LPG (3)	HVAC - LPG (2)	HVAC - LPG (1)
Space heating theoretical efficiency	76% - 74%	79% - 77%	> 80%
Space heating annual COP, real efficiency	0.78	0.81	0.83

Renewable Energies: Solar for hot water

Graphs within Figure 18: describe energy demands, global costs and payback periods associated with different cases of solar systems for hot water. The highest energy saving is associated with the case (10 m^2) (energy demand: 105.41 kWh/(m^2a)) while the lowest is with case of no solar system (energy demand: 110.82 kWh/(m^2a)). The difference between the highest and the lowest energy saving cases is 5.41 kWh/(m^2a). There is a big difference in global cost between the case of no solar system and the other two cases. The optimum global cost is associated with the case (10 m^2) (205 Euros/m^2) as well as the best payback period (0.5 years). The energy saving is increased by approximately 5% and the global costs decrease by approximately 21% between the highest and lowest cases.

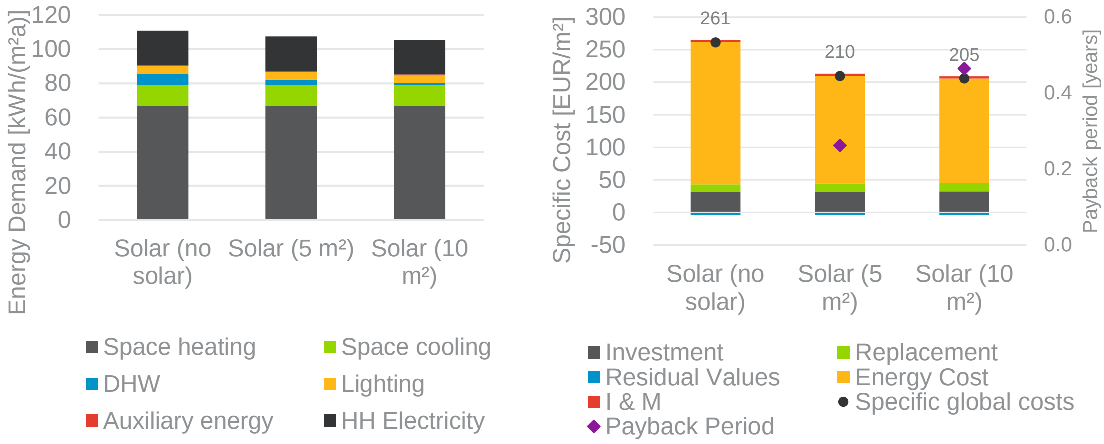


Figure 18: Solar systems for hot water, energy demand, related global costs and payback periods

Renewable energies: Photovoltaic (PV)

Graphs within Figure 19: describes energy demands, global costs and payback periods associated with different cases of photovoltaic systems. The highest energy saving is associated with the case of photovoltaic (25kWp-100% roof) (energy demand: 77.7 kWh/(m^{2}a)) while the lowest is with case of no photovoltaic system (energy demand: 110.82 kWh/(m^{2}a)). The difference between the highest and the lowest energy saving cases is 33.12 kWh/(m^{2}a). High gradual decrease in global cost is observed from the absence of PV system till the 100% roof coverage. The optimum global cost is associated with the case of PV (25kWp-100% roof) (181 Euros/m^2). The payback period is consistent for the two cases of PV systems (-3.2 years). The energy saving is increased by approximately 30% and the global costs decrease by approximately 31% between the highest and lowest cases.

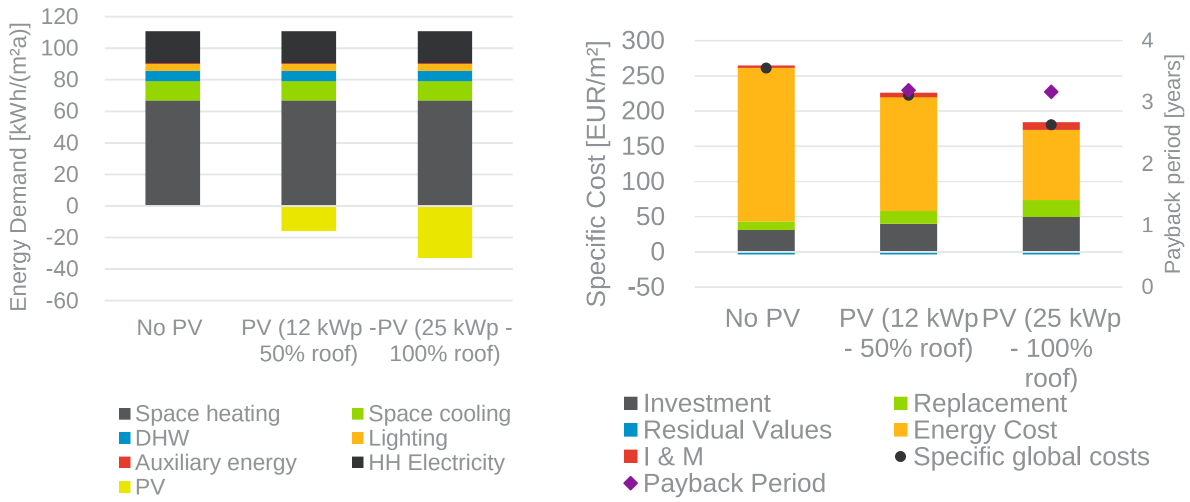


Figure 19: Photovoltaic systems, energy demand, related global costs, and payback periods

5.2.3 Results of the analysed measures

Table 10 presents the overview of the results derived from the analysis. The top 3 measures are (sorted by highest energy savings):

1- Photovoltaics

2- External wall insulation

3- Low E Window

These measures also have attractive economic savings and could significantly reduce the overall consumption. The remaining measures are as well to be considered as they have also low payback periods. Overall, the payback periods are rather low, due to the high energy prices which have been assumed for the upcoming 20 years with a yearly price increase of 3 %/year.

Table 10: Overview of energy and economic savings

Measure	Energy Savings in kWh/m²	Global cost savings in €/m²	Payback period
Thermal insulation of external walls	24	62	4
Thermal insulation of roof	7	51	2
More efficient windows	14	51	4
Solar shading	-	-	-
Efficient AC	5	55	1
Efficient space heating	4	2	4
Solar thermal systems for hot water	5	55	1
Photovoltaics	43	80	4

5.3 Overall Results: Existing building vs. Low cost vs. Optimized

Based on the previous cases and variants, the cases are categorized as three cases that vary according to costs and the application of energy saving measures:

- Baseline: Describing the status quo – not retrofitted building.
- Variant of low cost: The building including energy saving measures with a payback period lower than two years.
- Optimized variant: The building including all cost-optimal energy saving measures.

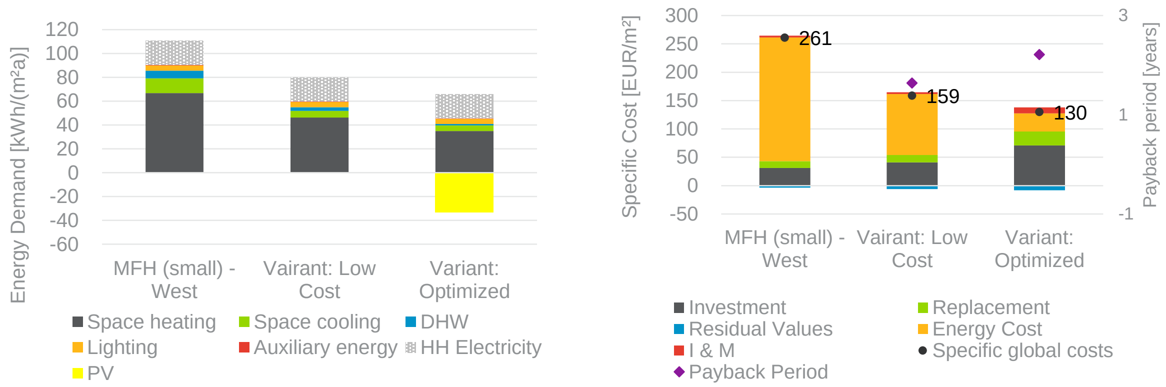


Figure 20: Energy demands, global costs and payback periods for three variants varying from baseline to optimized

Graphs above within Figure 20: describe the energy demands, global costs and the payback periods for different cases of optimization. The highest energy saving variant is observed in the optimized variant (energy demand: 34.99 kWh/(m^{2}a)) while the least energy saving is the baseline case (energy demand: 110.82 kWh/(m^{2}a)). The energy saved between the optimized case and the baseline is 75.83 kWh/(m^{2}a). The optimum global cost is for the optimized case and is valued 130 Euros/m^2. The difference in global cost between the optimized variant and the baseline is 131 Euros/m^2. The energy saving is increased by approximately 68% and the global cost is decreased by 50% between the highest and the lowest variants.

5.4 Technical Recommendations based on the case study

As seen overall, all analysed measures are cost-beneficial and could lead to energy savings. It is crucial to guide the homeowner towards package solutions to benefit from synergies, like if you consider installing photovoltaics on the roof, it would be good to take into account first the implementation of thermal insulation on the roof. Another example would be the connection of external wall insulation and the replacement of windows, this would ensure a proper minimization of leakages and a homogenous transmission flow (e.g., heat), while doing so – a ventilation concept needs to be considered as well, to avoid any possible mould development.

In any case, first reduce the energy demand using thermal insulation and then tackle renewables and highly efficient HVAC appliances as in the Trias Energitica concept.

Finally avoid any shallow retrofitting, which might be cost-beneficial in the short run but could create possible lock-in effects in the long-term. It´s recommended to follow cost-optimal thresholds, which consider the life cycle of the product and will produce higher savings in the long-term.

6. Recommendations

The following chapter identifies practical recommendations relevant to the savings achieved from different EE measures as analysed in the case study. This chapter also shows the phases which the design of a new finance product for EE measures should consider based on the success factors shown and explained in the best practice chapter.

6.1 Recommendations on the process

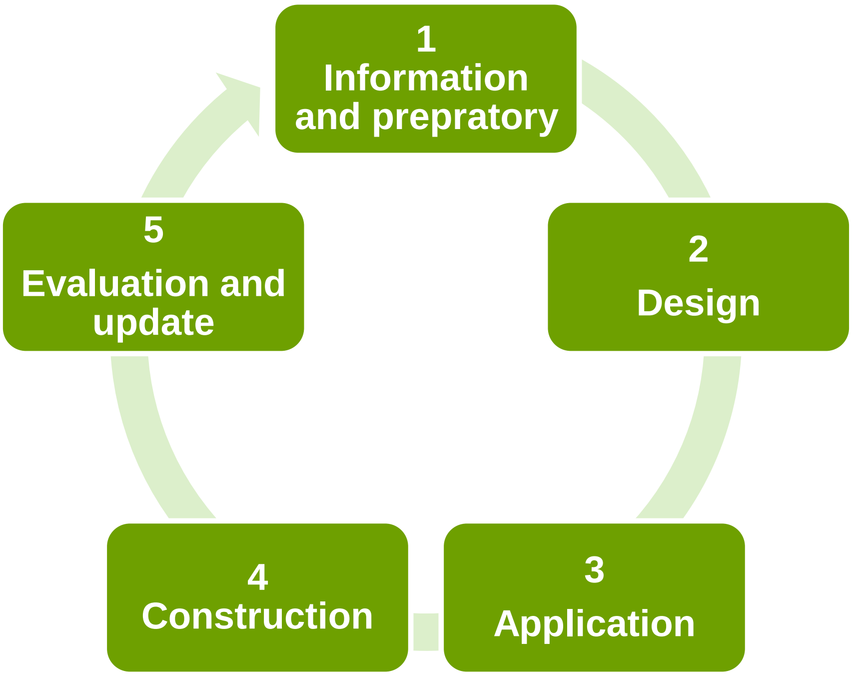


Figure 21: Different phases of financial instruments

6.1.1 Information and preparatory phase:

First comes the information or marketing phase, in which potential applicants look for information about an energy efficiency programme, or if looked at from the implementing agency's perspective, the programme is being advertised to potential customers. For example, if an applicant would like to renovate a building project or build a new building and is looking for finance for the costs of thermal insulation. It would be ideal to provide the applicant (project developer e.g., a company, architect, household) with the following set of information and support:

- Create a one-stop-shop for energy efficiency support. The one-stop-shop should include a clear procedure including templates of reporting, clear criteria of verification, clear timeline of the application etc.
- Ensure compatibility with other programmes to increase impact. For example, the consideration of a complete package of EE buildings including thermal insulation as an integral part of EE construction with RE, efficient windows and well insulated building envelope.
- A clear communication of costs and benefits – including non-energy benefits - for participation is needed, ideally supported through an external evaluation / study. The clear outcomes of the EE measures such as energy savings, return on investments, global costs must be well presented and verified.

- Self-qualification for a scheme can help to target a specific group and simplify application procedures. This can be achieved (for example) by providing a clear tool of calculation the savings achieved from using thermal insulation. This should also include the available materials and technologies available in the market.

- Publicise the programme information and the benefits both to households and construction companies, installers, architects and ESCOs through multiple channels (on the ground, local agencies).

6.1.2 Design phase

Next is the financial product design phase, advising the potential applicant in terms of benefits of the renovation, financial and technical options as well as technical assistance provided.

- Define the form of provided financial incentives. Please check the second chapter of this report. The financial incentives may include but not limited to: Grants and subsidies, loans, tax / VAT incentives and Energy Performance Contracting. A mix of different forms of incentives might be of a great interest for several applicants.

- Define the technical thresholds which is to be achieved in order to receive the financial incentives. As a starting point for that, please check the second part of this chapter 6.2 Technical Recommendations.
- Provide some form of technical assistance which can also support applicant, e.g., through a network of licenced experts and/or auditors.

- Develop a template for the building renovation passport for each homeowner. This should include all implemented EE measures such as the building envelope, windows, thermal insulation and their potential savings.

- Request mandatory energy audits / technical assistance before the definition of measures that will be put into the project design.

- Focus on multiple benefits from renovation (health, safety, energy efficiency) and other possible co-benefits.

6.1.3 Application phase

The application phase is, where the applicant is in contact with the implementing agency to properly prepare and submit the application.

- Easy and straightforward online application procedure, e.g., through existing channels such as house banks, energy providers or one-stop-shop.

- Link the level of support to achieved savings to incentivise deeper renovation measures.

- Provide special support for tenant management in multi-apartment projects with fragmented ownership structure (applicable only to MFH schemes).

6.1.4 Construction phase:

Fourth is the construction phase in which the energy efficiency renovations and new buildings take place.

- Pre-financing schemes are difficult for lower incomes to participate in. Provide special options for low-income households if general scheme set-up is prohibitive for lower incomes. Different incentives depending on the targeted groups of the incentive.

- High quality technical assistance of the construction works through network of licensed actors. This may include field visits and on-site verifications.

- Reimburse the cost of assistance might be considered as well.

- To define the auditing entities that will execute the site inspection before, during and after construction of the building.

6.1.5 Evaluation / Re-Design phase:

Last is the evaluation and re-design phase, which should expose potential free-riding and misuse of programme funds and provide recommendations for the improvement of the programme. These recommendations ought to be based on key performance indicators (KPIs) such as energy savings achieved, number of applicants reached and cost efficiency of the programme, etc. and be done periodically.

- Require an ex-post evaluation through technical assistance network if technical assistance was not already provided throughout the scheme.

- Evaluate entire scheme to identify possible improvements, incl. customer journey and feedback.

- Ensure that support for low-income households does not reduce general of welfare payments.

- Enable legal framework for EPC, based on private sector initiatives or other innovative solutions, such as on-bill financing or energy efficiency mortgages.

6.2 Technical recommendations (designing the programme)

The following subchapter builds on the previously presented design phase for the financial instrument. For this purpose, we recommend answering some of the following guiding questions below:

1. Where does the highest saving potential lie in?
2. What is the impact of ownership structures on the decision-making process?
3. Which financial support product fits to whom?

6.2.1 Allocate highest saving potential for thermal insulation

This subchapter focuses on the utilisation of thermal insulation in the building envelope and illustrates the relation between building component and building type leading to the highest saving potential.

Roof insulation

Due to the geometry of single-family houses (SFH) (ratio of roof surface and external walls), the saving potentials is compared to MFHs is within SFH higher (see case study calculation in table in below) indicating savings derived by roof insulation of 23% for SFH while a MFH is only saving 11%.

Table 11: Case Studies savings generated using thermal insulation in SFH and MFH

Amman-West (before 1990)		
	SFH	MFH large
Net floor	342	1908
Number of stories	1	4
Roof surface	380	530
Wall Surface (incl. Window surface)	335.5	1356
Ratio roof/external wall	113%	39%
U-value roof – existing	1.5	2
U-value wall – existing	1.8	3
U-value floor – existing	2.5	4
existing energy consumption	254.44	302.2
after roof insulation	195.57	269.61
after wall insulation	208.27	195.42
after floor insulation	255.2	302.24
after wall+ roof ins	153.94	160.9
Savings roof to 0.55 (EEBC)	23%	11%
Savings wall to 0.57 (EEBC)	18%	35%
Savings to floor 1.2 (EEBC)	0%	0%
Savings after wall+ roof ins	39%	47%

External wall insulation

Contradictory to the roof insulation is the wall insulation, as shown in the case study calculation in Table 11. Here the higher savings are generated in MFHs, mainly because of the higher external wall surface area. The case study depicts savings of 35% in MFH vs. 18% in SFH.

Floor insulation

The calculations have shown that the floor insulation is not a cost-benefit measure as it is leading hardly to no energy savings. Anyhow it is a difficult measure to be realized as a retrofit measure.

6.2.2 The influence of the ownership structure on the decision-making process

Based on the BUILD_ME country factsheets, 35% of the household units are rented, while 62% units are owned. Furthermore approx. 500,000 units are allocated in single-family house while approx. 300,000 units are to be found in MFHs. The two cases: single-family house and MFH have an influence on the how and what decisions are drawn, when considering energy retrofits.

6.2.2.1 The case of a single-family house

The probability that the SFHs is used by one owner of the house is higher compared to MFHs, where a higher share of tenants or several owners can be found. This will simplify the decision processes as the owner is directly benefiting from the achieved savings and will not experience a possible landlord tenant dilemma. Therefore, it can be assumed that the uptake of financial subsidies is faster in the segment of SFHs.

6.2.2.2 The case of a multi-family house

The ownership structure could be more diverse in the case of MFHs:

a) Fully rented / one owner.

b) Mixture of rented and/ or owned apartments.

These two different scenarios are illustrated in the following:

a) Fully rented and one owner.

If the MFH is completely rented, then only one landlord needs to be convinced, this would lead to a rather simple decision process. The financial stimulus needs to be attractive to persuade the landlord as he is not benefiting from the savings. This could be offered with grants or concessional loans, the later would be only become attractive, if the owner is planning to retrofit the façade anyhow and the energetic aspects can be added. Additionally, the landlord needs to be enabled to increase the (net) rents due to his additional financial burden. So, he could partially cross-finance the additional investments by the tenants rent. As the tenants are directly benefiting from the savings, ideally they would not experience a huge difference in their gross rent, because of the gained savings in their energy bill.

b) Mixture of rented and owned apartments.

This set-up of several owners owning one MFH could be difficult for the uptake of retrofit measures, questions like the following may arise:

a. Who owns the roof? This is relevant if measures like thermal insulation or solar on the roof is applied.

   i. Who benefits from the roof insulation? -> only the appt. below the roof. -> should they be the only one that should finance the measure.

   ii. Is not the complete MFH benefiting from the measure? -> as it will increase the asset value.

b. Or other central solutions like installing a central condensing boiler, how to convince apartment owners that don´t consume much space heating.

Or replacement of windows – vs one homogenous façade.

c. While other decentral solutions might be easier like,

   i. Thermal insulation of external wall – if it is installed as internal solution.

   ii. Or decentral Split Units with higher efficiency.

There are different solutions to overcome central decisions in a multi-owned family house, like strict regulations that oblige the roof insulation and the burden is put on all owners (e.g., Germany Energy Conservation Ordinance) or the possibility to rent the roof for the utilisation of photovoltaics.

But overall, the highest chances lie in building types where the decision are rather simple and do not need many stakeholders for one agreement (the case of SFH or one owner of a MFH).

6.2.3 Targeted financial offerings

It is recommended to design targeted programs depending on the wealth of the applicant, to avoid any oversupply for people who just need minor support to retrofit their house. A possibility to offer grants rather to low and middle income, while to concessional loans could be still perceived attractive to higher income applicants.

6.2.4 Current EEBC meets cost optimality

An interesting outcome of the presented case study calculation in chapter 5 is, that the EEBC thresholds (U-Value of roof and external wall) are in line with the cost optimality range. Besides the U-value for the floor – here insulation seems not to be appropriate as it is not a cost-benefit measure (could be even causing min higher energy consumption). The cost optimality is one of the core ideas of the European legislation, considering the life cycle cost of the specific measure.

6.3 Learnings of the best practices

In the following, some of the relevant success factors stated in Chapter 4 (Relevant best practices to finance EE retrofits) are recapitulated:

- A proper legal framework, thanks to an incentive-based regulation under the law on energy management.
- Direct and simplified access to bank financing for the end-user with recovery over five years via easy payments on the electricity bill.
- The involvement of the State utility as guarantor and debt enforcer, which improved domestic financial institutions trust and resulted in lowered financing costs for residential end-users.
- Continuous awareness about the economic benefits of the funded measure through targeted campaigns. Parallel to that, building confidence in the technology through quality and certification measures.
- A top-down and bottom-up quality assurance system for suppliers and products.
- Applicants can apply by themselves at no additional costs for them.
- Loans are available and provided by most of the commercial banks. The loans are as well subsidised and competitive in comparison with the normal commercial loans.
- Easy process with clear procedures. Reports and requirements have been standardized using clear templates.

It needs a tailored approach for the specific needs in Jordan, respecting the relevant boundary conditions like climate, building type, ownership structure, specific technical measure and available budget to formulate a successful financial stream. The above listed recommendations can be helpful ingredients to meet the envisaged objectives.

Annex

A.1 Boundary conditions of case study – existing multi-family house in Jordan

General information		
Remarks	-	MFH (small) - West
Building type I	-	MFH (Multi-family house/Apartment block)
Country	-	Jordan
Age group	-	Existing building (1990 - 2010)
Reference city (representative climate for the selected climate region)	-	Amman
Specify region (e.g., urban)	-	Amman-West
Geometry related parameters		
Building levels (floors)	-	4.00
Number of dwellings	-	8.00
Net floor height (Floor to ceiling)	m	3.40
Net floor area (i.e., living area)	m²	1,342.80
Roof area opaque	m²	373.00
Façade area opaque (excluding windows)	m²	1,220.72
Share of façade-oriented North	m²	353.06
Share of façade-oriented East	m²	238.70
Share of façade-oriented South	m²	355.66
Share of façade-oriented West	m²	273.30
Window area (Total = transparent + frame)	m²	165.88
Share of windows-oriented North	m²	63.44
Share of windows-oriented East	m²	20.80
Share of windows-oriented South	m²	60.84
Share of windows-oriented West	m²	20.80
Share of windows-oriented horizontal	m²	0.00
Area floor slap (ground plate)	m²	373.00

Building configuration		
Wall		
Wall renovation	-	Yes
Type (material)	-	Single Wall
Absorption (wall)	-	Intermediate colour (default) (0.6)
Specific heat capacity	J/(m²*K)	Medium (110,000)
Mass distribution (standard: M)	-	Class M (mass concentrated inside)
U-value (wall)	W/(m²K)	1.5
Thermal heat bridge (wall)	-	(4) Country average existing building
Thermal heat bridge (wall)	W/K	0.16
Roof		
Roof renovation	-	Yes
Type (material)	-	Flat Roof
Absorption (roof)	-	Intermediate colour (default) (0.6)
Specific heat capacity	J/(m²*K)	Medium (110,000)
Mass distribution (standard: M)	-	Class M (mass concentrated inside)
U-value (roof)	W/(m²K)	1.5
Thermal heat bridge (roof)	-	(4) Country average existing building
Thermal heat bridge (roof)	W/K	0.16
Slab (ground plate)		
Slab renovation	-	Yes
Type (material)	-	
Specific heat capacity	J/(m²*K)	Medium (110,000)
U-value (slab)	W/(m²K)	2.5
Thermal heat bridge (ground plate)	-	(4) Country average existing building
Thermal heat bridge (ground plate)	W/K	0.16
Window		
Window renovation	-	Yes
Window type	-	Single glass (U:5.7 | G: 0.85 | 4 mm)
G-value	-	0.85
U-value (window)	W/(m²K)	5.7
Thermal heat bridge (window)	-	(4) Country average existing building
Thermal heat bridge (window)	W/K	0.16
Shading system renovated?	-	Yes
Shading variant	-	Manual Shading
Shading factor for movable sun protection elements	-	0.6
Air change rate		
Free ventilation	-	(2) Normal window ventilation
Free ventilation	1/h	0.6
Infiltration	-	(3) Improved existing building standard
Infiltration	1/h	0.15
Space heating		
Space heating considered	-	Yes
System renovated?	-	Yes

Space heating system	-	Air conditioning system (reversible for heating; air-air heat pump)
Efficiency class primary heating system	-	(3) Minimum newbuild requirement
Energy carrier	-	Electricity
Resulting efficiency	%	3.8 - 3.2
Hot water generator	-	
Hot water considered		Yes
System renovated?	-	Yes
System technology	-	Dedicated electric heater (dedicated = only hot water generation)
Efficiency class primary DHW system	-	(2) Good newbuild standard
Energy carrier	-	Electricity
Resulting efficiency	%	100%
Specific hot water demand (leave blank if tool should detmine it)	kWh/m²	
Solar system for DHW	-	No
Type of solar system	-	Tube collector (thermo syphon with tank on top of panel)
Installed area of solar collector	m²	0
Space cooling system	-	
Space cooling considered		Yes
System renovated?	-	Yes
Space cooling system	-	Mounted single-split or window air conditioner│Usually a visible smaller system mounted outside the wall or above the window just supplying one room
Efficiency class primary AC system	-	(3) Minimum newbuild requirement
Resulting efficiency - EER (at 35°C outside, 26°C inside)	-	3.9 - 3.0
Ventilation	-	
Mechanical ventilation system		No
System renovated?	-	
Type of ventilation (system)	-	Mechanical ventilation system without heat recovery
Air change rate: ventilation system	-	(2) Standard ventilation
Air change rate: ventilation system	1/h	0.0
Heat recovery rate	%	0%
Photovoltaics	-	
Installed	-	No
System renovated?	-	
Capacity	kWp	0
Total module area	m²	0
Lighting system	-	
Lighting		Yes
System renovated?	-	Yes
Type of lighting technology	-	LED (Light emitting diode lamps)
Lighting sensors	-	(0) No sensors
Other operating parameters	-	
Internal heat gains (people, appliances)	W/m²	3.50
Additional electricity consumption (without light, HVAC)	-	(2) Average electricity consumption
Additional electricity consumption (without light, HVAC)	kWh/a	26,856

Conditioned area (heating)	%	100%
Conditioned area (cooling)	%	100%
Set point temperature - heating	°C	21
Set point temperature - cooling	°C	24

Energy prices

Energy prices and CO_2 emissions			
Parameter	Unit	Electricity	LPG
Energy price	JOD/kWh	*Depending on tariff class – see table in below*	0.048
Energy price	EUR/kWh		0.06
Price development	%/year	3	6
CO_2 emission factor	gCO2/kWh	635	300
Economic parameters			
Interest rate (real)	%/year	5	
Calculation period	years	20	
Exchange rate: 1 EUR = 1.3 JOD			

Electricity tariff classes	€/kWh
0.00	0.041
161.00	0.090
301.00	0.107
501.00	0.142
601.00	0.197
751.00	0.235
1001.00	0.331

CAPEX of RE/EE measures

Envelope				
		Wall	Roof	Floor
		EUR / m²	EUR / m²	EUR / m²
Cost per cm insulation		3.75		

Windows		
U-Value		€ / m²
	5.7	64
	2.9	89.6
	2.0	128
	1.1	153
	0.9	200

Heating	
	MFH (small)
Power heating system (in kW)	108.9
Efficiency Class	1
Gas non-condensing	21,477 €
Gas condensing	27,920 €
Oil non-condensing	17,416 €
Oil condensing	22,641 €
Portable LPG (gas) heater	17,416 €
Portable kerosene heater	15,674 €
Reversible Split Unit	31,521 €

Cooling	
	MFH (small)
Power heating system (in kW)	104.2
Efficiency Class	3
Only Central system: Distribution type	Air vent distribution
Mounted single-split or window air conditioner	11,156 €
Movable system	6,694 €
Centralised multi-split system	28,655 €
VRF	37,251 €
Central system	56,348 €

DHW	
	MFH (small)
Power DHW system (in kW)	10.6
Efficiency Class	3
Number of apartments	10
Dedicated gas heater	5,661 €
Dedicated electric heater	4,518 €
Combi system	5,603 €

Renewable Energies		
PV	950	€/kWp
Solar thermal		
Tube collector (thermo syphon)	225	€/m² collector surface
Flat collector (thermo syphon)	182.5	€/m² collector surface
Tube collector	255	€/m² collector surface
Flat collector	212.5	€/m² collector surface

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