UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE
Joint Task Force on Energy Efficiency Standards in Buildings

Compendium of best practices on standards and technologies for energy efficiency in buildings in the UNECE region

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- The Bureau of the Committee on Housing and Land Management and its Real Estate Markets Advisory Group (REM);
- The UNECE Group of Experts on Energy Efficiency;
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[1] Relevant information on the project are available at http://www.unece.org/housing/eestandardsinbuildings.html

CONTENTS

ACRONYMS AND ABBREVIATIONS

EBRD	European Bank for Reconstruction and Development
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Certificates
ESCO	Energy Service Company
EU	European Union
GEF	Global Environment Facility
GHG	Greenhouse gas
HVAC	Heating, ventilation and air conditioning
IEA	International Energy Agency
IFC	International Finance Corporation
ISO	International Organization for Standardization
KfW	German national development bank
LED	Light-emitting diode
LEED	Leadership in Energy and Environment Design
MAB	multi-apartment building
MFH	multi-family housing
REA	Russian Energy Agency
REE	Residential Energy Efficiency
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UN-Habitat	United Nations Human Settlements Programme
USAID	United States Agency for International Development

MEASURES ABBREVIATIONS

GWh	Gigawatt-hours
KWh/m^2	Kilowatt-hours per square meter
KWh/m^2 year	Kilowatt-hours per square meter per year
MWh	Megawatt-hours
toe	tonnes of oil equivalent

SUBREGIONS DEFINITION

Subregion A - Andorra, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Liechtenstein, Luxembourg, Monaco, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

Subregion B - Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia.

Subregion C - Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Republic of Moldova, Russian Federation, Tajikistan, , Turkmenistan, Ukraine, Uzbekistan.

Subregion D - Canada, United States of America.

Subregion E – Albania, Bosnia and Herzegovina, Republic of North Macedonia, Montenegro, Serbia

Subregion F - Turkey.

EXECUTIVE SUMMARY

This report has been prepared in the framework of the UNECE projects "Energy Efficiency Standards in Buildings in the UNECE region"[2] under the Forests, Land and Housing Division and "Enhancing national capacities for development and implementation of the energy efficiency standards in buildings in the UNECE region" under the Sustainable Energy Division and the activities of the UNECE Joint Task Force on Energy Efficiency Standards in Buildings.

The research presented in this study is aimed to identify best practices on adopting, implementing and enforcing energy efficiency standards and energy efficiency technologies for the building sector in the UNECE region and prepare a compendium of best practices. The compendium will serve as a basis to improve the knowledge of UNECE member States concerning energy efficiency best practices related to existing standards and technologies, so that they will be able to develop and implement more effective energy efficiency policies in buildings.

Due to the existing old building stock in the UNECE region and the need for retrofitting it, this report is more focused on the retrofit of the existing building stock compared to the new constructions and include more case studies related to the residential sector. The selected best practices have been organized in different sections: legislative and regulatory framework; management of multi-family housing stock; awareness raising and behavior change; technical measures; and financial mechanisms. These sections correspond to the topics of the case studies.

Information on the best case studies was gathered via desktop research and stakeholder outreach, in order to identify relevant best practices on energy efficiency standards and technologies across the UNECE region. Several stakeholders have been approached for collecting the case studies through a call for cases. Once the topics for the case studies have been selected by the UNECE secretariat, five case-studies templates have been prepared, one per each category of the research, which were distributed among the UNECE Joint Task Force on Energy Efficiency Standards in Buildings members and other energy experts from the UNECE region.

Collected best practices include, but are not limited to, thermal performance of buildings and their components; construction materials; and heating, ventilation and air conditioning (HVAC) systems; with examples on standards and technologies for energy efficiency in buildings.

52 case studies from 22 countries have been received for initial review. All of them were verified and evaluated according to the above-mentioned criteria and 38 have been selected to be included in this report.

The analysis of the collected case studies shows overall positive trends in energy efficiency in the building sector in all the identified subregions. Even countries of the subregions C, E, and F, which traditionally have low internal energy prices, have significantly increased mandatory energy efficiency requirements, especially for the newly constructed buildings.

Active work is conducted by Ministries, regional and municipal level authorities, local and international financial institutions, international organizations and other interested counterparts, resulting in various achievements towards energy consumption and CO_2 emission level reduction, as well as to support the availability of financial resources and the generation of the relevant local capacity.

The main findings identified in the report chapters, are presented below.

Six case studies from six countries have been selected for the **Legislative and regulatory framework** chapter. Their main focus was on the update of energy efficiency oriented legislation and design standards, in terms of harmonization with international (or EU) practice, in order to increase current specific energy efficiency parameters in buildings. Additional attention was paid to good practices in

[2] Relevant information on the project available at http://www.unece.org/housing/eestandardsinbuildings.html

the administrative enforcement of municipal energy management applications. Nevertheless, based on the comments given by the UNECE Joint Task Force members, additional work should be done regarding energy efficiency at municipal and district levels. Specific laws, regulations and standards are required to be adjusted to the local climatic conditions, primary energy source, overall development level and other parameters.

For the case studies on the **Management of multi-family housing (MFH) stock and public buildings** chapter, seven cases have been selected from six countries. Advanced renovation and objects management practices were demonstrated, as well as the significant role of smart energy data collection and auditing analysis for proper building maintenance and operation. As a result of such type of projects, homeowners can benefit from improved and more health-friendly buildings . The continuation of such a work with the introduction of Building Management Systems, including an administrative and technical component, will give more sustainable result in terms of the whole life-cycle of the building operation.

A big role in the dissemination of best energy efficiency practices in buildings was played by the seven cases from five countries presented in the chapter **Awareness raising, capacity building and behavior change**. The primary aim of such informational and training projects is to involve as much as possible representatives of the target audience, such as the homeowners, civil society etc., into the knowledge sharing and best practices dissemination process. Various examples of informational products and educational formats were presented for energy and engineering professionals, homeowners and youth (schools and universities). Online education is a step forward in the energy efficiency knowledge exchange that will allow to enhance international cooperation among the countries of the UNECE region. The successful results in all the presented cases confirm the possibility to reduce indirect energy consumption and CO_2 emissions levels and show high potential for replication in the near future.

The chapter on **Technical measures including smart and affordable technologies and innovation** includes eight cases from seven countries, and has a real focus on modern energy efficiency solutions, which are currently available in the market. The presented energy efficiency technologies and other technical solutions are currently affordable and have reasonable financial interest, even for countries of subregions E and F, with traditionally low energy prices. The growing amount of energy efficiency buildings constructed for low-income households or under governmental resettlement programmes, is a positive sign that confirms the high level of penetration and implementation of standard energy efficiency and basic renewable technologies.

The eight cases from eight countries, included in chapter on **Financial Mechanisms**, show two types of solutions, non-refundable grants and refundable loans of different variations.[3] The analysis of the presented cases highlights the high efficiency of existing energy efficiency financial and investment schemes, which are widely used across all countries of the UNECE region. However, the proper implementation of financial mechanisms requires long-term project sustainability. For this reason, it is preferable to use a combination of grant resources for apartments and public buildings, in case extra budgetary financing is required. In such a case, direct financial governmental support or guarantees could help building owners or operators to attract reliable energy service companies or receive special discounted offers from energy efficiency equipment suppliers and manufacturers.

[3] Financial resources provided by country level Governments, municipalities, International Organizations (UNDP, GIZ, USAID and others) and Internationsl Financial Instiurions (EBRD, KFW and others).

CHAPTER 1. INTRODUCTION

1.1. Objectives of the study and methodology

The research presented in this study is aimed to identify best practices on adopting, implementing and enforcing energy efficiency standards and energy efficiency technologies for the building sector in the UNECE region and prepare a compendium of best practices. The compendium will serve as a basis to improve the knowledge of UNECE member States concerning energy efficiency best practices related to existing standards and technologies in buildings so that they will be able to develop and implement more effective energy efficiency policies.

The collected best practices have been selected using, the criteria (attributes) identified in the study "Best Policy Practices for Promoting Energy Efficiency – Second Edition"[4], while the topics and areas of the case studies have been taken from the study "Good Practices for Energy-Efficient Housing in the UNECE Region".[5] The guiding documents of this study are the Geneva UN Charter on Sustainable Housing[6] and the Framework Guidelines on Energy Efficiency Standards in Buildings.[7]

Due to the existing old building stock in the UNECE region and the need for retrofitting it, this report is more focused on the retrofit of the existing building stock compared to new constructions and include more case studies related to the residential sector. The selected best practices have been divided in five main chapters: legislative and regulatory framework; management of multi-family housing stock; awareness raising and behavior change; technical measures; and financial mechanisms. These sections correspond to the topics of the case studies.

Information on the best practices was gathered via desk research and stakeholder outreach. With a call for case studies launched by the UNECE secretariat in November and December 2018, several stakeholders have been approached to submit the case studies. Once the topics for the case studies were selected by the UNECE secretariat, five case-studies templates were prepared, one per each category of the research, and distributed among the UNECE Joint Task Force on Energy Efficiency Standards in Buildings members and other energy experts from the UNECE region. Furthermore,the official evaluation criteria, the approaches to the study and the beginning of the data collection phase, were announced during the 9th International Forum on Energy for Sustainable Development in Kiev, Ukraine, 11-15 November 2018.

Collected best practices include, but are not limited to, thermal performance of buildings and their components, construction materials and heating, ventilation and air conditioning (HVAC) systems, with examples on standards and technologies for energy efficiency in buildings.

54 case studies from 22 countries have been received for initial review. All of them were verified and evaluated according to the above-mentioned criteria and 38 have been selected to be included in this report. The countries who submitted the case studies have been divided in six sub-regions, which have been presented above in the relative section.

[4] UNECE, Best Policy Practices for Promoting Energy Efficiency – Second Edition, (2017) p.35, available at http://www.unece.org/index.php?id=47415

[5] UNECE, Good Practices for Energy-Efficient Housing in the UNECE Region, available at https://www.unece.org/index.php?id=35186

[6] The Geneva UN Charter on Sustainable Housing is available in multiple languages at https://www.unece.org/housing/charter.html

[7] The Framework Guidelines on Energy Efficiency Standards in Buildings are available at https://www.unece.org/fileadmin/DAM/hlm/documents/2017/ECE_HBP_2017_3.en.pdf

1.2. Overview of policies and energy efficiency status in buildings in UNECE region

The analysis of the collected case studies shows overall positive trends in energy efficiency in the building sector in all the identified subregions. Even countries of the subregions C, E, and F, which traditionally have low internal energy prices, have significantly increased mandatory energy efficiency requirements, especially for the newly constructed buildings.

Almost for all countries of the UNECE region, there is a good trend matched on the correlation between the application of energy efficient technologies and the mandatory construction and design requirements of mandatory building standards. In addition to the numerous environmental benefits associated with decreased energy consumption and increased generation of renewable electricity, many of the technologies discussed in this report offer other non-energy related social benefits.

Various polices, norms and regulations have been published by each country to improve energy efficiency in the building sector. The implementation of these documents across countries of UNECE region had different level of success.

In the EU countries, much attention has been given over the past decade to energy efficiency in the building sector, with the following directives:

- directive of 16 December 2002 on the energy performance of buildings
- directive of 6 July 2005 establishing a framework for the setting of eco-design requirements for energy-using products
- directive of 5 April 2006 on energy end-use efficiency and energy services
- directive of 23 April 2009 on the promotion of the use of energy from renewable sources providing for the promotion of energy efficiency
- directive of 21 October 2009 establishing framework for setting of the Eco-design requirements for energy-related products
- directive of 19 May 2010 on the indication of energy efficiency labelling and standard product information of the consumption of energy and other resources by energy-related products
- directive of 19 May 2010 on the energy performance of buildings
- directive of 25 October 2012 on energy efficiency amending directives 2009/125/EC and 2010/30/EU and repealing directives 2004/8/EC and 2006/32/EC
- directive of 30 May 2018 amending directive 2010/31/EU on energy performance of buildings and directive 2012/27/EU on energy efficiency

To help officials in EU countries to implement the Energy Efficiency Directives, the European Commission has published several guidance notes. Country-level implementation of these directives should induce important changes in energy efficiency in Europe, especially in the building sector. In the United States, the Energy Policy Act of 2005[8] covers almost every aspect of energy generation, distribution, and consumption, along with guidelines on energy efficiency. In 2012, 31 USA states, by adopting either ASHRAE[9] 90.1.2007 or the ICC Energy Conservation 2000-2015[10], implemented model codes for residential and commercial buildings. Their provisions concerning energy efficiency in

[8] https://www.epa.gov/ust/energy-policy-act-2005-and-underground-storage-tanks-usts

[9] ASHRAE 90.1-2007 is the primary document for establishing the BASELINE BUILDING PERFORMANCE standard for the whole building energy simulation. The baseline building performance is the annual energy cost for a building design intended for use as a baseline for rating above standard design.

[10] The International Energy Conservation Code 2015 (IECC 2015) is a model code produced by the International Code Council (ICC). This document provides the foundation for many state and city codes.

buildings include: energy consumption reduction targets for public buildings; integrating efficient equipment in public procurement; new standards for 14 large appliances; and tax incentives for energy efficiency improvements in houses, commercial and public buildings.

In Canada, Vancouver's step-by-step plan to promote the uptake of highly energy efficient buildings by removing barriers to Passive House is linked to Vancouver's Greenest City Action Plan. The city offers compensatory benefits (e.g. extra floor area) to motivate building developers to build to a higher standard (also necessary to compensate for the extra insulation the higher building standard requires). Other non-financial incentives includes a favourable rezoning policy for Passive House buildings and the option to negotiate a reduction in other fees.

In countries like Serbia, Kazakhstan, Belarus, Russia and some other, the governance structure is such that building codes are made at the federal level, without an option for regional governments to choose whether to adopt the codes or not. In such cases, regions are able to prepare and submit additional design and construction norms or procurement procedures requirements, which will reflect the regional specifics, but will not contraddict the federal level law. This situation does not allow the codes to be updated more frequently considering the technological developments in the building sector. The regulatory bodies of these countries acting at the federal level are currently focusing on the implementation of performance-based building codes with minimum energy standards rather than prescriptive building codes. This will give building contractors and owners the flexibility to choose the best technological option to reduce energy consumption.

CHAPTER 2. CASE STUDIES ON THE LEGISLATIVE AND REGULATORY FRAMEWORK

This section includes best examples of developed and implemented policies and regulations supporting dissemination and wider integration of energy efficient standards and technologies in the building sector across the member States of UNECE. The selected case studies shows most efficient approaches to the issues of energy efficiency capital repair and new constructions. Methods of accumulation and distribution of financial resources for maintenance and capital repair of public and multi-family buildings.

The results of the research conducted for this report showed that the governments of UNECE countries are working on the development of good policies, strong institutions, and efficient public services to ensure support for public and private sector building energy users. The collected case studies present various aspects of enforcement for energy efficiency-oriented legislative and regulatory framework, including the development of institutions responsible for their implementation and regulation. Supportive governmental activities, in terms of clear guidelines for the promotion of energy efficiency technological developments can support regional economic growth; develop local competitive markets; increase employment; promote implementation of lower-cost and accessible energy efficient technologies; and develop international markets.
Activities performed in different countries across the UNECE region confirmed the need for a better cooperation between governments, industry, and energy programme administrations. This conclusion is based on the good results of analyzed cases where governments and various international organizations jointly supported the implementation of advanced energy efficiency technologies, by introducing incentives (administrative, tax, grants and others) and relevant supportive legal documents, even when the technology was not fully economically feasible.

Case studies overview

Total: 5 case studies from 5 countries

Albania has transposed the EU energy efficiency directives into laws and the EBRD is supporting the drafting of the sub-legislative acts. The Energy Efficiency Law, although approved in 2015, was not fully compliant with the directive and now, with the support of the EBRD it will be amended into being fully compliant. Until now the established technical working group has produced the first drafts and work is ongoing.

The case study from **Armenia** presents the development and adoption of construction norms and standards in the field of energy efficiency in buildings. In particular, the project helped the improvement of the national regulatory framework on energy efficiency in buildings; the test and certification of insulation materials, including support to the laboratories performing those tests; and the awareness rising through campaigns and educational programmes.

The project undergone **in Czech Republic** works on the extensive optimization and costcutting of energy consumption for buildings to meet the criteria of the national environmental certification SBToolCZ[11]. Therefore, in the submitted case study, the building's envelope was improved (more thermal insulation and triple glazed windows), heat recovery ventilation was installed in several flats, photothermic panels for domestic hot water pre-heating, rain water retention tank were installed and more greenery of facades were added.

[11] https://www.sbtool.cz/en/

The development of a regulatory framework for urban energy management system implementation was presented in the case study from **Russian Federation.** The main goal of Urban Energy Management Systems (UEMS) is the implementation of the special mechanism at the administrative level, which will support governmental policies in the field of energy efficiency, as well as provide the required level of energy efficiency in the municipal buildings.

The Ministry of Construction, Transport and Infrastructure of **Serbia** shared a case on the improvement of the country's legislative and regulatory framework for the buildings sector. Since 2011, it has been improved in order to harmonize it with the EU directives in this field. This improvement included the introduction of the National Data Management System for energy efficiency of buildings. A focused budgetary programme, which was started in order to prepare these updates, was funded by national and municipal budgets and was aimed to implement regular activities of the public administration in the field of energy efficiency. .

The case from **Turkmenistan** presents the work on energy efficient building codes as the main tool to achieve scaled-up benefits among new buildings. The project focused on the revision of the most important building codes in terms of increasing energy efficiency. The implementation of building energy codes are to transform the residential building design, thereby saving energy and cutting greenhous gas (GHG) emissions on a large scale. The new codes collectively mandate an average reduction of 15-25% in heat energy consumption in residential buildings compared with existing levels. The new thermal performance code incorporates whole-building energy performance requirements, and new documentation requirements (energy passports).

Case Study 1 Albania – Regulatory framework for the Law "On Performance of Energy in Buildings"

Project description

Starting from 2018, Albania is actively working on the development of the regulatory framework for the Law "on Performance of Energy in Buildings". The Ministry of Infrastructure and Energy and the Agency for Energy Efficiency with support of EBRD are working on the adoption and integration of the EU directives on energy efficiency and energy performance of buildings in order to increase the quality of local design and construction standards.

Key targets

The objective of the Regional Energy Efficiency Programme (REEP Plus) is to support Albania towards the full implementation of the Energy Performance in Buildings and the EU Directives.

Period

04/2018 - ongoing

Implementation steps

Step 1. Preliminary assessment of Albanian Legislative Framework

Step 2. Kick off meeting and discussion about the needed support in specific areas

Step 3. Expansion of the support also to the Energy Efficiency Law

Step 4. Development of the draft legislative acts, as agreed with the Ministry of Infrastructure and Energy

Step 5. Delivery of the final documents and follow up with the Ministry of Infrastructure and Energy until approval

National and international partners

Ministry of Infrastructure and Energy and Agency for Energy Efficiency

Achieved results

Albania has transposed both directives into laws and EBRD is supporting in the drafting of the sub-legislative acts. The Energy Efficiency Law, although approved in 2015, was not fully compliant with the directive and now, with the support of EBRD it will be amended into being fully compliant with the directive. Until now the technical working group with the support of EBRD has produced the first drafts and the work is ongoing.

Total benefits

Benefits and results of the implementation of this project are to reach energy savings and the national targets on energy efficiency in buildings.

Number of prepared policy drafts

For the Law on Energy Performance in Buildings:

- National Calculation Methodology
- Regulation on Minimum Energy Performance Standards
- Activity Database
- Regulation on Energy Performance Certification
- Results of the cost-benefit analysis for the residential sector

For the Energy Efficiency Law: the consultants are working together with the technical working group (TWG) into making the law fully compliant with the EU Energy Efficiency Directive

List of organized events

3 meetings have been conducted: one kick off meeting and 2 other meetings of the technical working group where representatives of EBRD, international and local consultants as well as the representatives from the Ministry of Infrastructure and Energy and Agency for Energy Efficiency participated

Author

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Case Study 2. Armenia – Buildings energy efficiency

Project description

This is a UNDP administrated and GEF funded Project, aimed at increasing the local capacity in the building sector by means of the introduction of the best international practices in the field of energy efficient building construction.

Key targets

- Development and implementation of the standard norms and rules and improvement of the national regulatory framework in the field of energy efficiency in buildings;
- Test and certification of the thermal insulation materials and technical support to the partner-laboratories;
- Awareness raising among inhabitants and educational programs in the area of EE building design;
- Demonstration of the benefits of integrated EE buildings design.

Period

2010 - 2016

Implementation steps

Step 1. The followings draft documents have been prepared:

- amendments to the law on energy saving and renewable energy from 2004. Based on this document, measures on energy efficiency and energy saving should be required for new residential buildings as well as for the retrofitting;
- requirements on energy saving and energy efficiency, which should be implemented within the building design, by experts and by public procurement;
- draft of the construction norms for the thermal protection, adopted by the Ministry of Construction;
- draft of the technical regulation on energy efficiency for the new residential constructions as well as for the buildings after capital repair, adopted by the Government of Armenia;
- drafts of the national standards on energy passports and methodology on energy audit conduction in the residential and public buildings; adapted more than 10 EN and ISO standards.

Step 2.

- developed and published the catalogue of the domestic and imported thermal insulation materials;
- opened 2 modern laboratories on buildings thermophysics for the conduction of tests and certifications of thermal insulation materials, and on energy efficiency or students;
- designed and certified more than 12 types of domestic and imported materials.

Step 3.

- organized trainings and competitions for journalists on the topic of highlighting EE issues in mass media;
- organized a range of educational events and master-classes for architects, builders, inspectors and other specialists, involving the international experts;

- prepared and published the tutorials «Green architecture» for students in 2 languages.

Step 4.

- published the catalogue of the technical solutions on buildings thermal insulation for engineers (adopted by the Decree of Ministry of Construction);
- published the catalogue of the typical projects of energy efficient individual houses (adopted by the Decree of Ministry of Construction).

Step 5. In order to demonstrate the benefits of such buildings design, construction of energy efficient buildings and energy efficient retrofitting, several pilot projects have been implemented:

- Goris city – construction of the 20-apartment social residential houses (the total energy savings - 62%);
- Yerevan city – modernization of existing 9-floors 36-apartments residential building (the total energy savings - 60%);
- Akhuryan settlement – construction of one multi-apartment building within the governmental resettlement programme (expected energy savings - 60%);
- Yerevan city - construction of the school according to the international LEED standard for 450 students

National and international partners

Ministry of Construction and Ministry of Environmental Protection

Achieved results

By means of the improvement of the local legislative and regulatory framework, the conditions have been created for the implementation of the high-efficient energy standards on design, expertise and organization of the public procurements in the building sector of Armenia.

Total benefits

The potential, gained within the project implementation and implemented efficient technologies, became the basis for the further development and introduction of modern energy efficiency measures, and as a result, the project named «Decreasing of risks and investments engagement to the buildings thermal modernization in Armenia» has been granted by Green Climate Fund (GCF).

Number of prepared policy drafts

- Law of the Republic of Armenia «Amendments to the law on energy saving and renewable energy»;
- Governmental Decree N426-Н from 12.04.2018г. «About adoption of technical regulation on energy efficiency for new multi-apartment residential buildings as well as for the retrofitting by the governmental funds»;
- Governmental Decree N 1504-Н from 25.12.2014г. «About implementation of measures, aimed at improvement of energy saving and energy efficiency both for the new construction and capital repairs, financed by governmental funds» ;
- SNIP 24-01-2016 «Buildings thermal insulation», adopted by the Ministry of Construction N120-Н from 16.06.2016г.;
- National standard «Energy saving. Energy passport of the building»;
- National standard «Methodology of energy audits conduction in the residential and public buildings».

Author

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Case Study 3. Czech Republic – X-LOFT - Sustainable multi-family housing

Project description

Project X-LOFT is the first residential project in Czech Republic to receive the silver certificate SBToolCZ from the Technical and Test Institute for Construction in Prague, in conjunction with the Technical University ČVUT. SBToolCZ is a national standard and uses a special methodology to evaluate a building with respect to sustainability criteria (these include several components, such as human and social environments, construction quality, operational costs, etc).

Key targets

High quality of design and standards, ecological and low running cost, centrally located, price of flats 80,000 Euro

Period

2003 - 2011

Implementation steps

Step 1. Purchase of brown-field (a former brewery);

Step 2. Obtaining the approval of the municipal authorities;

Step 3. Obtaining the building permission;

Step 4. Optimization of the project;

Step 5. Construction phase including sales.

National and international partners

Jiří Tencar - later ECOTEN (consultancy company)

Martin Vonka - The Czech Technical University in Prague (CTU)

Achieved results

The project underwent an extensive optimization in 2009-2010 in order to cut the cost and fulfill the criteria of the environmental Czech certification SBToolCZ. Therefore the buildings' envelope was improved (more thermal insulation and triple glazed windows), heat recovery ventilation was installed in several flats, photothermic panels for domestic hot water pre-heating, rain water retention tank were installed and more greenery of facades were added.

Total benefits

- 25,7 t CO_2 emission reduction for the new buildings created within the project compared to the legislation requirements in 2010
- 128 816 kWh electricity consumption reduction for the new buildings created within the project compared to the legislation requirements in 2010

List of organized events

- SBToolCZ residential buildings were tested and the first building (X-LOFT) was certified in 2010
- Project presented at the International Conference and Expo for Sustainable Building, Investment and Facility Management in Prague in 2012

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Project website: www.x-loft.cz

Case Study 4. Russian Federation – Implementation of the urban energy management system

Project description

This project was aimed to introduce efficient management mechanisms in order to establish the system of rational energy use on the municipal level, determine key energy performance indicatiors and prioritarise required actions. A set of policy and regulatory documents was prepared and implemented in order to establish an Urban Energy Management System (UEMS) in Pskov and Vologda Regions of Russia.

Key targets

The main goal of UEMS is the implementation of a special administrative mechanism, which supports the policy implementation in the field of energy efficiency, both at national level and at municipal level.

Period

05/2015 – 04/2018

Implementation steps

Step 1. Appointment of the regional energy manager and creation of a public sector building database;

Step 2. Setting the data of the database into the energy monitoring programme and calculation of the specific energy consumption in the public buildings;

Step 3. Ranking of the public buildings in accordance with the energy passport presence and consumption level;

Step 4. Summary UEMS indicators for the energy saving programme and calculation of the total saving potential due to the implemented energy conservation measures;

Step 5. Technical expert`s assistance with financial planning for regional administrations.

National and international partners

UNDP-GEF Project "Buildings energy efficiency in the North-West of Russia", Regional Administrations of Pskov and Vologda oblasts, Russian Energy Agency of the Ministry of Energy of Russian Federation, Pskov Communal Systems

Achieved results

UEMS were established in Pskov and Vologda regions with the support of the regional administrations and regional energy managers were appointed in both regions. The list of needed technical measures (with feasibility studies) was prepared for energy efficiency capital repairs and the needed technical measures were incentivized for municipal buildings. Seminars for specialists, responsible for energy efficiency in municipal buildings were organized and national energy managers were appointed in order to disseminate the gathered experience among other regions. Data for 160 buildings was entered into the newly created Energy Management Information System (EMIS).

Total benefits

UEMS implemented in the Pskov region proved its replicability. Thus, as a result of the inter-regional

experience exchange, since 2016 the energy manager in the Vologda region works at the regional level in close cooperation with his colleague from Pskov. The concept of the UEMS implementation at the national level obtained the support from FSBI "Russian Energy Agency" as a national implementing partner.

List of organized events/introduced methodologies/developed materials

• Seminars for regional energy managers in Pskov and Vologda regions;

• two national meetings for energy managers;

• Training courses for energy managers on the EMIS use - both online and in person (held by Russian and Croatian specialists);

• two study visits both by international delegations to Pskov region and by the Pskov delegation to Serbia;

• four educational sessions for representatives from more than 30 developing countries.

Author

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Case Study 5. Serbia - Improvement of the legislative and regulatory framework for buildings sector in Serbia

Project description

The project deals with the improvement of the country's legislative and regulatory framework for energy efficiency in buildings in order to harmonize and integrate in it the EU directives. The project supported the introduction of a National Data Management System for energy efficiency of buildings and improved local capacity to implement the new legislation.

Key targets

In Serbia, the building sector consumes 60% of the final energy. Therefore the Sustainable Development Strategy of Serbia identified the goal to reduce the final energy consumption by 9% until 2018 as compared to that of 2008. In order to achieve this goal, it was necessary to tighten the norms and standards in the building construction sector. Therefore the responsible Ministry of Construction (in 2011it was the Ministry of Environment Protection and Spatial Planning) started to improve the Serbian legislative and regulatory framework in line with EU directives regulating energy efficiency in the building sector.

Period

2011 – 2017

Implementation steps

Step 1. A comprehensive survey on the energy performance of the housing stock in Serbia was conducted within the IEE Project TABULA, during the period 2010-2012, which was prior the beginning of the regulatory framework improvement. It resulted in the development of the building typology structure in line with the adopted principles, it included some adjustments for particular national circumstances and existing heat supply systems. For each adopted building type, the following aspects were defined: typical elements of the thermal envelope and heat transfer coefficients (U values); characteristics of the heating and domestic hot water systems; frequency of the building type in the total national housing stock; and two levels of refurbishment measures for reduced energy consumption (standard and advanced improvements).

Step 2. The legal framework for energy efficiency of building was improved. The Planning and Construction Law was amended in 2011 and based on this, two bylaws were passed: the Regulation on Energy Efficiency in Buildings in 2011 and the Regulation on Conditions, Content and Way of Issuing Certificates on Energy Performance of buildings in 2012. Enforcement of these regulations has started from September 2012;

Step 3. The National Typology for Residential Buildings was created, which is based on the previous comprehensive research of the existing housing stock in Serbia within the TABULA project. It is also complemented by the typology of buildings built after legal changes. The housing stock has been classified per urban/architectural, construction/material and typically energy supply criteria and per period of construction. It resulted in the model buildings with different energy performance (expressed as average energy consumption per square meters), which should further serve as a starting point for approximate proposal of measures for the energy rehabilitation of the housing stock;

Step 4. Institutional and expert capacity for the implementation of the new legislation was improved. Within this process 5 Local Energy Efficiency Action Plan (LEEAP) were adopted, more than 2000 professionals (architects, construction engineers, municipal energy managers) obtained qualifications on energy efficiency in buildings and more than 180 companies were licensed for issuing energy

passports.

National and international partners

Ministry of Construction, Transport and Infrastructure and Deutsche Gezellschaft für internationale zusammenarbeit (GIZ), Ministry of Energy and Mining, Administrations of municipalities, Serbian Chamber of Engineers, Architectural Faculty of the University of Belgrade in cooperation with: the Mechanical Engineering Faculty of the University of Belgrade and the Civil Engineering and Architectural Faculty of the University of Niš

Achieved results

Based on expert estimation, from 2012 to the end of 2016, approximately 2,000 residential buildings have already been constructed or renovated in line with the new standard which started to be applied in September 2012. Rough calculations show that around 150,000 MWh less primary energy was consumed as a result and that over 30,000 t CO_2 are avoided each year.

Total benefits

- Evaluated CO_2 emissions reduction andclimate change mitigation effect: over 30,000 t
- Evaluated energy consumption reduction: 150,000 MWh of primary energy per year

List of organized events

Many events were organized during the preparation and after the adoption of the new legislation and the preparation of the local action plans for energy efficiency. In 2013, the responsible Ministry of Construction, Transport and Infrastructure visited 33 municipalities within the campaign for the dissemination of the information about the new legal framework for energy efficiency. In the period 2014-2015, 5 workshops were held titled"Training energy", attended by the representatives of 73 local self-governments. Two UNDA workshops (in 2014 and 2015), were organized in cooperation of the UNECE, UN/Habitat and the government to present the results of the activities in the field of energy efficiency.

Developed documents

- Amendments to the Law on Planning and Construction (''Official Gazette Republic of Serbia'', no. 72/2009, 81/2009, 64/2010, 24/2011)
- Regulation on Energy Efficiency in Buildings (''Official Gazette Republic of Serbia'', no. 61/2011).
- Regulation on Conditions, Content and Way of Issuing Certificates on Energy Performance (''Official Gazette Republic of Serbia'', no. 69/2012)
- National Typology of Housing Buildings in Serbia
- National Typology of Housing Buildings in Serbia - after 2013
- 3 adopted Local Action Plans for Energy Efficiency for cities: Pirot, Ivanjica and Vršac and two draft documents for: Vrbas and Soko Banja

Author

Svetlana Ristić, Ministry of Construction, Transport and Infrastructure of Serbia

Project links

- http://stanovanje.gov.rs/energetska-efikasnost.php
- https://www.unece.org/housing-and-land-management/projects/housingunda/serbia.html
- http://www.crep.gov.rs/
- http://eekalkulator.mgsi.gov.rs/
- http://www.ingkomora.rs/programi/kursevi/?gr=80&sifra=6381%20%20&prijava=1&post=0
- http://zelenaenergija.pks.rs/ZelenaEnergija.aspx?id=14&p=6
- http://www.15godinasaradnje.com/organizations_srb/giz_3.php

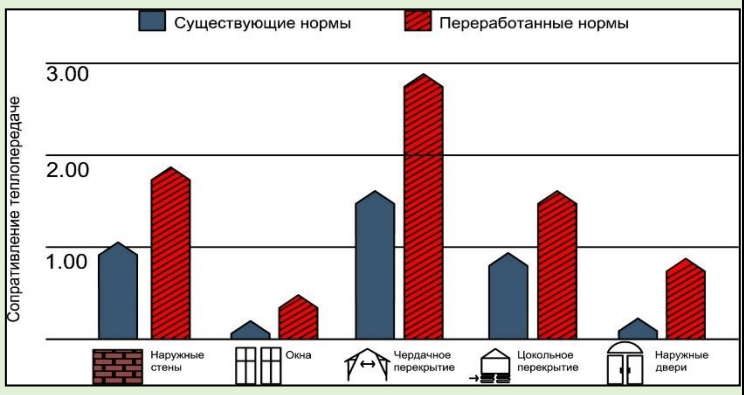
Case Study 6. Turkmenistan – Energy efficient building codes as the main instrument to achieve scaled-up benefits in new buildings

Project description

The project describes the development and application of the updated regulatory framework in the field of energy efficient construction, considering the regional climatic conditions.

Key targets

The major barrier to a better energy efficient housing at the beginning of the project was the lack of a legal framework to promote energy efficiency in buildings. The key objective of the project was to revise the most important building codes in terms of increasing energy efficiency levels. The building codes aim to provide the transformation of the residential building design, thereby saving energy and curtailing GHG emissions on a large scale via the implementation of building energy codes. The new codes collectively mandate an average reduction of 15-25% in heat energy consumption in residential buildings compared with the existing levels. The new thermal performance code incorporates whole-building energy performance requirements and new documentation requirements (energy passports).



Period

11/2011 – 07/2017

Implementation steps

Step 1. Technical specifications for revising the building codes were developed and approved by the Ministry of Construction and Architecture;

Step 2. Working groups of local and international experts for revising the building codes were established;

Step 3. The building codes were revised and sent for review to the local stakeholders including the Ministry of Construction and Architecture of Turkmenistan, and the Turkmen Design Institute;

Step 4. The building codes were finalized;

Step 5. The revised building codes were adopted by the Government of Turkmenistan.

National and international partners

State Corporation "Turkmengas", Ministry of Construction and Architecture of Turkmenistan, Turkmen Design Institute and UNDP Turkmenistan

Achieved results

Four building codes were revised within this project including Roofs and Roofing, Residential Buildings, Building Climatology, and Building Thermal Engineering. The revised versions were adopted by the Government during 2015-2017 and are now mandatory in Turkmenistan. The new building codes provide for the minimal energy savings for heating to 27-28%.

Total benefits

In addition to its work on the new content of codes, the project has also supported the facilitation of their compliance by building designers. In particular:

- Three guidance manuals on the revised codes (Residential Buildings, Roofs and Roofing, and Building Thermal Engineering) were developed to explain the new code requirements and provide

concrete recommended examples of design solutions and materials that can be used to achieve compliance. The manuals also provide guidance on technical calculations of energy consumption and other parameters.

- Compendium of solutions for thermal bridges at joints in building envelopes was also prepared. The report is aimed to prevent thermal bridges, offering significant energy savings at relatively little or no cost.
- Energy Passport documentation system for buildings was developed to facilitate the calculations by building designers and record-keeping with regard to the energy performance of buildings and allowing for comparisons and quantitative assessment.

Achieved energy conservation

Potential effects from the transition to revised building codes:

- Energy savings without using automated heat control in buildings: Heat – 27-28 %; Electricity – 14-17%; Natural gas savings (total energy savings converted into natural gas savings) - 188.8 mln. m^3 (total evaluated savings for 2017-2027);
- Energy savings with using automated heat control in buildings: Heat – 40-47 %; Electricity – 14-17%; Natural gas savings (total energy savings converted into natural gas savings) - 260.2 mln. m^3 (total evaluated savings for 2017-2027).
- Potential effects from use of the Compendium of solutions to thermal bridges at joints in building envelopes in design of residential buildings:
- Heat energy savings – 6-16 %; Electricity savings – 5-8 %; Natural gas savings (total energy savings converted into natural gas savings) - 75.5 mln. m^3 (total evaluated savings for 2017-2027).

Author

Irina Atamuradova, UNDP Turkmenistan

Project links

http://www.tm.undp.org/content/turkmenistan/en/home/library/environment_energy/revised-construction-norms.html

CHAPTER 3. CASE STUDIES ON THE MANAGEMENT OF MULTI-FAMILY HOUSING (MFH) STOCK AND PUBLIC BUILDINGS

This chapter comprises best practices of management and maintenance of multi-family housing stock and public buildings showing practical experience of effective buildings operation. It further includes good examples of internal instruction and operation methodologies development for a better dissemination of energy efficiency approaches; and daily operation practices, from utilities companies and management departments of public sector buildings.

Currently several countries across the UNECE region are actively working to increase energy efficiency in the building sector with primary focus on new constructions. Nevertheless immediately after commissioning, the building falls into the operation and maintenance process which is executed by specialized organizations and specialists. Proper management of multi-family housing stock and public buildings include effective administrative and technical solutions. The growing amount of public and private, small and medium size businesses requires better support by means of qualified experts, transparent financial solutions and useful tools, which can make the management process easier and more automated. Complex solutions of urban planning and buildings maintenance require adequate planning and financial support by responcible authorities. Additionally, a pre-approved list of eligible equipment manufacturers and suppliers, can assist in technical risks reduction. Another part of work with the building's management is the implementation and proper use of Energy Performance Certificates (EPC), which many countries already utilize. Currently, for most of the countries of the sub-region C, E and F, buildings energy performance certificates are mainly used for public information purposes, without connection to real financial incentives (eg. reduced ta rates, special price for domestic energy and building owners and other). EPCs could be used in additional ways to provide more value to building owners and further encourage energy efficiency investments.

Case studies overview

Total: 7 case studies from 6 countries

Two cases from **Austria** have been received. One shows some possibilities of buildings operation practices focused on the shift from energy efficient consumption to Passive House standard. A student dormitory was built using the Passive House concept with significant energy consumption reduction. Efficient building and energy management and management practices were implemented in line with a highly efficient ventilation system with heat and moisture recovery; optimized building skin and highest possible photovoltaic system. The energy consuming components were optimized and standby functions were avoided. The other case study presents complex urban territory development solutions. The city of Innsbruck has selected its eastern district to demonstrate the large scale implementation of energy efficient measures, with the objective of achieving on average 40 – 50% primary energy saving in the demo sites and to increase at least by 30% the share of renewables in the district's energy mix. Furthermore, about 66,000m^2 of residential and public buildings from the 30s-80s in the city will be retrofitted to dramatically improve indoor quality and energy performance, and reduce final energy demand by up to 80%.

The case from **Belgium** shows the interregional cooperation and synergies among the Belgian authorities and stakeholders, to support new collective renovation and retrofitting policies. This approach would act as a catalyst for both socially and economically beneficial climate-friendly development. Moreover, energy-efficient renovation of the Belgian housing stock is crucial in the framework of the Energy Efficiency Directive (2012/27/EU) and for reaching Belgium's climate and energy targets in the EU 2030 climate and energy framework. For Flanders, the Energy Renovation

Programme 2020 will be continued by the Renovation Pact, with goals until 2050. Walloon's building renovation strategy provides goals for 2020, 2030 and 2050.

The case from **Bulgaria** shows the renovation of a residential block under the National Program for Energy Efficiency in Multi-family Residential Buildings. Main objectives of the Programme are to secure better living conditions for the residents in the multi-family residential buildings, heat comfort and higher quality of living environment through the implementation of energy efficiency measures. The project is aimed to shift energy performance of the building from E to class B.

Complex energy audits conduction in the case from **Georgia** focused on the identification of energy saving potential in residential building, identification of energy efficiency measures, calculation of energy savings and CO_2 emission reduction.

The case from **The Republic of North Macedonia** presents the establishment of the residential management company "Habidom" for the maintenance and management of the national multi-family housing stock. The main objective of the project is to improve the management of the MFH and thus increase the access to finance mechanisms for energy efficiency upgrades. Improving the management of multi-apartment buildings, providing better services and facilitating the process of joint decision among homeowners to retrofit common spaces, is the core business of Habidom.

Case Study 7. Austria – Sinfonia Smart Cities

Project description

The city of Innsbruck has selected its eastern district to demonstrate the large scale implementation of energy efficient measures, with the objective of achieving primary energy savings in the demo sites and to increase the share of renewables in the district. About 66,000m² of residential and public buildings from the 30s-80s will be retrofitted to dramatically improve indoor quality and energy performance, and reduce final energy demand by up to 80%.

Key targets

The project's key targets include achieving on average 40 – 50% primary energy savings in the demonstration sites and to increase at least by 30% the share of renewables in the district's energy mix. Measures include: improved envelope (insulation, windows, thermal bridges,etc.); ventilation system with high efficiency heat recovery; integration of renewable energy sources on-site (PV, solar thermal, heat pumps). The district heating network will be extended and optimised to increase the use of renewable energy sources by 95% and reduce the use of fossil fuel by 22%. Measures include: deployment of a low temperature grid; recovery of heat/cold from local industries; integration of solar energy and innovative biomass gasification. Smart grids and smart home applications will combine demand and supply side measures to reduce the overall electricity demand by 3%. Buildings will be transformed to Smart Urban Model (SUM) houses. Measures include: smart load control for refrigerators, water boilers and heat pumps; involvement of customers.

Period

06/2014 – 05/2020

Implementation steps

Step 1. The district and its buildings were targeted for deep retrofits on a needs-based approach;

Step 2. Residents of residential buildings were informed of the retrofits before being carried out and involved in each step, to make inhabited-state retrofits possible;

Step 3. Retrofits were carried out to insulate the thermal envelope, ventilation systems where necessary: workers were able to retrofit faster as they became more adept/experienced. Thus, initial retrofits took longer than they do currently;

Step 4. Heating demand was reduced from 100-160kWh/m2a to just 25kWh/m2a;

Step 5. The Innsbruck Immobiliengesellschaft and Neue Heimat Tirol now only retrofits to the Passive House EnerPHit Standard.

Main participants

Neue Heimat Tirol (NHT is a non-profit building developer, which is 50% owned by the state of Tirol and 50% owned by the city of Innsbruck), Innsbruck Immobiliengesellschaft (the city-owned development company), City of Innsbruck, Passive House Institute

Achieved results

- Smart city tools were developed including the energy balance district tool (DistrictPH enables the user to investigate, with reference to desired performance indicators, the long-term consequences of planning decisions.)
- The CROCUS tool was elaborated to select a refurbishment plan (a prototype expert tool that simulates the energy consumption per end-use (lighting, heating, etc.) of a city, optimizes district heating, and provides cost/benefit analysis of different refurbishment strategies.)
- Several documents were prepared including Guidelines to build an energy baseline scenario, Good practices tool for stakeholders' involvement, SWOT analysis of Smart City plans

- Database of best available practices in energy-efficient refurbishment was established and policymaker workshops organized

Total benefits

- Successful deep retrofit of a district (step-by-step to ensure cost and life cycle optimization/feasibility).
- Capacity building of construction team at local building developer, allowing for increasingly time and cost-efficient retrofits (Increase the competence in energy sector).
- Conceptual concept from the first to the last step = Less planning costs for further retrofit steps due to proper initial planning, overall economic view over the entire building life cycle
- Official approval of EnerPHit Step retrofit plan by local government retrofit support programs (funding)
- No more "lock in" effects through less coordinated refurbishment steps

List of technical measures implemented during the management of building/buildings

- Insulation of thermal envelope (walls, roof, basement ceiling)
- avoidance and/or optimization of thermal bridges
- change of windows, installation in insulation level
- partially refurbishment of the heating system and Domestic Hot Water
- installation of PV panels
- mechanical ventilation with heat-recovery, with the consent of tenants
- more renewable energy sources, implementation of PV

Author

Giorgia Tzar, Passive Hause Institute

Case Study 8. Austria – Mineroom student dormitory in Leoben

Project description

The project consisted in the development of a student dormitory in Leoben, Austria using the Passive House concept and standards. The dormitory will accommodate about 200 international students.

Key targets

The mineroom was conceived as a passive house building with reduced energy consumption. Besides the highly efficient ventilation system with heat and moisture recovery, the optimized building skin, and the best possible photovoltaic system, key targets of the project included the optimization of the energy consuming components and the prevention of standby functions. The project also aimed to disseminate the Passive House and energy efficiency concepts among students who could also bring those ideas to their home countries.

Period

10/2015 – 09/2016

Implementation steps

Step 1. An architectural competition with general contractor and price guarantee as a basis was launched and as a result an execution company was selected.

Step 2. The urban design concept and building structure was developed. The design wasinspired by the liveliness and the play of colors of the ore stone.

Step 3. The design of the rooms and the interiors was developed with wide corridors.

In order to further emphasize the link with the Montan University, large-format photo wallpapers with motifs from mining and technology have been placed in the rooms and hallways.

Step 4. The construction phase started.

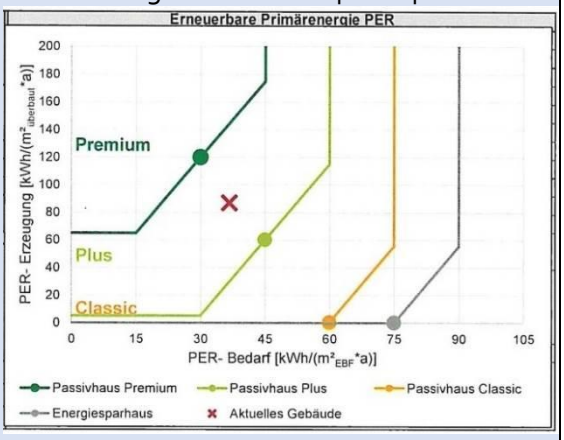
With the exception of the entrance area, the basement and the two staircases, the entire building was built in timber. The outer walls consist of a prefabricated timber frame construction with mineral wool. In the building about 1,900 m^3 of wood were used for the supporting structure and the façade, thereby binding approx. 2,000 tonnes of CO_2. Partition walls and ceilings are fitted with plasterboard liners to meet the fire and sound insulation requirements. Beams and columns were over-dimensioned to burnup and could therefore be left visible. Chemical management was used to avoid air pollutants from building materials and materials used as well as air pollutants were measured prior to occupancy of the building.

Step 5. During the upcycling phase, the door cut-outs of the building interior walls were turned into mobile furniture. The use of 250 m^2 glulam (glued laminated timber) instead of chipboard, helped to save some 25 tons of CO_2.

Step 6. Establishment of the Passive House concept, i.e.:

- Building envelope Passive House Standard according to PHI Darmstadt Photovoltaic system (388 PV modules in east-west orientation occupied, modules monocrystalline á 300Wp with 3 inverters)

- Total rated power: 116 kWp
- Total production per year: 105,000 kWh
- Total CO_2 savings per year: 12,600 kg / a
- Floor space and piping for power storage already provided. Use of LED lighting throughout the building motion detector and twilight switch in the general areas
- Comfort ventilation system with parallel rotary heat exchanger and use of special pocket and pleated filters to reduce the flow resistance of the ventilation system (Ventilation unit Trox Cube with 2 rotary heat exchangers)
- Lifts with recovery of braking energy Use of water saving valves with extended cold water range to reduce hot water consumption
- Coverage of residual heat demand and hot water treatment with district heating (process waste heat from VOEST Alpine Stahl)
- Charging for e-bikes and electric cars.



Step 7. Analysis

Main participants

Building owner: Gem. Wohn- u. Siedlungsgenossenschaft Ennstal

Operator: OeAD-WohnraumverwaltungsGmbH

Architecture: aap.architekten ZT-GmbH

Structural engineering: KPZT Kurt Pock Tragwerksplanung

Building physics: Schöberl & Pöll GmbH

Building services: BPS Engineering

Fire protection: IMS-Brandschutz Ingenieurbüro GmbH

General contractor: Swietelsky Baugesellschaft m. b. H. Weissenseer Holz-System-Bau GmbH

Achieved results

The building is klima: active GOLD certified. Certification by the Passive House Institute Darmstadt has also been carried out. Passive House Plus Standard was achieved.

Total benefits

- Very high comfort for the students
- Low energy costs
- High building standard and low costs for maintenance

List of technical measures implemented during the management of building/buildings

- Comfort ventilation system with parallel rotary heat exchanger and use of special pocket and pleated filters to reduce the flow resistance of the ventilation system (Ventilation unit Trox Cube with 2 rotary heat exchangers, Air volume flow 4,500m^3 / h per rotation exchanger Re-heat number (EN308) 90.58%Moisture content 73.14%);
- Lifts with recovery of braking energy;
- Use of water saving valves with extended cold water range to reduce hot water consumption;
- Coverage of residual heat demand and hot water treatment with district heating (process waste heat from VOEST Alpine Stahl);
- Electrical charging for e-bikes and electric cars;

- Natural lighting of the access zones and reduction of power consumption for lighting;
- "Green wall" in front of the south-facing façade parts in the courtyard and in Anzengrubergasse with positive effect on the microclimate.

Author

Martina Feirer, aap.architekten ZT-GmbH

Project links

http://www.aap.or.at/projekte/wohnbau/studierendenheim-mineroom-leoben

http://www.passivhausplaner.eu/MusterPH_Projektdoku_Bild/ph_Feirer_Leoben_4862.pdf

Case Study 9. Bulgaria – Renovation of a residential block under the National Program for Energy Efficiency in Multi-family Residential Buildings

Project description

The selected project presents the renovation of a residential building block in the municipality of Pernik. This project was developed under the national programme for Energy Efficiency in Multi-family Residential Buildings supported by the Ministry of Regional Development and Public Works of Bulgaria.

Key targets

The main objectives of the programme includes: to secure better living conditions for the residents in the multi-family residential buildings, heat comfort and higher quality of living environment through the implementation of energy efficiency measures. The project level objective was to retrofit the seleceted residential block so that it could pass from energy class E to B.

Period

03/2015 – 09/2017

Implementation steps

Step 1. Establishment of a Home-owners association and submission of application documents to the Municipality of Pernik;

Step 2. Signing of contracts for the participation in the Programme between the Home-owners association, Municipality of Pernik and Bulgarian Development Bank;

Step 3. Announcement of public procurement tenders for the execution of energy and technical audits in the building;

Step 4. Announcement of the tenders regarding the planning and investment project preparation, construction works, construction supervision, investor's control, compliance assessment;

Step 5. Execution of Construction/Renovation works

Main participants

National: The newly created home-owners association, Municipality of Pernik, Governor of Pernik, Housing Policy Directorate at the Ministry of Regional Development and Public Works, Bulgarian Development Bank, several contractors

Achieved results

Achieved socio-economic and environmental benefits from the renovation of a fifteen-floor block built, connected to district heating, in 1993 included:

- Average number of people per household – 1,97 people/apartment (138 inhabitants in 70 apartments)
- Expected reductions of expenditures due to the energy efficiency measures – 58 730 BGN/y

- Rate of return - 8,23 years
- Reduction in energy consumption in % - expected energy savings of 53,15%
- Calculated CO_2 avoided emissions – 233,27 tCO2/y.

Total benefits

- Opportunity for individual heat consumption monitoring and reporting;
- Maintenance services guarantees for 5 years after commissioning of the renovation works;
- Higher level of the energy efficiency achieved;
- Improved thermal comfort and conditions of the living environment in line with the sustainable development criteria;
- Energy costs decrease;
- Improved fire-resistance of the building.

List of technical measures implemented during the management of building/buildings

- Insulation of roof, basement and external walls;
- Reconstruction of the vertical heating system in horizontal, providing individual heat consumption reporting for each household in the building;
- Replacement of joinery/windows;
- Change to energy efficient lighting.

Author

Housing Policy Directorate, Ministry of Regional Development and Public Works of Bulgaria

Case Study 10. Belgium – Belgium Renovates for Energy Efficient Living (BE REEL)

Project description

The project deals with housiung renovation strategy development in Belgium, for the regions of Flanders and Wallonia. Energy-efficient renovation of the Belgian housing stock is crucial in the framework of the Energy Efficiency Directive (2012/27/EU) and for reaching Belgium's climate and energy targets in the EU 2030 climate and energy framework. Integrated projects were created for implementation of environmental and climate legislation and objectives on a larger scale and to increase the impact of the LIFE programme in the EU.

Key targets

The objective of LIFE IP CA 16 BE-REEL! is to create the conditions for the full implementation of the strategic housing renovation plans for the regions of Flanders and Wallonia in Belgium. There is a need for interregional cooperation, and synergies among the Belgian authorities and stakeholders, to support new collective renovation and retrofitting policies. This approach would act as a catalyst for both socially and economically beneficial climate-friendly development. For Flanders, the Energy Renovation Programme 2020 will be continued with the Renovation Pact, with goals until 2050.

Period

2018 – 2024

Implementation steps

Step 1. Establishment of a framework for the implementation of regional strategies;

Step 2. Development, evaluation, refinement and demonstration of the most appropriate structural measures for long-term increases in renovation rates and improved energy performance of all existing residential buildings by 2050;

Step 3. Improvment of knowledge and capacity inside the Flemish and Walloon administrations, and for all involved stakeholders and authorities. The project will support capacity building and training, and produce guidelines for the construction sector;

Step 4. Enhancment of cooperation with stakeholders, administrations and local authorities through roadmap exercises, networking, best practices learning and collaborations;

Step 5. Creation of synergies between the Flemish and Walloon regions, and also with the Brussels Capital Region, in the framework of a 'learning network', with the aim of building capacity, avoiding the duplication of effort and creating more coherent policies;

Step 6. Development and implemention of a communication and marketing strategy.

Achieved results

The demonstration and pilot actions will lead at the end of the project to more than 8000 renovated dwellings. The direct GHG emission reductions due to all the project actions are forecasted to amount to over 18 600 tones of CO_2 per year. In the long run, the goal of the strategies developed under the framework of this project is to renovate all existing housing, achieving an expected reduction of 75-80% of CO_2 emissions and energy use by 2050.

Total benefits

- Increased number of innovative technologies, systems and instruments and/or best practice solutions to reduce GHG emissions;
- A significant increase in the number of regions/cities/sectors applying integrated approaches with the support of the project or replicating the results of the project;
- Strengthened climate change mitigation management and governance, including the level of

involvement and commitment of the relevant competent authorities and stakeholders at local, regional and national level.

List of technical measures implemented during the management of building/buildings

As to the renovation of 8500 very diverse houses, the partner cities will renovate the technical and financial feasibility of in depth renovations. The focus here is on a collective approach. The demonstration projects include collective renovations of houses into low-energy and nearly Zero Eergy Building, almost energy neutral homes through renovations of large and small apartment blocks, communal solar panels, district renovations, shallow geothermal energy, energy investments for vulnerable groups of the population and third party funding for energy renovations. Good practices will again be translated into guidelines, playbooks, roadmaps and training courses that will be distributed among the stakeholders on a large scale.

Author

Stijn Van Wolputte, Agency for Domestic Governance of Flanders

Project links

www.be-reel.be

https://youtu.be/RDx5o4TGjD8

https://youtu.be/ncJp8M6DPO4

Case Study 11. Georgia – Energy Audit Report for "m2" Residential Building

Project description

This case study deals with energy auditing for "m2" Residential building and presents an approach to potential energy efficiency solutions finding and evaluation. It describes a common approach to the evaluation of measures aimed to improve the quality of internal comfort for inhabitants and decrease the specific energy consumption.

Key targets

The main objectives of the project are:

- Identification of energy saving potential in residential building;
- Identification of energy efficiency measures;
- Calculation of energy savings;
- Calculation of CO_2 emission reduction.

Period

07/2016 – 08/2016

Implementation steps

Step 1. Collection of technical data from the selected buildings;

Step 2. Data analysis and identification of baseline consumption;

Step 3. Identification of energy efficiency measures and potential energy savings calculation;

Step 4. Analysis of the results and reporting.

Achieved results

Energy audit of the selected residential buildings revealed annual energy saving potential is 1,346,332 kWh and approximately 255 tons of CO_2 emission reduction.

Total benefits

Natural gas consumption for space heating - 892,47 kWh

Natural gas consumption for hot water preparation - 393,232 kWh

List of technical measures implemented during the management of building/buildings

- Thermal insulation of roofs, ground floor and external walls;
- Installation of double-glazed PVC framed windows;
- Installation of modern gas boiler for space heating and hot water preparation.

Author

Konstantine Barjadze, Energy Efficiency Centre of Georgia

Case Study 12. Republic of North Macedonia – Improved Management to Energy Efficiency of MFH

Project description:

The proper management of multi-family apartment buildings is a crucial element to improve their energy efficiency, especially in post-comunist countries. Abandoned mechanisms for maintenance and management of MFH that existed during the previous social system and lack of new models, motivated Habitat for Humanity Macedonia to establish a residential management company, called "Habidom".

Key targets

The main objective of the project is to improve the management of MFH and thus increase the access to finance for energy efficiency upgrades. Improving the management of multi-apartment buildings, providing better services, granting access to finances for energy efficiency upgrades and facilitating the process of joint decision among homeowners to retrofit common spaces is the core business of Habidom.

Period

2015 – ongoing

Implementation steps

Step 1. Signing of contract for the management of multi-apartment building with homeowners/HOA;

Step 2. Conducting specific needs assessments for upgrades in the buildings with the participation of homeowners;

Step 3. Facilitation of decision making processes with homeowners (51% homeowners have to reach consent for any related activities regarding the common property);

Step 4. Technical and administrative support to homeowners to provide loans and to select vendors for reconstruction;

Step 5. Monitoring reconstruction and loans repayments.

Main participants

Habitat Macedonia: established Habidom and provides loans (finance) for homeowners and homeowner associations;

Habidom: management of MFH and direct services to homeowners, including access to finance;

Homeowners associations: participating in the decision making processes;

Homeowners: participating in the decision making processes and paying for the services provided.

Achieved results

Habidom was established in 2015, and up to date is managing 2.332 households in 100 multi family apartment buildings. This means improved management, services and access to finance for those households managed by Habidom. Two buildings have complete energy efficiency retrofitting (changing windows, doors, applying thermo-facade, roofing and upgrades of common spaces), while one building is still under work. Habidom provides homeowners with access to finance for elevators repairments and direct services to renovate stairs and common spaces. Also, electricity network and lightening of common spaces in the buildings managed by Habidom have been significantly improved, leading to lower consumption of electricity. Improved management of MFH brings many benefits to homeowners, such as newly painted common spaces, bicycle parking, installed door phones, increased security, accountability and transparency of accounts, as well as administrative and

financial support for homeowner's associations.

Further achieved results include for the two retrofitted buildings: reduction of CO_2 emissions of 121,5 t/annual and reduction of energy consumption of 319.628 kWh/annual.

Total benefits

- Improved quality of living in the managed multi-apartment buildings;
- Improved energy efficiency and access to finance for energy efficiency upgrades;
- Increased accountability and transparency of the finance of the managed buildings;
- Increased capacities of homeowners associations.

List of technical measures implemented during the management of building/buildings

- energy efficiency retrofits of facade;
- replacement of windows in apartments and entrance doors;
- repairs/renovation of elevators;
- repairs/replacement of liking roofs;
- repair of the electricity grid and lightening of common spaces;
- creation of parking lots for bicycles;
- painting of common spaces;
- installation of door phones.

Author

Liljana Alceva, Habitat for Humanity Macedonia

Project links:

www.habidom.com.mk;

www.habitat.org.mk;

www.domuvanje.org.mk

Case Study 13. Russian Federation – Individual residential "A+ house" in Ekaterinburg

Project description

The Project "A+ house" is a pilot project in the frame of the Road map "Establishment of the economical and organizational incentives to impement the innovative energy efficient technologies and eco materials in the building sector" and the Programme of the state Duma on the low-rise buildings development "Own home".

Key targets

The project aims to develop and implement energy efficient solutions, which are affordable for people living in different regions. One of the key targets of the project was to increase the affordability of the energy efficient technologies in each region and the development of applicable energy efficient solutions for the low-rise residential constructions.

Period

2014 – ongoing

Main participants of the financing mechanism

Private companies "Ecodolye", "Magnum House", "VELUX' and "Technonikole"

Developers from MSBU (Moscow State Building University) and Saint-Petersburg State Architecture and Building University

Achieved results

So far, the project delivered the first energy efficient model of single-family residential house (economy class) which achieved an optimal balance between energy consumption reduction, healthy microclimate and eco-friendly behavior. The Project "A+ house" is one of the winners of "National competition on ecological development and energy efficiency – Green Awards" and the building constructed under this project was recognized as one of the best individual residential houses.

Total benefits

- Low construction cost - around 700 USD/m2;
- Integration of the individual accounting systems with the automated managing systems related to the residential buildings;
- Implementation of assessment principles for the life-cycle cost in order to justify the economic efficiency;
- Implementation of the individual accounting systems, which allows the automated accounting of the measures parameters as well as displaying, calculation, accumulation, storage and transfer of this information to the consumer.

List of technical measures implemented during the management of building/buildings

- Ventilation unit with recuperation (-40% of energy consumption)
- Solar collectors (- 60% HWS)
- Automated UV-protection (-90% of energy consumption for air conditioning)

- Automation "Smart home" (-20% of energy consumption)
- Energy efficient appliances and lightig (-25% of electricity consumption)
- Hybrid ventilation (-20% of electricity consumption)
- External walls insulation

Author

Prof. Irina Ilina , Moscow Higher School of Economics

Project links

http://magnumhaus.ru/projects/aplus

http://ekat.ecodolie.ru/proekt/

CHAPTER 4. CASE STUDIES ON AWARENESS RAISING, CAPACITY BUILDING AND BEHAVIOR CHANGE

This chapter refers to best examples of initiatives and various incentives promoted by federal or regional governments, municipalities, public departments, housing associations or private companies involved in the construction and maintenance of buildings. Cases may include special training and educational programmes developed for targeted audience of construction professionals, maintenance specialists, inhabitants of residential and users of public buildings.

Awareness rising is a very important component of the energy efficiency promotion and technologies dissemination, which is widely used across almost all countries of the UNCE region. For the countries of subregions A, B and D priority focus is given on promotion of personal energy responsibility from the individual end user side. Countries of subregion C, E and F are more actively working with training and educational aspects aimed to the ceation or strengthening of additional technical capacity.

Currently bigger priority in energy efficiency oriented training and promotion activities is given to the implementation of modern technologies and solutions for new building construction. Nevertheless the analysis of the submitted case studies shows a growing demand for information on efficient retrofit and energy losses identificationAn important role in wider dissemination and penetration of energy efficiency technological solutions, is also played by interactive and attractive promotion of energy efficiency for the public audience, such as public intertainment activities, involvement of children and students, organization of competions and others.

Big amount of energy efficiency oriented financial products for buildings are currently offered on the markets of UNECE countries. However, there is still a gap in the technical competence of relevant banking specialists and lending officers that limitstheir understanding of the multiple benefits of energy efficiency investments. The selected cases present activities related to the introduction of energy management and energy efficiency-focused educational courses and programmes that were introduced into the standard country educational programmes. With additional focus on renovation of existing buildings, countries can obtain varied social benefits; one of which is increased job opportunities in small- and medium-sized enterprises.

Case studies overview

Total: 8 case studies from 6 countries

The case study from **Georgia** presents the development and implementation of trainings that aim to increase motivation and awareness of managers of municipal departments or public buildings, staff responsible for the daily energy management, maintenance and operation of the public buildings, municipality staff in charge of developing and controlling the budget of the public buildings.

Two cases were presented from **Portugal.** The first one, the Poupa Energia project results from an initiative of the Portuguese government to ensure transparency and full access to information in the liberalized energy market, providing a tool for consumers. The tool helps consumers to find clear information about energy offers, comparing among all variety of tariffs on the energy market and allowing consumers to switch energy supplier through the platform.

The second case study is about energy efficiency awareness rising on the voluntary energy labelling scheme for building construction products, which are not covered by the European energy label (such as windows and insulation materials). The scheme is managed by ADENE and is endorsed by the industry's associations, thus assuring a wide market acceptance. It has been setup as an independent and sustainable business model focused on product suppliers who voluntarily join to label the energy

performance of their products, as well as to gain market recognition through the CLASSE+ brand. The implementation of the scheme is based on public events, training and capacity building for manufacturers and suppliers.

Two cases were received from **Albania.** The first one presents awareness rising and training programmes focused on the promotion of energy efficiency benefits for building energy users, development of expert's network in the field of energy efficiency to support the activities aimed to the buildings construction. In addition, local specialists received a toll to assess the energy consumption of buildings used before, which served as a benchmark for new investments. The second project aimed at enhancing and improving the coordination of Sustainable Energy Action Plans' (SEAP's), in order to reach energy savings and the national targets on public buildings' energy efficiency. The project develops and test a technologically oriented methodology that focuses on increasing cooperation among public authorities through Joint Actions.

A case from **Germany** is about creation of Buildings Knowadge Hubs (BKH) for Europe. Train-to-NZEB project aims to provide world-class training on energy efficiency and RES in buildings, based on new training programmes, business plans and up-to-date training equipment for a set of training and consultation centers around Europe. BKHs have provision of consulting services conduction and expected to increase the interest and capacity for design and construction of nZEBs supported by RES in the focus countries and to stimulate the market demand for such solutions for both new buildings and building renovations.

The case submitted by **Armenia** relates to the topic of residential energy efficiency for low income households**. A** financial model was developed and tested for partial thermal retrofitting of residential buildings. A specialized information campaign was arranged to increase the level of knowledge and engineering capacity of local specialists, which will be later involved in the process of energy efficiency buildings retrofit.

The concept of continuous education model for all aged categories (from primary schools up to pensioners), prepared in **Russian Federation**, involved all available channels and methods of education, such as trainings, public events, specialized educational programs adopted for in-country implementation and other.

Case Study 14. Georgia – Training and Certification of Private Sector Energy Auditors and Awareness Campaign for Energy Efficiency in Buildings

Project description

The submitted project consisted in the training of 40 energy auditors in energy efficiency principles and energy auditing in buildings and to conduct 50 energy audits in public buildings.

Key targets

The project aimed to increase the motivation and awareness of managers of municipal departments or public buildings; staff responsible for the daily energy management, maintenance and operation of the public buildings; municipality staff in charge of developing and controlling the budget of the public buildings. In the framework of the project, twenty-five energy auditors have been trained with the objective to carry out energy audits in the future. The training programme was devoted to private individuals with experience in the field of energy efficiency and/or buildings, public officers in charge of/or with experience in building management, and students.

Period

04/2017 – 11/2018

Implementation steps

Step 1. Preparation of a training needs assessment, announcement, and pre-announcement

Step 2. Development of the training programme and ofthe training material

Step 3. Official announcement of trainings and selection of participants by the target authority

Step 4. Trainings execution

Step 5. Energy audits in public buildings

Main participants in the project implementation

NEFCO, Energy Efficiency Centre Georgia, Allplan

Achieved results

From the 77 participants to the trainings, 61 completed the theoretical part, 39 started conducting audits and 20 have already finished the audit reports. In total, from 122 buildings selected for the piloting phase, 51 have been involved in an audit. For 27 of those buildings, the audit reports are already finished.

Total benefits

- Awareness raising and increase of local specialists capacity;
- Expanding of practical and theoretical experience of managers of municipal departments or public buildings; staff responsible for the daily energy management, maintenance and operation of the public buildings; municipality staff in charge of developing and controlling the budget of the public buildings;
- Identification of energy saving potential in public buildings.

Number of involved people (per categories of educational stages)

- 1st Training - 40 participants
- 2nd Training - 37 participants

Both training sessions consisted of four days of theoretical lessons. After the theoretical part, the

participants had to conduct energy audits in different buildings in order to successfully finish the whole training.

Author
Konstantine Barjadze, Energy Efficiency Center of Georgia

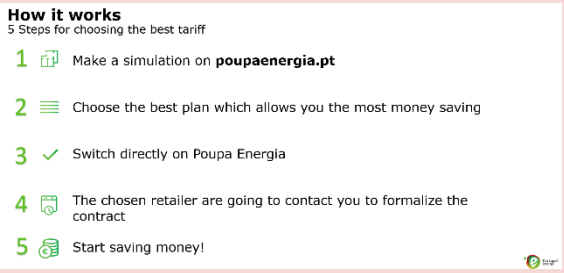
Case Study 15. Portugal – Interactive on-line EE tool Poupa Energia

Project description

The POUPA ENERGIA project consists in the development of an online energy efficiency tool upon initiative of the Portuguese government to ensure transparency and full access to information in the liberalized energy market, providing a free and unique tool for consumers.

Key targets

The POUPA ENERGIA online tool aims to: a) be the reference tool to providing clear information about energy offers; b) help consumers comparing among all variety of tariffs on the energy market; and c) allow consumers to switch supplier in real time through the platform.



Period

11/2017 – ongoing

Implementation steps

Step 1. Definition of content and platform structure;

Step 2. Creation and development of the online platform;

Step 3. Development and identification of articles and tips about energy efficiency to inform consumers;

Step 4. Establishment of the contact center for consumer support;

Step 5. Elaboration of a Mobile App for better use with other devices (in development).

Main participants in the project implementation

Energy Suppliers, Energy Supplier Switching Operator, Energy Services Regulatory Authority (ERSE), Directorate General for Energy (DGEG)

Achieved results

According to POUPA ENERGIA's last quarter report (Q3 2018), the tool has:

- Received 170,518 visitors
- Run 168,705 simulations
- Received 1,859 requests to switch tariff which allowed Portuguese consumers to save 187 k€ .

Total benefits

- It allowed consumers to save money for consumers by switching tariff through POUPA ENERGIA;
- Raised awareness in consumers about energy and how to save it;
- Provided transparency and access to all electricity and natural gas tariffs available on the market.

List of organized events/introduced methodologies/developed materials

- Elaboration of the methodology to make simulations of electricity and natural gas without consumption information, based on medium values for the portguese consumers;
- Availability of the POUPA ENERGIA Services on the Local Citizens Advice (national initiative to help consumers).

Author

Luis Castanheira, Investor Confidence Project Europe

Case Study 16. Albania Strenghtening the country's capacities on energy efficiency construction and design for buildings

Project description

In 2014-2015 the Ministry of Urban Development and Tourism and the National Housing Agency of Albania in cooperation with the International Financial Corporation (IFC), the United Nations Development Programme (UNDP) and the United Nations Economic Commission for Europe (UNECE), developed and conducted an awareness rising compaingn and a series of trainings for specialists working in the buildings construction and design sectors in order to integrate energy efficient practices and expiriences of advanced EU countries.

Key targets

The main targets of this projects include the following:

- To get aware of the main challenges that stakeholders are facing in the field of energy efficient housing and to share information on their initiatives especially in the field of legislation, regulations, norms and standards, financing and projects implemented;
- To share information on the country's EU obligation to reduce energy consumption, especially in the residential sector;
- To share knowledge on and assess the needs for energy efficient standards and norms;
- To pave a roadmap for future activities in the field of energy efficiency in the housing sector;
- To highlight the importance of housing (condominium) management in retrofitting the existing housing stock.

Period

07/2014 – 12/2015

Implementation steps

Step 1. Creation of a database for energy consumption in existing apartments buildings through audits;

Step 2. Organization of a regional seminar on energy efficiency, under the title 'Energy Efficiency in Housing for Sustainable Development';

Step 3. Signing of a cooperation agreement with the United Nations Office;

Step 4. Launch of the design contest 'Low cost and energy efficient building in Korca', as an opportunity not only to explore areas where investment was needed, but also to analyze and identify the challenges faced in this venture; in particular, cost effective assessment of investment for apartments to house low-income families.

Launch of the design competition for students and young architects on the topic "Social, Ecological and Energy Efficiency Housing".

Step 5. Human and technical capacity development through direct assistance.

Main participants in the project implementation

Ministry of Urban Development and Tourism, National Housing Agency; International Financial Corporation (IFC), United Nations Development Programme (UNDP), United Nations Economic Commission for Europe (UNECE).

Achieved results

- Raised awareness of the various stakeholders regarding the benefits of energy efficiency in housing for businesses, families, the economy and the environment;
- A network of experts 'ad hoc' in the field of energy efficiency was created to support the

programme and the further constructions.

- Experts enabled the partners to assess to the energy consumption of buildings used before the project was implemented, which served as a benchmark for new investments.

Number of involved people

- More than 50 people from the Albanian public sector;
- About 20 people from the private sector in the construction and manufacturing field;
- More than 50 students and young architects.

List of organized events/introduced methodologies/developed materials

- An open seminar Energy Efficiency in Housing for sustainable development';
- Two design competitions;
- Training.

Author

Doris Andoni, Ministry of Finance and Economy of Albania

Case Study 17. Train-to-NZEB: The Building Knowledge Hubs of Europe

Project description

The Train-to-NZEB project aims to provide world-class training on energy efficiency and RES in buildings, based on new training programmes, business plans and up-to-date training equipment for a set of training and consultation centers around Europe. Its goal is to improve the knowledge and skills in the construction sector and to provide practical trainings, demonstrations and comprehensive consulting services for design and construction of Nearly Zero-Energy Buildings (nZEB) supported by RES, based on the Passive House concept. All of these, combined with the provision of consulting services based on the ""One-stop shop" principle, is expected to increase the interest and capacity for design and construction of nZEBs supported by RES in the focus countries and to stimulate the market demand for such solutions for both new buildings and building renovations."

Key targets

The main tasks of the project include design and equipment of 5 fully active Building Knowledge Hubs (BKH) - in Bulgaria, Romania, Turkey, Czech Republic and Ukraine; the adaptation of existing and the development of new curricula for training of building professionals; training and certification for a total of 90 trainers, 2,400 construction workers, 480 designers and 720 non-specialists (representatives of public authorities, business managers, NGOs, consumer groups, media, etc.). All of these, combined with the provision of consulting services based on the ""One-stop shop"" principle, is expected to increase the interest and capacity for design and construction of nZEBs supported by RES in the focus countries and to stimulate the market demand for such solutions for both new buildings and building renovations."

Period

2015/06/01 - 2018/11/30

Implementation steps

Step 1. Development of Terms of Reference for local teams for the creation of Building Knowledge Hubs (BKH)
Step 2. Setting up 4 BKHs
Step 3. Development of Operational web-based networking platform
Step 4. Six new Memorandums of Understanding signed with new network members
Step 5. Preparation of new/adopted training programmes
Step 6. Conduction of training programs for professional and pedagogic training of trainers
Step 7. Support of a Website functioning for materials dessimination

Main participants in the project implementation

- "Limerick Institute of Technology (Ireland)
- Passive House Academy / MosArt (Ireland)
- Passive House Institute (Germany)
- National Institute for Research and Development in Construction, Urban Planning and Sustainable Spatial Development (Romania)
- Business Development Group (Romania)
- Pre-University Education Foundation – Future (Romania)
- Bulgarian Construction Chamber
- BSYS (Bulgaria)
- SEVEn (Czech Republic)
- Deparment of Civil Engineering at Ege University (Turkey)
- Municipal Development Institute (Ukraine)"

Achieved results

The EU-funded Train-to-NZEB project has established world-class energy efficiency training facilities and innovative new teaching programmes at five central and east European countries. This will enable the next generation of construction professionals to develop the skills and expertise needed to meet growing demand for net zero energy buildings (NZEB).

The training centres - or Building Knowledge Hubs - form part of a growing international network that combines theoretical lessons with practical hands-on exercises. The network also aims to increase interest in and awareness of NZEBs and stimulate market demand for optimal energy efficiency in new buildings and renovations.

Train-to-NZEB network concept will now be further developed and expanded. The new EU-funded project, Fit-to-nZEB, extending the network to Greece, Italy and Croatia was recently launched, with a focus on energy efficient building renovation.

Number of involved people

Training and certification for a total of 90 trainers, 2,400 construction workers, 480 designers and 720 non-specialists (representatives of public authorities, business managers, NGOs, consumer groups, media, etc.)

Author

Georgia Tzar, Passive House Institute

Case Study 18. Armenia – Residential Energy Efficiency for Law Income Households (REELIH) Project

Project description

REELIH project aims to improve residential energy efficiency while lowering energy consumption and costs for low-income households. Within the scope of the project Habitat for Humanity Armenia Foundation actively works with local authorities, financial institutions, homeowner associations (HOA), tenants and other key stakeholders in order to promote and improve energy efficiency in residential buildings. The project activities include implementation of energy upgrades of residential buildings, enhancing institutional capacities of HOAs, raising awareness of tenants and HOAs about the multiple benefits of EE measures implementation in the buildings, advocating to implement institutional and legislative reforms that will contribute to efficient management and maintenance of residential housing stock in the country and stimulate energy efficient investments in residential sector.

Key targets

The project aims at the following targets:

- To develop and test viable and replicable financial models for the implementation of energy efficiency measures in residential buildings;
- To mitigate the impact of the rising prices of energy for low-income households;
- To improve the legislative framework for residential energy efficiency (REE) in Armenia;
- To increase the capacity and awareness of homeowner associations' (HOAs) on REE

Period

05/2013 – 03/2019

Implementation steps

Step 1. Creation of partnerships with the municipality and financial institutions;

Step 2. Development of financial models for the thermal retrofitting of residential buildings;

Step 3. Organizetion of meetings with HOAs in the administrative districts in Yerevan in order to present the project and the participation terms;

Step 4. Organization of trainings on REE for HOAs;

Step 5. Introduction of the financial models and project participation terms to HOAs;

Step 6. Support to the interested HOAs to participate in the project and implement energy efficiency measures in the buildings via provision of technical assistance;

Step 7. Organization of opening ceremonies after successful completion of the works in the participating buildings.

Main participants in the project implementation

USAID, Habitat for Humanity Armenia Foundation (HFHA), Habitat for Humanity International, Inc. (HFHI), Yerevan Municipality, Inecobank CJSC

Achieved results

- Financial model developed and tested for partial thermal retrofitting of residential buildings;

- HOA managers gained knowledge on REE;
- 13 residential buildings energy upgraded as a result of introduced financial model and awareness raised among the HOAs and tenants.

Key benefits

- In total 265 HOA managers gained knowledge on REE, of which 6 HOA managers showed commitment to energy upgrade in 7 buildings;
- In total 13 buildings energy upgraded as a result of introduced financial model and awareness raised through trainings and meetings with HOAs.

Number of involved people

- Meetings organized in 10 administrative units in Yerevan: on average 25-30 HOA managers participated in each meeting;
- A total of 265 HOA managers participated in the trainings.

List of organized events/introduced methodologies/developed materials

- Meetings organized in 10 administrative districts in Yerevan to introduce the project and its terms of participation;
- Trainings materials prepared: presentations and information booklets;
- 19 trainings were organized for HOAs.
- Buildings selection criteria developed and application package developed for the HOAs
- According to the energy audit of 3 typical buildings the implementation of partial energy efficiency measures in residential buildings resulted in 2.8-14.2 tonnes/year CO_2 emissions reduction
- According to the energy audit of 3 typical buildings the implementation of partial energy efficiency measures in residential buildings resulted in energy savings of 13-64.5 mWh/year
- Other benefits from the implementation of financing mechanisms: tenants awareness raised about REE measures; capacities of HOAs improved: knowledge on REE obtained; HOAs started working with FI; the project also showed that HOAs can be good borrowers for the banks, as there have been no delays in the repayment of the loans.

Author

Varsenik Khloyan, Habitat for Humanity Armenia

Case Study 19. Russian Federation – Establishment of the continuous educational system in the field of energy efficiency

Project description

The concept of continuing education for the project was based on the individual ability to realize his/her potential at all ages, regardless of the place and time (in school, university, on workplace or at home) and using all available channels and methods of education. Under the framework of the UNDP-GEF Project "Buildings energy efficiency in the North-West of Russia", a holistic educational system in the field of energy efficiency was developed.

Key targets

The continuous education system on energy efficiency aimed at providing a continuity in the basic educational programmes in order to establish "efficient" models for personal behavior and develop the rational energy- end resources consumption skills, regardless of age, level of education and location.

Period

06/2011 – 12/2017

Implementation steps

Step 1. Development, publishing and dissemination of teaching and methodological materials;

Step 2. Organization and conduction of extra-curricular lessons for students, as well as events, grants, sessions and programmes within the current education;

Step 3. Execution of methodological work on the implementation of the training modules and programmes, by studying best practices from other institutions and experience exchange;

Step 4. Establishment of the Interregional Center of Professional Education and Personnel Training in the field of energy efficiency;

Step 5. Awareness raising among public authorities (festivals, seminars, publications etc.).

Main participants in the project implementation

Russian Energy Agency under the Ministry of Energy of Russian Federation, the Center of Energy Efficiency (under the Ministry of Education of Russian Federation), regional departments of education, regional educational institutions (schools, colleges, universities etc.), the International Center for Sustainable Energy Development (ISEDC) under the auspices of UNESCO.

Achieved results

The system of continuous education in the field of energy efficiency was established and successfully implemented in 11 regions of Russian Federation. More than 5000 school pupils in 47 schools and 3700 students trained in colleges, participated in the initiative. New educational programmes for higher education institutions (Energy management, master's degree) were introduced and implemented in 5 participating universities. Among the other achievements, the inter-regional center of online education (RUEELP) was

established and international educational programmes for young specialists from more than 35 countries were Organized.

Number of involved people

- 52 schools (elementary education);
- 1345 students in colleges;
- 2419 students in universities;
- 1400 professionals participated in the online training sessions;
- around 60 young specialists from more than 35 developing countries participated in the international educational sessions on energy management.

List of organized events/introduced methodologies/developed materials

- 17 tutorials for schools, colleges, universities and post-graduates;
- educational sessions for school teachers and lecturers from universities;
- 4 national and international competitions for schools and universities on the best project in the field of energy conservation;
- supported 2 national festivals #TogetherBrightly (organized by the Ministry of Energy of the Russian Federation).

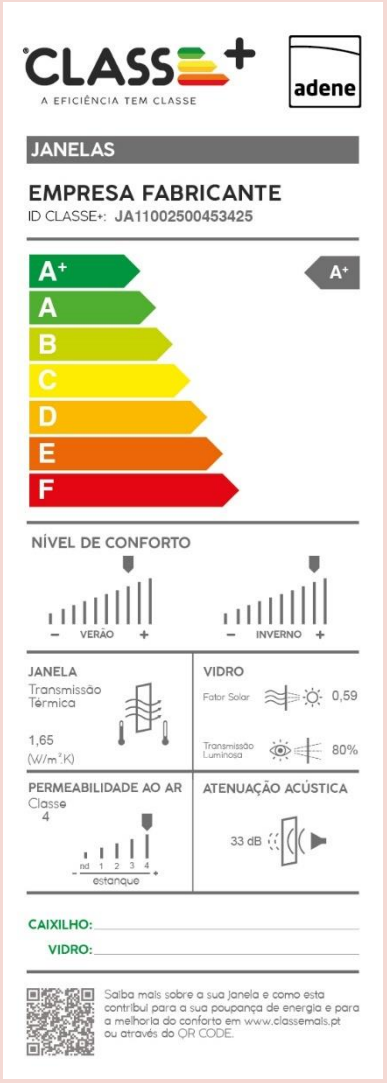
Author:

Maria Lukina-Lebedeva, Programme Support Consultant UNDP

Case Study 20. Portugal – CLASSE+ Voluntary Energy Labelling Scheme

Project description

This selected case study refers to the creation of a national voluntary energy labelling scheme called CLASSE+. CLASSE+ is a voluntary energy labelling scheme for building construction products not covered by the European energy label, such as windows and insulation materials. The scheme is managed by ADENE and is endorsed by the industry's associations, thus assuring a wide market acceptance.



Key targets

The labelling scheme has been setup as an independent and sustainable business model focused on products suppliers who voluntarily join to label the energy performance of their products, as well as to gain market recognition through the CLASSE+ brand. The label's rating level (from F to A+) has been used as a reference in financing and for public incentives schemes. CLASSE+ also involves training and qualification of installers.

Period

01/2018 – ongoing

Implementation steps

Step 1. Methodology development for energy performance rating of products not covered by EU regulations;

Step 2. Setting up of a labeling platform for centralized issuing of labels;

Step 3. Brand development and communication strategy;

Step 4. Business plan development and implementation.

Main participants in the project implementation

ADENE - Portuguese Energy Agency, ANFAJE - National Association of Efficient Windows and Facades, IteCons - Institute for Research and Technological Development in Construction, Energy, Environment and Sustainability, LNEC - National Laboratory of Civil Engineering

Achieved results

The CLASSE+ labelling initiative started in 2018 with labelling of windows' energy performance. It has been quickly and extensively adopted by the window market, with more than 100 companies voluntarily joining the scheme in the first year only. These companies cover more than 50% of national production, thus enabling the CLASSE+ window label to nearly become a common market standard. CLASSE+ labels for other products like insulation solutions, paints, window films are at final stages of preparation and are expected to roll out in 2019 and following years.

The scheme supports the reduction of CO_2 emissions associated to the energy consumption in buildings during their operation, in fact by adopting the scheme, it is expected up to 50% reduction in energy consumption/losses through the substitution of existing materials and products by new and more efficient ones with A or A+ labels by CLASSE+.

Number of involved people

- University degree - 3
- MBA / Doctorate - 1

List of organized events/introduced methodologies/developed materials

- Energy performance rating methodology for windows (PT climate region);
- Brand development and different communication materials;
- CLASSE+ launch event in December 2017;
- Ongoing different communication actions.

Author

Luis Castanheira, Investor Confidence Project Europe

Case Study 21. Albania – Joint Actions for Energy Efficiency (ENERJ)

Project description

ENERJ (Joint Actions for Energy Efficiency) is an Interreg Mediterranean (MED) project and aims at enhancing and improving the coordination of Sustainable Energy Action Plans' (SEAP's) and other relevant energy Efficiency Plans, in order to reach energy savings and the national targets on public buildings' energy efficiency. The project will develop and test a technologically oriented methodology that focuses on increasing cooperation among public authorities through Joint Actions.

Key targets

ENERJ (Joint Actions for Energy Efficiency) supports cities and towns in achieving their energy efficiency targets in their own municipal building stock. It fosters the collaboration among local governments for joint actions and simplifies decision making, designing and implementation of pilot actions. An ENERJ Platform will be created to host a database on Local Energy Action Plans and Energy Efficiency measures and serve as a forum for the interested stakeholders.

Main outputs will be: (i) integrated large-scale Joint Actions for EE, able to achieve economies of scale, significant impacts on energy consumptions and emissions, catalyse a wider range of investments and leverage Structural Funds through the ROPs; (ii) ENERJ web platform implementation, a geo-database of the EE measures adopted by the municipalities within SEAPs or other local energy plans; (iii) Enhancement of public and private stakeholders skills and delineation of the Joint Actions Coordinator to assess, define, adopt, implement and monitor EE actions and plans.

Period

11/2016 – 04/2019

Implementation steps

Step 1. In a first round of local conferences the partners informed their stakeholders about ENERJ, and collected their feed-back on planned projects, possible joint actions, barriers and obstacles, but also opportunities. At the same time, context analyses were executed to identify the basis for a common methodology for Joint Action on Energy Efficiency. The plan will contain the foreseen efficiency measures in existing energy plans (SEAPs), financing schemes and a selection of buildings in each partner region that will undergo energy audits.

Step 2. An online platform was created to collect the energy data gathered from the project implementation. The energy data of the audits will go onto the platform together with the EE measures already adopted by the municipalities.

Step 3. Creation of a Joint Action Coordinator who will be responsible to liaise with authorities at the local and district level and to develop supra-municipal interventions with an adequate project design, mobilization of EU structural and other funds and the involvement of ESCOs and other stakeholders. The project will organize trainings for joint action coordinators.

Main participants in the project implementation

ANATOLIKI S.A. - Development Agency of Eastern Thessaloniki' Local Authorities, Andalusian Federation of Municipalities and Provinces (ES), Albanian Ministry of Infrastructure and Energy (AL),

IRENA-Istrian Regional Energy Agency L.t.d. (HR), CEA-Cyprus Energy Agency (CY), Metropolitan City of Capital Rome (IT), GOLEA-Goriška Local Energy Agency (SI), AREANA Tejo-Regional Energy and Environment Agency from North Alentejo (PT), Climate Alliance Italy (IT), Gozo Development Agency – Gozo Regional Committee (MT), Climate Alliance Italy (IT)

Achieved results

The project so far achieved the following results:

- Publication of the report Public buildings energy audits which aims to collect existing data on selected public buildings and integrate it with new analyses and studies in order to complete the status quo situation.
- Publication of the Guidelines for Joint Actions for Energy Efficiency which are intended to provide partner organizations with useful indications on the technical and administrative steps needed to effectively plan, design, implement, manage and monitor joint actions for energy efficiency, preferably within the framework of joint SEAPs.
- Publication of the report Plans and Measures Analysis which investigate on the plans and measures on Energy Efficiency (EE) in the public building stock for each partner country and assesses the EU Directives that are relevant to the EE of public buildings and how they are nationally implemented in each of the partner Countries, along with the other specific laws that are related to EE of buildings.
- Publication of the Funding Tool Report which lists the funding opportunities to improve the energy efficiency of the public building stock in the partners' countries.

Key benefits

Benefits and results from the project implementation include reaching energy savings and the national targets on public buildings' energy efficiency.

List of organized events/introduced methodologies/developed materials

- ENERJ Kick-off meeting on 11 January 2017
- 1st local conference in Slovenia on 29 March 2017
- ENERGJ partner event at the EU Green Week in Seville and 1st local conference in Spain on 02 June 2017
- 1st local conference in Croatia on 13 June 2017
- ENERJ 2nd meeting on 31 May 2017
- ENERJ 3rd meeting on 22 november 2017
- 1st local conference in Italy on 13 February 2018
- ENERJ 4th meeting on 5 June 2018
- Advocacy boot camp with practical training in strategy, political influence, storytelling and digital communication on 22 May 2018
- ENRJ 5th meeting on 3 December 2018
- The booklet and the new video of the Efficient Buildings Community - the MED Community for more efficient public building animated by the MEDNICE horizontal project - are online.

Author:

Artan Leskoviku, National Agency of Natural Resources

Project link

https://enerj.interreg-med.eu/

CHAPTER 5. CASE STUDIES ON TECHNICAL MEASURES INCLUDING SMART AND AFFORDABLE TECHNOLOGIES AND INNOVATION

This chapter includes best practices of holistic approaches to improvements of energy performance of buildings and their components. Examples include all main categories of energy efficiency technologies in buildings: insulation and glazing; space heating; air conditioning; water heating and cooling; lighting; energy management systems and other modern energy efficiency technologies. A special focus is given to the implementation and use of smart and/or affordable technologies (including sensors, IoT, etc.) and innovative approaches.

The analysis of the presented case studies shows a significant change in the implementation of modern energy efficiency technologies as it was not the case previously. Various engineering solutions are implemented for the energy savings effect increase and improve building functionality. Also a trend on massive implementation of smart metering technologies was found, because of the need to evaluate achieved energy savings. In order to increase the transparency of the energy payments structure, individual residential homeowners and other energy users types are highly interested in the increase of the energy metering share installed, especially for heat energy measurement.

Most of the countries of UNECE region shows an increased adoption of highly efficient boilers, along with shifts to cleaner fuel sources. The case studies presented in the report show technology trends on the installation of efficient gas-fired boilers, electric boilers, solar collector systems, and heat pumps as well as improved design and construction stages. This is likely due to the market reacting to relevant EU and other local directives (for non EU counties), which also target technologies in building insulation and windows.

Case studies overview

Total: 8 case studies from 8 countries

The case study from **Albania** presents the rehabilitation of a students' dormitory building located in Tirana. the implemented energy efficiency measures aimed to improve the thermal comfort conditions in the student dormitory, having more efficient energy use and reduction of energy expenses. The environmental impact from the building operation was reduced due to the installation of renewable energy sources. A further energy monitoring system was installed to confirm the efficiency of implemented measures and proper buildings maintenance.

An energy efficient multiapartment residential house was constructed in **Belarus**. The aim of its design and construction was to apply perspective engineering solutions, which allow to reduce the fuel consumption for heating and hot water supply needs. It was expected to decrease the annual heat power consumption up to 15 kWh/m^2 per year and up to 30% for the hot water supply.

The case from **Bosnia and Herzegovina** refers to residential energy efficiency for low income households. Most importantly, the homeowners within the selected buildings had to reach a consensus not only on the energy efficiency renovations that they wanted to implement in their individual apartments and common spaces, but also on their readiness to co-finance these renovations, by means of taking an individual or a collective loan, if necessary.

Croatia submitted a case regarding the construction of a passive house using prefabricated wall panels with recycled insulation filling material. This is a ventilated prefabricated wall panel which utilizes recycled construction and demolition waste (CDW) and mineral wool produced using

innovative and sustainable technology for reduction of primary energy consumption in the building stock and harmful impacts on climate change.

Georgia submitted a case about Energy Efficiency Measures for Tbilisi Elders Boarding House. The project experts developed technical specifications and approved the implementation of energy efficiency measures. In particular they introduced solar thermal systems integrated with the existing heating and hot water supply systems working on natural gas and replaced incandescent light bulbs with LED bulbs. The second case from **Georgia** in this section concerns the retrofit of 3 kindergadens in the city of Rustavi. The project focused on the implementation of electrical and heat energy comsumption reduction and the creation of a demonstration case for further replication in Georgia.

The overall concept of the EuroPHit project, implemented in **Germany,** aimed to significantly increase the quality and efficiency of building retrofits leading to deep energy retrofits in the following countries: Germany, Italy, France, Ireland, Slovakia, Sweden, Spain, Denmark, Bulgaria, Czech Republic, United Kingdom. The new concepts developed on step-by-step retrofits has been put in use in various building case studies involved in the project – showing the way towards an increasingly high quality, energy efficient building stock.

The submitted project on the construction of energy efficient municipal residential buildings in **Russian Federation**, was aimed at demonstrating an example of energy efficiency increase in the residential building sector in comparison with the typical buildings construction within the governmental resettlement programs. In order to increase buildings' energy efficiency and reduce the greenhouse gas emissions, on the stage of the design and estimate, documentation correction was proposed in order to identify less costly and most efficient measures and technologies.

New energy-efficiency enhancements using typical designs for single-family residential buildings were conducted in **Turkmenistan**. Before 2016, there was no approved design tackling energy-efficiency in the residential sector in Turkmenistan. The key target was to achieve the transformation of single-family residential building design and construction in Turkmenistan, thereby saving energy and correspondingly curtailing greenhouse gas emissions on a large scale through the compliance with new code requirements.

Case Study 22. Albania – The Energy Efficient Rehabilitation of a Student's Campus in Tirana

Project description

The submitted case study deals with the implementation of energy efficient solutions for a student campus in Tirana. Four buildings of Student Campus no.2 have been involved in the project with a total gross floor area for all four buildings is 15,624m^2.

Key targets

The proposed package of energy efficiency measures aims to:

- Improve thermal comfort conditions in the student dormitories;
- Have more efficient energy use;
- Reduce energy costs ;
- Improve the environmental impact (use of renewable energy sources) of the buildings;
- Implement the energy saving measures with the least disruption to the building;
- Monitor savings to confirm that they have been achieved and ensure the maintenance of the buildings.

Period

09/2015 – ongoing

Implementation steps

Step 1. Refurbishment of the building envelope (thermo-insulation walls, roofs, ground floor, windows replacement, shading);

Step 2. Replacement of the former heating system with a modern system using renewable energy (Pellet boiler);

Step 3. Improvement of domestic hot water system by installing pellet boiler and solar panels

Step 4. Replacement of the ventilation system with an energy efficient one

Step 5. Installation of LED &CFL lights

National and international partners

Ministry of Infrastructure and Energy of Albania, KFW (Kreditanstalt für Wiederaufbau), Department of the Student City Administration No.2, Municipality of Tirana

Lessons learned

The following issues were identified in the buildings before starting the work:

- Walls were not insulated and plaster was often damaged; Windows were single-glazed with not insulated frames;
- Roofs were not thermo-insulated and the hydro-isolation was partly leaking;
- The Electrical System was old, unsafe and in very poor conditions;

The Heating System did not function and a central one for the overall building complex was missing. The heating system integrated in building No.1 during a former renovation never functioned. The boiler was wrongly installed and could never support the system. At the time of the inspection, all the remaining elements like the water based radiators or convectors and pipes were worn out and in very

bad conditions;

- The shower and sanitary rooms showed insufficient ventilation and bad hydro insulation;
- Water supply system was insufficient;
- The boilers for the domestic hot water production were old and worn outwith very bad performances. Thermal comfort was very poor especially during winter;
- The need for hot water was one of the biggest problems for the users.

Total benefits

- Normalised indoor temperature and humidity levels
- Decrease of heat and electrical energy consumption
- Reduced CO_2 emissions

Achieved energy conservation

- Reduction of the buildings energy consumption to 654,593 kWh/year (-82% compared to before the retrofit)
- Passage of the buildings to Class B of the EU energy classification
- Reduction of the energy cost to 80,278 €/year
- CO_2 reduction to 732,748 kg/year

Author:
Artan Leskoviku, National Agency of Natural Resource

Case Study 23. Belarus – Energy efficient residential house

Project description

The case study from Belarus concerns the creation of an energy efficient residential building in the municipality of Hrodna using cutting-edge engineering solutions to reduce the fuel consumption for heating and hot water supply needs.

Key targets

The project aimed to decrease the annual heat power consumption up to 15 kWh/m^2 per year and up to 30% for the hot water supply.

The following equipment was installedto achieve the targets:

- managing supply and exhaust ventilation system with heat power recuperation;
- heat recovery system for wastewater;
- two heat pumps as the key heat power source;
- photovoltaic batteries (total panels surface 400 m^2).

Period

01/2015 – 06/2017

Implementation steps

Step 1. Development of the energy efficient house concept and feasibility studies;

Step 2. Preparation of the design documentation, passing the state mandatory examination;

Step 3. Construction phase and quality control;

Step 4. Installation and adjustment of the energy efficient equipment, training of the operational services and future inhabitants;

Step 5. Monitoring and evaluation.

National and international partners

Department of energy efficiency of the Gosstandard, Ministry of Architecture and Construction of Belarus, Hrodna city Administration, UNDP Belarus, Hrodnapromstroy PSC

Identified barriers

- Lack of the energy efficient equipment use in the residential buildings
- Insufficient ventilation of premises
- Lack of the experience in the field of secondary and renewable energy resources use
- Low motivation of the inhabitants to conserve energy due to the low tariffs for heat power

Total benefits

- Increased air quality and improved temperature and humidity conditions in the building;
- Energy conservation by means of the improved buildings parameters while its exploitation
- Implementation of modern technical solutions in the field of secondary and renewable energy sources use;
- Application of modern energy efficient technologies;
- Awareness increase on the eco-friendly behavior among the inhabitants .

Achieved energy conservation

- Passage to energy class A+
- Annual heat power for heating – 340 000 kWh
- Annual heat power for hot water supply – 300 000 kWh
- Actual annual electricity production in 2017-2018 – 50 000 kWh

Author

Leonid Danilevsky, Pilipenka Uladzimir, Tserakhau Siargei, Katsynel Ryshard
Institute of Housing NIPTIS of name Ataev S.S., Institute Grodnograzhdanproect

Case Study 24. Bosnia and Herzegovina – Residential Energy Efficiency for Low Income Households

Project description

The Residential Energy Efficiency (REE) for Low-Income Households (REELIH) project established by Habitat for Humanity with the financial participation of USAID seeks to demonstrate that integrated efforts in this sector – both at the regional and national levels – addressing market, capacity and knowledge gaps will bring significant improvements to the living conditions of the low-income families in multi-unit apartment buildings, reduce energy costs and carbon emissions.

The REELIH project is focusing on developing a regional effort, resources and networks to address the impact of rising energy prices on collective housing. REELIH develops a sustainable model for the financing and management of residential energy efficiency improvements in selected multi-unit apartment buildings in five municipalities in Bosnia and Herzegovina.

Key targets

The overall objectives of the project are:

- Improve the REE investment environment in the region through a regional platform for knowledge sharing, awareness raising and advocacy, addressing financing approaches, promoting entrepreneurial solutions, developing jobs and making available appropriate technical information;
- Develop and test replicable financing models combining capital and subsidies for lower income households to decrease energy consumption and cost;
- National institutional capacity development and improve the management and maintenance of collective residential units by homeowner associations and/or other stakeholders in the public and private sectors.

Period

07/2015 – 09/2017

Implementation steps

Step 1. Building stock assessment;

Step 2. Preparation of residential energy efficiency action plans;

Step 3. Development of a sustainable financial model for the implementation of energy efficiency measures ;

Step 4. Homeowners associations education and trainings;

Step 5. Implementation of energy efficiency measures in the pilot buildings.

National and international partners

Habitat for Humanity International, Enova Sarajevo, Ministry of Spatial Planning and Environmental Protection of Tuzla Canton, Municipality of Banovići, Municipality of Živinice, Municipality of

Gračanica, Municipality of Gradačac, Municipality of Tešanj

Lessons learned

In the first phase, the REELIH project sought solutions for financing, through a combination of subsidies and commercial loans. The project wanted to target at least one demonstration building in partner municipalities in Bosnia and Herzegovina. Initially, there were 4 pilot buildings in Tesanj, Zivinice and Banovici, selected according to clear criteria developed by local financial partners, local governments, as well as Habitat for Humanity International. Most importantly, the homeowners within the selected buildings had to reach a consensus not only on the energy efficiency renovations that they wanted to implement in their individual apartments and common spaces, but also on their readiness to co-finance these renovations, by taking an individual or a collective loan, if necessary.

The REELIH program facilitated this process by providing all necessary information and a tailor-made training program for residential energy efficiency to homeowners' associations and apartment owners. The programme also assisted homeowners' associations to select construction companies to work with, independent construction supervisors to oversee the works, and energy audit companies.

Additional three buildings in municipalities Banovici, Gracanica and Gradacac were included during the second phase of the Project. Cantonal Ministries and Municipalities carried out the procedure of allocating funds, selecting the buildings and the construction company using experience gained through the first phase of the implementation of the REELIH Project. At the end, a total of 7 buildings were renovated through this project so far, mobilizing a total investment of almost 260,000 USD (mainly tenants' funds; the Ministries and municipalities supported up to 50% of the total investment), achieving savings in energy for heating of 37.13 % compared to the initial state, as well as savings in CO_2 emission of 151.16 t/year.

Total benefits

- 7 buildings renovated;
- Energy efficient buildings with thermal insulation on outer walls and roofs;
- Improvement of the environmental impact of buildings;
- Lower energy consumption for heating, less costs for heating and CO_2 emission reduction.

Achieved energy conservation

- 24,465.45 USD/year
- 527,403.45 kWh/year
- 151.16 t/year CO2 emission reduction

Author

Marin Petrovic, Enova Sarajevo

Project link

www.topaodom.ba

Case Study 25. Croatia – The first passive house which uses the ECO-SANDWICH® concept

Project description

Project is focused on construction of A+ energy standard multi- and single family buildings, with affordable consruction price for low- and middle-income households. Innovation energy efficient material ECO-SANDWICH® was used in building, opened in the city of Koprivnica, as one of the twelve planned typical multi-family houses

Key targets

The project is the world's first case of a ventilated prefabricated wall panel implementation, which utilizes recycled construction and demolition waste (CDW) and mineral wool produced using innovative and sustainable technology for the reduction of primary energy consumption in building stock and harmful impacts on climate changes. The prefabricated facade system was developed as a result of the cooperation of Croatian scientific institutions and industry. The construction of the first pilot house is the result of a long research on sustainable materials and systems development. This includes research on methods of architectural design for new constructions and high energy efficient renovations up to energy standard of passive house („A+") and higher. This small multifamily building with three storeys was designed as the type model which will be performed on the next eleven sites in the Green Quartier of the town of Koprivnica in Croatia.

Period

2015

Implementation steps

Step 1. Development of the project concept;

Step 2. Innovative Technology development

Step 3. Development of the architectural design;

Step 4. Construction of the building;

Step 5. Monitoring of the achieved results.

National and international partners

Town of Koprivnica - State Programme for Social Housing (APOS), EU (Eco-innovation programme), Inhabitants - the owners of the flats

List of technical measures implemented

- Innovative ventilated facade system
- Passive House Energy standard (A+)
- Architectural design for the first implementation
- Innovative details

Summary of achieved results

ECO-SANDWICH® was presented at 12 international and national conferences, in 8 technical and scientific journals, in 23 publications in newspapers and specialized magazines, in 32 web articles and 4 telecasts. Leaflets and brochures were designed and published, a web page was created and regularly updated. The report in English and Croatian, summarizing the projects' objectivities and results, was published.

Author
Prof. Ljubomir Miscevic, University of Zagreb

Project link
www.eco-sandwich.hr

Case Study 26. Georgia – Warm Elderly – Energy Efficiency Measures for Tbilisi Elders Boarding House

Project description

The Covenant of Mayors is a European movement involving local and regional authorities who voluntarily commit to increasing energy efficiency and use of renewable energy sources on their territories. By their commitment, Covenant signatories aimto meet and exceed the European Union 20% CO_2 reduction objective by 2020. The city of Tbilisi has joined the movement and committed to several targets by 2020. One of this targets is the renovation of municipal buildings following the standards for improved energy efficiency and use of renewables. This projects falls under this objective.

Key targets

The project aims at contributing to the national energy security and global environment by offering tools and means for improvement of energy efficiency in Georgian communities and reduction of GHG emissions in response to the challenge of climate change. The following are the project objectives:

1. To assess social, technical, economic and environmental aspects of the introduction of renewable energy and energy saving solutions in community facilities, regional, municipal and local, self-government in Georgia;
2. to promote the benefits of energy-saving technologies and practices in the state, municipal and community buildings among the energy managers or other decision makers responsible for energy related issues;
3. To demonstrate that the application of clean energy solutions in Georgia has the potential to meet energy demand, resulting in increased level of comfort along with energy bill and emissions' reduction;
4. To raise awareness on how energy resources are used in the workplace and how actions can directly affect energy consumption;
5. To Contribute to the capacity building of Georgian municipalities and self-governments in the development of the energy efficiency policies and local action plans.

Period

09/2015 – 06/2016

Implementation steps

Step 1. Elaboration of the energy auditing of Tbilisi Elders Boarding House building;

Step 2. Development of technical specifications for the implementation of energy efficiency measures, in particular the introduction of solar thermal systems integrated with the existing heating and hot water supply systems working on natural gas and replacement of incandescent light bulbs with LED bulbs;

Step 3. Preparation of the procurement documentation for the supply and installation of solar thermal system for building and supply of LED light bulbs for the building;

Step 4. Introduction of the solar thermal system integrated with autonomous heating and hot water supply system on natural gas; energy efficiency upgrade of the building envelope, including insulation of external walls; and construction of enclosure walls and doors to separate building cold spaces from warmer occupied areas;

Step 5. Replacement of incandescent light bulbs with LED lighting;

Step 6. After the commissioning of the installed equipment further monitoring of energy consumption was carried out for a year.

National and international partners

BP, Winrock Int., USAID, Energy Efficiency Center Georgia

Identified barriers

- Underheated room temperature
- Poor lighting quality
- Heat losses from building envelope (roof, windows, floor, walls)

Total benefits

- Upgrading of the building using energy afficient and renewable energy solutions;
- Local beneficiaries trained in operation and maintanance of clean energy technologies;
- Project informational promotional materials prepared and disseminated to raise awareness among the public and the residents;
- Study tour for representatives of other Covenant of Mayors municipalities and media to the project sites to share knowledge and experience.

Achieved energy conservation

- 9,000 USD (compared to baseline)
- 185,028 kW*h (compared to baseline)
- Average payback period: 9.3 years
- 31.4 Tons CO_2 emission reduction (compared to baseline)

Author

Konstantine Barjadze, Energy Efficiency Center Georgia

Project links

https://www.eecgeo.org/en/project_BP_new.htm

http://www.inogate.org/documents/INOGATE_Awareness-raising_Workshop_Ioseb_Vardoshvili_en.pdf

Case Study 27. Georgia – Retrofitting 3 kindergartens in the city of Rustavi to achieve high energy efficiency standards

Project description

This project deals with the retrofit of three indergardens in the city of Rustavi to make them more energy efficient. The project was conducted in cooperaton with different partners. and aimed to create an example which could be replicated in other cities in Georgia.

Key targets

The project is an example of a retrofit of public buildings and aimed to use renewable energy sources and more energy efficient technologies to improve the construction and operation of three kindergartens in Rustavi.

Period

2015 – 2017

Implementation steps

Step 1. Feasibility studies of 3 kindergartens in the city of Rustavi

Step 2. Energy auditing and development of energy passports with the energy performance certificates for these 3 kindergartens

Step 3. Rehabilitation plans and development of the technical designs

Step 4. Development of tender documentation using the EU guidelines and execution of the competitive tenders

Step 5. Supervision of construction works, monitoring, implementation, communication activities and, to conclude the project, assessment and dissemination of its results

Main participants in the project implementation

Sustainable Development and Policy Center (SDAP), Rustavi City Municipality Officials, Kindergardens staff

Achieved results

- Installation of the space heating system;
- Construction of the boiler room outside of the building;
- Installation of the hot water supply system in combination with the installed solar collectors;
- Installation of the comprehensive ventilation system with heat recovery;
- Installation of a comprehensive electrical system with efficient bulbs and ground loop;
- Installation of efficient windows with low emissive glazing and diffusion tight and diffusion open sealing tapes.

Organized events

- Training session dedicated to renewable energy and energy efficiency issues in Rustavi City Municipality
- One day training sessions were carried out in Batumi and Kutaisi for representatives of Covenant of Mayors signatory/potential signatory municipalities from Western Georgia on the replicability of the project results

Author

Nika Tortladze, Ministry of Economy and Sustainable Development of Georgia

Case Study 28. Germany – EuroPHit, buildings retrofits project

Project description

Recognizing the need for significant energy efficiency improvements to Europe's existing building stock and in order to reach EU energy goals, the EuroPHit project aimed to significantly increase the quality andefficiency of building retrofits – leading to deep energy retrofits. The new concepts developed on step-by-step retrofits has been put to use in the various building case studies involved in the project – showing the way towards an increasingly high quality, energy efficient building stock.

Key targets

With the EnerPHit Standard as the goal and Passive House principles as the basis, EuroPHit applied knowledge on deep energy retrofits to the oft-overlooked yet critical area of step-by-step refurbishments.

Period

01/04/2013 - 31/03/2016

Implementation steps

Step 1. Internal training for tradespersons and designers on case study projects

Step 2. Project consultation and initial design for case study projects

Step 3. Creation of the energy balance tool and criteria for step-by-step retrofits, along with training materials and a handbook with recommendations for step-by-step retrofits

Step 4. Creation of overall refurbishment plans and execution of first retrofit steps for the pilot projects

Step 5. Training for designers and tradespersons on step-by-step deep energy retrofits and documentation of findings from successful case studies

Step 6. Involvement of the financing institutions and development of financial guidelines and attractive financial support programmes or one-stop-shop models

Step 7. Product evaluation and support for the development of innovative concepts for new components for step-by-step retrofits

Step 8. Dissemination events: International Passive House Conferences and Component Awards

National and international partners

Project was done in following countries: Germany, Italy, France, Ireland, Slovakia, Sweden, Spain, Denmark, Bulgaria, Czech Republic, United Kingdom.

15 partners in 11 EU-Member State countries - PHI, iPHA, ZEPHIR, La Maison Passive, MosArt, Inštitút pre energeticky pasívne Domy, Plataforma de Edificacion Passivhaus, Passivhus.dk ApS, EnEffect Group, Atrea s.r.o., Askeen S.r.l., Onyx Solar Energy, S.L., IzN Friedrichsdorfer Institut zur Nachhaltigkeit e.V., Building Research Establishment"

List of technical measures implemented

- «Online manual on step-by-step deep energy retrofits to EnerPHit standard» was produced with recommendations and descriptions of the quality assurance process provided by the certification concept. Training modules for designers, craftsmen and airtightness-specialists were also set up and implemented in the training schedule of many of the project partners, to ensure adequate and growing capacity.
- Mechanical ventilation, with heat recovery for highly efficient buildings .
- Competent consultation and design and quality assurance.
- Product solutions for supplementary installation of renewables.

- Implementation of highly efficient components such as wall or roof insulation, high performance windows or doors
- Development of thermal bridge free connections or improved connection details for interim refurbishment stages

Summary of achieved results

- Creation of certification criteria, a balancing tool, a handbook, product design briefs for highly efficient components and training module syllabi for designers and craftsmen on the topic of step-by-step energy retrofits including renewable energy sources;
- Provision of full step by step refurbishment plans for 20 case studies in 8 countries, and implementation of the first step in each plan for the 11 pilot sites; deep retrofits of a total of almost 40.000m² of treated floor area (living area) was started with an investment of 26 Million €
- Training for designers and craftsmen on step-by-step refurbishments and deep energy retrofits as well as documentation of findings from successful case studies in the form of reports, recommendations, videos or product lists;
- Promotion of a better understanding of the necessity of deep energy retrofits and highly efficient step-by-step refurbishments among stakeholders within the financial sector and public administrations by performing 15 financial workshops in all partner countries
- Product evaluation as well as the development of design concepts and scientifically validated guidelines for 18 Passive House suitable components with a special focus on step-by-step refurbishments and the integration of renewable energies.

Achieved energy conservation

- Average calculated specific heating demand was reduced by 103 kWh/(m²a) to 79 kWh/(m²a) with the execution of the retrofit measures within EuroPHit. Further saving potential by the implementation of future retrofit steps indicates that the heating demand of the buildings can be improved by another 60kWh/(m²a) to an average of 18 kWh/(m²K).
- 1005 tonnes CO_2/annum for 20 projects with a total floor area of approx. 40,000m²

Author:

Giorgia Tzar, Passive Hause Institute

Project link

https://europhit.eu/case-studies

Case Study 29. Russian Federation – Energy efficiency in new construction in Parfino, Novgorod region


Project description

The submitted case study from Russian Federation presents construction of a new energy efficient residential building in the municipality of Parfino (Novgorod Region). Houses were constructed as a part of governmental program for resetlement from outdated houses in Russia. Municipally owned apartments are given for free to low-income families and inhabitants of buildings with emergency construction state. The project shows that energy efficient construction and modern technologies can be implemented also with a limited budget or for the execution of public municipal construction programmes.

Key targets

This demo-project was aimed at demonstrating an example of energy efficient residential building as compared with the typical buildings within the governmental resettlement programmes. In order to increase buildings energy efficiency and reduce greenhouse gas emissions at the design stage, it was proposed to use the least costly and at the same time the most efficient measures and technologies. The complex of energy efficient measures was developed considering the regional climate specific, construction materials and equipment affordability.

Period

05/2015-07/2016

Implementation steps

Step 1. Preparation of a feasibility study, based on documental and instrumental analysis of buildings technical characteristics and of a list of additional energy efficient technical solutions to be implemented in the building;

Step 2. Correction of the estimate documentation;

Step 3. Installation of energy efficiency equipment (automated individual heat point, energy efficient windows with argon gas, insulation of external walls, pedestal and attic floors, individual balancing equipment on heating appliances, individual recuperators, energy efficient lighting in common premises)

Step 4. Monitoring of energy efficiency consumption in comparison with similar houses without energy efficiency equipment;

Step 5. Awareness raising among inhabitants to keep an eco-friendly behaviour.

National and international partners

Administration of Novgorod region, Fund of assistance to reforming of housing and communal services, Russian Energy Agency under the Ministry of Energy of Russian Federation

List of technical measures implemented

- Insulation of the facades, pedestal and attic floors with mineral wool (150 mm thickness);
- energy efficient double-glazed windows with argon-gas filling;
- Installation of automated supply and exhaust ventilation units with the air recuperation;
- energy efficient lighting in the public premises;
- Automated individual heat point with weather control;
- Installation of the meters, balancing valves and thermostats on the heating appliances.

Summary of achieved results

The future inhabitants of the built energy efficient house in Parfino received the keys of their new apartments in summer 2016. According to the experts, the comparative energy saving potential of the new building is up to 57% due to the special windows installation and up to 86% due to facades insulation. This project implemented some of the most affordable, applicable and efficient technologies, which could be widely used among the region/regions with similar climate conditions.

Achieved energy conservation

- 13 600 kWt per year - annual electricity saving
- 115,11 Gkal - annual heat saving
- Estimated payback period - 27 years (including insulation)
- 28,12 t - annual CO_2 emissions reduction

Author:

Maria Lukina-Lebedeva, Programme Support Consultant UNDP

Prof. Irina Ilina, Moscow Higher School of Economics

Project links:

http://undp-eeb.ru/files/EE_construction_and_retrofit_ENG.pdf

https://youtu.be/UjFGqrWRsNc

Case Study 30. Turkmenistan – New energy efficiency enhancements to typical designs for single-family residential buildings

Project description

Funded by the GEF, this project seeks to develop new energy efficiency design and construction types of single family residential buildings, approved for typical conditions in the regions of Turkmenistan.

Key targets

Before 2016, there was no approved design tackling energy efficiency in the residential sector in Turkmenistan. The key target of the project was to achieve the transformation of single-family residential building design and construction in Turkmenistan, saving energy and curtailing greenhouse gas emissions on a large scale through the compliance with new code requirements.

Period

2016 – 2017

Implementation steps

Step 1. Development of technical specifications to add to to 11 existing designs of single-family residential buildings and approval of those by the Ministry of Construction and Architecture. The additional measures included the following:

- creation of vestibules (enclosures around entry doors)
- addition of external roller blinds to windows
- a light plastering system with mineral wool insulation
- enhanced insulation of attic floors
- enhanced insulation of walls
- use of heat-reflective screens behind heating devices
- installation of controls on heating devices
- reduction of the installed capacity of gas boilers and air conditioners
- use of solar water heaters

Step 2. Training of local professionals by international experts in order to elaborate the additions to 11 existing designs of single-family residential buildings.

Step 3. Elaboration of the additions to 11 existing designs of single-family residential buildings under guidance of international experts.

Step 4. Evaluation of energy savings.

National and international partners

State Corporation "Turkmengas", Ministry of Construction and Architecture of Turkmenistan, Turkmen Design Institute and UNDP Turkmenistan

Total benefits

The eleven designs have been prepared as complete packages – including technical drawings and specifications, calculations, and cost assessment. To ensure that these designs would be well

understood by the professionals responsible for using them, the project also delivered associated training on the design of energy-efficient single-family homes to eight building designers at the Turkmen State Building Design Institute. In addition, the project has conducted the baseline monitoring of two of the most common single-family houses, to establish a basis for determining real energy savings when the energy-efficient versions of the same homes are implemented.

Achieved results

The project developed some relatively simple additions to the most commonly-used existing designs, aimed at increasing their thermal efficiency to ensure new code compliance. The additional measures were introduced in various combinations to existing designs, yielding a total of 11 new design variants in total. Calculated energy consumption for heating and ventilation of the revised designs was reduced by an average of 57 percent, and cooling energy consumption by an average of 40 percent.

Achieved energy conservation

- Average increase in cost - 20%
- Average energy savings (converted into natural gas savings):
- For heat and ventilation - 57%; for cooling and ventilation - 50%; for domestic hot water supply - 27%
- Annual natural gas savings 17.4 m^3 / m^2 of residential area
- Average CO_2 emission reduction:
- Annual CO_2 emission reduction 0,033 tonns CO_2e/m^2 of residential area

Author

Irina Atamuradova, UNDP Turkmenistan

Project link

http://www.tm.undp.org/content/turkmenistan/en/home/library/environment_energy/energy-efficiency-results-brochure.html

CHAPTER 6. CASE STUDIES ON FINANCIAL MECHANISMS

This final chapter includes best examples of efficient mechanisms for supporting energy efficiency projects financing. This involves delivery mechanisms helping energy efficiencyactivities stimulated by the availability of specific assistance or the imposition of certain legal obligations and institutional mechanisms, activities developed/managed by public institutions. It further comprise financial mechanisms for energy efficiency measures stimulated by subsidies, loans, or price changes and fiscal solutions for energy efficiency activities financed and/or stimulated by the use of taxes.

The analysis undertaken in this study shows wide offer of various financial mechanisms and tools that are currently available in the market across the UNECE region. Most of them are focused on energy efficiency oriented loans distribution in cooperation with local or international banks, with a key focus on the increase of energy efficiency in the building sector, both for new constructions and retrofits. Additional financing resources come from private business investors (ESCOs, energy efficiency equipment manufacturers and suppliers). Some governments and international institutions provide financial tools for the evaluation of energy efficiency investments, to promote financing. Clear technical and financial criteria should be defined by financial institutions to grant loans. Additionally, a pre-approved list of eligible equipment manufacturers and suppliers can assist in measuring and avoiding risks.

Case studies overview

Total: 8 case studies from 8 countries

The main objective of the Bulgarian Energy Efficiency and Renewable Sources Fund (BgEEF) is to facilitate energy efficiency investments and promote the development of a modern technologies market in **Bulgaria,** as discussed in the case study from Bulgaria. The key principles and objectives for the creation of BgEEF are independent management, sustainability of operations, transparency in the administration of financial resources, equal opportunities for all applicants, energy consumption and GHG emissions reduction. The fund operates on revolving principle, meaning that it remains available to finance an organization's continuing operations without any fiscal year limitation, because the organization replenishes the fund by repaying money used from the account. The Fund has achieved one of its prime objectives to become self-sustainable after 5 years of operation.

The case study from **Croatia** presents an example of energy efficiency modernization of a public building using ESCO mechanisms and governmental co-financing. The share of investments included a public sector investment and a private ESCO investment. In this case the ESCO invested and took the technical and economic risk of the public energy efficiency fund, and fund does not take any additional costs. The public sector partner is obliged to ensure the payment of a compensation to the ESCO during the contract period. The payment of services is based on verifiable savings.

Estonia shared a case study on a reconstruction grant for residential housing associations. The grant is designed for housing associations for the deep renovation of their apartment buildings. The objectives of the grant include the achievement of better energy efficiency and indoor climate for existing apartment buildings and reduction of greenhouse gas emissions.

The case study from **Finland** deals with the development of energy efficiency agreements, which are voluntary committments to meet the international energy efficiency obligations imposed to Finland. The aim of the project is to cover more than half of the building energy-saving targets set for Finland in the EU's Energy Efficiency Directive.

The implementation of the "Climate Energy Plan - South Tyrol 2050" in the Autonomous Province of Bolzano (PAB), is presented in the case study from **Italy**. The whole building stock of the province of Bolzano is planned to be renovated, including 263 recorded public buildings, with very different surfaces and volumes as well as with very different uses. The overall buildings volume is about 3.1 million of m^3 with an overall net floor area of 810,000 m^2. The case study presents the actions performed in order to activate virtuous and innovative partnership mechanisms with professional investors in the energy efficiency sector.

The case study from **the Republic of North Macedonia**, about energy efficiency homes for low income households presents sustainable financial models and set of activities to help Macedonian households living in multi-family apartment buildings and reduce their vulnerability to the energy price increase and decrease air pollution. Through these activities six financial models were developed to support households to reduce energy consumption up to 40%. This innovative programme offered loans to homeowners associations, giving them more opportunities for energy efficiency upgrades in multi-family apartment buildings. In partnership with Macedonian financial institutions, the project developed and delivered loan products for individual houses, covering also vulnerable groups and rural areas.

A pilot project regarding a Biomass Heating System Programme for the Residential Sector was conducted in **Montenegro.** Its implementation aimed to a significant reduction of CO_2 emissions in the housing sector and contributed to the development of the biomass heating system market in the country. The programme is designed to offer a modern and sustainable financial mechanism to provide interest-free loans for the purchasing and installation of biomass heating systems coordinated by the Ministry of Economy.

The case study from **Portugal** presents mechanisms to support the access to financial instruments using energy performance certificates. This financial instrument, IFRRU 2020, was designed to support investments in urban rehabilitation in the whole Portuguese territory. IFRRU 2020 brings together various sources of funding to boost investment, including European funds from the development project PORTUGAL 2020 and funds from other entities such as the European Investment Bank and the Council of Europe Development Bank, combining them with commercial banking resources.

Case Study 31. Bulgaria – Bulgarian Energy Efficiency and Renewable Sources Fund (BgEEF)

Project description

The case study from Bulgaria deals with the establishment in 2005 of the Bulgarian Energy Efficiency and Renewable Sources Fund. BgEEF is a valid instrument to facilitate energy efficiency investments and promote the development of an energy efficiency market in the country.

Key targets

The key principles and objectives for the creation of BgEEF were independent management; sustainability of operations; transparency in the administration of financial resources; equal opportunities for all applicants; energy consumption reduction; GHG emissions reductions. The fund operates on the revolving principle so it remains available to finance an organization's continuing operations without any fiscal year fiscal year limitation, because the organization replenishes the fund by repaying money used from the account. It has achieved one of its prime objectives and became self-sustainable after the fifth year from its creation.

Period

06/2005 – ongoing

Implementation steps

Step 1. Implementation of a separate chapter in Energy Efficiency Law governing the Energy Efficiency Fund;

Step 2. Elaboration of the structure of the financing scheme;

Step 3. Development of the structure of the fund governance and procedures;

Step 4. Infrastructure set up, including personnel, office, systems, and operation manual;

Step 5. Selection of a private sector Fund manager (Consortium Econler/Elana/Eneffect).

The Fund manager developed all internal processes, procedures, and document templates, as well as defined the personnel's lines of accountability and responsibilities, etc. Econoler also established and implemented a specialized IT system to manage, monitor and report on client accounts, as well as key financial and technical indicators of the fund while following the reporting requirements of the EBRD.

National and international partners

Econoler (international), Elana and Eneffect (national)

List of technical measures implemented

- Thermal insulation and sanitation of buildings
- Reconstruction of heating, ventilation, air conditioning, lighting, hot water systems of buildings
- Energy efficiency in industrial processes
- Small systems for combined heat and power (CHP)
- Implementation of renewable energy projects

Summary achieved results

Since its launch , the fund has provided energy efficiency loans to over 200 projects, with a total project investment value of over USD 51.4 million (BGN 86.9 million). Additionally, it has provided partial credit guarantees or portfolio guarantees to 33 projects, for a total project investment of USD 14.3 million (BGN 24.2 million). Using only USD 15 million of capital, the fund has catalyzed more than USD 63 million in energy efficiency investment in Bulgaria. As of the end of Q3 2018, the investments financed or guaranteed by BgEEF contributed to annual savings of 124,161 MWh/year and 90,339 kt/year of CO_2eq.

Author
Stephanie Nour, Econoler

Case Study 32. Croatia – Energy renovation using ESCO financial mechanism

Project description

The project describes the renovation of an hospital in Croatia using the ESCO financial mechanism. It consisted in a public-private partnership with a shared investment between a public entity and a private ESCO company.

Key targets

The goal of the project was a complete renovation of the hospital that included several energy measures to provide a better comfort for the patients and personnel, to improve the building efficiency and to save costs. The main issue of the project was the need to carry out the works in a very short timeframe while ensuring the continuous operativity of the hospital.

Period

04/2015 – 09/2015

Implementation steps

Step 1. The Ministry of Construction and Physical Planning initiated the Energy Renewal Programme of the Public Sector Buildings;

Step 2. The Republic of Croatia has adopted a Decision on the Initiation of Reconstruction;

Step 3. A public call for projects was launched and the priority was given to the projects with high energy consumption and high energy savings;

Step 4. The Agency for Transactions and Mediation in Real Estate conducted the Public Procurement and selected the contractor which was for this project an ESCO company.

National and international partners

- The Environmental Protection and Energy Efficiency Fund (EPEEF)
- Private ESCO company

The Environmental Protection and Energy Efficiency Fund (EPEEF) financed 35% of eligible costs in accordance with the rules of the Fund. The ESCO (Energy Service Company) invests the remaining 65% and takes the technical and economic risk so that the Energy Service Client (ESC), the hospital, does not have any additional costs. ESC is obliged to ensure the payment of a compensation to the ESCO during the contract period. The payment of services is based on verifiable savings (service charge should be less than the savings). The energy efficiency contract does not represent a public debt for ESC.

Energy savings are proved with the Project.

Period of funding: 14 years

List of technical measures implemented

- Renovation of the entire building envelope, including flat roof repair and replacement of the exterior joinery;
- Sanitation of the boiler room;
- Modification of lighting fixtures;
- Deployment of renewable energy sources.

Summary achieved results

- 37000 sqm were renovated
- 18000 sqm facade, 7,700 sqm flat roof,
- 8300 sqm exterior joinery
- 58% less CO_2 emissions achieved
- 7.901.840,03 kwh /year of energy consumed with a saving of 56% from the previous hospital performance.

Key benefits

The ESCO model is pro-budgetary. It enabled the ESC to implement energy efficiency improvement measures in public sector buildings with no additional spending for the state budget. Besides that, it boosted private capital investments in public sector buildings.

Author

Ana Krakan, Ministry of Construction and Physical Planning of Croatia

Project link:

https://mgipu.gov.hr/o-ministarstvu-15/djelokrug/energetska-ucinkovitost-u-zgradarstvu/energetska-obnova-zgrada-8321/energetska-obnova-zgrada-javnog-sektora/3796

Case Study 33. Estonia – Reconstruction grant for apartment associations

Project description

The project deals with the establishment in Estonia of the a grant for housing association and communities with the purpose of renovating residential multi-apartment buildings at full-scale. The grant may be applied for the amount of 15%, 25% and 40% of the total project cost depending on the level of integration in the reconstruction of the relevant apartment building. The financial institution Fund KredEx has established this grant.

Key targets

The key objectives of the grant are achieving better energy efficiency and indoor climate for existing apartment buildings and reduction of greenhouse gas emissions.

Period

2015 – 2019

Implementation steps

Step 1. Preparation work in order to apply to the grant:

- -an energy audit, an EPC and technical design of the building ;
- -a renovation work approval with a simple majority of house inhabitants (50% +1);
- -a qualified technical consultant for steering the process;
- -approval(s) by the apartment association.

Step 2. Grant application:

- -preparation of the grant application;
- -a review of the technical documentation by third party experts;
- -the Fund approval that all requirements are met;
- -tendering with contractors;
- -a credit decision from the bank.

Step 3. Renovation work:

- -construction and renovation of the building;
- -loan payments;
- -grant payments (in two parts if needed);
- -commissioning protocols for ventilation rates and the heating system.

Step 4. Preparation of a EPC based on measured energy use after one year of operation.

National and international partners

- Ministry of Economic Affairs and Communications
- Apartment associations (beneficiary)
- Bank (provides renovation loan)
- Fund KredEx (provides grant and loan guarantee)

Financial terms: To apply for the grant, a relevant application shall be submitted to the bank issuing the renovation loan. If an applicant has sufficient self-financing for the construction work and does not use the renovation loan, or the grant necessary for the reconstruction of an apartment building completed after year 1993, the application shall be submitted to KredEx by mail or with digital

signature. A prerequisite for applying to the grant is the existence of an energy audit and building design(s). The grant shall be paid upon the completion of all construction works.

List of technical measures implemented

The grant is suitable for the following measures that have been and could be implemented:

- Insulation of building envelope
- Replacement of windows and doors
- Replacement or renovation of the heating system
- Renovation of the ventilation system or installation of new ventilation system with heat recovery
- Installation of renewable energy equipment
- reconstruction of the control system or drive of lifts
- design, project management and owner supervision

Summary achieved results

- Approximately 400 apartment buildings will be renovated by the end of 2019 with average heating energy reduction of 60%;
- Evaluated GHG emissions reduction - 11 000 t/CO_2
- Evaluated energy consumption reduction - 70 GWh

Author

Anu Sarnet, Estonian Housing Association (EKYL)

Project link

http://kredex.ee/en/apartment-association/toetused/rekonstrueerimise-toetus/

Case Study 34. Finland – Energy Efficiency Agreements

Project description

In 2018 the Government of Finland established the first period of the Energy Efficiency Agreements. These are voluntary committments by industry and municipalities to fulfil the EU energy efficiency obligations set for Finland without setting new legislation or other new coercive measures. A new phase has been launched in 2017 to 2025 to continue the process and find new signatories. The four Energy Efficiency Agreements to be signed for the period 2017–2025 include Industries (Industry, Energy sector and Private Service sector), Property Sector, Municipal Sector, and Oil Sector (Distribution of liquid heating fuels). The Government supports through grants and incentives the implementation of new energy-efficient technology, investments and audits of the participants, except the audits of large companies.

Key targets

The aim of these agreements is to improve the efficient use of energy within industry, the energy sector, service sector, real estate and building sector, municipalities, and oil-heated real estates. These voluntary agreements are a meansto meet the international energy efficiency obligations for Finland. The aim of the agreements is to cover more than half of the binding energy-saving targets set for Finland in the EU's Energy Efficiency Directive.

Period

2017 – 2025

Implementation steps

Step 1. When joining the agreement, the municipality sets a indicative target for quantitative energy savings (MWh) for the entire period 2017–2025 and an intermediate target for 2020. The target is calculated, based on the energy use of the current volume representing the normal annual use valid at the time of joining. The target for 2025 should equal the 7.5% and the target for 2020 should equal the 4% of the participant's current annual energy use.

Step 2. The participating entity includes continuous improvement in energy efficiency as part of its existing or planned management systems or operating plans.

Step 3. To meet their energy saving targets, when feasible, based on technical and financial provisions and considering the points of view concerning health, security and the environment, the participant is committed to the following: To organize and plan the measures to implement; to clarify the possibilities for improvement in energy efficiency; to implement cost-effective improvement measures for energy efficiency; to take energy efficiency into consideration in planning and purchasing.

Step 4. Other activities should be put into practice, including training the staff and communicating on energy efficiency matters; annual reporting; adopting new energy-efficient technology and increase the use of renewable energy sources, when possible.

Step 5. The participant shall use the Energy Efficiency Agreement monitoring system for annual reporting on its energy use compared to that of the previous year and the related improvement measures and on the implementation of other relevant actions.

National and international partners

The Agrements' partners differ according to the sector. For the municipal sector agreements, the partners are: the Ministry of Employment and Economy, the Energy Authority and the Association of Finnish Local and Regional Authorities.

Summary achieved results in the phase 2008-16 in municipalities

Hundreds of Finnish companies and municipalities had joined the Energy Efficiency Agreements 2008-2016. As a result of the energy efficiency measures they have implemented, the annual energy

consumption at the end of 2016 has been reduced by 15,9 TWh. The measures reduced annual carbon dioxide emissions by more than 4,7 million tonnes and unnecessary energy costs by EUR 560 million.

- Evaluated CO_2 emissions reduction: 141 kilotonnes annual reduction
- Evaluated energy consumption reduction: 454 GWh annual energy savings and 33.9 million € annual cost savings

Author

Jalonen Pauliina, Association of Finnish Local and Regional Authorities

Project link

http://www.energiatehokkuussopimukset2017-2025.fi/en/energy-efficiency-agreements

Case Study 35. Italy – Implementation of the "Climate Energy Plan - South Tyrol 2050" in the Autonomous Province of Bolzano (PAB)

Project description

The case study from Italy presents a renovation project of 263 public buildings in the Autonomous Province of Bolzano (PAB) with very different surfaces and volumes as well as with very different uses. The project is called "Climate Energy Plan - South Tyrol 2050". The overall volume of the renovation is about 3.1 million of m^3 with an overall net floor area of 810,000 m^2: as an average 11,000 m^3 and about 3,100 m^2 each building.

Key targets

The project has two main objectives: to reduce the energy costs of the public building stock and to generate innovative partnerships with the private sector. The public building stock in the province produces an yearly expense of 11.1 M€ overall for energy related uses, as recorded in 2015. The same expense varied between 11 M€ and 13.5 M€, in the period 2009-2015. At the same time, the PAB intends to activate virtuous and innovative partnership mechanisms with professional investors by developing a special ESCO mechanism and stimulating a production chain in the energy efficiency sector.

Period

11/2015 – ongoing

Implementation steps

Step 1. Establishment of a dedicated working group ("Energy management") for the implementation of the "Climate-Energy Plan – South Tyrol 2050" in the PAB;

Step 2. Identification of a first set of 27 buildings representing the whole building stock, on which an energy audit campaign was performed;

Step 3. Identification of funding sources (EIB, GSE - Thermal Account, eeef) to support the investment programme and activation of the Technical Assistance aimed at providing strategic, administrative, legal, economic and financial advice;

Step 4. Implementation of a financial vehicle (a closed-end real estate investment fund). The real estate fund holds economic and legal relations with PAB and with the entities (ESCO, construction companies, technology suppliers, designers, maintenance technicians, etc.) which will be in charge of carrying out the interventions. The Fund, through the proceeds deriving from the collection of rents from PAB, will repay the debt, pay dividends and reimburse investors.

Step 5. Implementation of the procurement procedure and signature of the contracts for the retrofit works and start of the interventions.

National and international partners

European Investment Bank (EIB), the European Energy Efficiency Fund (eeef) – the Gestore Servizi Energetici under the Ministry of Economic Development, the National Association of Italian Municipalities (ANCI) and the Ministry of Economy and Finance

- PAB will promote a closed-end real estate investment fund and will bring to the Fund real estate rights as required by the legislation (263 recorded public buildings). Moreover, the Province will pay the rents for use/availability representing the main income both for the Fund and its suppliers (ESCO, construction companies, technology suppliers, designers, maintenance technicians, etc.).
- Pool of Professional Investors (PPI) will manage the Fund and select suppliers; regulate stakeholdersrelationships; verify the works; monitor their progress during the construction phases; keep a fully compliant accounting system according to the applicable regulations and

the Bank of Italy rules.

- Professional investors will bring equity in cash to be invested for energy efficiency implementations.
- the EIB may bring debt
- the ESCO carries out interventions but does not take on financial risk

Summary achieved results

a) Increased access of the PAB to different sources of funding;
b) Analysis of alternative instruments (direct realization, PPP, financial instruments) and access to funding;
c) Risk shifting from the operator (ESCO) to professional investors (AIFs).

The expected benefits in terms of consumption can be summarized as follows:

- Final energy savings in terms of natural gas and district heating energy use avoided are about 13,400 MWh/year of final energy corresponding to 84% of the overall energy use for heating.
- Primary energy uses for heating are reduced by about 16,650 MWh/year (out of about 19,800 MWh/year before the retrofit) having accounted a primary to final energy factor of 1.05 for gas and of 1.5 for district heating.
- The corresponding avoided CO_2 emissions amount to 2.450 tons/year (0.25 $kgCO_2$/kWh from gas consumption and 0.10 $kgCO_2$/kWh from district heat use). The CO_2 savings amount to 77% of the whole emissions related the heating uses before retrofit.
- The savings on the energy bills due to gas and district heating energy saved sum to around 1.2 M€/year, calculated based on the last 5 years gas (72 €/MWh) and district heating costs (113 €/MWh).

List of technical measures implemented

- Support to the PAB in identifying non-repayable measures such as technical assistance costs;
- Interception of interest by professional investors and elaboration of relationships with them;
- Integration of interventions on energy systems and thermal coat;
- Support to the PAB in defining the scenarios in terms of functional lots, timing for the interventions, sustainability checks;
- Identification of the most efficient implementation tool (PPP, ESCO, real estate fund, investment fund, etc.) using also methods of Public Sector Comparator (PSC)[12];
- Elaboration of risk assessments and definition of the matrix of optimal risk allocation, involving all the actors contributing to the funding.

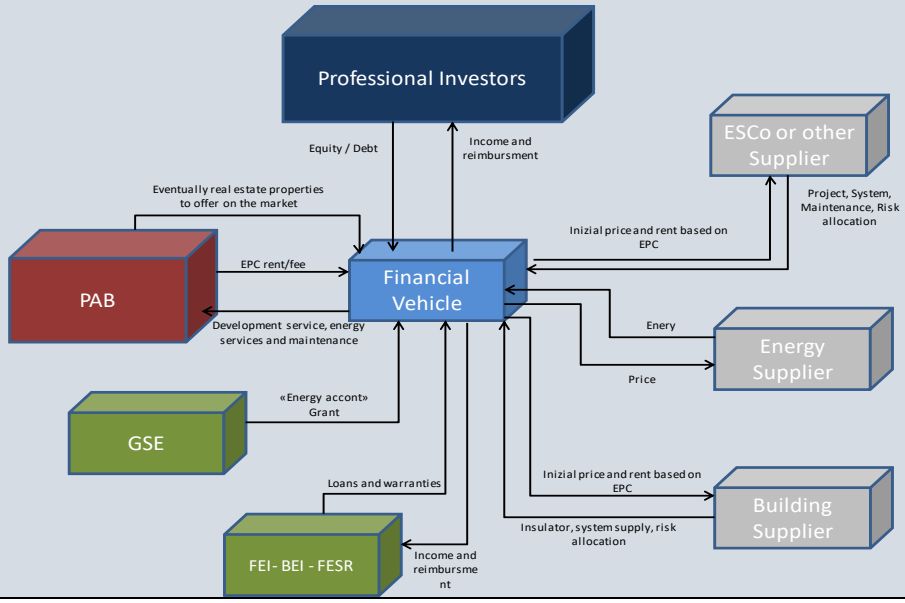
Total benefits

Very high expected returns, analysis of comparative tools aimed at overcoming the critical issues (i.e. credit crunch) of the ESCO market

Author

[12] According to the World Bank, "A Public Sector Comparator (PSC) is used by a government to make decisions by testing whether a private investment proposal offers value for money in comparison with the most efficient form of public procurement" at http://siteresources.worldbank.org/INTTRANSPORT/Resources/336291-1304446506690/DueDiligenceHighwayPPP_HKerali_April2011.pdf

Tommaso Dal Bosco, National Association of Italian Municipalities (ANCI)



Case Study 36. The Republic of North Macedonia – Energy Efficiency Homes for Low Income Households

Project description

The case study deals with the elaboration of 6 financial models to support households, expeciall those with low-income, to reduce their energy consumption from 20 to 40%. In the frame of the USAID financed project on EE in multi-apartment buildings (2011-2015), an unique loan product has been developed and offered directly to homeowners associations to improve energy efficiency in MAB. Partner organizations developed and delivered loan products for individual houses, covering also vulnerable groups and rural areas.

Key targets

The main objective of the project is to develop sustainable financial models and set of activities to help Macedonian households living in multi-family apartment buildings to reduce their vulnerability to the energy price increase and decrease the environmental impact of buildings while increasing their comfort. The project and the loans are especially focused on low-income households giving them the access to improving their houses.

Period

2009 – ongoing

Implementation steps

Step 1. Promotion of the programme and dissemination of its financial opportunities for energy efficiency upgrades among homeowners;

Step 2. Facilitation of the consent process among homeowners to start retrofitting the MAB;

Step 3. Offering of loans to homeowners and HOA; examination of the credit worthiness (if loans goes directly from Habitat Macedonia) of the applicants or introduction of the applicants with microfinance partners;

Step 4. Provision of loans for energy efficiency upgrades for homeowners using different financial models (according to the needs and financial ability of homeowners);

Step 5. Monitoring of loans repayment and energy efficiency retrofitting and provision of technical advises for homeowners when needed.

National and international partners

Habitat for Humanity Macedonia (HFHM), the Microcredit Foundation "Horizonti", Saving House "Moznosti" and private companies;

- HFHM: To facilitate homeowners to reach consent and start with energy efficiency retrofitting; to offer different financial models for energy efficiency upgrades; to provide retail loans to homeowners, including homeowner associations; to provide technical support to homeowners; to involve local governance in the process of energy efficiency retrofitting of MAB and thus provide sustainable mechanisms for the upgrades of the housing stock.
- Horizonti and Moznosti: to provide loans for homeowners in individual houses, covering

vulnerable groups and homeowners in rural areas.

- Private companies: replacement of windows and doors, façade renovations, roofing, technical assistance, energy audits.

Summary achieved results

Since 2009, Habitat Macedonia is actively involved in energy efficiency retrofitting of multi apartment buildings. Energy efficient reconstructions have been carried out on more than 60 apartment buildings in Macedonia with over 1900 apartments, resulting in overall annual energy savings of 7910 MWh and annual reductions of CO_2 emissions of 3670 t. As a result of Habitat involvement in energy efficiency retrofitting of MAB, several local governments in the Republic of North Macedonia introduced subsidy schemes to support homeowners. Also, microfinance organizations, which are long term partners of Habitat Macedonia, were motivated to develop and promote loans for energy efficiency in housing, reaching more homeowners among vulnerable groups and in rural areas.

Key benefits

The key benefits include subventions from the municipal budget for energy efficiency upgrades of multi-family apartment buildings and the involvement of motivating the Microcredit Foundations to develop and offer loans to vulnerable groups and to homeowners in rural areas.

List of technical measures implemented

- Replacement of windows and balcony doors in apartments
- Installment of thermo façade
- Repair and/or replacement of roofs
- Retrofitting of common spaces in MAB (windows, entrance door, plastering)

Author

Liljana Alceva, Habitat for Humanity Macedonia

Project links

www.habitat.org.mk

www.domuvanje.org.mk

Case Study 37. Montenegro – ENERGY WOOD II - Biomass Heating System Program for Residential Sector in Montenegro

Project description

Thanks to the contribution of the government fo Norway of 240.000 €, the Ministry of Economy of Montenegro has launched the project ENERGY WOOD II. Through this project, households will receive interest free loans for the purchase and installation of modern biomass heating systems (pellet, briquette). The partner banks (Atlas banka, Hipotekarna banka, Addiko banka, NLB Montenegrobanka and Prva banka) will provide indvidual loans up to 3500 € with a maximum repayment period of 5 years, with a 0% interest rate.

Key targets

The implementation of this Programme was aimed to significantly reduce CO2 emissions in the housing sector and it contributed to the development of the biomass heating system market in Montenegro. The Programme was designed to offer a modern and sustainable financial mechanism for providing interest-free loans for purchasing and installation of biomass heating systems and it was coordinated by the Ministry of Economy.

Other key targets include:

- To provide soft loans to citizens for the installation of heating systems on modern biomass fuels (with an interest rate is 0%).
- To achieve economic and energy savings through the introduction of high-efficiency technologies.
- To contribute to reducing greenhouse gas emissions through the use of energy sources that have a less harmful impact on the environment.
- To create markets for greater use of heating systems on modern biomass fuels.
- To ensure the participation of financial institutions with reduced risk when entering a new segment of market.

Period

10/2015 – 12/2018

Implementation steps

Step 1. Grant application by the Ministry of Economy;

Step 2. Selection of the partners banks in Montenegro in charge of providing the loans;

Step 3. Selection of eligible dealers/installers;

Step 4. Loan application by individual households;

Step 5. Installation of the modern biomass heating systems;

Step 6. Repayment of the loan in a five-year period from those who have benefitted from the loan.

National and international partners

The Ministry of Economy and thepartner banks: Prva bank, NLB bank, Addiko bank, Hipotekarna bank, Atlas bank.

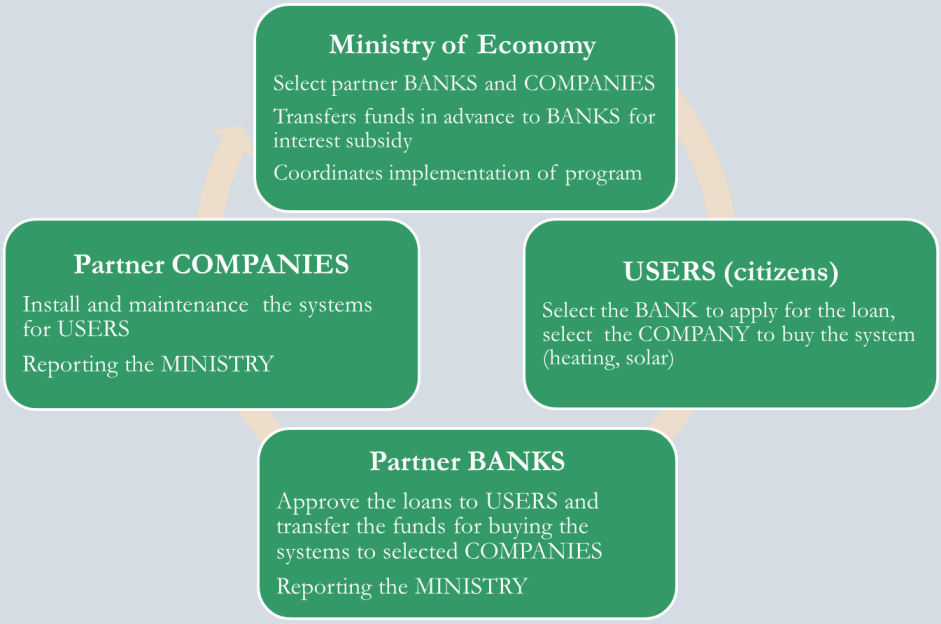
The Ministry of Economy provides funds for subsidizing the interest rate on loans and respective loan processing fees for the procurement and installation of the biomass heating systems. The amount of the loan, previously granted to the client, is transferred by the bank to the account of the client's selected dealer/installer. Selected eligible dealers/installers of biomass heating systems are in charge of installing and maintaining the biomass heating systems to clients.

Summary achieved results

- The partner banks have granted 532 loans for the procurement and installation of
- modern biomass heating systems in the total amount of € 1,193,557.06, whereby
- the amount of € 197,375.67 has been used to subsidize interest and loan processing fees;
- The final consumers (households) have replaced their "old-fashioned" heating systems, consuming other (more expensive) fuels (electricity, fuel oil, etc.), with new more modern biomass systems;
- The granted loans have significantly influenced the market for heating technologies in Montenegro, which is particularly significant for the companies (dealers/installers) dealing with this type of equipment;
- The replacement of old, less efficient technologies with modern biomass heating systems generates certain energy and financial savings and has a positive impact on the environment, particularly through the reduction of CO_2 emissions (853 t/year).

Key benefits

The main key beneft of the project is the development of a market for modern biomass technologies as well as a market of modern biomass fuels in Montenegro.



Author

Marko Canovic, Ministry of Sustainable Development and Tourism of Montenegro

Project link

http://www.energetska-efikasnost.me/ee.php?id=24&l=en

Case Study 38. Portugal – "IFRRU 2020 via SCE" - Buildings renovation - Support the access to financial instruments using energy performance certificates (EPC)

Project description

IFRRU 2020 is a financial instrument designed to support investments in urban rehabilitation in the whole Portuguese territory. IFRRU 2020 brings together various sources of funding to boost investment, both European funds from PORTUGAL 2020 and funds from other entities such as the European Investment Bank and the Council of Europe Development Bank, combining them with commercial banking resources.

Key targets

The aim of the initiative is to support urban rehabilitation projects, including buildings by improving their energy performance.

Period

11/2017 – 12/2023

Implementation steps

Step 1. Ex-ante evaluation that identifies the need to support urban regeneration, namely through financial instruments;

Step 2. Creation of the managing structure (Council of Ministers Resolution no.52-A/2015 of the 23rd july) and production of the strategic documents;

Step 3. Establishment of Funding Agreements with the funders (ESIFunds - Portugal 2020, EIB and CEB);

Step 4. Launch of public tenders for the selection of Financial Intermediaries;

Step 5. Open call for applications.

National and international partners

- IFRRU 2020 Managing Structure
- ADENE
- DGEG - Directorate-General for Energy and Geology
- All the Municipalities (1 focal point in each of the 308 participating portuguese municipalities);
- Managing Authorities of the 7 Regional Operational Programmes of Portugal 2020 (Norte, centro, Alentejo, Algarve, Lisboa, Açores and Madeira) and of the national Operational Programme for Sustainability and Efficiency in the Use of Resources (PO SEUR)
- European Investment Bank (EIB)
- Council of Europe Development Bank (CEB)
- Financial Intermediaries - Banks (BPI, Santander and Millennium bcp) and SPGM

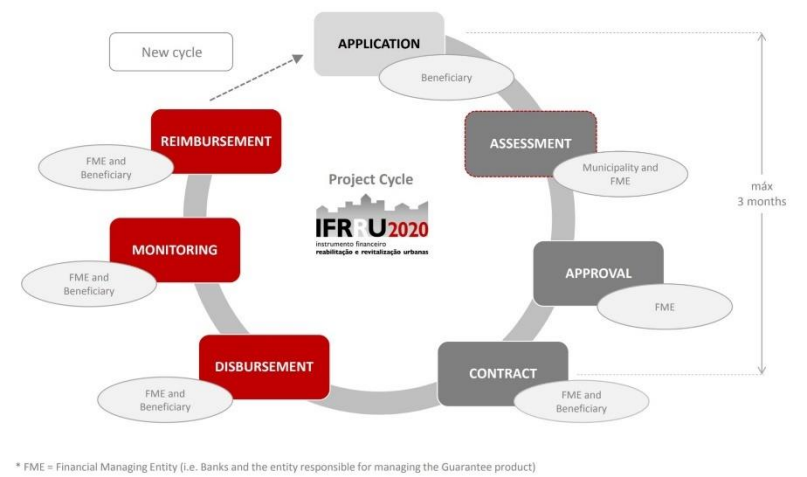
Summary achieved results

- Financial results (for projects contracted untill 30 nov 2018 - 1st year):
- 51 contracted projects
- 199 million € of investment
- Other results (for projects contracted until 30 sep 2018):

- 260 new residents
- 122 rehabilitated households
- 1.031 jobs created
- 85.523 public or commercial buildings renovated
- Environmental effects:
- 2335 tonns CO_2 equivalent (per year) (until 30/09/2018)
- 5.108 toe (per year) (until 30/09/2018)

List of technical measures implemented

- Civil construction works associated with the buildings rehabilitation
- Installation of insulation in the building envelope
- Installation of energy efficient windows
- Installation of efficient technical systems for heating/cooling/domestic hot water/lighting/ventilation/automation and control
- Installation of thermal solar collectors
- Installation of photovoltaic panels



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Project link:

https://www.portaldahabitacao.pt/pt/portal/reabilitacao/ifrru/index_EN.html

CONCLUSIONS

This "Compendium of best practices on standards and technologies for energy efficiency in buildings in the UNECE region" presents an overview of up-to-date activities performed by countries across UNECE the region, in order to increase buildings energy efficiency level both for the existing buildings stock and for the new constructions. From the contributions of the call for case studies and other expert sumbissions, thirty-seven cases from twenty-two countries were included in the report.

The analysis of the collected case studies shows overall positive trends in energy efficiency in the building sector in all the identified sub-regions. Even countries of the sub-regions C, E, and F, which traditionally have low internal energy prices, have significantly increased mandatory energy efficiency requirements, especially for the newly constructed buildings.

The promotion of energy efficiency in buildings has been widely conducted during last years, covering a number of topics reflected in the report, with strong financial and administrative support from allrelevant stakeholders including the governments, regional and municipal authorities as well as international organizations, NGOs and academia. The case-studies included in the report show reasonable approaches that confirmed their practical effect during the implementation phase.

Almost for all countries of the UNECE region, there is a good trend matched on the correlation between the application of energy efficient technologies and the construction and design requirements of mandatory building standards. In addition to the numerous environmental benefits associated with decreased energy consumption and increased generation of renewable electricity, many of the technologies discussed in this report offer other non-energy related social benefits. Various polices, norms and regulations have been adopted by each country to improve energy efficiency in the building sector. The implementation of these documents across the countries of the UNECE region had different levels of success.

Active work is conducted by national, regional and municipal level authorities, local and international financial institutions, international organizations and other relevant partners, resulting in various achievements towards energy consumption and CO_2 emission level reduction, as well as to support the availability of financial resources and generation of the relevant local capacity. The case studies selected for the **Legislative and regulatory framework** chapter present various aspects of the enforcement of energy efficiency-oriented legislative and regulatory framework, including the development of institutions responsible for their implementation and regulation. Supportive governmental activities, in terms of clear guidelines for the promotion of energy efficiency technological developments can support regional economic growth; develop local competitive markets; increase employment; promote the implementation of lower-cost and accessible energy efficient technologies; and develop international markets.

The main focus of the section was on the update of the energy efficiency oriented legislation and design standards, in terms of harmonization of national practices to the international ones in order to increase current specific energy efficiency parameters in buildings. Additional attention was paid to the administrative enforcement of municipal energy management practice. Nevertheless, based on the comments given be Joint Task Force members, additional work should be done on municipal and micro-district levels. Specific law, regulations and standard are required to be adjusted to the local climatic conditions, available primary energy sources, overall country development level and other parameters.

Activities performed in different countries across the UNECE region confirmed the need for a better cooperation between governments, industry, and energy programme administrations. This conclusion is based on the good results of analyzed cases where governments and various international organizations jointly supported the implementation of advanced energy efficiency technologies, by introducing incentives (administrative, tax, grants and others) and relevant supportive legal documents, even when the technology was not fully economically feasible.

The selected cases for the **Management of multi-family housing (MFH) stock and public buildings** chapter show advanced renovation and objects management practices, as well as underline the significant role of smart energy data collection and auditing analysis for the purposes of proper building maintenance and operation. The growing amount of public and private, small and medium size businesses in this sector requires better support by qualified experts, transparent financial solutions and useful tools, which can make the management process easier and more automated. Complex urban planning and buildings maintenance solutions require adequate planning and financial support by responsible authorities. Additionally, a pre-approved list of eligible equipment manufacturers and suppliers, can assist in technical risks reduction. Another part of work with the building's management is the implementation and proper use of Energy Performance Certificates (EPC), which many countries already utilize. Currently, for most of the countries of the sub-region C, E and F, buildings EPCs are mainly used for public information purposes, without connection to real financial incentives (eg. reduced tax rates, special price for domestic energy and building owners and other). EPCs could be also used in additional ways to provide more value to building owners and further encourage energy efficiency investments.

The projects selected in this section seem to have important benefits for the homeowners. In this regard, the continuation of such a work with a better focus on the introduction of Building Management Systems, including administrative and technical component, will give more sustainable result to the whole life-cycle of the building operation.

The important role of increasing capacity and awareness regarding energy efficiency in buildings is demonstrated by the selected case of the chapter **Awareness raising, capacity building and behavior change**. Awareness raising campaigns and training of trainers in the countries of the UNECE region aim to involve as much as possible the representatives of the target audience, into the knowledge sharing and best practices dissemination process. Currently a higher priority in the energy efficiency oriented training and promotion activities is given to the implementation of modern technologies and solutions for new building constructions and retrofit of the existing old building stock. Furthermore, a quite big amount of energy efficiency oriented financial products for buildings are currently offered on the markets of UNECE countries. However, there is still a gap in the technical competence of relevant banking specialists and lending officers that limits their understanding of the multiple benefits of energy efficiency investments. The selected cases present activities related to the introduction of energy management and energy efficiency-focused educational courses and programmes that have been introduced into the standard national educational programmes. With additional focus on the renovation of existing buildings, countries can obtain varied social benefits; one of which is increased job opportunities in small- and medium-sized enterprises.

Various examples of informational products and educational formats have been presented for energy and engineering professionals, homeowners and youth (schools and universities). On-line education is a step forward in the energy efficiency knowledge exchange that will allow to enhance international

cooperation between the countries of the UNECE region. The successful results of all the presented cases, confirm the opportunity to reduce indirect energy consumption and CO_2 emissions levels, and show the high potential for replication in the near future.

Nevertheless the analysis of the submitted case studies shows a growing demand for information on efficient retrofit and energy losses identification which can also be met by a wider dissemination and penetration of energy efficiency technological solutions. Interactive and attractive promotion of energy efficiency for the public audience, such as public intertainment activities, involvement of children and students, organization of competitions and others is another important contribution to raising awareness and increase the use and adoption of more energy efficient solutions for buildings.

The case studies analyzed in the chapter **Technical measures including smart and affordable technologies and innovation** have real focus on modern energy efficient solutions, which are currently available in the markets of the UNECE region. The presented technologies and other technical solutions are currently affordable and have a reasonable financial interest, even for the countries of the sub-regions E and F, with traditionally low energy prices. Various engineering solutions have been implemented for their energy savings effect increase and to improve building functionality. Most of the countries of UNECE region show an increased adoption of highly efficient boilers, along with shifts to cleaner fuel sources. The case studies presented in the report, in fact, show practical examples of which technologies have been utilized commonly in the countries and the technology trends on the installation of renewalble or efficient energy solutions such as efficient gas-fired boilers, electric boilers, solar collector systems, and heat pumps as well as improved design and construction stages.

Looking at the implemented cases and the trends in the region, the massive implementation of smart metering technologies was found. In fact these devices allow the reading of the consumed energy and the evealuation of the achieved energy savings. This is of primary importance for the individual residential homeowners and other energy users types since the meters allow for more transparency in the energy payments structure.

The growing amount of energy efficient buildings constructed for low-income households or under governmental programmes for resettlement, is a positive sign that confirms the high level of standard energy efficiency and basic renewable technologies penetration, implementation and affordability.

Finally the selected cases included in the chapter on **Financial Mechanisms**, show example of financial instruments that could be divided into two main types, non-refundable grants and refundable loans of different variations. The analysis of all cases shows high efficiency of existing energy efficiency financial and investment schemes, which are widely used across all countries of the UNECE region. Most of them are focused on energy efficiency-oriented loans distribution in cooperation with local or international banks, with a key focus on the increase of energy efficiency in the building sector, both for new constructions and retrofits. Additional financing resources come from private business investors (ESCOs, energy efficiency equipment manufacturers and suppliers). Some governments and international institutions provide financial tools for the evaluation of energy efficiency investments, to promote financing. However, clear technical and financial criteria should be defined by financial institutions to grant loans. Additionally, a pre-approved list of eligible equipment manufacturers and suppliers can assist in measuring and avoiding risks.

The proper implementation of financial mechanisms requires long-term project sustainability. For this reason, it is preferable to use a combination of grant resourses for the apartments and public buildings, in case extra budgetary financing is required. In such a case, direct financial governmental support or guarantees could help building owners or operators to attract reliable energy service companies or receive special discounted offers from energy efficiency equipment suppliers and manufacturers.