



ACTION FOR
ENERGY EFFICIENCY
IN BALTIC CITIES

ACT NOW!




GUIDELINE

Energy Efficiency Strategy for Municipal Buildings

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About the *Act Now!* project

The *Act Now!* project approaches energy efficiency in the existing building stock of small and medium sized municipalities around the Baltic Sea. The project's scope is to help municipal staff involved in building energy efficiency measures by improving their knowledge about energy losses, competences for preparing investments, and skills to stimulate private investments in energy efficiency.

The *Act Now!* project wants to support Baltic municipalities to succeed from Strategic Energy Action Plans (SEAPs) to achieve an actual reduction of CO_2 emissions. Energy efficiency is the key and the building stock is the treasure to be unearthed for a contribution to reach this goal. The *Act Now!* project aims to foster a new approach across decision makers focused on housing and public buildings.

Act Now! was initiated and coordinated by "Klimastadtbüro"- the climate city office of Bremerhaven, Germany. It was launched in February 2018 and continued with 17 partners in the Baltic Sea area to improve the energy efficiency.

actnow-baltic.eu

The report can be downloaded at actnow-baltic.eu/learning.

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List of abbreviations

CO_2	Carbon dioxide
CBS	Capacity Building Scheme
CoM	Covenant of Mayors
EE	Energy Efficiency
EED	Energy Efficiency Directive
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Contracting
EnMS	Energy Management System
EPC	Energy Performance Contracting
ESCo	Energy Service Company
EU	European Union
EU28	European Union (EU) consisting of a group of 28 countries before Brexit (Belgium, Bulgaria, Czech Republic, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden, United Kingdom)
GDP	Gross Domestic Product
GHG	Greenhouse Gas
TWh / GWh	Terra Watt hours / Giga Watt hours
IPCC	Intergovernmental Panel on Climate Change
LEEG	Local Energy Efficiency Group
NECP	National Energy and Climate Plan
PPP	Public Private Partnership
SEAP	Sustainable Energy Action Plan
SECAP	Sustainable Energy and Climate Action Plan
SWOT methodology	Strengths, Weaknesses, Opportunities, Threats methodology

1 | Introduction

1.1 | The *Act Now!* approach

Buildings are Europe's biggest energy resource consumers. Using energy more efficiently in the building stock is therefore a key objective for policies of different fields and levels.

Municipalities are key players for improving energy efficiency (EE) at the local level. As building owners, they operate a considerable amount of residential and non-residential buildings. They are the responsible authority for local building regulations, depending on the legislative framework, and can also provide information and advice relevant for building issues to private building owners as well. They can prove to lead by example, making the benefits of energy efficient buildings more visible and tangible for local society.

While the demand for energy efficiency in the municipal building stock is clear, actual implementation of energy efficiency measures is lagging behind. However, this is not because of a lack of available technologies. Materials, apparatus and solutions, such as insulation, building automation, efficient heating and LED lighting are technically mature and widely available. Instead, the project *Act Now!* – Action for Energy Efficiency in Baltic Cities [1] focuses on internal resources for putting energy efficiency into action. Although ideas and even elaborate action plans already exist, many municipalities lack the capacities many municipalities lack the capacities for implementation.

Over the course of three years (2018 – 2020), municipalities in the Baltic countries participating in the *Act Now!* project have acquired know-how and established the organisational structures necessary to develop and implement energy efficiency projects on their own. Following the principle of building skills to allow municipalities to help themselves', the *Act Now!* approach provides the knowledge and tools to identify and fill the gaps in local energy efficiency capacities, as well as to build the required organisational infrastructure. This customised capacity building ultimately helps municipalities to accumulate long-lasting know-how among those who are best acquainted with the local situation, instead of delegating the task to external experts.

This guideline is part of a larger set of materials making the *Act Now!* approach available to those not directly involved in the *Act Now!* project (Figure 1). While the actual capacity building is explained in the Manual "From SEAP to Investment", this guideline serves as support for municipalities in the process of developing their local energy efficiency strategy for municipal buildings.

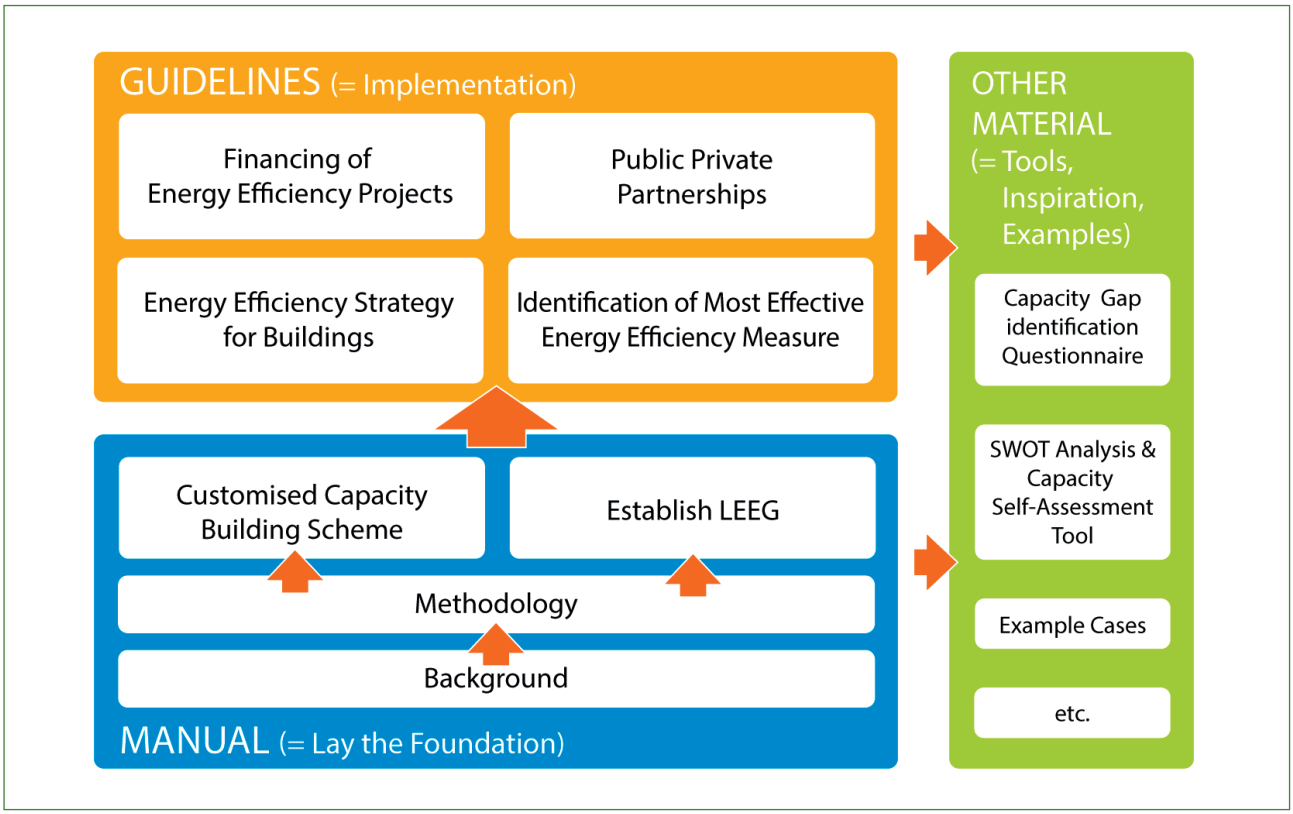


Figure 1: Relationship between this guideline, the Manual and other material produce within the Act Now! project.

This guideline is based on the concept of the *Act Now!* project and is specifically addressed to:

- Build a structured self-learning tool for target groups on local and regional level to be applicable at any location in the Baltic Sea Region programme area;
- Disseminate good practices providing key elements of municipal building energy efficiency strategies and energy management systems;
- Create a structure following the *Act Now!* project concept for the definition of tailored Capacity Building Schemes (CBS) in municipalities to improve their energy efficiency strategy for the municipal building stock in already existing SEAP, SECAP or existing energy efficiency plans.

1.2 | Objective of the guideline

The idea of this guideline is: how can an optimal energy efficiency strategy be found for municipal buildings by the support of an organized and structured self-assessment tool made to define capacity constraints in energy management in municipalities. At best this leads to define specific Capacity Building Schemes (CBS) ('*Act Now!* Manual "From SEAP to Investment', Chapter 4).

The starting point is the evaluation of the current strategic local energy plans (in terms of SEAP, SECAP or energy plans in municipalities). Further steps are dedicated to an organizational and process analysis at the administrative level in order to re-arrange work-flows and municipal energy management systems. In this context, it is beneficial to build retrofitting strategies including either building refurbishment actions or IT solutions for energy monitoring which are harmonized with potential investments in energy efficiency projects.

Thus, the purposes of this guideline are to:

- provide support on how to build an effective energy efficiency strategy for the municipal building stock in terms of a step-by-step process and how this reflects on the development of a specific and tailored Capacity Building Scheme in a municipality;
- suggest a method how to ensure a more sustainable and consistent decision-making process in municipalities and how to select and implement appropriate Capacity Building Schemes (CBS) focussed on energy efficiency in buildings;
- disseminate good practice examples tested in the *Act Now!* project municipalities;
- explore how to establish synergies with residential buildings within a certain municipality energy efficiency plan for municipal buildings.

1.3 | Who is this guideline for?

This guideline is for local policy-makers, planners and experts contributing to the development and implementation of building energy efficiency strategies, policies and projects in municipalities. It is intended for representatives at various levels of local government: heads of local governments, heads and specialists of technical and development departments, heads and technical directors of municipal companies, as well as cooperating institutions and companies or other groups in society, eventually including citizens.

Local public bodies are the main actors that can create the most important opportunity to improve energy efficiency and thus reduce carbon emissions from their municipal (and not only) building stock. The development of tailored municipal building energy efficiency strategies can trigger a link with the owners of private buildings providing best practices examples, thus stimulating the interests of building owners to take action.

Considering the above-mentioned information, this guideline serves to:

- Motivate municipalities to create more tailored and effective Energy Action Plans in comparison to the current ones;
- Define basic strategies for municipalities to follow when creating Energy Action Plans;
- Explain and provide information on the main knowledge gaps in the field of energy efficiency in buildings;
- Give the necessary tools and approaches for successful implementation of energy efficiency measures in municipal buildings.

More specifically, this guideline focuses on the following main aspects:

- Identification of capacity gaps within the energy efficiency strategy in Municipal Buildings with a self-assessment tool;
- Definition of proper and tailored energy efficiency for a specific building stock evaluating technical, financial, environmental solutions within the considered context;
- Application of the proposed concept within existing case studies developed within the *Act Now!* project.

1.4 | How to use this guideline?

This guideline is structured as follows:

- **First section (chapter 2):** defines the benefits from improving energy efficiency in buildings as well as numerous challenges and potential barriers in order to achieve potential benefits. Based on the benefits that are also related to specific significant challenges, an approach to define a long-term sustainable energy efficiency strategy for the improvement of the building stock is proposed.
- **Second section (chapter 3):** presents the potential improvement flowchart and steps as well as lists potential key actions to underpin the strategy to be integrated within the local energy efficiency plan.
- **Third section (chapter 4):** describes the main steps towards the definition of a step-by-step strategy for energy efficiency improvements in the building stocks. Examples of good practices from the implementation of the *Act Now!* project are documented in the *Act Now!* project learning platform actnow-baltic.eu/learning/municipalities.

2 | Energy efficiency for municipal buildings

Box 1: Energy management and energy efficiency definitions [34] [34] [35] [36] [37]

Energy management (EM) is defined as an organized and systematic coordination of the provision, conversion, storage, distribution and utilization of energy a building to match for ecological and economic requirements. The EM is a closed loop control system that aims to:

- collect and make further analysis of energy data;
- metering energy consumption in physical assets;
- finding opportunities to save energy;
- applying for pro-active actions to save energy;
- monitoring and following the progress of proposed solutions.

EM strategies could rely on both energy-saving efforts (mostly focused on a more effective and efficient use of existing buildings or equipment) or on energy awareness.

Energy Management System (EnMS) according to ISO 50001 is addressed to any organisation to pursue, following a systematic approach, the improvement of its own energy performance, in terms of: more efficient energy use and better use of the organisation's energy consuming assets, enhanced energy efficiency and energy costs reduction. An EnMS for municipality according to ISO 50001 aims to build up a tailored system suitable for its own goals. Therefore, ISO 50001 can be perfectly adapted to municipalities. According to the ISO 50001 standard a municipality should select the scope and boundaries of its EnMS and ensure its continuity towards more efficient energy use. The concept of the scope and boundaries for an EnMS allows a municipality to have a certain degree of flexibility to define what should be included in its own EnMS.

Energy efficiency (EE) is generally defined as the amount of output that can be produced with a given input of energy. EE could be measured as the percentage of energy output for a given energy input between 0% and 100%. In general terms, energy efficiency refers to the amount of output that can be produced with a given input of energy. Most commonly, energy efficiency is measured as the amount of energy output for a given energy input expressed as a percentage between 0% and 100%. According to the EU Energy Efficiency Directive EE has a wide definition in terms of "…the ratio of output of performance, service, goods or energy, to input of energy." The International Energy Agency has proposed guidelines for using energy efficiency indicators for policy-making [38].

2.1 | Background

Population growth and urbanization result in an ever-increasing global building stock. In this context the reduction of Greenhouse Gas (GHG) emissions from the buildings sector is one of the main priorities for sustainable development. In order to cap the global temperature, increase to less than 2 degrees Celsius above pre-industrial levels [2] the GHG emissions in the building sector should be reduced at least by 25% in 2030. In fact, the building sector is responsible for 40 % of the world's energy consumption equivalent to 36 % of the total global carbon dioxide emissions [3]. The share at EU level is similar [4].

Studies and reports show that around 75 % of the EU building stock is not energy efficient. This highlights the great potential to reduce wasted energy and to implement smart solutions with a more integrated approach involving different types of target groups.

In fact, energy losses in buildings can be reduced by implementing an optimal Energy Efficiency (EE) strategy merging the specific needs of a public authority (i.e. municipality) with cost-effective solutions. The overall effect can be beneficial because urban development has a major connection with municipal buildings. Nevertheless, in order to boost the effectiveness of EE actions, it is vital that municipal policy-makers implement a viable and holistic strategy. Here planning and policy tools available to municipalities should be applied in terms of efficiency targets, standards for buildings, refurbishment programmes or financial mechanism for specific EE actions [2].

Current EU policy goals foresee many changes regarding the energy sector. Actions to achieve the EU targets for tackling climate change are most effective when implemented on a local level, avoiding long (international) coordination procedures. Taking a local initiative and producing a municipal Energy Action Plan will allow to create a specific and well-tailored approach to local conditions in energy sector. This will produce a direct effect on local communities and promote their decision-making abilities, might be an example of good governance and may stimulate better energy management in other areas.

Several frameworks and approaches have gained popularity among local governments when drafting municipal Energy Action Plans. A most recognized concept is known as Sustainable Energy and Climate Action Plan (SECAP). SECAPs are developed by local authorities under the Covenant of Mayors for Climate and Energy and must be implemented before 2030. Another well recognized form of municipal energy action plans is the creation of an Energy Management System (EnMS). For this purpose, the International Organization of Standards (ISO) 50001 standard plays a major role. The ISO 50001 standard can be adopted not only by industrial or commercial companies but can also be applied to governmental institutions.

The technical conditions of buildings have an essential influence on the energy performance of the municipal energy sector. Specifically, buildings are mainly influencing the energy demand. When energy technologies in buildings are obsolete, defected or inappropriate by any means, unnecessary additional energy losses arise. This is also true, when the insulation of the buildings is not up to technical standards. Thus, measures aimed at increasing energy efficiency in buildings play a relevant role for creation of municipal energy action plan. Municipal buildings are a significant part of the local infrastructure, including governmental offices, hospitals, train and bus stations, schools, libraries and museums, and have an important role in municipal Energy Action Plans. It is a great advantage that EE measures in municipal buildings can be implemented directly by decisions of the local government.

EE is paramount to European energy policy and one of the main targets of the Europe 2020 Strategy for tuned, sustainable and comprehensive growth adopted by the European Commission. Because energy related emissions are responsible for almost 80 % of GHG emissions in the EU, it is evident that more efficient energy use promotes transition to a low-carbon economy and tackling climate change. In fact, building retrofitting could decrease the EU's total energy consumption by 5-6 % related to a CO_2 reduction by about 5%. Even though the increase of renovated buildings per year is fluctuating between 0.4 % - 1.2 % the renovation rate to reach the set environmental goals should be doubled at least.

In order to support this transition the EU recently defined policies towards the implementation of more tailored energy efficiency in buildings. Knowing that costs are often the major obstacle for renovation, the new rules also facilitate access to financing for the improvement of the building stock. The Energy Performance of Buildings Directive (EPBD) 2010/31/EU [5] and the Energy Efficiency Directive (EED) 2012/27/EU [6] were revised in 2018 in order to better steer a sustainable energy transition.
The EED declared that each Member State has to establish and apply minimum energy performance requirements for new and existing buildings. Further the energy performance of buildings has to be certified. The directive delegated that all new buildings must be "nearly zero-energy buildings" in EU by 2021. The new EED set a framework of common measures to ensure the achievement of a 20-% target for increased energy efficiency according to the Europe 2020 Strategy. According to EED all EU Member States are obliged to submit National Energy Efficiency Action Plans to the European Commission every third year [7].

Both EED and EPBD provide the background for Member States to set the target for the reduction of energy consumption in buildings, with consequential benefits in different sectors – i.e. economic, environmental, societal and energy security. The EPBD demands to: Establish a long-term strategy for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private.

In addition, each EU country must provide their EE strategy for buildings for the period 2021-2030 harmonized with the country's respective national energy and climate plan (NECP). It is expected and requested that the overall impact of these efforts should make it possible to reach the target of 32.5% energy efficiency by 2030.

The transition to a more energy efficient building stock in municipalities should be approached by creating a municipal energy efficiency plan where the needs and roles of citizens, local stakeholders, energy experts, research bodies and academia are addressed. Innovative energy efficiency solutions and strategies are essential to make this transition more viable and sustainable. It is thus essential to have a framework able to promote energy efficiency and/or to strengthening the role of renewable energies.

EE improvements provide the basis for potential profits. A consistent energy efficient strategy in the building stock will have several beneficial effects in terms of: improvement of comfort and well-being, reduction of heating and eventually electricity costs, decrease of dependence from energy price fluctuations, and increases of the building stock value.

2.2 | What is energy efficiency for the municipal building stock?

The definition of energy efficiency is based on the idea of the efficient use of energy resources, electricity and heat. In practice, we often face a situation where the opportunities to increase energy efficiency are numerous, but in fact are hardly used. Energy consumption can be not only minimal and maximal. It would be more appropriate to use the concept of optimal energy consumption. It is a much broader concept and includes not only the engineering aspects of the technology, but also the economic and financial, environmental and socio-economic justification for the choice of equipment.

In order to be able to compare energy uses with each other and evaluate their energy efficiency, it is necessary to obtain specific values for energy consumption – i.e. energy efficiency indicators. EE measures provide an opportunity to address technical, economic, socio-economic, legislative and environmental/climate issues. Implementation of EE activities is beneficial for several target groups:

- state budget- the less energy resources are spent, the less financial resources flow out at national level;
- local government budget- the less money must be paid for energy the more financial resources are left for local governments for development of communities;
- society – sustainable development of the energy sector ensures a more resilient energy system;
- environment and climate change mitigation.

Energy efficiency measures must not be implemented in a chaotic manner. They should start with an analysis of the situation, e.g. an energy audit of the building, which should be seen as the first step in implementing energy efficiency measures. EE measures need to be monitored and continued- even after the measures have been implemented.

Municipalities can create a portfolio of potential EE solutions for their municipal buildings (including real owning, leasing or managing). These opportunities are mostly addressed in terms of:

- improvement of the performance of the building shell;
- a more efficient heating/cooling system, introduction of renewable energy technologies (also including shading and passive solar heating);
- more efficient electrical system including lightning system;
- use of smart monitoring and control system technologies able to more effectively regulate the supply/demand of energy in the building.

2.3 | Which are the benefits for energy efficiency in the municipality building stock?

Before providing the conceptual approach towards the definition of a step-by-step strategy for energy efficiency in buildings, it is important to clarify the impacts and benefits that can be reached as impact of the EE improvements in the building stock. When carrying out an economic assessment of an energy saving investment for a building, the benefit is normally defined as energy cost saving. This sometimes underestimates the real overall beneficial impact. However, individual investors often do not value many benefits. When monetized benefits like air pollution reductions, improvement of health and eco-systems, more efficient resource use and, jobs created or energy security can be account for, the effect is surprisingly relevant:

> *Every €1 spent on energy efficiency produces an amount of around 50–70% of energy cost savings of not monetized benefits [8]*

The impacts of commencing a more a viable and sustainable energy efficiency strategy of buildings can thus involve main factor for economic, energy system, environmental and societal governance benefits.

A number of EU municipal energy action plans have already implemented integrated energy saving measures. One way is to prepare a municipal Sustainable Energy Action Plan (SEAP) recently improved to a Sustainable Energy and Climate Action Plan (SECAP). These plans have been promoted by the Covenant of Mayors initiative and supported by the European Commission. It became a large European movement involving local and regional authorities, that voluntarily committed to increasing energy efficiency and renewable energy in their territories providing for a reduction of GHG emissions of 40 % by 2030.

Each municipality draws up spatial development plans that not only cover the development of the industrial and agricultural sectors, but also are based on increasing a regional prosperity, demographic development and environmental performances. Measures to increase energy efficiency in buildings are one of the cornerstones of short-term environmental development.

Gross annual investments of €41 to €78 billion per year in the EU will bring on-going annual returns of €104 to €175 billion [9]

2.3.1 | Economic benefits

Improving energy efficiency in municipal buildings means to lower energy consumption that in turn optimizes the background conditions for maintaining an energy infrastructure in operation with a direct effect on the purchase of fuel. This has the consequence to bring a direct economic benefit for the municipality triggering the investment of the saved money in funds for other projects and/or infrastructure. Moreover, lower energy consumption will reduce the overall risk in terms of dependency from the use of fossil fuel, improving energy security and the overall resilience of the urban system. Energy efficiency can be considered as the most viable energy resource; it is in fact more convenient to save energy through energy efficiency measures than to replace them with any other alternatives [10] [11].

For individual low-income households in the EU, typically energy bills range between 3 to 24 % of the total household's consumption expenditure (Figure 2, [12]).

This dynamic effect can create a causal sequence of benefits for the local and national economy. Findings from studies have detected that additional income available from energy efficiency savings is mostly spent at the local level, in turn creating new job opportunities.
Figures from several studies tried to quantify the benefits of EE in household spending. An increase in the household energy efficiency score of 1% brings a benefit between 0.24 % to 0.71 % on energy spending [13].

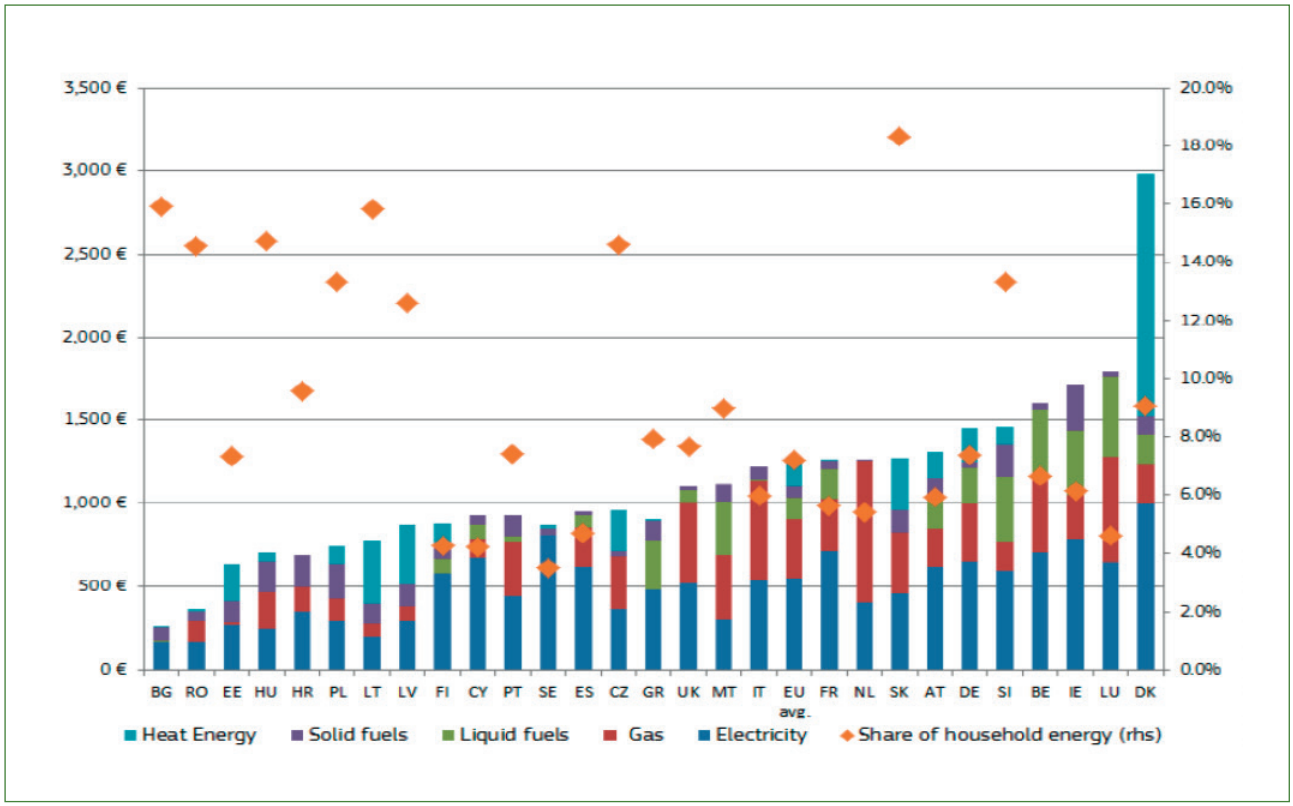


Figure 2: Expenditures on home energy for EU households in the lowest income decile

Impact on GDP
Several empirical studies show that improvements in energy efficiency have an effect on economic growth at the GDP level. It has been roughly evaluated that 1 per cent increase in the level of energy efficiency causes a 0.1 percentage point increase in the overall GDP [14]. It has also been evaluated from the impact of the EED that an increase in the EU's GDP of € 150 bn per year (+1.1 % compared to baseline) is necessary in order to reach the prescribed saving by 2030 [15].

Values of the buildings
There is evidence that buildings with higher energy performance will increase their resale value. Some figures report that better performing buildings can attract an increased sale value up to a maximum of +14% in the residential sector [16].

Energy import bill
Building renovation for energy efficiency will be beneficial in terms of lower costs for energy import. In 2018, the EU imported a big portion of its energy needs for a total cost of € 332.3 bn.

2.3.2 | Energy System Benefits

Energy security
Reducing energy demand with energy efficiency measures is a main aspect of energy security as reported in the "Energy security strategy" [17] and in the "The 2050 energy roadmap" [18] by the European Commission. The key priority is attributed to reaching the highest energy saving potential in the building and transport sectors.

Avoided new generation capacity
Figures from the EU Commission show that reaching the 20% energy efficiency targets would avoid the construction of 1,000 coal fired power stations equivalent to 500,000 wind turbine installations.

Reduced peak loads
The reduction of energy demand will be beneficial to avoid an unbalanced amount in the moment of high demand. This will be beneficial in terms of avoiding the use of expensive energy generation needed to cover peak demands. Hence, the load and the losses in the transmission and distribution systems will decrease with lower system operation costs.

2.3.3 | Environmental benefits

Climate change mitigation and carbon savings
The greenhouse effect and the resulting climate change are terms that are increasingly used in society. Municipalities must indicate the reduction of GHG emissions in terms of t CO_2/year or t CO_2/€ when applying for any funding for energy efficiency measures (i.e. heating systems, street lighting, building insulation and similar projects). Normally two types of GHG emission reduction projects in municipalities can be distinguished, namely: the implementation of energy efficiency measures or replacing fossil fuels with renewable energy sources (e.g. use of biomass and solar energy).

According to an EU study [16] both CO_2 and GHG emissions decrease in all scenarios. Furthermore, the magnitude of the impact of CO_2 and GHG emissions decreases according to the scenarios. This is driven by the level of investment and energy savings, with a change in CO_2 emissions in the EU28 ranging from-0.5 % to-7.8 % and a change in GHG emissions ranging from-0.4 % to-6.0 %.

The relevance of the building sector in terms of carbon savings is proposed by the Intergovernmental Panel on Climate Change (IPCC). The building sector is still an important potential for effective carbon emission reductions (Figure 3, [17]).

Decrease in air pollution
After implementation of EE measures, fewer fossil resources are needed for energy production which in turn lead to lower emissions of harmful compounds like SO_2, NO_x and particulate matter that are harmful to health, to buildings and the environment.

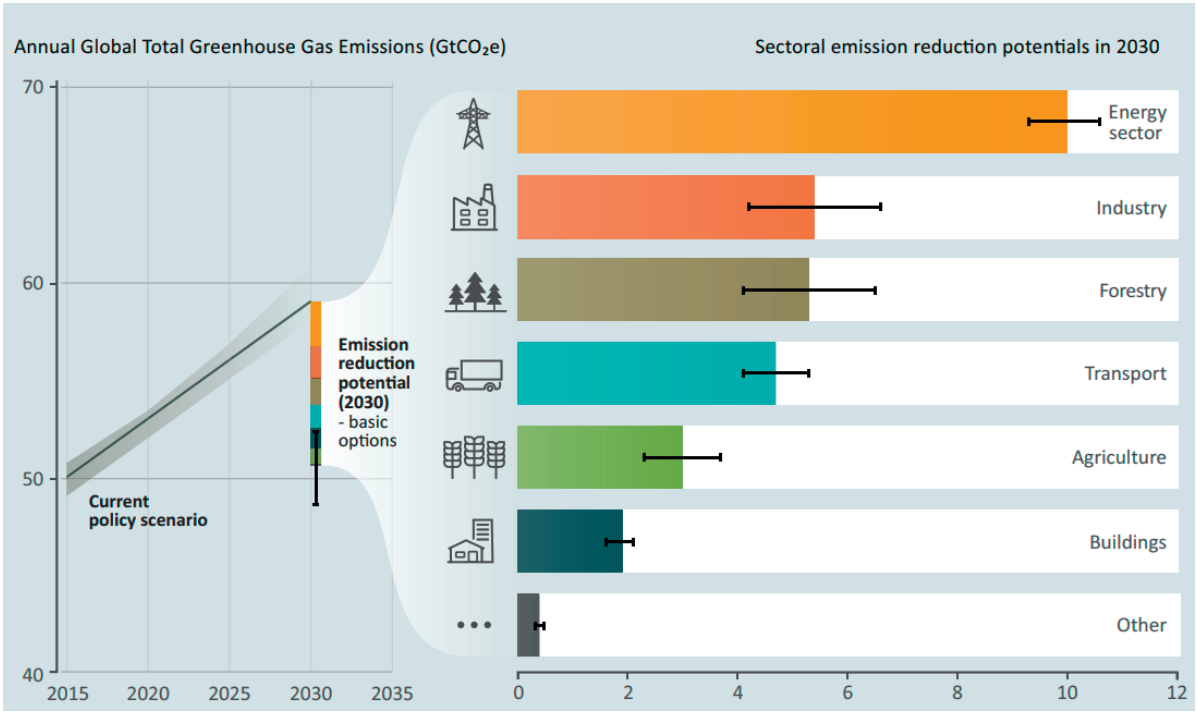


Figure 3: Comparison of cost-effective CO_2 reduction potential in 2030 by sector

2.3.4 | Social benefits

Solving of socio-economic issues

Socio-economic problems in local governments are related to both employment and import/export balance problems. The implementation of EE measures together with the use of renewable energy resources increases the number of jobs in the municipality in terms of permanent green jobs and further supports employment through offering re-training opportunities (e.g. builders are needed to insulate buildings or to install specific smart meter solutions, etc.). EE provides an important economic benefit at different levels (i.e. single citizens, communities, national). Several studies reported the impact in terms of job creations.

… every 1 million € in efficiency program creates a net gain of 40 job-years … [18]

The job placement and economic impact if seen in a more sustainable building stock development –should be considered over a value chain of main actors involved from manufacturing and installation through to professional expertize/services, management, financing and management (Figure 4, adapted from [19]). The study from the Copenhagen Economics Study highlights that deep renovation of the EU building stock could bring a benefit up to a maximum of two million jobs [19].

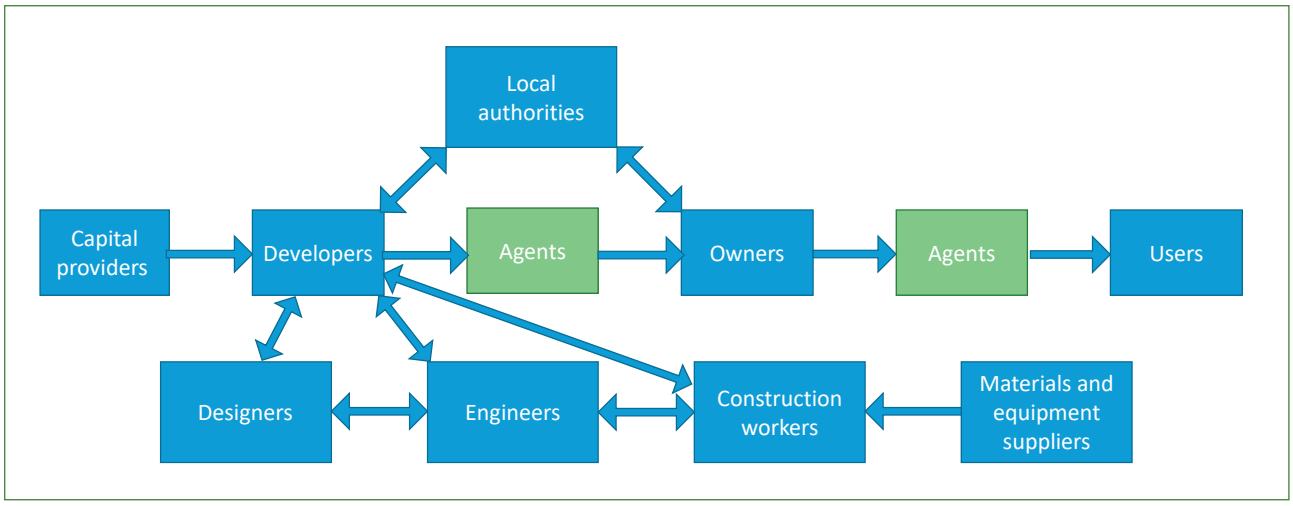


Figure 4: Schematic of building renovation value chain.

Covering the gap among households

Improved energy efficiency in municipal buildings could provide more beneficial and affordable energy access for disadvantaged households. In fact, compared with an average income household they have a higher share of the money spent for energy that an EE improvement could reduce.

Around 30 million persons in Europe are accounted as energy poor according to a study from the Council of Europe Development Bank [20]. A strategic renovation of social housing with the aim to decrease the risk of energy poverty can trigger a higher affordability of energy. Energy poverty rates also tend to drop by 0.21 % when the EE index score increases by one point, thus showing the direct effect of energy efficiency in helping to reduce energy-related economic vulnerability. The study from the European Commission (EC) shows the number of households, that might benefit of specific energy efficiency improvement policy, can rise up to 8.26 million [16].

Improved comfort and health

Improved energy efficiency provides better indoor quality preventing asthma and other diseases, as well as reducing the level of indoor pollutants. Studies have shown that there is higher probability for poor energy households to use medical services, especially children, who are 30 % more likely to have a medical check in hospitals or care assistance centre [20].

2.3.5 | Governance benefits

Municipal building efficiency measures could have a rebound effect on energy efficiency in other strategic sectors. In turn this may support the diffusion of innovative energy efficiency solutions which might lead to a further commercialization in the municipality. Moreover, the successful implementation of municipal building efficiency pilot projects can provide a reduced risk perception for potential investors.

2.4 | What are the challenges for energy efficiency in the municipal building stock?

There are several obstacles for local governments when selecting and transforming municipal building efficiency measures.

2.4.1 | Technical challenges

Energy efficiency measures in buildings can be divided into six groups according to their specific features:

Table 1: Groups and description of energy efficiency measures for buildings.

Energy efficiency measures for buildings	
Electrical equipment	*Energy efficiency measures that aim to reduce energy consumption through the use of electrical appliances (pumps, washing machines, TVs, refrigerators, etc.)*
Lighting	*Energy efficiency measures, that aim to reduce energy consumption in lighting systems.*

Energy efficiency measures for buildings

Building Enclosing Structures

Efficiency measures that aim to reduce energy consumption by insulating the building's enclosing structures.

The sector of the building materials refers to roofs, walls, windows, floors and doors of a building. It plays a leading role in the energy efficiency of a structure and must be carefully considered during the design and planning phase of a deep renovation. Building's heating requirements are greatly influenced by the selection of a specific type of building material with a direct connection to heat transfer characteristics.

Unlocking the full economic energy efficiency potential of a specific building needs proper designing, financing and energy efficiency investments. The main aspect for evaluation of the effectiveness of specific EE measures is the understanding of the annual energy needs of a building. Here, the thermal insulation and characteristics of the selected building material and the requirements for ventilation have to be considered. The heat transfer coefficient (U-value) is a measure of the thermal conductivity; meaning the lower it is for a given construction material, the better are the thermal insulation properties. For example: a 1 m thick brick wall has the same thermal insulation properties compared to a 10 cm thermal insulation board.

Roof and technical attic

Installing loft insulation in a not insulated pitched roof or technical attics (cold roofs) is one of the most cost-effective way to improve the efficiency in a building. Loose thermal insulation materials (like loose mineral wool or cellulose fibres) are typically the easiest option. For these cases the use of high-density thermal insulation board protected with a concrete slab is the optimal but probably most expensive solution.

Before the implementation of this energy efficiency measure it is always important to ensure that the roof is in sufficiently good technical condition. In all cases the installation of thermal insulation has to be carefully designed and planned to ensure there are no thermal bridging problems (in particular between the wall studs and the attic slabs). For cold roofs it is imperative that the attic area is ventilated to prevent condensation.

Walls

High energy losses occur through the material of the walls. Improving insulation can be an important measure, which helps both to save energy and to protect the building from further heavy maintenance works. In a deep renovation, façade walls and plinths are structural components of the wall, energy efficiency components of the building and a guarantee for the health of its occupants.

Before the application of thermal insulation, it is important that the substrate (i.e. exterior walls) meets the necessary air tightness and mechanical strength requirements. This means that all joints between panels and brick are adequately refurbished (application of sealing membranes, special plasters, and mechanical reinforcement such as steel reinforcing cages)

In a deep renovation two methods are the most commonly used for the thermal insulation of exterior walls:

- *External Thermal Insulation Composite System* is one of the most common ways to insulate a solid external wall by applying thermal insulation boards to the external fabric of the building and protecting it with a specialist render.
- *Ventilated façade* is a high performance solution, which takes advantage of mechanical anchoring elements. Thermal insulation boards are applied to the external material of the building and then protected with façade cladding which is mechanically fixed to the anchoring system. An air gap is left between the façades cladding and the thermal insulation, removing excess moisture.

Energy efficiency measures for buildings	
Building Enclosing Structures	**Windows and doors** The replacement of doors and windows requires particular attention during the installation phase in order to have an effective sealing between sills, jambs and window frames for proper air tightness. The main attributes that affect a window's performance are: number of glazing (double or triple), type of the glass used, type of gas used to fill the vapour space within double and triple glazing (like argon and xenon), design and type of installation. Nowadays double glazing is the minimum requirement when replacing windows, but specifying triple glazing on the whole building or on the North facing sides can offer further comfort and energy savings. High performance glass is recommended with a coating applied to it in order to improve insulation properties. This will reflect heat either back into the room or prevents it from entering the space from outside. **Basement** The thermal insulation of the basement ceiling is relevant for cold and unheated basements. For implementing this measure, it is essential to have an empty cellar, so that the insulation boards can be freely installed on the substrate. Moreover, electrical cable, lighting points and distribution pipes should not obstruct the application of insulation and be either removed or properly embedded in the insulation layer. The most common construction method for this measure is a composite system. Thermal insulation boards are applied to the ceiling of the basement and protected with a base coating emended with fibre glass mesh.
Heating System	*Efficiency measures that aim to reduce energy consumption by optimizing or replacing the heating system.* Modern individual heating units must meet the following requirements: ■ possibility to regulate the heating systems of buildings, ensuring optimal temperature chosen by the residents avoiding overheating; ■ possibility to adjust the required heating and hot water temperature regime for a certain period of time- day, week, etc. (for example, by lowering the hot water temperature and/or the room temperature at night); ■ possibility to install a heat exchanger for separation of the water circulating in the heat supply system of the building and external heating networks. This additionally allows to lose only a small part of the water during a leak in the event of a heating system accident; ■ possibility of the heating system to work under reduced pressure, thus making the operation of the system safer; ■ ensure minimal maintenance costs; ■ ensure even heating regime in all floors and sections of the building. It is important that the heating system is well balanced and that each heating element (convector or radiator) receives a precisely calculated water flow. If the heating system is unbalanced, some convectors receive too much flow, the capacity of these radiators is too high and the room temperature is very high. At the same time, other radiators receive too little flow, which results in lower heat output and lower temperatures in rooms with these heating elements. To raise the room temperature, the flow temperature to the radiators is usually raised. The result is a much higher temperature than necessary in rooms where it is already too high and, of course, energy overload. Heating systems equipped with thermostats on radiators are partially balanced The installation of an automatic temperature controller makes it possible to reduce heat energy consumption both during the day (for example, by supplying less heat at night) and at special times of the week, etc. The controllers also allow to program the water temperature.

Energy efficiency measures for buildings	
Heating System	In Latvia and other Baltic Countries many of the existing multifamily residential buildings are equipped with one-pipe heating systems without by-pass for flow control. These systems are often outdated and need substantial improvements. For renovating these systems there are two main options: ■ retrofit of the heating system using the same one pipe configuration, ■ installation of a two-pipe system with horizontal heat distribution to the flats. In most cases the retrofit of the heating system using a one-pipe configuration is recommended, because it enables good control and heat distribution with more affordable investment costs. The main limitation is metering, as individual heat metering by flats is not possible. Independently from the system configuration, when renovating a heating system all main distribution pipes in the basement and technical attic have to be insulated using ad-hoc technical insulation solutions. Then the system must include the installation of thermostatic radiators valves and suitable balancing valves for even temperature distribution throughout the building.
Domestic Hot Water System	Several multifamily residential buildings in Baltic Countries are equipped with a centralised domestic hot water system. The circulation loop of these systems is also used for space heating of the bathroom. The systems are often in rather poor technical conditions with substantial heat losses. In a deep building renovation project there are several solutions: from retrofitting the system (replacing all distribution pipes, but using the same system configuration) to the full decommissioning of the old system connection aiming to minimize the pipe diameters and length of the circulation loop.
Ventilation	*Energy efficiency measures that allow to reduce the amount of outdoor air infiltration and further the regulation of the air exchange rate (i.e. recover energy from the heating and cooling system, investigate the possibilities of natural cooling, night cooling and heat).* Ventilation systems supply air to the space and extract polluted air from it. They are very important, because proper ventilation avoids water condensation and mould formation. The design and specification of a building ventilation system has a big impact on energy use. Sometimes natural ventilation provides the best solution, while in other cases mechanical ventilation with heat recovery is needed. This depends on building type, use and occupancy. The specific system suiting your building has to be decided by ventilation experts during energy auditing and project design; in particular looking at the different options ranging from a fully centralised balanced ventilation systems or a decentralised hybrid ventilation system.
Management and Monitoring	*Energy efficiency measures to reduce energy consumption through monitoring, measuring and regulating the building utilities (heating, ventilation, hot water systems) and regulating the room temperature and air flow, as well as a building energy management.*

For achievement of the planned reduction in energy consumption, it is most often necessary to combine measures from different groups.

Some of the energy efficiency measures (Table 1) can be implemented by municipalities and residents only at the building level, but some only individually, i.e. in apartments or municipal office spaces. In general, the implementation of EE measures in buildings is mainly connected to deep renovation. Deep renovation is looking towards the full economic potential of energy efficiency and leads to remarkable energy savings. For some Baltics countries, the stock of multifamily residential buildings rapidly continues to deteriorate due to harsh weather conditions and the lack of proper maintenance. The concept is also attractive for private investors.

In a deep renovation all elements lead to:

- Reduced energy consumption – less energy required per m^2 heated;
- Better temperature control – with potential optimization of temperature in each room/heated space of the building or flat;
- Improved comfort and life conditions with a more suitable temperature and better indoor air quality;

- Improved health and better indoor quality favourable to decrease the risk of respiratory diseases which lead to savings in medical expenses;
- Lower capital expenditure: a more efficient and well-insulated building will require less extraordinary maintenance and lower expenses for repairs;
- Increase of the economic value of the asset;
- Investigating options of recovering energy from heat and cooling (and water, etc.)

Deep renovation is also a key aspect for the long-term preservation of a building.

Public building owners or tenants lack the technical background and expertise to select the appropriate energy efficiency solution in buildings. The challenge is to raise awareness of public building managers about the existin gap between the level of energy consumption and the level that could be reached, if a specific energy improvement strategy would be applied. In most cases, this lack of expertise is also connected to a deficiency of methods for monitoring energy consumption and/or regulations of physical energy parameters.

Box 2: Energy management as a reduction of energy consumption with small investments

Energy management is an ongoing process based on a Plan-Do-Check-Act approach (Figure 5, [30]):

- Plan: Define goals and an action plan to achieve results in line with energy policy;
- Do: Implement the action plan;
- Check: Monitor and conduct a process evaluation;
- Act: Introduce measures to continuously improve the energy management system.

The implementation of EE measures in municipal buildings provides an opportunity not only to reduce energy fees, but also to increase the value of real estate in buildings. The implementation of this type of projects should also be considered as an informative measure for local residents at the regional level and a way to encourage energy users to implement energy efficiency measures. The establishment and implementation of an energy management system is especially recommended for organizations with energy-intensive processes and increased GHG emissions.

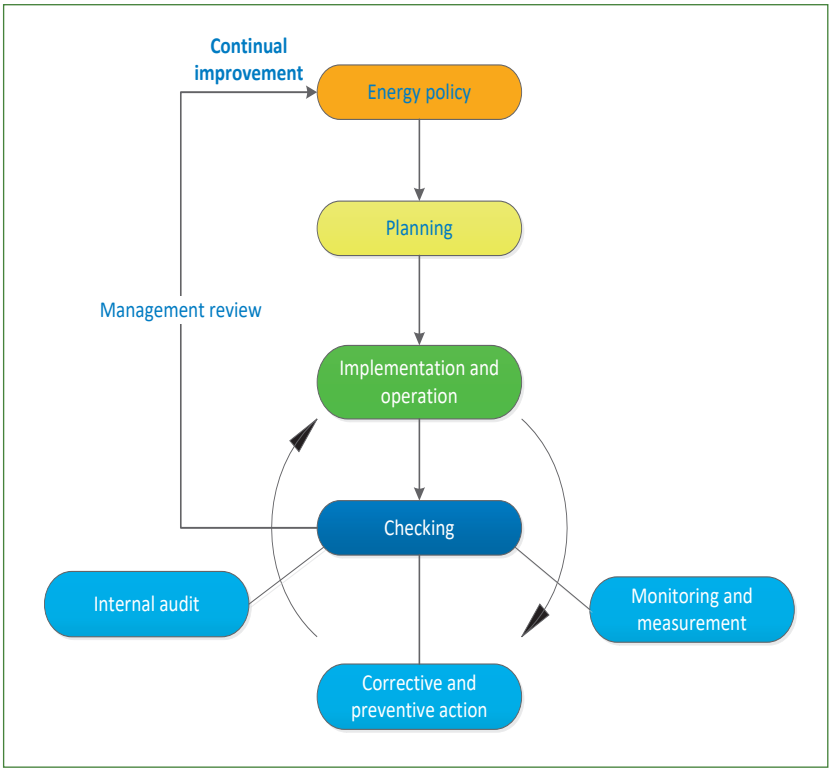


Figure 5: Plan-Do-Check-Act approach for municipality.

The simplest energy efficiency measure, which requires only a small investment, is energy management. It is a relatively easy measure to implement in the initial phase, which clearly outlines the next steps in saving energy. This can be implemented by any local government interested in reducing costs of heating and electricity.

Energy consumption management measures in the municipality start with data collection and analysis and continue with the planning, implementation and evaluation of energy efficiency measures. To achieve this with maximum return, an energy management program is required. The initial management of the energy consumption can be implemented without large capital investments, achieving energy savings of 10 – 20 % of the total energy consumption.

2.4.2 | Financial and budget challenges

Demonstrating the viability of an energy efficiency strategy for building projects is generally challenging. Energy prices fluctuate over time and often there is no incentive for savings, if budgets are distributed on an annual basis. In case of buildings owned or rented by public authorities, where costs are matched by an operating budget, this can result in an unwillingness to reduce costs.

Local governments could have the problem that the entire planned energy efficiency strategy for the building stock cannot be directly financed from public funding. In this case there is a need to define priorities which might neglect parts of the energy efficiency investments. Moreover, local government could have a low capacity to leverage debt. This could happen due to restrictions imposed by regulatory frameworks.

Box 3: Energy Performance Contracting (EPC)
[21] [22]

Energy Performance Contracting (EPC) is a mechanism whereby a contractor (an energy service company- ESCo) is engaged to improve the energy efficiency in a building. An ESCo is a natural or legal entity that delivers energy services and/or other energy efficiency improvement measures in a user's facility or premises, and which accepts some degree of financial risk in doing so. The payment for the services delivered is based (either wholly or in part) on the achievement of energy efficiency improvements and on the meeting of the other agreed performance criteria [27].

The ESCo will guarantee energy savings covering all (or part of) the investment required for the renovation works. Under this form of contract, the ESCo examines the building, evaluates the level of energy savings, and then provides a way how to implement the project. The key aspect of an EPC is that the ESCo guarantees the energy savings. If these savings are not reached, the ESCo will have to refund for the missed part and take actions to fix the problem using its own funds.

In any EPC the contracting rates that the ESCo will charge are clearly reported. These rates are based on the ESCo needs to cover the investment costs of the renovation works, the financial costs of the project, and also remuneration for operating and maintaining the measures implemented in the building. (More information in the '*Act Now!* Guideline Financing of Energy Efficiency Projects', online learning platform actnow-baltic.eu/learning)

2.4.3 | Environmental challenges

Energy production is associated with air pollution, smog, climate change, degradation of ecosystems, water pollution and radioactive hazards, all of which lead to serious health and environmental impacts. Enabling retrofitting of buildings with new energy efficiency technologies plays a critical role for tackling climate change.

Municipal or publicly owned buildings account for 12 % of the building area in the EU. Increasing energy efficiency in public buildings will have a positive influence on the overall environmental performance of the building sector by reducing a significant amount of CO_2 [22]. Moreover, there will be a beneficial effect on improved inside air quality and comfort with a decrease of respiratory diseases.

EU regulations have demonstrated to have an overall positive environmental impact with respect to energy efficiency in buildings. First measures were addressed to typical buildings from the 1980s with an important frame offered by new national building codes.

2.4.4 | Legislative and institutional challenges

Lack of regulations

A contradictory policy background might prevent the municipality's ability to provide consistent regulations and standards to create the framework for supporting energy efficiency strategies.

Limitation of institutional capacity

Limitation of institutional capacities in municipalities- in terms of financial, human resources and budget- can be an obstacle for being able to establish a baseline information necessary for the definition of consistent models to define the initial benchmarks. Moreover, limited experience can even increase the effort for the municipality to define, implement and further continue EE strategies or trigger new investments. Barriers among municipal departments might arise in terms of diverging goals competing for funding. Lack of cooperation with the private sector or in establishing with private-public partnerships (PPP) might also affect the viability of municipal building efficiency measures.

In addition, the implementation of an EE strategy for public buildings may have some legal, regulatory or institutional side effects:
municipal staff issues, absence of expertise about the energy management of building, lack of incentives because the energy tariffs are under a certain range of subsidies, difficult procurement processes in assigning an energy audit or lack of a clear engagement strategy for stakeholders and Public Private Partnerships.
(more information at the online learning platform actnow-baltic.eu/learning)

2.4.5 | Market and behavioural challenges

Market obstacles

In case of regions with low energy tariff or even subsidies for fossil fuel, this can prevent energy efficiency investments when the return of investment is not shown in a feasible time.

Energy efficiency measures and strategies need to create synergy and cooperation with several stakeholders dealing with different priorities. Expertise providers like building companies, energy utilities, energy operators and ESCo often require an advance management capacity from the municipality. For example, energy utilities could not support energy efficiency renovation, if they do not receive any compensation for promoting energy efficiency among their customers to cover a loss of income from the sale of energy.

Behavioural challenges

Lack of energy efficiency consciousness is one of the main behavioural challenges. Raising awareness on the energy efficiency benefits among municipal employees and citizens is a key factor for a sustainable and sound implementation of an energy efficiency mechanism. This is related to the great impact that the habits of homeowners and buildings have on the overall energy efficiency gains. Raising awareness of energy efficiency supports a more participatory decision-making process providing a favourable policy environment for setting more ambitious targets which can be implemented with more tailored energy efficiency policies and by also engaging the private sector.

3 | Energy efficiency strategy for municipal buildings – Where to start

From the definition of the potential challenges and barriers (Chapter 2) that might undermine the described benefits it is essential for each municipality to define a long-term energy efficiency strategy for the building stock harmonized with the main national targets and goals set.

As supported by the revised EU Energy Performance of Buildings Directive (EPBD) and the Energy Efficiency Directive (EED) the key elements of the strategy should address:

- Strengthen the long-term perspective of renovation and strategies,
- Promote nearly zero-energy buildings,
- Trigger the implementation of energy performance certificates,
- Evaluate the monetarized benefits for health and well-being (air pollution),
- Strengthen the role of smart technologies in the building stock.

At national level well-set long-term visions exist for the building sector:

- Denmark set already more than a decade ago the goal of fully phasing out fossil fuels in the energy and transport sectors by 2050;
- Estonia according to the National Energy and Climate Plan will renovate 170,000 m^2 of buildings space in period 2021-2030 and achieve the reduction of the end-use energy savings by 14,500 GWh;
- Finland's Integrated Energy and Climate Plan foresees 153 TWh total savings from energy efficiency measures in period 2021- 2030;
- Germany's National Energy Efficiency Action Plan is on the way to achieve an almost climate neutral building stock by 2050;
- Latvia in its National Energy and Climate Plan 2021-2030 will reduce total energy consumption by 20,500 GWh for the year 2030. This will be achieved by renovating 3% of total area of public buildings annually and reducing heat consumption in buildings by 100 KWh/m^2 per year;
- Polish National Energy and Climate Plan 2021-2030 states that the expected targets are energy savings due to improving energy performance of buildings by 43,500 MWh;
- Sweden's draft Integrated National Energy and Climate Plan sets targets for Sweden's energy use to be 50 percent more efficient by 2030 compared to 2005 in terms of primary energy use in relation to gross domestic product;
- Russia's Energy Strategy for the period up to 2030 foresees increase in energy efficiency of buildings at least 50 percent in 2030 as compared to 2005, mainly by increased responsibility for irrational and inefficient use of energy by including requirements for energy efficiency.

A long term vision in the energy efficiency renovation strategies for buildings needs to consider the complexity of the specific urban system considering the overall dynamics that could be established for each specific components of the "municipal structure" [23]. This means that, on the one hand, more extended benefits arising from energy saving renovations should be evaluated and, on the other, challenges and issues dealing for example with

the inertia of the building owners sector and the classic tenants barrier need to be tackled [19].

It is thus essential for the municipal planners to understand the overall benefits resulting from a certain energy efficiency strategy taking a holistic approach. They have to include an overall assessment of the emissions reductions and consider consequences for the environmental, human health and economics gains. Figure 6 (adapted from [18]) shows a circular approach with the main steps for this process [18].

This approach describes the steps to support the municipality planners to:

- Rank the main opportunities to improve the energy efficiency strategy for buildings considering a holistic evaluation (i.e. environment, health, energy system and building stock, and the economic perspective);
- Define a portfolio of energy efficiency strategies and/or renewable energy initiatives, including the non-energy benefits;
- Reach multiple goals in a more viable, sustainable and feasible way.

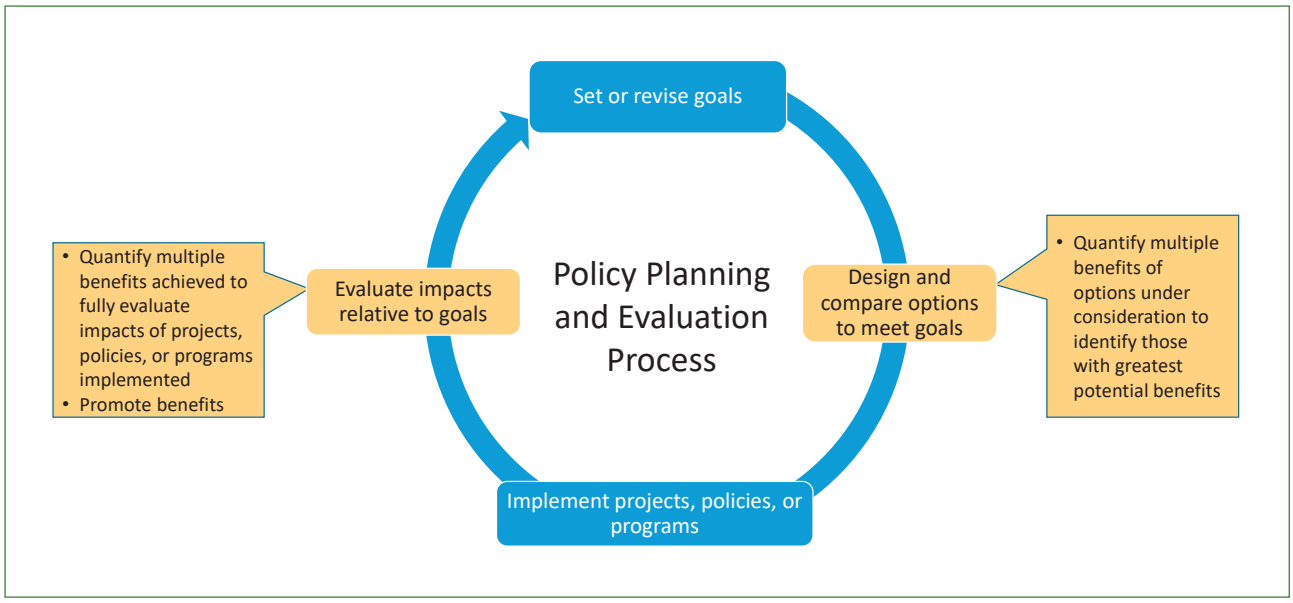


Figure 6: Policy, planning, and evaluation process for multiple benefits of energy efficiency.

It is important to customize a tailored response to identified barriers affecting buildings stock sectors. In this case the evaluation of strategic mechanisms and policies might result in a set of measures which involve different target groups (e.g. building categories, ownership and tenures). The report "Energy Efficiency: A Compelling Global Resource" [19] highlights the key role of having a constant assessment of the barriers in order to identify the correct strategic solutions in the shorter timeframe. This example of a holistic approach of EE strategies and policy development is depicted in Figure 7 (adapted from [19]):

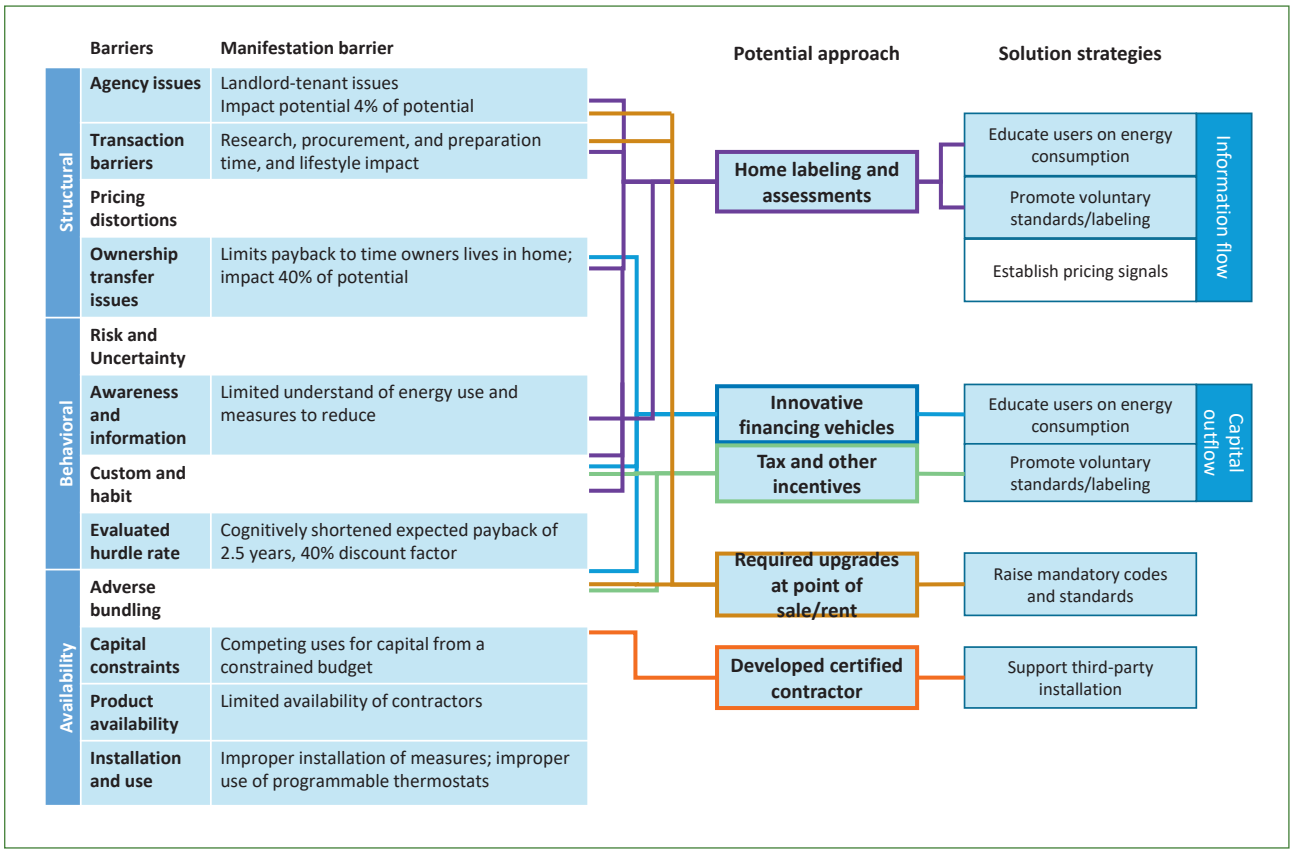


Figure 7: Example holistic approach for addressing policy measure to specific barriers.

Figure 8 (adapted from [18]) presents a framework for quantifying the multiple benefits of energy efficiency including also renewable energy. This can be adapted to energy efficiency improvements in buildings. The key points for the analysis of the benefits, which a decision-making public body should consider are:

- Understand and define the real goal and scope of the analysis;
- Define the EE goals and the set of potential strategies, policies and/or activities to be evaluated;
- Identify the benefits that depend on the identified goal and scope of the analysis;
- Define the level of precision of the benefit assessment. Several benefits can be assessed using basic ore more complex and detailed methods;
- Define the actual capacity to perform the analysis in terms of financial and staff resources or external expertise;
- Understand and define the available data and information;
- Define the perspective of the analysis, i.e. retro- or future-perspective. Benefits assessment from an existing program (i.e. retrospective view) brings less uncertainty than a future perspective benefits assessment.

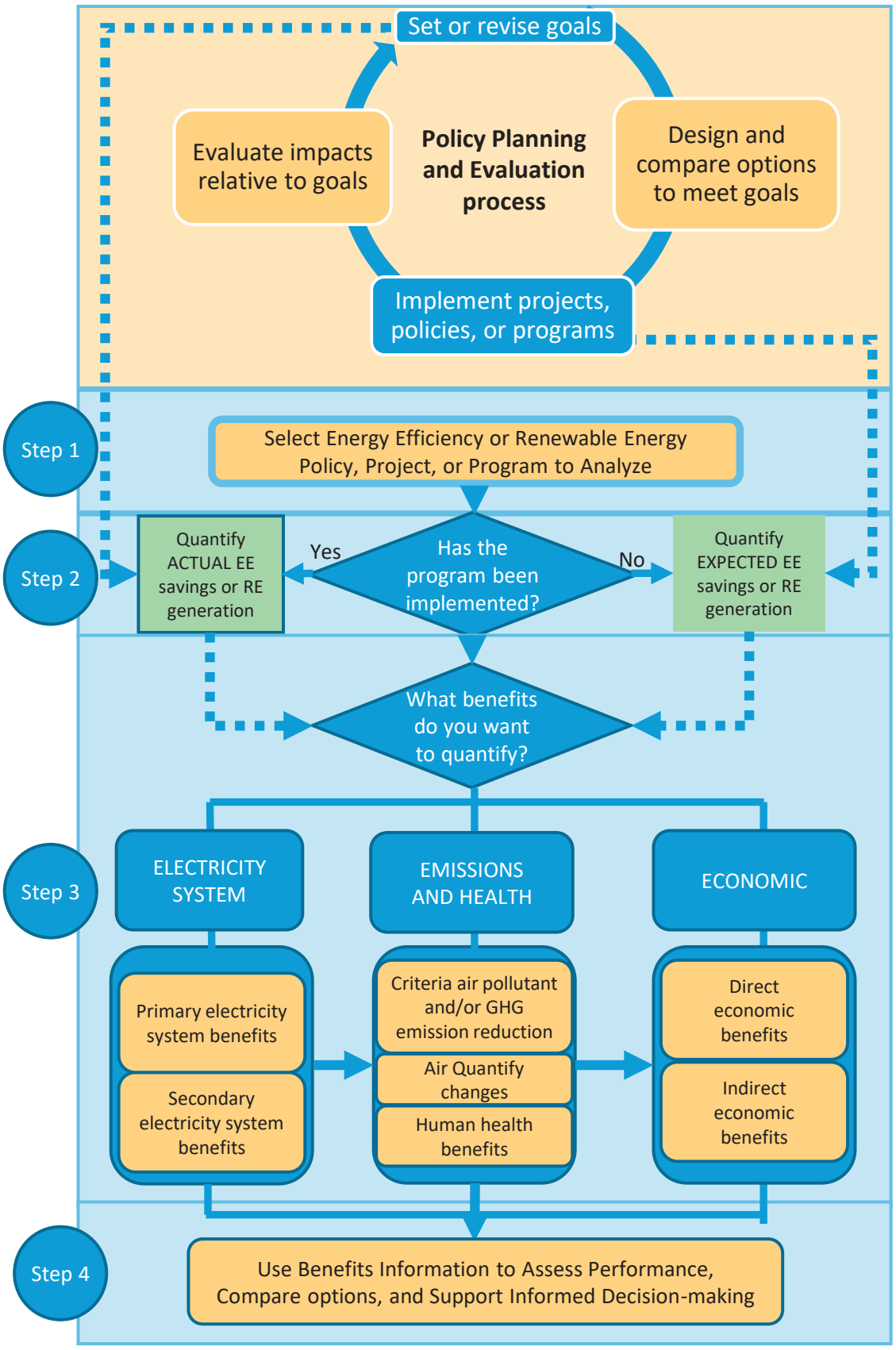


Figure 8: Energy Efficiency Strategy for Building: example of the evaluation process for the application of a holistic approach for benefit assessment.

4 | How to develop an energy efficiency strategy for the municipal building stock

This section presents the implementation of the concept developed within the *Act Now!* project to improve energy efficiency in municipal buildings. The key step for the selection of a tailored energy efficient strategy is the definition of a specific *Capacity Building Scheme* for each municipality (Figure 9). This holistic and innovative approach takes the mobilization of a capacity building action plan into account, which is rooted on the existing capacities of a municipality in terms of investments, Public-Private Partnerships, stakeholders' engagement and technological innovation diffusion.
(more in '*Act Now!* Manual From SEAP to Investment'; '*Act Now!* Guideline Public Private Partnership', '*Act Now!* Guideline Financing of Energy Efficiency Projects', online learning platform actnow-baltic.eu/learning)

The following main steps have been identified as main components of this concept:

1. Identification of needs through the implementation of a Capacity Building Scheme in order to improve the energy management system and increase energy efficiency in buildings;
2. Definition of a specific working group deemed Local Energy Efficiency Group (LEEG) (see the *Act Now!* Manual);
3. Assessment of the current situation in order to create a baseline scenario based on historical data (i.e. data collection);
4. Definition of the actual EE municipal personnel capacity and related main gaps towards setting clear EE targets for municipal buildings;
5. Definition of a tailored list of EE measures within the municipal building sector and prioritization of the potential capacity building measures;
6. Definition of a Capacity building scheme strategy considering several aspects: effect on the actual SEAP/SECAP (Box 4) or other type of municipality energy plan, reorganization of the municipal decision-making process including the possibility of integrating the established LEEG, strengthening of PPP, increasing technological knowledge capacity within the municipality management staff, stakeholder's engagement;
7. Evaluation of the potential financial and PPP capacities of the municipality
8. Monitoring (and re-evaluation).

Box 4: What is the Covenant of Mayors initiative? What is SEAP and SECAP? [28] [29] [30]

Covenant of Mayors (CoM). In 2008, the European Commission launched the first- and to date the most ambitious- initiative targeting local and subnational authorities to lead climate and energy action. The Covenant of Mayors for Climate and Energy is the mainstream European voluntary movement involving local authorities in the development and implementation of sustainable energy and climate policies.

Sustainable Energy Action Plan (SEAP). SEAP is the implementation tool for signatories that joined the Covenant of Mayors before October 2015. The action plan aims to reduce GHG emissions by at least 20% by 2020. The SEAP document describes concrete actions, responsibilities and timing to achieve the local authority's long-term energy consumption and CO_2 emissions reduction targets for a certain geographical area.

Sustainable Energy and Climate Action Plan (SECAP). SECAP is the current implementation tool for signatories of the CoM. This action plan aims to reduce GHG emissions by at least 40% by 2030, adapt to the impacts of climate change and alleviate energy poverty [https://eumayors.eu/support/faq.html].

Nowadays signatories of the CoM, targeted on emissions-reduction, are updating their current SEAPs to SECAPs by including new emissions-reduction targets and timeframes and integrating climate adaptation measures. Since 2015, the Signatories were asked to prepare, implement, monitor and report on SECAPs on the following major components:

- A framework to reduce CO_2 and other GHG emissions by at least 40% by 2030;
- A strategy to adapt to the impacts of climate change affecting the area;
- A comprehensive local action plan bringing together the above streams by outlining integrated measures, clear responsibilities, financing, etc. to achieve them;
- Clear monitoring and reporting plans to ensure effective implementation.

Figure 9 depicts the algorithm of the *Act Now!* methodology for defining a proper and tailored municipal capacity building scheme (CBS). More details can be found in the *Act Now!* Manual and the other Guidelines.

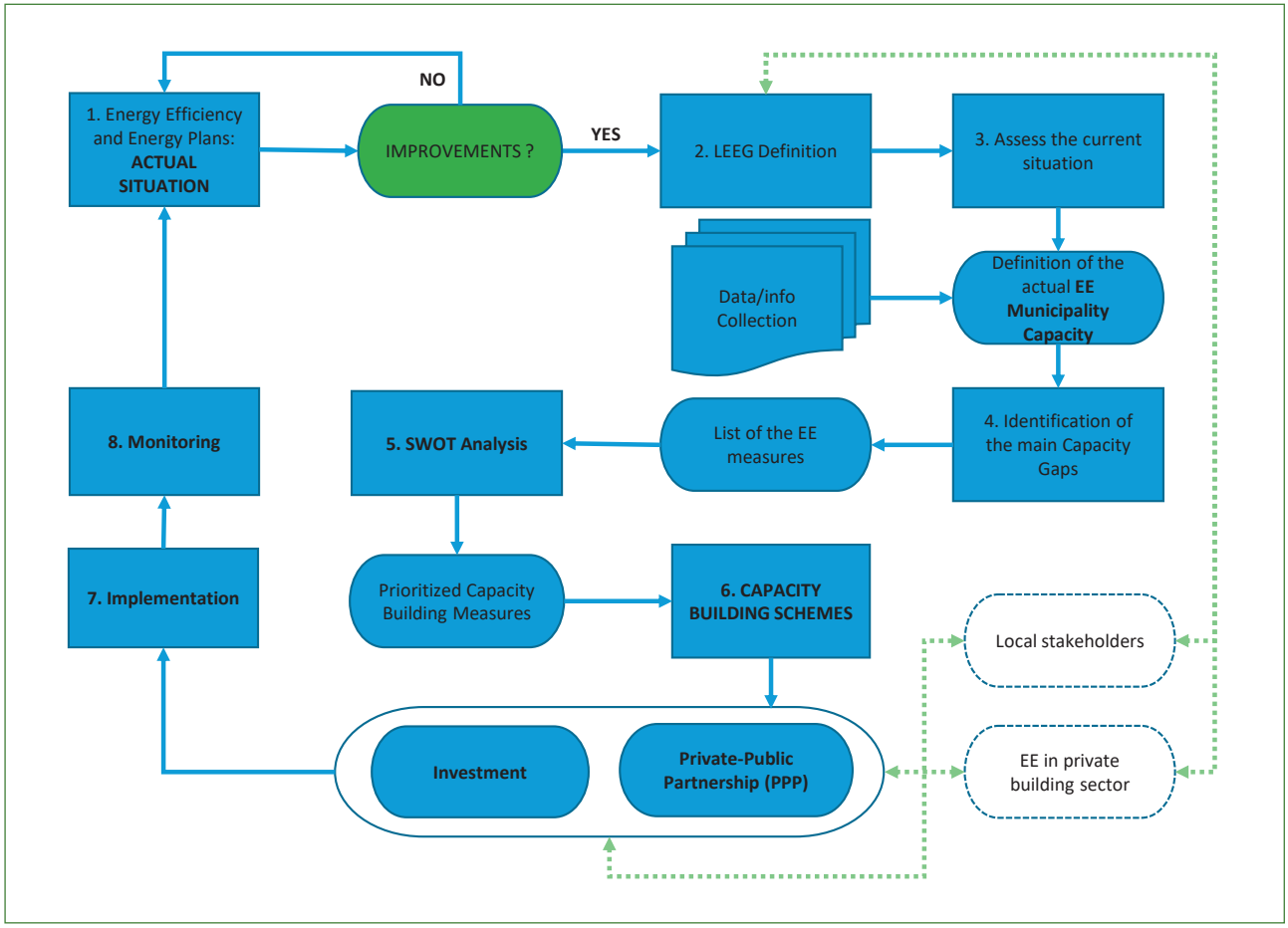


Figure 9: Act Now! project practical approach to implement municipal building energy efficiency measures.

4.1 | Initial step

The first step towards the implementation of more optimized and strategic local energy planning for energy efficiency in the building stock in municipalities is the implementation of a consistent method better identifying gaps and subsequently developing a tailored strategy for energy efficiency measures. It is essential for the municipality to understand where the main gaps are in order to prioritize the improvement strategies. The potential gaps can be identified using the *Act Now!* methodology. Key issues are:

- Are clear and ambitious targets set for the EE strategy in municipal buildings (eventually included in a SEAP and/or SECAP)?
- Is an Energy Management System (EnMS) in place? Are resources available, including financial.
- Is there cooperation among municipalities with a third investment party (i.e. ESCo)?
- Is there opportunity for cooperation between industry-academia-government and for creating an innovation diffusion able to trigger even more benefits to municipalities, i.e. by exploiting and application of new energy efficient technologies?
- Is a harmonized policy planning on an inter-departmental level and with an inter-municipal view ensured?
- Is there lack of expertise within the municipality which can be better provided with stakeholder engagement and technical cooperation?
- Is there a lack of cooperation with experts and/or academia for unlocking peer learning programmes and better dissemination of best practices (e.g. energy management), and which might finally raise awareness and strengthen a more conscious perception of the energy use habits?

4.2 | How to form a Local Energy Efficiency working group (LEEG)

According to the *Act Now!* project methodology in order to have a holistic approach on strategic planning for municipal building efficiency it is mandatory to establish a Local Energy Efficiency Group (LEEG) in order to have an optimal interface both among the different municipal departments and the local stakeholders involving energy facilities operators, energy efficiency experts and potential investors. This is a key step in order to facilitate better prioritization of funding opportunities and to have facilitated access to external funding for energy efficiency measures in municipal buildings. The LEEG is the best fit to provide a foundation upon which policy planning can be more effectively implemented taking into account inter- and intra-departmental, inter- and intra-municipal cooperation and stakeholders' engagement.

The LEEG it might function as an advisory board and/or as a body providing expertise and support among the municipal departments, the municipal agencies and the local stakeholders and main key actors. Creating such a group will be the main driver of building capacity within the municipality and will trigger long term solution and attract financing.

The '*Act Now!* Manual 'From SEAP to investment' (actnow-baltic.eu/learning) offers a detailed description from the municipalities involved in the project.

4.3 | How to make a baseline scenario

A key step that the local government needs to address, is whether a baseline exists (i.e. historical data) for estimating energy efficiency benefits in the municipal buildings stock. A baseline is needed for identifying the potential opportunities for energy efficiency improvements and instruments to be implemented within a more consistent and sustainable energy efficiency strategy. If a municipality does not have a baseline it would be pertinent to acquire data that can be collected directly from the municipality or supported by other data providers like the Central Statistical Bureau, relevant stakeholders or energy utility operators.

The aim for the municipality is to assess a baseline scenario for the energy performance of municipal buildings in order to select the most suitable strategy. Therefore, systematic data collection and a reliable way of defining the initial capacity of the municipality are needed to:

- prioritise key actions and policies to optimize energy efficiency in buildings,
- set ambitious but viable targets and
- link the overall strategy with a more holistic approach which also considers setting specific municipal-level climate goals.

The paper [24] provides support for municipalities to select proper tools among a wide range of sources for energy efficiency in buildings. Data collection and a more synergetic dialog among each municipal department are essential for defining a consistent benchmarking of the municipality's facilities and acquire energy performance data for every municipal building. Benchmarking allows to analyse the performance of buildings over time. This will identify spots with higher energy intensity and consequently enables tailored actions for the improvement of the building performance.

Box 5: Capacity Assessment approach in *Act Now!*

Within the *Act Now!* project, a specific step for the evaluation of the initial municipal capacity to improve EE in the building stock has also been supported by the development of an Initial capacity assessment tool. This tool is based on a methodology based on four main parts:

- Definition of a customized questionnaire identifying needs and gaps within the field of an Energy Management System (EnMs) and energy efficiency;
- Conducting a SWOT analysis for clear identification of key priorities for the implementation of Capacity Building Schemes;
- Definition of a quantitative self-assessment tool to be merged with the SWOT analysis for the definition of the strategic plan for capacity building schemes in EnMs and an energy efficiency in municipalities;
- Definition and implementation of customized strategies and schemes for improving capacity building.

('*Act Now!* Manual From SEAP to Investment', online learning platform actnow-baltic.eu/learning)

4.4 | How to define the main gaps in order to define specific targets

Once the baseline is established, it is important to determine the most important barriers to energy efficiency improvements. Barriers to energy efficiency are local and thus vary widely in different municipalities. In *Act Now!* this part of the process was mainly implemented using three main steps (Figure 10):

1. A questionnaire to identify the state-of-the-art of energy management and strategies in municipalities;
2. An excel-based capacity self-assessment;
3. A SWOT analysis based on an Excel tool for prioritizing specific actions.

All tools are available as learning material on the *Act Now!* learning platform (actnow-baltic.eu/learning/tools) and also described in the Manual.

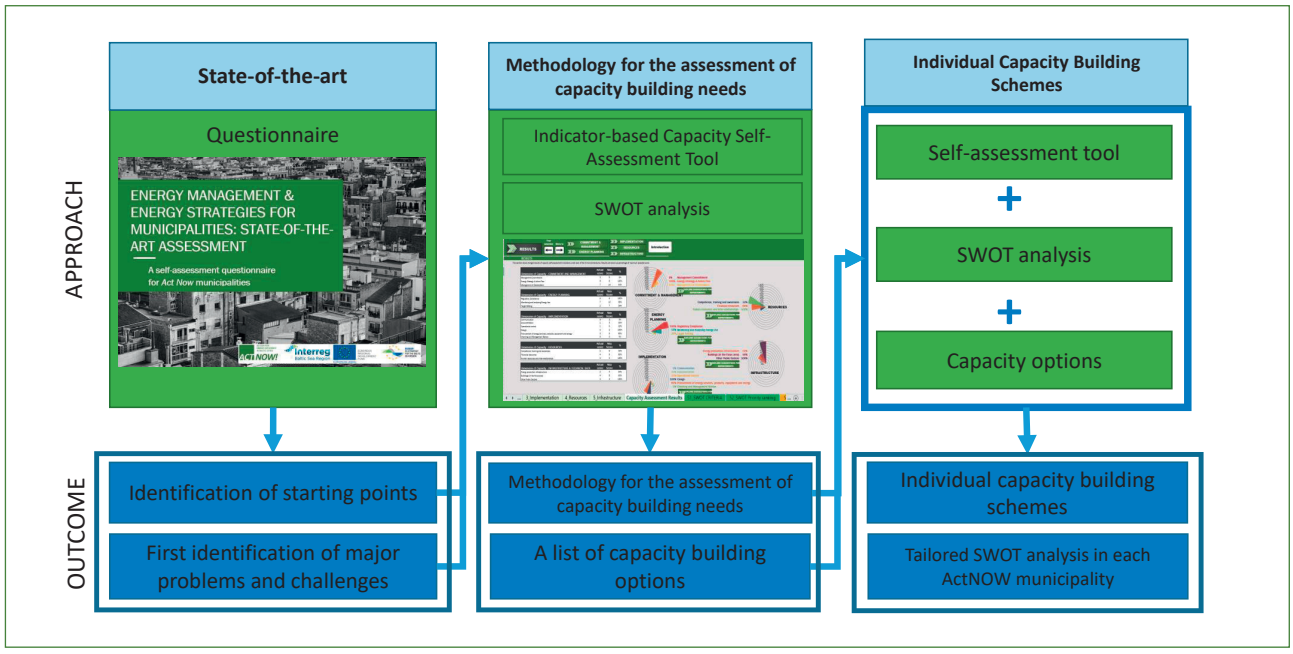


Figure 10: Act Now! methodology for assessing capacity gaps in municipalities.

Several examples from *Act Now!* municipalities show the success of implementing clear set targets within EE Strategies and Action Plans for buildings. This process, implemented by aid of a capacity self-assessment methodology, it consists of five strategic phases:

1. Assessment of the present capacity: Where we are now?
2. Definition of the desired state/ future vision: What do we want to achieve?
3. Comparison of the present situation and future desired state, identification of capacity gaps, planning strategies and actions to fill these gaps and achieve desired goals: How do we get there?
4. Implementation of capacity building measures: What actions do we take?
5. Monitoring and evaluation to feed-back experiences into the planning phase: How do we stay there?

Based on the five steps a schematic representation of the methodology for the capacity self-assessment is presented in Figure 11, adapted from [25])

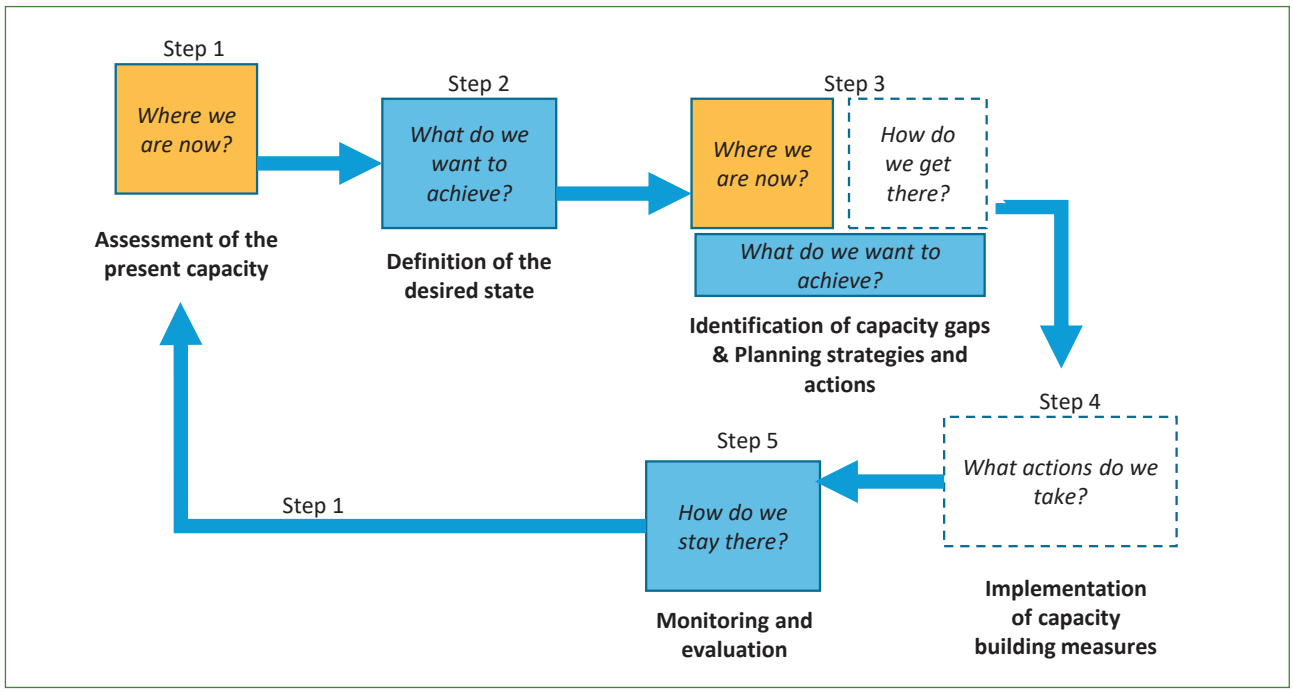


Figure 11: Five steps for the definition of a tailored capacity assessment.

A detailed description of the Capacity Assessment tool is given in the *Act Now!* Manual and in the training material within the web-based training programme of the *Act Now!* project.

Box 6: Extract of one aspect from the Capacity Assessment tool in *Act Now!*

The self-assessment tool considers requirements for developing effective systems and processes in the organizations to improve the energy performance according to the ISO 500001 energy management standard. The capacity evaluation criteria are grouped under six macro-dimensions as shown in Figure 12.

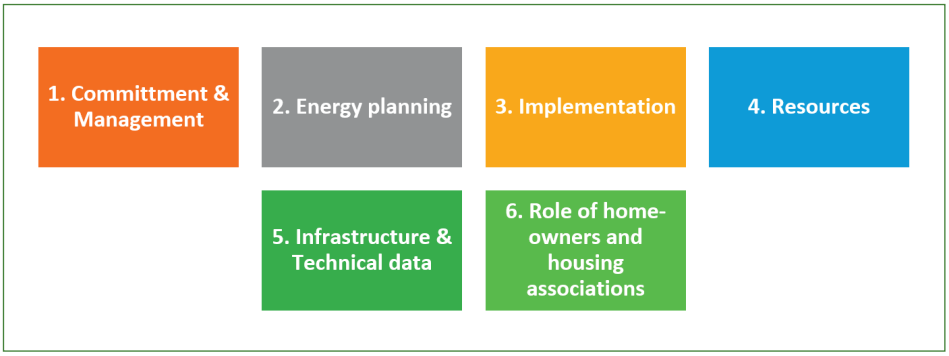


Figure 12: Macro-dimensions for capacity evaluation.

Each macro-dimension contains a number of criteria to evaluate the existing capacity.

4.5 | How to select and prioritize energy efficiency measures for the municipality building stock

The next steps are to design a selected strategy and to ensure its harmonization with the strategic policy instruments. The prioritisation of key actions and policies for optimizing energy efficiency in buildings is essential to allocate and more effectively mobilize municipality resources and capacities to reach the target.

These steps are described in the '*Act Now!* Guideline Identification of Most Effective Energy Efficiency Measures' and the Manual.

4.6 | How to make and implement a Capacity Building Scheme strategy

The definition of a Capacity Building Scheme (CBS) strategy is necessary to help reorganize municipal building efficiency into urban planning and at the same time provide more stability at political level to eventually attract potential investors. Moreover, a tailored CBS strategy will also support the achievement of the given climate goals. This section of the guideline reports the main key aspects to be considered.

Within the project *Act Now!* several key areas have been identified from the implementation of the self-assessment tool and the SWOT analysis covering several fields that can be summarized in the following main areas:

- Renewed or new SEAP/SECAP in the municipality;
- Implementation of an Improved Energy Management system (e.g. proposal of smart metering systems);
- Strategic reorganization of the municipal decision making process related to energy efficiency strategies;
- Diffusion of technological innovation to support for cooperation among municipalities, academia and local stakeholders;
- Strengthen local stakeholder engagement;
- Strengthening PPP and links with energy efficiency in the private building sector ('*Act Now!* Guideline Public Private Partnership', actnow-baltic.eu/learning);
- Promote behavioural change and raise awareness;
- Training of municipal employees.

Box 7: Best case practice - Municipality of Gulbene (Latvia): A Capacity Building Scheme focused on SECAP

Summary: The final version of the "capacity self-assessment tool" from Gulbene municipality was analysed by coaching and expert partners within the *Act Now!* project, namely Riga Technical University (RTU).
Each capacity dimension has been discussed within the tandem of the municipality and the coaching expert partner in order to create a more consistent capacity building action plan. The main outcome as result of this process focused on the creation of optimal synergies among the municipal staff, the formed LEEG (local energy efficiency group) and the coaching expert partner. According to the Capacity Self-Assessment Tool outputs, the definition of the CBS focused on the following main capacity dimensions: Commitment & Management, Energy Planning, Implementation, Resources and Infrastructure.

Results: All main gaps and critical issues identified from the implementation of the tool are reported in the following table as a summary including the overall score on a normalized scale 1-10 (Table 2).

Table 2: Self-assessment tool output for Gulbene municipality.

Dimension of Capacity - COMMITMENT AND MANAGEMENT	Actual score	Max Score	%
Management Commitment	0	6	0%
Energy Strategy & Action Plan	7	7	100%
Management & Stakeholders	7	14	50%

Dimension of Capacity - COMMITMENT AND MANAGEMENT	0,8
Management Commitment	0,0
Energy Strategy & Action Plan	0,6
Management & Stakeholders	0,3

Dimension of Capacity - ENERGY PLANNING	Actual score	Max Score	%
Regulatory Compliance	4	4	100%
Monitoring and Analyzing Energy Use	7	12	58%
Target Setting	2	7	29%

Dimension of Capacity - ENERGY PLANNING	1,0
Regulatory Compliance	0,6
Monitoring and Analyzing Energy Use	0,3
Target Setting	0,2

Dimension of Capacity - IMPLEMENTATION	Actual score	Max Score	%
Communication	0	3	0%
Documentation	1	3	33%
Operational Control	1	5	20%
Design	2	2	100%
Procurement of Energy Services, Products, Equipment and Energy	3	5	60%
Checking and Management Review	0	2	0%

Dimension of Capacity - IMPLEMENTATION	1,2
Communication	0,0
Documentation	0,2
Operational Control	0,1
Design	0,6
Procurement of Energy Services, Products, Equipment and Energy	0,3
Checking and Management Review	0,0

Dimension of Capacity - RESOURCES	Actual score	Max Score	%
Competence, Training and Awareness	2	6	33%
Financial Resources and Energy Financial Commitment	4	5	80%
Human Resources and Inter-Relationships	4	4	100%

Dimension of Capacity - RESOURCES	1,2
Competence, Training and Awareness	0,2
Financial Resources and Energy Financial Commitment	0,4
Human Resources and Inter-Relationships	0,6

Dimension of Capacity - INFRASTRUCTURE & TECHNICAL DATA	Actual score	Max Score	%
Energy Production Infrastructure	2	4	50%
Buildings (in the focus area)	4	8	50%
Other Public Sectors and Municipal inteventions	4	4	100%

Dimension of Capacity - INFRASTRUCTURE & TECHNICAL DATA	1,1
Energy Production Infrastructure	0,3
Buildings (in the focus area)	0,3
Other Public Sectors and Municipal inteventions	0,6

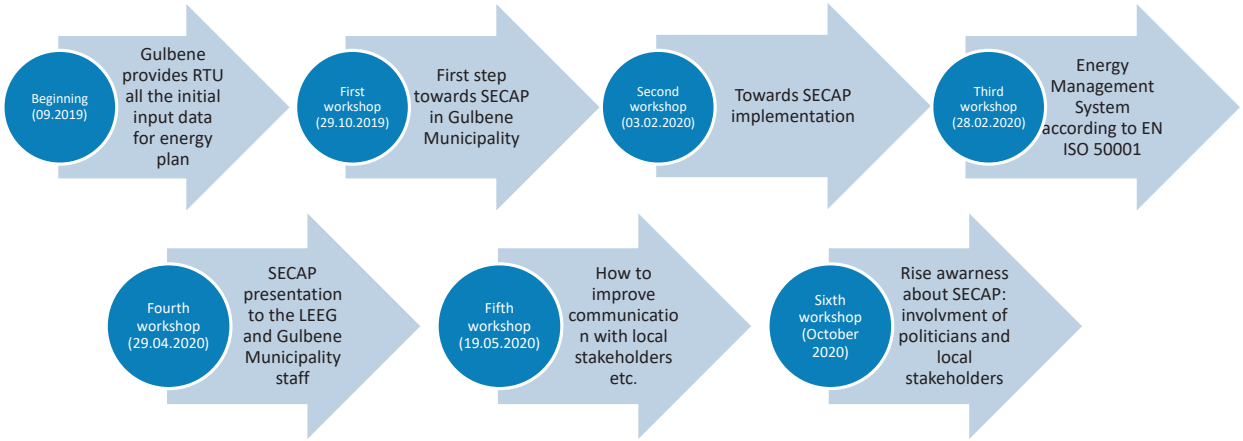
Capacity Self-Assessment Tool for Local Authorities (Municipality)	
FINAL SCORE	5,4

Specific critical issues have been identified in the following sub-indicators: *Management and commitments; Communication; Checking and management review*. Constraints are also evident in: *Operational control, Target setting, Documentation and Competence, Training and Awareness.*

The tailored action plan with the definition of an optimal Capacity Building Scheme has been defined considering the following main steps:

1. Development of an energy strategy based on SEAP approach and the implementation of a non-certified (at least in the first phase) Energy Management System (EnMS) in line with the requirements from the ISO 50001;
2. Definition of key roles of the LEEG and the interaction with the municipal management staff;
3. Definition of a specific action plan for increasing competence, training and awareness of the municipal management staff and the LEEG.

This was implemented in 6 workshops, the structure of which is shown below:



Success vs drawback: a tailored action plan with the definition of an optimal Capacity Building Scheme has been defined considering a synergetic approach among the municipality management staff, the established LEEG and the coaching expert partner (RTU). The general scheme is reported in Figure 13 below:

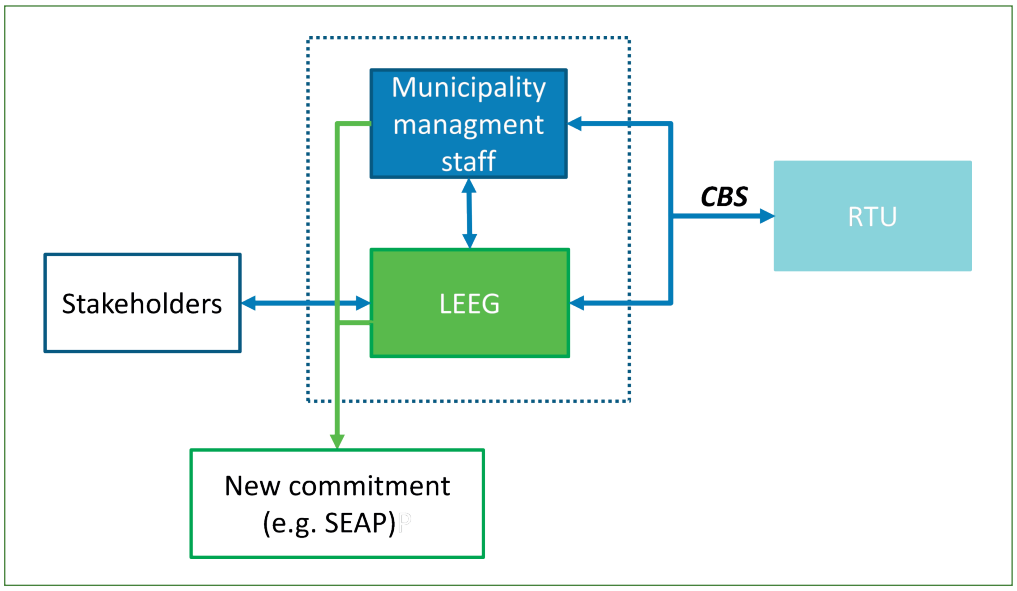


Figure 13: Act Now! approach for CBS implementation in Gulbene.

At this stage local stakeholders were not engaged.

Transferable value: The tandem approach and the synergy among Gulbene Municipal staff, the coaching expert partner RTU and the LEEG was the essential part for the development of a SECAP in Gulbene municipality. A tailored capacity building action plan implemented through a framework of 6 workshops was essential to create the basis for a proper knowledge transfer and a more participating decision-making process within the municipality. The established LEEG was included in the major decisions on municipal energy efficiency policy in the building sector.

This approach can be applied for municipalities that want to develop a new SECAP in place on an existing energy plan. Moreover, it can provide the grounds to facilitate the exchange of strategic planning in terms of creating synergy with experts and/or academia in order to promote sustainable and integrated planning.

With the identification of the most effective energy efficiency measure(s) completed, it is time to clarify the way how to provide the optimal financing opportunity and scheme.
[For further information see the '*Act Now!* Guideline Financing of Energy Efficiency Projects' and the '*Act Now!* Manual From SEAP to Investment'].

Policy practices for energy efficiency improvement in buildings, existing in various locations, and lessons learnt can also be an important source of information for policy design in certain municipalities.

4.7 | Importance of monitoring

Looking at the energy management definition (Box 1) it is finally time to close the loop of the proposed methodology for the evaluation of the effects of the selected CBS scheme. The use of the proposed self-assessment tool should be considered and compared to the baseline assessment.

In order to ensure that there is progress towards higher levels of energy efficiency is taking place, the impact of the implemented policy needs monitoring in the framework of a proper Energy Management system.

For an energy efficiency strategy for buildings tools based on inventories, scenarios and indicators can be considered in order to establish the most relevant framework for tracking and reporting the progress on energy efficiency improvement.

5 | Next steps

Based on the concept proposed in this guideline, once the energy efficiency strategy for buildings has been identified, the next stage is to understand the applicability and harmonization of this strategy. This includes the identification of the most effective energy efficiency measures to be implemented on an existing action plan and to further evaluate the financing opportunities as outlined in the other *Act Now!* guidelines.

References

[1] „*Act Now!* project," [Online]. Available: https://actnow-baltic.eu/.

[2] I. E. Agency, „Energy Technology Perspectives 2016," Paris, 2016.

[3] A. Mardiana and S. Riffat, "Building Energy Consumption and Carbon dioxide Emissions: Threat to Climate Change," Journal of Earth Science & Climatic Change, no. S3, p. 1, 2015.

[4] European Commission, 17 February 2017. [Online]. Available: https://ec.europa.eu/info/news/focus-energy-efficiency-buildings-2020-feb-17_en. [Accessed 5 August 2020].

[5] European Union, "Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings," Official Journal of the European Union, vol. L, no. 153, pp. 13-33, 2010.

[6] European Union, "Directive 2012/27/EU of the European Parliament and of the Council 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," Official Journal of the European Union, vol. L, no. 315, pp. 1-55, 2012.

[7] EFFECT project (Dialogue Platform on Energy and Resource Efficiency in the Baltic Sea Region), „Dialogue Platform on Energy and Resource Efficiency in the Baltic Sea Region. Policy review. Background paper II.," 2013.

[8] J. Thema, F. Suerkemper, J. Couder, N. Mzavanadze, S. Chatterjee, J. Teubler, S. Thomas, D. Ürge-Vorsatz, M. B. Hansen, S. Bouzarovski, J. Rasch and S. Wilke., "The Multiple Benefits of the 2030 EU Energy Efficiency Potential," Energies, vol. 12, no. 14, 2019.

[9] Renovate Europe, „Renovate Europe," 2017. [Online]. Available: https://renovate-europe.eu/wp-content/uploads/2015/10/Multiple-Benefits-Study_Key-Messages-Brochure.pdf. [Accessed 05 August 2020].

[10] M. Molina, „The Best Value for America's Energy Dollar: A National Review of the Cost of Utility Energy Efficiency Programs. Report Number U1402.," American Council for an Energy-Efficient Economy, 2014.

[11] M. Billingsley, I. Hoffman, E. Stuart, S. Schiller, C. Goldman and K. LaCommare, „The Program Administrator Cost of Saved Energy for Utility Customer-Funded Energy Efficiency Programs," Lawrence Berkeley National Laboratory, 2014.

[12] M. Rivas Rábago, „Energy prices and costs in Europe," Europe's leading independent think tank, 2019. [Online]. Available: https://www.ceps.eu/wp-content/uploads/2019/02/03082019%20CEPS_Rabago_Energy%20prices%20and%20costs%20in%20Europe.pdf. [Accessed 05 August 2020].

[13] E. Omic and J. Halb, „The social development bank in Europe," March 2013. [Online]. Available: https://coebank.org/media/documents/CEB_Study_Energy_Poverty_in_Europe.pdf. [Accessed 5 August 2020].

[14] The Climate Institute , „The Climate Institute," June 2013. [Online]. Available: http://www.climateinstitute.org.au/verve/_resources/Vivid_Economics_-_Energy_efficiency_and_economic_growth_June_2013.pdf. [Accessed 5 August 2020].

[15] International Energy Agency, „Capturing the Multiple Benefits of Energy Efficiency," International Energy Agency, 2014.

[16] European Commision, „The Macroeconomic and Other Benefits of Energy Efficiency – Final report," August 2016. [Online]. Available: https://ec.europa.eu/energy/sites/ener/files/documents/final_report_v4_final.pdf.

[17] European Commision, 2014. [Online]. Available: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52014DC0330&qid=1407855611566. [Accessed 27 August 2020].

[18] European Commision, 2011. [Online]. Available: https://eur-lex.europa.eu/legal-content/EN/ALL/;ELX_SESSIONID=pXNYJKSFbLwdq5JBWQ9CvYWyJxD9RF4mnS3ctywT2xXmFYhlnlW1!-868768807?uri=CELEX:52011DC0885. [Accessed 27 August 2020].

[19] Environmental Protection Agency, „Quantifying the Multiple Benefits of Energy Efficiency and Renewable Energy: A Guide for State and Local," Environmental Protection Agency, 2018.

[20] Buildings Performance Institute Europe, „A guide to developing strategies for building energy renovation," Buildings Performance Institute Europe, 2013.

[21] Council of Europe Development Bank, „Energy Poverty in Europe. How Energy Efficiency and Renewables Can Help," Council of Europe Development Bank, 2019.

[22] European PPP Expertise Centre, „Guidance on Energy Efficiency in Public Buildings," 2012.

[23] A. Blumberga, System Dynamics for Environmental Engineering, Riga: Riga Technical University, 2011.

[24] K. Petrichenko, N. Aden and A. Tsakiris, „Tools for Energy Efficiency. A GUIDE FOR POLICY-MAKERS AND EXPERTS," Copenhagen Centre on Energy Efficiency (C2E2), Copenhagen, 2016.

[25] M. Kay, T. Franks and S. Tato, "Capacity needs assessment in agricultural water management: Methodology and processes. ICID Workshop on Capacity Needs Assessment, Moscow.," in Workshop on Capacity Needs Assessment, Moscow, 2004.

[26] United Nations Environment Programme, „The Emissions Gap Report 2017. A UN Environment Synthesis Report," United Nations Environment Programme, 2017.

[27] SUNShINE project, [Online]. Available: https://sharex.lv/.

[28] European Union, "Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC," Official Journal of the European Union, vol. L, no. 114, pp. 64-85, 2006.

[29] Y. Saheb, A. Kona, I. Maschio and S. Szabo, „How to develop a Sustainable EnergyAction Plan (SEAP) in South Mediterranean Cities," European Commission, Joint Research Cenre institute of Energy and Transport, Luxembourg, 2014.

[30] P. Bertoldi, D. Bornás Cayuela, S. Monni and R. Piers de Raveschoot, „How to develop a Sustainable Energy Action Plan (SEAP)," European Commission, Joint Research Centre, Institute for Energy, Luxembourg, 2010.

[31] Compete4SECAP project, „Compete4SECAP," [Online]. Available: https://compete4secap.eu/home/. [Accessed 5 August 2020].

[32] F. Ferrero and A. Vesco, „Handbook of Research on Social, Economic, and Environmental Sustainability in the Development of Smart Cities. Information Science Reference," IGI Global, 2015.

[33] A. Brem and A. Radziwon, "Efficient Triple Helix collaboration fostering local niche innovation projects – A case from Denmark," Technological Forecasting and Social Change, vol. 123, pp. 130-141, 2017.

[34] United Nations Development Programme, „Capacity Assessment. User's guide," United Nations Development Programme, New York, 2008.

[35] F. Freschi and M. Repetto, "Artificial immune system in the management of complex small scale cogeneration systems," in Handbook of Research on Artificial Immune Systems and Natural Computing: Applying Complex Adaptive Technologies, IGI Global, 2009, pp. 141-158.

[36] VDI, „Standard VDI 4602 Blatt 1: Energy Management- Fundamentals," VDI.

[37] 50000&1SEAP, „https://50001seaps.eu/," February 2017. [Online]. Available: https://50001seaps.eu/fileadmin/user_upload/Materials/deliverables/D5.5_50001_ans_SusEnPlanning_Final1.pdf. [Accessed 27 August 2020].

[38] C. project, „ENERGY MANAGEMENT SYSTEM (EnMS) GUIDEBOOK FOR LOCAL AUTHORITIES," 2018.

[39] European Parliamentary Research Service Research PE 568.361, „Understanding energy efficiency," European Parliament, Brussels, 2015.

[40] International Energy Agency , „https://www.iea.org/," 2020. [Online]. Available: https://www.iea.org/publications/freepublications/publication/energy-efficiency-indicators-essentials-for-policy-making.html. [Accessed 27 August 2020].

Further *Act Now!* Material:
'*Act Now!* Manual From SEAP to Investment'
'*Act Now!* Guideline Energy Efficiency Strategy for Municipal Buildings'
'*Act Now!* Guideline Identification of Most Effective Energy Efficiency Measures'
'*Act Now!* Guideline Public Private Partnership'

***Act Now!* project website:**
https://actnow-baltic.eu/

***Act Now!* online learning platform:**
The four guidelines helping you to set up and implement your energy efficiency strategy:
actnow-baltic.eu/learning
Further tools and helpful information (Questionnaire, SWOT analysis, Capacity Self-Assessment Tool etc.):
actnow-baltic.eu/learning/tools
Examples from the municipalities which improved their energy efficiency capacities in the *Act Now!* project (Municipality Reports, actual Capacity Building Schemes and Case Studies, Feasibility Studies etc.):
actnow-baltic.eu/learning/municipalities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