MINISTRY OF ECONOMIC AFFAIRS
AND COMMUNICATIONS

National strategy for the reconstruction of buildings to improve energy efficiency

Estonia's Notification to the European Commission on the basis of Article 4 of Directive 2012/27/EU

…10.2017

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INTRODUCTION

This document was prepared in order to comply with the requirements of Section 4 of the Energy Sector Organisation Act and Article 4 of the EU Energy Efficiency Directive 2012/27/EU.

The document describes Estonia's guidelines and principles for achieving energy savings in buildings. This notification, which includes sectoral activities, has been developed by the Construction and Housing Department of the Ministry of Economic Affairs and Communications and is aimed at meeting the objectives specified in European Union Directive 2012/27/EU. The notification drawn up by a Member State describes the activities and documents that will be used as the basis for making the investments in the renovation of both public and private residential and commercial buildings in order to achieve energy efficiency to the relevant extent. An overview of the current situation with regard to the building stock is predominantly based on the supporting documents for preparing the draft 'Estonian Development Plan for the Energy Sector until 2030'[1] (ENMAK 2030) and on the analyses and studies carried out by the Ministry of Economic Affairs and Communications. The notification describes the nationally developed cost-effective, practicable and reasonable measures. The preparation of more detailed plans will be conducted in accordance with other sectoral development plans and strategies.

In accordance with Directive 2012/27/EU, the national strategy for the reconstruction of buildings to improve energy efficiency must include the following:

a) an overview of the national building stock;
b) identification of cost-effective approaches to renovations relevant to the building type and climatic zone;
c) policies and measures to stimulate cost-effective deep renovations of buildings, including staged deep renovations;
d) a forward-looking perspective to guide the investment decisions of the individuals, construction industry and financial institutions;
e) an evidence-based estimate of expected energy savings and wider benefits.

National strategic planning framework

Strategic planning is carried out in Estonia on the basis of the State Budget Act, which lays down the requirements for creating national development documents. One important objective of this Act, which entered into force in 2014, was to create better links between development plans and the drawing up of the state budget, as well as to reduce the creation of strategies that have limited objectives or are unrelated to other development documents. As of July 2017, 49 development documents guiding the future of 17 policy areas were in effect in Estonia. These 17 policy areas are as follows: improving the livelihood of families with children, the state reform, halting peripheralisation, security and national defence, foreign policy and European Union policy, raising incomes and promoting entrepreneurship, the energy industry, social protection and public health policy, legal order, internal security, science and education policy, culture and sports, Estonian language and Estonian identity, citizenship policy and integration, the

[1] https://eelnoud.valitsus.ee/main/mount/docList/c47dc155-35cf-4150-8030-af84d5c23cad

environment, rural life and agriculture, and the development of civil society.

The national strategy for the reconstruction of buildings most closely relates to the development documents in the energy area, in particular the 'National Development Plan for the Energy Sector until 2020'[2] and ENMAK 2030. In accordance with the State Budget Act, the Government of the Republic makes the decision regarding the preparation of a sectoral development plan and submits it to the Riigikogu in order to obtain its opinion prior to the plan's final approval. The discussion of ENMAK 2030 was held at the Riigikogu on 10 May 2017. ENMAK 2030 has been presented to the Government of the Republic for approval.

A. OVERVIEW OF THE NATIONAL BUILDING STOCK

An overview of the buildings situated in Estonia is provided in the following tables. The data was taken from the National Register of Buildings (as of 30 June 2013). Only the data on the buildings that are in use according to the data in the Register of Buildings has been presented. The classification provided in Regulation No 78[3] 'List of usage purposes of buildings' of the Minister for Economic Affairs and Communications has been used for the classification of buildings.

Building type	Area, thousand m^2	Number of buildings, pcs
Small residential buildings (one apartment)	23 667	198 857
Apartment buildings (several apartments)	33 745	3 576
Accommodation buildings	1 314	2 853
Food service buildings	384	908
Office buildings	4 693	4 093
Commercial and service buildings	10 225	5 441
Transport buildings (terminals and garages)	4 247	13 009
Industrial buildings and warehouses	14 841	16 088
Recreational buildings	813	1 006
Museums and library buildings	295	361
Educational and research buildings	4 240	2 123
Hospitals and other medical buildings	1 150	537
Sports buildings	748	629
Agricultural, forestry, hunting and fishing farm buildings	12 790	18 306
Miscellaneous buildings (including buildings of worship, historic buildings and special buildings)	17 782	312 777

Table 1: Net area and number of buildings by different purposes for use (source: Register of Buildings, 30 June 2013)

Although all the buildings shown in Table 1 are in use according to the Register of Buildings, there is no energy usage in some buildings, or the energy usage is negligible. Taking this into account, a separate survey has been conducted that assessed the area and the number of buildings where energy was used to ensure a certain quality of the air, including to maintain, increase or decrease the temperature. These buildings with so-called indoor climate control

[2] https://www.mkm.ee/sites/default/files/elfinder/article_files/energiamajanduse_arengukava_2020.pdf
[3] https://www.riigiteataja.ee/akt/107122012009

affect the energy usage of buildings most significantly.

Building type	Number of buildings, pcs	Area, m^2	%
Apartment buildings	27 385	34 281 629	31
Private houses	190 460	26 447 774	24
Other residential buildings	45 779	5 962 745	5
Offices	5 407	8 269 072	8
Accommodation	3 205	1 741 856	2
Service/commercial	7 814	6 487 440	6
Industry	17 832	16 658 128	15
Education	2 200	4 133 084	4
Healthcare	808	1 840 182	2
Other buildings	5 818	4 419 816	4
TOTAL	306 708	110 241 726	100

Table 2: Number of buildings with indoor climate control and the net area of the building stock (source: 'Survey of the Energy-Saving Potential of Buildings for the Renewal of the Estonian Development Plan for the Energy Sector: Improvement of the Energy Efficiency of the Building Stock – Energy Savings, Unit Costs and Volumes' 2013[4])

Type of heating system	Number, pcs
district heating	22 147
local central heating	38 429
electric heating	15 922
ground heating	1 566
air source heat pump heating	1 050
stove or fireplace heating	244 121
other	9 491
no heating system	292 476

Table 3: Number of different types of heating systems in buildings (source: Register of Buildings, 30 June 2013)

Since every building may be equipped with more than one heating system and it is not possible to identify the main type of heating system in a building due to the characteristics of data collection in the State Register of Buildings, the numbers of heating systems and buildings are not equivalent in value.

Type of heating system	Numbe
Buildings constructed before 2003	557 665
Buildings constructed in 2003–2013	23 777

Table 4: Number of buildings by date of construction (source: Register of Buildings, 30 June 2013)

[4] https://energiatalgud.ee/img_auth.php/5/51/ENMAK_2030._Hoonete_energias%C3%A4%C3%A4stupotentsiaali_u uring.pdf

B. IDENTIFICATION OF COST-EFFECTIVE APPROACHES TO RENOVATIONS RELEVANT TO THE BUILDING TYPE AND CLIMATIC ZONE

B.1 Identification of cost-effective renovation methods for buildings

Several surveys have been conducted in Estonia to identify the cost-effective renovation methods for buildings. The most important of these works are the following:

- ENMAK 2030 survey of the energy-saving potential of buildings[5];
- Study on the adaptation of Estonian infrastructure and the energy sector to climate changes[5].

The work on providing a good overview of the technical and economic feasibility of renovating buildings continues, and the Ministry of the Environment is carrying out an analysis to identify cost-effective activities for reducing greenhouse gas emissions in 2017. The survey also includes the potential reduction of CO_2 emissions that could be achieved by the building renovations.

B.2 ENMAK 2030 survey of the energy-saving potential of buildings

B.2.1 Purpose and organisation of the survey

A survey of the energy-saving potential of buildings was carried out when preparing ENMAK 2030. The main objective of the survey was to evaluate the economic and technical potential of the energy savings to be achieved by means of the comprehensive renovation of the existing building stock and the unit costs and volumes of the package solutions to be used for its implementation. The results were calculated by volume on the basis of the most important package solutions and standard buildings for major reconstruction, and generalised such as to be able to also evaluate the total savings potential of the construction sector on the basis of these solutions. The most cost-effective package solutions therefore represent the economic potential, while the package solutions for thorough and major reconstruction represent the technical potential.

When describing the existing building stock, it was taken into consideration that the majority of the building stock constitutes an object of improvement of energy efficiency with regard to its technical potential, since the energy efficiency of buildings has greatly improved during the last decade. The standard buildings referred to in this subsection’s calculation represent approximately 70 % of the volume of building stock with indoor climate control:

1. small residential buildings in which only the technical building systems need to be renovated
2. small residential buildings in which the building envelope must also be renovated
3. apartment buildings
4. office buildings
5. educational buildings
6. commercial and service buildings

[5] https://www.kik.ee/sites/default/files/uuringud/enfra_a_lopparuanne_taiendatud_02112015_0.pdf

7. industrial buildings (no processes).

B.2.2 Residential sector

The residential sector accounts for the largest share of the existing building stock and is considered to be one of the priority areas for energy conservation nationally, as stated in ENMAK 2030. The net area of residential buildings accounts for nearly 60 % of the net area of all buildings with indoor climate control.

The improvement of energy efficiency was calculated on several levels in all standard buildings in order to determine the package solutions that can be implemented to achieve the most feasible unit cost (how many euros must be spent to achieve savings of 1 Wh/y). A more ambitious improvement of energy efficiency provides an approximate evaluation of the technical savings potential. The improvement of energy efficiency at a lower level represents the economic potential of energy savings, i.e. the package solutions that are the most economically feasible to implement for the owner.

The package solutions used were chosen on the basis of earlier surveys and experience; they may be treated as general guidelines with regard to the complete and justified reconstruction solutions.

Energy savings were calculated with the help of simulation models of standard buildings that were prepared on the basis of the actual measured energy consumption of standard buildings. The evaluation of the cost of package solutions was mainly based on the data of the implemented projects and the established unit costs; estimation was also applied for a portion of the solutions due to a lack of data.

All the construction costs that were used describe the cost of the complete construction work, i.e. for insulation, the cost included the accompanying general construction and finishing work. The package solutions therefore also include the reinforcement of the main structures, which extends the service life of the building and raises the quality level with regard to the work performed. The work does not include the cost of other works (electrical work, water and sewerage systems, etc.) that are generally performed in the course of the renovation of apartment buildings but are not related to the improvement of energy efficiency; such works would increase the cost of the packages by up to approximately 25 %. The cost of the package solutions that improve energy efficiency and the technical condition of the building is therefore somewhat lower than the repairs and renovation performed where other works that are not related to energy efficiency are also included. The base level, i.e. the existing situation in calculations (if nothing is done), only proceeds from the energy costs. In fact, the technical condition of numerous buildings is so bad that it requires the performance of certain work (dilapidated roofs/façades) at any rate, and in reality the cost of such work would be added to the costs of the existing situation, which is important to take into consideration when interpreting the results.

The energy costs corresponding to the existing situation were calculated for every building type along with the energy savings and costs that accompany 3–4 package solutions on differentiated levels of renovation. The change in the supplied heat and electricity and the monetary energy savings were calculated separately (whereas, for example, any additional electricity consumption arising from the construction of a ventilation system was expressed in negative numbers). The cost of the implementation was also calculated in total for the entire net area of the building type

(€m), and the total change in heat and electricity consumption (GWh/y) was also calculated. On the basis of the aforesaid, the unit cost of energy savings was calculated, i.e. how many euros must be invested to achieve energy savings of 1 MWh per year. The net present value for 20 years, consisting of the construction cost and the discounted energy costs, has been used when drawing the overall conclusions.

B.2.2.1 Apartment buildings

The energy-efficient renovation packages have been prepared for five energy efficiency levels starting from the standard-usage current situation (energy performance class F) and taking it to the level of a low-energy building (energy performance class B).

Since additional insulation has been applied to the building envelopes of apartment buildings by now, an additional insulation of 50 mm was used for the side walls in the calculation model for the existing situation. This represents a situation where additional insulation has already been applied to a certain number of apartment buildings to a smaller or greater extent. It was additionally considered that approximately 2/3 of the windows in apartments have been replaced by now. When preparing the energy efficiency packages, it was considered that the chosen individual actions were optimal. For example, a thickness of 100 mm for additional insulation was not used for the packages, as this solution is no longer reasonable. The packages also include the insulation of the ceiling of the basement, even though it is not always required for achieving a certain energy efficiency level; however, it is necessary to ensure the thermal comfort of the inhabitants of the apartments on the ground floor. Several solutions have been provided in the packages with regard to the technical building systems, since the desired energy efficiency level can be achieved by using different systems depending on the size of the reference building.

Renovation packages analysed for apartment buildings

Energy performance class E

- exterior wall additional insulation +200 mm
- windows replaced (thermal conductivity 1.1 W/m2K).

Substantially reconstructed building level (energy performance class D)

- exterior wall additional insulation +200 mm
- roofing deck additional insulation +300 mm
- basement ceiling additional insulation +150 mm
- windows replaced (thermal conductivity 1.1 W/m2K)
- reconstruction of a single-pipe heating system, or a new double-pipe system
- exhaust ventilation without heat recovery or an exhaust air heat pump.

New building level (energy performance class C)

- exterior wall additional insulation +200 mm
- roofing deck additional insulation +300 mm
- basement ceiling additional insulation +150 mm
- windows replaced (thermal conductivity 1.1 W/m2K)
- new double-pipe heating system

- room-based or apartment-based ventilation unit.

Low-energy building level (energy performance class B)

- exterior wall additional insulation +200 mm
- roofing deck additional insulation +300 mm
- basement ceiling additional insulation +150 mm
- windows replaced (thermal conductivity 0.6 W/m^2K)
- new double-pipe heating system
- apartment-based ventilation unit
- solar thermal collectors for producing domestic hot water.

The costs of the measure were calculated on the basis of the budgets of the reconstruction work of apartment buildings that have applied for a renovation grant from SA KredEx.

Conclusions

For apartment buildings, the current situation (with inadequate ventilation and dilapidated structures) is marginally cheaper than the package solutions: net present value 280 €/m^2 vs 300 €/m^2. Reconstruction to the level of a new building (C) or a low-energy building (B) may be considered to be a justified objective due to the small difference in the net present values. However, the slightly higher net present value that accompanies class B indicates that this package is no longer economically feasible, even from the 20-year perspective. As the major packages (C and B) also entail a significantly higher initial investment, it is extremely likely that the energy savings potential of the major packages will not be realised under market conditions, as based on the construction cost the investments will more likely be limited to packages E and D. If packages E or D are chosen, the opportunity for energy savings corresponding to the major packages will essentially be lost for the next 10–20 years.

However, the differences between the net present values are relatively small between the energy performance classes E, D and C, permitting the conclusion that it is possible to renovate apartment buildings to a new level of energy efficiency without increasing the costs.

To realise the energy savings potential corresponding to levels C and B, a relatively small support grant would therefore be needed in order to shift the results of investment calculations so they become economically feasible for these packages. As there is no difference between levels C and B in terms of carrying out the reconstruction — in both instances, the technical solutions are slightly different to those of deep or major reconstruction — it may be expected that the technical potential of energy savings of apartment buildings could be implemented in practice with relatively small support grants. The realisation of the technical potential for apartment buildings would give impressive energy savings of approximately 2 TWh/y, compared to the packages that are most likely feasible in the current market conditions.

B.2.2.2 Small residential buildings

Options for improving the energy efficiency of small residential buildings have been researched on the basis of two types of sample buildings:

1. small residential buildings in which only the technical building systems need to be renovated
2. small residential buildings in which the building envelope must also be renovated.

When choosing the sample buildings, the typical solutions for the stock of small residential buildings related to the structures and heat sources were considered. The efficiency of various measures for improving energy efficiency (insulation of the floor, exterior wall and roofing deck, replacement of doors and windows, replacement of the ventilation system, replacement of the heating system, use of solar panels) was calculated in terms of energy savings, and their estimated unit costs were found. The results with the lowest net present values are presented in the currently applicable energy efficiency classes of small residential buildings along with the list of the works required to achieve the respective levels.

The renovation measures considered for technical building systems are the installation of a ventilation system with heat recovery (a plate heat exchanger system with a temperature ratio of 0.8), the replacement of the initial heat source (new heat sources: air-to-water heat pump, pellet boiler, geothermal heat pump) and the use of solar thermal collectors for heating water (up to 50 % of the energy used for heating domestic water).

The renovation measures considered for structures are the insulation of the floor (with an insulation layer of 100, 200 and 300 mm), insulation of the exterior wall (with an insulation layer of 50/100, 150/200 and 250/300 mm), insulation of the attic dropped ceiling or roofing deck (with an insulation layer of 50/100, 150/200 and 250/300 mm), replacement of the windows (with a thermal transmittance of 0.7 W/m^2K, 1.1 W/m^2K and 1.5 W/m^2K for the entire window) and replacement of doors (with a thermal transmittance of 1.0 W/m^2K and 1.5 W/m^2K for the entire door). The note '50/100' for the thickness of the insulation layer of the exterior wall and the roofing deck refers to a situation where 50 mm of additional insulation has been used for a newer sample building and 100 mm of additional insulation has been used for an older building in order to equalise the thermal transmittance of the structures in post-renovation conditions.

When evaluating the cost of the measures, the cost estimates provided by general contracting companies in the field of construction were used. Combining different measures has allowed the options with the lowest net present value corresponding to different energy efficiency classes to be found.

Renovation packages analysed for small residential buildings: buildings in which only the technical building systems need to be renovated

Energy efficiency class E:

- installation of a ventilation system with heat recovery.

Energy efficiency class D:

- installation of a ventilation system with heat recovery
- replacement of the heat source (pellet boiler).

Energy efficiency class C:

- installation of a ventilation system with heat recovery
- replacement of the heat source (geothermal heat pump)
- attic dropped ceiling additional insulation (50 mm of bulk insulation)
- replacement of windows (thermal conductivity 0.7 W/m_2K)
- replacement of doors (thermal conductivity 1.0 W/m_2K).

Energy efficiency class B:

- installation of a ventilation system with heat recovery
- replacement of the heat source (geothermal heat pump)
- solar thermal collectors for making hot water
- roofing deck additional insulation (250 mm of bulk insulation)
- exterior wall additional insulation (250 mm of mineral wool)
- floor insulation (300 mm of expanded polystyrene)
- replacement of windows (thermal conductivity 0.7 W/m2K)
- replacement of doors (thermal conductivity 1.0 W/m2K).

Renovation packages analysed for small residential buildings: buildings in which the building envelope must be renovated

Energy efficiency class E:

- installation of a ventilation system with heat recovery
- replacement of the heat source (pellet boiler), heating system based on radiator heating
- roofing deck additional insulation (250 mm of mineral wool)
- replacement of doors (thermal conductivity 1.0 W/m2K).

Energy efficiency class D:

- installation of a ventilation system with heat recovery
- replacement of the heat source (pellet boiler), heating system based on radiator heating
- roofing deck additional insulation (250 mm of mineral wool)
- exterior wall additional insulation (200 mm of mineral wool)
- replacement of windows (thermal conductivity 0.7 W/m2K)
- replacement of doors (thermal conductivity 1.0 W/m2K).

Energy efficiency class C:

- installation of a ventilation system with heat recovery
- replacement of the heat source (geothermal heat pump), heating system based on radiator heating
- roofing deck additional insulation (250 mm of mineral wool)
- exterior wall additional insulation (300 mm of mineral wool)
- replacement of windows (thermal conductivity 0.7 W/m2K)
- replacement of doors (thermal conductivity 1.0 W/m2K).

Maximum achievable energy savings potential (energy performance value 136 kWh/(m^2y):

- installation of a ventilation system with heat recovery
- replacement of the heat source (geothermal heat pump), heating system based on radiator heating
- solar thermal collectors for making hot water
- roofing deck additional insulation (300 mm of mineral wool)
- exterior wall additional insulation (300 mm of mineral wool)
- floor insulation (300 mm of expanded polystyrene)

- replacement of windows (thermal conductivity 0.7 W/m2K)
- replacement of doors (thermal conductivity 1.0 W/m2K).

Conclusions

For newer small residential buildings, only smaller repairs (the installation of a ventilation system with heat recovery or the replacement of the heat source) are cost-effective. However, the improvement in energy efficiency in this case is also relatively modest.

In older small residential buildings, major reconstruction solutions (with the smallest unit cost) are cost-effective, in the course of which the building envelope is insulated and the technical building systems are replaced. This results in the achievement of new building level (C), and the energy consumption is significantly reduced. Regardless of the cost-effectiveness, assessed both in terms of the unit cost and the net present value, the construction cost of 300 €/m2 must be considered, which is two times higher than for apartment buildings. Therefore, the realisation of major repairs is unlikely. Since, in practice, repairs are carried out in stages and generally without much regard for the complete solution or the final result, the realisation of the potential can only be ensured with supportive measures that require complete reconstruction to the economically feasible level C.

B.2.3 Non-residential buildings

B.2.3.1 Educational buildings

Data from the 29 educational buildings at the consultants' disposal was used as the basis for assessing the energy consumption of the existing educational buildings. The average heat energy supplied to the existing educational buildings is estimated to remain at 130–140 kWh/m^2. At the same time, it must be emphasised that the air circulation (ventilation) in the existing educational buildings is inadequate and does not meet the modern requirements. Once the air circulation meets the minimum requirements, the consumption of thermal energy would increase significantly.

The methodology and usage profiles provided in the regulations on the energy efficiency minimum requirements (Regulation No 68 of the Government of the Republic and Regulation No 63 of the Ministry of Economic Affairs and Communications) were used as the basis for preparing the models. The building envelopes and air circulation of the existing buildings were characterised by the following main indicators:

- thermal conductivity of exterior walls U ≈ 1.1 W/m2K
- thermal conductivity of roofs U ≈ 1 W/m2K
- thermal conductivity of windows U ≈ 1.8 W/m2K
- air circulation: 30 % of the minimum requirements.

In order to eliminate energy savings on account of the interior climate, the air circulation was increased to comply with the minimum requirements (e.g. the mechanical outflow and intake are compensated by means of the building envelope, or conditional increase of air circulation is provided by means of ventilation). The energy savings have been calculated for educational buildings with the current thermal performance and with the air circulation that meets the minimum requirements.

Mechanical intake/outflow ventilation must be installed in the building in order to ensure air circulation that meets the minimum requirements.

Renovation packages analysed for educational buildings:

Package I (energy performance class C):

- exterior wall additional insulation +200 mm
- roof additional insulation +250 mm
- replacement of windows (thermal conductivity 1.2 W/m2K)
- ventilation system with heat recovery.

Package II (energy performance class C):

- exterior wall additional insulation +250 mm
- roof additional insulation +300 mm
- replacement of windows (thermal conductivity 0.9 W/m2K)
- ventilation system with heat recovery
- lighting management.

Package III (energy performance class B):

- exterior wall additional insulation +250 mm
- roof additional insulation +300 mm
- replacement of windows (thermal conductivity 0.9 W/m2K)
- VAV (variable air volume) ventilation system with heat recovery
- lighting management.

Conclusions

Class C can be achieved with relative ease. Class B entails significant insulation of the building, efficient lighting and a demand-based ventilation system or local production of renewable energy.

The net present value (NPV) does not particularly depend on the thickness of the additional insulation. The optimal thickness of additional insulation is 15–20 cm for walls and 20–25 cm for roofs. Efficient lighting and a demand-based ventilation system increase the NPV. It was found that major reconstruction corresponding to the level of a new building (energy class C) is economically feasible in educational buildings. However, regardless of the economic feasibility, the latter packages require such a large initial investment that their implementation is unlikely to happen without other reasons, such as the necessity for repairs to the façade or roof of the building.

The necessity of state measures may only be considered for schools and preschools in order to aid the local governments in preparing the terms of reference to ensure a good interior climate and energy efficiency and in conducting well-organised construction procurements which, in the absence of state aid, could prove to be too daunting a task for smaller local governments. Since the economic feasibility is good, the need for aid is mainly manifested in the know-how.

B.2.3.2 Office buildings

The data of 15 office buildings at the consultants' disposal was used as the basis for assessing the energy consumption of the existing office buildings. The models of the existing situation were calibrated so as to ensure the energy consumption of the buildings in the region of 140 to 150 kWh/(m^2y). Energy consumption was calculated on the basis of the standard usage provided in Regulations. It must therefore be considered that the actual current energy consumption is approximately 45 kWh/(m^2y) higher. The building envelopes and air circulation of the existing buildings were characterised by the following main indicators:

- thermal conductivity of exterior walls U ≈ 1.1 W/m^2K
- thermal conductivity of roofs U ≈ 1 W/m^2K
- thermal conductivity of windows U ≈ 1.8 W/m^2K
- air circulation: 30 % of the minimum requirements.

In order to eliminate energy savings on account of the interior climate, the air circulation was increased to meet the minimum requirements. If the air circulation of an office building were to be brought into conformity with the minimum requirements, the consumption of thermal energy would increase by approximately 100 kWh/(m^2y). Mechanical intake/outflow ventilation must be installed in the building in order to ensure air circulation that meets the minimum requirements. The use of ventilation heat recovery reduces the consumption of thermal energy by approximately 100 kWh/(m^2y), provided that ventilation with air circulation that corresponds to the minimum requirements is used. Efficient lighting would reduce electricity consumption by 7 kWh/(m^2y) and increase the consumption of thermal energy by 4 kWh/(m^2y). Insulating the building envelope would allow the consumption of thermal energy to be reduced by 75–90 kWh/(m^2y).

Renovation packages analysed for office buildings:

Package I (energy performance class D):

- exterior wall additional insulation +200 mm
- roof additional insulation +250 mm
- replacement of windows (thermal conductivity 1.2 W/m^2K)
- ventilation system with heat recovery.

Package II (energy performance class C):

- exterior wall additional insulation +150 mm
- roof additional insulation +200 mm
- replacement of windows (thermal conductivity 0.9 W/m^2K)
- ventilation system with heat recovery
- lighting management.

Package III (energy performance class C):

- exterior wall additional insulation +250 mm
- roof additional insulation +300 mm
- replacement of windows (thermal conductivity 0.9 W/m^2K)
- ventilation system with heat recovery.

Package IV (energy performance class C):

- exterior wall additional insulation +250 mm
- roof additional insulation +300 mm

- replacement of windows (thermal conductivity 0.9 W/m^2K)
- ventilation system with heat recovery
- lighting management.

Conclusions

Class D can be achieved with relative ease. Class C entails significant insulation of the building and efficient lighting, or the local production of renewable energy.

The NPV does not particularly depend on the thickness of the additional insulation. The optimal thickness of additional insulation is 15–20 cm for walls and 20–25 cm for roofs. Efficient lighting increases the NPV.

It was found that major reconstruction corresponding to the level of a new building (energy class C) is economically feasible in office buildings; however, such a reconstruction would require a large initial investment.

B.2.3.3 Commercial and service buildings

This part of the building stock consists of buildings of various sizes and of varying construction quality, many of which were not initially planned to be commercial premises, yet are currently used for this purpose. The sample also includes buildings that are related to commercial activities according to their purpose of use, although their actual current usage is difficult to determine. Depending on the time of construction and the size of the building, any matters related to energy consumption and the possible solutions vary broadly. It is not possible to reach a clear conclusion that would indicate the exact energy consumption and the impact of the size of the building. A large share of the energy consumption of commercial buildings is formed by technical equipment, including refrigerators, refrigerated display cabinets and various other display cases. Depending on the nature of the commercial building, the electricity consumption of refrigeration equipment may extend to 45 % of the total consumption, as in the case of supermarkets. In the case of industrial production, this share is completely non-existent.

There are a number of different possibilities for improving the energy efficiency of commercial buildings. However, some of them are very specific and only suitable for certain building types. When assessing the packages for certain buildings, the general condition of the existing system or a part of the structure has also been taken into consideration.

Buildings related to commerce and trade

The following general measures for improving energy efficiency were

analysed:

Package I:

- renovation of lighting fittings.

Package II:

- renovation of lighting fittings
- renovation of the ventilation and heating systems
- improvement of automated equipment.

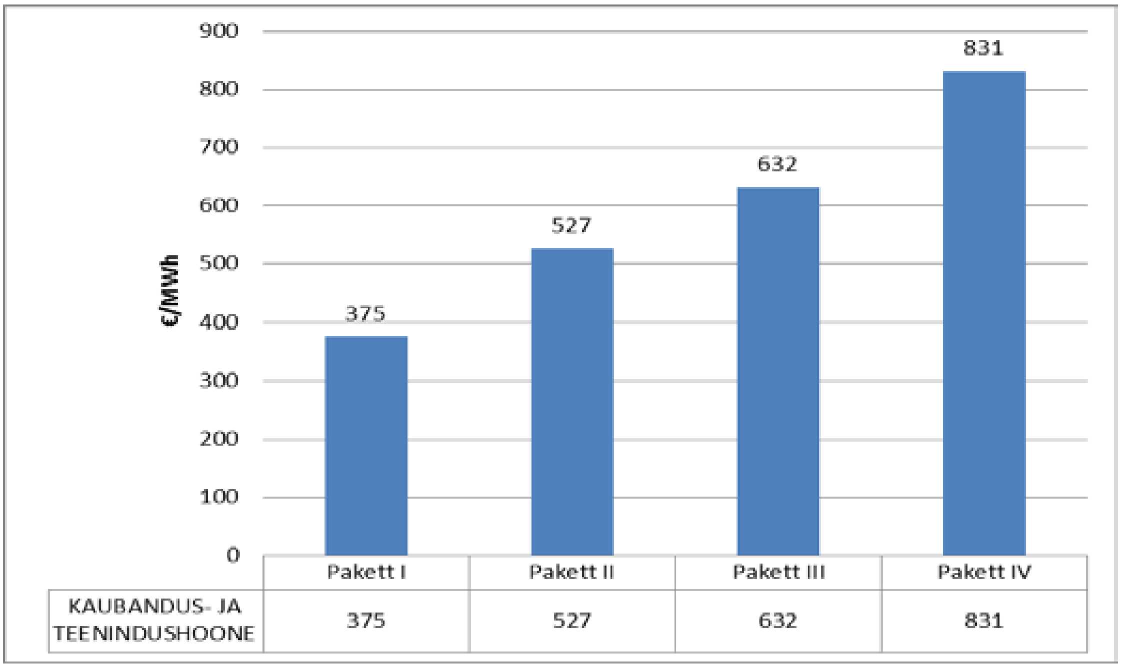
Package III:

- renovation of lighting fittings
- renovation of the ventilation and heating systems
- improvement of automated equipment
- improvement of technological equipment.

Package IV:

- renovation of lighting fittings
- renovation of the ventilation and heating systems
- improvement of automated equipment
- improvement of technological equipment
- insulation and renovation of the building envelope.

The following figure provides the cost of renovation packages, indicating the amount of investment for energy savings of 1 MWh/y.



	Package I	Package II	Package III	Package IV
Commercial and service building	*375*	*527*	*632*	*831*

Figure 1. Cost of renovation packages for commercial buildings

Conclusions

For commercial buildings, the latter solutions (such as insulating the building envelope in addition to renovating the technical building systems in the last package) are cost-effective based on the net present value, as compared to the existing situation (current air circulation). However, regardless of the economic feasibility, the latter packages require a very large initial investment. Good market economy prerequisites exist for these buildings with regard to the improvement of energy efficiency.

B.2.3.4 Industrial buildings (no production or processes)

When selecting the packages, it was taken into account that the possibilities of and the necessity for improving the energy efficiency of warehouses and industrial buildings mainly depend on the building's year of construction and the structural solutions used in the building. The exact purposes of use of the buildings, as well as their usage modes, have a big impact. The processes conducted in the building and the related possibilities for using the residual heat also impact the energy savings potential. The values provided in the tables are indicative: for every specific building, the major consumers must be examined separately.

Industrial buildings

The following renovation packages were

analysed:

Package I:

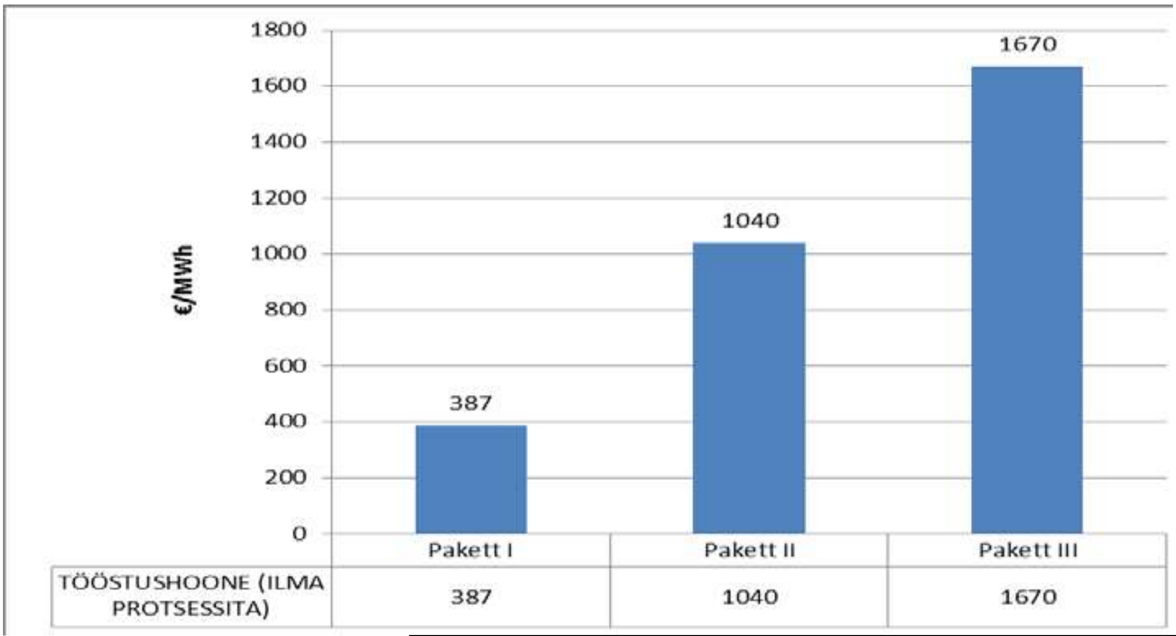
- renovation of lighting fittings.

Package II:

- renovation of lighting fittings
- renovation of the heating, heat supply and ventilation systems.

Package III:
- renovation of lighting fittings
- renovation of the heating, heat supply and ventilation systems
- insulation and renovation of the building envelope.

The following graph provides the cost of the renovation packages, indicating the amount of investment for energy savings of 1 MWh/y.



	Package I	*Package II*	*Package III*
Industrial building (no processes).	*387*	*1040*	*1670*

Figure 2. Cost of renovation packages for industrial buildings

<u>Conclusions</u>

With a 20-year perspective, reconstruction is economically feasible for industrial buildings. For these industrial buildings, the latter solutions (insulating the building envelope in addition to renovating the technical building systems in the last package) are cost-effective based on the net present value, as compared to the existing situation. Regardless of the economic feasibility, these packages require a very large initial investment. It can be stated that good market economy prerequisites exist for these buildings with regard to the improvement of energy efficiency.

B.3 Study on the adaptation of Estonian infrastructure and the energy sector to climate change

The aim of the study was to provide an overview of the impact of climate change and the necessary adaptation measures in buildings and infrastructure facilities, transport and the energy industry. As regards buildings, the focus was on buildings with indoor climate control. The study describes the trends applicable to the most important building types, the potential dangers of climate change and the measures for adapting to and mitigating the risks associated with climate change. Several measures that must be introduced in Estonia in order to adapt to climate change overlap with measures for improving energy efficiency in buildings, for example: support for the reconstruction of existing buildings to achieve energy savings and to improve indoor climate control, the exemplary role of the public sector in achieving energy savings through the reconstruction of buildings, promoting energy-efficient new buildings, including the identification of appropriate fiscal measures, etc.

The completed study became the basis for the ‘Climate Change Adaptation Development Plan until 2030’ approved by the Government of the Republic on 2 March 2017, and for its implementation plan[6].

C. POLICIES AND MEASURES TO STIMULATE COST-EFFECTIVE DEEP RENOVATIONS OF BUILDINGS, INCLUDING STAGED DEEP RENOVATIONS

C.1 Documents on the policies concerning the renovation of buildings in Estonia

The objective of the national energy savings policy is to ensure the efficient use of energy resources and their long-term accessibility at optimal prices, as well as to mitigate the environmental damage and risks arising from the consumption of energy. The programme for promoting the Estonian energy sector has been consistently implemented since the restoration of Estonian independence. The ‘National Development Plan for the Energy Sector until 2020’ approved by the Riigikogu in 2009 is still in force, although it will soon be replaced by the ‘Estonian Development Plan for the Energy Sector until 2030’ (ENMAK 2030), which is currently at the draft stage.

ENMAK 2030 considers achieving a more efficient use of primary energy to be one of its sub-goals. To achieve this, eight measures are proposed in transport, in improving the energy efficiency of the existing building stock, in demonstrating the example shown by the public sector, in manufacturing undertakings and in street lighting. Measures 2.4 ‘Increasing the energy efficiency of the existing building stock’ and 2.7 ‘Exemplary role of the public sector’ are aimed at the existing building stock.

The table below describes the quantitative targets of Measure 2.4 for 2030.

[6] http://www.envir.ee/et/eesmargid-tegevused/kliima/kliimamuutustega-kohanemise-arengukava

Measure 2.4. Increasing the energy efficiency of the existing building stock			
Metric	**Baseline**	**Target 2020**	**Target 2030**
1. Net area of residential buildings additionally reconstructed with the aid of national support, million m^2			
apartment buildings	1.97 (2014)		17
small residential buildings	0.040 (2014)		10.4
2. Number of households with an improved energy consumption class (apartments and small residential buildings) *Source: SA KredEx*	30 000 (2014)		320 000
3. Energy savings achieved in the buildings reconstructed with the support			
apartment buildings (energy class C)	5.8 %		50 %
small residential buildings (energy class C or D)	0.2 %		40%
Source: Register of Buildings			
4. Number of apartment buildings demolished due to depreciation or abandonment *Source: Ministry of Economic Affairs and Communications*	0	98	250

The most important activities resulting from the implementation of Measure 2.4 of ENMAK 2030 are as follows:

- stimulating the reconstruction of apartment buildings through support/loan measures
- stimulating the reconstruction of small residential buildings through support/loan measures
- transfer of residential buildings from the old voltage system to the new voltage system
- stimulating the reconstruction of non-residential buildings through informational activities
- implementation of the demolition subsidy for the derelict or abandoned houses as part of the 'Nature Conservation Development Plan until 2020' activities
- organising training to improve the sectoral competence of specialised professionals
- development of legislation for energy associations to promote the production of renewable energy
- research and development activities, including the commissioning of surveys and analyses in the housing sector.

The table below describes the quantitative and qualitative targets of Measure 2.7 achievable by 2030 and relating to the reconstruction of buildings.

Measure 2.7. Exemplary role of the public sector			
Metric	**Baseline**	**Target 2020**	**Target 2030**
1. Proportion of the net area of buildings that meet the minimum energy efficiency requirements enforced in 2013 and that are used by the central government, % *Source: SA KredEx*	0	20 %	37 % (2014)
2. Developed system of green labels *Source: Ministry of Finance*	Under development	Completed	
3. Guidelines developed in collaboration with the National Heritage Board for ensuring energy efficiency when restoring buildings of cultural and environmental value or under heritage conservation	Under development	Completed	

The most important activities resulting from the implementation of Measure 2.7 of ENMAK 2030 are as follows:

- preparation and implementation of the pilot projects for designing and building public sector nearly-zero energy buildings, including implementation of new innovative technical solutions
- reconstruction or replacement of the central government buildings
- stimulating the reconstruction of schools and preschools
- supporting the preservation of urban and other cultural heritage in the energy-efficient renovation of residential and other buildings of architectural value or located in heritage conservation areas, or of cultural and environmental value
- development of the system of green labels and green public procurements (environmental impact as a quality criterion)
- research and development activities, including the commissioning of surveys and analyses in the buildings sector.

The subsections of this chapter provide a more comprehensive overview of the measures to be implemented in Estonia in order to stimulate the renovation of buildings. In particular, those measures are considered that are directly aimed at initiating the reconstruction activities. This document does not cover the measures organised in Estonia that have an indirect impact on the initiation of reconstruction activities (such as the training of professionals involved in the renovation process, raising awareness of the owners, requirements for expertise in construction projects, requirements for supervision by the owner and for the involvement of technical consultants in the construction process, cooperation with the authorities who finance the renovation, cooperation with the professional organisations supplying the specialists involved in the renovation process, providing maintenance allowances to people with low incomes, subsidies by local governments for stimulating renovation).

C.2 Measures to support renovation of buildings in Estonia

C.2.1 Measures to promote energy efficiency and the use of renewable energy in private sector buildings

C.2.1.1 Support scheme for reconstruction of apartment buildings

Support for the reconstruction of apartment buildings is provided pursuant to Regulation No 23 of 20 March 2015 'Conditions for granting support for the reconstruction of apartment buildings' of the Minister for Economic Affairs and Communications.

The following entities can apply for the support:

- an apartment association managing the apartment building;
- a rural municipality or a city, if the apartment building is owned entirely by the rural municipality or city.

The support can be applied for at 15 %, 25 % or 40 % of the total cost of the project, depending on the level of complexity of the apartment building reconstruction, and 50 % of the cost of a technical consultant or design and owner supervision services. If an application is submitted for the support required for the reconstruction of an apartment building located in Ida-Viru rural municipality, the proportion of the support will be increased by 10 %, except in cases where the proportion of the support is 50 %. Support can be requested only for renovation work that has not yet been completed, which is set out in a construction project and for which the principle of a comprehensive solution has been applied.

When applying for any rate of support, the interior climate must be improved, which means the reconstruction of the ventilation system. For the 15 % support, the work to be completed must achieve 20 % energy savings, while the 25 % support requires the reconstruction of the heating system, the insulation of the façade and roof, and the replacement of all old windows. For the 40 % support, in addition to the above measures, windows should also be raised to the level of insulation to prevent thermal bridges, or the window panel should be insulated and a ventilation system with heat recovery should be installed.

The following costs related to the reconstruction of an apartment building are eligible for support:

1) reconstruction and insulation of the façade of an apartment building and associated work;
2) renovation of balconies and loggias of an apartment building, as well as enclosing them in accordance with the project;
3) reconstruction and insulation of the roof and roofing deck of an apartment building;
4) replacement or renovation of the windows and exterior doors of an apartment building and associated work;
5) insulation of the cellar ceiling of an apartment building;
6) replacement, reconstruction or rebalancing of the heating system of an apartment building and preparing a record of the balancing of the heating system;
7) replacement or reconstruction of the water and sewage system of an apartment building (including rainwater drainage, installation of a waste water residual heat device, installation of a water heating device or a hot water distribution system);
8) construction of a new ventilation system with heat recovery in an apartment building or reconstruction of the ventilation system and preparation of a surveying record of the

ventilation system;

9) purchase and installation of the equipment necessary for the use of renewable energy in an apartment building;

10) partial or complete reconstruction of the control system or actuator of lifts in an apartment building and associated works;

11) replacement or reconstruction of the electrical system located in public areas of an apartment building;

12) restoration of the interior decoration required in the course of reconstruction works after installing windows at the level of insulation in apartments and public areas, as well as after constructing the ventilation system;

13) installation of ramps and handrails on staircases for disabled access to the building during reconstruction of the apartment building;

14) preparation of an energy audit of an apartment building;

15) preparation of the building design documentation required for the works mentioned in points 1–13 above;

16) use of a technical consultant’s service for the reconstruction works in an apartment building;

17) supervision performed by the owner.

The implementation of the support scheme will be arranged by SA KredEx.

C.2.1.2 Loan guarantees for apartment buildings

Loan guarantees are intended for the apartment buildings that wish to take out a bank loan for financing the work related to renovating or improving the quality of life of the residents, but whose risk is considered by the bank to be higher than average (such as a high proportion of debtors, location of the apartment building in an area where the market value of apartments is low or in a mono-functional settlement, the investment per sq. m being significantly higher than usual) or one that wishes to use the guarantee to insure against the risk of payment difficulties.

The loan guarantee for apartment buildings will be offered by SA KredEx.

The loan guarantee can constitute up to 75 % of the loan amount, and the amount of the guarantee is reduced in proportion to the loan amount. The guarantee fee is 1.2–1.7 % of the balance of the guarantee per annum. In the event of payment difficulties, the borrower may contact KredEx with a request that KredEx temporarily pay the premiums on the borrower’s behalf in accordance with the payment plan. Payments by KredEx to the bank on the borrower’s behalf do not constitute an advance payment of the guarantee. The borrower's obligations to KredEx arising from such payments are regulated by a separate agreement between the parties. If the borrower is an association, the administrator will be involved in the collection of repayments to KredEx from the apartment owners and, if necessary, in issuing claims against the apartment owners.

In 2016, the KredEx portfolio of loans to apartment buildings amounted to EUR 23.9 million.

C.2.1.3 Tax incentives for private individuals to encourage the reconstruction of buildings

In accordance with Section 25 of the Income Tax Act, natural persons may deduct from their income the interest on a loan or a lease taken out for the purposes of insulating a residential building or apartment used for their own housing. Insulation is also defined as the construction, extension or renovation of a building within the meaning of the Building Code, if the space

distribution inside the building is changed, or if the construction and installation work is carried out in connection with the technological reorganisation of the building on the basis of a building permit or construction project. Therefore this tax incentive also stimulates the reconstruction of privately owned residential buildings. The interest on residential housing loans
was deducted from taxable income for 107 941 declarations in 2015, while the total number of declarations for the same year was 589 069.

C.2.1.4 Tax incentives for businesses to encourage the reconstruction of buildings

In accordance with Section 50 of the Income Tax Act, businesses in Estonia only pay the income tax on distributed profits (and some expenses), while the dividends received from Estonian companies by the individual residents are excluded from taxable income. Businesses can save or reinvest their retained profits. In general, it can be concluded that the non-taxation of profits has influenced the decision of at least half of the businesses to reinvest their profits[7]. Essentially, entrepreneurs invest in the acquisition or reconstruction of land and buildings, as well as in the acquisition of machinery and equipment: according to the survey data[7], more than 80 % of the businesses make investments in equipment, while over 40 % of the businesses acquire land and buildings or reconstruct them. In 2015, the businesses spent EUR 661 million on the acquisition of buildings and EUR 938 million on the construction and reconstruction of buildings[8].

C.2.1.5 Support provided to businesses for improving resource efficiency

Support is provided to businesses for innovative investments to increase energy and resource efficiency within the framework of Activity 4.3.1 'Investments in the best possible resource-efficient technology; subsidies for resource management systems and supporting IT applications' of Measure 4.3 'Resource efficiency of undertakings' of the 'Operational Programme for Cohesion Policy Funds'.[9] The aim of this Activity is to reduce the amount of resources needed per unit of production in the manufacturing industry and to increase the resource productivity of the Estonian manufacturing industry. The supported activities include the following:

- acquisition and/or replacement of equipment with innovative and more sustainable equipment
- information and communication technology solutions in the manufacturing processes to ensure sustainability.

These activities also allow the optimisation of the energy use of technical building systems.
The proposed budget for this measure is EUR 221 million, and its implementation is to be coordinated by SA Environmental Investment Centre.

C.2.1.6 Support for reconstruction of small residential buildings

Support for the increased energy efficiency of small residential buildings is intended for natural persons who own small residential buildings and wish to make their housing more energy efficient.

The object of the support can be a section of a detached, terraced or semi-detached house, a

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[7] 'Impact of Non-Taxable Retained Profits on Investments and Economic Development', RAKE and PRAXIS 2010, http://www.praxis.ee/tood/ettevotete-jaotamata-kasumi-mittemaksustamise-moju-investeeringutele-ja-majandusarengule/
[8] Statistics Estonia, EM014 (26 September 2017)
[9] https://www.struktuurifondid.ee/sites/default/files/rakenduskava.pdf

residential building or terraced house with two apartments, as well as a summer cottage or a garden house which is to be reconstructed with the use of this support for all-year-round use and whose purpose is to be changed in the National Register of Buildings to a detached residential house upon completion of the work.

The supported activities include the following:

- costs related to insulating the façade, basement or foundations
- costs related to insulating the roof, roofing deck or attic ceiling
- costs related to replacing windows and external doors
- costs related to insulating the floor on the ground floor or above an unheated area
- costs related to replacement or reconstruction of the heating system
- costs related to construction, replacement or reconstruction of the ventilation system
- costs related to acquisition and installation of the equipment necessary for a renewable energy generation unit and the energy conversion, as well as for saving energy production
- costs related to preparation of the energy performance certificate
- costs related to installation of high-performance air-water type heat pumps or water-water type (geothermal heat pump) heat pumps.

Within the framework of the Measure, reconstruction of one house can receive support of up to EUR 15 000, although the support cannot constitute more than 30 % of the eligible costs.

The Measure was launched in November 2016, and its implementation is arranged by SA KredEx.

C.2.2 Promotion of energy efficiency and the use of renewable energy in public sector buildings

C.2.2.1 Organisation of reconstruction of public sector buildings

This document considers the buildings that belong to the state or local authorities to be public sector buildings. The obligation to reconstruct state-owned buildings is laid down in the Energy Sector Organisation Act. It provides that each year 3 % of the surface area of central government buildings should be reconstructed. The enforcement of this obligation is coordinated by the Ministry of Finance, which is the energy conservation coordinator for the central government real estate in accordance with the Energy Sector Organisation Act. An overview of how the completion of the measures is organised is compiled in the annual report on implementation of Directive 2012/27/EU for submission to the European Commission.

The obligation of local authorities to carry out the reconstruction of the buildings that belong to them is not prescribed by the law. At the same time, the Energy Sector Organisation Act obliges the coordinator in the area of energy savings to share best practices and to encourage public sector bodies, including at regional and local level, and the authorities in charge of social housing to do the following:

- adopt an energy efficiency plan
- implement an energy management system and arrange energy audits
- involve, where appropriate, energy service companies and conclude agreements on energy efficiency in order to maintain or improve energy efficiency.

C.2.2.2 Funding of the measures carried out in public sector buildings

The use of the resources available when trading with emission units allowed by the EU for greenhouse gases between 2013 and 2020 is determined by the measures in the State Budget Strategy. One of these measures is 'Promotion of energy efficiency and the use of renewable energy in public sector buildings'. The auction revenue from this proposed measure is distributed so that 54 % is provided to local government buildings (municipal preschools and welfare institutions) and 46 % goes to central government buildings to improve energy efficiency and to promote the use of renewable energy.

The measure includes three sub-measures:

- 'Conditions and procedure for the use of support for promoting energy efficiency and the use of renewable energy in buildings housing preschools';
- 'Conditions and procedure for the use of support for promoting energy efficiency and the use of renewable energy in buildings housing local government welfare institutions';
- sub-measure for promoting energy efficiency and the use of renewable energy in public sector buildings.

The measures for the reconstruction of public sector buildings, related to the reconstruction of buildings in general, will also be financed using European Union Cohesion Policy funds. The following measures are to be implemented in Estonia, based on the Estonian 'Operational Programme for Cohesion Policy Funds', for renovating buildings used by the public sector:

- Activity 1.4.1 'Modernisation of sustainable schools carried out within the framework of the organisation of the school network' of Measure 1.4 'Organisation of the school network';
- Activity 2.4.2 'Supporting investments in population centres with a primary care health centre infrastructure by providing affordable and diversified primary care services' of Measure 2.4 'Ensuring affordable and high-quality healthcare to increase the number of people remaining in employment and returning to employment';
- Activity 2.5.1 'Reorganisation of special welfare institutions' of Measure 2.5 'Development of welfare infrastructure, adaptation of the environment to the needs of people with disabilities';
- Activity 4.1.1 'Institutional development programme for R&D institutions and higher education establishments' of Measure 4.1 'Increasing the international competitiveness of Estonian R&D institutions and participating in pan-European research initiatives'.

C.2.2.3 Support for the reconstruction of preschool buildings

In order to implement sub-Measure 'Conditions and procedure for the use of support for promoting energy efficiency and the use of renewable energy in buildings housing preschools', legislation on the conditions for granting the support was prepared in 2015/2016 (Regulation No 32 of the Minister for Public Administration), and the assessment criteria for project proposals were determined. Taking into consideration the accompanying criterion of compliance with the ongoing administrative reform in Estonia (since the applicants for support under the sub-Measure implemented between 2015 and 2017 were local governments or companies under their governing influence), in addition to pledging the energy efficiency and renewable energy goals, the planned amount of the measure support for the years 2015-2017 was disbursed on the basis of one round of applications.

To date, the support allocation decisions have been made as a result of one round of applications. Support for various objects to the total amount of EUR 12.1 million has been granted by an order of the Minister for Public Administration. The support is intended for the local governments to reconstruct preschools, improving their energy efficiency and reducing operating costs. The implementation of the projects began in July 2017, and they are expected to reach completion no later than by the end of 2019.

The implementation of this sub-Measure is coordinated by SA Environmental Investment Centre.

C.2.2.4 Support for the reconstruction of buildings of welfare institutions

The framework of the second sub-Measure 'Conditions and procedure for the use of support for promoting energy efficiency and the use of renewable energy in the buildings of welfare institutions of the local government' supports the use of energy supplied to a building with internal space separated from the external environment with a roof or other external barriers, as well as the costs of maintaining the building and the reconstruction works that reduce greenhouse gas emissions, increase energy savings and promote the use of renewable energy.

The estimated budget of this sub-Measure is EUR 10.4 million, which depends on the receipt of the auctioned income and is in compliance with the provisions of Annex 3 of the State Budget Strategy 2018-2021[10]. The application round opened on 15 June 2017, and the deadline for submission of the applications is 15 October 2017. The projects are scheduled to be implemented no later than by the end of 2019.

The Ministry of Finance is to organise the implementation of this sub-Measure.

C.2.2.5 Measure for the reconstruction of central government buildings

The third sub-Measure is aimed at promoting energy efficiency and the use of renewable energy in central government buildings in order to fulfil the obligation to reconstruct the central government buildings that arises from Directive 2012/27/EU. The Ministry of Finance and the coordinator of implementation of the country's real estate policy Riigi Kinnisvara AS [State Real Estate JSC] have jointly negotiated the principles and criteria for granting the support, and the source document laying down the conditions of the sub-Measure is being prepared. In line with the provisions of Annex 3 of the State Budget Strategy 2018-2021[11], the use of the support is scheduled to start in 2018 (using the auctioned expense received since 2018).

C.2.2.6 Modernisation of sustainable schools carried out within the framework of organisation of the school network

The aim of this Activity is to organise the school network in accordance with the Lifelong Learning Strategy School Network Programme by bringing the places of study in general education schools in line with demographic changes. The support will be granted for the modernisation of the buildings of state high schools, basic schools and schools for children with special educational needs.

As a result of this Measure, it is expected that by 2023 there will be fewer than 100 high schools in Estonia instead of approximately 200 high schools at present, the sustainability of the remaining

[10] https://www.rahandusministeerium.ee/system/files_force/document_files/res-2018-2021.pdf

basic schools will increase and their network will be organised while the number of schools for pupils with special educational needs will decrease by around one third. The efficiency of surface use in general education schools will improve, and the costs related to the maintenance of buildings will decrease.

Based on the study 'Impact of the Measures Financed by the EU Structural Fund on the Implementation of the National Energy Sector Objectives'[12] commissioned by the Ministry of Economic Affairs and Communications, the energy savings of 3.4 GWh/y will be achieved in 2020 as a result of this Measure.

SA Innove is to organise the implementation of this Measure.

C.2.2.7 Supporting investments in population centres with a primary care health centre infrastructure

The general objective of this support is to ensure that people remain in employment and return to employment. The construction of health centres will ensure accessible and diversified primary healthcare services, will improve access to services, reduce health-related inequalities and promote social inclusion. The investments are intended to help to upgrade 35 primary care health centres across Estonia by 2023, and the study[11] estimates that as a result of the implementation of this Measure, the energy savings of 4.3 GWh/y will be achieved by 2020.

C.2.2.8 Reorganisation of special welfare institutions

Within the framework of this Activity, support will be granted for the reorganisation of service units of 24-hour special care providers, where one building contains more than thirty 24-hour special care service places, and for creating a community-based infrastructure for special care services. The objective of this support is to ensure better living, studying and working conditions for people with special mental health needs. The study[11] estimates that the energy savings of 9.7 GWh/y will be achieved by 2020 as a result of the implementation of this Measure.

C.2.2.9 Institutional development programme for R&D institutions and higher education establishments

The objective of this Activity is to increase the competitiveness of research and development institutions and universities in the areas of responsibility and smart specialisation, as well as to increase the efficiency of research and development and of higher education. Within the framework of this Activity, the energy savings will be achieved through the reconstruction of old buildings, or construction of a new building to replace the old, if the use of the old building is then terminated. The reconstruction of four existing education or research buildings in total, or their replacement with new buildings, is planned within the framework of this Measure.

The study[11] estimates that the energy savings of 4.7 GWh/y will be achieved by 2020 as a result of the implementation of this Measure.

D. A FORWARD-LOOKING PERSPECTIVE TO GUIDE THE INVESTMENT DECISIONS OF THE INDIVIDUALS,

[12] https://www.mkm.ee/sites/default/files/ey_mkm_energiamajandus_lopparuanne.pdf

CONSTRUCTION INDUSTRY AND FINANCIAL INSTITUTIONS

Investment decisions made by the private sector regarding the reconstruction of buildings are influenced by the government's economic, environmental and fiscal policies. The Government of the Republic of Estonia has developed the practice of preparing and implementing long-term national policies, and the bases for this practice are laid down in the State Budget Act. The aim of the national long-term planning is to identify the issues that need addressing by the state and to create the conditions for resolving them through legislation or other state measures that may require funding with the help of the state budget, national guarantees or tax deductions.

On a broader level, an overview of the objectives of the economic, environmental and fiscal policies applied by the Government of the Republic is compiled in the following documents approved by the Government of the Republic: 'Estonia 2020' competitiveness strategy[13] and the 'State Budget Strategy 2018-2021'. Related to the environmental policy are the activities concerning the reconstruction of buildings in order to mitigate climate change and to adapt to the policy documents, such as the 'General Principles of Climate Policy until 2050'[14] approved by the Riigikogu on 5 April 2017, and the 'Development Plan for Climate Change Adaptation until 2030' approved by the Government of the Republic on 2 March 2017[15].

A comprehensive overview of the government measures for eliminating any market failures during the reconstruction of buildings was provided in Chapter C, while the additional assurance for investments in the reconstruction of buildings may be offered by the views, objectives, measures and activities contained in the national strategy documents referred to in the paragraph above.

E. AN EVIDENCE-BASED ESTIMATE OF EXPECTED ENERGY SAVINGS AND WIDER BENEFITS

E.1 Energy savings potential of buildings

According to the survey report prepared by the Development Fund 'Improvement of the Energy Efficiency of the Building Stock – Energy Savings, Unit Costs and Volumes', the technical energy savings potential of Estonian buildings is up to 80 % of the current energy consumption of the building stock. The technical savings potential of thermal energy is therefore extremely large — 9.3 TWh/y, whereas the savings potential of electricity is virtually negligent — 0.2 TWh/y. The potential for savings on electricity is rather small, because controlling the interior climate (ventilation) and the usage of heat pumps replaces the savings on electricity to be achieved by means of insulation. The technical energy savings potential of buildings — approximately 10 TWh/y — amounts to nearly a third of the total final consumption of energy (33–34 TWh/y) in Estonia.

E.2 Estimate of wider benefits

The survey report 'Improvement of the Energy Efficiency of the Building Stock – Energy Savings,

[13] https://riigikantselei.ee/et/konkurentsivoime-kava-eesti-2020
[14] http://www.envir.ee/et/eesmargid-tegevused/kliima/kliimapoliitika-pohialused-aastani-2050-0
[15] http://www.envir.ee/et/eesmargid-tegevused/kliima/kliimamuutustega-kohanemise-arengukava

Unit Costs and Volumes' considered the potential for energy savings in various scenarios. The scenarios comprise the measures and activities required to solve the problems and to meet the objectives within the sector. Various scenarios contain different activities implemented within their framework, with a varying scope of application. The scope of achievement of energy savings and of the state intervention also varies between scenarios. The following three scenarios were considered for improving the energy efficiency of the building stock:

1. The non-interventional scenario seeks a market economy-based improvement of energy efficiency and proceeds from the viewpoint that there are more important fields into which the state resources should be directed.
2. The minimally interventional scenario attempts to achieve the meeting of the objectives of ENMAK 2030 and the improvement of the socioeconomic and living environments by using the existing resources in the most economically efficient ways.
3. The knowledge-based interventional scenario invests and takes risks in order to receive economic gain from contributing to energy efficiency and pursues a high-quality living environment.

E.2.1 Non-interventional scenario

According to this scenario, the current regulation remains valid. Only requirements directly arising from EU directives pursuant to the directives' minimum programme will be established, and no other intervention by the state will take place. The summary of the results and effects of this scenario is compiled in the table below.

Scenario	*Non-interventional (-1 % 'savings', 52.1 million €/y, 670 man-years per year)*	*Cost, million €/y*	*Savings/revenue, million €/y*	*Energy savings, GWh/y*
Goals	Market economy-based improvement of energy efficiency, redirection of the state resources elsewhere and meeting			
List of measures and sub-activities				
Reconstruction of the existing building stock	15 % of apartment buildings to be reconstructed in 20 years (level E), support for apartment buildings 15 %	3.47	0.88	8.53
	10 % of small residential buildings to be reconstructed in 20 years (market economy-based, level E)	0	-0.41	-2.88
	10 % of non-residential buildings to be reconstructed (market economy-based, level D)	0	0.49	3.37
Energy-efficient new buildings	Minimum requirements to be taken to the level of a nearly-zero energy building	0	0.80	8.90
Raising awareness	Organising training to improve sectoral competence	0.1	0	0

Economic effects of the scenario				
Direct tax revenue	Receipt of tax revenue from reconstruction procurements	0	13.99	0
External impact	Possible EU fines and sanctions, legal aid	0	-1.0	0
	Construction faults caused by a lack of know-how	0	-3.20	0
	Savings to be achieved through indoor climate control	0	1.85	0
	Impact of abandonment and new buildings	0	0	-29.37
Result	**Costs, revenue and energy savings related to the implementation of the scenario**	**3.57**	**13.39**	**-11.5**

The scenario would result in an increase of energy consumption by 1 % in 20 years and reconstruction-related employment by 670 man-years per year. The overall cost without new buildings is 52.11 million €/y, of which the contribution of the private sector amounts to 48.54 million €/y and the contribution of the state amounts to 3.57 million €/y.

The non-interventional scenario essentially involves the continuation of a single measure — the support for apartment buildings introduced by SA KredEx, in the minimum scope — pursuant to the requirements of the Energy Efficiency Directive. 15 % of the apartment building stock will be reconstructed in 20 years, meaning an annual support of EUR 3.47 million at a support percentage of 15 %. The support for apartment buildings will provide energy savings of 8.53 GWh per year, resulting in a monetary value of EUR 0.88 million per year. Small residential buildings and non-residential buildings will also be renovated on a market economy basis to a small extent (10 % in 20 years). The reconstruction of small residential buildings without the support of the state will lead to the exploitation of partially heated rooms and a slight increase in energy consumption. Minor energy savings will be gained in non-residential buildings. As the persons ordering the reconstruction of residential buildings are not professionals, and no contributions are made to the development of know-how in this scenario, many construction faults will occur, and their cost has been estimated to be 20 % of the procurement cost in every third procurement (3.20 million €/y). For new buildings, it is expected that the construction of buildings that only meet the nearly-zero energy building requirements will be delayed by 5 years, i.e. construction will be carried out according to the established minimum requirements for 15 years, and according to the nearly-zero energy building requirements for 5 years (as upon the implementation of the nearly-zero energy building requirements, the construction sector will lack the technical solutions and skills to construct buildings at a new technical level). The situation will then become unavoidable, and the state will only be able to delay the implementation of the requirements by 5 years in order to develop the respective technology and skills in cooperation with the construction sector during that period. Compared to the current construction that complies with the minimum requirements, even construction pursuant to the nearly-zero energy requirements delayed by 5 years would result in significant savings (8.90 GWh/y).

This scenario results in small energy savings and also a small amount of tax revenue from reconstruction procurements (13.99 million €/y). The energy savings to be achieved are not sufficient to decrease the energy usage of the building stock, as the energy usage of the new buildings to be constructed will be significantly higher than the savings. Therefore, in this scenario, the energy usage of the building stock continues to grow (25.2 GWh/y, indicated in the table as negative savings). The scenario is characterised by construction faults arising from the lack of developed know-how, and the economic damage caused by an insufficient interior climate is especially notable, since the ventilation issue of the building stock will remain unresolved in the majority of the buildings. In this scenario, the savings on the healthcare costs of 1.85 million €/y to be achieved by means of indoor climate control arise from new buildings with indoor climate control and from the reduction of the building stock.

E.2.2 Minimally interventional scenario

In this scenario, attempts will be made to initiate the reconstruction of buildings so as to achieve the energy savings objective along with improving the housing conditions and increasing the lifespan of buildings.

With support from the state, private capital will be involved in the reconstruction activities, and by developing know-how and exercising supervision, the use of the correct and sustainable technical solutions will be ensured both in reconstruction and for new buildings. Thanks to the considerable support (25 %), it is possible to demand that extensive and comprehensive reconstruction solutions with high energy savings be used, generally resulting in the achievement of energy performance class C, which corresponds to the minimum requirements for new buildings. The levels D and C of small residential buildings provided in the table mean that in newer buildings, energy performance class D will be achieved (reconstruction to class C is not justified in a relatively new building), while a geothermal heat pump (C) will be installed in half of the older small residential buildings and a pellet boiler (D) installed in the other half. Thanks to the state support, the energy savings to be achieved in residential buildings will be much greater than in the first scenario.

Since the use of the correct and sustainable technical solutions will generally be successful, the value of the real estate of the renovated residential buildings will statistically increase by 69 €/m^2, which at the reconstruction volumes of 1.5 % and 1 % per year of this scenario will amount to EUR 53.46 million per year. The market economy-based renovation of non-residential buildings will be 5 % higher, as the respective know-how will be developed with the state support, and people’s awareness will be raised. Thanks to the considerable reconstruction volumes, the tax revenue will be three times higher than in the first scenario.

In new buildings, the nearly-zero energy building requirements will be implemented pursuant to the Directive and according to the plan, resulting in the doubling of the achieved energy savings compared to the first scenario. This will be possible because standard projects and the required know-how will have been developed in advance and contributions will have been made to make construction supervision stricter. Pilot projects involving the construction of public sector nearly-zero energy buildings will also be of great help. This includes support for the training of specialists for the construction of nearly-zero energy buildings to the amount of 1.5 million €/y, whereas the projects will be completed immediately before the implementation of the new requirements. As a result of the aforesaid, the construction sector in this scenario will be able to achieve a qualitative leap without any major setbacks. As far as plans are concerned, it has been estimated that the detailed plans that need preparing will follow the established comprehensive plan (instead of amending the plan according to the needs of the owner). The impact of the measure is quantified in the transport scenarios.

Scenario	*Minimally interventional (8 % savings, 171 million €/y, 2 150 man-years per year)*	*Cost, million €/y*	*Savings/revenue, million €/y*	*Energy savings, GWh/y*
Goals	Achievement of the objectives of ENMAK 2030 and improvement of socioeconomic and living environments by using the existing resources in the most economically efficient way			
List of measures and sub-activities				
Reconstruction of the existing building stock	30 % of apartment buildings to be reconstructed in 20 years (level C), support for apartment buildings 25 %	20.54	3.76	42.59
	20 % of small residential buildings to be reconstructed in 20 years (levels D and C), support for small residential buildings 25 %	16.57	1.07	26.70
	15 % of non-residential buildings to be reconstructed (market economy-based, level C + know-how measure)	0	1.10	7.86
Energy-efficient new buildings	Minimum requirements to be taken to the level of a nearly-zero energy building	0	1.59	17.79
	Commissioning standard projects for nearly-zero energy buildings	0.3	0	0
	Creating the know-how and raising awareness for the energy-efficient new buildings	0.5	0	0
	Making construction supervision stricter	0.4	0	0
Improving the efficiency of land usage and planning	Introduction of amendments that favour more efficient transport and infrastructure solutions into the Planning Act and its implementing legislation (quantified in the transport scenarios)			
	During preparation, there is a requirement to assess the energy consumption and CO_2 impact of buildings and	0	0	0
Exemplary role of the public sector	3 % of the central government buildings to be reconstructed (included in the volume of reconstruction of non-residential buildings)	0	0	0

	Pilot projects involving the construction of public sector nearly-zero energy buildings	1.5	0	0
Development of legal environment	Content and scope of monitoring of the surveys and measures required for updating the legislation	0.5	0	0
Raising awareness	Organising training to improve sectoral competence	0.2	0	0
Direct tax revenue	Receipt of tax revenue from reconstruction procurements	0	45.08	0
Economic effects of the scenario				
External impact	Increase in the value of real estate (+69 €/m_2 in reconstructed residential buildings)	0	53.46	0
	Savings to be achieved through indoor climate control	0	3.91	0
	Impact of abandonment and new buildings			
Result	Costs, revenue and energy savings related to the implementation of the scenario	**40.51**	**109.97**	**65.6**

The scenario would result in energy savings of 8 % in 20 years and increase reconstruction-related employment by 2 150 man-years per year. The overall cost without new buildings is 170.98 million €/y, of which the contribution of the private sector amounts to 130.46 million €/y and the contribution of the state amounts to 40.51 million €/y.

The public sector obligation to reconstruct 3 % of the central government buildings pursuant to the minimum requirements will be performed by the local governments in this scenario. It is expected that the aforementioned buildings must be reconstructed in any case, and the state does not need to provide support for this purpose. The monetary cost of the pilot projects, surveys and training activities is provided in the table, but their impact in terms of energy savings and other possible revenue has not been indicated separately, as the savings and revenue are included in the activities of reconstruction and the construction of new buildings. This means that the pilot projects, surveys and training must be interpreted as the facilitators of activities of reconstruction and the construction of new buildings, since without contributing to know-how, it would not be possible to achieve the above savings. The savings on the healthcare costs of the state to be achieved by means of indoor climate control arise in this scenario from indoor climate control in both reconstructed buildings and new buildings, and the amount is therefore over two times higher than in the first scenario.

The minimally interventional scenario ensures a high level of energy savings (51.8 GWh/y), and the state contribution and support (40.51 million €/y) will be fully returned by means of direct tax revenue (45.08 million €/y). Since the buildings will be reconstructed with the correct and sustainable technical solutions, the value of real estate will increase considerably and the total revenue of the scenario without the impact of planning is approximately 110 million €/y. Increasing the density of the urban environment with the help of planning will provide additional energy savings thanks to a decrease in passenger car traffic, which is quantified in the transport scenarios.

E.2.3 Knowledge-based (dedicated) scenario

The knowledge-based scenario includes a collection of almost all the possible measures with which the state is able to achieve the objectives of energy savings and improvement of the living environment to the maximum extent. The chosen measures and their volumes are at the risk limit, taking into consideration the long-term economic feasibility. If contributing to energy efficiency to such an extent initiates the anticipated creation of jobs, economic growth and export, the contributed funds will be returned to the state. The risk is approximately EUR 40 million per year, which should be received back by the state thanks to the external impact as well as direct tax revenue to make the scenario economically feasible.

Scenario	***Knowledge-based interventional (18 % savings, 354 million €/y, 4 240 man-years per year)***	***Cost, million €/y***	***Savings/revenue, million €/y***	***Energy savings, GWh/y***
Goals	Economic benefits of contributing to energy efficiency, investing and taking risks, a high-level socioeconomic and living environment			
List of measures and sub-activities				
Reconstruction of the existing building stock	50 % of apartment buildings to be reconstructed in 20 years (level C), support for apartment buildings 35 %	47.93	6.27	70.99
	40 % of small residential buildings to be reconstructed in 20 years (levels D and C), support for small residential buildings 35 %	46.40	2.15	53.41
	20 % of non-residential buildings to be reconstructed (market economy-based, level C + know-how measure)	0	1.46	10.49
	Support for demolition of abandoned apartment buildings	2	0	0
	40 % of schools and preschools to be reconstructed in 20 years, support 35 %	6.0	0.36	6.17
Energy-efficient new buildings	Accelerated implementation of nearly-zero energy buildings	0	2.39	26.69
	Support for the construction of nearly-zero energy buildings	5.0	0	0
	Development of legislation for energy associations to promote the production of renewable energy	0.5	0	0
	Commissioning standard projects for nearly-zero energy buildings	0.3	0	0

	Creating the know-how and raising awareness for the energy-efficient new buildings	0.5	0	0
	Making construction supervision	0.6	0	0
Improving the efficiency of land usage and planning	Introduction of amendments that favour more efficient transport and infrastructure solutions into the Planning Act and its implementing legislation (quantified in ENMAK 2030 transport scenarios)			
	Implementation of infrastructure charges (100 €/m^2 on 30 % of buildings) for valuing land with detailed plans and direction of construction	0	23.12	0
	During preparation, there is a requirement to assess the energy consumption and CO_2 impact of buildings and transport	0	0	0
Exemplary role of the public sector	3 % of the central government buildings to be reconstructed (25 % support)	2.64	0.28	3.79
	Green labels and green public procurements (environmental impact as a quality criterion)	0	0	0
	Pilot projects involving the construction of public sector nearly-zero energy buildings	4.0	0	0
	Creation of an energy-efficient rental housing fund owned by the public sector, placement of resources of pension funds in the foundation (100 apartments per year)	4.8	0	0
	Comprehensive spatial renovation of apartment buildings	4.0	0	0
	Supporting the preservation of building heritage in areas of cultural and environmental value	0.2	0	0
Development of legal environment	Content and scope of monitoring of the surveys and measures required for updating the legislation	1.0	0	0
Raising awareness	Organising training to improve sectoral competence	0.3	0	0
Economic effects of the scenario				
Direct tax revenue	Receipt of tax revenue from reconstruction procurements	0	88.95	0

External impact	Increase in the value of real estate (+93 €/m^2 in reconstructed residential buildings)	0	128.18	0
	Savings to be achieved through indoor climate control	0	5.33	0
	Impact of abandonment and new buildings	0	0	-29.37
Result	Costs, revenue and energy savings related to the implementation of the scenario	126.17	258.48	142.2

The knowledge-based interventional scenario would result in energy savings of 18 % in 20 years and increase reconstruction-related employment by 4 240 man-years per year. The overall cost without new buildings is 353.85 million €/y, of which the contribution of the private sector amounts to 227.68 million €/y and the contribution of the state amounts to 126.17 million €/y.

In the knowledge-based scenario, reconstruction is performed to a greater extent compared to the minimally interventional scenario. Considerably more attention is paid to creating know-how and raising awareness. The support, volumes and energy savings are therefore greater. Additional reconstruction activities include support for the demolition of abandoned apartment buildings and support for schools and preschools. For new buildings, the additional cost of the first nearly-zero energy buildings is partially compensated in order to rapidly initiate their construction. Legislation for energy associations will be developed for the flexible production of renewable energy by nearly-zero energy buildings, allowing developers to invest in and link a nearby renewable energy production facility with a building and use this as evidence for meeting the nearly-zero energy requirements. When providing guidance for the land use and planning, measures will be taken to enable more efficient transport and infrastructure solutions, resulting in a slight reduction of passenger car traffic and a decrease in the investments in the construction of infrastructure. The savings on the construction of infrastructure have not been quantified. In this scenario, the public sector takes the exemplary role. The state will support the local governments with the aim of reconstructing central government buildings, and a foundation will be created to build energy-efficient and economic rental apartments for the open market with the resources of pension funds. The scenario also pays heed to the areas of cultural and environmental value and the spatial organisation of areas with apartment buildings. The measure of organisation of apartment building areas includes state support of 2 million €/y (25 %), local government participation of 2 million €/y (25 %) and the contribution of applicants (50 %).

E.2.4 Long-term results of the scenarios

The energy savings of the scenarios have been indicated as the savings percentage to be achieved in 20 years (2030 in this case) based on the initial situation (2010 in this case). In the first scenario, the energy consumption of the building stock increases by 1 %, while in the second and third scenarios the energy consumption decreases by 8 % and 18 %, respectively. The unit cost of energy savings has been calculated on the basis of the total energy savings and the cost for the state budget. The employment in the scenarios has been calculated as the direct employment for reconstruction procurements, which, depending on the scenario, ranges between 670 and 4 240 man-years of work per year. Direct employment will be accompanied by indirect employment, as well as by indirect tax revenue in the construction materials industry, planning, supervision, etc. — all of which have not been quantified. As an approximate evaluation, one job on the construction site will create 0.5–1 jobs in the industry, services and commerce, i.e. the actual employment will be approximately 1.5–2 times higher compared to the direct employment numbers provided in the table.

The consolidated data of the electricity and heat consumption of buildings, the energy savings, investments and state support in 2030 and, provided that the same process continues, in 2050, is given in the table below.

Expected results, 2030	**S1 Non-interventional**	**S2 Minimally interventional**	**S3 Knowledg e-based**
Electricity and heat consumption of buildings			
Consumption of thermal energy, TWh/y	11.7	10.3	8.9
Consumption of electricity, TWh/y	5.0	5.0	4.9
Electricity and heat consumption of buildings/maintenance costs[1]			
Savings on heat consumption (for owners of buildings), million €/y	29.9	188.4	345.8
Savings on electricity consumption (for owners of buildings), million €/y	-110.4	-96.3	-76.4
Savings on maintenance costs of buildings, million €/y	1.5	3.1	5.5
Investments/support[2]			
Reconstruction (investment), million €/y	48.5	130.5	227.7
Energy-efficient new buildings (investment), million	953.0	953.0	953.0
Support paid (total state support), million €/y	3.6	40.5	126.2
Receipt of tax revenue from reconstruction procurements, million €/y	14.3	46.1	90.9
Expected results, 2050	**S1 Non-interventional**	**S2 Minimally interventional**	**S3 Knowledge-based**
Electricity and heat consumption of buildings			
Consumption of thermal energy, TWh/y	11.2	8.5	5.9
Consumption of electricity, TWh/y	5.2	5.2	5.1
Electricity and heat consumption of buildings/maintenance costs[1]			
Savings on heat consumption (for owners of buildings), million €/y	134.2	575.5	1 013.0
Savings on electricity consumption (for owners of	-287.4	-271.7	-235.1
Savings on maintenance costs of buildings, million €/y	3.1	6.2	11.0
Investments/support[2]			
Reconstruction (investment), million €/y	48.5	130.5	227.7
Energy-efficient new buildings (investment), million €/y	953.0	953.0	953.0
Support paid (total state support), million €/y	3.6	40.5	126.2

Receipt of tax revenue from reconstruction procurements, million €/y	14.3	46.1	90.9

1 The energy savings have been calculated for 2010 and the increase in the price of energy has been taken into consideration

2 Changes in prices have not been taken into consideration; all prices are at 2010 levels and include value added tax