ROADMAP

towards a sustainable low-carbon economy

Collection of Roadmaps

Northern Bulgaria (BG)
South Bohemian Region (CZ)
Estonia (EE)
Borsod-Abaúj-Zemplén
and Heves counties (HU)
Ignalina Nuclear Power Plant region (LT)
Vidzemes Planning Region (LV)
North-East Planning Region (MK)
Mazovian Voivodeship (PL)
Bucharest-Ilfov region (RO)
Podravje Region (SI)

English version

PANEL 2050 – Partnership for New Energy Leadership 2050

Deliverable D3.5

Date: October 2018

CEE SEN CENTRAL EASTERN EUROPEAN SUSTAINABLE ENERGY NETWORK

ROADMAP
towards a sustainable low-carbon economy

Region: Northern Bulgaria
English Version

Prepared by
WWF Bulgaria

PANEL 2050 – Partnership for New Energy Leadership 2050
Deliverable 3.5

Date: December 2018

CENTRAL EASTERN EUROPEAN SUSTAINABLE ENERGY NETWORK

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Roadmap model

About Panel 2050 project

The PANEL 2050 project has the aim to create durable and replicable sustainable energy networks at local (municipality/community) level, where relevant local stakeholders collaborate for the creation of local Energy Visions, Roadmaps and Action Plans. The aim of these networks is to contribute to and actively work for the transition towards low carbon communities in 2050. The PANEL 2050 partnership will provide support for the creation of first successful local energy networks in the CEE countries. In the course of the project, organisations from 10 CEE countries will collaborate on creating regional energy strategies and action plans. For more information visit https://ceesen.org/panel2050/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696173.

The PANEL model

PANEL model is a comprehensive approach for implementing local long-term energy management, supported by the community. PANEL model consists of seven main elements: Stakeholder Engagement, Training Program, Guidebook, Long-term Energy Visions/Roadmaps/Action Plans and Central and Eastern European Sustainable Energy Network (CEESEN). These elements are developed by PANEL 2050 project to support the CEE communities on achieving their sustainability goals.

The Roadmap at hand is the output of the long-term energy planning process with the aim of plotting the regional transition towards a low-carbon community.

Attached to the Roadmap 10 specific Action Plans were developed, representing the first steps on this road towards low-carbon community by 2050.

Roadmapping process in North Bulgaria

Stage 1

Baseline – Regional Energy Profile for Pleven region

Stage 2

Vision

In 2050, Northern Bulgaria will have a modern and developed low-carbon economy. The electricity production from RES will reach a minimum 85 % from the overall share of consumed energy and fuels.

Stage 3

Roadmap

Increasing the share of renewable energy in produced electricity

Implementation of the Roadmap

Stage 4

Energy efficiency and RES in households

Action 1
Support for energy vulnerable consumers in Pleven region

Action 2
Support for energy vulnerable consumers in Berkovitsa

Action 3
Support for energy vulnerable consumers in Gorna Malina

Energy efficiency and RES in public buildings

Action 4
EE and introduction of RES in public buildings in Nikopol

Action 5
EE and introduction of RES in public buildings in Belene

Action 6
Introduction of solar heating for public buildings in Berkovitsa

Financing and business models / Biomass and Bioenergy/ Low-carbon public transportation / Awareness rising

Action 7
Financial models for solar heating in public buildings in the municipality of Gorna Malina

Action 8
Utilization of biomass for heating in Gulyantsi

Action 9
Introduction of electro-mobility in Nikopol, Belene and Levski municipalities

Action 10
Information system for EE and RES for households in Pleven region

1 Introduction

The present Roadmap for Vision[1] achieving was prepared after identification and discussions with local stakeholders in Pleven Region, as well as Gorna Malina and Berkovitsa municipalities, together with the project[2] target groups and the so called - "Pioneers/Forerunners" - experts who have passed expert trainings on the methodologies for elaboration of long-term strategies for the project in 2018. The Roadmap will concentrate its scope on Pleven Region for which was also developed the Regional Energy Profile under Panel 2050 project. Participants involved in the Roadmapping process agreed that this strategic document would focus on several priority areas and possible scenarios (assumptions) for long-term development, having the same understanding that implementing of concrete policy actions, in order to achieve the Vision, is essential. In this regard, its measures and Action Plans must lead to significant financial savings, which will allocate funds for continuing efforts, including the initiation of specific investments to meet the Vision's goals by 2050.

Energy Vision

In 2050, Northern Bulgaria will have a modern and developed low-carbon economy. The energy and electricity production from renewable energy sources will reach a minimum of 85% from the overall share of the consumed energy and fuels. The region will implement a concrete plan with deadlines for transition to 100% clean and future-oriented zero carbon energy system. This energy system will provide the regional and national security and independence while ensuring the environmental protection, and also contributing to the realization of the UN Sustainable Development, the Paris Agreement and other strategic initiatives and processes in these areas.

2 Priority areas

Stakeholders that were part of the Roadmap and the Energy Vision development process defined four priority areas for Energy efficiency and three priority areas for Renewable energy sources, which are to be addressed in ten Action Plans on the territory of Northern Bulgaria. The priority areas are also in line with the methodology of preparation of the Roadmap and the Energy Vision, which are recommending a focus on energy savings opportunities and attracting investments under the Panel 2050 project. These areas were highlighted as the most important for the success of the transition to a low-carbon economy, including for Pleven Region during the Vision and Roadmap process preparation.

Currently, there is a significant development in Pleven municipality, which is the most energy-intensive region covered under Panel 2050 project. There is visible progress in the municipality under Priority 2.3. Conservation of the Environment, Resource and Energy Efficiency of the Municipal Development Plan for the period 2014-2020, as follows[3]:

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[1] Energy Vision, Bulgaria, developed by WWF Bulgaria under the project "Panel 2050 - Partnership for New Energy Leadership 2050"

[2] The legal entities, which expressed their willingness to participate with a letter of support for the project PANEL2050 at its launch and actively participating in seminars and trainings during the project

[3] https://www.pleven.bg/uploads/posts/mezhdinna-otsenka-na-opr-2014-2020.pdf (p. 51-62 from the document)

- For comparison only one residential building under Project BG161PO001-1.2.01-0001 "Energy renovation of Bulgarian homes" under Operational Programme "Regional Development" 2007-2013 was renovated in the period 2014-2016. Energy efficiency measures have been undertaken in 52 other residential buildings and these measures are in a different phase of implementation.

- The reduction of electricity consumption in 2016 compared to 2014 is quite insignificant or more precisely: for non-household consumers the share has increased by 2.7%, and for households has fell by 3.5%, or the overall decrease is below 1%.

For the last years between 2016-2018 only under the National Programme for Energy Efficiency were approved 28 multi-family buildings that are in a different stage of renovation process. Overall there are 55 registered owners' associations which have submitted an application for complete renovation.

Priority Areas in Energy Efficiency Sector

Households Level

For the last 4-5 years, the Bulgarian government, supported by the EU Structural Funds, implemented a number of EE measures for households and the public sector. Bulgaria was among the first EU Member States to declare the achievement of national targets for reaching the share of renewable energy in the country's final consumption by 2020[4], despite controversial statistical data and reporting methodology that does not take into account European standards and legislation. Therefore, it is questionable whether the country has achieved its 2020 targets in this area.

In recent years, several national programmes and funds are implemented, in order comprehensive measures to be introduced for increasing energy efficiency in multifamily residential buildings. However, owners are not encouraged to perform investments, including these through targeted funding, which in practice puts the sustainability and long-term effects of such an approach at great risk. However, the investments do not meet the latest legislative and technical EE requirements, as well as the good examples and practices, thus the invested billions of leva have a much lower efficiency than what is possible.

An understanding emerged in the Bulgarian society, that in order to have a good, lasting and long-term effect the approach to the realization of EE should be towards common implementation of measures for the whole building rather than individual components or systems. The need and potential to improve EE in households remain high as the number of renovated buildings per year is far from the national indicative targets, which Bulgaria has to reach in order to achieve the political commitments under these policies.

Even low-grade EE measures (class C) which are implemented at the moment have relatively good results. This is due to the low EE building characteristics and respectively the high energy intensity of the households, because of which Bulgaria and Pleven Region are among the regions with the lowest performances.

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[4] Roadmap for the Development of Bulgarian Electricity to 2050: Main Milestones, Policy Brief No. 70, October 2017, Center for the Study of Democracy.

Public Buildings Level

In Bulgaria, according to Directive 2012/27/EC[5] on EE and to the National Energy Efficiency Plan, a number of measures are being implemented to increase the EE of buildings owned and managed by public institutions. Several types of buildings are excluded from the current measures. The maintained lists[6] of public buildings indicate a significant need to achieve a higher energy efficiency class, including changing the fuel base and heating systems, and reducing the carbon emissions from the public building stock. Regardless of the good examples in many communities, the renovation and the changing of the fuel base still covers a small part of the public building stock. Some sectors such as healthcare facilities, community centers, scientific and cultural institutions do not actually implement any projects, actions and measures, mainly due to lack of expertise and capacity, available state funding, support, as well as political will in the field of EE.

Transport and Electro mobility Level

Priority for Bulgaria for the increase of the EE in the transport sector by 2050 is investing in clean and safe rail transport, as well as raising the share of urban electric transport and the related infrastructure, for all regions and municipalities.

On regional level, it is crucial to encourage the use of electric vehicles for business and for individual transport. Energy savings in the public transport sector depend directly on the successful implementation of integrated urban transport, intermodal connections and relevant investment in intelligent transportation systems in the urban environment. These measures also include traffic forecasting and management, travel information, travel fees management, accessibility, social policies and etc.

The development of non-motorized transport - the use of bicycles and other non-motorized vehicles for individual trips and for business services is part of the measures to save fuel and energy in urban transport sector. For example, Pleven Region implements integrated urban transport projects. Through them it renews the city's trolley transport, creates an electronic system for charging, introduces video surveillance and plans a network of bicycle lanes by implementing measures to improve overall road safety.

The future development of city transport relies on the strong development of electric transport. Despite the stated intentions, the trends on national and on a regional/ local level are for a visible increase in the number of private cars, as proved by statistics, and that often becomes a major contributor to air pollution in some cities in adverse weather conditions. Some of the reasons for this situation are rooted in the inefficiency of public transport, both urban and long-distance. As almost everywhere worldwide, the transport sector in Northern Bulgaria has a significant increase in the share of fossil fuel consumption, which also leads to an increase in the share of both carbon and other harmful emissions with approximately 50% over the last decade. That is why the measures in the Action Plan must be highly effective and address this problem in the medium and long term, with particular attention to public transport.

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[5] This Roadmap only considers current legislation. The directives adopted for the "Clean Energy for All Europeans" Package are not yet reflected as the updated targets, percentages and measures are not transposed at national level, which will happen after the end of Panel 2050.

[6] http://www.seea.government.bg/bg/spisaci

Passive Buildings Level

The concept of Nearly Zero-Energy Buildings should be applied to the future construction of new buildings in Bulgaria after 2020[7], following the European targets, and in case of proven cost-effectiveness, the concept should be applied to the renovation of existing buildings. Almost all legal terms and requirements for the construction of Nearly Zero-Energy Buildings are created. However, the issue, as well the objectives and benefits are not well spread among the construction business and architects and practically in Pleven Region, such buildings are absent. There are two implemented pilot projects in Northern Bulgaria: in Gabrovo - a kindergarten and in Varna - a private residential building. The problem for the realization of passive buildings, first of all, is administrative on a local level – by the issuing of construction permissions new regulatory requirements are not met. The new regulations are not taken into account when building permits are issued. Another problem is that the foreseen requirements for passive buildings do not even apply to new buildings. It is necessary to assess the current implementation of the National Plan for Nearly Zero-Energy Buildings 2015-2020, as well as a preparation of new strategic document after 2020, with all the climate and energy objectives implemented. There is no EE valuation as part of tackling climate change, which is particularly important for Northern Bulgaria where energy intensity is 4-5 times above the EU average.

Priority Areas for RES

Practically, with an inexhaustible natural resource (sun, wind, water, geothermal, biomass and biogas) and with proven expertise in the digital sector, Bulgaria has everything it needs to implement many innovative practices. The cheapest way the Bulgarian energy and transport sector to be decarbonised is a step-by-step substitution of coal-fired power plants and coal use with renewable energy sources[8], as in certain assumptions natural gas can be used. The usage of electric transport should be planned on all levels.

In Northern Bulgaria one of the last coal-fired power plants was switched from coal to gas in 2017 (TPP Varna). Most of the district heating power plants have already done the same (Pleven, Razgrad, Vratsa and Veliko Tarnovo) as only two regional cities are still using coal (Ruse and Gabrovo). Due to these factors it is necessary to start a quick and seamless integration of small and medium-sized producers of energy into the energy system, but also for businesses offering more competitive prices of heat and electricity, in order independent production and consumption of renewable energy in all sectors of the economy and households to be promoted.

Significant regulatory barriers that delay the current and future development of RES can be overcome by:

- Providing support for the development of renewable energy at regional, municipal and community level, supported by nationally adopted promotion tools, including financial, for different economy sectors and socially vulnerable groups;
- Preparation of common rules and methodology for connection of new RES installations to the electricity grid and construction of local heating systems;

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7 National plan for buildings with near-zero energy consumption 2015-2020

8 Roadmap for the Development of Bulgarian Electricity market to 2050: Main Milestones, Policy Brief No. 70, October 2017, Center for the Study of Democracy

- Elimination of existing regulatory constraints and energy market liberalization, as well as establishing equal competition rules and suspension of the fossil fuels subsidies in compliance with the European rules;
- Creation of opportunities for public-private schemes for planning the development of new projects in the field of RES;
- Creation of financial incentives for end users;
- Decentralization of production.

Bioenergy/Biomass

Currently, there is only one small biogas plant installation in Pleven Region but there is a model example for the local energy use of residual biomass from agriculture and harvesting the biomass and producing pellets and briquettes from the restoration and sustainable management of the wetland "Kaikusha Swamp".

Biomass is the most widely used energy resource in Northern Bulgaria - mainly firewood for domestic heating. In recent years, firewood consumption has grown significantly due to rising of fuel and electricity prices. Processed wood fuel - kindling wood, pellets and briquettes became increasingly popular for heating. Experts estimate that the extraction and utilization of biomass in Bulgaria can significantly increase from forests, agriculture and energy crops residues. The potential for increasing forest biomass utilization is related to sustainable forest management optimization.[9]

There is a need to encourage investment in the use of a biodegradable fraction of municipal solid waste as well as sediments from domestic wastewater treatment plants, although the burning of RDF fuel as part of the circular economy is not with high potential because it is in contradiction with the new European policies and recycling targets. The same production is no longer part of the RES targets for 2030 from Clean Energy Package, and its development will not be prioritized. The potential for biogas production from primary and secondary agricultural residues in Northern Bulgaria is also significant. A stable legal framework is needed, following LULUCF and the future biomass utilization standards and targets, which have to be drawn up in Member States at national level for the Clean Energy Package. All these policy goals, supported by financial instruments, also aim to facilitate and to make more transparent the issuing procedures for the necessary permissions for investment in biogas plants.

Wind

The wind potential in Pleven Region is well known and estimated, but still limited. There are possibilities to use micro wind turbines in individual buildings with an objective assessment of the specific wind potential at a given point. Investments in research and development work are needed in order to apply new wind technology for biodiversity protection.

Currently, only 4 wind turbines with a total installed capacity of 10 MW are built. They were all built 4-5 years ago and there is no development since then. The area is suitable for further development, but the higher investment cost compared to photovoltaic facilities is an obstacle to building on a larger scale.

[9] National Renewable Energy Action Plan, December 2012

In the municipality of Pleven, the project "Development of product innovation - a silent wind turbine with a vertical axis" is implemented[10], as a part of innovation development, under the OP "Innovation and Competitiveness" 2014-2020.

Micro wind turbines are already well-grounded energy technology, which will inevitably become part of the smart energy networks, and that will allow diversification and energy independence to be achieved in stages.

Solar

The total number of solar installations in Pleven Region is 55 with a capacity of 56.8 MW and it is expected to increase. The area is very suitable for photovoltaic installations, with sunshine on an optimally sloping surface on an annual basis[11] of 1600-1800 KWh/m².

Pleven Region is situated in a climate zone, rich in sunshine. This determines the great potential for developing solar power and heating capacities both for industrial purposes and for individual consumption in households and individual buildings. According to the Center for the Study of Democracy's analysis[12], "The techno-economic potential by 2050 for decentralized production of roof photovoltaic installations is about 5.4 TWh or about 1/7 of the country's final electricity consumption." In their view, the realization of this potential is near to an energy revolution and is directly related to the decentralization of electricity production. It is important to note that, due to future constraints, the construction of photovoltaic installations will not be possible to be realized in agricultural and forest areas and will be redirected to urbanized areas (especially in connection with the development of smart grids and the relationship between micro-producers and consumers). The capacity for solar collectors for hot water (domestic-hot water supply) is enormous due to the climate conditions of the region.

3 Action and Development Scenarios

The highest significance for the decarbonisation of the energy sector in Northern Bulgaria would be the change of the fuel base and the gradual decommissioning of obsolete TPPs and replacement with renewable energy sources of their energy capacity. This is directly related to the decentralization of energy production, the liberalization of the energy market and the introduction of smart energy systems. Ambitious goals and time frame are leading in the assumptions for different decarbonisation scenarios. Based on the principles adopted in the Vision, we assume that, by the scenario development, no nuclear power will be built in the area by 2050, but the achievement of the goals depends on the national decarbonisation ambitions.

3.1 Status of R&D, Innovations and Technology

According to the European Innovation Scoreboard, Bulgaria is defined as "a modest innovator"[13]. Although in 2010 the country was rated as one of the rapidly advancing

[10] https://www.pleven.bg/uploads/posts/mezhdinna-otsenka-na-opr-2014-2020.pdf

[11] Joint Research Center, Institute for Energy and Transport, Global Radiation and Solar Power Potential, Optimal Sloping Photovoltaic Modules

[12] http://www.csd.bg/artShowbg.php?id=18186

[13] https://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards_en

Member States in innovation activity, by 2017 our Summary Innovation Index (SII) did not change significantly. There are no specific achievements and progress in the energy direction, as can be seen from the previously mentioned document.

In September 2010, a National Roadmap for Scientific Infrastructure[14] , developed by the Ministry of Education and Science, was adopted by the Council of Ministers. The map covers larger scientific complexes supporting the specific economic and social needs of the country, and the region of South-Eastern Europe and the Pan-European infrastructures, where Bulgaria will take part. The main priorities of the scientific infrastructure are in the field of energy, marine research, new materials for different applications, information and communication technologies, social research.

In Bulgaria, we lack a coordinated policy of activities affecting the relationship between science and innovation under the Education Development Programme[15]. There is also inefficiency of existing and lack of a sufficient number of transfer offices to provide a link with industry and the energy sector, and to encourage the search for and the realization of new and/ or renewed products, technologies and services. Less than 10% of active innovative enterprises have links with research organizations according to the National Strategy for Research and Development. The different elements of the Bulgarian innovation system are not connected - fundamental and sectoral studies are developed separately[16].

Innovation towards decarbonisation, both in the energy sector and in the economy, is highly problematic for Northern Bulgaria, but also for the whole country. At this stage there is no clear and long-term strategic approach, there is no specific funding on all levels. On a positive note, there are various good examples within different pilot projects, on the municipal level and among the scientific community, the business and the non-governmental sector. In general, Bulgaria should strive actively to attract funds from possible ongoing financial projects and programmes, and also to engage in diverse initiatives to international cooperation; to catch up with the gap and to ensure the achievement of the Vision's goals.

3.2 Business-as-usual Scenario - Preserving the Status Quo

The No-Target Scenario. It is in line with the implementation of the current energy policies (including renewable energy targets for 2020 and the construction of all officially planned power plants), taking into account the rising cost of carbon emissions, but not the 2050 reduction targets in the EU Member States or candidate countries. This scenario is rather passive and presents a baseline that compares the other two scenarios. It is assumed that Bulgaria fulfils basic EU requirements such as those for large combustion plants and for more intensive development of RES and takes into accounts the logical interest in the implementation of measures for the efficient use of energy. RES as a final energy source does not exceed 30% by 2050.

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14 National Strategy of Scientific Research to 2020

15 Programme for Development of Education, Science and Youth Policy in the Republic of Bulgaria (2009-2020)

16 THIRD NATIONAL ACTION PLAN FOR CLIMATE CHANGE FOR THE PERIOD 2013-2020 Approved by Council of Ministers Decision № 459 of 1 June 2012

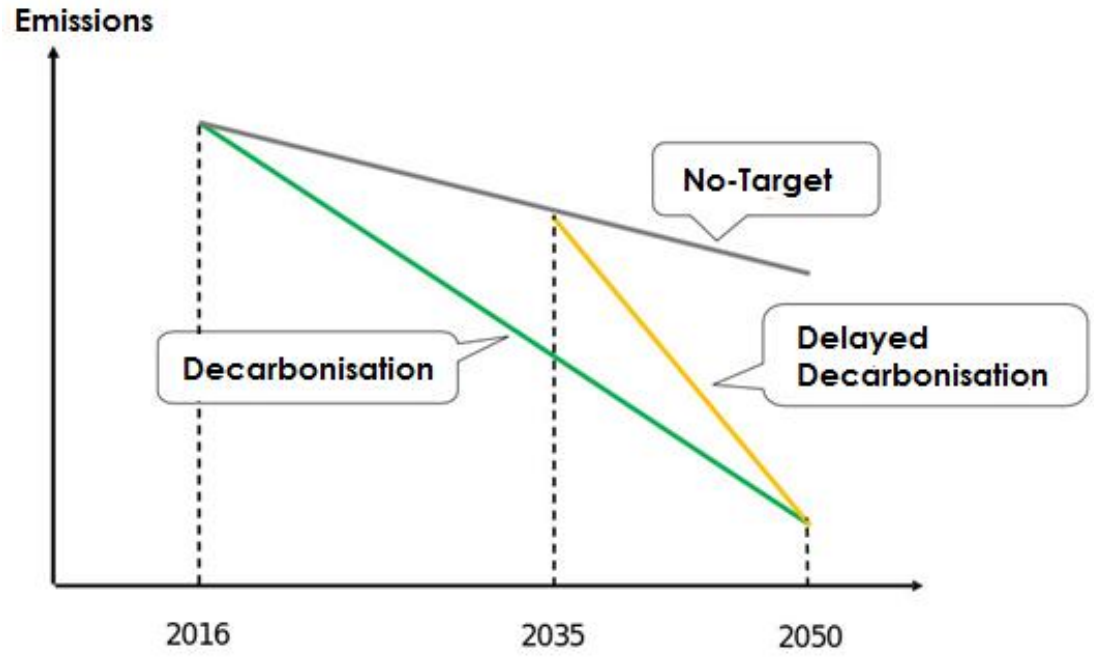

Figure 1 Comparison of decarbonisation scenarios

3.3 Development Scenarios

The "Decarbonisation" Scenario. It reflects a long-term strategy to reduce carbon dioxide emissions by 96.7% (for Bulgaria) compared to 1990, in line with the EU's overall carbon reduction targets for the energy sector by 2050, due to the rising cost of emission allowances and strong government support for RES.

The "Decarbonisation" Scenario implies the decommissioning of coal-fired power plants in Bulgaria by mid-2024, after that a need for electricity imports arises. Also in 2024 there is a need to introduce 420 MW natural gas power to cover the power deficit. The new and/ or rehabilitated, at the beginning of the researched period, natural gas use capacities gradually will decrease their annual usability and will turn into reserve capacities.

Increasing the energy efficiency of production and consumption helps to overcome possible difficulties in the period with insufficient generating capacities.

The "Delayed Decarbonisation" Scenario. Initial implementation of current national investment plans is adopted, and then a change occurs in policy direction after 2035, with the same 2050 reduction target being achieved as in the "Decarbonisation" Scenario. Increasing the cost of emissions and raised support for renewable energy sources after 2035 will determine the transformation.

The EC's energy forecasts with the PRIMES model[17] show a different degree that could be included as a decarbonisation measures, based on the economy specifications of regions and the Member States.

The current Roadmap is being developed at a time when this energy planning and modelling tool is being replaced by a new one and by 2019 PRIMES will be replaced by

[17] https://ec.europa.eu/energy/en/data-analysis/energy-modelling

POTEnCIA[18], which is poorly known and insufficiently used as a tool for energy modelling. Its mass use and distribution are forthcoming. Currently, what is still used by experts and is being done in Bulgaria on PRIMES, including the preparation of the future National Energy Strategy, and it is expected in a few years the modelling based on the POTEnCIA tool to be considered as well.

The "Delayed Decarbonisation" Scenario requires large investments existing capacities to be renovated and to be build-up more efficient and clean replacing capacities for coal or natural gas. At the same time, RES are developing, EE levels are increasing and, united, all these measures are reducing emissions. The electricity consumption is increasing due to the gradual transition of a number of thermal processes and partly of the transport sector towards usage of electricity instead of liquid fuels or coal. During the period it will be relied on the production of rehabilitated nuclear power of 2200 MW. At the end of the researched period, the relative share of energy from RES reaches 32% of gross final consumption. Consumption of solid and liquid fossil fuels is decreasing, which is in line with the European policy for limiting environmental pollution in the development of the energy sector.

The scenario envisages an increase in generating capacity, mainly instead of the introduction of new RES. New gas capacities are also being introduced, mainly to replace solid fuels. They are not expected to exceed 420 MW and appear after 2040 when they can be effectively used for cold reserve or regulation. Biofuel plants with higher mobility have potential too. Electricity trade with neighbouring countries and EU countries are expected to get more intensive following the further development of the electricity market, which also helps to overcome the difficulties in managing the power system related to the massive inclusion of RES plants.

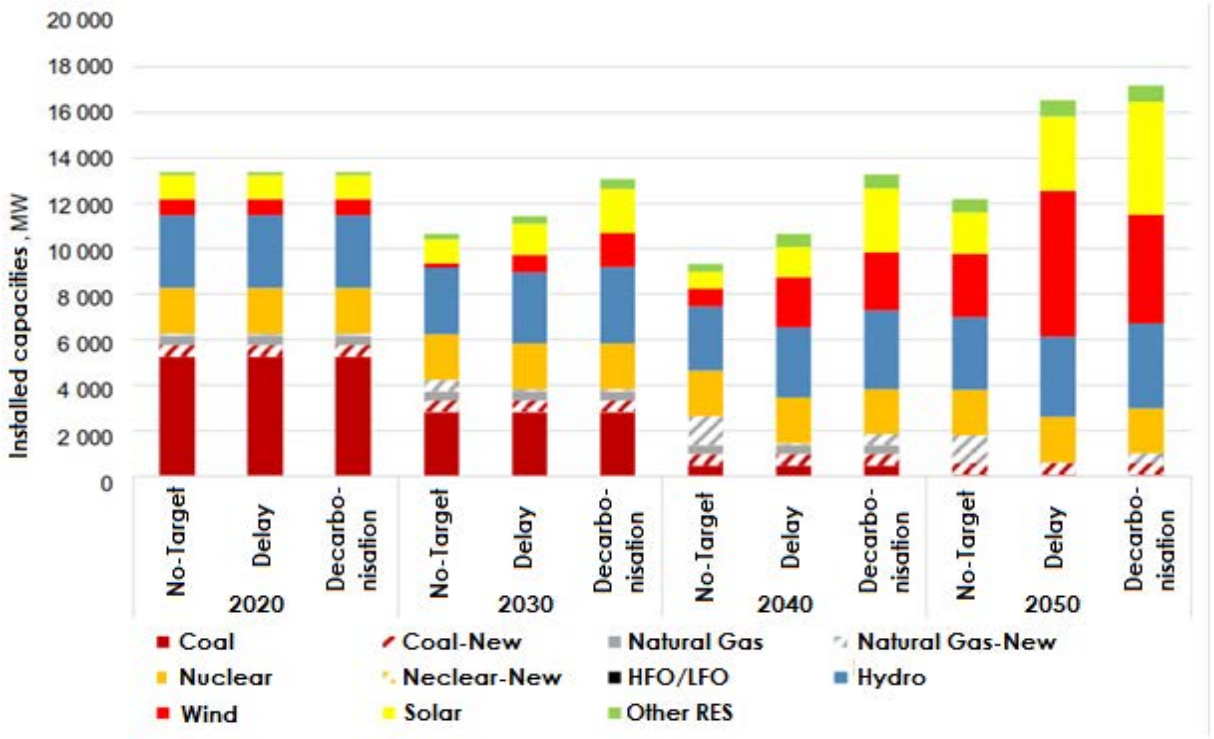

Figure 2 Installed capacities by type of energy sources according to three development scenarios. Source: SEERMAP Project

[18] https://ec.europa.eu/jrc/en/potencia

Key Activities and Objectives for the Achievement of Priority Areas of the Vision and the Roadmap

Activity 1: Protection and support of energy vulnerable consumers in the Pleven Province.

Dealing with energy poverty combined with energy transformation will be the greatest challenge for the Pleven Province. The planned activities rely on the active utilization of local potential, resources and capabilities, also indicated in the regional energy profile within the „Panel 2050" project for overcoming the challenges concerning the energy vulnerable consumers.

Objective: The objective of this activity is the identification of the energy poor households within the Pleven Province, as well as to indicate the proper steps for reducing their number by a minimum of **25% by 2030,** chiefly through energy efficiency measures and the replacement of the fuels used for applicable RES technologies.

Time schedule: The first stage in the achievement of the objective of the Vision and the Roadmap will take place in the period 2020–2030

Activity 2: Protection and support of energy vulnerable consumers in Gorna Malina Municipality.

Gorna Malina municipality is highly motivated to launch pilot measures in the area of energy efficiency, in order to demonstrate the effects of the various mechanisms for supporting households in meeting their energy needs and addressing energy poverty.

Objective: The objective of this activity is to identify the energy poor households in Gorna Malina Municipality, as well as to indicate the relevant steps to reduce their number by **50% by 2030,** chiefly through energy efficiency measures.

Time schedule: The first stage in the achievement of the objective of the Vision and the Roadmap will be implemented through this activity in the period 2020–2030

Activity 3: Protection and support of energy vulnerable consumers in Berkovitsa Municipality.

In Berkovitsa this issue is rather clearly seen, also due to the fact that a large share of the population in the municipality is of Roma origin, and members of this ethnos are largely classified as energy poor. Both on a national level and in Berkovitsa there is no clear and public classification and definition of energy poor households.

Objective: The objective of this activity is to identify the energy poor households in Berkovitsa Municipality, as well as to indicate the relevant steps to reduce their number by **40% by 2030,** chiefly through energy efficiency measures and the replacement of the fuels used for applicable RES technologies.

Time schedule: The first stage in the achievement of the objective of the Vision and the Roadmap will be implemented through this activity in the period 2020–2030

Activity 4: Implementing Energy Efficiency measures combined with RES installations for municipal buildings to reduce energy use in Nikopol Municipality

Nikopol municipality has placed energy efficiency and renewable energy among its long long-term priorities. First of all, the specific measures cover the public municipal buildings – a process, for the implementation of which the municipality has been actively working in recent years. Secondly, EE measures are also planned for multiple family buildings and households in general. The implementation of suitable RES technologies, in both Municipality's public buildings and the households, is also in a process of planning for subsequent implementation, using all the available financing

options.

Objective: Implementation of energy efficiency measures **in 5 municipal buildings** and reduction of the carbon emissions and energy costs of the municipality by **30 % by 2030**

Time schedule: The first stage in the achievement of the objective of The Vision and the Roadmap with this activity will take place in the period 2019–2025 in the area of EE. Then, in the period 2025 – 2030 the focus will be on the EE for multiple family buildings and households, as well as the implementation of RES, by replacing the fuel used for heating and electricity generation.

Activity 5: Implementing Energy Efficiency measures combined with RES installations for municipal buildings to reduce energy use in Belene Municipality.

For almost forty years Belene Municipality has been functioning, based on the still not implemented plans for the construction of a second nuclear power plant in Bulgaria, planned to take place in this area. This policy has resulted in Municipality's lagging behind in terms of the planning of sufficient strategic documents, measures and projects in the area of energy efficiency and renewable energy sources, for both the municipal public property and the households in this Municipality.

Objective: The objective of this activity is to draft a plan for the implementation of energy efficiency measures for the municipal buildings in the Belene Municipality and installing RES for thermal energy. This will result in a **30%** decrease in the greenhouse gas emissions and Municipality's financial costs by **2030**

Time schedule: The first stage in the achievement of the objective of the Vision and the Roadmap will be implemented through this activity in the period 2020–2030

Activity 6: Analysing of the possibilities for building solar heating system for public buildings in the municipality of Berkovitsa.

The process of development and implementation of a solar heating system requires a number of administrative steps, studies and specific energy modelling, in order to ensure the implementation of the best possible combination of technologies separately for each building and for all buildings together, with view of the overall potential for the implementation of such a system in the Berkovitsa Municipality.

Objective: The objective of this activity is to carry out a detailed analysis of the potential for the construction of a solar heating system, referred to as "Solar District Heating ". This analysis should result in the development of a clear approach as to how and why it is possible to implement Solar District Heating, which would ensure a **40-50%** decrease in the heating costs and carbon emissions.

Time schedule: The first stage in the achievement of the objective of the Vision and the Roadmap will be implemented through this activity in the period 2020–2030

Activity 7: Development of possible financial schemes for implementation of solar heating system in municipal buildings – Gorna Malina Municipality

Gorna Malina is the first green municipality in Bulgaria and within the Panel 2050 project it considers the possibilities to implement the Solar District Heating idea on its territory in three phases. All necessary preliminary data has been collected in recent years, and the step-by-step planning of this project has commenced.

Objective: The implementation of Solar District Heating in Gorna Malina, planned in several phases, starting with a pilot phase in 3 public buildings; The implementation of phase one will enable the municipality to achieve significant financial and energy savings of **40 to 60%** on an annual basis.

Time schedule: The first stage in the achievement of the objective of the Vision and the Roadmap will be implemented through this activity in the period 2020–2030.

Activity 8: Utilization of wetland biomass and agricultural residues as local heating source in Guliantsi Municipality

Guliantsi Municipality's efforts are focused on the sustainable development of agriculture and the protection of biodiversity in the protected areas, which are mainly wetlands and agricultural land within the area of the municipality. This is planned to take place by supporting and encouraging farmers to utilize residual biomass. This biomass is planned to be used for the production of pellets and compressed blocks (briquettes), to transform it into a local heating and electricity source, to gradually replace the use of firewood and coal.

Objective: The planned activities will demonstrate the capabilitiesтe and potential for using biomass from wetlands and agriculture as local energy resources. This will result in at least **20% decrease in the carbon emissions of the municipality**, due to the change of the fuel used and allow **the sustainable management of at least 1000 hectares of agricultural land and wetlands to start being managed.**

Time schedule: The first stage in the achievement of the objective of the Vision and the Roadmap will be implemented through this activity in the period 2020–2030

Activity 9: Introduction of electro-mobility and development of adequate interurban bus transport system and connections at Nikopol, Belene, Levski Municipalities.

The aforesaid municipalities often suffer from a shortage and underfunding of the transport services. It is often necessary to terminate contracts with transport companies for certain non-profitable lines, resulting in the temporary or permanent lack of transport services for some villages and towns.

Objective: the main objective of this activity is to ensure the availability of public transport, through electric vehicles, connecting 10 neighbouring villages and towns with a total population of 7 000 people, which have natural geographic connection and need interurban links, which is however currently hard to achieve.

Time schedule: The first stage in the achievement of the objective of the Vision and the Roadmap will be implemented through this activity in the period 2020–2030

Activity 10: Development of an information system and awareness raising measures for the promotion of EE and RES among households in the Municipalities of Pleven.

This is a platform for increased awareness of the consumers, regarding the electricity, thermal and natural gas energy they are using, explaining the benefits of the implementation of EE and RES measures and energy transformation.

Objective: The objective of this activity is to establish the foundation and provide perspectives for the development of an information system, which would cover and reach at least 2000 households on an annual basis, in 123 towns and villages in the Pleven Province.

Time schedule: The first stage in the achievement of the objective of the Vision and the Roadmap will be implemented through this activity in the period 2020–2030 r

3.4 Milestones

2021 - Strategic documents on a national, regional and local level should be prepared and the objectives of the Vision, Roadmap and Action Plans to be taken into account.

2025 - Reporting the progress of the Action Plans. The progress will mainly come through funding in the next programming period, where at least 25% of the funds under different operational programmes are expected to support decarbonisation, decentralization, EE, campaigns, environmental protection and tackling climate change in general and etc.

2027 - Monitoring the achievement of the interim goals, including the planning of financial options for the next EU programming period after 2027 and first assumptions for the timeframe until 2040, also in line with the EU targets and policies.

2030 – Implemented Action Plans and final evaluation of the results achieved for decarbonisation of the energy system and impact on local economies. Final planning of the next actions and objectives for the Vision and Roadmap in the period 2030-2040, and preparation of new Action Plans.

2033 - Mid-term review of objectives and outcomes of the Vision, Roadmap and new Action Plans, including a comparison with the EU financial parameters for the next programming period after 2034.

2038 - Monitoring the achievement of the interim goals, including first assumptions for the 2050 timeframe, also in line with the EU targets and policies, which are in preparation.

2040 - Mid-term review of objectives and results.

2045 - Mid-term review of objectives and results.

4 Impact on the Regional Economy

Taking into account the National Adaptation Strategy, the region of Northern Bulgaria is expected to change. Periods of intense drought will increase, periods and quantities of evenly distributed seasonal rainfall will decrease, the length of negative temperatures and snow cover in the lowlands will be reduced, the water balance will change in the soil and regional agricultural plants will need to be replaced. These changes will certainly restrict some current economic sectors but will also create the possibility of emerging new ones.

On this basis, it is expected the opportunities for building of networks to be enhanced for electricity distribution and electric power transmission as a backbone of future low-carbon energy systems at regional and international level. These networks will be with a high degree of integration between all energy carriers and will connect power systems with gas, heating and cooling networks supported by energy storage and electricity conversion processes.

Such energy systems will be digitized and with a high level of automation. Effective markets supported by digital platforms, from wholesale to retail stage, will allow all stakeholders in the energy system to trade energy including producers who sell their unused energy in the neighbourhood in "peer to peer" deals. Digital solutions will be compatible, certified, and secured in cyberspace.

According to the Vision of 2050, the electrification of European energy systems will have a leading role for its societies and markets. This will require the gradual connection of electricity and gas networks, including locally, through the production of carbon-neutral synthetic gases (methane) to ensure long-term supply security (seasonal storage) for the

renewable energy system. A low-carbon local economy will also include the connection of electrical, heating and cooling systems, as well as electricity and liquid fuels, supplemented with biofuel, for heavy vehicles, river and maritime transport and aviation.

The realization of the energy transition should be market-oriented: investments in technologies in energy systems will boost innovation and spreading in other economic and technological sectors, thus contributing to the growth of the local and national economy. The implementation of Vision 2050 requires significant investments for the large-scale development and spread of energy transformation and storage facilities, the modernization and expansion of the Pan-European energy transmission system (electricity and gas) and local distribution (electricity, gas, heating and cooling) with use of digital solutions. In addition, competitive retail markets will ensure that the aggregation of consumers will be valued by local markets. Compared to previous years, additional investment will be rewarded by increased benefits for social welfare and the environment; including climate change adaptation and mitigation lower costs, as well as new green jobs.

5 Involvement of Stakeholders

As a part of the implementation of the PANEL 2050 Project, we have developed a network of stakeholders and forerunners (experts and legal entities) and also with the active involvement of local actors, who have contributed a valuable expertise to the energy planning for Northern Bulgaria Region and to the development of the Vision, Roadmap and Action Plans, and they were intensively involved in all processes. Through the project activities, more than 20 stakeholders' representatives participated and contributed to the creation of an Energy Vision, Roadmap and related Action Plans. Some participants were recognized as new stakeholders in the project. Most of them are representatives of the non-governmental sector, municipalities or organizations with whom WWF has been working on these topics for a long time. As a non-governmental organization, we work mainly with NGOs on national level. Our contact with them is regular, based on weekly or monthly communications. Thus, the stakeholder involvement in the Roadmap's developing process is mainly done through regular work communication, individual meetings and phone or Skype calls.

The following stakeholders were involved in the planning and development of the Roadmap: Municipalities Gorna Malina and Berkovitsa, Pleven Region and Municipalities from Pleven Region, EcoEnergy Network, EnEffect, IZEB, Zelenika Foundation, Climate Action Coalition, The Greens, Sustainable Energy Development Agency and others.

The work process is ensured mainly through regular meetings with local communities, but for the further implementation of the Action Plans more focused contact with municipal representatives will be required.

On the other hand, the long-term commitment of stakeholders will be crucial for the implementation of the actions, needed to achieve the goals by 2050. This can be achieved through different approaches:

Coordinating meetings of the forerunners and the stakeholders:

• Should be held regularly;

• The process of Roadmap development should be evaluated;

• A Possibility of external experts to be invited for specific topic needs;

Disadvantage: Internal organizational meetings assume the risk of becoming routine;

Regular discussion meetings of energy groups

• To be held regularly;

• Meetings are informal;

• They may have different focuses and areas for discussion;

• Ability to exchange and share of experience in a certain expert group from a specific area;

Disadvantage: Heterogeneous group with changing members;

Thematic seminars

• Provide specific feedback on your questions;

• Generate contributions from a wide range of stakeholders at an expert level;

• Opportunity for different thematic focuses;

Disadvantage: Participants and speakers should be well-selected, credible results to be received;

On-site visit and study visits

• A Practical, tangible way to send a message or knowledge sharing;

• Provides the opportunity to present examples of best practices;

• Participants receive internal knowledge and can be engaged in discussions with performers;

Disadvantage: More time and resource than other types of events.

Rewards and competitions

• For example, Energy talks competition; Awards for exceptional energy projects, Exchange programme for heaters, "Ice Challenge";

• Can be targeted at different consumer groups, e.g. individuals, households, businesses, schools and etc.;

• Rewards raise public awareness;

• Participants in reward games act as models and multipliers;

• Low threshold methods for collecting ideas and visions for the regional energy future;

Disadvantages:

- Resource for setting, marketing, and pricing need to be allocated;

- Chance for failure due to low public interest;

Civil action groups / Self-organizing groups and people

• Mostly self-organized civil movement for implementation of a local renewable energy system (e.g. solar heat, PV);

• Development of a common ownership model in the renewable energy sector;

• Long-term commitment to the future of renewable energy;

Disadvantage: Depends on individual engagement

This approach will be needed in order stakeholders to get informed and engaged for a longer period of time.

6 Impact on National Regulations

At the time of completion of this Roadmap, it is expected with the help from the project' forerunners it to be promoted as a positive example and to impact the following current or forthcoming strategic documents:

- National Development Programme: Bulgaria 2020;

- Energy Strategy of the Republic of Bulgaria 2020;

- National Energy Efficiency Action Plan 2014-2020;

- National Renewable Energy Action Plan 2020;

- National Programme for Promotion of the Biofuel Consumption in the Transport Sector 2008-2020;

- Strategy for Development of the Transport System of the Republic of Bulgaria until 2020;

- National Strategic Plan for Gradual Reduction of the Quantities of Biodegradable Waste for Disposal 2010-2020;

- Third National Action Plan on Climate Change 2013-2020;

- National Plan for Nearly Zero Energy Buildings 2015 – 2020.

The challenges and the lack of long-term strategic and policy documents in the field of climate and energy in Bulgaria after 2020 inevitably influenced the current Roadmap. Despite this, the process of gathering working groups for the preparation of some upcoming strategic documents and the specific targets in them has already begun in several key areas. The Vision, Roadmap and Action Plans are expected to influence positively on a number of strategic documents and on their preparation process. Project outcomes will be used mainly from stakeholders, forerunners and other partners, participated in the preparation process. Strategic documents, already in preparation or are forthcoming soon, are as follows:

- National Energy Strategy 2030 with strategic goals until 2050;

- The National Climate and Energy Plans 2030 as part of the Clean Energy for All European Package;

- A Low-Carbon Development Strategy by 2050 as part of the Paris Agreement;

- National Strategy and Action Plan for Adaptation to Climate Change by 2030 - Part of the EU member states obligation to develop adaptation strategies;

- National Development Strategy Bulgaria 2030;

- Regional Development Strategies for 2030;

- Municipal Development Strategies after 2020.

7 Endorsement by Implementers and Political Decision-Makers

In the developing process of the Roadmap and the Vision, representatives of leading organizations, expert teams and business associations plus targeted groups of the municipalities and provinces participated actively in various aspects of the desired future energy transformation, and the transition to a low carbon economy. Developments and lessons learned from their work are included in this strategic document. These legal entities will most likely be those who, at the present time, but also in the coming years, will benefit from the results of the Panel 2050 project.

The Greens

Da Bulgaria Movement

"Democratic Bulgaria" Union

Municipal Network EcoEnergy

Sustainable Energy Development Agency

Bulgarian Solar Association

Bulgarian Photovoltaic Association

Climate Action Coalition - Bulgaria

Ecological Association "Za Zemiata"

Center for the Study of Democracy

Greenpeace

WWF

8 Financing/Fundraising

Below is placed basic non-exhaustive list of funding opportunities available at the time of developing the Roadmap, but also active financial instruments for the next 3-5 years. There is a need for a detailed assessment of the applicability of each instrument to specific project ideas. It is known that each of them or in combination is available to finance energy projects in the short and medium term.

For the region of Northern Bulgaria, especially for smaller municipalities, the lack of financial capacity to co-finance projects is a widespread problem. A serious analysis of each project idea is needed in order to be planed the financial instruments that can be used.

- National budget for rehabilitation of multifamily buildings (non-regular);

- National Investment Programme (non-regular);
- EU OP (Structural and Cohesion Funds);
- EU R&D Funds;
- Fund of Funds;
- ESCO schemes;
- Financing for innovation and development;
- Private investments;
- Public-Private Partnerships;
- Bulgarian Development Bank;
- Emissions trading revenues;
- Special Fund for Just Transition;
- Innovation Norway;
- Energy System Security Fund;
- Modernization Fund – ETS;
- Kozloduy Fund;
- Municipal bonds.

9 Roadmap Team

The organizer of initiating and developing the Vision, Roadmap and Action Plans is WWF Bulgaria. The NGO was able to attract, perhaps the most active experts and legal entities in the field of Energy Planning, Energy Efficiency and Renewable Energy Sources in Bulgaria, from the beginning of the implementation of the Panel 2050 project. Through various approaches, such as expert opinion and expert assessment, active involvement in meetings and direct work on the project documents, the participants contributed to the compatibility and acceptance of these documents by stakeholders and end users.

Among the active participants, we cannot miss to point out the special representatives below. We should remember that there are people not mentioned in this list, but involved in the preparation in the different stages of all documents to whom we are also grateful for their views and efforts:

Borislav Sandov - Climate Action Coalition and the Greens;

Milan Rashevski - Institute for Zero Energy Buildings;

Nikolay Nikolov - European Labour Institute

Dragomir Tsanev - Municipal Network for EcoEnergy;

Stanislav Andreev - EnEffect;

Petko Kovachev - Green Policy Institute;

Todor Todorov - Ecological Association "Za Zemiata";

Dragomir Konstantinov - "Zelenika" Association;

Yordan Velikov - Sustainable Energy Development Agency;

Malinka Nikolova - Bulgarian Solar Association.

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ANNEX: Letters of Commitment

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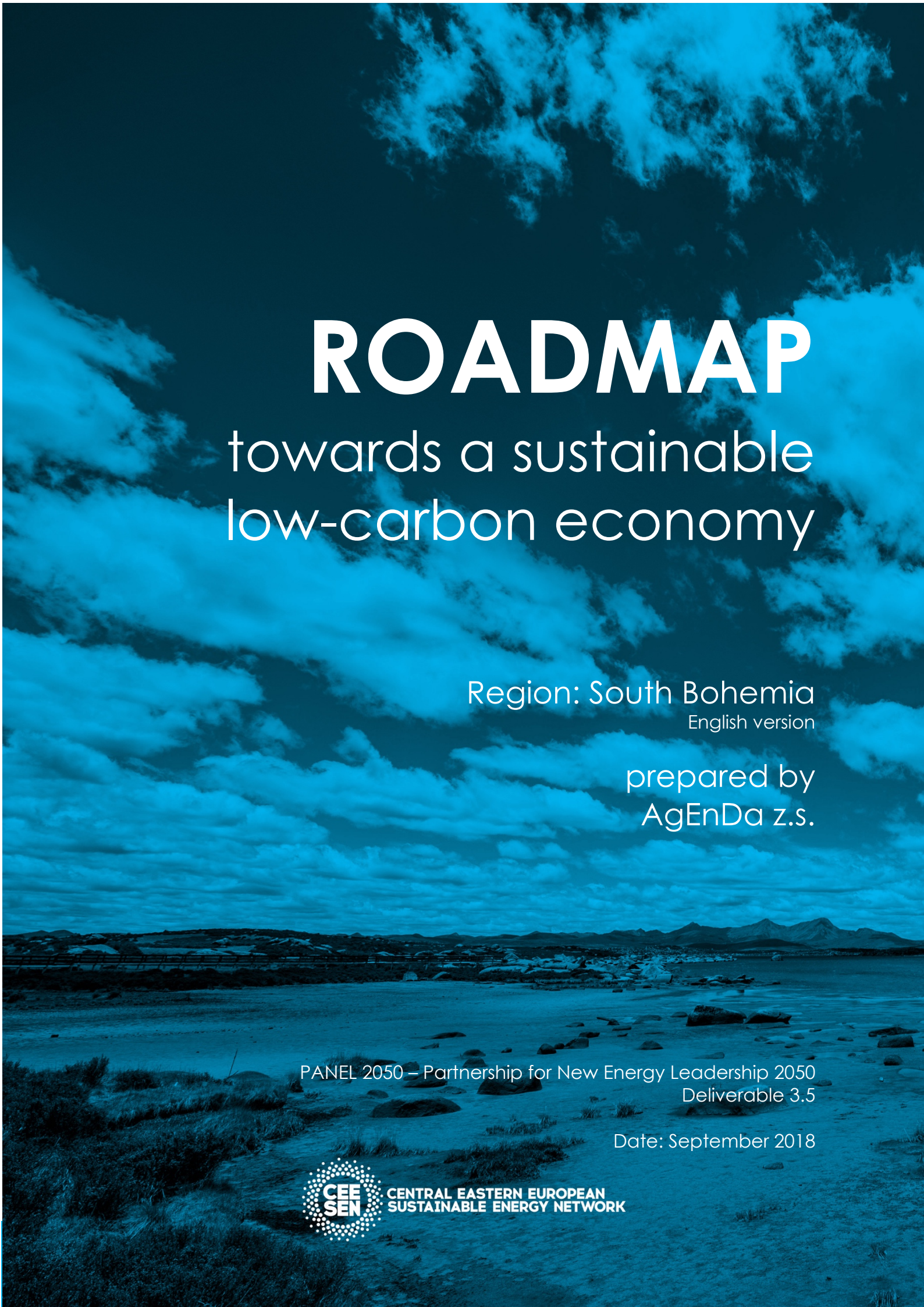
SUSTAINABLE ENERGY NETWORK



ROADMAP

towards a sustainable low-carbon economy

Region: South Bohemia

English version

prepared by

AgEnDa z.s.

PANEL 2050 – Partnership for New Energy Leadership 2050

Deliverable 3.5

Date: September 2018

CEE SEN CENTRAL EASTERN EUROPEAN SUSTAINABLE ENERGY NETWORK

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About Panel 2050 project

The PANEL 2050 project has the aim to create durable and replicable sustainable energy networks at local (municipality/community) level, where relevant local stakeholders collaborate for the creation of a local energy visions, strategies and action plans. The aim of these networks is to contribute to and actively work for the transition towards low carbon communities in 2050. The PANEL 2050 partnership will provide support for the creation of first successful local energy networks in the CEE countries. In the course of the project, organisations from 10 CEE countries will collaborate on creating regional energy strategies and action plans. For more information visit https://ceesen.org/panel2050/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696173.

The PANEL model

PANEL model is a comprehensive approach for implementing local long-term energy management, supported by the community. PANEL model consists of seven main elements: Stakeholder Engagement, Training Program, Guidebook, Long-term Energy Visions/Roadmaps/Action Plans and Central and Eastern European Sustainable Energy Network CEESEN. These elements are developed by PANEL 2050 project to support the CEE communities on achieving their sustainability goals.

The Roadmap at hand is the output of the long-term energy planning process with the aim of plotting the regional transition towards a low-carbon community.

Attached to the Roadmap 10 specific Action Plans were developed, representing the first steps on this road toward low-carbon community by 2050.

Roadmapping process
South Bohemia, Czech Republic

Stage 1 — **Baseline – Regional Energy Profile *South Bohemia***

Stage 2

Vision

By 2050 South Bohemia will exploit its natural and economical preconditions to become a centre for technology and knowledge in the sector of self-sufficient buildings, biogas utilization and advanced knowledge base for financial instruments focused on EE and RES investments.

Stage 3 — **Roadmap**

Stage 4

— Energy efficiency in households —

Action 1
Establishment of regional technology platform for self-sufficient buildings

Action 2
Elaboration of Strategic Research Agenda for the Technology platform

Action 3
Elaboration of Implementation Action Plan and Technology Foresight for 2025 - 2050

— Renewable energy / bioenergy —

Action 4
Biogas plants transition to biomethane production sites system

Action 5
Agriculture biogas plants conversion to waste utilization

Action 6
Biogas utilization as regulation and local energy system

— Financing and business models —

Action 7
Status quo analysis

Action 8
Alternative financing methods (Crowdfunding)

Action 9
Loans scheme

Action 10
Subsidy schemes for off-grid systems

1 Introduction

The regional energy roadmap elaborated within the implementation of the PANEL 2050 project is based on Regional Energy Profile and intensive communication and cooperation with various group of stakeholders, decision makers and forerunners.

In the mid of 2018 the Regional Energy vision was defined in the first version and further extended in August 2018 with the two trending topics – biogas utilization and energy financing.

Regional energy vision

By 2050 South Bohemia will exploit its natural and economical preconditions to become a centre for technology and knowledge in the sector of self-sufficient buildings, biogas utilization and advanced knowledge base for financial instruments focused on Energy Efficiency and Renewable Energy Sources investments.

2 Priority areas

The regional roadmap will therefore focus on following priority areas:

Energy Efficiency

- ⇒ Households
- ⇒ Financing and business models

Renewable energy priority areas

- ⇒ Bioenergy
- ⇒ Financing and business models

Main rationale and motives

Since the beginning of 2006, the first pioneers in the field of gentle energy have been able to get support for their projects reducing the dependence of the Czech Republic on fossil sources. The current Czech goal is to achieve at least 15.3% of the share of energy from all renewable sources in gross final energy consumption by 2020. This commitment is part of a Europe-wide effort in which the EU as a whole wants to achieve a 20% share of renewable energy by the end of this decade.

The Czech commitment belongs to the lower ones in Europe. Nevertheless, as shown by the development of green energy projects and potential studies, the possibilities of electricity and heat production from renewable sources in our country are much higher. Another option to extend the potential of gentle energy comes with a drop in the price of new technologies.

The previous State Energy Concept, for example, in the case of solar power and biogas stations, was expected to have almost zero potential up to 2030. However, both these renewable sources already cover 9% of the current electricity production today. Solar energy is also the most widespread clean energy source in our country. The number of licenses issued for the operation of photovoltaic power plants (both household and industrial projects) has reached almost 29,000. Gradual and stable growth of renewable resources is one of the easiest solutions to getting rid of the dependence on coal and external sources in addition to investing in reducing the energy performance of buildings or industry.

Not only default natural characteristic of the South Bohemian region as described in Regional energy profile but also a unique mixture of promising initiatives (as a result of of forerunners identification) and current technology development followed by existing legal and financial pre-conditions is behind the selection of given priority areas.

Energetics in the region is mostly influenced by presence of Nuclear Power Plant Temelín and its future extension (doubling the installed power) that is planned however there is a clear and accessible potential for RES utilization.

Biomass – South Bohemia has big potential for energy utilization of biomass thanks to the high share of wooded area, as well as for phytoenergetics deployment and growing crop on uncultivated land.

Wind energy – Only few locations in the south are being above the level of profitability and on top of that construction of wind power plants is very difficult due to the nature preservation.

Solar energy – Solar conditions for photovoltaics are pretty good, intensity of solar radiation reaches almost 3800 MJ/m^2/year. Region is also known for high share of households and farms with great potential for installment of solar panels.

Hydro energy – increase of current installed power is depended on construction of new elements such as weirs and reservoirs. Rivers in the South Bohemia are not much steep which limits the power of current water power plants.

Geothermal – Geothermal energy can be utilized by heat pumps. Especially suitable locations can be found in the west part of Jindřichův Hradec districts, south of Písek city, southeast of Strakonice city and part of Budweis district.

From above stated overview it's clear that South Bohemian region has sufficient potential of biomass, solar, hydro and geothermal energy with marginal significance of wind energy potential. Optimal regional strategy would be based in utilization of biomass and solar energy. The use of hydro power is depended on number of other aspects.

These basic premises indirectly formed the roadmapping team and resulted in identification of the most potential initiatives related to the topic of **self-sufficient housing** represented by very succesful forerunners from *Czech Off-Grid House* and to the bioenergy represented by well-developed **biogas plant infrastructure** in the region as well as the other group of forerunners behind national technology platform *Czech Biogas Association*. The interlinking provides actual topic of **energy financing** including new and alternative methods such as crowdsourcing or crowdfunding.

3 Actions and development scenarios

3.1 Status of R&D, innovations and technology

3.1.1 Self-sufficient buildings

The basic presumption of fulfilling the vision is the current state of technological progress, geopolitical situation and the environment. By 2050, the world's population will reach 9.6 billion, and by 2020 around 35% more electricity will need globally than now (2018).

Electricity generation produces 60% of greenhouse gases. The second most energy-demanding sector, after transport, is a non-industrial building that now consumes 29% of all world energy and produces 21% of global emissions of CO_2 and other poisonous gases. The average water consumption in Czech households per capita in 2015 was 87.9 liters of drinking water. Although this may not seem to be the case in the Czech Republic, water is becoming a very scarce product, as we consume it and pollute more than nature can clean and restore itself. Almost 80% of human waste water is discharged into the world's rivers and oceans without any cleaning. Half of the world's population (3.5 billion people) lives in densely populated cities, of which 830 million in slums. Cities occupy an area of 3 %of the world's surface, but they consume up to 80 %of their energy and produce 75% of greenhouse emissions.

Respected international energy agencies predict photovoltaics to grow further. For example, the International Energy Agency (IEA) has released a study by which solar power could become the largest energy source in the world by 2050. If technological progress can be made in the production of photovoltaic modules, solar electricity can compete with conventional sources - coal or nuclear power plants. Based on the analysis of the roof areas of family houses and flats derived from CZSO statistics and an estimate of the usability of roofs for installation of PV panels in the amount of 55%, the real total roof area of family and apartment buildings suitable for the installation of PV panels was set at 29 601 026 m^2. Other buildings are assumed to have lower roof utilization - it is assumed that only 25% of the total roof area of other buildings is technically suitable for installing roof roofs, representing 48 360 041 m^2 usable roof areas.

Development of photovoltaics in the Czech Republic

The price of photovoltaic panels has fallen by ten percent over the past five years. The fall of the prices was motivated in 2008 - 2012 mainly by the growth of solar power in the European Union. Now in Europe, growth has stabilized in a number of countries, and unfortunately in some countries - like the Czech Republic - de facto stopped. New solar power plants are growing in the last two years, especially in China, the United States or India. Respected international energy agencies predict photovoltaics to grow further. For example, the International Energy Agency (IEA) has released a study by which solar power could become the largest energy source in the world by 2050. If technological progress can be made in the production of photovoltaic modules, solar electricity can compete with conventional sources - coal or nuclear power plants.

The instability of the legal environment strongly influences the potential of renewable sources in the Czech Republic. Starting in 2005, when adopting legislation to support renewable energy, it encountered a non-conceptual approach by the state that failed to respond to the dynamic development of photovoltaics (removing problematic limits to year-on-year changes in the purchase price, retroactive measures in relation to already

implemented projects, etc.). Solar energy did not benefit from a negative campaign against investors in this field as well. Subsequent repeated changes in legislation combined with delimitation of the renewable energy sector led to a stagnation of further use of solar power in the Czech Republic. According to the latest available statistical data, there are 28 194 licensed PVPs with a total installed capacity of 2 113,83 MWp.

The current production price of electricity produced from the roof PVP is around 2.89 CZK / kWh. This production price, however, represents a condition where all electricity produced is used in its own consumption point of consumption. If only part of the production is utilized (e.g. by limiting the power of the inverter to eliminate overflows to the EC), the production price of the electricity from the PVP is higher.

The technical potential of PVP has been analyzed by a mixed top-down and bottom up approach based on primary or derived statistical data on building roofs in the residential sector (family and apartment buildings) and other buildings (public sector, services, industry). Primarily, the analysis focused on the household sector.

Based on the analysis of the roof areas of family houses and flats derived from CZSO statistics and an estimate of the usability of roofs for installation of PV panels in the amount of 55%, the real total roof area of family and apartment buildings suitable for the installation of PV panels was set at 29 601 026 m^2. Other buildings are assumed to have lower roof utilization - it is assumed that only 25% of the total roof area of other buildings is technically suitable for installing roof roofs, representing 48 360 041 m^2 usable roof areas.

At an average power density of 6.55 m^2 / kWp and with respect to the time horizon of 2050 the technical potential of installed PV power in family, dwelling and other buildings is set at a total of 7,367 MWp in 2050. The above power is it is necessary to reduce by about 294 MW already installed power in roof power plants to 100 kWp. The value of the total potential of new roof installations of PVP between 2015 and 2045 was set at 7,074 MWp. With an even decomposition of up to 30 years (2016-2045), the total potential of 7GW represents about 236 MW of annual output of installed PV roof power. In connection with the established potential, it should be mentioned that it does not include installations on open areas. Restrictions for PVP on farmland are understandable, and further potential analyzes can not be expected to relieve these restrictions, but scenarios also count on open space installations. For example, brownfields, contaminated or otherwise degraded areas, former landfill sites or reclaimed areas are not suitable for other uses.

Since the amendment to the Energy Act does not require State Authorization for sources below 1MW, the possibility of realization of the WWTP is also open to open areas on non-agricultural land under normal commercial conditions. The technical potential for installations on free non-agricultural plots can not be estimated reliably, it will be hundreds of MW to GW units. This all leads up to the stimulation of research and development of technologies that enables energy storage and advanced utilization.

This segment is far from saturated and offers significant potential for further development. In addition, in the household segment and in the small business segment as the market segments with the highest end-user electricity price, the market price parity is the fastest approaching electricity price. The production of electricity from PVP in these segments for own consumption can be economically advantageous even with minimal support and in the future, it is assumed that depending on the rise in electricity prices and the fall in technology prices, these segments will be the first to reach market parity.

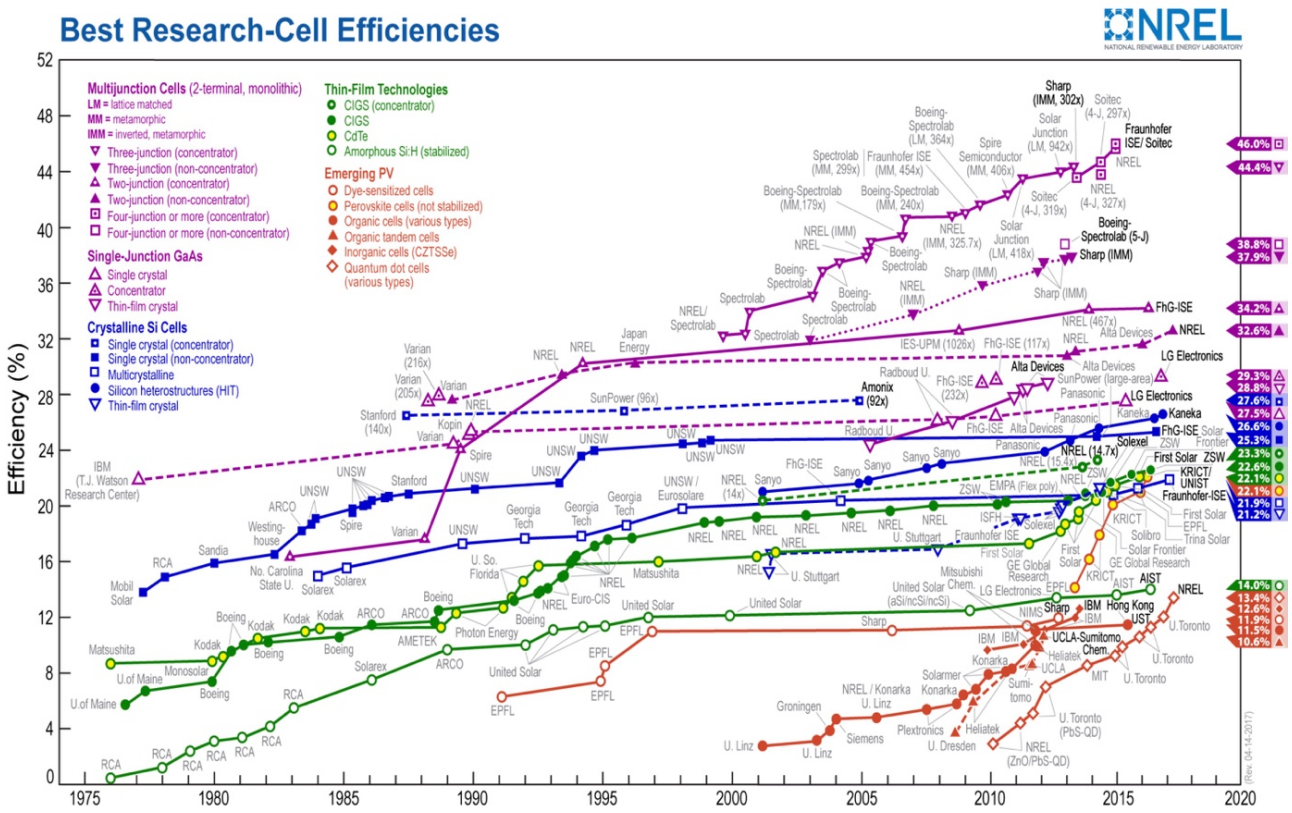
Development of battery power systems

Today's worldwide installed battery power is roughly 2 GW. Most battery systems are installed in the US - roughly one third of the total battery capacity. Followed by South Korea, Japan and Germany. The International Renewable Energy Agency (IRENA) expects that by 2030 the battery output will increase to 170-420 GW. The largest battery manufacturer is China, which currently produces 55% of all batteries in the world. The Chinese government plans to build further factories to produce 120 GWh of batteries in 2021. For comparison: California Tesla reaches its gigafactory at 35 GWh batteries per year. Market developments indicate a global boom in the use and installation of battery systems in combination with RES. They appear to be the most versatile and can be built to sizes up to tens of MW. They have very fast responses in tens of milliseconds, and thanks to the inverters and high precision they can hold every supportive function of the system. That's why they are the technologies with the most successful projects, and they are expected to be big in the future, especially Li-ion technology (and their sub-catheters), which can be expected to be big in electromobility and Na-S for larger systems.

The Bloomberg New Energy Finance (BNEF), a renowned consultancy, has prepared a view of the cost of accumulation. It states that the price of lithium-ion batteries has fallen from incredible 73% since 2010, to 273 US dollars / kWh in 2016. By 2030 BNEF is expected to fall to $ 74 / kWh. The engine of cost savings will be to increase competition and the rise of further innovations. Any doubling of battery production will, moreover, lead to a 19% decline in the price of BNEF. Another favorite is SNG and H_2. By improving the efficiency of their production and conversion, which is especially low for hydrogen due to fuel cells, this technology will find it very useful, for example, in wind farms. Both substances can then be transported to a more advantageous place of use or serve as fuel for hybrid electric vehicles.

An interesting benefit for the future could be the thermal technology of liquefied air. Unlike other thermal technologies, this is not geological and geographic, it allows the storage of energy in GWh units and has a response in seconds. Thanks to these features, it could be an alternative to pumping power plants in the future. Frequency control has proven to be a benefit of flywheel technology, thanks to its shortest response time and high output power, the ideal prerequisite as a complementary system to classic frequency control systems. However, for its short discharging time, no breakthrough in other support services can be expected.

Image 1 Cell efficiency development

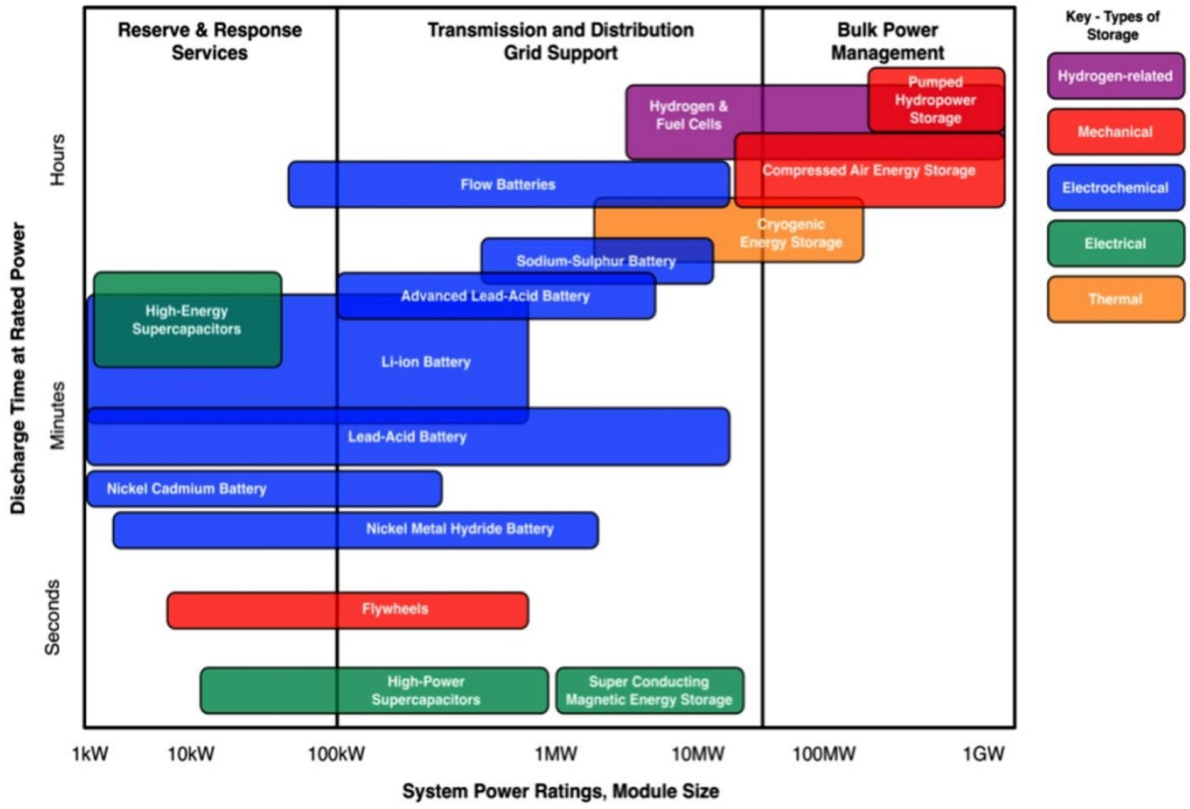


Energy-saving batteries can be decentralized systems with adequate installed capacity for homes, businesses, industrial enterprises, cities, regions or entire states and their distribution networks. Accumulating energy from renewable sources increases the energy independence and self-sufficiency of all these entities. Today, the so-called hybrid solar power plants that connect photovoltaic panels on the roof and batteries located inside or outside these buildings are available on the market. In the event of a power outage, the building can switch to so-called island mode and draw the stored energy from the batteries.

Batteries also help in day-to-day operation: the building makes it possible to use the energy produced by solar panels over the day in the evening. Larger battery systems with installed unit capacity or tens of megawatt hours are then an appropriate element for network control. These applications help stabilize network performance and help to integrate more efficiently the growing production of wind and solar power plants and can play an important role in protecting the network from so-called blackouts.

Storage of clean electricity is very difficult, so most systems use electricity to transform it into a different form in which it can be stored more efficiently and converted back into electricity if necessary. The technologies themselves differ in capacity and size, in conversion efficiency or response time, and in the time, they are able to store the accumulated energy with acceptable losses. By the principle of energy storage, we can divide the systems into storage methods by means of electrical, electrochemical, mechanical, chemical and thermal energy.

Image 2 Comparsion of different battery types properties



All of these methods have their specifics and uses to increase the self-sufficiency of the entities for which they are installed - whether it is a single dwelling unit in a panel house or a huge pumping power plant for the state distribution network.

Basic battery types

a) Electrical systems

- Super-Capacitors (DLC)
- Superconducting Magnetic Storage System (SMES)

b) Electrochemical systems

Energy is stored in the form of chemical energy. It includes all types of batteries in this category. These can be divided into primary and secondary. Primary appeared first and are batteries whose function does not allow re-charging. Therefore, after discharging, they are destined for ecological disposal and will not be dealt with for the purposes of strategic research agenda. Secondary type are batteries with the possibility of cyclic charging and discharging, which we call accumulators. Accumulators and their properties are, among other things, given the size of the article. The large capacities needed in EC storage systems are achieved by folding individual cells into blocks and blocks into the resulting stations. The special type of electrochemical systems is so-called "Flow battery".

- Li-ion batteries (Li-ion)
- Nickel-cadmium accumulators (NiCd)

- Lead accumulators (Pb)
- Sodium-sulfur (Na-S)
- Metal-air accumulators
- (Redox) Flow Battery (RFB)

c) Mechanical systems

- Pumped water power station (PVE)
- Flywheel (FESS)
- Energy storage with compressed air (CAES)d) Chemické systémy

Compared to battery systems or pumping stations, they still have very little efficiency, but as the only technology they have a prerequisite for storing TWh energy for very long periods of time.

- Hydrogen (H2)
- Synthetic Natural Gas (SNG) - Power to Gas (P2G)

e) Heat systems

3.1.2 Bioenergy – biogas

3.1.2.1 Biogas in the Czech Republic

The development of the biogas industry in the Czech Republic can be dated from 2005, following the adoption of Act No. 180/2005 Coll., On support for the production of electricity from renewable sources, which stipulated the purchase prices and green bonuses for the production of RES electricity.

The intensive development of the BPS plant was halted in 2014, with the reduction or disappearance of both investment and operating support. At present, 554 BPS (with a total installed capacity of 360 MW) is in operation in the Czech Republic.

The representation of individual species of BPS is shown in the following table:

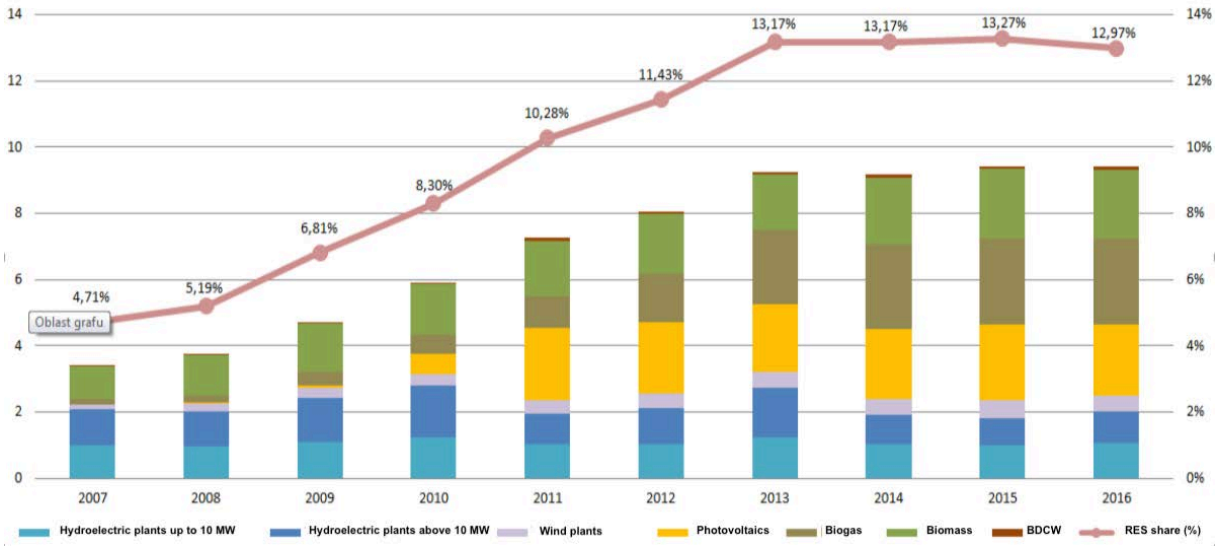
Table 1 Representation of individual types of BPS in the Czech Republic (source: CZBA, 2016)

Type of biogas plant	Number of installations	Installed power (MW)
Agricultural	382	312 MW
WWT	98	22 MW
Communal waste	56	19 MW
Industrial	18	7 MW
Total	554	360 MW

In terms of use and technology, combined electricity and heat production is dominated, which will probably not change significantly, as the current scheme only supports small installations. Follow-up biogas processing and use technologies are not significantly expanded and biomethane is not pushed into the grid.

The production of biogas electricity accounts for 25% of the total RES production in the Czech Republic, which is also evident from the following graph:

Graph 1: Graph of development of electricity generation from RES and its share in domestic consumption in the period 2007 - 2016 (source: ERÚ, 2017)



Gross electricity and heat production from biogas in the period 2003 - 2015 is presented in the following table:

Table 2 Gross electricity production from biogas in the period 2003 - 2015 (MWh), (source: ERÚ, 2016)

Year	Biogas total	Communal WWTP	Industrial WWTP	Biogas plants	Landfill gas
2003	107 856	54 119	1 691	6 519	45 527
2004	138 793	63 591	2 001	7 130	66 071
2005	160 858	71 447	2 869	8 243	78 299
2006	175 839	67 662	2 070	19 211	86 896
2007	215 223	70 865	3 292	43 248	97 818
2008	266 868	74 036	4 016	91 580	97 236
2009	441 267	79 191	3 616	262 622	95 838
2010	634 662	85 002	4 971	447 424	97 265
2011	928 715	88 278	6 924	724 802	108 711
2012	1 467 684	85 902	8 517	1 264 273	108 992
2013	2 293 593	90 206	8 800	2 083 546	111 041
2014	2 583 363	91 091	17 419	2 363 319	111 534
2015	2 614 065	86 878	16 537	2 411 843	98 808

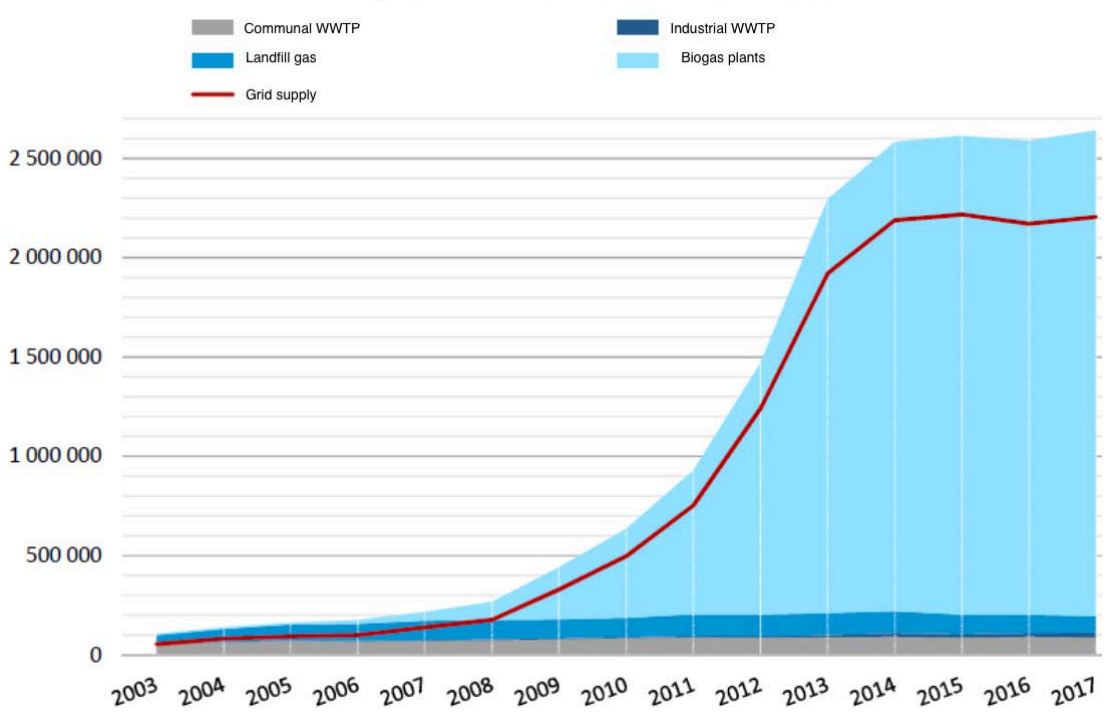
Table 3 Biogas Heat Production in the Period 2003 - 2015 (GJ), (Source: ERÚ, 2016)

Year	Biogas total	Communal WWTP	Industrial WWTP	Biogas plants	Landfill gas
2003	780 639	552 416	81 167	57 324	89 732
2004	968 452	722 850	74 478	67 553	103 572
2005	1 009 902	791 463	60 077	67 223	91 140
2006	918 511	709 546	50 501	80 270	78 193
2007	1 009 211	695 569	53 486	167 776	92 390
2008	1 065 390	690 252	63 232	226 452	86 454
2009	1 210 969	678 140	58 679	397 616	76 534
2010	1 610 361	714 710	62 779	752 400	80 473
2011	1 910 636	745 856	71 484	1 015 821	77 474
2012	2 452 894	681 942	105 033	1 580 765	85 154
2013	3 571 077	664 633	85 055	2 724 264	97 125
2014	3 964 548	598 878	148 007	3 129 431	88 232
2015	4 158 488	617 838	218 717	3 239 708	82 226

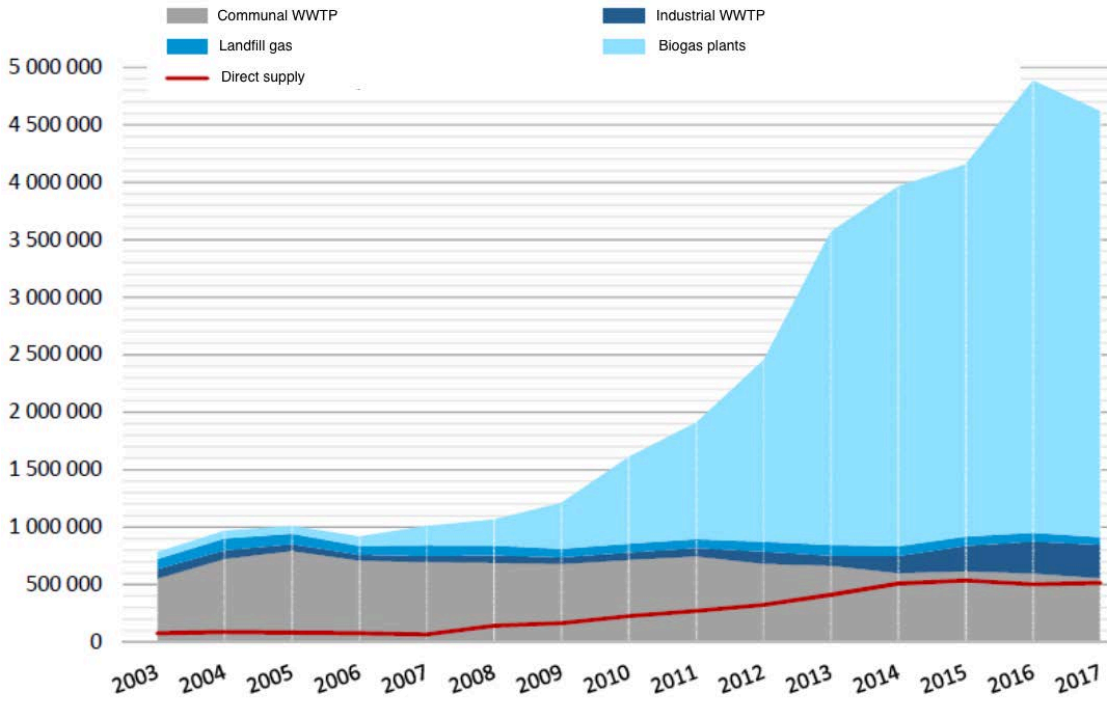
The total utilized energy from biogas in 2015 was 25 663 773 GJ, representing 1.5% of total energy consumption and 14% of total RES share of energy consumed.

Development of electricity and heat supply from biogas plants

Graph 2: Development of electricity production from biogas in the Czech Republic (MWh), (Source: MPO - OZE ČR, 2017)



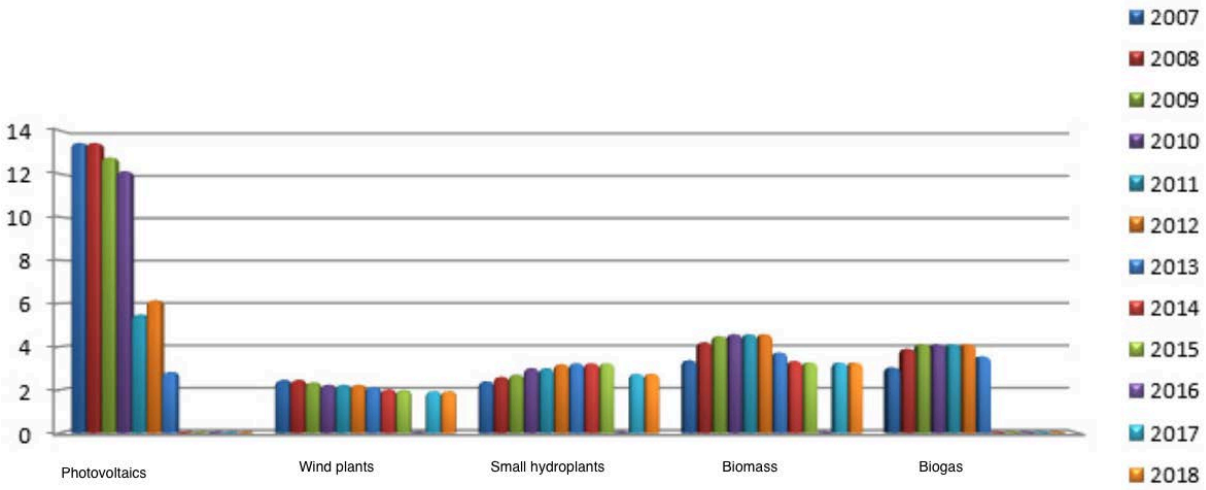
Graph 3: Development of heat production from biogas in the Czech Republic (MWh), (Source: MPO - OZE ČR, 2017)



From 2006 to 2008, the heat supplied exceeded the electricity supply. With the increasing number of biogas plants, however, the supplied electricity increased significantly faster. In 2014, the amount of electricity supplied was more than double compared to thermal, although almost all new plants use cogeneration units.

Interesting is the comparison of purchase prices of individual sources of RES:

Graph 4: Comparison of the purchase prices of electricity from renewable sources in the Czech Republic in CZK / kWh (Source: MPO - SEK ČR, 2014)



Since early 2014 support for new biogas plants has been suspended, redemption (reference) prices only apply to so-called residual projects, ie projects with authorization issued before October 1, 2013.

Since 2009, the purchase price and the green bonus have been divided by the categorization of BPS pursuant to Decree No. 482/2005 Coll., Which specifies the types, ways of utilization and parameters of biomass in support of the production of electricity from biomass (replaced by Decree No. 477/2012 , On Specifying Types and Parameters of Supported Renewable Sources for Electricity, Heat or Biomethane, and on the Establishment and Storage of Documents, as amended). The AF1 category includes BPSs that process only energy crops and also if the energy crops and their parts account for more than half of the weight of the input raw material in the biogas plant in the given calendar month and the rest of the feedstock is the biomass set out in group no. (2) (a) to (g). All other biomass, including their mixtures, is included in the AF2 category.

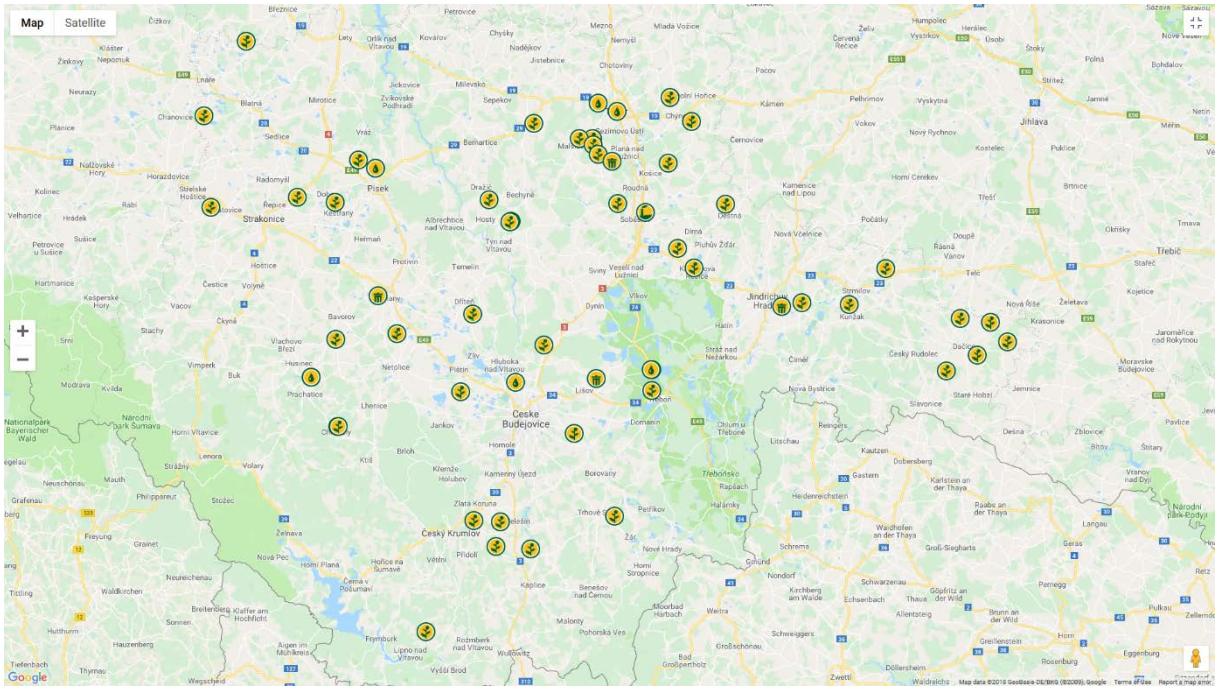
In 2012, the purchase price and the green bonus were divided by the fulfillment of the condition of production and the effective use of the produced heat at least 10% of the produced electricity for which the aid is applied in the given calendar year.

In 2013, the redemption price and the green bonus were split based on the installed BPS power, set at 550 kW.

3.1.2.2 Biogas in South Bohemia region

In 2018 there are 60 biogas plants with a total electric power (EV) of 33,652 MW and a thermal capacity (TV) of 33,054 MW in the territory of the South Bohemian Region.

Image 3 – Biogas production sites in South Bohemia region (Czech Biogas Association)



We can divide these devices by type:

- 5x use of biogas at the landfill (EV: 616 kW, TV: 685 kW)
- 7x use of biogas in sewage treatment plants (EV: 958 kW, TV: 610 kW)
- 48x biogas stations - all BPSs are of agricultural type (EV: 32,078 kW, TV: 31,759 kW)

Further distribution of the device is based on electrical power and thermal output (number of devices)

Output (kW)	Electricity power	Heat power
up to 200 kW	14 plants	11 plants
201 kW – 550 kW	16 plants	14 plants
551 - 1000 kW	26 plants	28 plants
above 1001 kW	4 plants	7 plants

Surface areas

- Extent of agricultural land fund [ha] 425 688.0
- Extent of arable land [ha] 251 063.6
- The area of grassland [ha] 171 843.2

Available biomass potential in the area of interest

- Slurry energy [GJ] 5 079 787.43
- Crop energy [GJ] 13 269 443.57
- Fast growing trees [GJ] 10 594.41

Consumption of biomass in the area of interest

- Biogas plants [GJ] 1 874 822.40
- Heat Power plants [GJ] 3 332 396.02
- Heat Plants [GJ] 528 825.60
- Central Heat Supply [GJ] 221.04

Current legislation

The main act is currently Act No. 165/2012 Coll., On Supported Energy Sources and on Amendments to Certain Acts, as amended. With the adoption of the law, the support of new installations was halted and, as a result, no BPS had been put into operation since January 2014, although almost 400 projects were running, and a network of BPS suppliers and service providers is being developed in the Czech Republic.

Strategic documents include the National Action Plan for Renewable Energy Sources (MIT), the Biomass Action Plan for the Czech Republic for 2012-2020, the Strategic Research Agenda and the Action Implementation Plan (CZBA). At national or regional level there is no industry development plan, only recommendations on the use of biogas technology to reduce greenhouse gas emissions in agriculture.

Support options for RES (biogas plants)

- OPPIK Renewable Energy Program
- OPPIK Low-carbon Technology Program
- OP Environment Priority axis 3: Waste and material flows, ecological burdens and risks
- Rural Development Program - Measure 6 Development of agricultural holdings and entrepreneurial activity

Biogas research and development

Biogas research is relatively extensive and long-term. Over the past 10 years, more than 50 research and development projects have been implemented.

From the point of view of focus it is possible to mention, for example, the following framework topics:

- Improving the efficiency of processes and technologies
- development of container technologies - BPSs themselves, methanisation units
- improvement of digestate properties (thickening, etc.), utilization of residues from BPS
- the upgrading, purification and treatment of biogas for biomethane
- testing of new input substrates, cultivation of energy crops
- use of waste heat from BPS
- strategic use of BPS - energy security and self-sufficiency

For biogas, biomethane, or gasification and other uses of biomass for energy purposes, roofing and R & DI is a major organization of CzBA.

The Czech Biogas Association (CzBA) is a technology platform - a roofing professional institution for biogas production and use in the Czech Republic. The members of the association are scientists, experts, designers, suppliers, operators and service companies of biogas stations. CzBA is a founding member of the European Biogas Association and has extensive experience with international projects. CzBA is a South Bohemian organization with national competence. Currently, it has prepared a new Implementation Action Plan for a Strategy for the Development of R & D & I in the Czech Republic.

3.1.3 Energy financing and business models

The possibilities of financing energy-saving measures and renewable energy sources in the Czech Republic are mainly national and international grant programs.

For households, programs such as „Green Savings Programme“ and „Boilers subsidies“ are important at both national and regional level. They enable to finance the insulation of buildings and the exchange of old technologies for more efficient use of renewable sources.

Other national programs (EFEKT, Operational Program Enterprise and Innovation for Competitiveness) and international (COSME, Horizon2020, Innovfin) are intended for companies mostly.

There are several banking institutions in the Czech Republic which provide comprehensive services related to energy investment / efficiency projects including preparation, financing and project implementation. Products are available for households, SME's and large businesses.

For households, the largest electric power supplier have prepared products in the form of a comprehensive photovoltaic system, including subsidy management.

The EPC and ESCO markets are quite emerging with around 1000 buildings being rennovated since 1994. There are several recognized consultancy and implementation companies on the market offering services in this area.

Several investment funds are also focused on investments renewable energy projects.

On the contrary there is a huge future potential for equity based financing and crowdfunding in the field of RES investments or EE measures especially on local / regional level within community based initiatives.

3.2 Business-as-usual scenario

As for the sector of biogas and partly also for other RES which are related to the self-sufficient building topic, the main drivers are those that determine demand and supply. These are three factors:

1) Operating subsidies (public support) for renewable energy
2) Price of power electricity sold by biogas station
3) Demand for biomethane and its price

For example, demand for heat and its price, demand for services in waste management (bio-waste for their energy use), or the potential for savings in the operation of biogas stations may be other, less significant, driving forces.

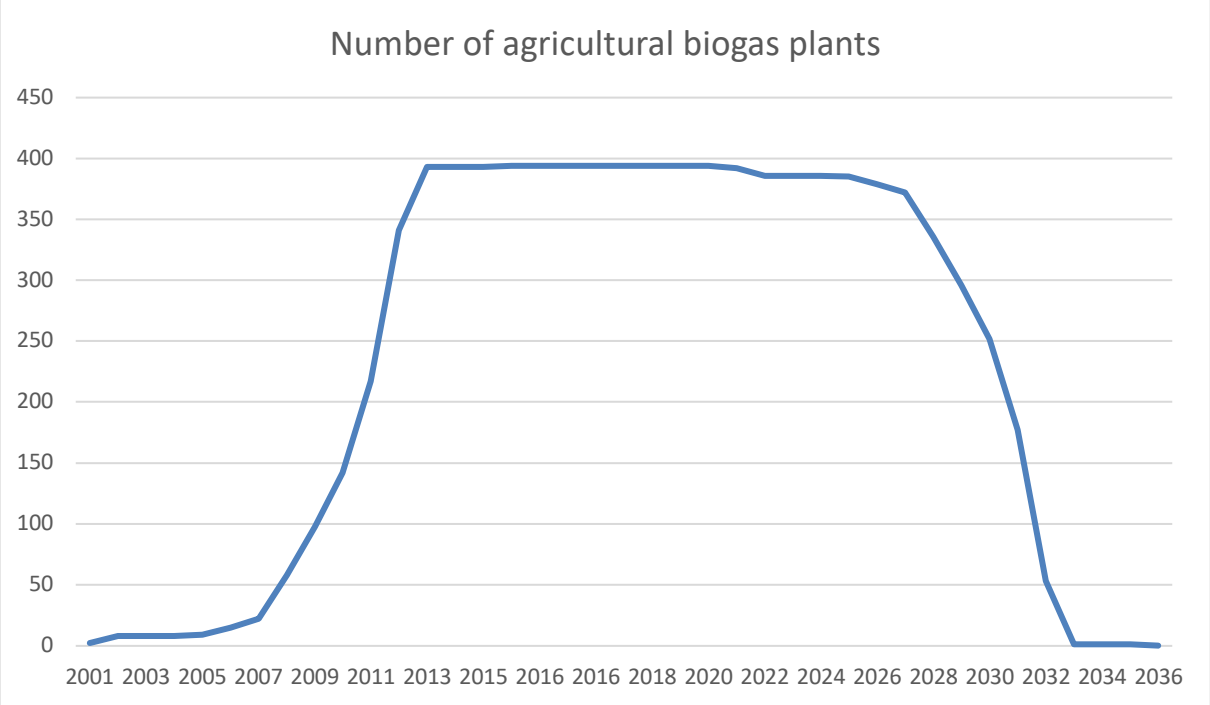
Operating subsidies for the production of biogas electricity is currently a major driving force. Without it, virtually all biogas plants would end up with production within a few weeks, as they would not even cover the operating costs, let alone the repayments of the loans that were used to build the biogas plant. Most plants has guaranteed support of CZK 4,120 / MWh of electricity. (in the form of mandatory redemption, in the case of a green bonus the amounts vary according to the actual value of the electricity). Only some have a lower subsidy, either due to the use of partially or fully biowaste, or due to launch in the last year of support (2013).

Installations put into operation after 31.12.2013 are not eligible for any operating support, except for the support of high-efficiency cogeneration and / or small installations. However, these are only individual cases.

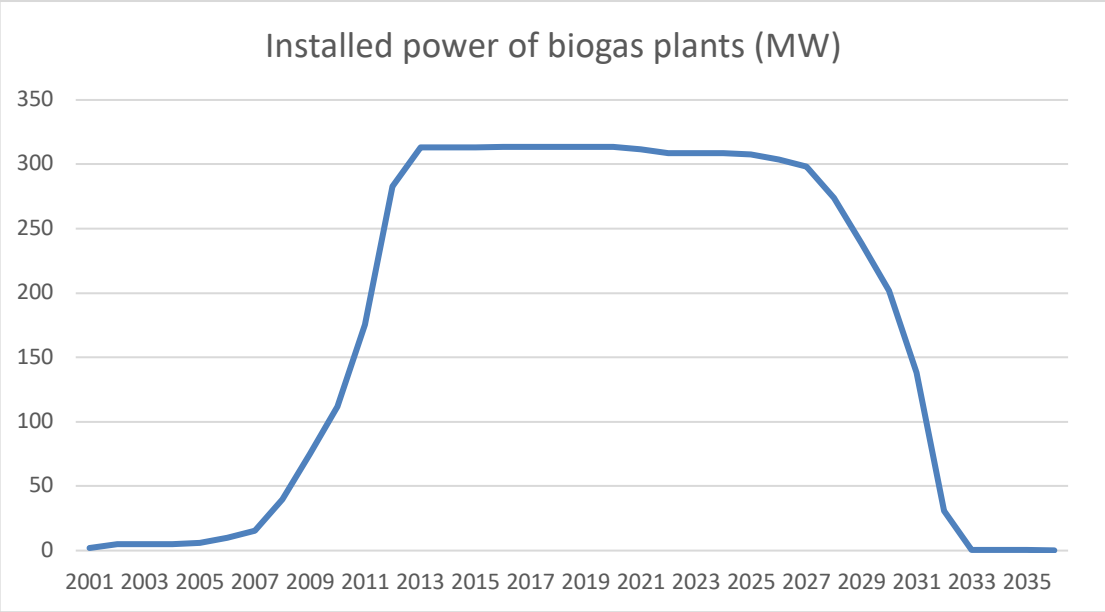
The entitlement to the aid is determined by the provision of Section 7, paragraph 3 of Act No. 165/2012 Coll. Renewable electricity generating plants have the right to support electricity over the useful life of the power plant set out in the implementing legal regulation, which is Decree No. 296/2015 Coll. on the technical and economic parameters for fixing the purchase prices for the production of electricity and green heat bonuses and on the determination of the lifetime of electricity generating and heat generating plants from renewable energy sources (Decree on technical and economic parameters) of 26 October 2015 in the current version, for older sources put into service before 2012) a decree in the version valid at the date of commissioning. Generally, biogas plants are 20 years old.

Twenty years after launch of operations, individual plants will therefore become eligible for operating subsidy. For some, it may be earlier if 10 years of control prove that a simple return on investment has not reached the statutory 15-year period or that there has been a cumulation of subsidies. However, we will not anticipate this situation, and we expect that there will be no changes, ie the current price of power electricity (CZK 900 / MWh), no operating aid, no interest in biomethane or significantly cheaper (or with a negative price) inputs to BPS. Then, the number of BPSs and their installed capacity would begin to decrease rapidly around 2027 and the last BPS would end in 2033.

Graph 4: Chart of the development of the number of agricultural plants in the Czech Republic in the years 2001-2016, with the prediction of termination of their activities in the years 2017 - 2036



Graph 5: Graph of the development of the installed output of agricultural BPS in the Czech Republic in 2001 - 2016, with a prediction of termination of their activities in the years 2017 - 2036



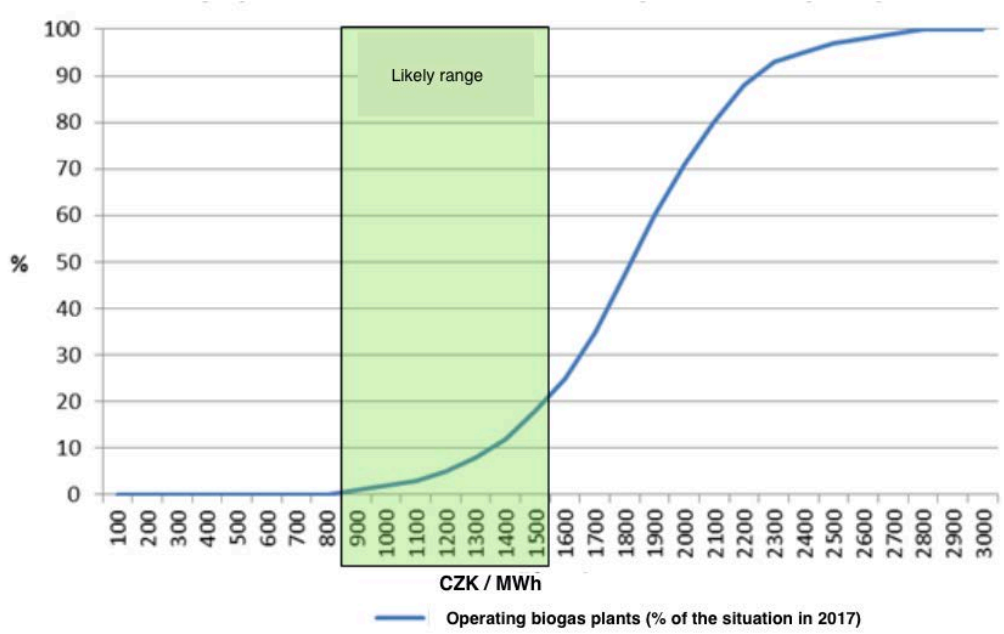
However, the above assumption is very pessimistic and it is to be expected that the major driving forces will develop. In the case of public support, there will clearly be a significant reduction compared to the current state. In any case, it will be necessary to meet the required production quota in renewable energy sources, respectively. share of RES in consumption. However, this is likely to be partially met even without subsidies (especially for domestic photovoltaics and biomass boilers). For the remaining part of the required

energy from RES, public tenders will most likely be announced. The contract (and hence the support) then gets those resources that offer the lowest price.

For biogas plants, of course, the handicap of organic matter that has its cost, or if it is delivered with a negative price (bio-waste), has its additional costs exceeding that negative price. Unlike other RES, biogas needs to count on high operating costs. Operational support will be based on the level of competitive resources, especially water and wind, or even solar power plants. At the same time, it will be possible, at least in the period up to 2040, to expect that there will be no significant renewal or construction of new RES. Current support for these power plants ranges from 1,930 - 2,700 crowns for feed-in tariffs and 1,430 - 2,100 CZK with green bonuses (in the case of solar power plants, support is suspended from 2014). It is to be expected that the tenderers will go 30-50% below their requirements (with paid loans and relatively low-cost technologies). Therefore, even the under-threshold (most expensive available resources) will probably not exceed CZK 1,500 / MWh in the case of future promotion tenders.

Unless other conditions change, it means that most of the biogas plant is decommissioned as shown in the following chart.

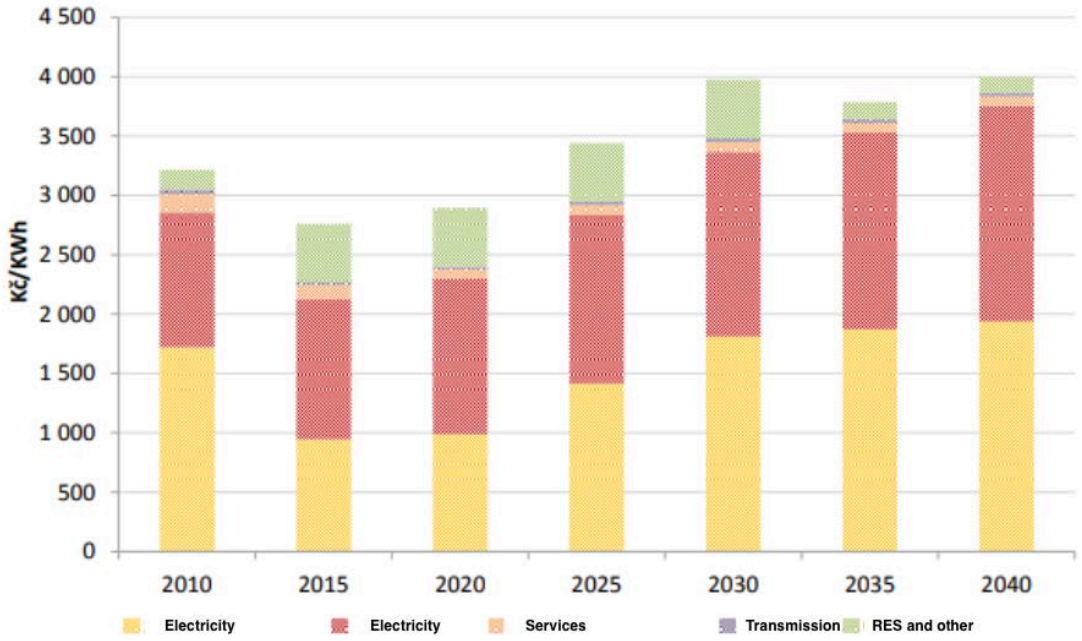
Graph 6: Operating biogas stations depending on operational support



For the last few years, electricity prices have moved within the European space at a level that is insufficient for the development of conventional energy sources, let alone renewable energy sources. Major financial flows have shifted to energy services and subsidies.

The situation of the year 2008, when the electricity oscillated around 2000 CZK / MWh, is really a past, and although the trend in the last two years has reversed, it can not be expected that at any time during the 2020 - 2040 electricity period, electricity will sharply exceed 1500 CZK / MWh in today's prices). However, it depends on how renewable energy is going to be financed. The State Energy Concept envisages electricity prices between 2030 and 2040 between 1500-2000 CZK / MWh.

Graph 7: Structure and evolution of the final electricity price at nn level (source: MPO - SEK ČR, 2014)



In addition, the State Energy Concept (updated by the Government of the Czech Republic on May 18, 2015) states that the issue of emission allowance price developments is a key factor in the commodity component, with the optimized scenario anticipating the backloading effect and the introduction of a stabilization reserve after 2020. An important factor is the rate of elimination of market distortions, which currently exert a great deal of pressure on the fall in the price of electricity. It will manifest at least half of this decade. Subsequent long-term moderate growth is due to both more expensive emission allowances and the need to restore the manufacturing portfolio across Europe. This will be reflected either directly in the price of electricity (ie the commodity component) or in the implementation of different forms of capacity mechanisms within the EU. Slow growth in prices may thus be accompanied by short-term (multi-year) deviations following the extent of market distortions and irregular sectoral developments in relation to the stability of legislation and the wider regulatory framework.

The price of electricity can play a crucial role for the survival and further development of biogas stations after 2030. If it actually reaches the level of around CZK 2,000 / MWh, it is possible to imagine at least a part of the biogas stations that will be able without further support in the type of increase type operational efficiency, maximum heat utilization and, in particular, cheaper substrate substitutions to exist without additional public funds.

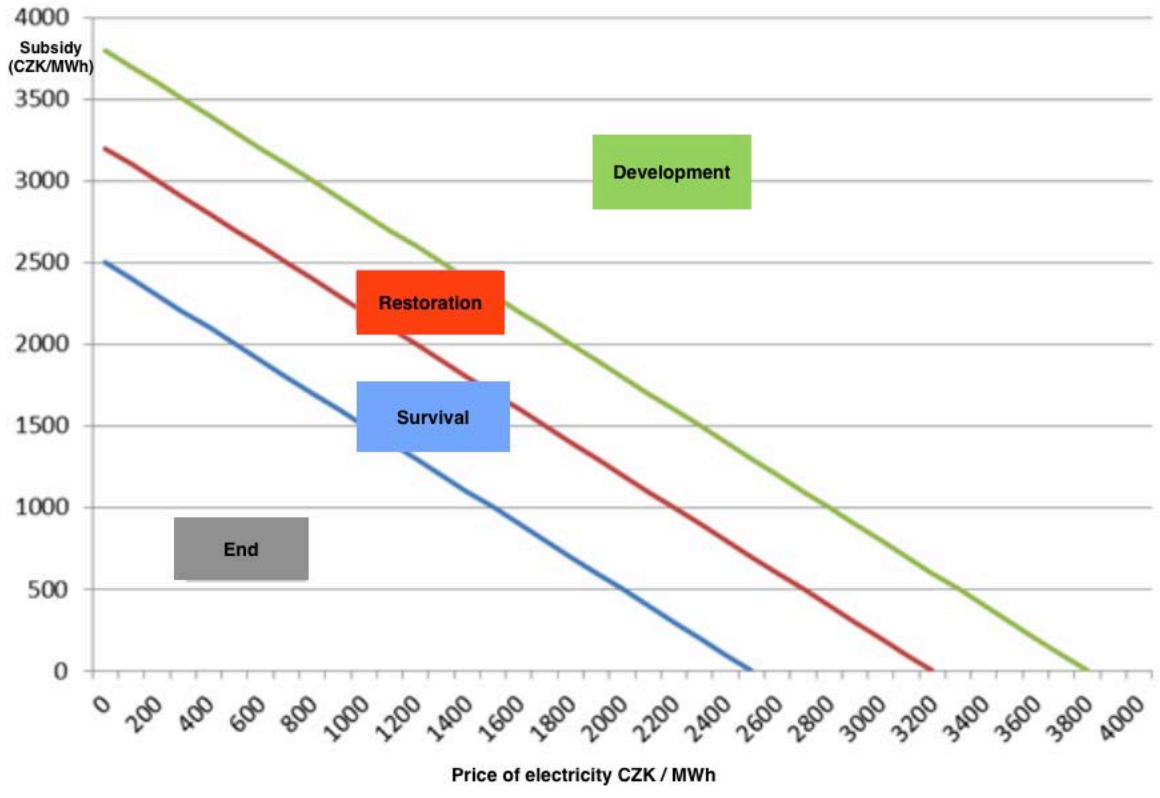
Operating costs for the production of 1 000 m^3 of biogas, containing about 6 MWh of energy, are now subject to substrate and technology between 8.000 – 12.000 CZK. With 40% efficiency of biogas production (and approximately the same heat production efficiency) we get usable 2.4 MWh of electricity and 9 GJ of heat. After deduction of additional revenues from the sale of heat (CZK 3,000), we will obtain operating costs converted to MWh produced in the amount of CZK 2,000-3,750. Following optimization in the substrate domain, some BPSs could reach a price of power electricity that would cover operating costs, even under CZK 2,000 / MWh. This, of course, guarantees only the survival of BPS and not its renewal or the construction of new BPSs.

If we combine the influence of the two main driving forces, namely public operating subsidies and power electricity prices, it is possible to define four scenario areas:

1. END (no additional investment, no research and development, maintenance of only residual, economically efficient production and technology, phasing out),
2. SURVIVAL (no additional investments, only possible enhancements and modifications to make better use of existing potential, very limited R & D, maintenance of economically efficient production and technology, gradual gradual extinction or minimal renewal),
3. RESTORATION (limited additional investment, exceptionally new projects, R & D only to the extent required - on demand, technology renewal and maintenance of the industry in the current range, with a gradual change of structure),
4. DEVELOPMENT (additional investments, new plans and installations, development of use, boom of research, development and innovation, growth of the field and synergy with other energy and environmental social themes).

These can be taken as basic scenarios, which are further developed in combination with other conditions that form the framework of future trends. The below-mentioned boundaries (in today's prices) between the baseline scenarios are indicative and may vary according to the level of technological progress, savings and cost savings of BPS.

Graph 8: Baseline Scenarios Depending on Operating Subsidies and Power Price



In the South Bohemian Region, the expected development is identical to the nationwide forecasts. Unless there is a radical change in the assumptions, the existence of biogas

stations is at risk. For landfills and WWTPs, there will be a more gradual decline, as they will run the device to the end of its useful life.

Demand for biomethane

Biogas stations are unique technologies of RES because they are able to accumulate energy in the form of biogas, where it is possible to postpone the production of energy from it both in time and distance. In principle, biomethan is the most prominent form of biogas plant output, and it is very versatile in terms of energy and fuels. It can be used for:

- electricity and heat generation or transport (alternatively to CNG) anywhere as natural gas (after injection into the distribution system);
- local fuel supply as an alternative to CNG (ie CBG),
- chemical production - like methane.

Biomethane is dominantly produced and used in Germany (185 biomethane stations), Great Britain (80), Sweden (61). Demand for biomethane is also reflected in other countries. An example may be Switzerland. Here the demand for households (!) After biomethane is much higher than domestic production, which is reflected in the increasing import of biomethane into Switzerland.

Similar trends can be expected in other countries, including the Czech Republic. Here, however, the "green" gas is started to be explored. Operational support for biomethane has never been implemented in the Czech Republic and therefore there is no relevant supply of this commodity.

Furthermore, biomethan is an alternative to complying with the EU fuel cell fuel quotas set by the European Parliament and Council Directive 2009/28 / EC on the promotion of the use of energy from renewable sources. In the Community, the mandatory minimum target to be achieved by all Member States by 2020 is a 10% share of biofuels in total petrol and diesel consumption in transport. If biomethane is used, for example, already in the preparation of bioethanol, its climatic influence can be added to the bioethanol parameters, and less it can be added to petrol.

For trade in biomethane, both within the Czech Republic and throughout Europe, it is necessary to set up an independent register to verify the origin of biomethane, especially the raw materials from which it is produced, and to deal in real time with trades. Meanwhile, a European register was created - in Ghent, Belgium, on September 28, 2016, nine members from eight European countries agreed to establish the ERGaR association aisbl. The main mission of the new association is to create an independent, transparent and credible biomaterial mass balance sheet.

For local supply of the transport fuel market, such a combination of technologies is essential to allow for the cheapest possible cleaning and compression of biomethane, including subsequent filling in vehicles. Ideally, this means biogas plants with both cogeneration (using on-site outputs) and a small membrane technology for upgrading biogas currently available on the market in capacities sufficient for a standard filling station.

Biomethane can be used for sale or for own vehicles - a number of farms produce their own food or other products and need to distribute them, on the farms, landfills or water treatment plants with the use of transport and handling equipment (tractors), etc. All CNG technologies can use the cleaned biogas, independent of the methane content, unless it

drops significantly below 90% when it could risk freezing the fuel system at higher frosts (carbon dioxide fading).

The benefit of using methane as a fuel is the low environmental burden when, compared to diesel or gasoline, the production of certain harmful emission components is several percent of the original value.

Biomethane is a very important alternative in thinking about the future of biogas stations, which must move from continuous operation to spinning mode or support services (electricity generation according to the needs of the transmission / distribution network operator) or to the production of biomethane, which also serves as a disposable energy supply.

Biogas plants are currently conceived as a stable source of electricity with continuous production at a seasonal variation of 10-15%. They are also connected to the power system and operated. The only failures are planned repairs of the cogeneration unit (KGJ) or technological parts. For the power grid, however, it is much more interesting when it is possible to regulate the biogas plants' performance at least in some way, so that it can use a resource that can very quickly run down or reduce its power (at the gas power plant level), to cover the peak in electricity consumption or in production collected electricity from photovoltaic and wind power plants. The condition of this theoretical possibility, however, is to associate biogas plants into regulated regional virtual blocks, which will have a unified management and meet all the conditions given by ČEPS, a.s., for a certain type of support services. The minimum size of such a block ranges from 10 MW of controllable output, the optimal would be about 30 MW.

Existing plants are not down to full electricity shutdown regulation for several hours a day. Likewise, part of the electricity production has a capacity with a low power reserve (in the period of maximum biogas development), so it is not possible to process a significant surplus of biogas accumulated during the shutdown.

At the same time, this service is not interested because the biogas plant has a certain amount of operating subsidy and it was difficult for the transmission system operators to handle relatively small resources. Since they are about hundreds of MW together that coal power plants are leaking, and gas resources are relatively expensive, it is possible to expect that both sides' attitudes will change within a decade.

The disadvantage of biogas plant for targeted use in support services is, at present, their low performance and time-limited possibility of regulation. On the other hand, there is a problem with a fast response and a 0-100% power control within the biogas plant virtual block.

It is clear that the further development of these sectors is motivated by the interest of the transmission / distribution system operators, electricity traders and advanced measuring, regulatory and communication technologies.

Demand for heat and its price is like a driving force hard to identify. It will be locally very different and has its significant limits in that biogas plant is mostly in the countryside behind the village. Generally speaking, demand for heat is likely to decrease due to the progressive thermal insulation. On the other hand, its price will grow along with the cost of infrastructure and fuel.

The demand for services in waste management (the supply of bio-waste for their energy use) depends significantly on the further fate of landfills. The Ministry of the Environment

sees development potential in the field of energy recovery of municipal waste. According to the municipal waste management forecast by 2024, an increase in municipal waste energy use is projected to be close to the EU average.

Regarding the application of biomethane and its injection into the public distribution network, the South Bohemian Region is one of the weakest places. There is a predominantly low-pressure and medium-pressure pipeline that can not be forced into larger quantities of biomethane. For South Bohemia it is so promising to use biomethane in transport directly (bioLNG). Only in the area of České Budějovice and Tábor and towards the transit routes (part of Jindřichův Hradec district) is real and the injection of biomethane into the distribution network.

Since the concrete focus of the action plans related to the topic of self-sufficient houses is based on initiation of regional technology platform which has certain formal procedures and specific steps business-as-usual scenario is not really relevant for description.

3.3 Development scenarios

Energy efficiency in households
Action title 1: Establishment of regional technology platform for self-sufficient buildings Objective: The main objective is to establish a regional technology platform for self-sufficient buildings as a basic driver as well as becoming a centre of excellence for deployment of related technologies and thus making self-sufficient buildings as household standard by 2050. Timeline: – Evaluation of the progress with verification of basic challenges and current market potential / focus (September – November 2017) – Institutionalization – forming an appropriate legal entity (December 2017) – Building up the platform (3 stages) – until 2030 – Self-sufficient buildings as household standard by 2050
Action title 2: Elaboration of Strategic Research Agenda Objective: The goal of this measure is to elaborate main strategy documents for the technology platform, namely the Strategic Research Agenda towards goals by 2050. Timeline: – Elaboration of SRA by 2020
Action title 3: Elaboration of Implementation Action Plan and Technology Foresight 2025 - 2050 Objective: The goal of this measure is to elaborate Implementation Action Plan (IAP) and Technology Foresight (TF) for the Technology Platform of Self-sufficient Buildings. Timeline: – Elaboration of Implementation Action Plan by 2022 – Technology Foresight 2025 - 2050 by 2023
Renewable energy / bioenergy
Action title 4: Biogas plants transition to biomethane production sites system Objective: The main objective is to support the gradual transition of existing biogas stations in the region to biomethane production and its use in local and global energy and local transport. Timeline: – The emergence of small upgrading unit for the production of biomethane for local purposes in the South Bohemian region: 1 unit until 2025, 3 units until 2040

- The construction of biomethane station the South Bohemian region: full technical and construction documentation until 2030 and implementation by 2035
- The share of biomethane in the production of biogas stations in the South Bohemia: 50% by 2050

Action title 5: Agriculture biogas plants conversion to waste utilization

Objective:

The main objective is to replace maize as the dominant substrate for biogas production with alternative crops and especially waste.

Timeline:

- Reduction of sowing area of silage maize for biogas production by 15 % until 2028
- Implementation of the projects to support the goal (3 projects by 2028, 5 projects by 2040)

Action title 6: Biogas utilization as regulation and local energy system

Objective:

The main objective is to support the preparation and building of regional energy self-sufficiency and local and supra-regional smart grids based on biogas stations and regional needs.

Timeline:

- Utilization of the regulatory power of biogas stations in the South Bohemian Region (2 MW until 2030, 10 MW until 2040, 25 MW until 2050)
- Local energy network project in JčK (Documentation until 2035, Implementation until 2040)
- Local smart grids project (Documentation until 2045, Implementation until 2050)
- Increasing the degree of local self-sufficiency in the production of renewable energy (by 20 % do 2030, by 50 % do 2050)
- Self-sufficiency in transport (from RES) (10 % do 2050)

Financing and business models

Action title 7: Status quo analysis

Objective:

The main objective is to evaluate and preserve, or efficiently develop, the existing financial instruments and procedures applicable to the implementation of EE and RES projects. From a regional point of view, the development of the network of their providers and instruments for reducing the interest load or the level of private co-financing.

Timeline:

- Introduce at least 1 new tool for financing RES and EE projects by 2025 - regional loans, a crowfunding platform etc.
- Provide low-interest or interest-free loans for the implementation of RES and EE projects by 2030
- Maintain the existing possibilities to support the realization of renewable energy sources and EE (e.g. New Green Savings) by 2030

Action title 8: Alternative financing methods (CrowdFunding)

Objective:

The main objective of this measure is to create a functional electronic application for providing alternative sources of financing for regional energy projects (RES, EE) and its integration into the normal management practices of private and public investors.

Timeline:

- Functional web application for crowdfunding activity in RES and EE by 2025.
- By 2030 – 5 mio. CZK funded via the application in RES/EE projects
- By 2050 – 50 mio. CZK funded via the application in RES/EE projects

Action title 9: Green regional loans

Objective:

Main objective of this Action Plan si to prepare and launch regional loans scheme of offering interest-free regional loans for the implementation of RES and EE projects.

Timeline:

- Launch of a support scheme of interest-free regional loans for the implementation of RES and EE projects by 2025.
- Provision of loans for RES and EE projects in the range of min. CZK 10 million through regional interest-free loans until 2030.
- Provision of loans for RES and EE projects in the range of min. CZK 50 million through regional interest-free loans until 2050.

Action title 10: Subsidy schemes for off-grid and self-sufficient systems

Objective:

The main objective of this measure is to initiate a regional subsidy program to support the implementation of energy self-sufficiency and off-grid systems.

Timeline:

- Launch of a subsidy scheme to support the implementation of energy self-sufficiency and off-grid systems by 2030.
- Funding of off-grid and self-sufficiency projects in the range of min. CZK 10 million through regional subsidy scheme until 2030.
- Funding of off-grid and self-sufficiency projects in the range of min. CZK 30 million through regional subsidy scheme until 2050.

3.4 Milestones

Table 4 Milestones - national level

Action no.	Activity	Partners	Who	When
9,10	Design and implementation of new RES support schemes	MPO, ERÚ	CzBA, Chamber of RES	2019
4,10	Revision and application of the new RES Act	MPO, ERÚ, PSP ČR	CzBA, Chamber of RES, Chamber of Commerce	2021
4,5,6,7	Scenarios modification, probability selection, impact definition	TP Biogas	CzBA, AgEnDA	2023
4,5,6	Biogas plants operators training - Solutions Impact, Technology Changes, New Focus	biogas operators	CzBA	2025
1,2,3, 4,5,6, 8,9,10	Implementation of proposed measures, new business plans	Investors, biogas operators	CzBA, MPO (OP PIK or alternatively PRV	2028
1,2,3,	The emergence of a technology platform for self-sustaining technologies beyond the regional and national levels	CSD and its partners, R&D institutions	CSD	2022
1,2,3,	Linking the Technology Platform to the European Technology Platform	CSD	CSD	2025

Table 5 Milestones - regional level

Action no.	Co	S kým	Kdo	Kdy
9,10	Design and implementation of new RES support schemes on the regional level	South Bohemian Agrarian Chamber, South Bohemian Chamber of Commerce, municipalities, microregions	AgEnDa	2019
4,10	Revision and application of the new RES Act - capacity building for biogas plant operators	South Bohemian Agrarian Chamber, South Bohemian Chamber of Commerce, biogas operators, RERA	AgEnDa, JAIP, CzBA	2021
4,5,6,7	Regional impacts of modified scenarios	CzBA	AgEnDa	2023
4,5,6	Biogas plants operators training - Solutions Impact, Technology Changes, New Focus	Biogas plan operators	CzBA, AgEnDa, local suppliers	2025
1,2,3, 4,5,6, 8,9,10	Implementation of proposed measures, new business plans in South Bohemia	Investors, biogas plant operators	CzBA, AgEnDa, local suppliers	2028
1,2,3	Realization of pilot installations of self-sufficient houses and subsequent dissemination and education	Investors, CSD	AgEnDA	2030

4 Impacts on regional economy

Table 6 Scenarios impact on regional economy

AP	Regional GDP	Employment	Energy safety	R&D, innovations	Rural development	RIS3	Regional Development Plan	Conflicts
1	Benefit: hundreds of millions of CZK at the 10-year horizon	Hundreds of new jobs at the 10-year horizon	Significantly strengthening security and self-sufficiency	Obtaining a technology platform for the region	Support for development - rural involvement. entities, production from local raw materials, target territory of construction	Significantly contributes to fulfillment, new impulses, TP as stakeholder network, intelligent buildings and households, IT	It contributes to the development of the region and creates space for further local business activities	No
2	Benefit: millions of CZK at the 20-year horizon	Neutral	Promoting technologies and practices leading to energy security and self-sufficiency	Strategic R&D framework with an emphasis on the region	Neutral	It greatly contributes to the RIS3 fulfillment and further expansion	It develops the region's potential through R&D	No
3	Benefit: hundreds of millions of CZK at the 20-year horizon	Creation of jobs requiring a high level of qualification	Promoting technologies and practices leading to energy security and self-sufficiency	Developing strategic partnerships, transferring know-how to the region	Support for development through the impact of IAP projects after implementation	It significantly contributes to RIS3 fulfillment	Production support with high added value	No
4	Benefit: hundreds of millions of CZK at the 20-year horizon	Improve / keep tens of jobs	Significantly strengthening security and self-sufficiency	Applied research in the region, R&D partnership and business sector	Biogas plant as essential elements of micro-regions economical stability	Fulfillment - advanced technologies, renewable energy	It contributes to the development of the region and creates space for further local business activities	Partly with the biogas plants strategy as the energy center of the region (nuclear power)
5	Benefit: hundreds of millions of CZK at the 15-year horizon	Improve / keep tens of jobs	Maintaining a level of security and moderately strengthening self-sufficiency	Applied research in the region, R&D partnership and business sector, interdisc. cooperation	Strengthening the rural - urban linkage, increasing economic stability	Fulfillment - Circular Economy, Renewable Energy	It contributes to the development of the region, solves the problem of biowaste	No

6	Benefit: hundreds of millions of CZK at the 20-year horizon	Improve / keep tens of jobs	Significantly strengthening security and self-sufficiency	Applied research in the region, R&D partnership and business sector, interdisc. cooperation, showcase projects	Biogas plant as essential elements of micro-regions economical stability	Fulfillment - advanced technologies, renewable energy, smart grids, intelligent houses	It contributes to the development of the region and creates space for further local business activities	Partly with the strategy of transition to biomethane
7	Benefit: hundreds of millions of CZK at the 15-year horizon	Increased demand for skilled workers	Supporting projects that enhance security and self-sufficiency	Application and innovation by manufacturers - mediated impact	Support for individual or community projects or projects with an impact on regions	Fulfillment - Support regional applications of advanced technologies, SW, IT	Positive influence, increase of the local suppliers, development of the potential of the region	No
8	Benefit: tens of millions of CZK at the 10-year horizon	No major influence	According to the individual focus, limited influence (small projects)	Demonstration and pilot projects, application of interesting ideas	According to the individual focus, limited influence (small projects)	Rather small meaning, but positive - space for new technologies	Neutral, meaning rather socio-economic and relational	No
9	Benefit: tens of millions of CZK at the 10-year horizon	Increased demand for skilled workers	Supporting projects that enhance security and self-sufficiency	Application and innovation by manufacturers - mediated impact	Support for individual or community projects or projects with an impact on regions	Fulfillment - Support regional applications of advanced technologies, SW, IT	Positive influence, increase of the local suppliers, development of the potential of the region	No
10	Benefit: tens of millions of CZK at the 10-year horizon	Create dozens of jobs	Supporting projects that enhance security and self-sufficiency	Application and innovation by manufacturers - mediated impact	Through implemented projects - increasing technological and educational level	Fulfillment - Supporting regional applications of advanced technologies, SW, IT, professional qualifications	It contributes to the development of the region and creates space for further local business activities	No

5 Involvement of stakeholders

Table 7 Recommended techniques and tools of stakeholder engagement for different actions

Action no	Stakeholder engagement technique / tool recommendation
1	Individual meetings (selection) Participation at thematic events PR activities Awards / competitions
2	Workshops Surveys
3	Workshops Surveys
4	Investors / biogas operators forums Specialized webinars Conferences / workshops Study trips / field missions
5	Investors / biogas operators forums Specialized webinars Conferences / workshops Study trips / field missions
6	Investors / biogas operators forums Specialized webinars Conferences / workshops Study trips / field missions
7	Regional Energy Agency re-establishment Workshops
8	Regional energy hub Awareness events (best practise showcase) Trainings
9	Regional energy hub establishment Workshops Trainings
10	Regional energy hub establishment Workshops Trainings Citizen Action Groups

Table 8 Overview of previous communication and meetings related to creation of vision, roadmap and action plans

Date, place	*Participants*	**Content / Results / conclusions**
20.7. 2017, Prague	– Vlastimil Šantín, Ministry of Trade and Business (MPO), Department of Energy – Jaroslav Huďáček, Ministry of Agriculture (MZe), Department of RES – Richard Nikischev, Ministry of Spatial Development (MMR), Regional policy department – Lukáš Minařík, Ministry of Environment (MŽP), Energy and Climate protection department – Jan Weger, The Silva Tarouca Research Institute for Landscape and Ornamental Gardening – Pavel Chotěboř, Ministry of Environment (MŽP), Nature Preservation department – Jan Zaplatílek, Ministry of Trade and Business (MPO), Gas and Liquid Fuels department – Leoš Gál (National Technology Platform for Biofuels) – Jan Matějka (Czech Biogas Association / ECO trend)	The main goal of this event was to discuss integrated initiative focused on energy transition and self-sufficiency. Main results: - received feedback from related ministries on potential approach towards regional visions - introduction of CEESEN at the highest level - decision to extend to other sectors (transport, building)
21.7. 2017, České Budějovice	– Pavel Podruh (Czech Off-Grid House) – Jan Jareš (AgEnDa)	First introduction of CEESEN and goals + invitation to the conference CEE Energy Transition as speaker
5.2. 2018, České Budějovice	– Pavel Podruh (Czech Off-Grid House) – Jakub Hořický (Czech Off-Grid House) – Jan Jareš (AgEnDa) – Jan Matějka (ECO trend)	Formulation of initial steps towards foundation of national technology platform
14.3. 2018, Prague	– Jan Matějka (ECO trend s.r.o.) – Jan Štambaský (European Biogas Association) – Miroslav Kajan (Czech Biogas Association) – Jan Jareš (AgEnDa)	After training session – discussion on formulation of regional vision for biomethane utilization based on technology and policy foresight elaborated by CzBA.

23. - 27.4. 2018, Budapest	– Daniel Brýda (Czech Off-Grid House) – Leoš Gál (National Technology Platform for Biofuels) – Jan Jareš (AgEnDa)	Capacity building and re-drafting the regional vision concept
24.5. 2018, České Budějovice	– Pavel Podruh (Czech Off-Grid House) – Jakub Hořický (Czech Off-Grid House) – Jan Jareš (AgEnDa) – Jan Matějka (ECO trend) – Luboš Nobilis (AgEnDa)	Finalization of the regional vision for 2050 and drafting next steps in roadmapping process + discussion on action plans
14.9. 20128	– Tomáš Cílek (ReRa) – Jan Jareš (AgEnDa)	Presentation of Roadmap and Action Plans (8,9,10) to the CEO of Regional Development Agency of South Bohemia
21.9. 2018, Prague	– Jan Jareš (AgEnDa) – Leoš Gál (CTBP)	Meeting with forerunner L. Gál - role of biofuels in SB Roadmap and Action Plans
26.9. 2018, České Budějovice	– Jan Jareš (AgEnDa) – Michaela Novotná (South Bohemian Innovation Agency)	Presentation of selected AP's and discussion on ways of regional authority's commitment
4. - 5.10. 2018, Třeboň	– Jan Jareš (AgEnDa) – Miroslav Kajan (CzBA) – Jan Štambaský (EBA) – Jan Matějka (ECO trend)	Participation at national biogas conference organized by CzBA, discussion with the biogas experts, oral presentation of the Roadmpa fundaments and Action Plan drafts Participation at the E-FIX (Horizon2020) workshop on the topic of energy financing

19.10. 2018, Prague	– Jan Jareš (AgEnDa) – Daniel Brýda (CSD)	Meeting with forerunner D. Brýda - discussion over the final version of related Action Plans
18.2. 2019, Prague	– around 60 participants (see attendance list)	Final presentation and discussion of 3 biogas related Action Plans.

6 Endorsement by implementers and political decision-makers

Formal endorsement of this Roadmap will be shared by more institution based on various character and focus of individual Actions (Action Plans). Therefore, the Action Plans themselves will be submitted for endorsement by relevant bodies. However, PANEL 2050 has been recognized as one of the priority projects by Regional Innovation Committee at their official meeting on the 12.12. 2018.

Table 9 Following institutions provided their letter of commitment for the Action Plans

Energy efficiency in households	
Action Plan 1: Establishment of regional technology platform for self-sufficient buildings	Czech Sustainable House as guarantor of the measure
Action Plan 2: Elaboration of Strategic Research Agenda	Czech Sustainable House as guarantor of the measure
Action Plan 3: Elaboration of Implementation Action Plan and Technology Foresight 2025 - 2050	Czech Sustainable House as guarantor of the measure
Renewable energy / bioenergy	
Action Plan 4: Biogas plants transition to biomethane production sites system	Czech Biogas Association European Biogas Association
Action Plan 5: Agriculture biogas plants conversion to waste utilization	Czech Biogas Association European Biogas Association
Action Plan 6: Biogas utilization as regulation and local energy system	Czech Biogas Association European Biogas Association
Financing and business models	

Action Plan 7: Status quo analysis	Development Agency of South Bohemia
Action Plan 8: Alternative financing methods (CrowdFunding)	Development Agency of South Bohemia South Bohemian Innovation Agency
Action Plan 9: Green regional loans	South Bohemian Technology Park South Bohemian Innovation Agency
Action Plan 10: Subsidy schemes for off-grid and self-sufficient systems	South Bohemian Technology Park Czech Sustainable House

7 Financing

Funding is essential for the Roadmap and Action Plans implementation. All measures within the Roadmap and Action Plans have been proposed with the respect to their feasibility in terms of funding availability.

For the Action Plans 1 - 3 related to the establishment and development of the Regional technology platform there are available sources of funding (EU operational program on national level) once the main documents (Strategic Research Agenda and Implementation Action Plan) are elaborated.

Other three Action Plans 4 - 6 which are related specifically to biogas sector the main presumption is that the sector will follow technological, environmental and security trends in the EU. Biomethane utilization, waste utilization and local energy systems are clearly defined in all related long-term strategies therefore EU funding will be in some form available as well.

Last four Action Plans focusing on financing energy projects and measures are directly connected with the improvement of profitability, energy savings and following the regional trends in financing energy projects along with the trend of decentralization of the subsidy schemes.

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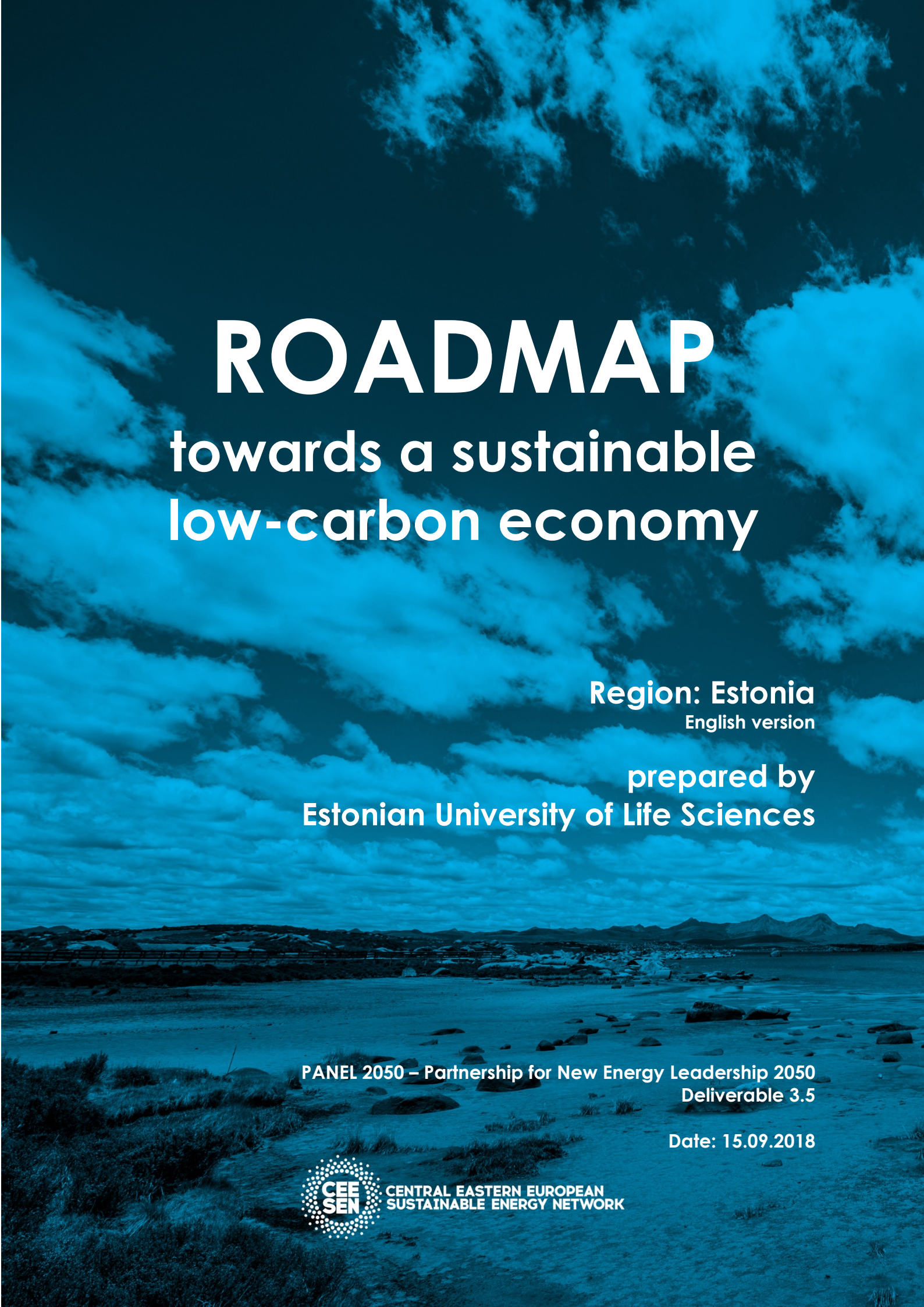


ROADMAP

towards a sustainable low-carbon economy

Region: Estonia
English version

prepared by
Estonian University of Life Sciences

PANEL 2050 – Partnership for New Energy Leadership 2050
Deliverable 3.5

Date: 15.09.2018

CEE SEN CENTRAL EASTERN EUROPEAN SUSTAINABLE ENERGY NETWORK

About Panel 2050 project

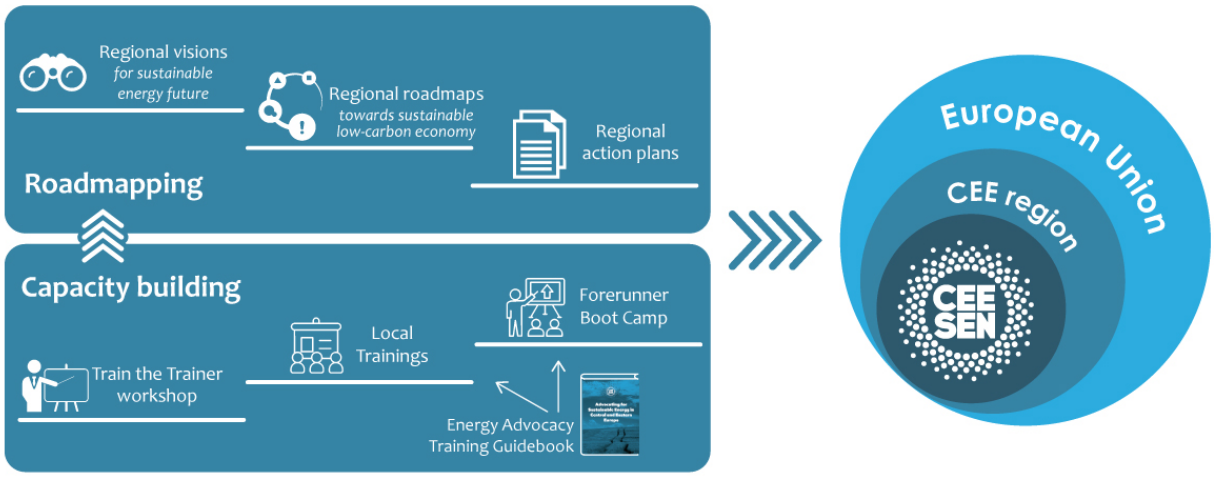
The PANEL 2050 project has the aim to create durable and replicable sustainable energy networks at local (municipality/community) level, where relevant local stakeholders collaborate for the creation of a local energy visions, strategies and action plans. The aim of these networks is to contribute to and actively work for the transition towards low carbon communities in 2050. The PANEL 2050 partnership will provide support for the creation of first successful local energy networks in the CEE countries. In the course of the project, organisations from 10 CEE countries will collaborate on creating regional energy strategies and action plans. For more information visit https://ceesen.org/panel2050/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696173.

The PANEL model

PANEL model is a comprehensive approach for implementing local long-term energy management, supported by the community. PANEL model consists of seven main elements: Stakeholder Engagement, Training Program, Guidebook, Long-term Energy Visions/Roadmaps/Action Plans and Central and Eastern European Sustainable Energy Network CEESEN. These elements are developed by PANEL 2050 project to support the CEE communities on achieving their sustainability goals.

PANEL2050 model for Central and Eastern Europe Sustainable Energy Network CEESEN



The Roadmap at hand is the output of the long-term energy planning process with the aim of plotting the regional transition towards a low-carbon community.

Attached to the Roadmap 10 specific Action Plans were developed, representing the first steps on this road toward low-carbon community by 2050.

Roadmapping process Estonia

Stage 1 — **Baseline – Regional Energy Profile *Estonia***

Stage 2 — **Vision**

In 2050, Estonia will be a region that relies 100% on local renewable energy sources.

Stage 3 — **Roadmap**

Stage 4

— Wind energy for large scale electricity generation —

Action 1
Development of wind parks

Action 2
Increasing awareness and acceptance towards RES of the population

— Solar energy for distributed electricity generation

Action 3
Solar roofs for municipally owned buildings

Action 4
Applied research and development of distributed energy generation

— Biomass based efficient heat and electricity generation

Action 5
Transition of the last fossil fuel based boilers to biomass based boilers

Action 6
Transition of knowledge between local and international parties

— Energy efficiency in buildings and transport —

Action 7
Knowledge building of local municipalities

Action 8
Mitigating the usage of personal cars

— General priorities —

Action 9
Energy transition curriculum

Action 10
Overview of existing RE generation facilities

Action 11
Legislation for energy cooperatives

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1 Introduction

Current roadmap for transition to sustainable low-carbon economy looks at our development possibilities until 2050, with a bit more detailed focus until 2030. The region under development is the Republic of Estonia as a whole. The reason for this is that most stakeholders in the energy sector are active on the national level, also Estonian population is only 1.3 million out of which nearly 500 000 people live in the capital and its surroundings. When developing low carbon economy, special focus is on energy as in 2018 90% of our CO_2 emissions comes from energy sector, which mostly is based on oil-shale.

Estonian vision for 2050 is to produce **at least 80%** of heat and **at least 100%** of electricity from renewable energy sources. This will be achieved by promoting higher renewable energy production that will be supported by the improvement of energy efficiency throughout all sectors.

The aims for 2050:

- Most of energy in Estonia is produced from renewable sources.
- Using modern and green technologies, Estonia will become an energy exporter in the established Northern-Baltic energy market.
- Estonia's energy independence and securing it in the long term will become the main foundation of economic welfare of the country's residents, competitiveness of local businesses and Estonia's energy security.
- The most economically feasible option for consumers is the combination of renewable energy based and energy-efficient solutions.
- Free and reliable information about energy saving and sustainable consumption possibilities is easily accessible and known to consumers.
- Estonia has enough renewable energy and energy efficiency specialists with necessary skills and knowledge. Everybody has access to the required courses and there are active advisory services available on fuel and energy savings measuring and management.
- Estonia has filled all obligations from relevant EU directives. National statistics and other data enable us to monitor the effect of planned measures on fuel and energy consumption and assess the related environmental impact.
- The consumers and energy producers are interested in carrying out energy saving projects. The necessary funding opportunities are sufficient, including for small-scale projects.

The document views two scenarios. One that is the continuation of the current course in the region's energy sector and the other is a total transition to renewable energy. It is highly likely that the reality in the year 2030 will be somewhere between those two scenarios.

2 Priority areas

The priority areas for achieving previously mentioned vision are selected based on recent research and the analysis of existing sustainable energy policies. The selection is also dependent on Estonian climatic and geographical conditions. The renewable energy production increase will need a support of suitable energy storage to balance the

stochasticy of renewable energy production and increased energy efficiency to slow down the need for more energy, especially when it comes to heating.

The Estonian vision for the energy sector focuses on increasing renewable energy production with the support of energy efficiency measures. The priority areas are the following:

- **Wind energy** (on-shore and offshore) for electricity production has the biggest potential in Estonia, when it comes to electricity production. With the global price reduction of wind energy technologies in the recent years, it is the most profitable development sector when it comes to renewable electricity generation.
  Wind was selected as priority area for Estonia because of the excellent wind resource in the country. Especially offshore wind has great potential and the most critical aspect is to get the consensus of the local population on developing offshore wind parks. The total power of perspective offshore wind parks is in the range of 3000 MW which is around twice the peak electricity consumption power of Estonia.
- **Biomass energy** (mainly for heating and electricity cogeneration). Biomass is a priority area, because about 53% of Estonia is covered with forest and about ¾ of Estonian municipalities' forest coverage is more that 40%. This makes wood chips and pellets a suitable local resource for heating and co-generation of heat and electricity, while also creating jobs on the local level.
- **Solar energy** has potential in Estonia mainly as distributed electricity production, because the country has a low population density and a large share of the distribution grid is underutilized. The climatic conditions (long, dark winters) are not most favourable for solar energy production, but the average solar irradiation level in Estonia ~1000 kWh/m^2/year combined with the cool summers result in a similar energy production potential to northern Germany.
- **Energy efficiency measures,** including the retrofitting of housing and public buildings, have the highest potential in reducing energy consumption, because 60% of the Estonian population lives in apartment buildings. Renovation activities would be activated the mostly by efficiency awareness raising actions on consumer level. Energy efficiency measures include also the promotion of more efficient transport than personal cars, because the Estonian private car stock is one of the oldest in Europe. The low population density causes also a need for an efficient transport system.

3 Actions and development scenarios

The business as usual scenario in Estonia will be oil-shale based as the current infrastructure is built up based on this and currently 85% of our electricity is still produced like this. The demand of electricity and heat will be supplied by oil-shale, as it is supported by the infrastructure that does not require large-scale investments and development. This also guarantees our nations strategical energy independence.

The second scenario is TE100 scenario which focuses on complete transition to renewable energy based on wind and solar energy production and improvement of the energy efficiency of housing stock. We do not look at hydro-, wave, and nuclear energy as Estonia is not suitable for developing those in economically feasible way.

When describing the scenarios we focus on:

- **CO_2 emissions per kWh electricity produced**. Currently the emission equivalent of electricity from oil-shale is 1100 g/kWh which is one of the highest in the world. With the implementation of the TE100 scenario the direct emission of electricity production will be nearly zero and Estonia would stop the emission of 15 million tons of CO_2 per year as of 2030.
- **Investment costs**. The investments needed to transition fully to renewable energy by 2030 is 3887 million euros.
- **Change in employment**. Currently the oil-shale industry employs 6400 persons which has all been concentrated in North-East Estonia. Transition to complete renewable energy would create ca 14 000 jobs all over Estonia in the energy sector.
- **GDP increase**. Our calculations show that the transition to complete renewable energy production will increase Estonia's GDP approximately 2.2% per year (ca 500 million euros) in 2020-2030.
- **Foreign trade balance**. Our calculations show that first we can expect a decrease in energy export. At the same time fuel import will also decrease. In 2030 Estonia needs to import 604 million euros worth of fuels less.

3.1 Status of R&D, innovations and technology

Energy related R&D is represented in three main Estonian universities - Tallinn University of Technology, Tartu University and Estonian University of Life Sciences. Due to sufficient available resource and long history, R&D activities in the field of oil shale are of remarkable quality. Nevertheless aspects of environmental impact of energy production are widely addressed focusing both new developments and reconstruction of existing production units, paying special attention to emission control, incl carbon capture and storage technologies and taking steps towards near-zero level.

The high level of R&D in material science (PV, smart films, energy storage) is clearly described by two centres of excellence (on PV awarded to Tallinn University of Technology and on energy storage awarded to Tartu University). The third centre of excellence has been awarded to Tallinn University of Technology on knowledge based building. The expertise in this field explains high participation in the topics linked to energy efficiency in Horizon 2020.

As more than 60% of Estonian inhabitants are connected to district heating, the whole value chain is covered with national R&D - fuel production and logistics, development of smart solutions for combined and flexible heat (and electricity) production, controlled transmission and efficient consumption. Fuel production has raised numerous R&D topics on biomass and renewable fuels technologies. Transmission and distribution grid operators are in close cooperation with universities and are actively participating in smart grid initiatives and cross-border cooperation in Horizon 2020.

Recent changes and developments have brought along new topics, such as electromobility and electric vehicles as a component in the energy supply chain, smart energy solutions (street lighting) for urban areas, distributed energy supply solutions, smart use of waste heating/cooling energy etc. Estonian researchers, SMEs and industrial enterprises have been highly valued partners since FP5. Compared to average success rate of 12% in EU, Estonian energy related participants have reached success rate of more than 13% in Horizon 2020 with the outcome of about 15 M€ contribution of EU research money into Estonian energy R&D.

3.2 Business-as-usual scenario (BAU)

Business as usual – Estonia will be energy independent, relying on oil-shale (currently 85% of electricity is generated from oil-shale), while also exporting a significant share of its electricity production (around 33%). The prolonging of this scenario has the potential to generate increasingly bad publicity for Estonia on the international scene as it is one of highest polluting energy production options.

The oil-shale industry relies heavily on already existing infrastructure and thus does not need major improvements for grid development. Electricity and heat demand will be supplied basing mainly on oil-shale, pairing it with moderate oil-shale technology development. Estonian government has created clear energy security criteria for our electricity sector and support oil-shale energy production through various mechanisms.

3.3 Development scenario – TE100 transition to 100% renewable energy

Rapid increase of renewable energy production (TE100) – different political and financial instruments enable Estonia to increase the production of electricity from wind, biomass and solar energy.

In the renewable energy scenario we have set a target for each year for all the renewable energy sources. Each year a certain share of domestic heat and electricity consumption should be covered by suitable renewable source. The state will forbid the use of non-renewable sources in energy sector, except peat and waste. The CHPs have to operate under good efficiency rule. There will be no subsidies and oil-shale price is value-based. In the case of value-based oil-shale price it is most sensible to invest in transition to other fuels.

For heat production and balancing of base load biomass is used (mainly wood and agricultural energy crops and waste). Electricity production will mostly be based on wind energy.

The scenario is characterized by diverse and distributed energy production that is based on local resources. This will ensure the energy security of the nation. The feasibility of the TE100 scenario is supported by the fact that the decrease of renewable energy technology prices has been more rapid than even the most optimistic prognosis have predicted and the cost of CO_2 emission allowances have increased, which makes fossil fuels even more expensive to use.

The production profile of renewables will be competitive and Estonia can increase its income from emission trading as our own emissions decrease. During the building and operating new renewable energy stations more jobs will be created all over Estonia. Estonia will be renewable energy competence centre and will increase our energy and knowledge export thus increasing the economic value and our citizens buying power.

The planned actions to fulfil current roadmap and planned vision are following:

Priority area: Wind Energy

Action title 1: Development of wind parks in Estonia (Estonian Wind Power Association)
Objective: The objective is to produce 49.8% of electricity from offshore wind parks and 12.4% from onshore wind parks by 2030 (TE100 scenario). The nominal capacity of onshore wind parks will increase from current 200 MW to 360 MW by 2025. Offshore wind parks will reach the capacity of 600 MW by 2025.
Timeline: The first offshore wind park planning and investment confirmation will happen in 2020. The designing, building and put into operation will happen by 2025.
Additional onshore wind parks will be planned by 2020, and built and put into operation by 2025.
Action: Solving the resistance of local communities. Efficient engagement and informing.

Action title 2: Increase of knowhow about renewable energy production among locals. (TREA)
Objective: The objective is to reduce public opposition to renewable energy development, especially with wind parks. This will be monitored by questionnaires which we expect to show that 80% of the population supports the wider development of renewable energy in 2025.
Timeline: Continuous educating and informing of public on renewable energy technologies will take place. By 2025 the society has understood that the development of renewable energy has positive not negative effect on the living environment.
Actions: Regular events will take place, like annual renewable energy conference "The research and use of renewable energy sources", Green forum Rohevik, and Mooste energy conference. There will be active sectoral organisations like Estonian Renewable energy Association, Estonian Wind Power Association, Estonian PV Association, Estonian Biofuels Association, Estonian Biogas Association, NORDEN, Tartu Science Park, TREA and Centre of Renewable energy of EMÜ.
These organisations will keep the discussion alive in the media. In addition they will be responsible for organising thematic events, conferences, trainings, and publishing mainstream as well as scientific articles.

Priority area: Solar Energy

Action title 3: Installing Solar panels to Tallinn municipal buildings (Tallinn Energy Agency)
Objective: The objective is to show public example in developing distributed renewable energy.
Timeline: By 2021 the investment decisions have been made. By 2023 the solar panels have been built and connected to the electricity grid as production units.
Timeline: Getting confirmation from the city government and relevant organisations.
Action: Gaining political support for the idea. Planning necessary funds in the city budget.

Action title 4: Research and development activities on micro- and distributed production of renewable energy (EMÜ)
Objective: The objective is to simplify the use of new renewable energy technologies for the consumer.
Timeline: In 2020 additional competitive renewable energy storage options will come to the market. Production and storage close to the consumer will widen the usability of distributed renewable energy production. Efficient use of innovative solutions will require new automation and business models by 2025.
Action: Carrying out applied research and development mainstream guidelines.

Priority area: Biomass
Action title 5: Transfer of fossil fuel boilers to local alternative energy sources and adaptation of legislation to motivate investment and enable energy companies to enter the market. (Estonian Biofuel Association, Estonian Power and Heat Association) **Objective:** The objective is to completely eliminate fossil fuels, including natural gas, in local heating systems, replacing it with indigenous renewable energy sources such as wood, straw, reeds, etc., or heat pumps. **Timeline:** By 2030, fossil fuels for the production of heat for the supply of heat for social objects and housing sector will no longer be used in Estonia. There are at least 5 energy cooperatives in Estonia. **Action:** Grants + legislation or taxes that encourage the transition to renewable energy sources. Distribution of knowledge, training, capacity building of market participants on energy efficiency, energy saving and renewables. **Action title 6: Developing local and international technology transfer in renewable energy (EMÜ, MKM)** **Objective:** The objective is to strengthen EMU position in the lead of technology transfer and increase the technology transfer from the university to the society. **Timeline:** Joining Task37 workgroup of the International Energy Agency in 2019. Developing cooperation with renewable energy organisations. By 2025 EMU has 40 active cooperation contracts with the local and international sectoral entrepreneurs. **Action:** Participation in the International Energy Agency work and development of cooperation between the university and local entrepreneurs.
Priority area: Energy Efficiency
Action title 7: Increasing the awareness of local governments about improving energy efficiency in public buildings (improvement of local government energy management skills) (TREA) **Objective:** Improve the number of energy efficient public buildings. **Timeline:** From 2019 all new public buildings have to be near zero energy buildings. Currently the old public buildings do not have to follow any regulations, their renovation is done for economic reasons. After 2030 the local governments will compete over the chance to have new renewable energy production units in their territory. **Action:** Creating local government sustainable energy action plans. Improving the competence of public energy specialists. **Action title 8: Reduction of private car use in the cities (Tartu City Government)** **Objective:** The objective is to reduce the amount of fine particles and the noise in the urban environment. Improve the movement habits of citizens of Tartu by creating a bicycle and walking routes' network throughout the city. Development of convenient and environmentally friendly public transportation system, including creating of rental bicycle network. **Timeline:** In 2025 the citizens of Tartu will use shared transport more than private cars on their own. By 2025 Tartu city is completely covered with a network of well-connected bicycle and walking routes and user-friendly rental bicycle network has been implemented. **Action:** Development of bicycle and walking routes infrastructure, limiting the use of private cars in the city centre.

General priorities
Action title 9. National energy transition training program (Skytte Institute, University of Tartu) **Objective:** Training public officers and energy specialists **Timeline:** By 2021 the Skytte institute has developed in-service training course which focuses on different aspects of energy transition and helps to strategically plan and carry out transition to low carbon economy. By 2025 there are at least 150 graduates of the course. **Action:** Developing the in-service training program on energy transition. **Action title 10. Increasing the energy management capacity of local level administration (EMÜ and ETEK)** **Objective:** Creating a geographical up-to-date overview of renewable energy production units. **Timeline:** Annual update of the visual material with new additional data. **Action:** Creation of visual material showing current renewable energy production units in all categories to be used for research, development, increase of public knowledge and as an analytical material to improve the political decision-making. **Action title 11. Creating supportive environment for developing community energy production units. (TREA)** **Objective**: The objective is to determine suitable community energy models for Estonia, based on practical models and expert knowledge. Create a co-operation platform for people interested in developing community energy production units and to give motivation and basis for the creating of community energy units. Promote IT solutions' use in community energy development. **Timeline:** By 2025 there will be at least 10 community energy organisations in Estonia. **Action:** Workshops, seminars, trainings to different stakeholders, consultation to potential community energy initiatives and policy makers.

The projected effect of aforementioned actions to achieve TE100 scenario will be a decrease in heat consumption (Figure 1). The electricity production will transfer from mainly oil-shale to a diverse renewable energy based production (Figure 2).

The heat production has been reduced from current 13.5 TWh/year to 11.9 TWh/year by 2030 which is 12% less than in 2018. The savings will be achieved my large-scale renovation of housing stock. However, our calculations show that the energy efficient renovation will increase the electricity consumption due to change in technologies and due to increase of welfare of our citizens.

The main replacement for oil-shale energy will be combination of off-shore wind parks that is supported by the pump-hydro-accumulation station to help balance the stochasticy of wind and solar energy.

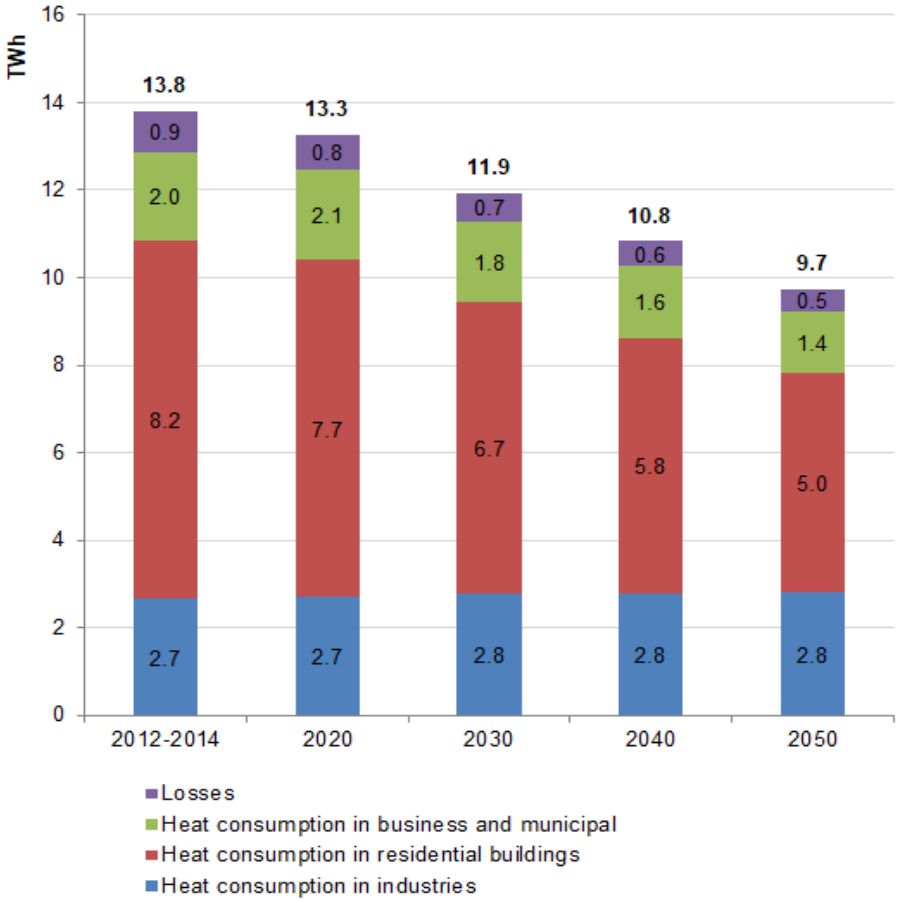


Figure 1. Vision for heat consumption in Estonia in the case of renovations of buildings.

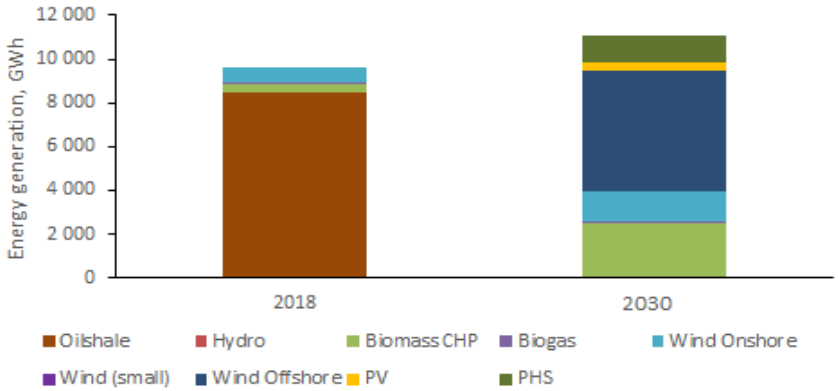
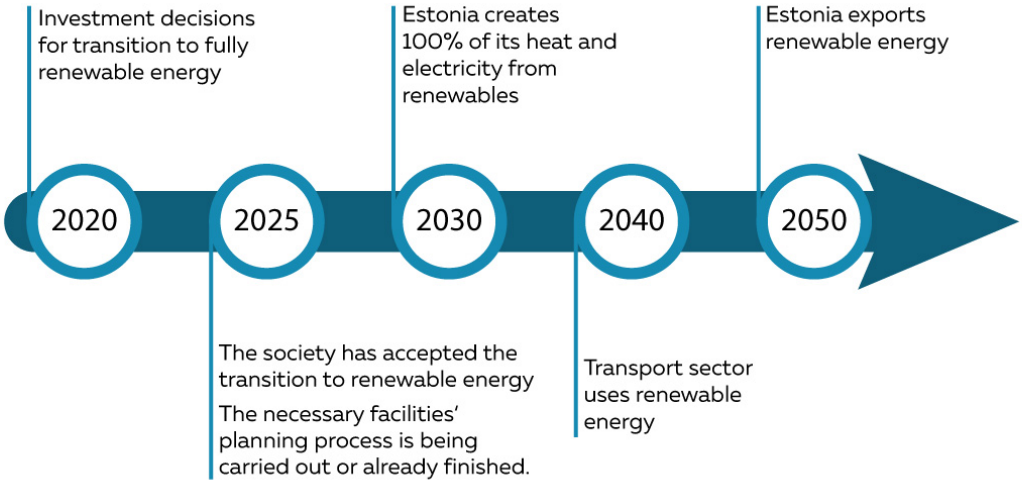


Figure 2. Electricity production in Estonia in 2018 and according to the 100% Renewable Energy scenario in 2030.

3.4 Milestones



The milestones for fully renewable energy based economy are per five years in the nearest future and per ten years after 2030. The Milestones are seen as follows:

A. In 2020 the government and the energy sector has decided on most of the large scale investment needs to transfer fully to renewable energy
B. By 2025 Estonian society has accepted the need for full transition to renewable energy and the planning process for building most facilities' needed is efficiently being carried out.
C. In 2030 Estonia has reached 100% of renewables' share in heat and electricity production
D. By 2040 Estonia is using mostly renewable energy also in transport sector.
E. By 2050 Estonia is able to export renewable energy to the EU unified energy market.

4 Impacts on regional economy

In 2018 85% of Estonian electricity production is still based on oil-shale and about third of our electricity is exported. It is expected that with the transition to fully renewable energy the export of energy will decrease which will have negative effect on the national economy. The electricity export is expected to recover by 2050 at the latest, being based fully on renewables.

North-East Estonia's economy is mostly based on oil-shale mining and valorisation (energy, oil and chemical industry). This makes the region very sensitive to global market price fluctuations of fossil fuels. The economic structure will change due to transition away from oil-shale industry. In addition about third of the employees in the oil-shale industry are people close to the retirement so it is expected that they will leave the job market with the decrease of the oil-shale industry.

TE100 scenario predicts 14 000 new jobs to be created all over Estonia by 2030. These jobs would be mostly away from regional centres thus helping the regional development and employment in rural areas. Transitioning fully to renewables would decrease our sensitivity to global fossil fuel prices and would increase the effect of regional (Nordpool Spot) electricity price effect on our economy. Estonian energy independence, which is evaluated as very high by the World Energy Council, would temporarily decrease during the transition process. Complete energy independence is regained with the full transition to renewable energy.

Local universities have necessary capacity and competence to school and re-train necessary specialists to meet the changing situation in the job market.

Taking into account the local energy production and energy efficiency improvement plans then following the TE100 scenario would improve and speed up the fulfilment of both local as well as national ENMAK plan. In addition current vision and roadmap help to strengthen the implementation of smart specialisation strategy.

5 Involvement of stakeholders

Within the PANEL2050 project we have created a network of stakeholders. We have mapped out more than 30 key stakeholder groups whose input is necessary for the visioning and roadmapping process and who would be with key importance in preparing and carrying out the action plans for fulfilling the roadmap.

Some of them are new contacts however most of them are already long-term partners. As the Centre of Renewable Energy our cooperation network covers different structural units and workgroups within the university, University of Tartu and its different units, and other various research organisations all over Estonia. We have involved our partners in various workshops and trainings carried out within PANEL2050 project which has given us an important input to current roadmap and vision preparation.

For mapping the activities and preparing the vision and roadmap we engaged following stakeholders: Estonian Renewable Energy Association, which brings together most largest renewable energy producers; Estonian Wind Energy Association, which brings together 24 Estonian biggest wind energy producers; Estonian Solar Energy Association, which comprises of 12 largest solar energy producers and grid operators; Estonian Biofuels Associations, which brings together more than 30 biofuel expert organisations and biofuel producers and distributors.

Within the project we had regular meetings with all the stakeholder groups. The core group was formed of organisations most interested to give their input to our activities. In addition we had regular meetings and workshops with Tartu City government and Tallinn Energy Agency.

Current roadmap has been prepared mostly by previously mentioned regular meetings.

Main engagement actions have been:

- Coordination meetings of the core working group
    - Took place regularly (every week)

    - Went through and discussed about international and national energy policies
    - Planned and coordinated the vision, roadmap and action plan development
- Thematic workshops
    - Involved additional experts
    - Were carried out regularly (1-3 times a month) based on the topics that needed input
    - The topics were more specific – challenges, strategies and necessary actions to be taken
- Meeting of energy group regulars' table
    - More unofficial environment
    - Took place regularly (once a month)
    - Involved stakeholders discussed their opinions, thoughts and recommendations regarding energy sector development

The most challenging part will be further engagement of current and additional stakeholders to carry out the activities planned within current roadmap.

Following table presents necessary engagement methods for all the planned activities within current roadmap:

Action number	**Action name**	**Recommended engagement strategies**
Action 1	Development of wind parks in Estonia	Thematic workshops Regular meeting of energy groups – regulars' table Coordination meetings of the working group
Action 2	Increase of knowhow about renewable energy production among locals	Citizen action groups / DIY groups Thematic workshops Regular meeting of energy groups – regulars' table Coordination meetings of the working group
Action 3	Installing Solar panels to Tallinn municipal buildings	Field trip and study visits Thematic workshops Coordination meetings of the working group
Action 4	Research and development activities on micro- and distributed production of renewable energy	Awards and competitions Field trip and study visits Thematic workshops Regular meeting of energy groups – regulars' table Coordination meetings of the working group

Action 5	Transfer of fossil fuel boilers to local alternative energy sources and adaptation of legislation to motivate investment and enable energy companies to enter the market	Field trip and study visits Thematic workshops Coordination meetings of the working group
Action 6	Developing local and international technology transfer in renewable energy	Field trip and study visits Thematic workshops Regular meeting of energy groups – regulars' table Coordination meetings of the working group
Action 7	Increasing the awareness of local governments about improving energy efficiency in public buildings	Field trip and study visits Thematic workshops Regular meeting of energy groups – regulars' table Coordination meetings of the working group
Action 8	Reduction of private car use in the cities	Citizen action groups / DIY groups Awards and competitions Field trip and study visits Thematic workshops Regular meeting of energy groups – regulars' table Coordination meetings of the working group
Action 9	National energy transition training program	Thematic workshops Coordination meetings of the working group
Action 10	Increasing the energy management capacity of local level administration	Field trip and study visits Thematic workshops Regular meeting of energy groups – regulars' table Coordination meetings of the working group
Action 11	Creating supportive environment for developing community energy production units	Field trip and study visits Thematic workshops Coordination meetings of the working group

6 Endorsement by implementers and political decision-makers

The roadmapping team met with all the representatives of the organisations responsible for implementing the action plans. Most of them have been involved throughout all the project activities.

When putting together the vision, roadmap and action plans we met with several representatives of national renewable energy sectoral associations and due to their interests being well represented in current roadmap they are very interested to support carrying out the activities and promote them further. In addition we have gained valuable input form Ministry of Economic and Communication Affairs, Tartu City government and Tallinn Energy Agency.

The main challenge will be keeping all the current stakeholders interested and bring new stakeholders on board as needed to carry out the action plans as efficiently as possible.

7 Impact to National Regulations

Current roadmap and action plans will enable fulfilment of following policies and speed up their implementation:

- National Development Plan of the Energy Sector until 2030
- Estonian Research and Development and Innovation Strategy 2014-2020 "Knowledge-based Estonia" that determines Estonian smart specialisation areas.
- Estonian low carbon strategy "General Principles of Climate Policy until 2050"
- The national strategy on climate change adaptation „Climate Change Adaptation Development Plan until 2030"
- Climate change adaptation strategy and measures for thematic fields of natural environment and bioeconomy
- Estonian Climate Adaptation Strategy for Infrastructure and Energy
- Estonian Renewable energy Association's development strategy "Renewable Energy 100"
- Tallinn Smart building strategy
- Tartu City development plan which aims to reduce its ecological footprint through the more environmentally responsible behaviour of its citizens as well as the use of renewable energy and modern technology.

Current vision and roadmap is in line with following policies, including accompanying regulations:

- National Development Plan of the Energy Sector until 2030
- Climate Change Adaptation Development Plan until 2030
- Action plan for mitigating and adapting to climate change in Agricultural sector
- National plan "Estonia 2030+

- Estonian low carbon strategy, named "General Principles of Climate Policy until 2050"

In addition, current roadmap supports the implementation of public development plan "Renewable energy 100% - transition towards clean energy" prepared by Estonian Renewable Energy Association.

The national targets set by the EU legislation that the current vision and roadmap will help to fulfil (set by EU Framework for Climate and Energy, renewable energy directive 2009/28/EC, and energy efficiency directive 2012/27/EU):

- 27% of final energy consumption is produced from renewables.
- Primary energy consumption is reduced by 27%
- GHG emissions are reduced by 40% (vs. 1990)
- CO2-eq emissions from ETS sectors are reduced by 43% vs. 2005 (12.6 Mt CO2-eq /y)
- CO2-eq emissions from non-ETS are reduced by 30% vs. 2005 (5.67 Mt CO2-eq /y)
- In 2030, domestic primary energy consumption is 10% lower than in 2012
- Energy intensity of Estonian economy decreases from current 5.6 MWh/1,000 €$_{GDP2012}$ to 2 MWh/1,000 €$_{GDP2012}$

The national targets current roadmap helps to fulfil (set by NDPES2030):

- Fuel and electricity markets operate in a free, unsubsidised and open manner;
- Electricity generation capacity in Estonia is sufficient when the N-1-1 criterion is satisfied (for generation equipment);
- Electricity generated from renewable sources accounts for 50% of domestic final electricity consumption and new generation equipment for renewable electricity is built under the conditions of an open electricity market without additional domestic subsidies;
- The share of the largest supply source in Estonia's gas market does not exceed 70%;
- The share of the largest gas seller in Estonia's gas market does not exceed 32%;
- District heating systems have been preserved in areas where they are sustainable and capable of providing consumers with reasonably priced energy solutions in line with environmental requirements;
- 80% of heat generated in Estonia is generated from renewable sources; the importance of local energy sources for heat generation is increased through the use of peat. The target will be met mainly through market mechanisms;

- The System Average Interruption Duration Index (SAIDI) in the distribution grid does not exceed 90 minutes per consumption point and this level is achieved without additional burden on consumer tariffs;

- Renovation efforts have improved the energy efficiency of buildings (40% of small residential buildings have energy efficiency class C or D, 50% of apartment buildings have class C, 20% of non-residential buildings have class C);

- New buildings have an energy performance indicator, which conforms to the requirement for nearly zero-energy buildings;

- 37% of the total net area of the buildings used by the central government is located in buildings that satisfy at least the minimum energy efficiency requirements enforced in 2013;

- Fuel consumption of vehicles in 2030 does not exceed the level of year 2012 (8.3 TWh).

8 Financing

The main funding of the roadmap activities will be through the own budgets of participating organisations. Most of those budgets are based on different national (mainly KIK and Kredex) and international projects (INTERREG, Life+, Horizon 2020, and other structural funds).

The main national support schemes, which will be useful for current roadmap activities, are:

- Local heating solutions instead of district heating (KIK)
- Biogas-based public transport development (KIK)
- Renovating apartment buildings to become more energy efficient (Kredex)
- Compiling regional heating development plan (Kredex)

Most of the national funding comes from European Cohesion Fund and Regional Development Fund as well as national emission taxes and CO_2 emission allowances sale.

However it should be noted that currently the funding post 2020 is still unclear so it is crucial for all our stakeholders to participate in the national level decision making process to ensure the continuation of funding for necessary actions.

9 Roadmap Team

For mapping the activities and preparing the vision and roadmap we engaged following stakeholders: Estonian Renewable Energy Association, which brings together most largest renewable energy producers; Estonian Wind Energy Association, which brings together 24 Estonian biggest wind energy producers; Estonian Solar Energy Association, which comprises of 12 largest solar energy producers and grid operators; Estonian Biofuels Associations, which brings together more than 30 biofuel expert organisations and biofuel producers and distributors.

Within the project we had regular meetings with all the stakeholder groups. The core group was formed of organisations most interested to give their input to our activities. In addition we had regular meetings and workshops with Tartu City government and Tallinn Energy Agency.

Contact

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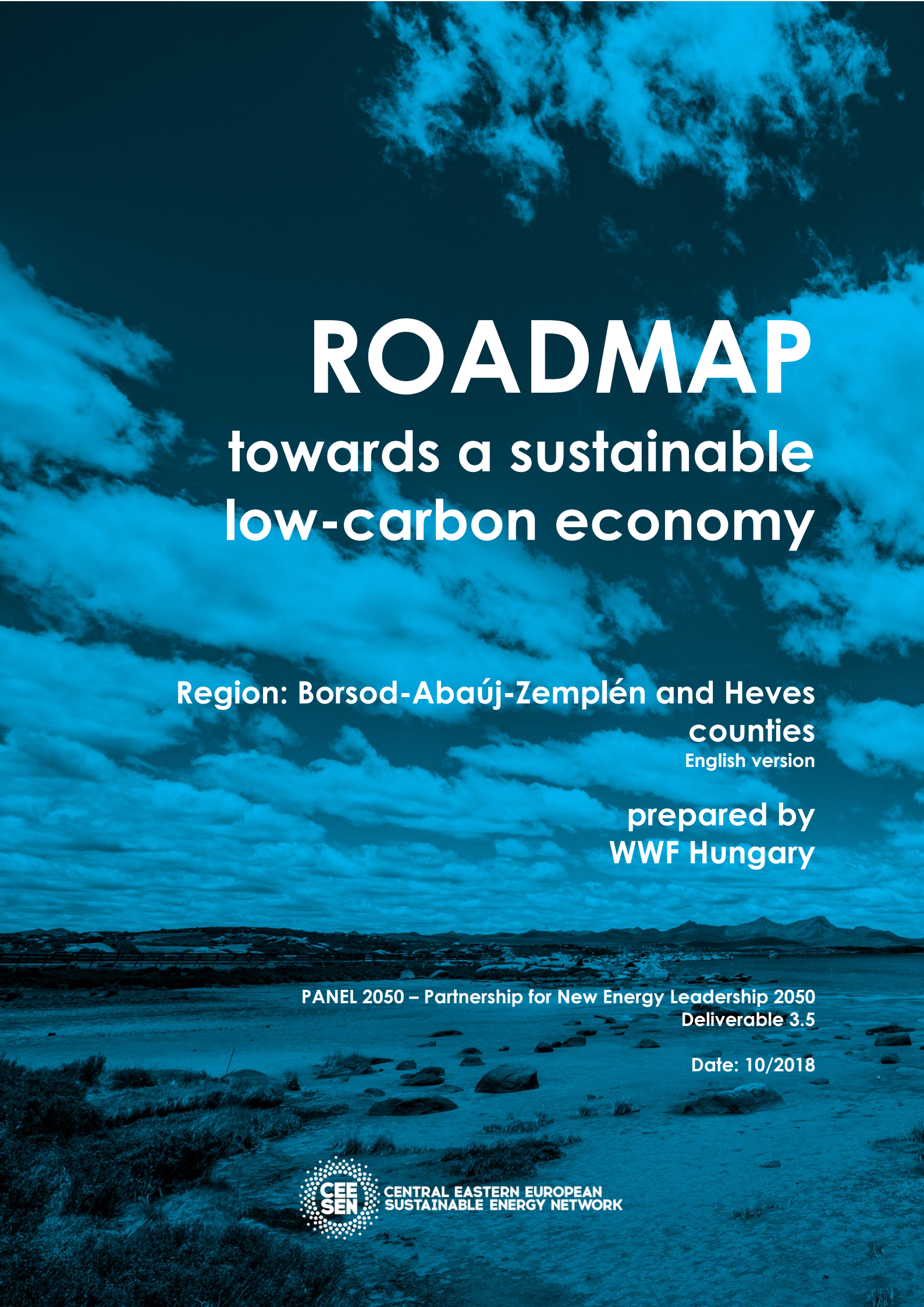

ROADMAP

towards a sustainable low-carbon economy

Region: Borsod-Abaúj-Zemplén and Heves counties

English version

prepared by
WWF Hungary

PANEL 2050 – Partnership for New Energy Leadership 2050
Deliverable 3.5

Date: 10/2018

CEE SEN
CENTRAL EASTERN EUROPEAN SUSTAINABLE ENERGY NETWORK

Roadmap model

About Panel 2050 project

The PANEL 2050 project has the aim to create durable and replicable sustainable energy networks at local (municipality/community) level, where relevant local stakeholders collaborate for the creation of a local energy visions, strategies and action plans. The aim of these networks is to contribute to and actively work for the transition towards low carbon communities in 2050. The PANEL 2050 partnership will provide support for the creation of first successful local energy networks in the CEE countries. In the course of the project, organisations from 10 CEE countries will collaborate on creating regional energy strategies and action plans. For more information visit https://ceesen.org/panel2050/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696173.

The PANEL model

PANEL model is a comprehensive approach for implementing local long-term energy management, supported by the community. PANEL model consists of seven main elements: Stakeholder Engagement, Training Program, Guidebook, Long-term Energy Visions/Roadmaps/Action Plans and Central and Eastern European Sustainable Energy Network CEESEN. These elements are developed by PANEL 2050 project to support the CEE communities on achieving their sustainability goals.

The Roadmap at hand is the output of the long-term energy planning process with the aim of plotting the regional transition towards a low-carbon community.

Attached to the Roadmap 10 specific Action Plans were developed, representing the first steps on this road toward low-carbon community by 2050.

Roadmapping process - Borsod-Abaúj-Zemplén and Heves counties, Hungary

Stage 1

Baseline – Regional Energy Profile *Borsod-Abaúj-Zemplén and Heves counties*

Stage 2

Vision

In 2050, the population of Borsod-Abaúj-Zemplén and Heves counties will be healthy and climate aware, consume energy in an efficient way from locally available renewable energy sources, emit 70% less CO2 than in 1990, and its economy will be based on innovative, green technologies.

Stage 3

Roadmap

Stage 4

— Energy efficiency in the residential building sector —

Action 1
Energy efficiency adviser office for every district

Action 2
Real solution for energy poverty

Action 3
Residential Energy Loan Program

— Decentralized renewable energy production

Action 4
Eco villages for guidance

Action 5
Heating supply of public building with local bioenergy

Action 6
Green district heating against air pollution

— Awareness rising —

Action 7
Climate-aware Decision Makers Program

Action 8
Climate Change Education and Awareness in primary education

— Low-carbon transportation —

Action 9
Public transport goes green!

Action 10
Share your car!

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1 Introduction

The roadmapping process presented above was implemented in the Hungarian study area, Borsod-Abaúj-Zemplén and Heves counties. Present roadmap shows how the region can reach the desired vision defined by local stakeholders:

In 2050, the population of Borsod-Abaúj-Zemplén and Heves counties will be healthy and climate aware, consume energy in an efficient way from locally available renewable energy sources, emit 70% less CO_2 than in 1990, and its economy will be based on innovative, green technologies.

To reach the vision, improvement in four priority areas is needed. These four areas are the main components of the vision statement. Energy efficiency is the clearest way to decrease CO_2 emission, while through the help of the PV and sustainable biomass deployment and the decarbonisation of the transport sector, the decreased energy consumption can be covered by locally available renewable energy sources. However, this shift cannot be happen without the human element: climate-aware responsible individuals are needed who support the energy transition and willing to reduce its energy consumption and invest in renewable energy and energy efficiency measures. These four priority areas are detailed further in ten action plans, presented in separate documents.

2 Priority areas

Energy efficiency in the residential building sector

Hungary is behind the schedule regarding the implementation of the IV. National Energy Efficiency Action Plan, where the greatest savings potential is found in the residential sector, both in real terms and as percentage of the 2012 consumption. However, the originally planned fund for the residential energy efficiency from the Cohesion Fund was reprogrammed in favour of the central governmental buildings. Other funds are available but not coordinated with each other and have the following limitations:

- Warmth of Home Programme: financed from the sale of emission allowances in the EU Emissions Trading System, funds are available in every year generally for upgrading the large consumer household appliances, with high share of own source.
- Hungarian Development Bank long term loan for energy efficiency measures: fund based on European Investment Fund, available until the end of 2022 provides loan with 0% interest rate, and maturity time of up to 20 years. The administrative burden which comes with the application was reduced multiple time over the years, however, there are still some limiting factor which hinder its widely use, such us 10% own contribution, loan up to 5 million HUF (~EUR 16 100) require mortgage or up to a defined tax dept and arrears on utility bills, application is not possible.

Borsod-Abaúj-Zemplén county – which covers the two-third of the project region and also where the majority of the population lives – is among the most underdeveloped ones, the average income of a household is 78% of the national average. Unless financial help, this can hinder the will of renovation and the building of new apartments which are in the upcoming years shall meet the new energy efficiency building standards and require more financial sources.

Besides of the financial issues, households are also have to be aware of the potential saving they can reach and have to be advocated regarding the investment. One action plan addresses the financial issue, which can help households in the use of nationally available fund, or to implement investment solely with local fund, while the other help in the professional background. The third action plan under this priority area is specially focuses on energy poor households.

Decentralized renewable energy production

90% of the energy consumption is covered by fossil fuels, however, as the regional energy profile pointed out that there is significant potential of locally available renewable energy sources. Due to the extreme reduction of the cost of PV, the roadmapping group decided the deployment of PV does not need additional help with action plans, only as part of other action plans. As the regional energy profile pointed out, there are some parts of the region where the geothermal, biogas and wind energy potential is significant, however, those technologies despite of the technology development are still need significant investment capital, not to mention that the latter one is block above 1 MW by law.

Forestry solid biomass is already highly utilized in the region with well-established supply chains, but with low efficiency. Also potential is available in case of short energy rotations/energy forest. Two action plans, in close connection with each other, are based on these factors: using existing supply chains and develop new ones sourced by energy plantations, providing local heat supply with small scale district heating systems, which can be a good solution for air quality and social issues as well.

High share of renewables in the energy mix is only possible if it diversified, and exploits the energy efficiency potential of the production and consumption side as well. The third action plan under this priority areas focuses on ecovillages, which can be served as a knowledge hub for climate friendly solutions and good examples for other villages in the region.

Low-carbon transportation

In Hungary the transport sector is among the few ones which GHG emission is increasing continuously, and the growing mobility needs and the increasing number of vehicles challenge the mitigation efforts. The action plans were developed in order to reverse this trend. One action is focusing the fuel shift of public transport to electricity or alternative fuels. However, the fragmented structure of municipalities limits the economy viability of public transport in small settlements. Passenger transport of these villages can be more effective with carpooling, which is the focus area of the other action plan.

Awareness rising

In the EU the residential energy consumption is 27% of the final energy use, while in Hungary 32%. In addition, according to a survey from 2012, only two-third of the individuals in Hungary is aware of the cause and effect relationship between the energy consumption and climate change. Without awareness rising, the risk is high that the indicators of action plans of other priority areas will not be reached.

Therefore two action plans were developed to – as a horizontal actions – will support the implementation of the other three priority areas. Young generation can be reached most efficiently by awareness rising actions, therefore one action plan will focus on them. They are also able to raise the awareness of the older generation, e.g. in their family. However, urgent action is needed to tackle climate change, and we do not have the time to wait until the already educated generation grow up. Therefore actions have to be done regarding the older generation as well, especially for decision makers, who are the focus group of the other action plan.

Stakeholder engagement priority areas

The stakeholder engagement of different kind of target groups and potential partners are described in detail in the action plans. However, in general stakeholders will be engaged with the help of existing partnership. The further development of action plans have to be done in active participatory process, using co-creation and co-design which ensures that the there is a common understanding regarding the exact implementation of the actions, and it is a common interest for the stakeholders. Coordinator role of the process was determined in case of each action plans.

3 Actions and development scenarios

3.1 Status of R&D, innovations and technology

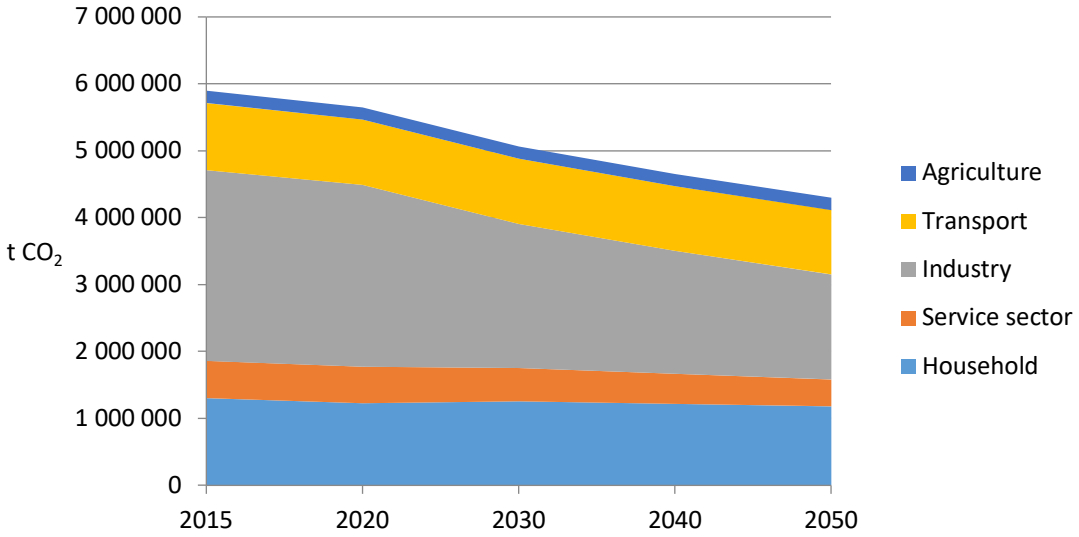
The research and development expenditure in Hungary was 1,2% of the GDP, which is significantly lower than the EU average (2%, 2016). There is no specific energy technology research, development and innovation strategy and the National Energy Strategy 2030 contains no energy technology-related research and innovation goals or objectives. Therefore innovations which affect the renewable energy trend in the region are global trends. Currently the spread of PV and heat pumps can be observed in the region.

PV price has fallen only in the last year with 30%, reaching ~ 0,3 $/Watt. The country reached its currently ~480 MW capacity in a few years, and the government expect that it will be grown to 2-3 thousand MW. The realization of this development can be observed in the region as well, not only on small-scale household level but in terms of larger PV plants as well. Households with PV plants are charged once a year after their electricity consumption, which means that they can use a network as a storage. This

prosperous regulatory environment encourages the spread of heat pumps, which are also getting popular on household level.

The high potential of renewable energy sources can be a good basis for local R&D, innovations. Both universities have courses related to renewable energy, and the Bay Zoltán Nonprofit Ltd. for Applied Research which also has office in Miskolc already has relevant R&D projects in the field of bioeconomy, circular economy, and agro-biotechnology. These organization can be the knowledge hub of local innovation in the future.

3.2 Business-as-usual scenario



If no additional policies will be implemented, based on the Hungarian data of the EU Reference scenario, GHG emission will be reduced around 28% from 2015, from 5,9 to 4,3 million tons of CO_2 equivalent. The most significant reduction is forecasted in the industry sector, where the current emission will decrease by 45%. The lowest reduction is forecasted in the household and transport sector, where the decrease is only 10% and 5%, respectively.

3.3 Development scenarios

To reach the targeted GHG reduction target, 2 million tons of CO_2 equivalent reduction is needed compared to the BAU scenario. Priority areas targeting the household and the transport sector can lead significant reduction in these two sectors – where the reduction in the BAU scenario is the lowest. However, this interventions are not enough to reach the target, since the current emission of these sectors is around 2,3 million tons of CO_2 equivalent, which means that the household and transport sector should be almost GHG

neutral. But awareness rising action plans as horizontal interventions can lead additional reduction in all sectors.

Energy efficiency in the residential building sector
Energy efficiency adviser office for every district. To exploit the huge energy efficiency potential in buildings, end users need advice on how they can reduce their energy bills in a most cost-efficient way. For this, adviser offices are needed on local level where energy efficiency consultants can guide the end users from the idea to the implementation, including financing option, but also creating link between end users and relevant local companies. There are good examples in Hungary for this kind of offices, but not a single one exists in the project region. The ideal state would be one office per each district (altogether 23 in the project region). Objective: By 2025 half of the district centre will establish local energy adviser office, by 2030 all district centre will provide this service. By 2035, half of the households will use the service Timeline: 2030
Real solution for energy poverty. Comparing to other part of Hungary, the project area is highly effected by energy poverty, which associated with serious air pollution resulted by inefficient furnaces and fuel, including wet fire wood, lignite/brown coal and household waste. In the frame of the program dedicated fund and credit with no interest rate would be available for energy poor household to replace their old furnaces. As a requirement, applicants have to take course about the health consequences of low quality fuels. However, the success of this initiative is highly depending on the regulation side, i.e. controlling the illegal burning of household waste, ban of burning lignite/coal on household level. Objective: By 2030 40 thousand energy poor household will have modern, high efficient heating appliances. Timeline: 2030
Residential Energy Loan Program. Where the financial circumstances allow, municipalities should foster end users to implement energy efficiency measures. A best tool for this is to offer green loan without interest rate. This kind of initiative is available on national level in frame of a European Social Fund based programme, but the strict conditions hinder its wide-spread utilization. This barrier can be solved locally, or the local loan could be the cover the own contribution. Objective: By 2030 20 thousand, by 2050 60 thousand household will implement energy efficiency measures/renewable energy investments with the help of the loan with 0%

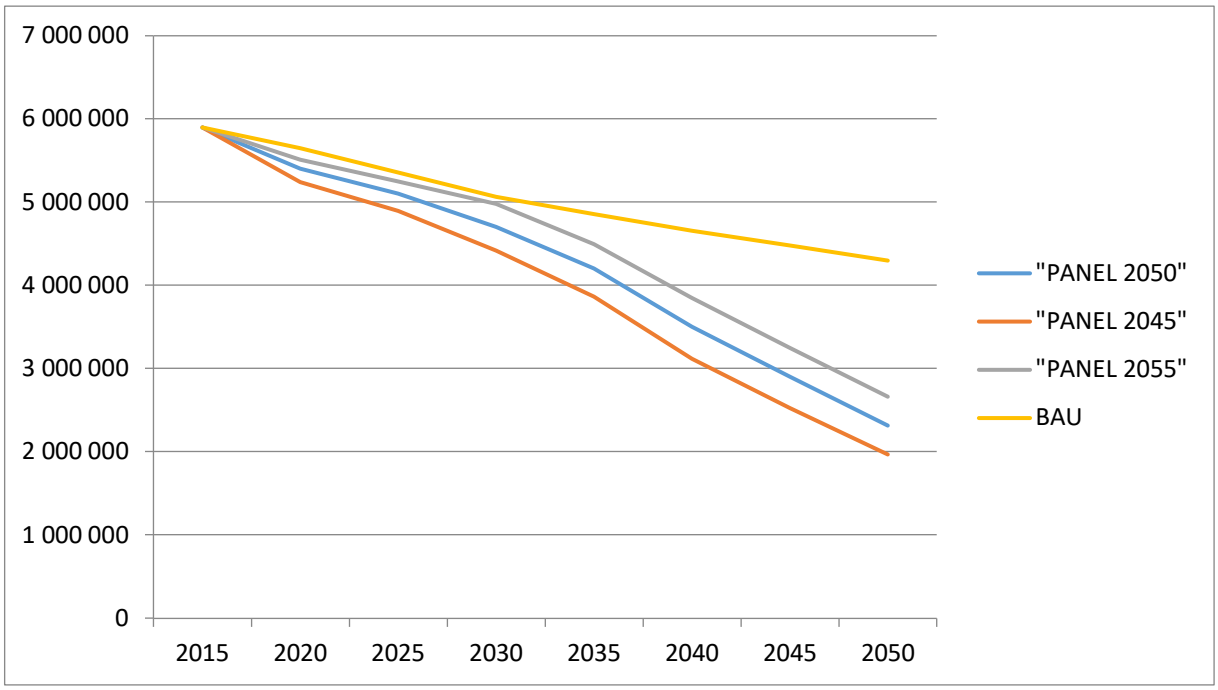
interest from municipalities. Timeline:2050
Decentralized renewable energy production
Eco villages for guidance. Central and Eastern Europe is almost completely lack of 100% renewable energy based eco villages which not only climate friendly because they produce their own energy from locally based renewable energy sources, but also lean on locally grown food and climate smart agriculture. This ecovillages provide complex solutions for climate change, and they could be the local knowledge and exchange centre for climate smart solutions. Objective: By 2030 10, by 2040 30, by 2050 75 ecovillages will exist in the region. Timeline: 2050
Heating supply of public building with local bioenergy. Abandoned land can be a source of local biomass, either as energy plantations or forest. This municipality owned or leased land can be a basis for municipalities to develop local biomass supply chain. The action plan provides help for this. This action plan can be implemented in connection with the "Green district heating against air pollution" program. Objective: By 2035 3 thousand, by 2050 10 thousand hectare of municipal property/leased land will serve as a source of local biomass supply for heating public buildings. Timeline:2050
Green district heating against air pollution. The Particulate matter (PM) concentration in Hungary is often excess the limit value during the heating season due to inadequate heating fuel and furnace in the households. The most effected part is the valley of the Sajó river, where most of the energy poor families live and where air traps in the lowest part of the valley due to the specific geographical conditions. This complex problem can be solved with local district heating systems. Sustainable biomass can supply these systems, also in connection with the "Heating supply of public building with local bioenergy" action plan. Objective: by 2035 20, by 2050 40 settlements will have green district heating system Timeline:2050
Awareness rising
Climate-aware Decision Makers Program. Decision makers independently on their political view, have to be aware of the effect of climate change and how human can tackle it. This program would include serious of lectures to the mayors and higher level

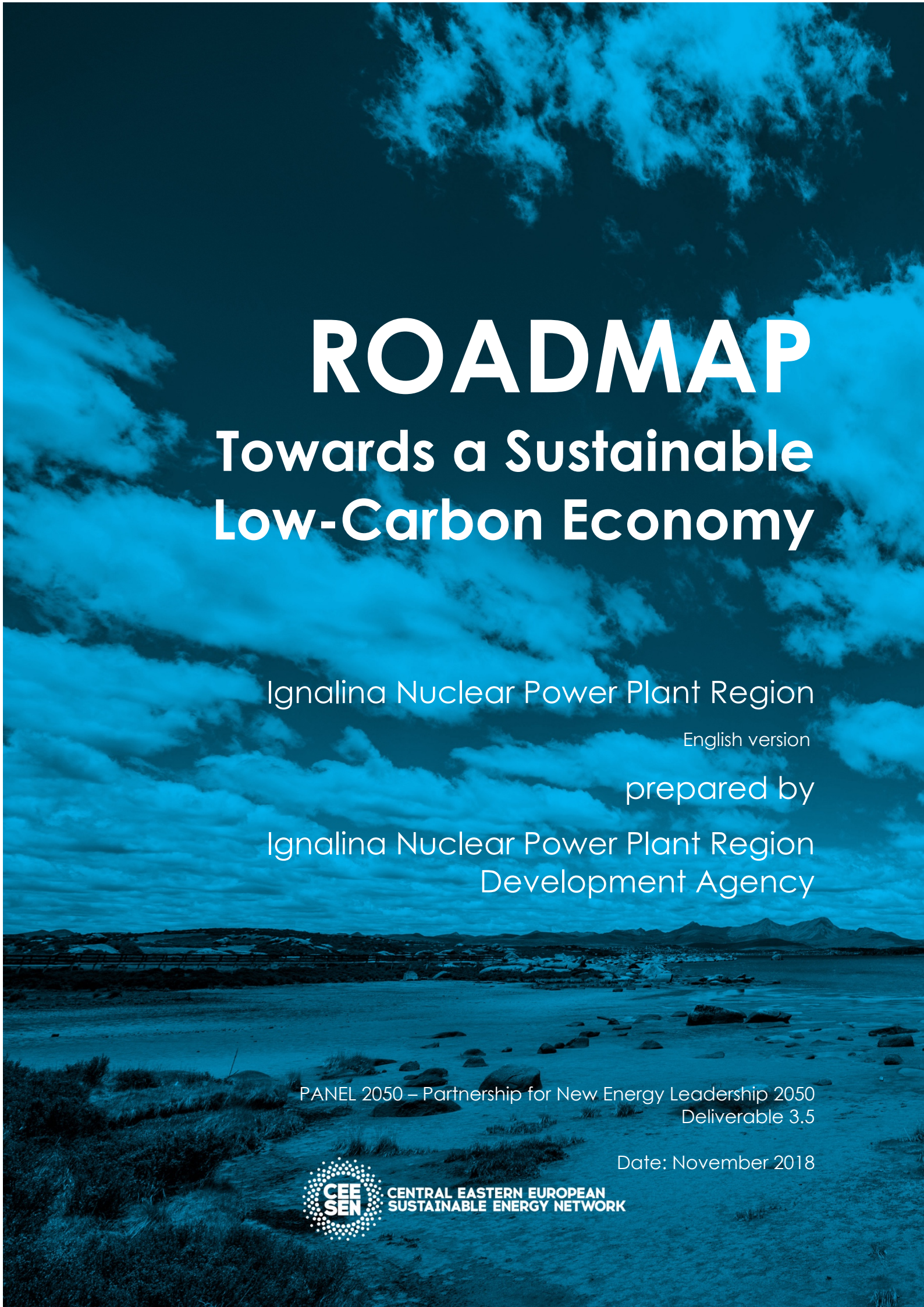
decision makers. Objective: By 2023 climate change awareness-rising training series for mayors and member of local municipal councils is in operation Timeline: 2023
Climate Change Education and Awareness in primary education. However children in primary education generally receive climate awareness training in part of thematic days in school or other program, but dedicated, well-established curriculum is needed to make real effect on children. Objective: By 2035 all students will have learn in schools which are meet with the eco-school standards and where climate awareness-rising is integrated into their curriculum. Timeline: 2035
Low-carbon transportation
Public transport goes green!. The transport sector is one from the few sectors which energy utilization and GHG emission is growing year by year. To meet the addressed target, the development and decarbonisation of the public transport is needed. One key element of that is to shift their fuel to renewable based solutions. Objective: By 2050 the public vehicle fleet will be electric of use alternative fuel. Timeline: 2050
Share your car! Population density in rural areas of the project region is low, and public transport to small villages is only exists in a limited way due to economic barrier. For this settlements carpooling can be a viable alternative solution. Carpooling is getting popular in the country, but incentives are needed in order to become a well-spread option. Objective: By 2050 75% of the total passenger km will happen by carpooling. Timeline: 2050

As it can be seen above, significant part of the action plans do not lead GHG emission reduction directly, especially those who focus on awareness rising, therefore to estimate the exact potential of GHG reduction of the action plans is not realistic. However, the roadmap team think if the action plans will be implemented and the targeted objectives will be reached, the GHG emission can be reduced to the desired level.

As the latest special report from IPCC on the 1,5 degree highlighted, drastic change is needed to limit global warming below 1,5 C degree, and the global emission should be

reach zero emission by 2050. The roadmap team hope that this message will affect the implementation of the strategy, and the vison can be reached earlier, by 2045. Also, a "pessimistic" scenario was set, in which the vison would be reached only in 2055.





ROADMAP

Towards a Sustainable Low-Carbon Economy

Ignalina Nuclear Power Plant Region

English version

prepared by

Ignalina Nuclear Power Plant Region Development Agency

PANEL 2050 – Partnership for New Energy Leadership 2050
Deliverable 3.5

Date: November 2018

CEE SEN CENTRAL EASTERN EUROPEAN SUSTAINABLE ENERGY NETWORK

About Panel 2050 project

The PANEL 2050 project has the aim to create durable and replicable sustainable energy networks at local (municipality/community) level, where relevant local stakeholders collaborate for the creation of a local energy visions, strategies and action plans. The aim of these networks is to contribute to and actively work for the transition towards low carbon communities in 2050. The PANEL 2050 partnership will provide support for the creation of first successful local energy networks in the CEE countries. In the course of the project, organisations from 10 CEE countries will collaborate on creating regional energy strategies and action plans. For more information visit https://ceesen.org/panel2050/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696173.

The PANEL model

PANEL model is a comprehensive approach for implementing local long-term energy management, supported by the community. PANEL model consists of seven main elements: Stakeholder Engagement, Training Program, Guidebook, Long-term Energy Visions/Roadmaps/Action Plans and Central and Eastern European Sustainable Energy Network CEESEN. These elements are developed by PANEL 2050 project to support the CEE communities on achieving their sustainability goals.

The Roadmap at hand is the output of the long-term energy planning process with the aim of plotting the regional transition towards a low-carbon community.

Attached to the Roadmap 10 specific Action Plans were developed, representing the first steps on this road toward low-carbon community by 2050.

Roadmapping process
INPP region, Lithuania

Stage 1 — **Baseline – Regional Energy Profile *INPP region***

Stage 2 — **Vision**

Ignalina NPP region is located in East Aukštaitija (Lithuania), in which energy-efficient innovative businesses, as well as sustainable tourism and organic farming are being developed

Stage 3 — **Roadmap**

Stage 4

Action 1
Transition of Ignalina city heat networks for operation in low-temperature mode

Action 2
Reorganization of the centralized heating system into a closed one and increasing the energy efficiency of public and apartment buildings in Visaginas municipality

Action 3
To renovate public and residential buildings and reduce pollution in the municipality of the Zarasai district

Action 4
Renovation of heat pathways as well as trunk-line and distribution of drinking water routes and sewer networks in Visaginas

Action 5
The incorporation of the package of socio-economic measures, which include measures for the energy sector, aimed at mitigating the consequences of decommissioning of the State Enterprise Ignalina NPP

Action 6
Development of alternative energy sources and improvement of energy efficiency in the Euroregion "Country of Lakes"

Action 7
Visaginas Technology and Business Vocational Training Center (TBVTC) Energy Efficiency Improvement Plan, Stage II

Action 8
Publicity of alternative energy development opportunities and implementation of pilot projects on energy efficiency in Aukštaitija National and Labanoras Regional parks

Action 9
The implementation of social and technological applied research on the renewable energy sector in the region

Action 10
Installation of a solar power plant for the needs of the Ilgiai Community

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1 Introduction

The strategy reflects current global trends when both households and the public and private sectors are moving towards sustainable energy consumption. The strategy is based on Lithuania's international commitments, Lithuanian legislation, and strategic documents related to the energy sector. The strategy provides opportunities to attract new investment in the region, to use the potential of local renewable energy sources, and to save energy. Thus, its implementation will more effectively address the following relevant issues in the region:

- insufficient use of local and renewable energy sources;
- low energy efficiency in buildings;
- inefficient and irrational use of technology/devices;
- lack of capacity of local energy generation;
- the need for modernization of the heat economy;
- habits of residents, poor education on environmental protection issues;
- lack of investment;
- undeveloped scientific potential.

Strategic goals will help to reduce energy consumption, increase the use of local renewable energy sources, and reduce greenhouse gas emissions. Public education and inclusion in environmental protection projects and the use of renewable energy potential existing in the region would reduce the demand for imported fuels, price increases and negative environmental impacts. Support for local initiatives and promotion of domestic investment would lead to the creation of an advanced business sector. Without effective and well-timed energy saving measures and actions, energy consumption will increase for heating and lighting of buildings, which would deteriorate the region's economic and social situation. The strategy is targeted at municipalities, residents and businesses. Individual action plans have been prepared for each municipality of the Ignalina NPP region in order to achieve the goals set in the strategy.

2 Priority areas

By taking into account the current situation and future prospects in the Ignalina Nuclear Power Plant (further abbreviated as INPP) region, the priority areas (on which the focus is planned) are tied to the vision of creating a region in which energy-efficient innovative businesses emerge, and sustainable tourism and advanced agriculture are being developed. It also takes into account the EU and the state's objectives to increase the share of renewable energy in total consumption.

Seeking to change and to become a low-carbon society by 2050, the public sector, households, and the transport sector all have an important role to play, as they cover about 70% of total energy consumption. Considering the regional potential of renewable energy sources, bio and solar energy will be the key renewable energy sources (further abbreviated as RES) of the INPP region in the near future. Efficient use of energy and the production of energy from local sources would allow redistribution of funds and direct them towards the development of tourism and the creation of favourable conditions for business.

The priority areas of the regional focus are:

1. Energy efficiency of public and apartment buildings, modernization of public spaces, buildings, energy infrustructure and street lighting, and business enterprises in

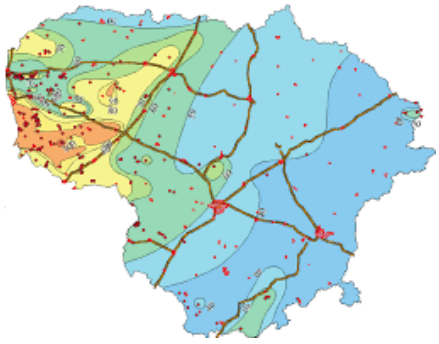
terms of heat and energy economy. Regional goal: public and apartment buildings in the region, which are connected to the central heating system, are 100% renovated in order to maximize the reduction of energy consumption and environmental pollution, to improve working and living conditions for consumers, and aesthetic picture of cities and settlements. In this area, a considerable amount of work has been done while preparing documentation, identifying the goals and characteristics of the renovation, as well as consulting the owners and residents of the building on the renovation process, prices, methods and selection of materials.

The region seeks to renew public spaces, buildings and street lighting systems by replacing light bulbs with modern and energy-saving ones, as well as by installing optimal height poles and automatic lighting systems according to the need. This would allow to timely switch the light on and off in relation to the length of the day, and would also result in better living and working conditions, street and road safety and the reduction of electricity costs.

A large part of the population of the city and other settlements uses central heating systems that use biomass as fuel. For efficient energy use it is necessary to modernize all heat tracks and to optimize heat production equipment. Wherever possible, it is also needed to install heat pumps or devices generating heat through solar power and automatic regulating devices, as well as to switch to a low-temperature heating system. The modernization of energy economy of business enterprises and cost savings would allow companies to be competitive, innovative and attract investment.

2. **Modernization of households.** This area is important, but the energy modernization of private households is much slower than that of the public sector and apartment buildings. At the national level, a significant number of support schemes related to the energy modernization of private households and more efficient energy consumption have been developed, but information on the potential benefits and reimbursement is not reachable to most of the population. State institutions, municipalities, rural and urban communities, and business entities could unite and offer complete and clear processes and products to the population, related to the energy modernization of private households, as well as to educate society.

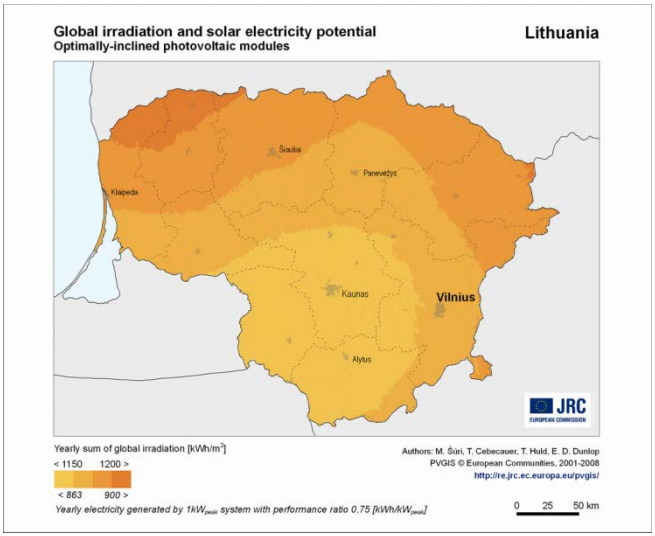
3. **Development of solar and bio energy production, and parking of electric vehicles.** Taking into account renewable energy sources in our region it is most convenient to develop bio and solar energy sectors; the climate conditions are not suitable for the development of other sectors (hydro, wind, deep geothermal).



Map of deep geothermal water temperature

Map of prevailing winds in Lithuania

Our region is sufficiently suitable for solar energy use in households, business and public sectors. Generation of heat, hot water, electricity – these are the areas that need to be developed in our region.



According to the data on October, 2018 (State Energy Inspectorate under the Ministry of Energy of the Republic of Lithuania), during the period of 2002-2018 there were 2135 permissions issued for electricity generation in the country, of which 25 in our region: 12 for solar power plants (5 in Zarasai district, 2 in Visaginas and 5 in Ignalina dist. municipalities), 2 for hydro power plants (1 in Zarasai and 1 in Ignalina dist. municipalities), 1 for a cogeneration plant (biogas) (in Ignalina dist. municipality), 11 for solar light (photovoltaic) power plants (4 in Zarasai dist., 2 in Visaginas and 5 in Ignalina dist. municipalities), and 1 for a wind turbine (in Ignalina dist. municipality).

The conditions for the production of biomass are also favourable in the INPP region, because the soil in the region is not sufficiently fertile to produce grain crops but is suitable for growing biomass. A great prevalence of forests and advanced wood processing industry, which produces a lot of wood waste during the production process, allows the development of biomass fuel production.

Due to the increasing negative impact of vehicle traffic on the environment, health and human well-being, changes in the transport system have become a necessity. These solutions cover all modes of transport, but the focus could be given to the development of the prevalence of electric cars.

It is likely that in the coming years electric cars will experience a breakthrough in the vehicle market. Many years ago, the biggest problem was the range of electrified vehicles. With the improvements of batteries and expanded charging networks, the numbers of consumers are also growing. In the last six years, the electric vehicle numbers in Lithuania has increased by 56%. It is expected that in the near future (after 2021) the share of electric cars will increase significantly, not only voluntarily but also to a large extent due to tightening conditions on pollution and the ban on the use of petrol and diesel vehicles. In the INPP region, the infrastructure of electric vehicles is not developed, so a network of charging stations must be developed in order to meet the needs of electric vehicles in the whole region. This is especially true for our region due to prospects for the development of the tourism sector and innovative business. A wide range of charging points and their proper publicity would provide a competitive advantage in this sector.

In the city of Visaginas to promote the use of electric cars and, thus, reduce the negative impact of transport on the environment, it is planned to install two charging access points for electric cars, i.e., one charging point with high power and one with ordinary power.

3 Actions and development scenarios

This Roadmap is based on the energy vision of the INPP region. The Roadmap provides a general direction and concrete steps to move towards the vision. Several different scenarios for the regional development, described in the guidelines, allow the transition from the status quo (current situation) to the implementation of the regional vision. A multi-scenario analysis is the basis for taking energy-related decisions and foreseeing possible actions. Measure or action plans, which are an integral part of the guidelines, help to gradually achieve the vision and ensure that the development path is concrete and realizable.

The action plan includes these main areas of the regional energy sector:

- renovation of public and apartment buildings;
- transition to a low-temperature central heating;
- modernization of public buildings, spaces and street lighting systems (by changing lamps, supports, and installing automatic control systems);
- modernization of decentralized heating systems of public buildings (by installing renewable energy sources: heat pumps combined with solar power plants);
- implementation of the following programs: renovation of private houses, production and use of energy resources, innovative business support programs, education on sustainable property management;
- production of solar and bioenergy.

The national policy anticipates that by 2020 renewable energy resources will amount to 30%, by 2030 to 45%, and by 2050 to 80% of total energy consumption. Obviously, the region will have to contribute to the achievement of targets. It is expected that in 2050 a much more important role will be given to electricity than it is today. Therefore, some actions related to a low carbon society will be related to the generation of electricity. Individual electricity generation will contribute to the total electricity production and energy storage, which will play an important role in allocating the power grid load. At the same time, the networks will need to be modernized to meet these extra loads and become smarter. All this will attract new investment and have a positive impact on the regional economy.

Taking into account the national and the EU aspirations in the energy sector and the fact that the region is suffering after the decommissioning of the Ignalina Nuclear Power Plant as one of the largest employers in the whole Lithuania, and is lagging behind in terms of the basic socio-economic parameters (even compared to the national average), the following scenarios are formed:

1. According to the decision of the Government of the Republic of Lithuania, the funds of the European Commission and / or the state budget will be allocated not only for the physical decommissioning of the Ignalina Nuclear Power Plant and for the disposal of nuclear fuel and contaminated waste, but also to mitigate the socio-economic consequences caused by the decommissioning of the power plant. Regarding significant support in the period 2004-2014, the development of the region has been accelerating, but after its termination an intensive regression has begun. The local government actively seeks to support business, public initiatives, infrastructure improvement, to provide

electricity tariff relief, and to implement innovations in the energy sector, as well as in other areas in the power plant pollution zone. The region has prepared a development program and has provided concrete measures on how to develop the region in terms of the vision.

According to this most likely scenario, the development of the region would have a significant financial impact in areas such as: full renovation of public and residential buildings, lighting of streets and public spaces, solar and biomass energy production, community initiatives, improvement of business energy efficiency, development of innovative businesses.

2. Increasing energy demand, rising taxes on pollution, climate change, and awareness of people are conditions for intensive implementation of innovation and progress in energy economy. The growing demand for natural nature will attract large flows of tourists to the INPP region, which will increase income of the residents and improve their quality of life.

According to this scenario, the development of the region is associated with the overall progress and natural development. The main focus in this case should be on access to the most up-to-date information, the dissemination of the regional vision, and the development of tourism.

3. The increasing attention of the authorities of Lithuania and the European Union to the search for energy resources, the reduction of pollution, and the optimization of the consumption of energy resources will lead to a reallocation of resources and an increase in their availability to the residents, the business and the public sector of our region.

Experience shows that our region lags behind the country's average in terms of investment attraction, but by deliberately introducing measures on business privileges, by choosing a clear direction of specialization and focusing available resources on it, it would be possible to attract additional finances not only from the country but also from abroad, as well as use the EU and national support funds more intensively. The created attractive image of the region would open much greater opportunities for the local people to create businesses and to exploit the potential of tourism.

3.1 Status of R&D, innovations and technology

The existing Lithuanian energy infrastructure creates preconditions for secure energy supply and production, but regions should be developed through the development of energy technologies. The future of energy sector is the smart network of electricity and the system of intelligent consumers, where production is no longer concentrated on several sites, but consumers themselves become small producers as well. Thus, education and training of people here play an important role.

The development of solar and bio energy production technologies and the innovations in the lighting industry are essential for our region, which seeks to completely renovate the energy economy making it energy efficient.

Currently, the biomass sector is not developed in the region. It consists of the production of wood chips, pellets and briquettes, the use of straw for the heat production of local individual households, and the cultivation of other energy crops (willows). Most of the wood waste products from the local producers are bought for heating of boiler houses in the region. This encourages local business, saves money for transportation, and contributes to the reduction of pollution.

The electric vehicle network in the region is also not developed; there is only one public place for charging electric vehicles in the region (in Zarasai district, Degučiai village). In the near future, all municipalities of the INPP region plan to create a network of such stations and are ready to respond flexibly to the growing demand. The private initiative is very important in this sector: charging points next to major supermarkets, catering establishments, and tourist attractions.

3.2 Business-as-usual scenario

Taking into account the best experience of other countries, the model chosen for the promotion of renewable energy in Lithuania is a model that will ensure fair and healthy competition and the lowest price. At the same time, it will help to achieve a strategic goal of Lithuania: to develop clean local electricity production and reduce dependence on its imports.

The National Energy Strategy foresees that in 2025 RES based power plants will generate twice as much electricity than they are generating today (from 2.5 TWh to 5 TWh), which will allow to reduce the demand for electricity imports up to 30 percent.

Under the new procedure approved by the Government of the Republic of Lithuania, business support for RES power plants will continue to be determined at auctions, as this method will ensure the lowest price. Therefore, the most important criterion for winning new auctions will be the smallest addition to the market price of electricity on Nordpool, which will be paid over a 12-year period.

The support will be distributed by means of technologically neutral auctions, which means that various plants using renewable energy technologies in electricity generating will be able to participate. Technologically neutral auctions will allow to select only the most economically viable projects and lead to technological progress.

Technological progress is also linked to the production of materials for the construction and reconstruction of buildings. High requirements to materials for energy efficiency leads to implementation of innovations in production and to search for new raw materials and production methods.

If the region fails to implement the first and third scenarios, according to the second scenario, the development of the region's energy economy will be natural, influenced by national, local government, population and business decisions.

3.3 Development scenarios

The INPP regional economy is energy efficient, cost effective and introducing energy innovations, and the whole region seeks to become a clean natural land.

As the Ignalina NPP region consists of three separate municipalities with their own separate management bodies, different needs and specialty of the economy, we present the development scenarios of the energy sector according to the priorities of the municipalities themselves and the organizations involved in the project.

Each of the actions described below is a step towards the goal of the region, some actions will be a good incentive and an example for other regional stakeholders.

Action title 1:

Transition of Ignalina city heat networks for operation in low-temperature mode

Objective:

For each of the above-mentioned goals, the municipality has provided related measures both in its 2018-2024 strategic development plan and in this regional document. The nearest goal is to renovate all apartment buildings connected to the centralized heating system in 2019 and to renovate the remaining apartment buildings and public buildings as much as possible until 2024. Currently, 106 buildings are renovated out of 162 apartment buildings in the district; among them 104 buildings are in Ignalina city and 93 of them already renovated, and in 2019 all the remaining 11 houses will be renovated. Also, all 40 public buildings in the district were already repaired.

Due to the reduction of environmental pollution and CO2 at the same time, various measures will be implemented to achieve these indicators by 2024:

- Public and residential houses connected to central heating transitioned to heating on a low-temperature mode in Ignalina city.
- Domestic and industrial waste water is 100 percent cleaned up to the required rates;
- The share of recycled or otherwise used municipal waste from the total amount of waste collected per year reaches 65 percent (27,5% was in 2016);
- The share of the population connected to sewage collection networks as a proportion of the total population reaches 67 percent (28,2% was in 2016);
- 100 percent of Ignalina city street lighting lamps are changed to LED type, while the used 100W lamps were used to light the streets of the district by replacing those that are of 150-200 watts until the district is able to replace them with LED lamps.

An example of Ignalina city can be unique not only in Lithuania but also across Europe, as the municipality administration is taking real steps not only towards the 100 percent renovation of public and residential apartment buildings and the 100 percent of district heating from renewable sources (biomass), but also other innovations in the energy sector. This is the transition of centralized heating to low temperature parameters. The target is to reduce the current temperature of the supplied water, thus maximize the reduce of losses in the main pipelines. A specific lower temperature would be discovered by making the necessary calculations in a feasibility study.

For consumers this would have an additional effect, and the heat supply company would also save on costly networks and devote more money to modernization. Another important step in the modernization of the heating industry is the acquisition of new optimal power heat generation installations and the optimization of the production process of hot water during the summer. By installing both solar collectors and photovoltaic batteries on facades and roofs of the renovated buildings, residents would not only provide themselves with hot water, but also produce electricity.

In order to implement heat supply at low temperatures, the Ignalina District Municipality Administration together with the Ministry of Environment of the Republic of Lithuania, initiates a process for initiative of Federal Ministry for the Environment, Nature Conservation and Nuclear Safety of Federal Republic of Germany "Due to joint implementation of environmental innovation projects in the Republic of Lithuania" and received an assessment as eligible and innovative, provided that a comprehensive case study and an investment project are prepared. Due to a lack of funds in the municipality, this project is suspended at the moment. The funds are being sought.

By upgrading street lighting the municipality administration focuses not only on changing of bulbs to a new generation of lamps but also on the introduction of management systems, which essentially give a significant effect. At present, automatic lighting network management systems are installed not only in Ignalina but also in the largest settlements of the district: in Didžiasalis and Dūkštas. In the near future, it is planned to install a management system in the remaining settlements.

Timeline:

These investments are planned by the Ignalina District Municipality Administration and its subordinate institutions in 2019-2024.

Action title 2:

Reorganization of the centralized heating system into a closed one and increasing the energy efficiency of public and apartment buildings in Visaginas municipality

Objective:

Due to the reduction of environmental pollution and CO2, as well as energy efficiency, the Visaginas municipality will implement various measures aimed at achieving these indicators by 2022:

- the share of heat generated from renewable energy sources: 63 percent (32% was in 2015);
- modernization of 20 km of engineering and street lighting networks. In the near future it is planned to implement a project "Modernization of Visaginas City Lighting System". This will contribute to the cleaning of the environment and it is planned to have CO2 savings (ton / year) of about 575 t.
- to insulate 100 percent of public buildings, i.e. 25 buildings;
- to renovate 50 apartment buildings from existing 254. Currently only one apartment building is renovated.

Visaginas also seeks to become a centre for innovative industry development, in which science and business closely co-operate. For this purpose, by the year 2022, it is planned to process and adapt 8.9 ha of land and sign a minimum of 3 cooperation agreements between local businesses, education and applied science organizations and business representatives, as well as to initiate at least 2 pilot projects involving scientists, business representatives, INPP and other organizations.

Also, the project "Implementation of Sustainable Mobility Measures in Visaginas City" is being implemented in the Visaginas municipality, the objective of which is in accordance with the Operational Programme for the European Union Funds' Investments in 2014-2020, approved by the European Commission in on September 8,2014, Decision No C(2014)6397, the fourth priority "Promoting energy efficiency and production and use of renewable energy", measure 04.5.1-TID-R-514 "Implementation of sustainable movement measures" and its objective: promoting sustainable mobility and developing environmentally friendly transport in order to reduce carbon emissions. After implementation of the sustainable mobility measures, residents of the Visaginas municipality will be encouraged to choose public urban and suburban transport, as well as other sustainable transport solutions: biking, hiking. The attitude of passengers towards the public transport and their behaviour will be changed. It will also reduce environmental pollution. By implementing the project's

objective, a sustainable mobility system will be created which will result in inclusion, as well as the promotion of non-motorised transport, increased traffic safety and security.

Timeline:

The Visaginas Municipality Administration plans to implement these investments during 2019-2022.

Action title 3:

To renovate public and residential buildings and reduce pollution in the municipality of the Zarasai district

Objective:

Most of the Zarasai district municipality's property consists of public buildings and apartment buildings. The arrangement of this area would allow to use energy resources more efficiently and to save costs that would be directed to other needs in the future. Currently there are 39 public buildings in the district of which 33 are currently renovated. There are 306 apartment buildings in the district of which 23 are renovated. It is planned to renovate another 51 apartment buildings until 2021.

Due to the reduction of environmental pollution and CO2 at the same time, various measures will be implemented to achieve these indicators by 2021:

- reducing the amount of air pollutant emissions from stationary sources per square kilometre with 5 kilograms per year (128,9 kg/km^2 was in 2013);
- to carry out management of biological waste;
- to carry out monitoring of air pollution / reduce CO2 emissions;
- to carry out environmental education of community;
- to install and develop innovations in the transport system (installing electric vehicle charging points).

Timeline:

The Zarasai District Municipality Administration plans to implement these investments during 2019-2021.

Action title 4:

Renovation of heat pathways as well as trunk mains and distribution mains of drinking water and sewer networks in Visaginas municipality

Objective:

State enterprise "Visaginas energy" provides a complex of energy supply to the consumers of the Visaginas municipality: heat energy (production and supply of heat, steam and hot water), cold water (production, preparation and supply of drinking cold water), and management of sewage services. Currently, the transfer of ownership rights of the owners of the company from the Ministry of Economy of the Republic of Lithuania to the Visaginas municipality is being addressed. In turn, the municipality has high requirements for the company in relation to the modernization of the heat economy and the reduction of

environmental pollution, and by mutual agreement provides the following goals for the near future:

- to renovate 12 km of heat tracks;
- to convert the centralized heating system into a closed one.
- During 2019-2022, to renovate about 8 km of trunk-line, water distribution and sewer routes.

Timeline:

These investments are planned to be carried out by "Visaginas Energy" during 2019-2022.

Action title 5:

The incorporation of the package of socio-economic measures, which include measures for the energy sector, aimed at mitigating the consequences of decommissioning of the State Enterprise Ignalina NPP in the final agreement between the Republic of Lithuania and the European Commission on the funding of the decommissioning of the State Enterprise Ignalina Nuclear Power Plant.

Objective**:**

With the joint efforts of the regional municipality and the authorities of the Republic of Lithuania to draw the attention of the European Union to the fact that, with the consent of the country in January 1, 2009, to decommission the power plant, the region suffered serious damage, the consequences of which cannot be overcome without additional support. The Action Plan includes measures that relate to the saving of energy resources and the development of a renewable energy economy:

- to implement projects for the promotion of small and medium-sized business;
- demolition / modernization of abandoned / unsafe buildings and arrangement of the territory in order to create suitable conditions for creating innovative business;
- to implement energy efficiency projects of public buildings;
- to implement energy efficiency projects (modernization of street lighting networks, installation of electric vehicle charging stations);
- to implement renewable energy projects for public buildings;
- to implement the renovation program for private houses;
- to develop solar power and biomass production.

The administrative role of the implementation of measures is planned for the Agency.

Timeline:

These investments are planned to be carried out by Ignalina Nuclear Power Plant Regional Development Agency during 2019-2027.

Action title 6:

Development of alternative energy sources and improvement of energy efficiency in the Euroregion "Country of Lakes"

Objective:

The development of Euroregion "Country of Lakes" as a region of the natural environment is closely linked to the reduction of CO2 and the development of a sustainable energy economy. In this document, based on the Strategy of the Euroregion "Country of Lakes" 2014-2020 the following main objectives are set: to implement innovative and creative projects in the field of energy, to establish solid foundations for cooperation and promote the Euroregion. This will be achieved by initiating international projects aimed at the education of the community, introducing technological innovations, modernization of households and developing energy sector by using the partnership between science and business.

Timeline:

Euroregion "Country of Lakes" office plans to implement these investments during 2020-2025.

Action title 7:

Visaginas Technology and Business Vocational Training Centre (TBVTC) Energy Efficiency Improvement Plan, Stage II

Objective:

Visaginas TBVTC Energy Efficiency Improvement Plan vision is to improve the technical and energy normative properties of the training centre buildings in order to achieve the essential maintenance of the building requirements, reduction of thermal energy consumption and rational use of energy resources, reduction of electricity costs and expenses for heating and improvement of the quality of training conditions. By 2025 it is planned:

1. to improve the energetic characteristics of the Visaginas Technology and Business Vocational Training Centre's dormitory building (Festivalio str. 9, Visaginas), to ensure economical and efficient energy consumption in this building;
2. to carry out modernization of the lighting system in all VTBVTC buildings, to ensure energy saving and efficient use of energy;
3. to carry out modernization of heating infrastructure in all buildings, installing thermostatic control of heating devices.

Timeline:

Visaginas Technology and Business Vocational Training Centre plans to implement these investments during 2020-2025.

Action title 8:

Publicity of alternative energy development opportunities and implementation of pilot projects on energy efficiency in Aukštaitija National and Labanoras Regional parks

Objective:

Directorate of Aukštaitija National Park and Labanoras Regional Park ties two parks: Aukštaitija National Park (ANP) and Labanoras Regional Park (LRP). ANP is the oldest

national park in Lithuania, founded in 1974. LRP was established in the eastern part of Lithuania, in the districts of Švenčionys, Molėtai and Utena, in 1992.

The Directorate of the park carries out a wide range of services related to the supervision of vegetation, wildlife and landscape, protection of natural and cultural heritage, nature research, and educational activities.

The Nature School was set up particularly for educational activities, the main goals of which are to carry out environmental education and promote advanced environmental protection ideas.

By expanding the range of activities carried out by the Nature School, the Directorate of parks will aim to reach the following objectives during the period of 2019-2027:

- To consult business entities and private owners operating in the area of parks on the installation of alternative energy sources in new facilities and their adaptability to existing facilities. This will be done without an economic benefit and further contributing to the preservation of the natural environment of the park, the promotion of eco-tourism and clean energy ideas.
- To implement educational programs for park visitors, to carry out thematic seminars on topics of the alternative energy development for employees of other parks in order to achieve sustainable and progressive development of the parks, thus, developing the local economy without concentrating on prohibitions and restrictions, but at the same time very responsibly and as active as possible.
- To carry out applied research and collect information on natural resources, including those related to RES.

The Directorate also plans to prepare and implement pilot projects aimed at the increase of energy efficiency and reduction of the use of resources in the parks:

- Reconstruction of a bicycle path by installing a lightning system of solar panels.
- Acquisition of golf-type electric vehicles for organisation of educational activities and tours in the parks.

Timeline:

Aukštaitija National and Labanoras Regional parks plan to implement these investments during 2019-2027.

Action title 9:

The implementation of social and technological applied research on the renewable energy sector in the region

Objective:

As the region is less economically and technologically advanced than the national average, and according to social welfare parameters is the worst in the country, the application of research methods is necessary for a thorough analysis of the situation, to find better solutions and a direction for development.

The main tasks are: to select and analyse the characteristics of sustainable energy development by using the accumulated informational material and statistical data, and to determine the interdependence between the environmental, economic and social

indicators related to the energy sector. Also, provide local enterprises and organizations with the opportunity to receive competent advice on issues related to the preparation, implementation and monitoring of energy plans.

The contribution of this partner to the implementation of the strategy would be very useful due to its experience and capabilities, as other partners lack skills in the field of research and are oriented towards the implementation of other types of measures. The Institute also has an advantage as it does not operate in the INPP region, thus avoiding direct interests and a biased approach to the research, as well as preparation of conclusions and suggestions.

Target tasks of this Action:

- to carry out the analysis of sustainable energy development indicators of the region, to identify trends and their relevance to the principles of sustainable development;
- conduct consultations on development and implementation of energy plans and monitoring of indicators.

Timeline:

Future society institute plans to implement these investments during 2019-2027.

Action title 10:

Installation of a solar power plant for the needs of the Ilgiai Community

Objective:

The Ilgiai Community is one of the many rural communities located in the region, but its innovative ideas and development projects stand out not only in the region but also throughout the whole country. As usual, communities based on volunteering lacks funding, so the main sources of funding for the implementation of activities are voluntary contributions, municipal funding, which is usually limited to co-financing of larger projects, or support funds for projects.

With the support of the EU and the municipality, the community has renewed the building assigned to it from the foundations and now there successfully implements activities related to active leisure time of children and youth from socially disadvantaged families. It is important to mention that the building is classified as A + energy class building, and it is very warm, economical and attracts other communities as an object of interest.

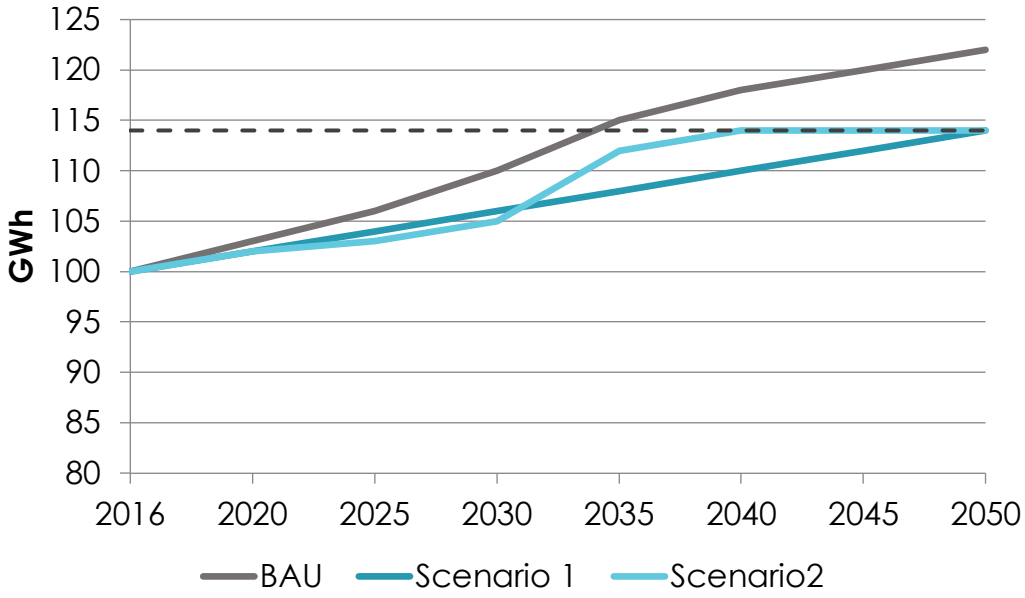
The experience of this project participant is very important to the region by demonstrating an example: how an initiative of local people can implement energy-saving projects, significantly improve conditions of activities, gather the community for advanced work, and turn a rural area into an attractive place to live and work.

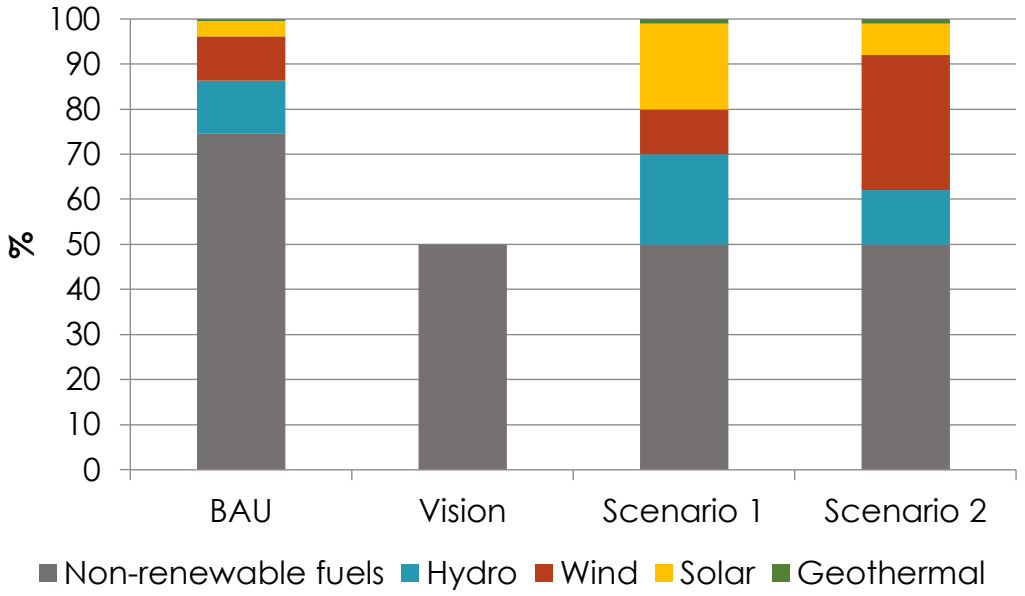
The community wants to continue energy-related projects and in the near future plans to:

- to install 2 solar power plants on top of community and public buildings;
- to prepare and implement an educational program "Energy Safari: the Green, Smart House".

Timeline:

Ilgiai Community plans to implement these investments during 2019-2027.





3.4 Milestones

Most projects of the Roadmap will start in 2019. Most investment activities will be completed by 2030, so in some cases monitoring will start even earlier. At the same time, it is also recommended to review some of the proposed action plans or to prepare new ones.

In 2030, it will be important to check not only the achievements of the national strategy but also of the region. Based on the results corrective measures could be implemented. The same procedure is also recommended in 2040.

In 2050, it is expected that the region will be as clean as possible, smart and have a widespread use of renewable resources.

4 Impacts on regional economy

In the medium term, domestic demand will be an essential engine both for the region and for the Lithuanian economy. It will be promoted not only by government decisions related to increasing the income of the population and strengthening of incentives for investment, but also by implementation of investment projects funded by direct foreign investment and the European Union financial assistance, as well as the tight labour market, which dictates the need for businesses to invest in the automation of activities, technological improvement, innovations and other measures enhancing work efficiency and productivity. All three scenarios for the regional development are linked with these positive developments.

The first scenario is not a scenario for natural development, but its impact can be significant and implemented in the short term. Whether this will have a lasting positive effect depends on specific choices, the perception of local government, and on the local population and business activity. In addition to the economic impact of additional investment and its multiplicative effect, the factor of social equity is also crucial. The residents of the region involuntarily lost their largest employer, which not only directly provided work to thousands of people, but also to several dozen companies, which provided services around this employer's activities.

The appointment of targeted funds and the implementation of established measures would have a direct impact on the population, as various community initiatives would be implemented, living and working conditions improved, and jobs created.

The implementation of the second scenario would require more effort and to concentrate local resources. The beginning is likely to be long, but successful implementation would ensure long-term impact not only on economic but also on the social development. Obviously, for the implementation of this scenario, not only the attraction of investment and innovative technologies but also the recruitment of human resources is important. This scenario is most likely to be fulfilled with the development of tourism business in Ignalina and Zarasai districts and the development of innovative industry in Visaginas. In the absence of human resources, it is necessary to adopt favourable laws for the import of labour, not only from neighbouring states, but also beyond their borders.

This scenario would be sustainable, consistently increasing human income, complementing the region with new residents and ensuring the natural course of development.

The third scenario is a derivative scenario between the first and second, as additional investment flows are linked with both the EU and national support instruments, and with natural technological advances and the attraction of private investment. In order to implement this scenario, it is important to invest on the capacity building of human resources in the near future, which would result in a stronger preparedness to compete with other public and private actors that seek the EU and public support.

5 Involvement of stakeholders

All "Panel2050" project participants were introduced to the Roadmap preparation process; the regional municipalities were also actively involved in the process, as they are the main makers of the vision and strategies of the districts and have close contacts with all the stakeholders.

The preparation of the Action Plans for this document, as well as for the regional energy vision and strategy, is well-timed, because the year 2019 will mark the beginning of preparation of the Utena Region Development Plan for 2021-2028, in which the objectives and measures will have a realistic financial basis. Therefore, it is likely that most of the objectives and measures from the documents we are preparing will be repeated and specified in the Utena Region Development Plan for 2021-2028.

Prepared documents are also very relevant when negotiating with the European Commission for the funding of the decommissioning of the Ignalina Nuclear Power Plant. The region seeks to focus funds not only on financing the plant's dismantling and radioactive waste storage processes but also on mitigating the social and economic consequences of the decommissioning of the plant.

The mayors of Ignalina and Zarasai districts, and Visaginas city, who are also members of the councils of the Utena region and the Ignalina NPP Regional Development, were actively involved in the document preparation process. Heads of municipality administrations, managers and employees of local economy, strategic planning and investment attraction divisions were also actively involved. The latter also provided statistical information and other relevant data for the preparation of this document.

An important role in the energy sector can be played not only by the regional municipal administrations and its subordinate institutions, but also by other organizations included in our project, because they are strong and advanced organizations, which represent different sectors and have a significant influence on the overall development of the region, including the energy sector. Their implementation of projects and the dissemination of good practices inspires other organizations and regional leaders.

The schedule of meetings regarding the Roadmapping process:

Date, place	**Participants**	**Content/Results / Conclusions**
06/09/2017, Ignalina	Henrikas Šiaudinis, Mayor of the Ignalina district and Chairman of the Ignalina NPP Regional Development Board; Inga Šidlauskienė, Director of the Ignalina NPP Regional Development Agency; Nikolajus Gusevas, Mayor of the Zarasai district; Dalia Štraupaitė, Mayor of Visaginas	Meeting on the vision of the INPP region
18/06/2018, Ignalina	Lina Sabaitienė, Deputy Minister of Energy of the Republic of Lithuania; Henrikas Šiaudinis, Mayor of the Ignalina district and Chairman of the Ignalina NPP Regional Development Board; Vidas Kreivėnas, Director of the Ignalina Distric Municipality Administration; Inga Šidlauskienė, Director of the Ignalina NPP Regional Development Agency	Meeting for discussions on the situation in the INPP region, review of future prospects, financing of the decommissioning of the Ignalina NPP

13/07/2018, Ignalina	Arūnas Gražulis, Deputy Minister of the Interior of the Republic of Lithuania; Henrikas Šiaudinis, Mayor of the Ignalina district and Chairman of the INPP Regional Development Board; Arnoldas Abramavičius, member of the European Committee of the Regions, Deputy Mayor of the Zarasai district municipality; Nikolajus Gusevas, Mayor of the Zarasai district; Dalia Štraupaitė, Mayor of Visaginas; Vidas Kreivėnas, Director of the Ignalina Distric Municipality Administration; Inga Šidlauskienė, Director of the Ignalina NPP Regional Development Agency	Session on discussions of the situation in the Ignalina NPP region, future perspectives, and the Programme of the Ignalina Nuclear Power Plant Region for 2019-2027
16/10/2018, Vilnius	Algirdas Stončiatis, Chancellor of the Government of the Republic of Lithuania; Bronis Ropė, member of the European Union Parliament, former member of the INPP Regional Development Board and former Mayor of the Ignalina district; Lina Sabaitienė, Deputy Minister of Energy of the Republic of Lithuania; Algimantas Dumbrava, member of the Seimas of the Republic of Lithuania; Vytautas Kindurys, member of the Seimas of the Republic of Lithuania; Henrikas Šiaudinis, Mayor of the Ignalina district and Chairman of the INPP Regional Development Board; Nikolajus Gusevas, Mayor of the Zarasai district; Dalia Štraupaitė, Mayor of Visaginas; Inga Šidlauskienė, Director of the Ignalina NPP Regional Development Agency	Meeting on the financing of the development plan of the Ignalina NPP region and socio-economic measures
May-October/ 2018	Rytis Kajėnas, Specialist in the Ignalina District Municipality Administration; Vidmantas Čepulėnas, Head of the Investment Division of the Ignalina District Municipality Administration; Donatas Mačys, Deputy Director of the Ignalina District Municipality Administration; Ramunė Šileikienė, Head of the Investment Division of the Zarasai District Municipality Administration; Elvyra Glušakova, Specialist in the Zarasai District Municipality Administration; Jonas Žusinas, Specialist in the Zarasai District Municipality Administration; Sergej Mickevič, Director of the Visaginas Municipality Administration; Inga Stankevičienė, Senior Specialist of the Investment Division of the Visaginas Municipality Administration; Rimutė Rinkevičienė, Head of the Property Division of the Visaginas Municipality Administration;	Discussions via phone, emails, meetings to determine the goals and the vision of the region and to make an action plan

	Viktorija Abaravičienė, Economist of state enterprise "Visaginas Energy"; Gediminas Kukanauskas, Director of Aukstaitija National Park and Labanoras Regional Park; Artūras Abaravičius, Chairman of Ilgiai Community; Erika Furman, Director of Future Society Institute	

6 Endorsement by implementers and political decision-makers

Regional politicians and municipal representatives were included in the planning process and are interested in the continuation of the strategy and implementation of the measures. An alignment of the development plans of municipalities with this Roadmap would ensure continuity. We will strive for this by following these steps:

1. The action and measure plans of the INPP region and the vision of the region firstly will be presented at the INPP Regional Development Council, consisting of mayors of regional municipalities, members of municipal councils and representatives of the Ministry of Interior of the Republic of Lithuania.

2. In the next stage, the documents will be presented at each of the regional municipal councils, consisting of elected representatives of the population. With the approval of documents, the action plans will be aligned with each municipality's development plans.

3. In the final stage, the documents will be submitted to the Utena Regional Development Council for approval and for harmonization of some measures and / or for its placement to the Utena Region Development Plan for 2021-2028.

7 Financing

Possible sources of funding are:

- European Commission funds;
- EU funds of targeted programs;
- State budget funds;
- Decommissioning fund of state enterprise Ignalina Nuclear Power Plant;
- Funds of municipalities of Ignalina and Zarasai districts and Visaginas;
- Private funds of residents and businesses.

A part of the funding will reach the region with the redistribution of EU funds through the Utena Regional Development Council according to approved priorities and concrete projects. Another part of the measures can be funded by submitting project applications to targeted funds and competing with national and EU projects.

According to their capabilities, regional municipalities will contribute with the co-financing of support funds.

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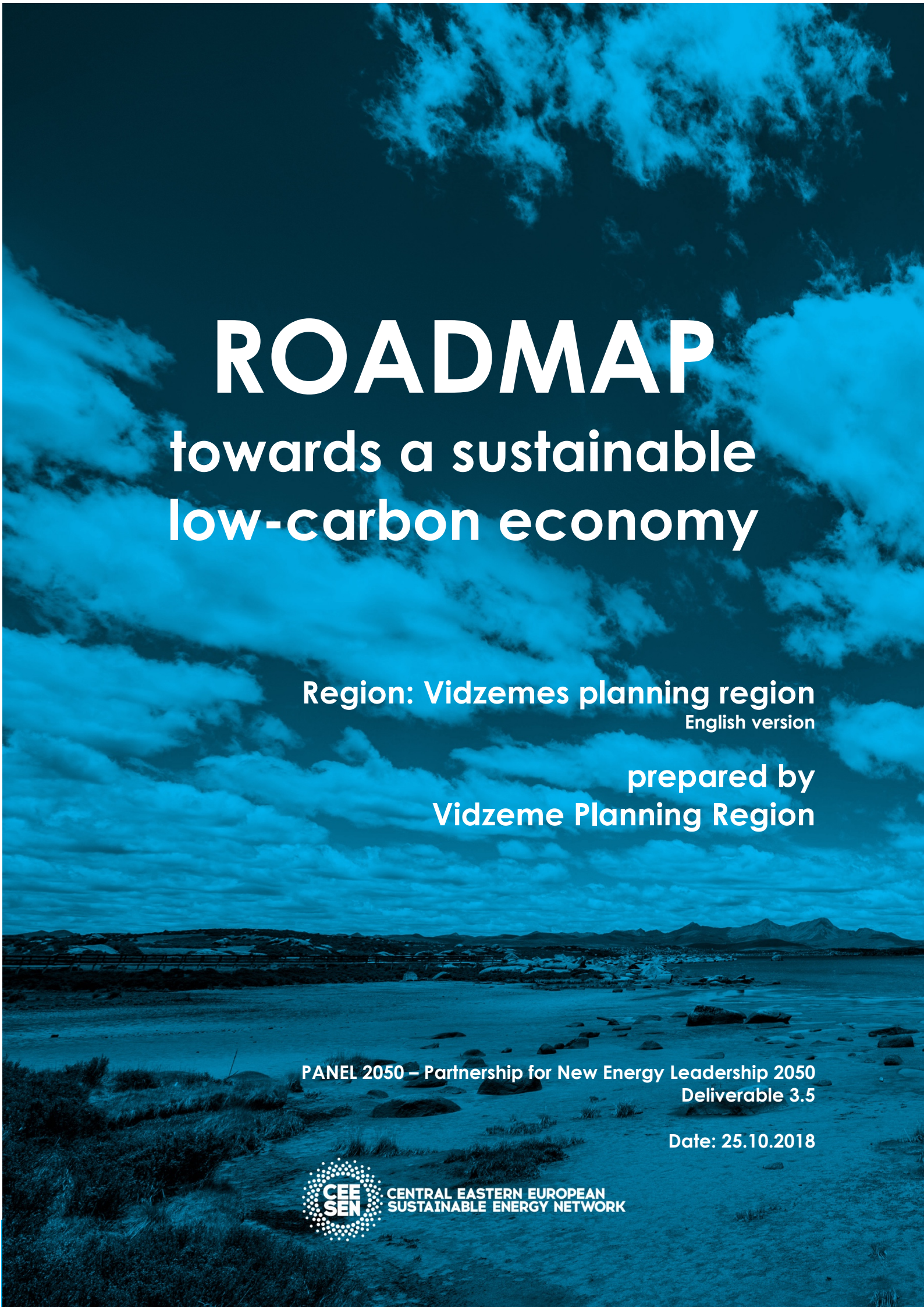
SUSTAINABLE ENERGY NETWORK



ROADMAP

towards a sustainable low-carbon economy

Region: Vidzemes planning region
English version

prepared by
Vidzeme Planning Region

PANEL 2050 – Partnership for New Energy Leadership 2050
Deliverable 3.5

Date: 25.10.2018

CEE SEN CENTRAL EASTERN EUROPEAN SUSTAINABLE ENERGY NETWORK

Roadmap scheme

About Panel 2050 project

The PANEL 2050 project has the aim to create durable and replicable sustainable energy networks at local (municipality/community) level, where relevant local stakeholders collaborate for the creation of a local energy visions, strategies and action plans. The aim of these networks is to contribute to and actively work for the transition towards low carbon communities in 2050. The PANEL 2050 partnership will provide support for the creation of first successful local energy networks in the CEE countries. In the course of the project, organisations from 10 CEE countries will collaborate on creating regional energy strategies and action plans. For more information visit https://ceesen.org/panel2050/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696173.

The PANEL model

PANEL model is a comprehensive approach for implementing local long-term energy management, supported by the community. PANEL model consists of seven main elements: Stakeholder Engagement, Training Program, Guidebook, Long-term Energy Visions/Roadmaps/Action Plans and Central and Eastern European Sustainable Energy Network CEESEN. These elements are developed by PANEL 2050 project to support the CEE communities on achieving their sustainability goals.

The Roadmap at hand is the output of the long-term energy planning process with the aim of plotting the regional transition towards a low-carbon community.

Attached to the Roadmap 10 specific Action Plans were developed, representing the first steps on this road toward low-carbon community by 2050.

Roadmapping process
Vidzeme Planning Region, Latvia

Stage 1

Baseline – Regional Energy Profile, VPR

Stage 2

Vision

In 2050, Vidzeme Planning Region is the region of smart solutions and climate aware population. Based on ICT and smart technologies & networks the Region effectively utilizes all kinds of available renewable energy resources (RES) and widely implement energy efficiency (EE) measures. The economy of the region is based on circular economy principles and ensures competitive development and increased well-being alongside with minimal CO_2 emissions. The region in 2050 emit around 70% less CO_2 than in 2015, the emissions reduction is reached in all sectors of region economy. Regional and local governments implement highly competent governance aimed at sustainable use of natural capital and responding/adapting to climate change.

Stage 3

Roadmap

Stage 4

Energy efficiency in public buildings

Action 1
Energy Action Plan for Vidzeme hospital

Action 2
Energy Action Plan for Priekuļi municipality

Action 3
Energy Action Plan for Pārgauja municipality

Action 4
Energy Action Plan for Lubāna municipality

Action 5
Energy Action Plan for Lizuma secondary school

Action 6
Energy Action Plan for Jaunpiebalga municipality

Action 7
Energy Action Plan for Gulbene municipality

Action 8
Energy Action Plan for Cesvaine municipality

Action 9
Energy Action Plan for Ape municipality

Action 10
Energy Action Plan for Alūksne municipality

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1 Introduction

The presented Roadmap of Vidzeme Planning Region towards a sustainable low-carbon economy is based on initially elaborated region's Energy Vision and CO_2 emission reduction target set for 2050 incorporating the principles of low-carbon circular economy. The development of the Roadmap had included such steps as (a) comprehensive analysis of current state of the region's energy sector, (b) definition of alternative development scenarios and evaluation of their perspective implementation on meeting the set 2050 target. By substantiating on these results, the priority areas of the Roadmap had been selected, followed by identification of the particular activities and measures within each of the areas.

The activities and measures outlined by the Roadmap will serve as a framework/guideline for Vidzeme Planning Region to set future detailed targets, develop action plans and projects regarding energy supply-demand sector.

Vision

In 2050, Vidzeme Planning Region is the region of smart solutions and population supporting climate friendly consumption. Based on ICT and smart technologies and networks the Region effectively utilizes all kinds of available renewable energy resources (RES) and widely implements energy efficiency measures. The economy of the region is based on circular economy principles and ensures competitive development and increased well-being alongside with minimal CO_2 emissions. In 2050 the region emits around 65-70% less CO_2 than in 2015, the emissions reduction is reached in all sectors of the regional economy. Regional and local governments implement highly competent governance aimed at sustainable use of natural capital and responding/adapting to climate change.

The 2050 Vision of Vidzeme Planning Region is supported by well-grounded development projections based on the analysis of the current situation, comprising projections on regional population numbers, economic activity, technology development and its use, and takes into account changes in the behaviour of energy end user at the growing level of information, knowledge, awareness and motivation of society on the whole as well as definite target groups and change agents.

2 Priority areas

The Roadmap focuses on four priority sectors:

- **Development of energy information system in the Region**
- **Energy efficiency: Public buildings**
- **Energy efficiency: Residential buildings**
- **Bioenergy**

When selecting the priority areas, the following was taken into account:

- The share of buildings in the final energy consumption in the region currently and their energy efficiency potential.

- Availability of regional resources for ensuring the development of bioenergy as a priority area.

- The capacity of regional /local government institutions to implement measures aimed at the development of these areas.

Development of energy information system in the Region

Effective organization of the energy sector data, information gathering and flow in the region, improving energy efficiency and monitoring the policy of increased RES use are the main preconditions for further execution of measures, assessing of the implemented measures and organizing cooperation among the parties involved. Implementing the given activities in the area will foster the development of a medium term energy development plan based on a quantitative and exhaustive analysis, monitoring of the plan execution, wider involvement of interested groups and community in the execution of the selected activities.

Energy efficiency in public buildings and **Energy efficiency in residential buildings**

The fact that energy efficiency in public buildings of local governments is a sphere of their direct impact was considered when deciding on improving energy efficiency in buildings to be a priority area. Public buildings are a significant energy end consumer. The household sector with its 29% in 2015 was the biggest energy end consumer among the sectors in the region. The greatest part of energy was used for district heating. Renovation of residential buildings and construction of new energy efficient buildings have high energy efficiency potential. Regional /local governments can vitally promote improvement of energy efficiency in residential buildings by different informative, counselling and other support measures motivating the apartment owners and inhabitants at large to engage in activities aimed at improving energy efficiency.

Use of bioenergy

Considering the available bioenergy resources in the region, the local governments in cooperation with private sector and inhabitants may promote further development of using bioenergy resources in all sectors of energy transformation and consumption in the region. Bioenergy as a priority area is aimed at increasing the self-supply of the region with energy and more rational and sustainable use of the available bioenergy resources as well as strengthening the regional network of economic cooperation in the bioenergy sector.

3 Actions and development scenarios

To assess the ways for achieving the goals set in the Vision and define the priority areas in the Roadmap for Vidzeme Planning Region, several energy development scenarios were prepared and analysed. The given scenarios provide an opportunity to analyse development from the current situation to the goals set in the Vision. The energy scenario analysis served as a basis for defining priority areas in the Roadmap.

In its turn, analysis of the socio-economic scenarios developed for Vidzeme Planning Region Sustainable Development Strategy (Strategy 2030) served as a basis for creating these alternative energy development scenarios. Socio-economic forecasts from the Cooperation scenario in Strategy 2030, balancing competitive and cohesive approaches,

were used to create alternative energy development scenarios. The Cooperation scenario underlines developing cooperation between economic, knowledge and governance networks. Great attention is paid to ensuring availability to social services in remote and scarcely populated areas by a wide-scale use of information technologies. The Cooperation scenario envisages implementation of integrated inter-sectoral policy solutions, specialization of less developed areas, combining of material and immaterial development tools, good coordination between different governance levels and sectors. The Cooperation scenario sees cooperation between local governments as one of the vital factors to improve effectiveness of service costs and ensure efficient introduction and maintenance of infrastructure.

3.1 Status of R&D, innovations and technology

Global perspective

Implementation of the Energy Development Scenario 2050 for Vidzeme Planning Region is grounded on the current global scale development of energy efficiency and RES technologies resulting in the economic benefits when using these technologies alongside with competitiveness with the existing technologies.

Electricity production

The Scenarios foresee active implementation of **solar PV technologies.** The forecasts of these technologies' future cost clearly show the decreasing trend for the specific investment cost for the total system:

- ***small residential PV installations, usually mounted on the roof:*** in 2030 the specific investment, compared to 2020, will decrease by almost 25%. Significant decrease of the cost is expected after 2030; in 2050 the anticipated cost is per almost 50% lower, compared to 2020.

- ***commercial PV systems*** (with capacity up to 500kW, typically installed on service/public sector buildings): in 2030 the specific investment, compared to 2020, will decrease by 20%; in 2050, compared to 2020, the anticipated cost is per almost 40% lower. It has to be noted, the specific investment for the larger building-scale system will be lower, if compared to small residential installations, due to scale effect.

- ***Large scale utility systems, mounted on the ground (PV parks):*** in 2030 the specific investment, compared to 2020, will decrease by almost 20% as well; in its turn, in 2050, compared to 2020, the anticipated decrease of cost is slightly above 30%.

Trend in research and development (R&D) activities on solar PV reflects a change of focus from manufacturing and scale-up issues (2005-2010) and cost reduction topics (2010-2013) to implementation of high efficiency solutions and documentation of lifetime/durability issues (2013-). In 2020-2030 crystalline silicon (c-Si) as well as thin film solar cells is expected to dominate the world market. In its turn, polymer/organic solar cells are emerging technologies where significant research activities are among others currently addressing efficiency and lifetime issues, these cells are expected to develop into commercial products by 2020-2030, but are currently not considered candidates for grid-connected

systems. Important, cost evaluations show, in 2030 the specific investment of solar PV technologies will be lower, compared to wind energy technologies.

Wind technologies. The forecasts of large scale on-shore wind technologies' future cost also show the decreasing trend for the specific investment for the total system, however this decrease will not be so significant, compared to described above solar PV technologies. In its turn, for small scale wind technologies (below 25 kW) rather high specific investment will continue. Global R&D activities will relate to reduced investment costs resulting from improved design methods and load reduction technologies, more efficient methods to determine wind resources, incl. external design conditions, e.g. normal and extreme wind conditions, improved aerodynamic performance, reduced operational and maintenance costs resulting from improvements in wind turbine component reliability, development in ancillary services and interactions with the energy systems, improved tools for wind power forecasting and participation in balancing and intraday markets, improved power quality, noise reduction (new technology will possible utilize good sites better, where the noise set the limit of number of turbines), repowering strategies, storage issues as well as public acceptance.

Biomass (wood) CHP technologies. The forecasts of biomass (wood) CHP technologies' future cost do not anticipate significant change in specific investment for the whole period up to 2050. Highly important task of biomass technologies development will be providing compliance with tightening regulation on air polluting emissions. Global R&D will relate to reduce the cost of fuel, by improved collection and pre-treatment, better characterisation and measurement methods, to improve combustion process and flue gas cleaning technologies to reduce emissions, to provide environmentally safe recycling of ashes, handling and combustion of new types of fuels (e.g., garden/park waste), etc. The research on solid biomass gasification and penetration of related technologies will continue. It has to be anticipated also penetration of such advanced technologies as solid oxide fuel cell CHP (natural gas/biogas) and Stirling engines (gasified biomass).

Biogas R&D activities will focus on a number of areas to increase energy production and improve the economy of the plants, better technologies of reducing storage of animal slurry before digestion, reduction of methane leakage from tanks and processing equipment, biological optimisation, use of material with higher dry-matter content, optimisation of logistics, etc. Due to the R&D, in 2050 the decrease of the specific investment cost of biogas CHP technologies per 10-20% (depending on type and configuration of the technology), compared to 2020, is anticipated.

Biogas Upgrading is an alternative technology to on-site combustion. Due to active R&D and competition among different upgrading technologies, the significant increase of technological performance as well as economical performance will take place. In 2050 the decrease of the specific investment cost of biogas upgrading technologies up to 25%, compared to 2020, is anticipated.

District Heating

District heating (DH) currently plays important role in the towns of Vidzeme planning region. The development of DH systems as a whole and their particular technologies/components demonstrates the long-term tendencies in urban heat supply. In 2020-2050 the transition to fourth and further generations of DH systems will take place. The clear trend for DH systems is to move to much lower distribution temperatures and distributed heat transfer

instead of combustion. The transition from load side district heating to source side district heating saves energy and accommodates the recycling of heat.

The ***fourth*** generation (4G) DH is based on a lower temperature water distribution to limit installation costs and heat losses to the ground, together with a higher contribution from local/regional renewable energy sources and secondary heat sources (such as waste heat or heat transfer from groundwater) in order to limit both CO_2 emissions and reduce air pollution. Reducing the operating temperature of heat networks allows the installation of less expensive distribution circuits between buildings, without the need for expensive insulation to restrict heat losses to the ground and allowing for absorbing heat from low grade waste heat sources. A 4G DH network is coupled with higher insulation standards for buildings to restrict the amount of heat needed and looks forward to the electrification of heat by using heat transfer instead of combustion to provide the heat and to integrate with smart electric networks to balance the demands on the electric grid by using the thermal mass of buildings to store heat, and to restrict demand for electricity when there is supply pressure on the grid. Thus, cost effective retrofit of existing buildings, including the buildings that are not currently on DH networks, so that they can be connected into scalable heat networks, and more efficient heat emitter systems within buildings to accommodate lower operating temperatures, are necessary pre-condition for implementing 4G DH network. The development of 4G DH also employs distributed heat transfer in building using heat pumps to achieve heating when buildings need heating, and to reject heat to the network when a buildings need cooling.

However certain restrictions related to development of such next generation DH system exist. As already underlined above, the one of key pre-conditions for implementation of 4G DH system is deep energy efficient retrofit of existing buildings. At the same time it might appear there is no economically justified to reach such high energy efficiency in case of renovating existing multi-apartment buildings. Thus, in particular areas with renovated multi-apartment buildings the previous DH systems with maximally improved efficiency could continue to operate. In its turn, the construction of new apartment and public buildings have to be considered in the context of perspective development of 4G DH system.

Regional capacity

The region is relatively rich in resources for bioenergy (wooded) and different wood processing companies operate successfully there. Use of low-value wood resources for generating renewable energy and first processing of wood is well developed in Vidzeme. The population ratio with specialization in wood processing is high, providing a potential use of logging and wood processing waste. Food manufacturing companies, operating in the region, also has biowaste that can be put to good use. Recycling of biologically degradable waste is one of the bioeconomy spheres for the region to be able to develop.

National perspective

Use of solid biomass for heat production

Latvia has considerable experience and local experienced companies regarding the use of all types of wood biomass (wood, wood processing waste, wood chips, briquettes and pellets).

At the same time, Latvia has relatively little experience as regards the use of straw; only one boiler house has recognized it as the basic fuel. Use of straw, including research about it as supplementary fuel, is one of the prospective tasks.

Grain processing residues accumulate in Latvia as well, consequently they might be used for heat generation. SC Rīgas dzirnavnieks used co-financing from the National Green Investment Scheme (NGIS) for the purpose. In the period 2014-2016 the company used as fuel about 2.6 thousand tons of grain processing residues.

Use of solid biomass for electricity generation

Latvia started accumulated experience as regards the use of wood biomass at the beginning of the 2000s. Currently, the average power plant electrical capacity is 1.36 MWel. The average number of working hours (referred to total electricity generation capacity) is 5730.

In Jelgava, Ltd Fortum-Jelgava, a high capacity combined heat and power plant with electric turbine 23 MW_{el}, uses solid biomass.

Technologies used in Latvia:

- engines,
- ORC cycle,
- steam turbine,
- relatively little experience regarding solid biomass gasification technology[1].

Use of biogas for electricity generation

In the 2007-2013 EU funds planning period, from 2010, **biogas production from agricultural raw materials** started developing significantly, supported by the national Rural Development Programme.

The average power plant electrical capacity is about 1 MW_{el}. The average number of working hours (referred to total electricity generation capacity) is 6891h.

Attention needs to be focused on the following challenging issue. Today maize stems constitute most of raw material for biogas. In the future biogas power plants have to contribute increasingly in the development of sustainable agriculture. Thus, the challenge will be large-scale digestion of organic manure (prospectively up to 70% of all raw materials for biogas). The problem of food waste as admixture for biogas production is to be solved as well.

Biogas power plants on landfill sites. In Latvia there operate several biogas power plants in landfills already now; Ltd. ZAOO, operating in the Vidzeme Planning region, is one of them.

[1] Only one relatively high capacity power plant of 1MWel was launched in the period 2007-2013, supported by the EU funding.

Biogas production from sewage sludge. It is not widely used in Latvia. Riga Waste Water Treatment Plant is one to use sewage sludge for biogas production. Sewage sludge and organic waste are used in Jaunkalsnava biogas power plant, too.

Biogas upgrading to biomethane quality. Latvia has no experience in this field up to now. Mainly it is because no strategic target has been set consistently at a national level regarding the use of biogas in vehicles. In the long-term perspective biomethane use as a vehicle fuel should be considered as a one of RES developments in the transport sector.

Research and technologies

National perspective

Important research on energy and mitigating climate change impacts is done within the framework of the National Research Programme. Separate themes are also investigated in the collaborative research projects and thematic research projects within the framework of national Fundamental and Applied Research Programme as well as in the projects for science and research co-financed by the EU Structural Funds.

Scientific research institutes and organizations of Latvia actively participate in the EU Horizontal Programmes: the EU Research and Innovation Programme Horizon 2020 (also *ERA-NET* projects), *LIFE* programme (the EU's financial instrument supporting environmental, nature conservation and climate action projects aimed at innovative and sustainable improvements) as well as developing solutions to be implemented in practice within the framework of the Interregional Cooperation Programme for Europe *INTERREG*.

Regional capacity

Several higher educational establishments operate in Vidzeme Planning Region offering engineering and ICT study programmes:

- **Vidzeme University of Applied Sciences:** the 17 study programmes include also such as Information Technologies, Construction of Wooden Buildings and Ecobuildings, Mechatronics. In 2014 a modernized complex for engineering studies was launched.

- **Riga Technical University Cēsis Affiliate** (among the study programmes are such as Computer Systems, Computer Control of Electrical Technologies, Power and Electrical Engineering)

- **Riga Technical College, Vocational Education Competence Centre in Priekuļi.**

Research is also developed in these higher educational establishments. Vidzeme University of Applied Sciences has Socio-technical Systems Engineering Institute, Institute of Social, Economic and Humanities Research, and Knowledge and Technology Centre. Bioeconomy is researched at a research centre of national importance – **Agricultural Resources and Economics Priekuļi Affiliate at the Latvia University of Life Sciences and Technologies**. Priekuļi municipality houses also the **Institute for Environmental Solutions,** a foundation which utilising the latest information technologies, especially airborne remote sensing technologies, develops innovative environmental solutions for sustainable use of natural resources. However, the R&D potential in the region is not sufficient to ensure research in all the selected fields (climate policy, energy efficiency, RES technologies) and

developing active cooperation not only between the national research institutes, but also international cooperation is required.

3.2 Business-as-usual scenario

Synopsis on the current situation

Population. The population in Vidzeme region was 195998 inhabitants at the beginning of 2016. About 21% of the total regional population resided in the two biggest regional towns (Valmiera and Cēsis). At the beginning of 2016 in comparison with 2010 the population number in Vidzeme region was by 7.5% lower. The working age population constituted 61.5%.

Final energy consumption. The calculated final energy consumption in 2015 in Vidzeme region was 4900 GWh. Among the sectors, the household sector had the highest final energy consumption (29%), while the ratio of the services sector (public and private services) constituted 16%. As regards the other sectors: transportation – 26%, industry – 18%, agriculture – 11%.

Analysis of the primary energy supply allows concluding that RES constitute almost 50% of the total primary sources. They are made up by solid, gaseous and liquid biomass, hydropower and solar energy. Wood biomass constitutes about 85% of the total RES volume in Vidzeme planning region. About 50% of the primary energy resources are provided by imported fossil resources (oil products, natural gas and coal).

Heating. District heating systems are widely used in the region. About 56% of the supplied heat is produced by using local wood biomass as fuel.

Electricity generation. The capacity of fossil fuel and RES power plants in Vidzeme region is low if compared to the total power capacity generated in the state. Irrespective of the launched RES power plants in Vidzeme region in the last decade, in 2015 they provided only about 23% of electricity consumption in the region. Total RES power generating capacity in Vidzeme region is slightly above 34 MW. About 43% of the total RES generating capacity is produced by the biomass fuelled combined heat power plants (CHPP), 30% – by the small hydropower plants and the rest by the biogas fuelled CHPPs. Assessment of the power volume generated by RES allows concluding that the greatest part is produced by the biomass fuelled CHPPs (56%), ranking next are the biogas fuelled CHPPs (35%), and the share of the small hydropower plants is 19%.

Most of **CO_2 emissions** in Vidzeme Planning Region is due to the use of fuel in road transport (45%). Other sectors produce approximately an equal amount of the remaining share: the services sector – 15%, industry – 11%, the household sector – 14% and agriculture – 15%. A note should be made that in agriculture only those emissions are calculated which are produced from combustion of fuel in stationary and mobile equipment.

Baseline scenario

The baseline scenario for developing the energy sector presumes continuation of the current trends regarding improvement of energy efficiency and RES use. Energy consumption is projected on the basis of the following assumptions:

- Changes in the population number;
- Changes in added value in the sectors of economy;
- Changes in heat consumption per m^2 in residential buildings, based on the intensity of building renovation;
- Changes in the energy efficiency trends in the sectors of economy, services and transportation.

Population: until the year 2035 the current trends continue and the population number decreases. After 2035 the number stabilizes.

Economy: growth in all the most important sectors, i.e. manufacturing industry, services and agriculture. The economic development rate is similar to the projected development trends in the national economy. No rapid and cardinal structural changes in economy are predicted, i.e. material changes in the ratio of separate sectors, and the economic development is in line with the approach of balancing cooperation and cohesion as laid down in the Cooperation scenario in Strategy 2030.

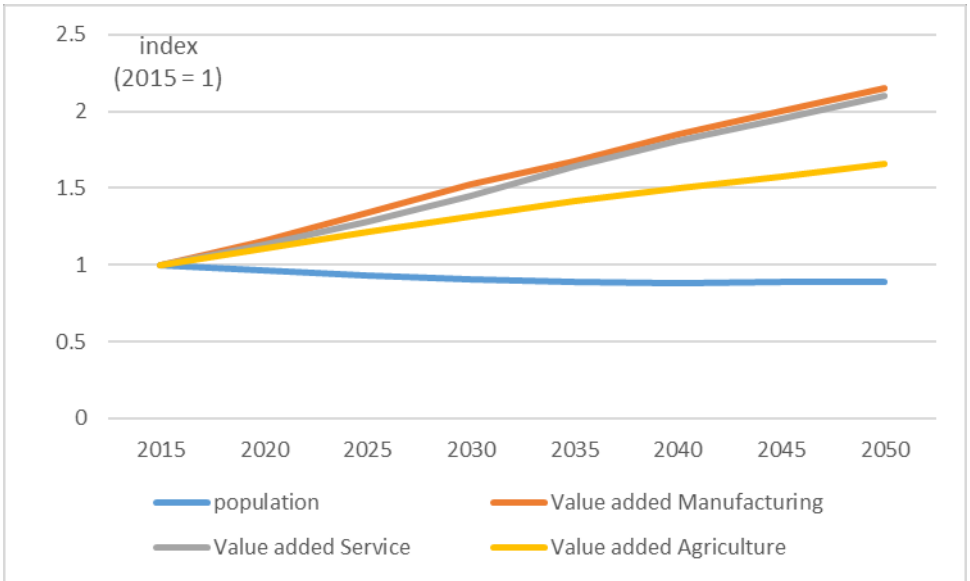

Figure 1 The main macroeconomic indices applied for calculation of energy demand in Baseline scenario

It is important to underline that the **baseline scenario is not a stagnant scenario.** It forecasts relatively high renovation of present houses and construction of new buildings which makes the reduction of specific heat consumption (kWh/m^2/y) in households possible. RES use continues to increase by reducing the specific CO_2 emissions average factor (t CO_2/MWh) in the power and district heating systems. Consequently, it needs to be underlined that the implementation of the baseline scenario will require effort and specific actions to ensure sustainable further development of the current trends in the energy sector.

Preconditions for the reduction of specific heat consumption in residential buildings in the baseline scenario

The baseline scenario predicts the specific heat consumption in residential buildings by 50% lower in the year 2050 than in 2015. The target will be reached as about 25% of apartment blocks are houses constructed after 2015 and 50% of the present buildings are renovated. Similar trends, though with lower renovation intensity, are predicted for single-family residential buildings.

The baseline scenario predicts that the economy growth rate, competition and innovations ensure continuous improvement of energy efficiency in all economic sectors. Assumptions about the improvement of energy efficiency imply energy intensity in the sectors of industry and services to be by about 40% lower in the year 2050 than in 2015.

On the basis of the given assumptions, final energy consumption and CO_2 emissions were projected in the baseline scenario (see Figures below).

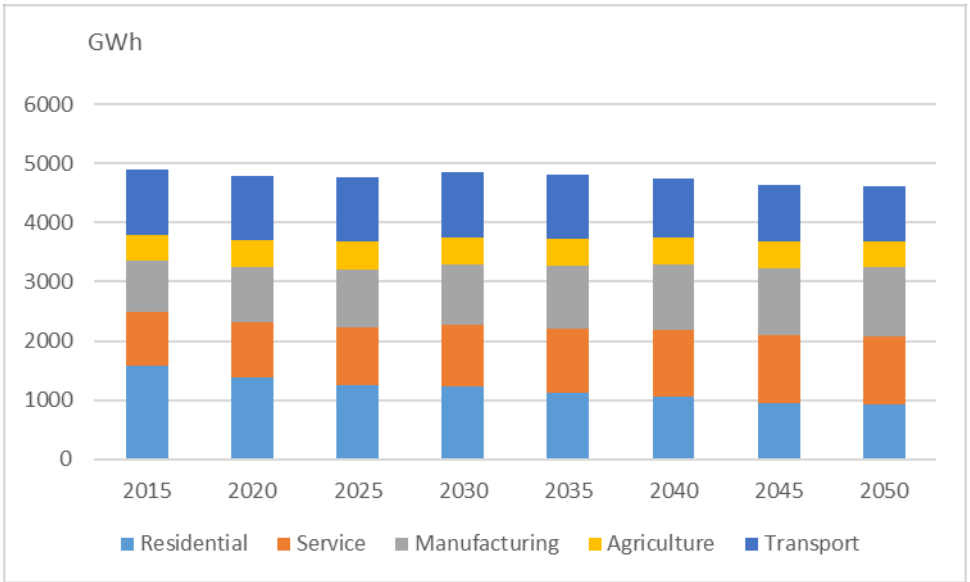

Figure 2 Projected Final energy demand in Baseline scenario, GWh

On the basis of the above described predictions on economic development and demographic indices the projected final energy consumption is by 6% lower in the year 2050 than in 2015. The greatest changes in the final energy consumption occur in households where it decreases by about 40%, considering the demographic projections and energy efficiency measures implemented in buildings. Reduction is projected also in agriculture and transportation, while in the sectors of services and industry, irrespective of assumptions about reduced energy intensity due to the increase of production and services rendered, final energy consumption is predicted to increase up to 25% in the year 2050, compared to 2015.

The baseline scenario envisages a wider use of RES in electricity and heat production. The forecast includes an extensive use of electrical vehicles and alternative fuels (CNG, LNG, biofuels and biomethane) in the road transport sector. Taking account of the above, the

predicted CO_2 emissions are by 28% lower in all sectors, the greatest reduction being in the household and transportation sectors, 42% and 40% accordingly.

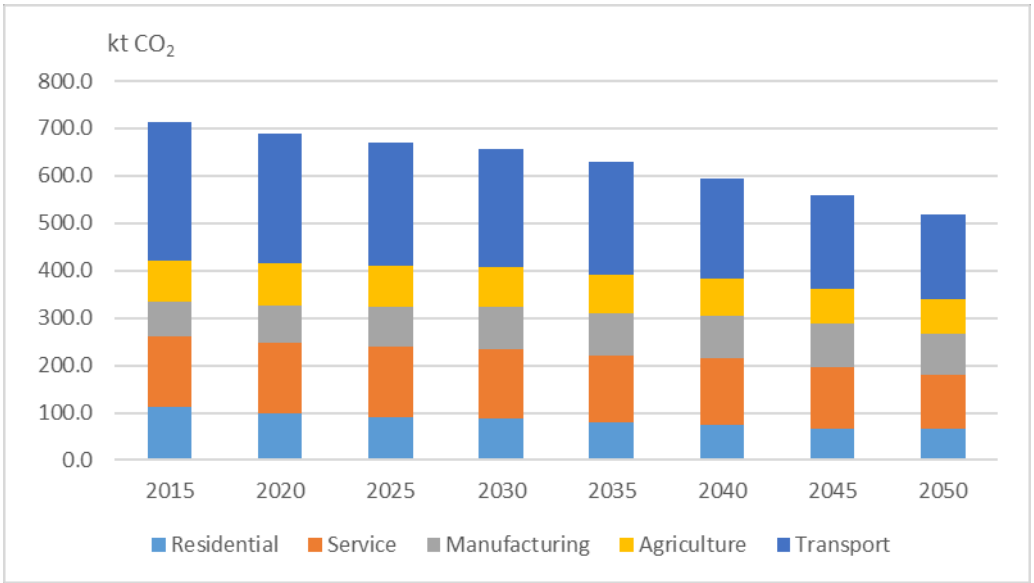

Figure 3 Calculated CO2 emission projections under Baseline scenario

3.3 Development scenarios

Analysis of the baseline scenario reveals that the predicted development regarding the increase of energy efficiency and a wider use of RES is not sufficient for attaining the goals set in the Vision for the region. To assess the possibilities for reaching the targets, two alternative scenarios were developed containing the calculation of final energy consumption and CO_2 emissions:

- **Energy efficiency scenario** which offers high-intensity implementation of energy efficiency measures compared to the baseline scenario, and
- **Target scenario,** the precondition of its execution requires a wider use of RES in combination with the implementation of additional energy efficiency measures.

Energy efficiency scenario

Assessment of the energy efficiency scenario is vital as energy efficiency is recognized as the first leading principle for CO_2 emissions reduction. When developing the energy efficiency scenario, compared to the baseline scenario, a wider range of possibilities were analysed for implementing the energy efficiency measures in all energy consuming sectors. As regards RES use, the energy efficiency scenario retains the preconditions of the baseline scenario.

Residential buildings. According to this scenario, relatively vital renovation and construction of residential buildings take place, thus allowing the reduction of specific heat consumption (kWh/m²/y) in residential buildings by about 65% in the year 2050, compared to 2015.

Preconditions for the reduction of specific heat consumption in residential buildings in the energy efficiency scenario

To reach the specific heat consumption reduction in residential buildings in the year 2050 compared to 2015, about 40% of the apartment blocks are houses constructed after 2015 and about 90% of the remaining present apartment blocks are renovated. About 40% of the single-family residential buildings are constructed after 2015.

Other sectors. Introduction of new and replacement of old present technologies make it possible to reduce energy intensity in the sectors of industry and services by about 40% in the year 2050, if the energy efficiency scenario is compared to the baseline scenario.

Target scenario

The target scenario, compared to the baseline and energy efficiency scenario, predicts a much wider use of RES in electricity and heat production (the solar, wind, all types of biomass, etc.) and the use of electrical vehicles and alternative fuels (CNG, LNG, biofuels, biomethane) in the road transport sector. Alternative fuels (biofuels and biomethane) are also widely used in agriculture. Due to the wide-scale use of RES the specific CO_2 emissions average factor (t CO_2/MWh) in the electricity and district heating production is by about to 50% lower in the year 2050, compared to 2015.

Based on the assumptions made, final energy consumption and CO_2 emissions were calculated in the target and energy efficiency scenario. On the whole, assumptions about high-intensity implementation of energy efficiency policy and measures predict reduction of final energy consumption in the energy efficiency scenario by about 31% in the year 2050, compared to the baseline scenario. In the energy efficiency scenario the predicted CO_2 emissions in 2050 are by about 29% lower than in the baseline scenario and by about 49% lower than in the year 2015.

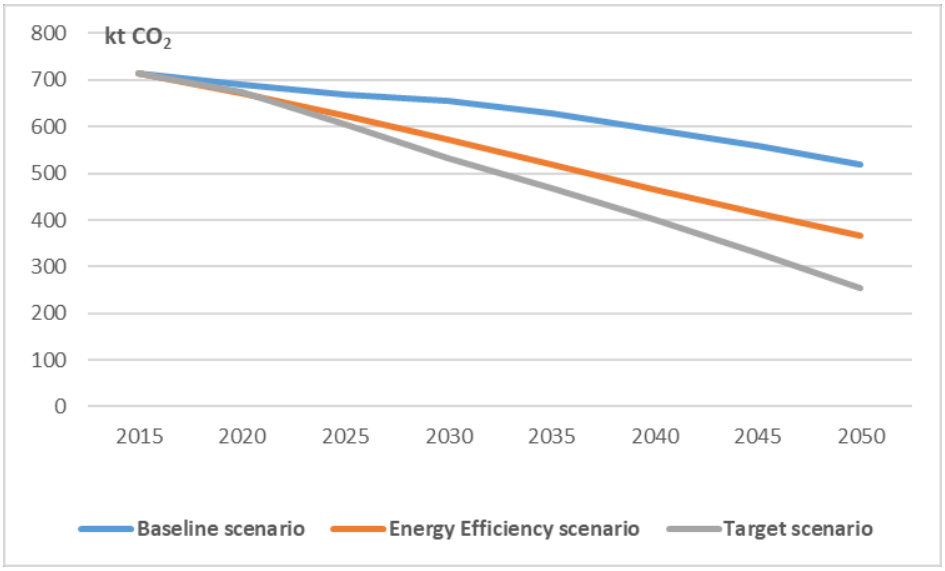

Figure 4 Calculated CO2 emission projections under Baseline and development scenarios

The predicted CO_2 emissions in the target scenario are by 50% lower than in the baseline scenario in 2050 and by 65% lower than in the year 2015. In all sectors reduction of CO_2 emissions in the target scenario in the year 2050, compared to 2015, is within the range 50-74%.

In the target scenario in 2050 most of emissions are in the transportation sector (35%) and the services sector (20%). The remaining share falls in approximately equal parts between the sectors of industry, households and agriculture.

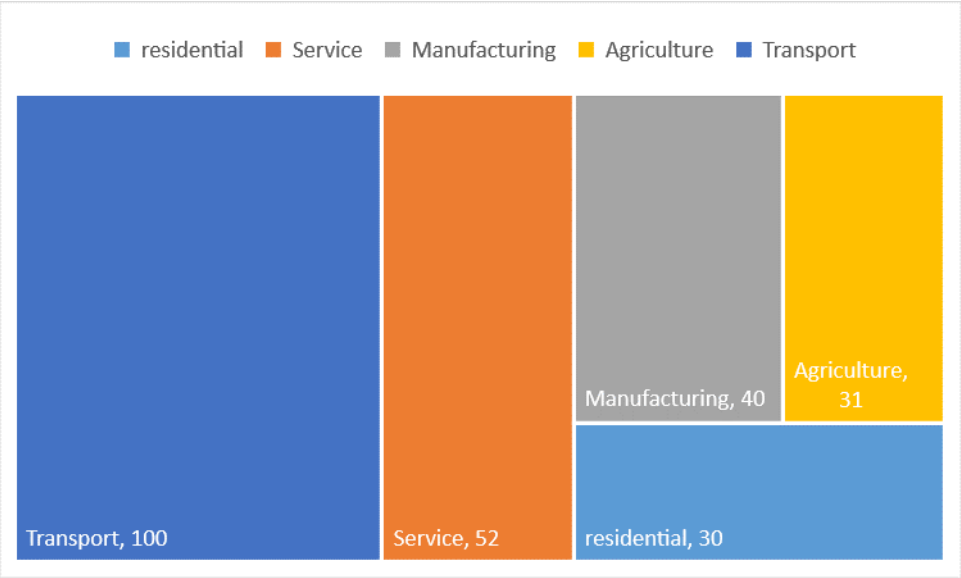

Figure 5 Calculated CO2 emission under Target scenario in 2050 by sectors, kt CO2

Preconditions for implementation of Target scenario

To implement the energy development direction and CO_2 emissions reduction outlined in the target scenario by 2050 in line with the priority areas, the following long-term actions are to be executed to ensure sustainable energy supply:

In **urban areas efficient district heating** is supplied, based on using bioenergy resources in combination with effective decentralized technologies.

Use of **high-efficiency** bioenergy and geothermal energy technologies, ensuring synergy for meeting air quality targets.

Use of smart technologies for ensuring construction of nearly zero energy new buildings.

Most of **public and residential buildings** are connected to **high-efficiency district heating systems** with an integrated feedback, ensuring flexible energy consumption.

Different **efficient energy saving technologies**, energy generating microtechnologies, energy storage technologies and solutions are combined in buildings.

Use of decentralized **solar energy technologies** in buildings (solar collectors and solar PV).

Public buildings with the installed smart technologies and solutions **serve as an example**.

An **energy management system** is installed in buildings, adapted to the demand and individual lifestyle of the inhabitants: smart and real-time power management tools enhance energy efficient lifestyle, flexible energy consumption and supportive infrastructure.

Public buildings have an **energy management system**, promoting versatility of their use according to the 24/7 principle.

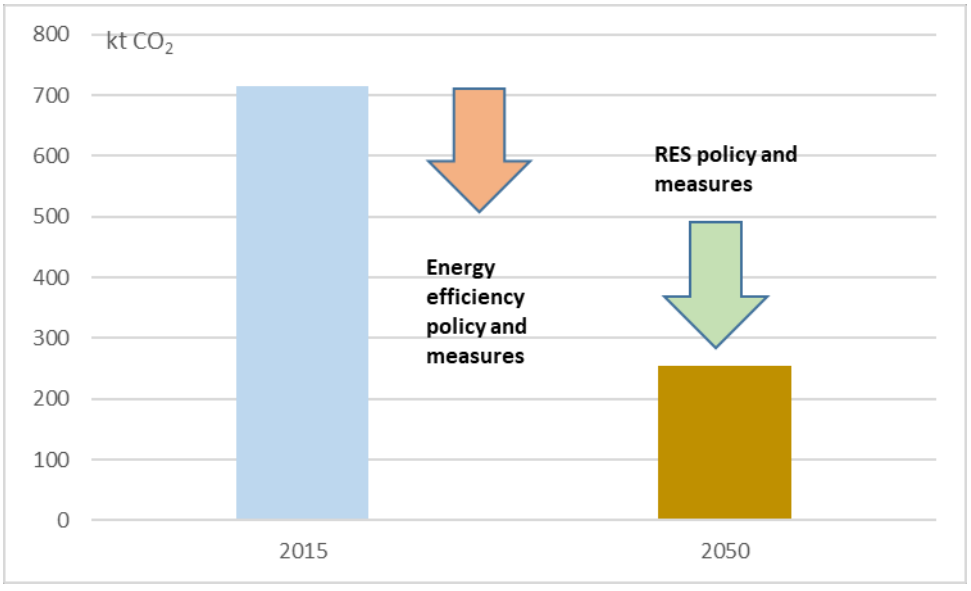

Figure 6 Actual (2015) and projected (2050) CO2 emissions in Vidzeme planning region and potential of Energy efficiency and RES policy to reduce CO2 emissions

Below in the chapter the overview of the *Roadmap's* selected priority areas and main activities and measures to be implemented in each of them are presented.

Priority area: Regional energy information and communication system
General Objective 2050: Effective co-operation between administrative levels and stakeholders **Specific Objectives:** • an efficient energy information and communication system operates in the region, providing timely, targeted and high-quality information to diverse target groups in the region; • an effective energy planning and energy management coordination system operates in the region. **Target Groups:** • energy end users target groups of the region • energy generation utilities of the region • administration system of the region and municipalities (institutions) • population of the region as a whole **Measures:** **Coordination of Energy Planning in the Vidzeme Planning Region** **The main tasks in the planning coordination will be:** • Organizing co-operation in the energy-climate sector between different levels of administrative governance (state-region and region-local government); coordination of energy and climate policies and measures between administrative levels. • Organizing co-operation in the energy-climate sector between stakeholders at different levels (state, region, municipalities) and areas of activity: renewable energy resources producers, energy (heat and electricity) producers (energy supply utilities), energy end-users in different sectors, construction companies acting at energy efficiency and the RES sector, investors and developers, funders, research institutes, and others. • Defence of the interests of the region at national level energy strategies, programmes and regulatory documents; inclusion of topical activities of municipalities of the region in the national energy-climate management; • Regional level planning in the energy sector; adaptation of national energy and climate policy objectives and tasks to regional and municipal policies, including the policy of the national low-carbon development plan, the allocation of activities and tasks at the regional level. • Developing a Regional Climate-Energy Plan linking sectoral development issues with GHG emissions reduction and adaptation to climate change. • Regional bioeconomic planning, demonstrating the impact of energy efficiency and RES on employment, local economy, land use, real estate value, etc. • Organization of sub-regional (several local municipalities) co-operation on energy supply-consumption planning issues.

- Establishing of energy advisors network in the region, elaboration and coordination of the network's operating programme, provision of informative materials for network operation. Organizing events to inform building and apartment owners and tenants about the various methods and practices used to improve the energy efficiency in buildings.
- Reducing barriers to implementation of energy efficiency measures by offering innovative programmes, presenting them to decision makers at different levels, and actively proposing changes to national strategy documents to facilitate the implementation of energy efficiency measures.

Activities of the Regional Energy Forum representing the stakeholders

- Determining the functions, rights, tasks and work procedures of the forum (elaboration of a forum statute, in co-operation with stakeholders)
- Organization of a regular, structured, solution-oriented dialogue among stakeholders within the Forum framework
- Consultations with the Forum in the process of elaboration of regional development and planning documents
- Assessment and integration of Forum recommendations in regional development and planning documents, recommendations for integration in documents at local municipalities and national level.

Establishment and operation of regional energy information and communication system

Providing end-user target groups with qualified and relevant knowledge and training, advising, promoting their engagement in activities, and shaping new forms of social organization. This includes the following tasks:

- Establish a regional-local government advisory (advisers) network for households.
- Inform all target groups about national level advisory activities.
- Develop information materials and provide information through diverse forms of communication (single campaigns and regular events, information on heat energy bills, development of a long-term information campaign on energy efficiency in buildings, etc.).
- Provide information on the possibilities of reducing energy consumption, the economic indicators of energy efficiency measures, the possibilities to attract funding to households and other target groups.
- Provide high-quality individual consultations: interactive web-based tools, Energy Efficiency Phone, and other ICT tools.
- Regional/Municipal Energy days.

Demonstration project network and its operation in the region

- Establish a system for demonstration of almost zero energy buildings in the region (residential and public buildings).
- With positive and tangible results demonstrate to the public the possibilities of using the RES and take the first steps in the wider use of the RES - creation of project folders with different perspective types of use of RES in buildings in the

Vidzeme planning region and further development and submission of projects to various funding sources.

Development and operation of regional energy data and information circulation and monitoring system

- Establish a data and information system for fuel and energy consumption in residential and public buildings, in co-operation with local municipalities and energy suppliers.
- In the information system, register the energy efficiency measures implemented in renovated residential and public buildings as well as the time of implementation.
- Develop tools that provide the preparation and delivery of the necessary data to local governments and other interested groups for the use in elaboration of various planning documents.
- Develop online tools that enable residents to make energy consumption comparisons between different residential buildings.
- Provide residents an access to energy consumption data in public buildings using online tools.
- Develop online tools that enable interested groups to assess the economic performance indicators of different energy efficiency measures and the use of RES technologies.
- Establish a planning and monitoring tool for energy efficiency measures based on the energy consumption data system.

Funding model

Existing:

Planning Region Administration - budget of the administration and funding from attracted projects.

To be developed in perspective:

- A common budget made up of local municipality contributions to ensure the basis of the regional energy planning coordination activities.
- Resources attracted by the planning region from the EU horizontal programmes.
- State budget line for the support of regional energy planning institutions (it is necessary to lobby for the establishment of such a budget line).
- Establishment of a paid service system for the provision of services.

Priority area: Energy Efficiency in Residential Buildings

General Objective 2050:
Energy-efficient and comfort providing residential buildings

Specific Objectives:
Decrease of specific energy consumption for heating in buildings, % vs 2015

Year 2030	Year 2050
By at least 30%	By at least 60%

Target groups:

- owners of apartments in multi-apartment residential buildings, owners' associations;
- tenants of apartments in multi-apartment residential buildings (non-privatized apartments);
- owners of single-family houses and residents of single-family houses in general;
- social risk/vulnerable social groups;
- society as a whole.

Sequence of implementation of strategic activities:

- **Information.** Includes the acquisition of data and information, the summarising of information, the creation of databases, organization of information in the target group-friendly manner, etc.
- **Organization of target groups.** Measures taken (i) to achieve a higher level of internal organization of the target group (e.g. multi-apartment residentioal building owners' associations and better organization of their work); (ii) at the same time, it also includes measures that provide organizational support within the municipality's structure (for example, a technical consultant for the building renovation projects in a municipality's administration structure).
- **Information for target groups, education, building-up the motivation.** Based on the established and improved organization of the target groups, information, advising, etc. measures are carried out creating incentives for the target group to undertake energy efficiency measures. Target group oriented information development, public availability of energy efficiency databases of buildings, including targeted user-friendly tools for evaluating the benefits of energy efficiency, including economic benefits, etc.
- **Local municipality financial support and immovable property tax credit programmes** for owners of existing housing stock for energy-efficient renovation of buildings
- **Local government** activities for the creation of a new energy-efficient housing stock.
- Providing highly qualified energy efficiency improving **renovation specialists in the region**.

Measures

Information on energy consumption

- Energy certification of multi-apartment residential buildings, municipal support programme for the energy certification of multi-apartment residential buildings.
- Creation of an energy consumption database of multi-apartment residential buildings, user-friendly tools for analysis of information included in the database.

Organization of target groups

- Establishment/development/improvement of work organization of apartment owners' associations of multi-apartment residential buildings
- Training and networking of energy managers of multi-apartment residential buildings (exchange of experience)
- Technical consultant for energy efficiency renovation projects in municipalities administration

Information for target groups, education, building-up the motivation

- Establishment of a regional energy efficiency advisory network (municipal co-operation programme and funding), provision of information and advice to residents, motivation of residents for participation in national level programmes (in co-operation with the national responsible organization)

Local municipality financial support and immovable property tax credit programmes

- Local municipality co-financing programme for small-scale investments in building elements/engineering systems/building energy management systems in multi-apartment residential buildings.
- Local municipality small-scale support programmes for the energy audit of single-family houses – both for buildings and for the evaluation of the efficiency of the equipment in buildings (e.g. boilers).
- Local municipality support programmes for specific social risk target groups for implementation of energy efficiency measures.
- Local municipality support programme for demonstration projects of energy efficient technologies and smart energy management tools in residential buildings [2].

Local municipality activities for creation of new energy efficient housing stock

- A municipal programme for the construction of new low-energy tenement houses (in municipalities with demand for housing space)
- Voluntary agreements with real estate developers on energy efficiency indicators in newly built residential buildings
- In the binding municipal regulations for the planning, use and building of the territory provide for favourable norms / numerical values to those owners / developers of buildings that renovate / develop highly energy efficient residential buildings (including the use of RES micro-technologies in them), in so far as this is not contrary to the public interest.

Providing highly qualified energy efficiency improving renovation specialists in the region

- At the regional level, in co-operation with professional associations and vocational education institutions, training is organized on the best available practice.

Funding model / possibilities

Existing

- Co-financing from EU funds (up to 2022 inclusive)
- Local municipality budget - municipal co-financing programmes
- Self-financing by owners
- Financing off the cost of energy savings

[2] The task of the programme is to establish a regional scale demonstration network for small-scale solutions in residential buildings. It is necessary to test both the possibilities of new technologies in practice/regional conditions, and to carry out this kind of demonstration close to the people of the region.

To be developed in perspective

- **Co-financing from EU funds for the next planning period**
- **Financing of municipal heat supply utilities.** Develop a mutually beneficial system (both for the utility and the consumer) where municipal heat supply utilities invest in energy efficiency improvements on the side of the heat final consumer.
- **Third-party financing -** ESCO companies. To develop an offer for the large-scale renovation of multi-apartment buildings to ESCO company(s).
- Develop and apply a credit of immovable property tax for investments in energy efficiency: the buildings have been renovated in accordance with the energy efficiency requirements of the renovated building, the reduction rate of the property tax according to the exceedance of minimum energy efficiency requirements.
- Develop a system (model) of attracting of funding from tenants, taking into account the future benefits from an energy efficient building.

Parties involved in the implementation of the measures:

Public sector

- National level: Implementers of a national support programme for residential buildings
- Regional level: Planning Region Administration, regional energy issues coordinating institution
- Municipal level: Municipal Council, municipal administration specialists, local municipality institutions, municipal capital companies
- Energy service provider level: municipal heat supply utilities

Research & Development sector – organization of co-operation with regional and national education and research institutions

Private sector:

- Residents-owners
- Energy managers of multi-apartment buildings,
- Financiers.

Priority area: Energy Efficiency in Public Buildings

General Objective 2050:
Energy-efficient public buildings

Specific Objectives:
Decrease of specific energy consumption for heating in buildings, % vs 2015

Year 2030	Year 2050
By at least 25%	By at least 60%

Main target groups:

- municipalities, municipal institutions, capital companies - owners of public buildings
- private sector - service providers in public buildings
- users of public buildings (service recipients / visitors)
- employees of institutions / companies located in public buildings
- society in general.

Measures

Information

- energy audit and energy certification of public buildings (meeting normative requirements and additional voluntary measures)
- creation of energy consumption database for public buildings
- public access to energy consumption data on the internet (for major public buildings)
- demonstration of renovated and new public buildings as a leading example for other target groups.

Organization

- Implementation of energy consumption management system in public buildings, including promoting the diversity of their uses according to the 24/7 principle.
- Development of renovation schedule for the public buildings (setting the minimum annual amount to be renovated).

Technical requirements and solutions

- When carrying out the renovation of the buildings owned by the municipality and/or the construction of new buildings, higher energy efficiency standards than specified in the national regulations are set.
- Installation of solar PV when renovating or constructing new municipal public buildings (schools, kindergartens and others).
- complying with high energy efficiency requirements in the building design of new public buildings: a combination of intelligent technological solutions (various efficient energy-saving technologies are combined in buildings, including energy recovery technologies, micro-technologies for energy production, especially solar PV, and energy storage technologies and solutions).

Financing model/possibilities

- Renovation, using co-financing from EU funds
- Budget of local municipality - a municipal programme for public building renovation.
- Financing off the cost of energy savings.

- Attracting the third-party funding (ESCO companies).
- Public-private partnership (PPP) models.
- Creating motivation for employees employed in public buildings, for finding the addition energy saving opportunities.
- Models for attracting financial resources of local / regional population: residents' co-operatives for the installation of RES technologies in public buildings[3].
- Implementing the economy of funds based on the scale principle - organizing regional procurement ensuring larger volumes purchases of equipment, devices and technologies.

Parties involved in implementation of measures:
Public sector
- Regional level: Planning Region Administration, regional energy issues co-ordinating institution
- Municipal level: Municipal Council, municipal administration specialists, local government institutions, municipal capital companies
- Energy service providers: municipal heat supply utilities
- Energy managers of public buildings.

Research & Development sector – organization of co-operation with regional and national education and research institutions
Private sector:
- Involvement in public procurement in accordance with the conditions specified in the national legal normative documents.
- Public-private partnership model.

Priority area: Bioenergy
General Objective 2050: Sustainable utilization of the region's bioenergy resources in general, implementation of circular economics in the bioresources sector **Specific Objectives:** • At least 90% of the heat energy constitutes RES • At least 90% of the electricity produced in the region constitutes RES **Main target groups:** • Owners/producers of biomass primary resources, • Producers of energy and fuel by utilizing biomass resources, • End-users of energy and fuel , • Society as a whole

[3] This kind of inhabitants co-operatives can be established for the attraction of funds to install renewable energy technologies such as solar PV, in public buildings of high-importance and used by significant numbers of people, such as schools.

Priority measures have been developed to cover the full range of the bioenergy resource chain, which ensures both the availability of bioenergy resources and the efficient use of bioenergy resources.

The sequence of implementation of strategic activities:

- Provision of information and organization.
- Energy planning in the municipality and integration of energy plans in municipal development planning documents.
- Spatial planning: promotion of bio-energy resources (RES resources in general) acquisition and use by developing the regional and municipal spatial plans and the municipal regulations for the planning, use and building of the territory
- Target group organization, including the establishment of a forum for mutual co-operation between the stakeholders and promotion of its work.
- Technical measures to expand the possibilities of using of bioenergy resources.

Measures

Provision of information and organization

- Mapping the territory of the region and municipalities regarding availability and volume of bioenergy resources (solid, liquid and gaseous bioenergy resources) and bioenergy production.
  (a) Traditional (already in large scale) bioenergy resources and their sites / production facilities,
  (b) New bio-energy resources (they are currently not used at all or used only in insignificant amounts) and their sites / production facilities,
  (c) Evaluation of the amount of the bioresidues in different sectors and their current uses, identification of new processing possibilities.
- Acquisition and analysis of information about the companies, both the bioenergy resources owners/producers and final energy consumers, development plans.

Energy planning

- Mapping of energy consumption of municipal territories (cogeneration potential, unused industrial heat potential, consumption according to types of energy resources, etc.) for the use of bioresources (for RES resources in general).
- **Analysis of a specific, previously unused bioenergy resource usage framework according to the scheme:** available potential of the resource in the region/subregion; the degree of development of the processing technologies; analysis of a specific target group (end users who will use this new energy resource or energy produced from it); a special emphasis on the use of bioenergy in the transport sector, particularly in public transport.
- Identification of sectoral bioenergy targets in different sectors.
- Development of municipal energy plans, linking them with the municipal energy management system.
- **Specific plans for the use of priority bioenergy resources with high processing need**[4]
- Integration of energy plans into the municipal integrated development planning system.

[4] As an example of such a specific plan is the processing of residues from food production and catering enterprises at biogas plants.

Spatial planning

- Thematic plan of bioenergy (RES in general) resource extraction/availability and bioenergy (RES in general) production units - regional and municipal level plans
- When planning new construction areas, it is recommended to include norms in municipal regulations for the planning, use and building of the territory that will promote the using of bioenergy (RES in general).
- Zoning of district heating based on bioenergy resources in regional municipalities (major cities).

Organization of target groups

Promote awareness among stakeholders of the benefits of bioenergy and foster mutual co-operation between them

- Public-private partnership planning. Integrated planning of three components "Production and supply of bioenergy resources - energy production - energy consumption" based on the co-operation of the parties involved. The involvement of local bioenergy resources owners/processors among the owners of the district heating companies, or the concession approach might be used.
- Social acceptance creation programme. The aim of the measure is to identify among the population of the region the main obstacles perceived and to carry out a well-considered campaign and information providing to increase the social acceptance for bioenergy (and RES in general) technologies.
- Development of a broader content regional bioeconomics plan, elaboration of a benefit-loss analysis.
- Establishment of a regional bioenergy (RES in general) stakeholder forum [5].
- Based on the work of the forum – establishing of bio-clusters in the region/sub-regions
- Coordination of the biomass logistics center.
- Promote co-operation between education and research institutions (national and regional level) and entrepreneurs on the development of bioenergy (RES in general) technologies in the region.
- Establishment of regional bioenergy technology demonstration center (in co-operation with national and regional research institutions),
- Promote the development of the region's smart specialization potential in the field of wood and biomass use.

Measures to ensure the consumption of bioenergy resources

- Efficient centralized production of heat energy from bioenergy resources - combining boiler houses into a single bio-energy network and, where appropriate, closing small / inefficient boiler houses.
- Effective transfer of heat energy from bioenergy resources – heating network renovation/replacement to reduce heat loss.
- Connecting new consumers to district heating networks using bioenergy resources.
- Efficient decentralized production of heat energy from bioenergy resources – promotion of replacement of inefficient heat-generating boilers with biomass-efficient boilers (as far as decentralized production is efficient) in the households and services sectors (municipal support programme might be considered).

[5] The forum's task is to create a regional framework for the use of bioenergy in the region, as well as the promotion of a concrete form of co-operation between consumers-suppliers and the public sector – private sector operators.

- Biogas upgrading to biomethane quality and utilization in the region's public transport.
- Green public procurement - the inclusion of green energy requirements in public procurement performed by the region and its municipalities, including green procurement in the public transport sector.

Finansing model/possibilities

Existing

- Co-financing from EU funds (up to 2022 inclusive)
- National green investment programme (Emissions Allowances Auction Instrument)
- Financing from municipal capital companies - heat supply utilities.
- Local municipality budget - municipal co-financing programmes
- Self-financing by owners: owners of residential buildings, private sector - services, manufacturing sectors
- active use of EU horizontal programmes, available for applied biomass energy research and implementation issues.

To be developed in perspective

- Develop funding programmes combining various available resources - EU financial support programmes, national budget programmes, local governments budgets, planning region financial resources, private funding.
- Public – private funding models.
- Cooperative funding: residents cooperatives for the implementation of bioenergy projects in the region and its municipalities.
- Centralized regional purchases of the bioenergy technologies and their components (scale effect, allowing for a reduction in the unit cost in the procurement).
- Immovable property tax credits for investments in high bioenergy (RES in general) technologies.

Promotion of national framework conditions
Development of new framework for the promotion of use of RES

Parties involved in implementation of measures:
Public sector

- National level: implementers of a national support programmes for bioenergy
- Regional level: Planning Region Administration, regional energy issues coordinating institution
- Municipal level: Municipal Council, municipal administration specialists, local government institutions, municipal capital companies
- Energy service providers: municipal heat supply utilities

Research & Development sector – organization of co-operation with regional and national education and research institutions
Private sector:

- residents-owners
- service and manufacturing sector companies

3.4 Milestones

Table 1 Summary of the sequence of implemented measures

Groups of measures	Year 2020	Year 2025	Year 2030	Year 2050
Priority area: Regional energy information and communication system				
Coordination of Energy Planning of the Vidzeme Planning Region	◎	◎	◎	◎
Activities of the Regional Energy Forum representing the interested/involved parties		◎	◎	◎
Establishment and operation of a regional energy information and communication system		◎	◎	◎
Demonstration project network and its operation in the region		◎	◎	◎
Regional energy data and information circulation system, monitoring system development and operation		◎	◎	◎
Priority area: Energy efficiency in residential buildings				
Information on energy consumption	◎	◎	◎	◎
Organization of target groups	◎	◎	◎	◎
Information for target groups, education, creating motivation	◎	◎	◎	◎
Municipal financial support and immovable property tax credit programmes		◎	◎	◎
Priority area: Energy efficiency in public buildings				
Information about energy consumption	◎	◎	◎	◎
Development of a time schedule for renovation of public buildings		◎	◎	◎
Technical requirements and solutions		◎	◎	◎
Priority area: Bioenergy				
Provision of information and organization		◎	◎	◎
Energy planning	◎	◎	◎	◎

Spatial planning				
Organization of target groups				
Measures to ensure the consumption possibilities of bioenergy resources				
 The programme for the implementation of the measures has been developed and implementation of measures has started		 The activity is implemented in accordance with the developed programme		

4 Impacts on regional economy

In all scenarios, including the Baseline Scenario, there is an increase in energy efficiency and expansion of the use of local RES. Thus, all scenarios have a predictable positive impact on the region's economy. Increasing energy efficiency has a positive impact on reducing energy intensity of manufactured products and services, thus increasing the competitiveness of companies in the regional. The greatest positive impact is expected in the Target Scenario.

Impact on employment

In the region, new jobs are created as direct jobs, as indirect jobs and as induced employment.

Direct employment is the jobs created (i) in the design, manufacturing, supply of RES or energy efficiency technologies; (ii) in the construction of RES plants or the implementation of energy efficiency technologies, including the management of the project implementation, (iii) in the direct operation of the constructed RES plants or new energy efficiency technologies, as well as in produced energy trading operations. ***Indirect employment (supply effect)*** means jobs created to: 1) produce the materials required for the supply of RES or energy efficiency technologies ("downstream" delivery effect); and (2) provide supplies for the operation of existing RES or energy efficiency technology ("upstream" delivery effect). ***Induced employment (induced effects on the general economy)*** are jobs created by increased economic activity, spending on employees in direct and indirect jobs.

Induced employment is a very important factor in assessing the impact of energy efficiency measures. In this case, a large part of the induced effect arises from the reduction of energy consumption by households thus earning additional funds for the consumption of other goods and services, thus contributing to economic activity in the region. In this respect, it is essential to make energy-efficiency investments in high-energy consumption households and to develop appropriate support instruments. Induced employment significantly increases the cost-benefit justification of energy efficiency measures.

It is important to point out that jobs, taking into account the supply chain and the mobility of population, occur at the regional, national and international levels (international supplies).

A conservative assessment shows that the introduction of RES technologies could generate around 400 direct jobs and around 800 indirect jobs. By contrast, the

implementation of energy efficiency measures in buildings could lead to around 800-1000 direct jobs and around 1200 - 2200 indirect jobs. Taking into account the scale of Latvia, part of these jobs will be attributed to the whole of Latvia, but most, of course, to the planning region.

The other important positive benefits are:

- The prices of RES (biomass) and produced energy are less susceptible to fluctuations than fossil fuel prices, which are determined by global trends,
- The use of local RES resources significantly increases energy security in the region,
- The use of local RES resources contributes to the region's positive import-export balance, as payments for local biomass resources are mostly kept in the region (instead of being paid off, as is the case with fossil resources),
- Since there is already a computer science and engineering study base estabished in the region at the regional (Vidzeme) university, the use of local resources and the demand for energy efficiency technologies will contribute to the further development of regional knowledge.

Regional economic specialization

Priority areas of smart specialization provided by the Regional Sustainable Development Strategy 2030:

A. *In the traditional areas of the region*
- high (higher) value added products, especially high added value timber products,
- production of healthy food and beverages
- recreation and sustainable tourism

B. *In areas related to the existing specialization*
- use of biomass for chemical processing and energy,
- rehabilitation and health services,
- smart materials.

C. *In the knowledge economy sectors*
- information and communication technologies
- cultural and creative industries,
- remote work and services

There is a joint development of different areas of specialization and interindustry co-operation, for example, products and services are created by linking with ICT, cultural and creative industries, etc.

As we see, the implementation of the Vision of the development of energy sector will contribute to areas of smart specialization in the region, such as the use of biomass for energy, information and communication technologies, smart materials and technologies. Significantly, increasing the use of production residues for energy production will contribute to the creation of a regional circular economy.

Implementing the Vision of the energy sector, there are no predictable major target conflicts with other regional development strategies.

One of the potential risks could be potential competition between the use of biomass for the production of high added value products and the use of biomass for energy production. At the same time, taking into account the diversity of biomass resources and the adequate planning of their use, it is possible to meet the interests of both parties.

5 Involvement of stakeholders

Regional Municipal Management and expert working group/groups.

At least 2 times a year, local municipality experts meet to discuss topical issues and develop and agree on common solutions. Specific working groups are:

- municipal management / executive management
- municipal development planning experts
- municipal project managers
- municipal energy managers
- municipal energy supply (heat supply) utilities

Regional stakeholder forum

Provides support for implementation of energy efficiency and the use of RES in the region. A regular, structured, solution-oriented dialogue takes place within the Forum. The Forum provides advice and recommendations in the process of elaboration of regional development and planning documents. The Forum provides recommendations for the region's climate-energy plan and its activities. The Forum also provides advice and recommendations to particular municipalities related to the energy sector development in their administrative areas. The forum meets at least once a year. The second meeting of the Forum Group is scheduled to be combined with the annual Regional Thematic Seminar "Vidzeme Energy Days".

The Forum will actively use modern IT communication forms for the completion of its tasks, thus ensuring regular work of the Forum, summarising opinions of the Forum members on topical issues, active communication with all other interested parties. The forum's coordinator in the IT environment will contribute to a high efficiency of the forum work.

The Forum will support the creation of energy clusters in the region.

The forum is intended to invite the following **stakeholders in the region:**

- Producers of RES and energy efficiency technologies or their components,
- RES technology project developers
- Energy efficiency project implementers
- Innovative companies in the region
- Regional business associations
- Regional farmers' associations
- Professional organizations in the region
- Local municipality leaders and development planners, municipal energy managers
- Municipal energy (heat) supply utilities
- Representatives from higher education / research institutions in the region
- Local NGOs
- Local action groups (LEADER groups)

Conflict Pro-active Identification

In order to promote the development of RES technology in the region, the Vidzeme Planning Region Administration, its energy planning specialists will have a task to identify

potential barriers and conflict points for the implementation of this kind of projects in a timely manner in co-operation with the Forum of Stakeholders and local authorities, and by proactively addressing them, facilitating social acceptance of the introduction of RES technologies among the various target groups in the region; identify those groups of population whose interests may be affected by the realization of such projects and pro-actively organize meetings, other types of advisory and mediatorial work to proactively resolve such conflicts.

Communication of the residents of the region and their specific target groups

Based on the 4 components of the general Environmental and Climate Communication cycle:

- provision of information
- offer of deeper non-formal education on specific topics
- provision of participation opportunities for the society target groups in order to promote energy efficiency and the use of RES in the region,
- climate-friendly behaviour of the society target groups.

Taking into account the specifics of the sector, the last two components are often merged in practice.

Specific measures are planned within the framework of the priority areas described above

Information provision and advisory assistance for target groups

Possible institutional solutions to be considered

- Energy expert or department in the administration structure of Vidzeme planning region
- Regional Energy Agency
- Regional/sub-regional (comprising several municipalities) Energy advisers
- Regional on-line/telephone advisory service

An important event will be the **regional club for the general society discussions on energy efficiency and the use of RES in households**. The administration of the Vidzeme planning region creates an organizational model of this club and a model of mutual communication. The club's goal is to disseminate information about projects and events implemented in the region. The club will place particular emphasis on the dissemination of information provided by the beneficiaries of energy efficiency and RES measures (for example, concrete benefits to inhabitants as well as other issues related to the energy-efficient renovation of apartment buildings). The club operates on both a regional scale and at the level of municipalities or several municipalities (in co-operation with the administration of local municipalities). There are both face-to-face meetings and seminars, as well as active club activities in the IT environment. There are also specific site visitations where innovative solutions for energy efficiency and/or use of RES technologies have been implemented.

Promoting new forms of population co-operation:

Most likely, that the creation of such forms of funding will not be possible in the near future, but can be considered in the long term perspective.

- Local savings and loan associations and their involvement in financing of small-scale energy efficiency and renewable energy resources projects

- An energy co-operative, created by the local/regional inhabitants, as the owner of renewable energy technologies (installation of technologies, management of them, etc.).

Broad-scale regional events

- Annual thematic seminar "Vidzeme Energy Days"
- Annual Energy Efficiency Award "Vidzeme Energy Efficiency Award" (prize categories for different target groups)
- Annual Innovative Renewable Energy Award "Vidzeme RES" (prize categories for different target groups)

Engagement of external stakeholders will include potential investors, national energy supply companies, national renewable energy associations, coordination with public administration institutions (national level), co-operation with national and international research. Participation is facilitated by the administration of the Vidzeme planning region in co-operation with local governments and the Forum of Stakeholders.

Overview of activities on development of the Roadmap

Date,place	Participants	Content/Results/Conclusions
18.05.2018, Valmiera	Entrepreneurs of Vidzeme region	The main goal was to interview entrepreneurs of Vidzeme region to get more information about their needs and obstacles to implement more energy efficiency measures in their production facilities.
14.06.2018, Valmiera	Municipalities of Vidzeme Planning Region	Presentation of Sustainable Energy Development Strategy in Europe and in Vidzeme Planning Region, Discussion on developed Action plans.
25.06.2018., social network	Followers of Vidzeme Planning Region Facebook account	The main goal of this survey was to find out what needs to be done in the near future and in the long term in order to ensure sustainable energy development in the region. We received 10 completed questionnaires with deep insight, what priorities are currently most significant in Vidzeme region.
10.09.2018., Liepa	– Municipalities of Vidzeme Planning Region	Discussion on roadmapping process and next steps in energy transition and stakeholder engagement.

6 Endorsement by implementers and political decision-makers.

The Roadmap will be approved by the decision making authority of the planning region - Vidzeme Planning Region's Development Council. After the approval, the Roadmap will have binding force for all of planning region's local municipalities which should take its priority areas, activities and measures into account when developing in future their local plans for energy sector development.

7 Financing

The implementation of the measures is based on several considerations:

1. Financial support for implementing measures
2. Tax considerations.
3. Payback time of the measure.

Sources of Funding

External financial support

- **Co-financing from EU funds, including the national Rural Development Programme –** energy efficiency of multi-apartment buildings, energy efficiency of public buildings, bio-energy in district heating systems, as well as other programmes. Currently available until the year 2022 inclusive (some activities can be completed sooner). After 2023 (the programming period of the EU funds 2021-2027), the financing model is currently under development, however, it is expected (National Climate Plan 2030, published 1st version, September 2018) that activities such as increasing the efficiency of district heating systems, the energy efficiency in multi-apartment buildings will be continued. During the programming period of the EU funds 2021-2027, it is planned to develop a support programme for the implementation of a district cooling system, which is an essential element in public buildings, and until now there have been no support programmes for this type of investment in Latvia. Taking into account the large number of single-family houses in Latvia, consideration is also given to the possibility of developing an energy efficiency improvement programme within the programming period of the EU funds 2021-2027 for this target group. It is planned to implement in the 2021-2027 planning period a similar type of energy efficiency programme for businesses. The type of support (grant, financial instrument) that will be provided to businesses is still under consideration.
    - In 2021-2027 Latvia will have an access to the EU **Innovation Fund**. The amount of funding available to Latvia is unpredictable, as the funds of the Innovation Fund will be applied by the Member States themselves after evaluating and approving the submission of projects from the project applicants in the country.
    - Member States whose GDP per capita in 2013 (at market prices) is less than 60% of the EU average, will be eligible for funding from the **EU Modernization Fund** after 2020. The Modernization fund will be available to finance energy efficiency improvement and energy sector modernization projects (including small-scale projects) in ten EU Member States, including Latvia. The amount available to Latvia for the implementation of projects could range from 54 MEUR to 112 MEUR.

- **EU horizontal co-operation programs for research and promotion of a supportive environment.** An increase in the available funds (in the EU as a whole) in these programmes is expected.
- **ES horizontal municipal co-operation programmes.**
- **National budget.**

Internal sources of financing

- National budget provided financing for the Planning Region.
- Local government shared financing for regional activities.
- Local government financing (for small-scale projects).
- Immovable property tax credits for target groups.
- Internal self-financing of target groups.

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CENTRAL EASTERN EUROPEAN
SUSTAINABLE ENERGY NETWORK

ROADMAP
towards a sustainable low-carbon economy

Region: North East Planning Region
(Republic of Macedonia)
English version

prepared by
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About PANEL 2050 project

The PANEL 2050 project (Partnership for New Energy Leadership 2050) has the aim to create durable and replicable sustainable energy networks at local (municipality/community) level, where relevant local stakeholders collaborate for the creation of a local energy visions, strategies and action plans. The aim of these networks is to contribute to and actively work for the transition towards low carbon communities in 2050. The Partnership for New Energy Leadership 2050 will provide support for the creation of first successful local energy networks in the CEE countries. In the course of the project, organisations from 10 CEE countries will collaborate on creating regional energy strategies and action plans. For more information visit https://ceesen.org/panel2050/.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696173.

The PANEL model

PANEL model is a comprehensive approach for implementing local long-term energy management, supported by the community. PANEL model consists of seven main elements: Stakeholder Engagement, Training Program, Guidebook, Long-term Energy Visions/Roadmaps/Action Plans and Central and Eastern European Sustainable Energy Network CEESEN. These elements are developed by PANEL 2050 project to support the CEE communities on achieving their sustainability goals.

This document is a result of the long-term energy planning process, in order to strengthen the regional transition to a low carbon economy. The 10 specific action plans that are attached to the Energy Transition Roadmap (ETR) were developed, representing the first steps on this path to a low carbon economy by 2050.

Roadmapping process

North East Planning Region, Republic of Macedonia

Stage 1 — **Baseline – Regional Energy Profile North East Planning Region**

Stage 2 — **Vision**

Bo In the 2050 the North East Planning Region is recognised as a Green Region, with energy-efficient innovative businesses and households, and developed sustainable tourism and organic farming.

Stage 3 — **Roadmap for Energy Transition**

Stage 4

— Energy Efficiency —

Action 1
Energy efficient public sector in the municipality of Kumanovo

Action 2
Energy efficient public sector in the municipality of Kratovo

Action 3
Energy efficient public sector in the municipality of Kriva Palanka

Action 4
Energy efficient public sector in the municipality of Rankovce

Action 5
Energy efficient public sector in the municipality of Staro Nagoricane

Action 6
Energy efficient school buildings in the municipality of Kumanovo

Action 7
Energy efficient public lighting in the municipality of Staro Nagorichane

— Decentralized production of renewable energy —

Action 8

Solar roofs in the Northeast

Action 9
RES for the optimum technological process

— Integrated measures for a low-carbon economy —

Action 10

Eco-villages in the Northeast

1 Introduction

The Roadmap for energy transition to a sustainable low carbon economy in the North East Planning Region (The Roadmap) is considering ways to improve energy efficiency (EE) and the use of renewable energy sources (RES) by 2050, with a more detailed focus by 2025. The identified objectives, the measures identified, and the developed action plans within the project had the main goal of raising awareness among all stakeholders in the region in the process of energy transition, and to encourage each separately to develop its own energy transition policy, which should take its proper place in the development plans that will be developed in the upcoming period. This is especially important for the North East Planning Region, considering that in 2019 a new National Strategy for Regional Development and the accompanying Action Plan will be prepared, followed up with the development of the Programs and Action Plans of individual regions and municipalities.

Vision for Energy Transition in the North East Planning Region

In 2050 the North East Planning Region is recognized as a "green" region with energy-efficient innovative businesses and households, and developed sustainable tourism and organic farming.

In the total final energy consumption in the region by 2050, ***renewable energy sources will increase to 40%***, and the greenhouse gas emissions ***will be reduced by 30% compared to 2016.***

The Roadmap does not replace national, regional and local efforts in terms of energy efficiency and modernization of energy supply, but is trying to develop a long-term regional framework in which these policies will be more effective. The approach to energy mapping will increase security and solidarity and will reduce costs compared to parallel national schemes by providing a wider and more flexible regional market for new products and services.

In this regard, it is important to mention the use of natural gas in accordance with the national gasification plans of the country, the implementation of which is of high priority and will be reflected in the plans and priorities of the region and municipalities, including households and the business sector. Gasification is not the subject of this roadmap, although its impact in some of the accompanying action plans is taken into account, in order to take into account that it is part of the energy transition process, but also as a risk in the use of RES and the slowdown in the process of energy transition.

The Roadmap aims to draw the attention of policy makers and implementers to the need for cooperation and the creation of a society that understands energy and in this direction emphasize the need for activities for:

- Creating a climate neutral economy
- Social fair economy and
- Joint, integrated activities in strategic areas

Here, the cooperation and support of the partners in the PANEL 2050 project, which through the exchange of experience and knowledge, should be emphasized in raising the awareness of the potential in the use of RES and the improvement of the EE, strengthening

the capacities of the stakeholders, the development of this Roadmap, and in identifying part of the accompanying Action Plans[1].

2 Priority areas

The Statement for Vision identifies three priority areas for focusing on the NEPR in order to become a "green region" over the next decades: 1) promoting and using local accessible renewable energy sources by the public sector, energy efficient, innovative businesses and households; 2) development of sustainable tourism; and 3) development of organic farming.

The specific goals that are aimed to be achieved by 2050 are:

- Consumers and energy producers are interested in implementing projects for the use of RES and energy saving. The necessary funding opportunities are sufficient, including for small projects (for households and small businesses);
- Renovated public and residential buildings with high standards for energy efficiency;
- Intelligent public lighting networks;
- Established smart energy distribution networks;
- Private operators adopt environmentally and energy-efficient heating, electricity and hot water systems for residential and commercial buildings;
- There are active advisory services available for the use of RES and improvement of EE. Consumers have available free and easily accessible reliable information on energy saving and sustainable energy consumption opportunities;
- Consumers use a combination of modern and green technologies for energy-efficient solutions based on renewable energy;
- Ensured sustainability of the environment and fight against climate change;
- The existence of many sustainable tourist attractions;
- Much of the agricultural production is organic;
- An integrated way of planning and supporting the development of the NEPR.

Priority areas for achieving the vision and specific objectives have been identified on the basis of research and analysis of current policies for improving EE and using RES in the region, the energy potential of RES, as well as the climate and geographical conditions of the NEPR. These are defined through the process of developing the Transition Power Transmission Network within the framework of the PANEL 2050 Project.

The areas of sustainable tourism development and organic farming are not part of the priorities of this plan, given that the measures resulting from the goals of improving EE, the use of RES and the environmental sustainability and the fight against climate change will be in focus on the development of other planning documents in the region. Reduction of CO2 emissions is reflected through the use of RES.

An overview of energy potentials from RES and the potential results of using RES in the NEPR are given in Table 1.

[1] AP: Solar roofs in the Northeast; AP: Eco-villages in the Northeast

Table 1: Energy potential from RES in the North East Planning Region

Renewable energy source	Energy potential	Annual generated energy savings, GWh/y		Annual Fossil/organic fuels savings, k. tones		Annual CO2 emissions reduction, k.t./y	Possible heated area		Required costs for renewable energy potential use, mil. EURO
		heat	power	coal	Fire wood		Green houses, ha	Residential, mil. m2	
1. Natural geothermal water source (heat)	974,40	3.008,80	0,00	578,00	1.042,80	1.075,10	326,10	9,39	601,66
2. Geothermal water sources artificially recovered (heat)	1.656,40	5.114,50	0,00	982,20	1.773,80	1.826,80	555,80	15,92	1.662,40
3. Aquifer steam-water natural sources (electricity)	326,05	0,00	1.883,80	967,00	0,00	1.798,50	0,00	0,00	476,80
4. Aquifer steam-water natural sources artificially recovered (electricity)	540,20	0,00	3.203,70	1.588,80	0,00	2.954,30	0,00	0,00	1.032,40
5. Heat sources of dry rocks, depth to 1500 м (heat)	524,90	1.629,60	0,00	312,10	565,00	581,50	177,40	5,10	570,40
6. Heat sources of dry rocks, depth to 3000 м (electricity)	125,00	0,00	728,80	372,90	0,00	707,10	0,00	0,00	267,80
7. Ground surface layer heat (heat)	186,15	780,20	0,00	149,60	270,40	278,20	0,00	0,00	146,20
8. Solar heat units (heat)	108,00	496,20	0,00	95,00	171,70	176,60	0,00	0,00	124,34
9. Solar photovoltaic units (electricity)	5,69	0,00	26,13	13,46	0,00	24,95	0,00	0,00	16,10
10. Wind power generators (electricity)	1,63	0,00	3,47	1,70	0,00	4,01	0,00	0,00	2,95
11. Biogas units (heat)	0,65	5,14	0,00	0,99	1,78	1,84	0,24	0,01	0,25
TOTAL	**2.747,13 heat** **768,98 electricity**	**11.034,4**	**5.845,9**	**5.061,8**	**3.825,2**	**9.428,74**	**1.059,7**	**31,09**	**4.901,19**

The table shows that the energy potential of NEPR from RES is important, both for the production of heat and for the production of electricity. Bearing in mind that this potential is almost unused, the measures for its use represent a great opportunity and challenge for all stakeholders in the NEPR.

In order the NEPR to become a low carbon community by the year 2050, the public sector, households and the transport sector must play an important role, given that they cover about 70% of the total energy consumption. Given the regional potential for RES, biomass and solar energy can be the main drivers for the use of RES in the region.

The following priority areas will be important for the NEPR to achieve the set goals by 2050:

The priority areas identified in order to initiate and implement the "first step of measures" aim, on the one hand, to ensure the further implementation of the already started implementation of the individual EE measures for each of the stakeholders, and on the other hand to provide an appropriate broad and multifunctional environment that will

enable consumers and energy producers to be very interested in using RES and energy saving.

In the period until 2030, it is important to provide support from consumers and energy producers who are interested in implementing projects for RES and EE improvement. Promotional activities, exchange of experiences, good practices, and above all the establishment of financial schemes to support the measures are a priority for all stakeholders, primarily the municipalities, and apply to all priority areas.

The identified priority areas are given below:

- **Energy efficiency**

This area may be the closest to the public sector, households and small businesses, from the point of view of the existence of examples in improving the efficiency of facilities, mostly by applying materials that increase the energy efficiency of buildings.

In terms of energy efficiency and the use of RES, public buildings should serve as an example for other buildings, primarily residential buildings. This means that the level of energy efficiency should be at least at the level of the requirements for efficient use of energy in buildings. In recent years, investments in municipalities in several public buildings are ongoing, but given that the levels of these renovations are not comprehensive, and as a result, most of the energy requirements can not be met. There is still great potential for improvements in this area.

Public buildings should be an example of good practice for residential buildings and in that direction there are initial steps for renovating residential buildings in the region, but it will still be necessary to promote the renovation of single family houses in order to achieve the desired level of energy efficiency buildings.

Energy efficiency in delivering public services is also of particular importance in the region. Here the focus will be on street lighting. Each of the municipalities has invested money in improving the service for the past years, through the reconstruction of the system, its expansion, replacement of existing lamps with new EE lamps. Also, the water supply and transport sectors in terms of their importance should increasingly be the focus of the municipal authorities in terms of EE.

In the context of the current and previously realized planning activities in this area, it is necessary, in accordance with the legal requirements, to develop, revise and upgrade the operational plans for energy efficiency in all municipalities in the region (including the municipality of Lipkovo that has not yet developed the Operational Plan for Energy Efficiency (OPEE).

- **Decentralized production of renewable energy**

The region's energy potential creates conditions for investments in decentralized renewable energy production. Bearing in mind that the region almost does not produce energy, the new Energy Law creates opportunities for decentralized electricity generation in the region.

HEAT ENERGY - As indicated in the Regional Energy Profile, the region has high potential for wood biomass (NEPR covers 19% of the total forest land in the country. The NEPR forest land is almost 100% in certain individual economies). Heating with renewable sources is extremely important for the decarbonization process. It is necessary to transfer energy consumption to low-carbon and locally produced energy sources (including heat pumps) and renewable energy (solar collectors of heat, biomass, geothermal energy). It is also necessary to modernize existing district heating systems by upgrading renewable sources and building new such systems. For decarbonization, a large amount of wood biomass for heating will be needed. This is an opportunity for local supply of wood biomass, which offers a positive effect on the regional economy.

ELECTRICITY - Considering that all new buildings must be buildings with near zero energy, the same will be achieved not only with the overall energy efficiency and the use of RES for heating, but also with the production of electricity. The new Energy Law allows households, small consumers and the public sector to become a consumer-producer. The producer-producer can build an object for the production of electricity from a renewable energy source, where the generated electricity is used for own consumption, and the surplus of the produced electricity is transferred to the electricity distribution network. The potential of solar energy is significant here.

Small businesses are an important local stakeholder for developing the economy in the NEPR. The measures for decentralized renewable energy production should be applied not only in the process of building or reconstructing facilities, but also in production systems, which will enable them to increase their competitiveness.

While this is an activity of the central government, it is important to emphasize that this will be one of the priority areas to be found in the national action plan. The energy infrastructure in the NEPR in order to be able to handle all additional burdens that will result from individual production of electricity or from the transport sector that will promote the use of electronic vehicles, the electricity grid will need to be improved. At the same time, smart networks should be implemented that can effectively integrate the features and activities of all network-related users - manufacturers, consumers and manufacturers-consumers, in order to provide an economically efficient, sustainable low-loss network, a high level the quality and security of supply.

- **Integrated measures for a low-carbon economy**

The integration of policies from different sectors at the regional level will be crucial in the development of the new Program for the development of the NEPR, and it will be an opportunity to develop action plans and projects that will enable the integration of the EE measures and the use of RES. This area could be a place for a new impulse in the development of the region's economy and to be the main area in the process of its energy transition. It has found its place in the Roadmap, due to the low level of integration of activities between the different sectors, which leads to limited effects in efforts to strengthen the pace of economic growth in the region. SIPR is still the most indebted region in the country, and if it is desired to make movements upward, growth rates need to be more optimistic, but also adequately supported in the process of implementation of the identified measures.

Energy poverty in the region is a sensitive and complex problem requiring integrated measures: social, demographic, EE and RES measures. From the aspect of its overcoming it should be seen and treated as an integral part of the development plans of different sectors in the region and municipalities.

Electromobility is a sector that is in intensive development, which in the next thirty years will have significant reflection in the region, especially in the integration with other sectors, such as transport and sustainable tourism.

3 Activities and development scenarios

3.1 Research & Development, Innovation and Technology Status

The research & development of increasing EE and decentralized energy production can be said that don't exist in the region. Given the proximity of the capital, there are no significant higher education institutions, research centers or significant technological innovations in the NEPR that could trigger critical change in priority areas.

Here, as a first step, a support center for measures to improve EE and the use of renewable energies in the region should be established. This center should be a place where the public sector, the households and the business sector will receive free and useful information in the process of implementation of the energy transition measures. Establishing active freely available EE and RES databases are crucial in supporting research and development in the region.

Ideas, research and their linkage are a key element in their application in the region. In this regard, the information and computer technologies within the artificial intelligence in the next 30 years, it is more than certain that they will find their place in the public sector as well as in the households and businesses in the region.

3.2 Scenario "Business as usual"

The Republic of Macedonia does not have specific goals at the regional level, so national goals by 2020 and 2030 are used to compare the goals and the development of the "business as usual" (BAU) scenario:

- an average of 21% share of renewable energy in final energy consumption by 2020 and 27,6% by 2030.
- The share of RES in electricity production can increase to around 25% in 2020 and to about 30% in 2030

In a scenario as usual, the region continues to contribute to national goals depending on the available investment.

In the development of the Roadmap, the usual BAU scenario in the NEPR will be to cover the energy needs without specific and significant measures for the use of RES and the improvement of EE. With this scenario, the region is expected to continue to be the main energy source in the region in providing energy needs in the region, increasing the share of natural gas, as well as insignificant increase in consumption and production of renewable energy. This scenario can provide energy stability to the North East but the energy will continue to be mainly imported, with undeveloped and undistributed renewable energy production that would not have significant share in the final energy consumption in the region.

3.3 Development scenario

The second scenario focuses on the achievement of the goals set by the vision of the energy transition of the region: 1) by 2050 in the total final energy consumption in the region, renewable energy sources will increase to 40%, and 2) the greenhouse gas

emissions will be decreased by 30% compared to 2016. Given that the production of energy in general (few hydro power plants) is insignificant, this will be a serious and significant challenge for all stakeholders in the region. The energy consumption from renewable energy sources (hydro, wind, solar, biomass and wastes, and geothermal energy) should increase significantly over the next 30 years in relation to the current 11%. In this regard, the Energy Transition Roadmap sets a series of achievements that should represent key turning points for a period of 5 to 10 years.

Unlike the BAU scenario, energy renovation of buildings will continue in the region, and for this purpose new investors will be sought. The region will aim to improve the share of renewable energy in final energy consumption by up to 20% by 2030, up to 30% by 2040, and up to 40% by 2050.

Every year, a certain share in the domestic consumption of heat and electricity should be covered by an appropriate renewable source. The state should prohibit the use of non-renewable energy sources, other than peat and waste. Cogeneration (combined heat and power - CHP) and Triggeneration (combined cooling, heat and power - CCHP) should function according to the rules of good efficiency.

For the production of heat and balancing on the basis of biomass, mainly wood and agricultural energy crops and waste are used. The production of electricity will mostly be based on solar energy.

The scenario is characterized by a diversified and distributed production of energy that is based on local resources.

The scenario is supported by the fact that the reduction in the prices of renewable energy technology is faster than even the most optimistic forecasts, and that the cost of CO2 emissions has increased, making fossil fuels even more expensive to use.

The scenario involves an established and affordable emissions trading system.

With the identification of priority areas, there is room for developing action plans in each of the areas, by each affected party in the region[2]. During the preparation of the Roadmap, it was recognized that it is important to present and promote the efforts that the municipalities have made in support of the improvement of the EE and the use of RES in the previous period and now.

The planned activities for monitoring the road map and fulfilling the measures and the planned vision are the following:

[2] The development of the initial action plans stemming from the Roadmap proved that it is not an easy task for the current leaders of the process of energy transition in the region, which are the municipalities

Priority area: Energy efficiency
Title of the Action 1: Energy efficient sector in the municipality of Kumanovo **Objective**: To reduce the energy costs in the municipality, primarily in the part of public buildings, street lighting and vehicles owned by the local self-government (Municipality, Public Enterprise, Public Utility Company). **Time frame:** 1) 2018 - 2019 Functional EE team; Continuation of EE projects in buildings, street lighting and traffic; Start of using RES; 2) 2020-2025 in 50% of the facilities has implemented projects for RES use; 3) 2030-2040 all public buildings are EE; All public buildings have solar roofs; Constructed central heating system with biogas plant; 4) 2050 The energy consumption is 100% of the RES. **Activities**: Building an effective EE team; Free and available active database for EE; Household and business support for EE and RES measures; Providing Financial Resources.
Title of the Action 2: Energy efficient sector in the municipality of Kratovo **Objective**: To reduce budget spending on energy and to reduce emissions into the atmosphere. **Time frame:** 1) 2018 - 2019 Functional EE team; Continuation of EE projects in buildings, street lighting and traffic; Start of using RES; 2) 2020 - 2025 EE public lighting; in 50% of the facilities has implemented projects for using RES; 3) 2030-2040 all public buildings are EE; 100% gasification[3] 4) 2050 The energy consumption is 100% of the RES. **Activities**: Building an effective EE team; Free and available active database for EE; Household and business support for EE and RES measures; Providing Financial Resources.
Title of the Action 3: Energy efficient sector in the municipality of Kriva Palanka **Objective**: Set guidelines how to achieve an energy efficient public sector in the municipality of Kriva Palanka in order to reduce the budgetary costs for energy. **Time frame:** 1) 2018 - 2019 Functional EE team; Continuation of EE projects in buildings, street lighting and traffic; Start of using RES; 2) 2020 - 2025 EE public lighting; in 30% of the facilities has implemented projects for the use of RES; 3) 2030-2040 all public buildings are EE; 100% gasification 4) 2050 The energy consumption is 100% of the RES. **Activities**: Building an effective EE team; Free and available active database for EE; Household and business support for EE and RES measures; Providing Financial Resources.
Title of the Action 4: Energy efficient sector in the municipality of Rankovce **Objective**: To reduce the energy costs in the municipality, both in the part of public buildings and on street lighting.

[3] Although natural gas does not belong to the RES group, the delayed gasification of the Republic of Macedonia makes energy, which in the next 20-30 years will play a significant role in energy consumption.

Time frame: 1) 2018 - 2019 Functional EE team; Continuation of EE projects in buildings, street lighting and traffic; Start of using RES; 2) 2020 - 2025 EE public lighting; in 50% of the facilities has implemented projects for using RES; 3) 2030-2040 all public buildings are EE; 100% gasification 4) 2050 Energy consumption in public facilities is 100% of RES.

Activities: Building an effective EE team; Free and available active database for EE; Household and business support for EE and RES measures; Providing Financial Resources.

Title of the Action 5: Energy efficient sector in the municipality of Staro Nagorichane

Objective: To contribute to reducing the total energy demand in the public sector of the municipality

Time frame: 1) 2018 - 2019 Implementation of ongoing projects; Developed EMU 2019-2022 and AP 2) 2020 - 2025 Start of EE and RES in households; in 50% of the facilities has implemented projects for using RES; 3) 2030 all public buildings are EE; EE street lighting in every inhabited place; 50% of households implemented at least one EE / RES measure 4) 2050 100% energy consumption from RES.

Activities: Building an effective EE team; Free and available active database for EE; Household and business support for EE and RES measures; Providing Financial Resources.

Title of the Action 6: Energy efficient school buildings in the municipality of Kumanovo

Objective: To reduce the costs and energy consumption in the school buildings in the municipality of Kumanovo through their reconstruction (full or partial) by applying energy efficiency measures.

Time frame: 1) 2019 - 2020 Functional EE team; Continuation of projects for reconstruction of school buildings; 2) 2020 - 2025 30% of school buildings have implemented projects for using RES; 3) 2030 All school buildings are EE; 4) 2050 100% energy consumption from RES.

Activities: Building an effective EE team; Free and available active database for EE; Household and business support for EE and RES measures; Providing Financial Resources.

Title of the Action 7: Energy efficient street lighting in the municipality of Staro Nagoricane

Objective: To contribute to reducing the overall energy demand of the municipality.

Time frame: 1) 2019 - 2020 Implementation of Phase 1 for establishing EE street lighting; 2) 2020 - 2025 EU Existing street lighting and network expansion; 3) 2030 EE street lighting in every inhabited place; 4) 2050 EE street lighting in every inhabited place.

Activities: Building an effective EE team; Free and available active database for EE; Providing Financial Resources.

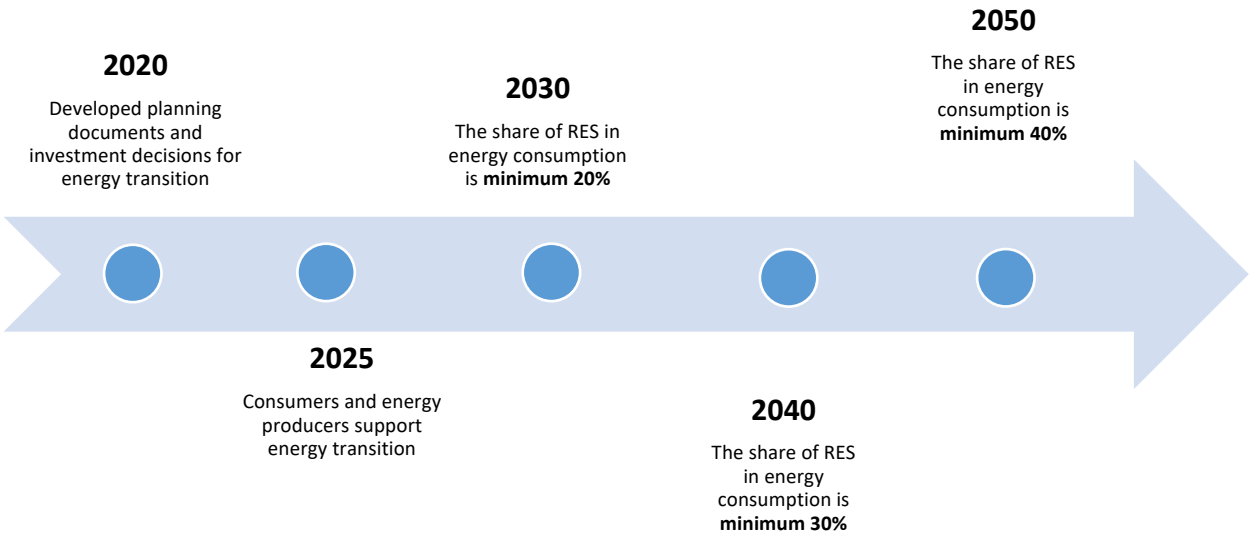
Priority area: Decentralized production of renewable energy

Title of the Action 8: Solar roofs in the Northeast

Objective: By 2050 at least 40% of the final energy consumption from RES is from local production through installed solar collectors for heat and photovoltaics.

Time frame: 1) 2019 - 2021 The RES policy is part of the development documents of the region; 2) 2025 EE RES are supported by the community; There are functional pilot solar roofs in each of the municipalities of the SIPR Existing street lighting and network expansion; 3) 2030 At least 2000 households and businesses in the North-East Region have installed solar collectors and photovoltaics; 4) 2050 40% of the final energy consumption from RES is from solar energy. **Activities**: Building an effective EE team; Free and available active database for EE; Providing Financial Resources.
Title of the Action 9: RES for optimal technological process **Objective:** by 2050 at least 40% of the final energy consumption from RES is from local production through installed solar collectors for heat and photovoltaics **Time frame:** 1) 2018 Analysis of optimization of the system and use of solar collectors for production of electricity; 2) 2020 EE project developed; 3) 2030 for 70% reduced energy consumption; Sharing results; 4) 2050 40% of the final energy consumption from RES is from solar energy **Activities:** Analyzes; Draft EE developed; Providing Financial Resources.
Priority area: Integrated measures for a low-carbon economy
Title of the Action 10: Eco-villages in the Northeast **Objective:** By 2050 there will be at least 12 eco-villages in the region. **Time frame:** 1) 2019 - 2021 Developed a model for eco-villages in the northeast 2) 2025 Application of the eco-village model and tools; Mentoring Network; 3); At least 6 eco-villages; Brand eco-village 4) 2050 At least 12 eco-villages. **Activities:** Model; Promotion; Support; Obtaining Financial Resources.

3.4 Key achievements



The turning points for the economy of the Northeast, which aims to increase the share of renewable energy, is given for five years in the immediate future and ten years after 2030. The key achievements are the following:

- In 2020, the NEPR, the municipalities, the energy sector and the central government installed the energy transition of the NEPR into a low-carbon economy in the respective development plans and make investment decisions for energy transition. they decided that most of the big ones needed a major investment for fully transferring renewable energy
- By 2025, consumers and energy producers already support the energy transition of NEPR to renewable energy sources and the process of implementation of EE measures and renewable energy use has been started
- By 2030, NEPR reaches a minimum of 20% RES share in energy consumption
- By 2040, NEPR reaches a minimum of 30% RES share in energy consumption
- By 2050,NEPR reaches a minimum 40% share of RES in energy consumption

4 Impact on the regional economy

The Northeast planning region is the economically least developed planning region in the Republic of Macedonia. Its share in the Gross Domestic Product of the Republic of Macedonia is at a modest 5,5%, which is much less than the share of the region in the total territory and the total population of the country.

The acceleration of the economic activity in the region and the gradual exit from the crisis since the end of the last decade condition the GDP per capita in the region, compared to the state average to grow faster and from a modest 51,4% of the level of the average for the Republic of Macedonia to climb to 67,7 %, which represents a relatively good result and indicates a real recovery of the economy in this region. Overall, NEPR developed relatively faster than some other regions, however, according to the Decision on classification of the planning regions according to the degree of development, NEPR has a development index of 0,56, an economic social index of 0.33 and a demographic index of 0,701. Thus, NEPR remains to be the last place in the eight planning regions in Macedonia.

Table 2 presents the economic activities that can be influenced in the process of energy transition to the low-carbon economy of NEPR.

Table 2: Economic activities in NEPR under the influence of RES

Economic activity	Kumanovo	Kratovo	Kriva Palanka	Lipkovo	Rankovce	Staro Nagoricane
1. Electricity production	geothermal, solar and wind energy	geothermal, solar and wind energy	geothermal, solar and wind energy	geothermal, solar and wind energy	geothermal, solar and wind energy	geothermal, solar and wind energy
2. Consumers of hot water	geothermal, solar	geothermal, sunny, biomass	geothermal, solar	geothermal, sunny, biomass	geothermal, solar	geothermal, sunny, biomass
3. Construction of heating plants for homes, bathrooms, industrial and agricultural facilities - primarily on greenhouses and greenhouses	geothermal energy	geothermal energy and biomass	geothermal energy	geothermal energy and biomass	geothermal energy	geothermal energy
4. Requirements for bathrooms - creating pools, therapeutic baths and showers		✓	✓	✓	✓	✓
5. Bottling of mineral types of geothermal water		✓	✓	✓	✓	✓

EE and RES, together with the sustainable development of tourism and organic farming, can be key factors in moving the economy in the region, and investment in them is a key

turning point in the development of the NEPR. In NEPR, more than 13% of households are beneficiaries of social assistance, which is directly related to energy poverty.

5 Stakeholder engagement and communication

In the framework of PANEL 2050 Project, stakeholder representatives were involved in all phases of the development of the Energy Transition Road Map of the region towards a low-carbon economy by participating in workshops on defining the vision of the region for energy transition, the roadmap and formulation of the identified action plans. The coordination of the stakeholders was carried out by the Center for Development of NEPR, with the participation of representatives from the municipalities, public institutions and enterprises, the non-governmental and business sector in the region.

The long-term engagement of the stakeholders will be key to implementing the activities needed to achieve the set goals by 2050. This can be achieved with different approaches. The recommended communication tools and techniques are given below:

Co-ordination meetings of the working group

- Should take place on a regular basis
- To assess process of roadmapping
- Opportunity to invite external experts for specific thematic inputs

Disadvantage:

- Involves the risk of getting routine

Regular meeting of energy groups

- Takes place regularly
- Meeting with informal character
- Can features different focus areas for discussion
- Opportunity to exchange experience in a specific group of experts of the field

Disadvantage:

- Heterogeneous group with changing members

Regular meeting of the EE team

- It takes place regular
- Meeting with a formal charact
- There may be various focal areas for discussi
- Possibility to exchange experiences in a particular group of experts in the field

Disadvantage:

- Includes risk of routine and lack of time and dedication

Thematic workshops

- Provides specific feedback to your questions

- Generates input from a wide range of stakeholders on expert level
- Possibility to have different thematic focuses

Disadvantage:

- Participants and speakers have to be well chosen to get representative results

Field trip and study visits

- Practical, tangible way to convey a message
- Gives best practice examples the opportunity to present
- Participants get insider knowledge and can engage in discussion with implementers

Disadvantage:

- More time and resource consuming than other event types

Awards and competitions

- E.g. energy conversation competition, awards for outstanding energy projects, "boiler exchange" program, "Ice-block challenge"
- Can be targeted at different user groups, e.g. individuals, households, businesses, schools, …
- Award events raise public awareness
- Award participants act role models and multiplicators
- Low-threshold methods to collect ideas and visions for regional energy future

Disadvantages:

- Resources for setup, marketing and prices have to be allocated

Citizen action groups

- Mostly self-organized movement of citizen to apply renewable energy system on local level (e.g. solar thermal, PV)
- Development of common ownership model in the renewable energy sector
- Long-term commitment to a renewable energy future

Disadvantage:

- Depends on the commitment of individuals

The stakeholders will be needed to be informed of these approaches and be engaged for a longer period of time.

6 Funding

Funding is essential for the implementation of the Energy Transmission Roadmap and the Action Plans that have emerged or will be further developed.

To finance the envisaged activities that arise or will arise from the Roadmap and the relevant Action Plans, the following sources of funding can be used:

- Programs for balanced regional development
- Budget of the municipalities;
- Donations;
- Assets of ministries and national agencies;
- Loans from domestic and international financial institutions;
- Special Purpose Fund
- Different financial models and schemes

It is crucial that the energy efficiency teams, as well as the other development teams in the municipalities, constantly monitor the open calls for funding activities in the field of EE and RES, while initiating and establishing working communication with potential project partners from the EU that work in the energy and environmental sectors.

7 Team for the Roadmap preparation

The Team for preparing the Roadmap and the Action Plans in the framework of PANEL 2050, was led by the Center for Development of North East Planning Region, with the participation of representatives from the municipalities, public institutions and enterprises, the non-governmental and business sector in the region. The team includes representatives from BDS, Skopje, as partners in the international consortium for the implementation of the activities of PANEL 2050 project in the North East Europe Region.

8 Support from policy makers and implementers

The support to the Roadmap to low-carbon economy will be reviewed by the Council of the North East Planning Region to include the identified areas and measures for improvement of EE and the use of RES in the development plans of the region, as well as in supporting the emerged projects developed by the Center for Development of NEPR, municipalities and other stakeholders, for the implementation of these measures.

The Partnership for New Energy Leadership - PANEL 2050 is recognized as one of the instruments of the North East Planning Region for the implementation of the measures and identified the first Action Plans part of the Roadmap to the low-carbon economy.

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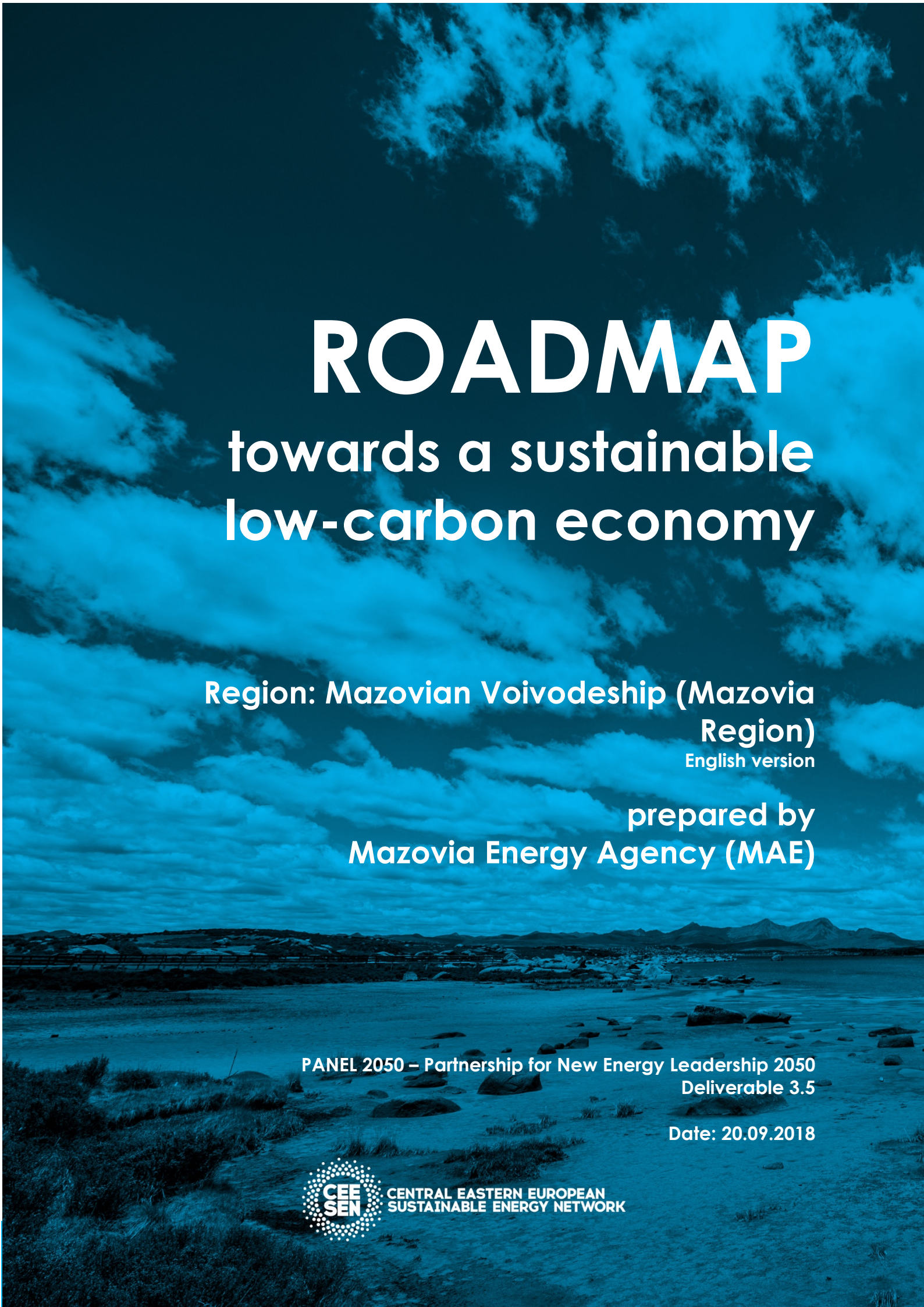
SUSTAINABLE ENERGY NETWORK



ROADMAP

towards a sustainable low-carbon economy

Region: Mazovian Voivodeship (Mazovia Region)

English version

prepared by

Mazovia Energy Agency (MAE)

PANEL 2050 – Partnership for New Energy Leadership 2050

Deliverable 3.5

Date: 20.09.2018

CEE SEN CENTRAL EASTERN EUROPEAN SUSTAINABLE ENERGY NETWORK

About Panel 2050 project

The PANEL 2050 project has the aim to create durable and replicable sustainable energy networks at local (municipality/community) level, where relevant local stakeholders collaborate for the creation of a local energy visions, strategies and action plans. The aim of these networks is to contribute to and actively work for the transition towards low carbon communities in 2050. The PANEL 2050 partnership will provide support for the creation of first successful local energy networks in the CEE countries. In the course of the project, organisations from 10 CEE countries will collaborate on creating regional energy strategies and action plans. For more information visit https://ceesen.org/panel2050/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696173.

The PANEL model

PANEL model is a comprehensive approach for implementing local long-term energy management, supported by the community. PANEL model consists of seven main elements: Stakeholder Engagement, Training Program, Guidebook, Long-term Energy Visions/Roadmaps/Action Plans and Central and Eastern European Sustainable Energy Network CEESEN. These elements are developed by PANEL 2050 project to support the CEE communities on achieving their sustainability goals.

The Roadmap at hand is the output of the long-term energy planning process with the aim of plotting the regional transition towards a low-carbon community.

Attached to the Roadmap 10 specific Action Plans were developed, representing the first steps on this road toward low-carbon community by 2050.

Roadmapping process
Mazovian Voivodeship, Poland

Stage 1

Baseline – Regional Energy Profile *Mazovian Voivodeship*

Stage 2

Vision

In 2050 Mazovia is the region of Poland with **50% reduction of the emission** of energy economy (measured by CO_2 emissions) in comparison to 1990.

Stage 3

Roadmap

— Increasing the share of RES in overall energy production —

Stage 4

Action 1
Energy for the future – RES in Stara Kornica municipality

Action 2
Solar municipalities of East Mazvia – solar energy in Repki municipality

Action 3
Solar municipalities of East Mazvia – solar energy in Przesmyki municipality

Action 4
Solar municipalities of East Mazvia – solar energy in Korczew municipality

Action 5
Solar municipalities of East Mazvia – solar energy Paprotnia municipality

Action 6
Ecological Mazovia Municipalities – solar energy in Suchozebry municipality

Action 7
Construction of RES in Kotun municipality

Action 8
Construction of RES in Domanice municipality

Action 9
Construction of RES in Mokobody municipality

Action 10
Construction of RES in Skorzec municipality

Action 11
Construction of RES in Wodynie municipality

— Increased energy efficiency in public sector —

Action 12

Thermomodernization of public buildings in Stara Kornica municipality

Action 13

Thermomodernization of public buildings in Korczew municipality

Action 14

Thermomodernization of public buildings in Kotun municipality

— Increased energy efficiency in housing sector —

Action 15

Replacement of heating devices in residential buildings in Korczew municipality

Action 16

Replacement of heating devices in residential buildings in Jablonna Lacki municipality

Action 17

Replacement of heating devices in residential buildings in Stara Kornica municipality

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1 Introduction

Reduction of the emission of the Mazovian energy economy (measured by CO_2 emissions) by 50% in comparison to 1990

Due to the large area, Mazovia has been divided into six subregions differing in population size, structure, shape and intensity of land development, level of economic development and the nature of business activity, to increase the intensity and effectiveness of undertaken activities.

For the presentation of the strategy undertaken and the packages of action programs resulting from it, Subregion Siedlce was selected. The choice was made due to the fact that it is the 4th largest sub-region with characteristics and economic level slightly below the average of Mazovia. In addition, the Siedlce Subregion is an entity of the Strategic Intervention of the Mazovian Voivodeship.

Subregion - thanks to the use of renewable energy sources and low-emission fuels, will lead to energy self-sufficiency of rural communes (areas) as well as cities creating Autonomous Energy Regions - ARE which will improve energy security and the quality of the environment for residents, entrepreneurs in the region.

The main assumption of this strategy is the fact that the program developed for the Siedlce Subregion is a kind of pilot program that will also be able to be used for replication and adaptation in the development of programs for other subregions except for the Warsaw Subregion (exceptionally different from other subregions.

2 Priority areas

After consultation and analysis of the needs of the region, the priority areas of the Roadmappin and Action Plans were specified:

1. ***Share of renewable energy sources in overall energy production***

   The current consumption of electricity in the Siedlce subregion is much larger than its production. The total electric power from existing sources is insufficient. Due to the upward trend in final energy consumption, activities related to the diversification of sources should be carried out. For this purpose, it is extremely important to use the potential of renewable energy sources occurring in the

Siedlce subregion and to increase their share in the production of electricity and heat.

2. ***Energy efficiency in the public sector***

In the fight against the reduction of energy consumption and CO_2 emissions, buildings are often overlooked. Currently, they are responsible for 40% of energy consumption in Europe. In the Mazovian Voivodeship, the weighted average value of the primary energy index for non-residential ones is 165 kWh / m2 / year, thus indicating their prioritization. Significant potential for improving energy efficiency is seen in street lighting and squares.

3. ***Energy efficiency in the housing sector***

As mentioned above, the building is responsible for 40% of energy consumption in Europe. In the Mazowieckie voivodship, the weighted average value of the primary energy index for multi-family residential buildings was estimated at 106 kWh / sq.m / year, thus indicating their prioritization.

3 Actions and development scenarios

3.1 Status of R&D, innovations and technology

3.1.1 Photovoltaics

According to the IEO report "Photovoltaic Market in Poland", the structure of solar modules available on the Polish market is similar to 2015: crystalline technologies dominate: polycrystalline 57% and monocrystalline 30.6%. The power of available modules ranges from 5 W to 345 W. Over the years 2015 - 2017, unit prices of solar modules in different power ranges have decreased.

It is worth adding the latest news about the development of photowotaic with Polish participation: Polish producer of PV modules Freevolt has patented and prepared for production a technology called PVGRAF - photovoltaic modules with a graphene layer. The use of graphene is to translate into higher efficiency and resistance of modules, leading to a reduction in the cost of solar energy production by up to half.

3.1.2 Solar panels

In Poland, the market is dominated by flat and vacuum tube collectors with a rather large majority of flat plate collectors. A novelty appearing on the market are solar collectors based on aluminum. 15-20 years ago, absorbers were made of stainless steel, later copper was used, and in recent years - aluminum. Hewalex introduced the first completely made of aluminum solar collector The reason for introducing a new type of solar collector is to provide customers with more attractive, affordable solutions while maintaining or even improving work parameters.

3.1.3 Thermomodernization

When it comes to thermomodernization of buildings, new materials with an increasingly lower heat transfer coefficient appear every now and again, but on the Polish market usually tried and cheaper substitutes are used.

3.2 Business-as-usual scenario

3.2.1 Share of renewable energy sources in overall energy production

The current consumption of electricity in the Siedlce subregion is much larger than its production. The total electric power from existing sources is insufficient. The projected increase in final energy consumption by 2030 for the whole country will amount to approx. 29% (Forecast of demand for fuels and energy until 2030, the Ministry of Economy's report from 2009). The upward trend should also be taken into account in relation to the Mazovian Voivodship and the Siedlce subregion and activities related to the diversification of sources. For this purpose, it is extremely important to use the potential of renewable energy sources occurring in the Siedlce subregion and to increase their share in the production of electricity and heat.

At the end of 2011, the total installed capacity of renewable energy sources (RES) in Mazovian Region amounted to 150 MW (IEO Report, Determination of the energy potential of Poland's regions in the field of renewable energy sources), which ranked the region on the fifth position in the voivodships, indicating at the same time further need for renewable energy development. The increase in the use of renewable energy is perceived in particular in relation to the development of solar energy, which provides practically unlimited potential for using free resources (99.9%). The biomass resources occurring are also significant (the economic potential has been estimated at around 10.6% in the region) as well as biogas. The wider use of renewable energy will not only affect the improvement of local energy supply, but also reduce the energy losses associated with transmission through its production closer to the final recipient.

The activities in the field of energy production from renewable energy sources will be directed primarily to units with lower generation capacity. The implementation of the assumptions will be based on generation of energy in a distributed system, based on the construction of local, small sources of electricity and heat for local needs that will not require long-distance transmission. Energy production in small decentralized plants will also be an additional source of income for local communities. Under such assumptions, the production of renewable energy will additionally contribute to the growth of economic potential of structurally weak subregions and rural areas.

At the same time, the expected increase in the production of "clean" energy will be intensified along with linking support for investments in connecting renewable sources to the grid. The lack of such activities may block the further development of RES.

Diversification of energy sources towards renewable energy will not only reduce the emission of harmful substances into the atmosphere, but also prevent local energy shortages occurring in the Siedlce subregion, thus increasing the energy security of the

subregion. Further development of RES will be a significant potential for the use of modern technologies and will contribute to the creation of new "green" jobs.

The value of the share of electricity produced from renewable sources in Mazovia and accordingly in Siedlce subregion in 2013 was estimated at around 8%. Our immediate goal is to obtain 25% in 2025 and 70% in 2050.

3.2.2 Energy efficiency in the public sector and in the housing sector

In the Mazoviane voivodship, the weighted average value of the primary energy index for multi-family residential buildings was estimated at 106 kWh / m^2 / year and for non-residential buildings 165 kWh / m^2 / year, thus indicating their prioritization. The measures taken so far have allowed for an increase in energy efficiency, but this area is still in great demand. In the context of primary energy demand, Mazovian Region occupies the middle position compared to other voivodships. This is due to from the fact that there is the smallest percentage of buildings completed by 1945 in the region - 12.4%. and the highest percentage of newest buildings, i.e. built after 2002 - 13.7%, where regulations regarding energy efficiency and heat protection were already in force.

In the case of thermal energy production in the Siedlce subregion, coal is still of key importance. This promotes occurrence of exceedances of air quality standards and relatively high emissions of carbon dioxide into the air.

Decreasing the share of air pollutant emissions will bring actions to increase energy efficiency through thermal modernization of buildings, which is also one of the most economical ways to reduce energy consumption.

Saving energy and distributing its sources will also help reduce the risk of power failure. Interventions in the field of energy efficiency improvement will bring relatively fast and visible effects in the Siedlce subregion, which is particularly important in the face of threats related to power shortage. An increase in energy efficiency will reduce future modernization needs and costs associated with generation and transmission of energy.

The implemented investments leading to energy savings (in particular against the expected increase in energy demand) will contribute to reducing energy costs, which will translate into an acceptable level of financial burdens for its users, leading to a reduction in energy poverty.

The need to modernize energy along with the replacement of equipment for energy-efficient buildings should be a priority. It is necessary to intensify activities bringing the highest energy efficiency within one investment or in investment divided into stages, as a result leading to a deep thermo-modernization including its scope, among others:

- building insulation,
- replacement of windows, external doors and lighting for energy-saving

- reconstruction of heating systems (including replacement and connection to a heat source),
- reconstruction of ventilation and air conditioning systems
- installation of renewable energy in energy-efficient buildings
- installation of cooling systems, including renewable energy sources

Identification of the optimal set of measures to increase energy efficiency in a given building is made on the basis of an energy audit, which is an essential element of the project. Bearing in mind the above, during the implementation of measures will take into account the need to install individual heating meters in multi-family / multi-dwelling buildings connected to the heating network, as well as carry out renovation works with the installation of thermostatic valves in these buildings (in the absence of earlier activities in this area).

The percentage of public buildings in the Siedlce subregion with a primary energy demand below 65 kWh / m2 in a year 2013 amounted to 15%. Our immediate goal is to obtain 50% in 2025 and 90% in 2050.

The percentage of used residential buildings in the Siedlce subregion with a primary energy demand below 95 kWh / m2 in a year 2013 amounted to 2%. Our immediate goal is to obtain 20% in 2025 and 50% in 2050.

3.3 Development scenarios

At the end of 2020, Mazovia - the largest region of Poland - is to reduce the emission efficiency of the energy economy by 20% compared to 1990. Despite the intensive actions undertaken in this direction, the targets set by 2020 are unlikely to be achieved. In order to achieve a reduction in the energy efficiency of Mazovia in accordance with the EU policy in 2050, it is necessary to undertake multidirectional intensive actions consisting of:

- improvement of energy efficiency - reduction of energy demand;
- introduction of renewable energy sources into operation;
- defining the methodology for financing projects.

Increasing the share of renewable energy sources in overall energy production
Action title 1: Energy for the future - renewable energy sources in Stara Kornica municipality Objective: The subject of the measure is carrying out construction works involving the installation of photovoltaic devices and installations, solar collectors in buildings and private premises, and on public buildings located in the municipality of Stara Kornica. 247 installations (power generation units) are implemented within 238 locations with a total energy production from RES in the amount of 528 MWh / year Timeline: This investment is planned for implementation in 2019-2022. In 2019, investment works are planned (purchase and installation of solar installations and solar collectors).
Action title 2: Sunny municipalities of East Mazovia - solar energy in Repki municipality Objective: The subject of activity is the assembly of photovoltaic installations and solar collectors in Repki. PV installations will be installed mainly in households on residential, commercial or ground buildings as well as public facilities, while solar collectors will be installed only on residential buildings. The aim of the project is to increase the renewable energy production capacity in farms in the municipality and to reduce the emission of atmospheric pollutants from conventional energy sources. As a result of the project,

there will be 372 renewable energy installations with a total energy production of 688 MWh / year.

Timeline:

This investment is planned for implementation in 2019-2022. In 2019, investment works are planned (purchase and installation of solar installations and solar collectors).

Action title 3: Sunny municipalities of East Mazovia - solar energy in Przesmyki municipality

Objective:

The subject of activity is the assembly of photovoltaic installations and solar collectors in Przesmyki. PV installations will be installed mainly in households on residential, commercial or ground buildings as well as public facilities, while solar collectors will be installed only on residential buildings. The aim of the project is to increase the renewable energy production capacity in farms in the municipality and to reduce the emission of atmospheric pollutants from conventional energy sources. As a result of the project, there will be 226 renewable energy installations with a total energy production of 415 MWh / year.

Timeline:

This investment is planned for implementation in 2019-2022. In 2019, investment works are planned (purchase and installation of solar installations and solar collectors).

Action title 4: Sunny municipalities of East Mazovia - solar energy in Korczew municipality

Objective:

The subject of activity is the assembly of photovoltaic installations and solar collectors in Korczew. PV installations will be installed mainly in households on residential, commercial or ground buildings as well as public facilities, while solar collectors will be installed only on residential buildings. The aim of the project is to increase the renewable energy production capacity in farms in the municipality and to reduce the emission of atmospheric pollutants from conventional energy sources. As a result of the project, there will be 208renewable energy installations with a total energy production of 402 MWh / year.

Timeline:

This investment is planned for implementation in 2019-2022. In 2019, investment works are planned (purchase and installation of solar installations and solar collectors).

Action title 5: Sunny municipalities of East Mazovia - solar energy in Paprotnia municipality

Objective:

The subject of activity is the assembly of photovoltaic installations and solar collectors in Paprotnia. PV installations will be installed mainly in households on residential, commercial or ground buildings as well as public facilities, while solar collectors will be installed only on residential buildings. The aim of the project is to increase the renewable energy production capacity in farms in the municipality and to reduce the emission of atmospheric pollutants from conventional energy sources. As a result of the project, there will be 270 renewable energy installations with a total energy production of 478 MWh / year.

Timeline:

This investment is planned for implementation in 2019-2022. In 2019, investment works are planned (purchase and installation of solar installations and solar collectors).

Action title 6: Ecological Mazovia Municipalities - solar energy in Suchozebry municipality

Objective:

The subject of activity is the assembly of photovoltaic installations and solar collectors in the municipalities of Suchożebry. PV installations will be installed in households on residential, commercial or ground buildings, while solar collectors will be installed only on residential buildings. The aim of the project is to increase the renewable energy production capacity in farms in the commune and reduce the emission of atmospheric pollutants from conventional energy sources. Thanks to the investment, the production of electricity and heat will increase.

Timeline:

This investment is planned for implementation in 2020-2023

Action title 7: Construction of renewable energy installations in Kotun municipality

Objective:

The subject of activity is the assembly of photovoltaic installations and solar collectors in the municipalities of Kotun. PV installations will be installed in households on residential, commercial or ground buildings, while solar collectors will be installed only on residential buildings. The aim of the project is to increase the renewable energy production capacity in farms in the commune and reduce the emission of atmospheric pollutants from conventional energy sources. Thanks to the investment, the production of

electricity and heat will increase. As a result of the project, about 265 renewable energy installations will be built with a total energy production of 1287,6 MWh / year.

Timeline:

This investment is planned for implementation in 2020-2023

Action title 8: Construction of renewable energy installations in Domanice municipality

Objective:

The aim of the action plan is to: increase the production of electricity from renewable sources in the Domanice municipality, reduce the amount of greenhouse gases emitted to the atmosphere and diversify energy sources by installing solar photovoltaic installations in public buildings. This activity is also intended to encourage the residents of the municipality to develop further renewable energy in its area, which will contribute to the implementation of the plans established in the municipality's strategic documents. As a result of the project, 9 photovoltaic installations will be built with a total energy production amounting to 83,33 MWh / year.

Timeline:

This investment is planned for implementation in 2020-2023

Action title 9: Construction of renewable energy installations in Mokobody municipality

Objective:

The aim of the action plan is to: increase the production of electricity from renewable sources in the Mokobody municipality, reduce the amount of greenhouse gases emitted to the atmosphere and diversify energy sources. The project is to bring the above results by installing PV and solar collectors in households. Thanks to the use of renewable energy sources, the production of electricity and heat will increase. This activity is also intended to encourage the residents of the municipality to develop further renewable energy in its area, which will contribute to the implementation of the plans established in the municipality's strategic documents. As a result of the project, 228 RES installations will be built with a total energy production of 890 MWh / year.

Timeline:

This investment is planned for implementation in 2020-2023

Action title 10: Construction of renewable energy installations in Skorzec municipality

Objective:

The aim of the action plan is to: increase the production of electricity and heat from

renewable sources in the Skorzec municipality, reduce the amount of greenhouse gases emitted to the atmosphere and diversify energy sources. The project is to bring the above results by installing photovoltaic installations and heat pumps in public buildings. Thanks to the use of renewable energy sources, the production of electricity and heat will increase. This activity is also intended to encourage the residents of municipality to develop renewable energy in its area, which will contribute to the implementation of the plans established in the municipality's strategic documents. As a result of the project, there will be 12 RES installations with a total energy production of 341 MWh / year.

Timeline:

This investment is planned for implementation in 2020-2023

Action title 11: Construction of renewable energy installations in Wodynie municipality

Objective:

The aim of the action plan is to: increase the production of electricity and heat from renewable sources in the Wodynie municipality, reduce the amount of greenhouse gases emitted to the atmosphere and diversify energy sources. The project is to bring the above results by installing photovoltaic installations and solar collectors in renewable energy sources, the production of electricity and heat will increase. This activity is to encourage the residents of the Wodynie municipality to develop renewable energy in its area, which will contribute to the implementation of the plans established in the municipality's strategic documents. As a result of the project, 152 RES installations will be built with a total energy production amounting to 1008,4 MWh / year.

Timeline:

This investment is planned for implementation in 2020-2023

Increased energy efficiency in the public sector

Action title 12: Thermomodernization of public buildings in Stara Kornica municipality

Objective:

The project concerns the thermal modernization of public buildings in the Municipality of Stara Kornica. The main objective of the project is to increase the energy efficiency of 4 public buildings with a target demand for primary energy below 65 kWh / m^2.

Timeline:

This investment is planned for implementation in 2019-2021

Action title 13:: Thermomodernization of public buildings in Korczew municipality

Objective:

The project concerns the thermal modernization of public buildings in the Municipality of Stara Kornica. The main objective of the project is to increase the energy efficiency of 2 public buildings with a target demand for primary energy below 65 kWh / m^2.

Timeline:

This investment is planned for implementation in 2019-2020

Action title 14: Thermomodernization of public buildings in Kotuń municipality

Objective:

The project concerns the thermal modernization of public buildings in the Municipality of Kotun. The main objective of the project is to increase the energy efficiency of 6 public buildings with a target demand for primary energy below 65 kWh / m^2.

Timeline:

This investment is planned for implementation in 2019-2021

Increased energy efficiency in the housing sector

Action title 15: Replacement of heating devices in residential buildings in Korczew municipality

Objective:

The aim of the project is to improve the air quality in the municipalities of Korczew by reducing emissions of pollutants and greenhouse gases from households. The investment consists in replacing heat sources with low efficiency (central heating boilers for solid fuel) for automatic boilers for biomass, oil, gasifying wood, electric and gas. The subject of the project is also the installation of photovoltaic and solar installations on residential buildings. The measure aims to increase the energy efficiency of 80 residential houses and reduce CO_2 and PM10 emissions to the 650 Mg CO_2 / year.

Timeline:

This investment is planned for implementation in 2019-2022

Action title 16: Replacement of heating devices in residential buildings in Jablonna Lacki municipality

Objective:

The aim of the project is to improve the air quality in the municipalities of Jablonna Lacki by reducing emissions of pollutants and greenhouse gases from households. The investment consists in replacing heat sources with low efficiency (central heating boilers for solid fuel) for automatic boilers for biomass, oil, gasifying wood, electric and gas. The subject of the project is also the installation of photovoltaic and solar installations on residential buildings. The measure aims to increase the energy efficiency of 20 residential houses and reduce CO_2 and PM10 emissions to the 255,9 Mg CO_2 / year.

Timeline:

This investment is planned for implementation in 2019-2022

Action title 17: Replacement of heating devices in residential buildings in Stara Kornica municipality

Objective:

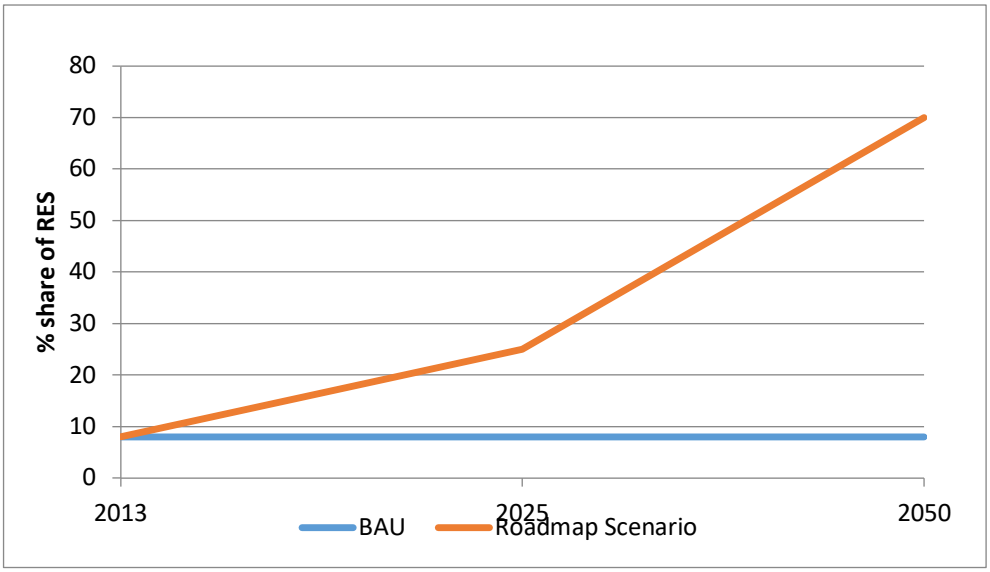
The aim of the action plan is to improve air cleanliness in the Municipality of Stara Kornica by reducing pollution to the atmosphere and increasing the energy efficiency of household buildings. The investment consists in exchanging heat sources of low efficiency (solid fuel central heating boilers) for automatic biomass boilers, oil, gasified wood, electric and gas. This objective requires improving the efficiency of thermal energy use, reducing the costs of heating objects or introducing society into the ecological thinking path.

Timeline:

This investment is planned for implementation in 2021-2024

The value of the share of electricity generated from renewable sources in Mazovia in 2013, as in the Siedlce subregion was around 8%, Our immediate goal is to obtain 25% in 2025 and 70% in 2050.

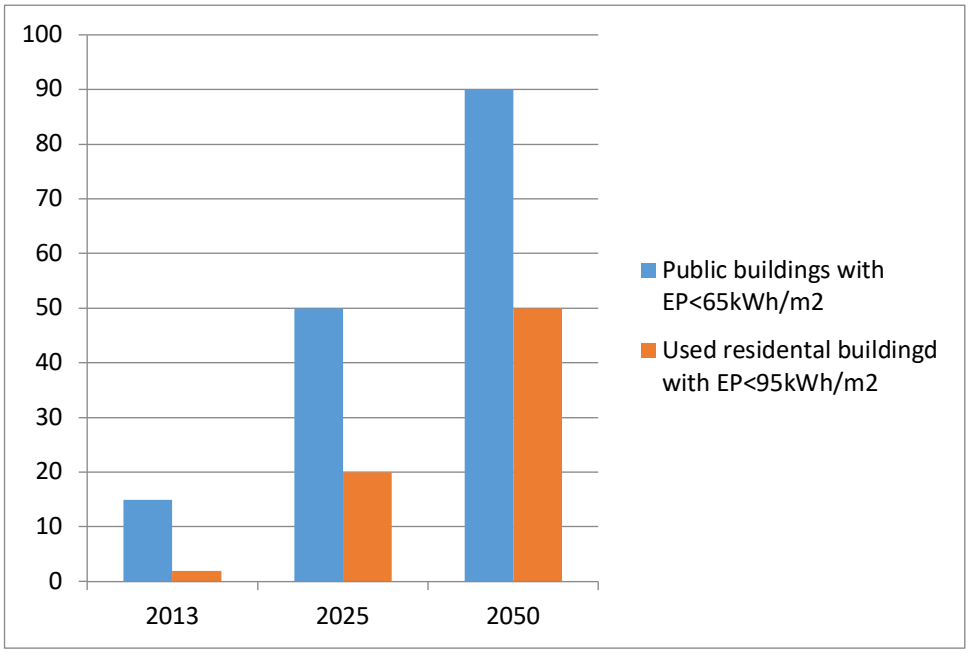
Graph 1 Graph of comparison percentage of share of RES in Buisness as usual and Roadmap scenario



The percentage of public buildings in the Siedlce subregion with a primary energy demand below 65 kWh / m² in a year 2013 amounted to 15%. Our immediate goal is to obtain 50% in 2025 and 90% in 2050.

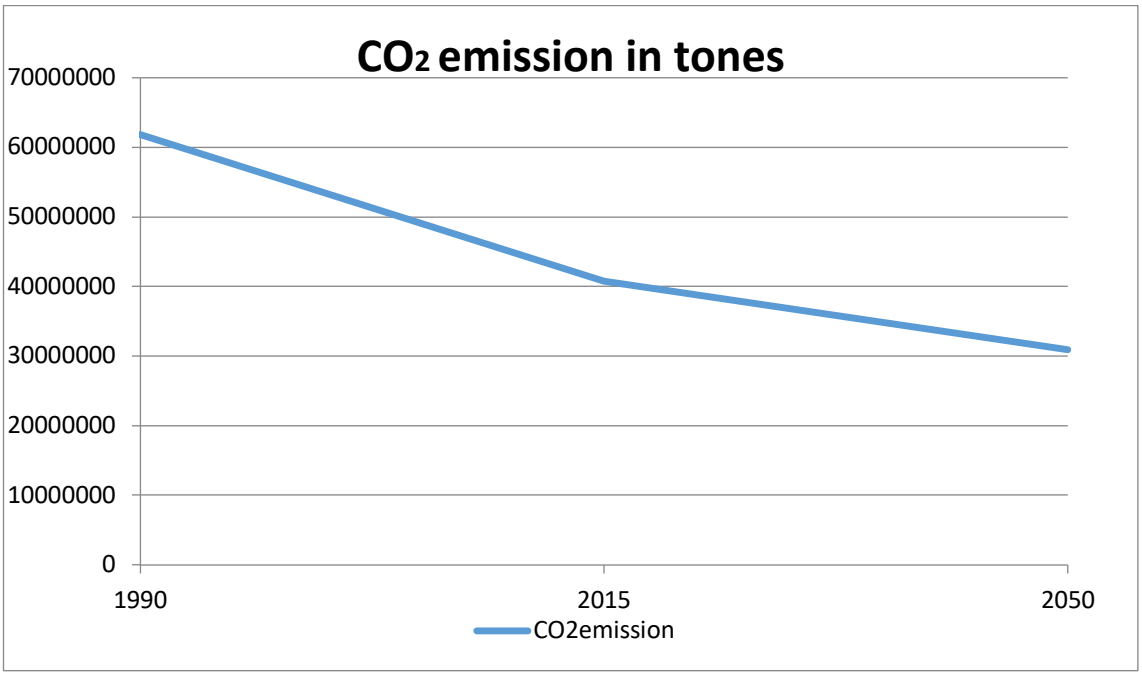
The percentage of residential buildings in the Siedlce subregion with a primary energy demand below 95 kWh / m² in a year 2013 amounted to 2%. Our immediate goal is to obtain 20% in 2025 and 50% in 2050

Graph 2 The percentage of public and residential buildings with a primary energy below a baseline in 2013 and our immediate goal in 2025



The reduction of CO_2 emmision in Mazovia was calculated in year 1990 as a base year and in year 2015 (the most current data). In 2015 the reduction was on the level of 34% from the base year. Our immediate goal is to obtain 50% reduction in 2050 in Mazovia region with the help of improving one of the most needed subregion which is responsible for almost 6% of region emmision – Subregion Siedlce.

Graph 3 Predicted CO_2 emission reduction



3.4 Milestones

Table 1 Milestones

Action no.	Activity	Partners	Who	When
1,2,3,4,5,12, 13,14,15,16	Start of the action plans	Stara Kornica, Repki, Przesmyki, Korczew, Paprotnia, Kotuń, Jabłonna Lacki	MAE, Stara Kornica, Repki, Przesmyki, Korczew, Paprotnia, Kotuń, Jabłonna Lacki	2019
6-11	Start of the action plans	Suchożebry, Kotuń, Domanice, Mokobody, Skórzec, Wodynie	MAE, Suchożebry , Kotuń, Domanice, Mokobody, Skórzec, Wodynie	2020
17	Start of the action plans	Stara Kornica	MAE, Stara Kornica	2021
13	Completion of the action plans	Korczew	MAE, Korczew	2020
12, 14	Completion of the action plans	Stara Kornica, Kotuń	MAE, Stara Kornica, Kotuń	2021
15,16	Completion of the action plans	Korczew, Jabłonna Lacki	MAE, Korczew, Jabłonna Lacki	2022
1-11	Completion of the action plans	Stara Kornica, Repki, Przesmyki, Korczew, Paprotnia,, Suchożebry,	MAE, Stara Kornica, Repki, Przesmyki, Korczew, Paprotnia,,	2023

		Kotuń, Domanice, Mokobody, Skórzec, Wodynie	Suchożebry, Kotuń, Domanice, Mokobody, Skórzec, Wodynie	
17	Completion of the action plans	Stara Kornica	MAE, Stara Kornica	2024
1-17	First monitoring of progress; 25% share of electricity produced from renewable RES sources; 50% of public buildings in the Siedlce subregion with a primary energy demand below 65 kWh / m2, 20% residential buildings in the Siedlce subregion with a primary energy demand below 95 kWh / m2. Subsequent copying of the strategy by other Mazovia subregions	All municipalities from action plans	MAE	2025
1-17	The monitoring of progress in Mazovia will reduce the emission efficiency of the energy economy (measured by CO2 emissions) by 50% compared to 1990.	Mazovia subregions	MAE	2050

4 Impacts on regional economy

The developed detailed action plans for the Siedlce region will be used as examples of good practices for other subregions (except for the metropolitan area of Warsaw - different from the others) in regional long-term energy planning and energy management, supported by local communities. The Masovian Voivodeship is composed of 5 subregions (siedlecki, ostrołęcki, ciechanowski, płocki, radomski) and 2 areas forming the metropolitan area of Warsaw (Warsaw and poviats surrounding Warsaw). As the Mazovian Energy Agency operates in the area of the entire Mazovian Voivodeship, as part of its statutory tasks, by visiting the municipalities of Mazovia, it presents the approach from the Panel 2050 Model and encourages its replication.

The CEESEN Platform helps with replication and promotion of the project and becomes a main communication tool for municipalities in Mazovia. In this way, they have access to the complex model and results of Roadmapping. Thanks to the created network, they can contact selected units and learn through their actions. In addition, the PANEL2050 project precursors coming from different areas of the Mazovia, due to the increase in awareness by the influence of regional trainings and meetings, can spread their experience by involving local communities in the preparation of low-carbon emission plans

Apart from the PANEL 2050 project activity, the key importance is the MAE representative in the team responsible for implementation and monitoring of the Mazovia Development Strategy 2030 (in the area of Energy and Environment), where the model and results of the Panel 2050 project will be indicated as good practices for use in the area all over Mazovia. In addition, financial instruments at the disposal of regional authorities will be used to finance such projects.

The above-mentioned actions have their effects already and replications of pilotage in the Siedlce region are already taking their first steps in the Płock, Ciechanow and Ostrołęka regions.

Ecological needs (the need for clean air) apply to all residents. The reduction of air pollutant emissions from the strategic point of view is possible primarily in the following areas: new solutions in the field of energy (including RES), construction (thermomodernization) and support and education of residents in the field of efficient energy use. The planned activities will affect the regional economy by solving the following problems:

1. Excessive emission of air pollutants from the combustion of conventional energy sources,

2. The marginal ability to generate renewable energy,

3. Incorrect share of heat energy and electricity production from RES installations.

The development of electricity production from RES will increase energy security of the Siedlce subregion. This will increase the availability of connection capacity for the growing sector of small and medium enterprises and farms. The risk of economic activity and agricultural production will also decrease due to interruptions in electricity supply and related to changes in electricity prices.

The demand for electricity is difficult to estimate due to the dependence on the business cycle, climatic conditions and high dependence of the energy price and the price of coal in Poland. Therefore, it should be based on calculations and estimates made by the Ministry of Economy and independent experts.

According to the forecasts of the Ministry of Economy, it is assumed that the national energy demand will increase in the perspective until 2030. Long-term forecasts taking into account the resultant economic growth and decrease in energy intensity of the economy assume a systematic increase in energy demand. In addition, the increase in energy demand from renewable energy sources.

The Ministry of Economy also prepared forecasts regarding the generation capacities of the domestic power sector. According to forecasts, domestic electricity production may reach the level of 201.8 TWh in 2030. It means energy shortage at the level of approx. 16 TWh in 2030, moreover, the forecasted domestic production is lower than the demand for electricity in Poland in all forecast years. This means that in the perspective of 2030 Poland will still be a net importer of electricity. Due to the surplus of demand over the supply of electricity in Poland and EU regulations, a significant increase in electricity prices in Poland is forecasted.

Improving the energy efficiency of buildings and reducing final energy consumption in residential and public buildings will increase the availability of energy for the production and services sector (especially electricity). This will enable the development of the sector of small and medium enterprises.

At the same time, the reduction of pollutant emissions to the atmosphere from the residential sector will improve the air quality, which will increase the tourist attractiveness of the Siedlce subregion, which due to its natural and landscape values is an increasingly common tourist destination for residents from the metropolitan area of Warsaw. This will increase the number of jobs in the tourism and cultural services sector.

The development of energy production from RES will be a significant potential for the use of modern technologies and will contribute to the creation of new green jobs. Planned expenditures for fixed assets as part of improving the energy efficiency of buildings will increase the demand for construction works. This will increase the number of jobs in the construction sector. The improvement of air quality will also affect the development of the ecological industry and the production of healthy food. "Safe food" is one of the four smart specializations of Mazovia. The implementation of the objectives will improve the competitiveness of the Siedlce subregion by strengthening this smart specialization. There is no risk of conflicting Roadmap goals with other regional development policies.

5 Involvement of stakeholders

Regarding the nature of our strategy in the Roadmapping process, we focused on the involvement of local governments and local authorities, as they are direct decision-makers in the region.

Among the stakeholders involved, based on the main problems and factors affecting the implementation of the low-emission economy in Mazovia, taking into account territorial diversity, especially metropolitan areas from peripheral / agricultural subregions, were selected from those involved in the Siedlce subregion - selected as a representative area.

During telephone consultations and meetings and other activities, many distinguished themselves as active partners involved in the PANEL 2050 mission during the Roadmapping process. From among them a team was chosen to conduct the Roadmapping process. Representatives of four organizations - Kotuń, Suchożebry, Stara Kornica, and LGD Siedlce - have been involved at every stage as MAE's forerunners

The involvement of stakeholders in the development of energy strategy and action plans was twofold. On the one hand, there were consultations with energy experts involved in the development of renewable energy in Mazovia. On the other hand, in order to determine the vision of rural areas (non-urbanized), in particular based on the experiences and conditions of the Siedlce subregion, local meetings were held with the authorities of the Siedlce subregion. During these discussions, the main issues discussed were priority areas of action, in line with society's needs, barriers and challenges that could block possible actions

The following entities participated in the strategy creation process: Municipalities: Stara Kornica, Kotuń, Suchożebry, Wodynie, Siedlce, Mordy, Kotuń, Korczew, Paprotnia, Suchożebry, Przesmyki, Stara Kornica, Wodynie, Kotuń and the Siedlce Poviat. Selected entrepreneurs and experts from the list of stakeholders: Local Action Group Siedlec (LGD Siedlce), Mazovian Cluster of EE and renewable energy and EKAR.

Table 2 Schedule of meetings regarding the Roadmapping process

Date, place	***Participants***	***Content / Results / Conclusions***
12.04.2018, Kotuń	Jacek Świrski, Mayor of Municipality Suchożebry Grzegorz Góral, Mayor of Municipality Kotuń, Hubert Pasiak, LGD Siedlce, Mayor of Municipality Wodynie Ireneusz Kaługa, LGD Siedlce Arkadiusz Piotrowski, MAE	Discussion of the energy situation of the Siedlce subregion, analysis. Identification of the main challenges and directions of action Indication of the main areas of intervention of local authorities Assessment of the dominant barriers to the low-carbon economy Applications for the needs of the vision being created
15.05.2018 Warsaw	Arkadiusz Piotrowski, MAE Żaneta Latarowska, MAE Krzysztof Arnold, EKAR Bartosz Dubiński, MAE	Collecting the main factors affecting the vision created Shaping the basic elements of the vision Determination of basic indicators
07.06.2018, Stara Kornica	Kazimierz Hawryluk, Mayor of Municipality Stara Kornica Krzysztof Arnold, EKAR Arkadiusz Piotrowski, MAE Emilia Borysiak, Municipality Kornica, LGD Tygiel Bugu	Verification of the developed vision from the point of view of the conditions of the eastern part of the Siedlce sub-region Summary and conclusions for visions Collecting data and ideas for creating a roadmap

27.08.2018, Warsaw	Arkadiusz Piotrowski, MAE Żaneta Latarowska, MAE Krzysztof Arnold, EKAR Bartosz Dubiński, MAE	Reassumption of affinity activities and opinions about visions Optimizing the shape of verbal vision Active work on energy strategy, identification of the need to collect additional information, decision on organizing workshops
18.09.2018 Siedlce	Arkadiusz Piotrowski, MAE Żaneta Latarowska, MAE Aneta Dziewulska, Siedlce Poviat Anna Kowalska –Kasuska, Siedlce Poviat Marta Maciejewska, Municipality Siedlce Tomasz Sawicki, Municipality Siedlce Małgorzata Liciecka, Municipality Mordy Paweł Polkowski, Municipality Kotuń Ireneusz Kaługa, LGD Siedlce Sławomir Wasiulczuk, Municipality Korczew Przemysław Kosieradzki, Municipality Paprotnia, Communal Relationshp of Paprotnia, Repki, Przesmyki Municipalities Aneta Nasiłowska, Municipality Suchożebry Andrzej Skoliowski, Municipality Przesmyki Kazimierz Hawryluk Municipality Stara Kornica Hubert Pasiak, Municipality Wodynie Jacek Świrski, Municipality Suchożebry Grzegorz Góral, Municipality Kotuń	Presentation of the vision Discussing the factors affecting the roadmapping process Discussing the needs and priority areas Discussion on the challenge, barriers and threats Gathering strategic goals, proposed action plans

6 Endorsement by implementers and political decision-makers.

In the Roadmapping process, from the very beginning we have focused on the involvement of local governments and local authorities because they are direct decision-makers and implementers in a given region. As confirmed in Chapter 5, their engagement was successful. During multiple meetings attended by representatives of the authorities or most often direct authorities (voivodes) of the region, they showed a great interest in the activities and readiness to sign the commitment letters. In October 2018 our region is waiting for local government elections, after which our intensive activities in the field of cooperation with stakeholders will be continued also in the event of changes of political decision makers (leaders of local communities).

7 Impact to National Regulations

Contribiution to national and region al targets

The developed vision will develop energy goals contained in national documents:

"Poland's energy policy until 2030" The document sets out the following directions of the state's energy policy at the national level: improvement of energy efficiency, development of the use of renewable energy sources, limiting the impact of energy on the environment.

"Development Strategy of the Mazovian Voivodeship until 2030. Innovative Mazovia ". As one of the priority strategic objectives, it defines the region's economy's assurance of diversified energy supply with sustainable management of environmental resources.

And also in the documents: National Action Plan on energy efficiency, National Action Plan for Renewable Energy, Operational Program Infrastructure and Environment for 2014-2020, Regional Operational Program of the Mazovian Voivodeship for 2014-2020.

Contribiution to climate change mitigation

The developed fits into part of the climate objectives set out in the National Program for the Development of Low-emission Economy. The main objective specified in the document is the development of a low-emission economy while ensuring sustainable development of the country. Specific objectives include issues such as low-carbon energy sources, energy efficiency, resource efficiency, materials and waste management, low-emission technologies, and new consumption patterns. Similarly to the Program, the Vision points out that specific measures will be taken in the above areas, which will result in lowering the emissivity of the Polish economy.

8 Financing

The planned projects will be co-financed primarily from the EU funds from the ERDF under the Regional Operational Program of the Mazovian Voivodeship and as part of the national Operational Program Infrastructure and Environment. These programs provide for measures to move to a low-carbon economy.

In the case of insufficient funds, the actions will be financed from national funds from the National Fund for Environmental Protection and the Voivodship Fund for Environmental Protection and Water Management as part of programs supporting activities in the field of air protection.

Local authorities will also secure own funds for co-financing of planned projects.

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CEE
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CENTRAL EASTERN EUROPEAN
SUSTAINABLE ENERGY NETWORK

ROADMAP

Towards a Sustainable Low-Carbon Economy

Bucharest-Ilfov Region, Romania

English version

prepared by

AEEPM – Local Energy Agency Bucharest

PANEL 2050 – Partnership for New Energy Leadership 2050
Deliverable 3.5

Date: November 2018

CEE SEN CENTRAL EASTERN EUROPEAN SUSTAINABLE ENERGY NETWORK

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About Panel 2050 project

The PANEL 2050 project has the aim to create durable and replicable sustainable energy networks at local (municipality/community) level, where relevant local stakeholders collaborate for the creation of a local energy visions, strategies and action plans. The aim of these networks is to contribute to and actively work for the transition towards low carbon communities in 2050. The PANEL 2050 partnership will provide support for the creation of first successful local energy networks in the CEE countries. In the course of the project, organisations from 10 CEE countries will collaborate on creating regional energy strategies and action plans. For more information visit https://ceesen.org/panel2050/

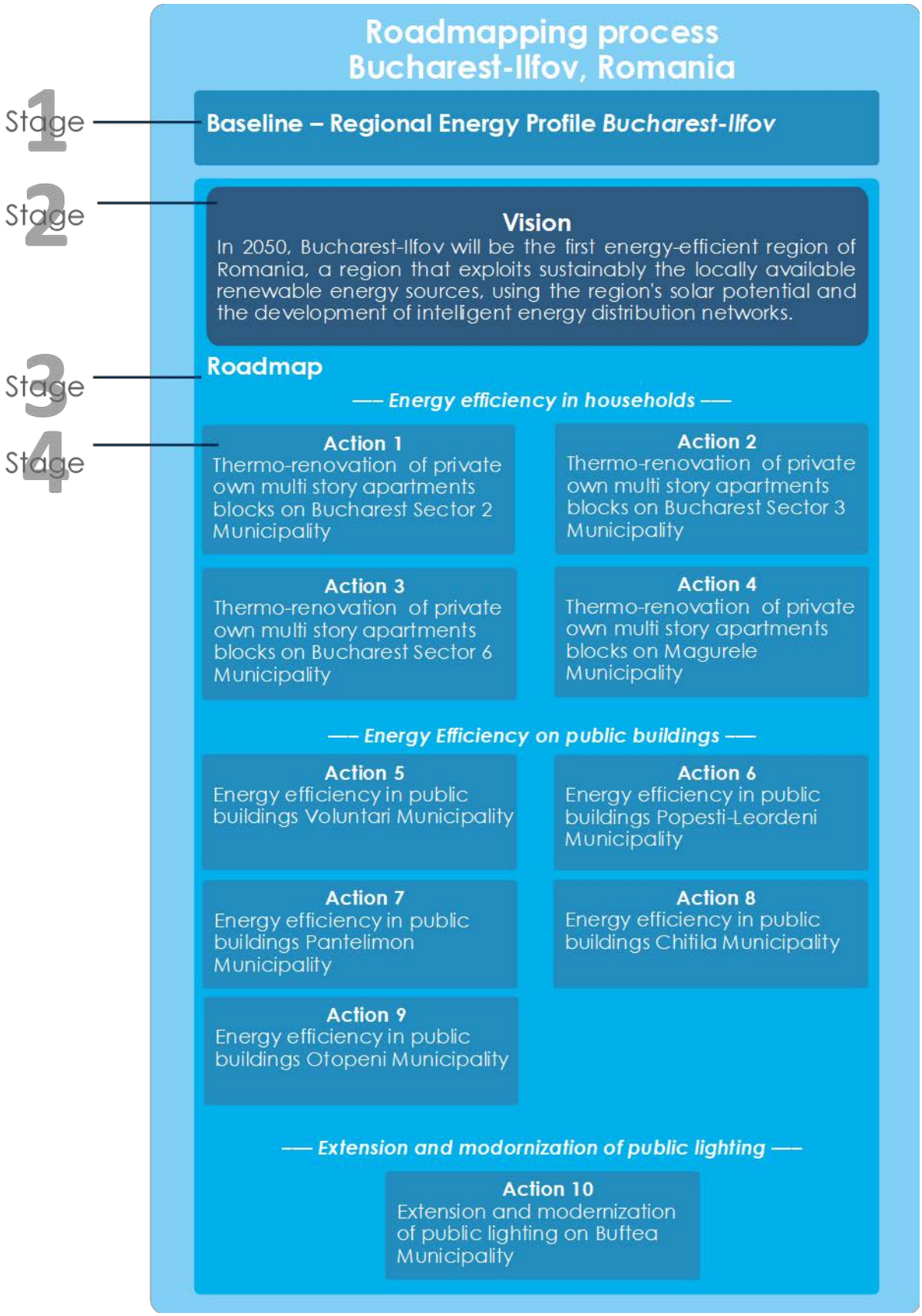
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696173.

The PANEL model

PANEL model is a comprehensive approach for implementing local long-term energy management, supported by the community. PANEL model consists of seven main elements: Stakeholder Engagement, Training Program, Guidebook, Long-term Energy Visions/Roadmaps/Action Plans and Central and Eastern European Sustainable Energy Network CEESEN. These elements are developed by PANEL 2050 project to support the CEE communities on achieving their sustainability goals.

The Roadmap at hand is the output of the long-term energy planning process with the aim of plotting the regional transition towards a low-carbon community.

Attached to the Roadmap 10 specific Action Plans were developed, representing the first steps on this road toward low-carbon community by 2050.


Roadmapping process
Bucharest-Ilfov, Romania
Stage 1
Baseline – Regional Energy Profile Bucharest-Ilfov
Stage 2
Vision
In 2050, Bucharest-Ilfov will be the first energy-efficient region of Romania, a region that exploits sustainably the locally available renewable energy sources, using the region's solar potential and the development of intelligent energy distribution networks.
Stage 3
Roadmap
Stage 4
— Energy efficiency in households —
Action 1
Thermo-renovation of private own multi story apartments blocks on Bucharest Sector 2 Municipality
Action 2
Thermo-renovation of private own multi story apartments blocks on Bucharest Sector 3 Municipality
Action 3
Thermo-renovation of private own multi story apartments blocks on Bucharest Sector 6 Municipality
Action 4
Thermo-renovation of private own multi story apartments blocks on Magurele Municipality
— Energy Efficiency on public buildings —
Action 5
Energy efficiency in public buildings Voluntari Municipality
Action 6
Energy efficiency in public buildings Popesti-Leordeni Municipality
Action 7
Energy efficiency in public buildings Pantelimon Municipality
Action 8
Energy efficiency in public buildings Chitila Municipality
Action 9
Energy efficiency in public buildings Otopeni Municipality
— Extension and modornization of public lighting —
Action 10
Extension and modernization of public lighting on Buftea Municipality

1 Introduction

In 2050, **Bucharest-Ilfov** will be *the first energy-efficient region of Romania*, a region that exploits sustainably the locally available renewable energy sources, using the region's solar potential and the development of intelligent energy distribution networks.

The strategy reflects current global trends when both households and the public and private sectors are moving towards sustainable energy consumption.

The Roadmap does not replace national, regional and local efforts in terms of energy efficiency and modernizing the energy supply but seeks to develop a long-term regional framework in which these policies will be more effective.

The strategy reflects current global trends when both households and the public and private sectors are moving towards sustainable energy consumption.

The strategy provides opportunities to attract new investment in the region, to use the potential of local renewable energy sources, and to save energy.

Achieving EU targets on energy efficiency and renewable energy in 2030 will not be possible without greater innovation and intelligence in networks, both at transport and distribution levels, notably through information and communication technologies.

These will be essential in adopting demand management and other intelligent network services.

With the promotion of solar photovoltaic systems and efficient cogeneration systems, the **Bucharest-Ilfov Region** could significantly contribute to the achievement of the national RES objective in the final consumption of electricity by 2050.

The region's main challenges are:

- Increase the energy performance of buildings and introduce new green technologies;
- Ensure local energy supply from solar sources;
- Develop smart grids for energy distribution;
- Development of transport based on electric municipal transport.

Implementation will address the following relevant issues in the region:

- low energy efficiency in public and household buildings;
- the need for modernization of the building heating and cooling;
- public lighting modernization and RES integration using local solar potential;

Strategic goals will help to reduce energy consumption, increase the use of local renewable energy sources, and reduce greenhouse gas emissions.

The strategy is targeted at municipalities, residents and businesses.

Individual action plans have been prepared for 10 municipalities in order to support and achieve the goals set in the strategy.

2 Priority areas

In order to become a low-carbon society by 2050, the public sector, households, and the transport sector all have an important role to play.

Considering the regional potential of renewable energy sources, solar energy will be the key renewable energy sources of the region.

The priority areas of the regional focus are:

1 Energy efficiency of public buildings, energy infrastructure and street lighting

The region must renew public spaces, buildings and street lighting systems by replacing light bulbs with modern and energy-saving ones, as well as by installing optimal height poles and automatic lighting systems and implementing solar sources as alternative.

2 Energy efficiency of private own multi story apartments buildings.

Regional goal: apartment buildings in the region, which are connected to the central heating system, are 100% renovated in order to maximize the reduction of energy consumption.

In this area, a considerable amount of work has been done, and good practices from Bucharest Sector 1 which run a large-scale programme for thermo-renovation for over 900 blocks of apartments is a good motivation for all other municipalities in the Bucharest-Ilfov Region.

3 Development of solar energy production, development of public infrastructure for electric vehicles.

Considering renewable energy sources in our region the and solar energy sectors must be developed.

Romanian Ministry for Climate just designed a subsidy scheme to support individual to become prosumer delivering electricity and heat from solar sources.

Bucharest-Ilfov region is sufficiently suitable for solar energy use in households, business and public sectors. Generation of heat, hot water, electricity – these are the areas that need to be developed.

Romania National Regulatory Authority just finalized the national action plan for solar energy production and distributed consumption.

Due to the Bucharest-Ilfov specific more than 30% of traffic is produced by commuters living in to the region and work in Bucharest Capital.

The negative impact of vehicle traffic on the environment, health and human well-being conducted to conclusion that the regional authority must focus on non-motorized and electric transport investments.

Recently many businesses put focus on developing electric charger infrastructure for electric vehicle (EnelX, Renovatio, Tesla, etc) but also municipalities in the region invest in to the electric busses and public charging station electric infrastructure.

3 Actions and development scenarios

This Roadmap is based on the energy vision of the Bucharest-Ilfov region.

The Roadmap provides a general direction and concrete steps to move towards the vision.

Several different scenarios for the regional development, described in the guidelines, allow the transition from the status quo (current situation) to the implementation of the regional vision.

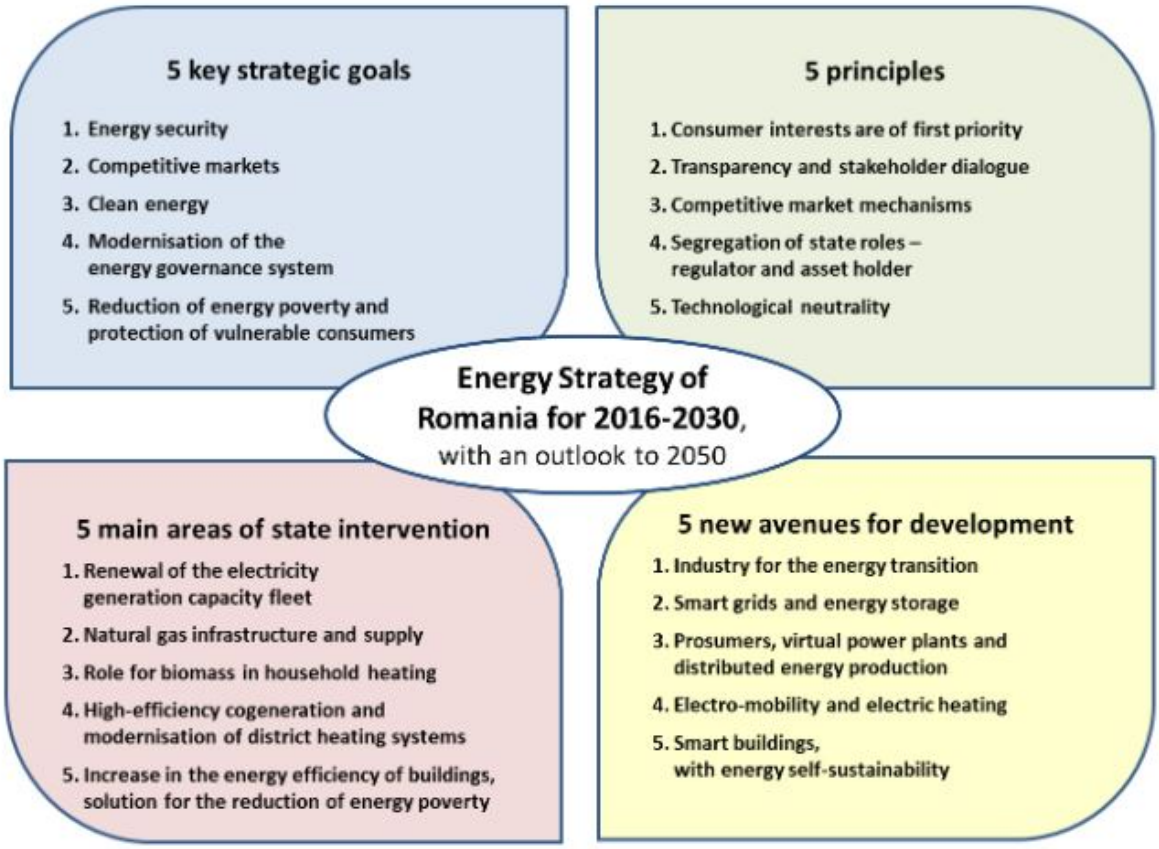
A multi-scenario analysis is the basis for taking energy-related decisions and foreseeing possible actions.

Measure or action plans, which are an integral part of the guidelines, help to gradually achieve the vision and ensure that the development path is concrete and realizable.

The action plan includes these main areas of the regional energy sector:

- renovation of public buildings;
- energy infrastructure;
- modernization of public street lighting systems (by changing lamps, supports, and installing automatic control systems);
- energy efficiency of private own multi story apartments buildings;
- development of solar energy production, development of public infrastructure for electric vehicles.

The national Romanian policy anticipates that by 2020 renewable energy resources will amount to 27%, by 2030 to 45%, and by 2050 to 80% of total energy consumption.



Energy Strategy of Romania for 2016-2030 with an outlook to 2050

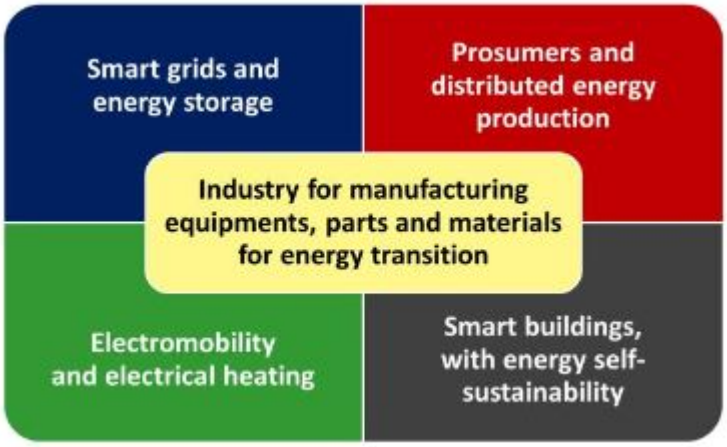
Bucharest-Ilfov region will have to contribute to the achievement of targets.

It is expected that in 2050 a much more important role will be given to solar resources than it is today.

Therefore, some actions related to a low carbon society will be related to the generation of electricity but also heat and cooling from solar sources.

Individual electricity generation will contribute to the total electricity production and energy storage, which will play an important role in allocating the power grid load.

At the same time, the networks will need to be modernized to meet these extra loads and become smarter. All this will attract new investment and have a positive impact on the regional economy.



Romanian Energy trend and strategy by 2050

Considering the national and the EU aspirations in the energy sector the following scenarios are formed for the Bucharest-Ilfov Region:

1 Central and local government actively seeks to support individuals, business, public initiatives, infrastructure improvement, to provide electricity, heat and cooling from solar sources, and to implement innovations in the energy sector.

The region has prepared and approved an Energy Strategy (November 2018) and has provided concrete measures on how to develop the region in terms of the vision.

According to this most likely scenario, the development of the region would have a significant financial impact in areas such as: full renovation of public and residential buildings, public lighting, solar energy production, community initiatives, improvement of business energy efficiency, development of innovative businesses and new local jobs.

2 Bucharest-Ilfov Region is the most developed region in Romania and Increasing energy demand, rising taxes on pollution, climate change, and awareness of people are conditions for intensive implementation of innovation and progress in energy economy. The growing demand must be decupled from the energy demand and promote sustainable development.

According to this scenario, the development of the region is associated with the overall progress and natural development. The focus in this case should be on access to the most up-to-date information, the dissemination of the regional vision, and the sustainable development.

3 The increasing attention of the Romanian authorities to the valorised solar energy local potential, the reduction of pollution, and the optimization of the consumption of energy resources will lead to a reallocation of resources and an increase in their availability to the residents, the business and the public sector of our region.

Becoming the first Romanian Energy efficient Region by 2050, Bucharest-Ilfov will become a shining example for other regions and contribute to the general European 2050 objectives on climate and energy.

3.1 Status of R&D, innovations and technology

Bucharest-Ilfov Region is the most developed region in Romania and significant part of Romanian R&D, innovation and technology infrastructure and business found here.

The well-known and the powerful Lasers Research facility, build by on European research consortium is located on the New Magurele Technology Park developed by Ilfov County.

The existing energy infrastructure creates preconditions for secure energy supply and production, but regions should be developed through the development of energy new technologies.

The future is the smart network of electricity and the system of intelligent consumers, where production is no longer concentrated on several sites, but consumers themselves become small producers as well. Thus, education and training of people here play an important role.

The development of solar energy production technologies and the innovations in the lighting industry are essential for the region.

The electric vehicle network in the region start to be developed.

Public authority supported by the National Environment and Climate fund start to develop public electric vehicle charging station.

Also, private business is investing in to regional network of charging stations.

The private initiative is very important in this sector: charging points next to major supermarkets, catering establishments, and tourist attractions.

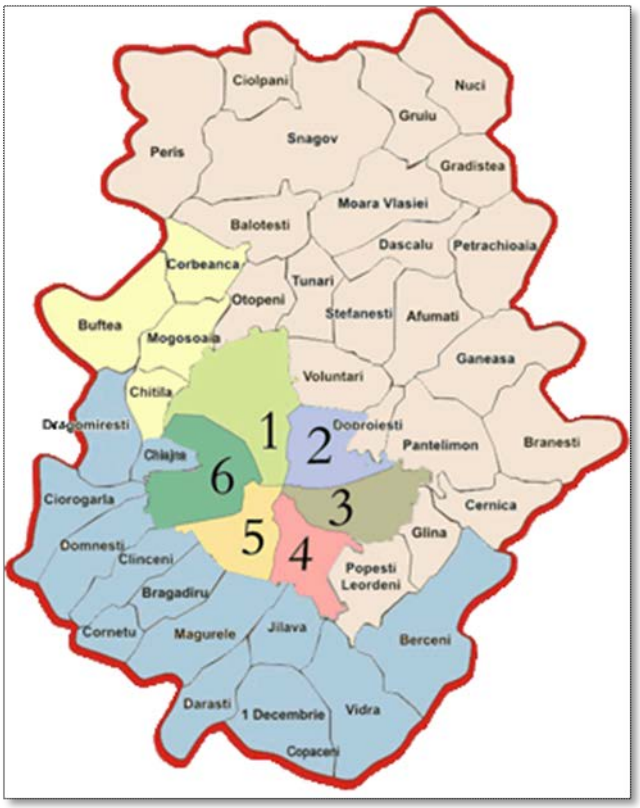
3.2 Business-as-usual scenario

Considering the best experience of other countries, the model chosen for the promotion of renewable energy in Romania is a model that will ensure production and use of energy distributed and promote change of energy user from consumer to prosumer stage.

At the same time, it will help to achieve a strategic goal of Romania: to develop clean local electricity production and reduce dependence on its imports and in the same time to reduce energy poverty.

Technological progress is also linked to the production of materials for the construction and reconstruction of buildings. High requirements to materials for energy efficiency leads to implementation of innovations in production and to search for new raw materials and production methods.

3.3 Development scenarios



Bucharest-Ilfov Region

Due to the administrative and political landscape of the Region Bucharest-Ilfov

- Bucharest Capital, with 6 districts (sectors)
- 8 cities
- 32 communes
- 91 villages

AEEPM present the development scenarios of the energy sector according to the priorities of the municipalities themselves and the organizations involved in the project.

Energy efficiency in households
Action title 1: Thermo-renovation of private own multi story apartments blocks on Bucharest Sector 2 Objective: The goal is to renovate all apartment buildings connected to the centralized heating system. Currently, 140 buildings are renovated out of 2100 apartment buildings in the Sector 2. Timeline: – Energy audit for all buildings (December 2019) – Public bidings for the feasibility studies works (March 2020) – Thermo-renovation works for all buildings (2020-2030) – Self-sufficient buildings as household standard by 2050
Action title 2: Thermo-renovation of private own multi story apartments blocks on Bucharest Sector 3 Objective: The goal is to renovate all apartment buildings connected to the centralized heating system. Currently, 215 buildings are renovated out of 2450 apartment buildings in the Sector 3. Timeline: – Energy audit for all buildings (December 2019) – Public bidings for the easibility studies works (March 2020) – Thermo-renovation works for all buildings (2020-2030) – Self-sufficient buildings as household standard by 2050
Action title 3: Thermo-renovation of private own multi story apartments blocks on Bucharest Sector 6 Objective: The goal is to renovate all apartment buildings connected to the centralized heating system. Currently, 75 buildings are renovated out of 1450 apartment buildings in the Sector 6. Timeline: – Energy audit for all buildings (December 2019) – Public bidings for the fesibilities studies works (March 2020) – Thermo-renovation works for all buildings (2020-2030) – Self-sufficient buildings as household standard by 2050
Action title 4: Thermo-renovation of private own multi story apartments blocks on Magurele Municipality Objective: The goal is to renovate all apartment buildings connected to the centralized heating system. Currently, 15 buildings are renovated out of 150 apartment buildings on Magurele Municipality. Timeline: – Energy audit for all buildings (December 2019) – Public bidings for the feasibility studies works (March 2020) – Thermo-renovation works for all buildings (2020-2030)
Energy Efficiency on public buildings

Action title 5: Energy Efficiency in public buildings Voluntari Municipality

Objective:

School Centre of Voluntari consists of 8 buildings recognized as energy inefficient. The energy renovation project foresees the implementation of measures on the building envelope (facade, ceiling, window replacement), replacement of lighting, renovation of the ventilation system and the replacement/renovation of the heating system.

Timeline:

- Energy audit for all buildings (December 2019)
- Public bidings for the feasibility studies works (March 2020)
- Energy efficiency works for all buildings (2020-2030)

Action title 6: Energy Efficiency in public buildings Popesti-Leordeni Municipality

Objective:

School Centre of Popesti-Leordeni consists of 4 buildings recognized as energy inefficient. Popesti-Leordenu Municipality has also 2 hospitals on their responsibility. The energy renovation project foresees the implementation of measures on the building envelope (facade, ceiling, window replacement), replacement of lighting, renovation of the ventilation system and the replacement/renovation of the heating system.

Timeline:

- Energy audit for all buildings (December 2019)
- Public bidings for the feasibility studies works (March 2020)
- Energy efficiency works for all buildings (2020-2030)

Action title 7: Energy Efficiency in public buildings Pantelimon Municipality

Objective:

School Centre of Pantelimon consists of 5 buildings recognized as energy inefficient. The social houses complex consists of 6 buildings. The energy renovation project foresees the implementation of measures on the building envelope (facade, ceiling, window replacement), replacement of lighting, renovation of the ventilation system and the replacement/renovation of the heating system.

Timeline:

- Energy audit for all buildings (December 2019)
- Public bidings for the feasibility studies works (March 2020)
- Energy efficiency works for all buildings (2020-2030)

Action title 8: Energy Efficiency in public buildings Chitila Municipality

Objective:

School Centre of Chitila consists of 6 buildings recognized as energy inefficient. The social complex consists of 4 buildings. The energy renovation project foresees the implementation of measures on the building envelope (facade, ceiling, window replacement), replacement of lighting, renovation of the ventilation system and the replacement/renovation of the heating system.

Timeline:

- Energy audit for all buildings (December 2019)
- Public bidings for the feasibility studies works (March 2020)
- Energy efficiency works for all buildings (2020-2030)

Action title 9: Energy Efficiency in public buildings Otopeni Municipality Objective: School Centre of Otopeni consists of 4 buildings recognized as energy inefficient. The social houses complex consists of 6 buildings. The energy renovation project foresees the implementation of measures on the building envelope (facade, ceiling, window replacement), replacement of lighting, renovation of the ventilation system and the replacement/renovation of the heating system. Timeline: – Energy audit for all buildings (December 2019) – Public bidings for the feasibility studies works (March 2020) – Energy efficiency works for all buildings (2020-2030)
Extension and modernization of public lighting
Action title 10: Extension and modernization of public lighting on Buftea Municipality Objective: The main objective is to extend and modernized public lighting system by replacing all existing lamps with more energy efficient LED technology combined with automate management system and solar energy source. Timeline: – Public bidings for the feasibility studies works (September 2019) – Extension and modernization of public lighting (2020-2028)

3.4 Milestones

Most projects of the Roadmap will start in 2019.

Most investment activities will be completed by 2030 but in some cases, monitoring will start even earlier. At the same time, it is also recommended to review some of the proposed action plans or to prepare new ones.

In 2030, it will be important to check not only the achievements of the national strategy but also of the region. Based on the results corrective measures could be implemented. The same procedure is also recommended in 2040.

In 2050, it is expected that the **Bucharest-Ilfov** Region will be *the first energy-efficient region on Romania.*

4 Impacts on regional economy

AP	Regional GDP	Employment	Energy safety	R&D, innovations	Rural development	RIS3	Regional Development Plan	Conflicts
1	Benefit: hundreds of millions of Euro at the 20-year horizon	Hundreds of new local jobs	Promoting technologies and practices leading to energy security and self-sufficiency	Applied research in the region, R&D partnership and business sector	Neutral	Fulfillment - advanced technologies, renewable energy, smart grids, intelligent houses	It contributes to the development of the region and creates space for further local business activities	No
2	Benefit: hundreds of millions of Euro at the 20-year horizon	Hundreds of new local jobs	Promoting technologies and practices leading to energy security and self-sufficiency	Applied research in the region, R&D partnership and business sector	Neutral	Fulfillment - advanced technologies, renewable energy, smart grids, intelligent houses	It contributes to the development of the region and creates space for further local business activities	No
3	Benefit: hundreds of millions of Euro at the 20-year horizon	Hundreds of new local jobs	Promoting technologies and practices leading to energy security and self-sufficiency	Applied research in the region, R&D partnership and business sector	Neutral	Fulfillment - advanced technologies, renewable energy, smart grids, intelligent houses	It contributes to the development of the region and creates space for further local business activities	No
4	Benefit: of millions of Euro at the 20-year horizon	100 new jobs	Significantly strengthening security and self-sufficiency	Applied research in the region, R&D partnership and business sector	Neutral	Fulfillment - advanced technologies, renewable energy	It contributes to the development of the region and creates space for further local business activities	No
5	Benefit: of millions of Euro at the 20-year horizon	200 new jobs	Significantly strengthening security and self-sufficiency	Applied research in the region, R&D partnership and business sector	Strengthening the rural - urban linkage, increasing economic stability	Fulfillment - advanced technologies, renewable energy, smart grids, intelligent houses	It contributes to the development of the region and creates space for further local business activities	No
6	Benefit: of millions of Euro at the 20-year horizon	200 new jobs	Significantly strengthening security and self-sufficiency	Applied research in the region, R&D partnership and business sector	Strengthening the rural - urban linkage, increasing economic stability	Fulfillment - advanced technologies, renewable energy, smart grids, intelligent houses	It contributes to the development of the region and creates space for further local business activities	No

7	Benefit: of millions of Euro at the 20-year horizon	300 new jobs	Significantly strengthening security and self-sufficiency	Applied research in the region, R&D partnership and business sector	Strengthening the rural - urban linkage, increasing economic stability	Fulfillment - advanced technologies, renewable energy, smart grids, intelligent houses	It contributes to the development of the region and creates space for further local business activities	No
8	Benefit: of millions of Euro at the 20-year horizon	300 new jobs	Significantly strengthening security and self-sufficiency	Applied research in the region, R&D partnership and business sector	Strengthening the rural - urban linkage, increasing economic stability	Fulfillment - advanced technologies, renewable energy, smart grids, intelligent houses	It contributes to the development of the region and creates space for further local business activities	No
9	Benefit: of millions of Euro at the 20-year horizon	300 new jobs	Significantly strengthening security and self-sufficiency	Applied research in the region, R&D partnership and business sector	Strengthening the rural - urban linkage, increasing economic stability	Fulfillment - advanced technologies, renewable energy, smart grids, intelligent houses	It contributes to the development of the region and creates space for further local business activities	No
10	Benefit: tens of 6 millions of Euro at the 10-year horizon	Increased demand for skilled workers	Supporting projects that enhance security and self-sufficiency	Applied research in the region, R&D partnership and business sector	Neutral	Fulfillment - Supporting regional applications of advanced technologies, SW, IT, professional qualifications	Positive influence, increase of the local suppliers, development of the potential of the region	No

5 Involvement of stakeholders

All "Panel2050" project participants were introduced to the Roadmap preparation process; the regional municipalities were also actively involved in the process, as they are the main makers of the vision and strategies of the districts and have close contacts with all the stakeholders.

The preparation of the Action Plans for this document, as well as for the regional energy vision and strategy receive a final approval by the Regional Council since was integrated in to the Regional Energy Strategy approved by Regional Council in November 2018.

The mayors of Bucharest Sector 2, Bucharest Sector 3, Bucharest Sector 6, Magurele, Voluntari, Popesti-Leordeni, Pantelimon, Chitila, Otopeni and Buftea municipalities are members of the Bucharest-Ilfov Regional Development Agency and were actively involved in the document preparation process. Heads of municipality administrations, managers and employees of local economy, strategic planning and investment

attraction divisions were also actively involved. The latter also provided statistical information and other relevant data for the preparation of this document.

Important role in this energy planning process played not only by the regional municipal administrations and its subordinate institutions, but also by other organizations included in our project meetings, because they are energy auditors, energy suppliers or major business players and have a significant influence on the overall development of the region, including the energy sector.

The schedule of meetings regarding the Road mapping process:

Date, place	*Participants*	**Content / Results / conclusions**
28.07.2017, Bucharest	– Irinel SCRIOSTEANU, city manager, Ilfov County – Paul DOBRE, energy officer, Ilfov County – Gabriel MUTU, mayor, Bucharest Sector 6 – Iulian GHEORGHE, staff, Bucharest Sector 6 – Robert NEGOITA, mayor, Bucharest Sector 3 – Teodor MACIUCA, staff, Bucharest Sector 3 – Mihai TOADER, mayor, Bucharest 2 – Cristian POPESCU, vicemayor, Bucharest Sector 2 – Daniel NITU, staff, Bucharest Sector 2 – Gheorghe PISTOL, mayor, Buftea Municipality – Elena OPREA, staff, Buftea Municipality – Emilian OPREA, mayor, Chitila Municipality – Marian IVAN, mayor, Pantelimon Municipality – David DUMITRU, vicemayor, Pantelimon Municipality – Petre IACOB, mayor, Popesti-Leordeni Municipality – Maria VRABIE, staff, Popesti-Leordeni Municipality – Narcis CONSTANTIN, mayor, Magurele Municipality – Teodora ILIE, staff, Magurele Municipality – Silviu CONSTANTIN, mayor, Otopeni Municipality – Sanda ALEXE, staff, Otopeni Municipality – Constantin COSTACHE, vicemayor, Voluntari Municipality	The main goal of this event was to discuss PANEL project framework and Road mapping process Main results: - approach towards regional visions - introduction of CEESEN at the political level - decisions to participate in to Road mapping process

	– Gheorghe HRISCU (AEEPM) – Ion DOGEANU (AEEPM)	
24.08.2017, Bucharest	– Sanda ALEXE, staff, Otopeni Municipality – Maria VRABIE, staff, Popesti-Leordeni Municipality – Antonio COSTEA, staff, Pantelimon Municipality – Valentin MARISOIU, staff, Chitila Municipality – Virgil TEODOR, staff, Buftea Municipality – Bogdan VASILE, staff, Magurele Municipality – Gheorghe HRISCU (AEEPM) – Ion DOGEANU (AEEPM)	First training on visioning and planning process
15.09.2017, Bucharest	– Daniel NITU, staff Bucharest Sector 2 – Teodor MACIUCA, staff Bucharest Sector 3 – Paul DOBRE, staff, Ilfov County – Andrei NICOLAE, staff, Bucharest Sector 6 – Irina MATEI, staff, Voluntari Municipality – Gheorghe HRISCU (AEEPM) – Ion DOGEANU (AEEPM)	Second training on energy planning process
27.10.2017, Bucharest	– Paul DOBRE, staff, Ilfov County – Elena POPESCU, staff, Ilfov County – Ion DOGEANU (AEEPM)	Training session – discussion on formulation of regional vision
09.05.2018 Bucharest	– Elena POPESCU, staff, Ilfov County – Daniel NITU, staff, Bucharest Sector 2 – Irina Matei, staff, Voluntari Municipality – Virgil TEODOR, staff, Buftea Municipality – Bogdan VASILE, staff, Magurele Municipality – Ion DOGEANU (AEEPM)	Capacity building and re-drafting the regional vision concept
04.06.2018, Bucharest	– Irinel SCRIOSTEANU, city manager, Ilfov County – Sanda ALEXE, staff, Otopeni Municipality – Maria VRABIE, staff, Popesti-Leordeni Municipality – Antonio COSTEA, staff, Pantelimon Municipality – Valentin MARISOIU, staff, Chitila Municipality – Virgil TEODOR, staff, Buftea Municipality – Bogdan VASILE, staff, Magurele Municipality	Finalization of the regional vision for 2050 and drafting next steps in road mapping process + discussion on action plans

	– Ion DOGEANU (AEEPM)	
09.10.2018, Bucharest	– Irinel SCRIOSTEANU, city manager, Ilfov County – Paul DOBRE, staff, Ilfov County – Ion DOGEANU (AEEPM)	Presentation of Roadmap and Action Plans to the Regional Council Office
27.11.2018, Otopeni	– Ion DOGEANU (AEEPM) – Sanda ALEXE, staff, Otopeni Municipality – Maria VRABIE, staff, Popesti-Leordeni Municipality – Antonio COSTEA, staff, Pantelimon Municipality	Presentation of Roadmap and Action Plans to the Municipalities
28.11.2018, Bucharest	– Ion DOGEANU (AEEPM) – Irina Matei, staff, Voluntari Municipality – Iulian GHEORGHE, staff, Bucharest Sector 6 – Teodor MACIUCA, staff, Bucharest Sector 3 – Daniel NITU, staff, Bucharest Sector 2	Presentation of Roadmap and Action Plans to the Municipalities
29.11.2018, Buftea	– Ion DOGEANU (AEEPM) – Valentin MARISOIU, staff, Chitila Municipality – Virgil TEODOR, staff, Buftea Municipality – Bogdan VASILE, staff, Magurele Municipality	Presentation of Roadmap and Action Plans to the Municipalities

6 Endorsement by implementers and political decision-makers

Regional politicians and municipal representatives were included in the planning process and are interested in the continuation of the strategy and implementation of the measures.

The content of Roadmap and following Action Plans was included in to Ilfov County Energy Strategy approved by Ilfov County Council on **November 2018**.

An alignment of the development plans of municipalities with this Roadmap ensure continuity by following these steps:

1. The action and measure plans of the Bucharest-Ilfov region and the vision of the region firstly will be presented at Bucharest Metropolitan Area Council, consisting of mayors of municipalities, members of municipal councils and member of County Council.
2. In the next stage we will support each municipality to integrate in to their annual budget financial allocation to support energy actions assumed by Ilfov Energy Strategy.

   Following institutions provided their letter of commitment for the Action Plans

Energy efficiency in households	
Action Plan 1: Thermo-renovation of private own multi story apartments blocks on Bucharest Sector 2	Bucharest Sector 2 mayor
Action Plan 2: Thermo-renovation of private own multi story apartments blocks on Bucharest Sector 3	Bucharest Sector 3 mayor
Action Plan 3: Thermo-renovation of private own multi story apartments blocks on Bucharest Sector 6	Bucharest Sector 6 mayor
Action Plan 4: Thermo-renovation of private own multi story apartments blocks on Magurele Municipality	Magurele Municipality mayor
Energy Efficiency on public buildings	
Action Plan 5: Energy Efficiency in public buildings Voluntari Municipality	Voluntari Municipality mayor
Action Plan 6: Energy Efficiency in public buildings Popesti-Leordeni Municipality	Popesti-Leordeni Municipality mayor
Action Plan 7: Energy Efficiency in public buildings Pantelimon Municipality	Pantelimon Municipality mayor
Action Plan 8: Energy Efficiency in public buildings Chitila Municipality	Chitila Municipality mayor
Action Plan 9: Energy Efficiency in public buildings Otopeni Municipality	Otopeni Municipality mayor
Financing and business models	
Action Plan 10: Extension and modernization of public lighting on Buftea Municipality	Buftea Municipality mayor

7 Financing

Identified sources of funding are:

- European Commission Cohesion funds;
- EU funds of targeted programs;
- 33% contribution from Ilfov County Budget
- 30% State budget funds;
- Funds of municipalities of Bucharest Sector 2, Bucharest Sector 3, Bucharest Sector 6, Buftea, Otopeni, Chitila, Magurele, Pantelimon, Voluntari and Popesti-Leordeni;
- Private funds of residents and businesses.

A part of the funding will reach the region through the Ilfov County Council according to approved priorities and concrete projects. Another part of the measures can be funded by submitting project applications to targeted funds and competing with national and EU projects.

According to their capabilities, municipalities will contribute with the co-financing of support funds.

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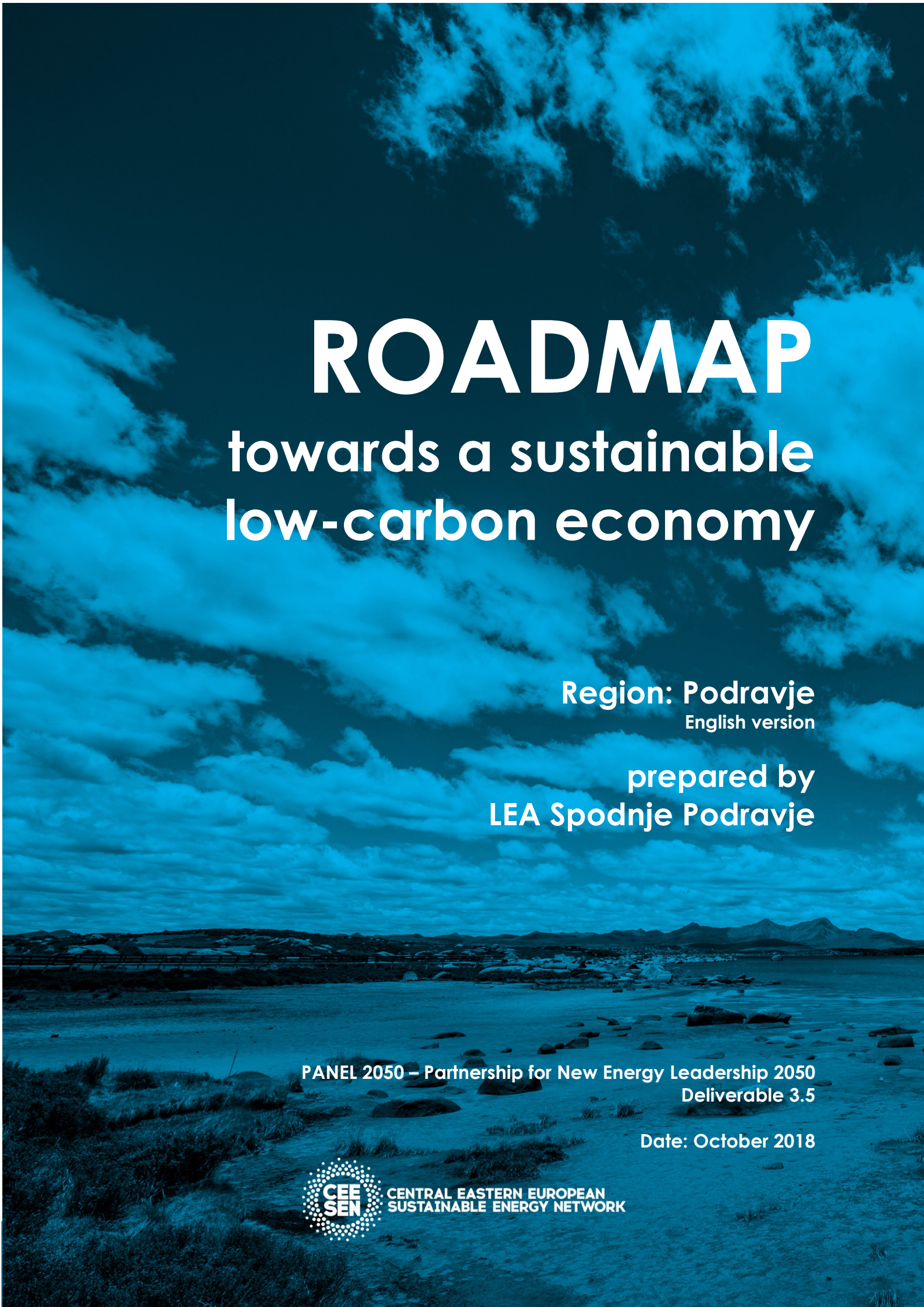

ROADMAP

towards a sustainable low-carbon economy

Region: Podravje
English version

prepared by
LEA Spodnje Podravje

PANEL 2050 – Partnership for New Energy Leadership 2050
Deliverable 3.5

Date: October 2018

CEE SEN CENTRAL EASTERN EUROPEAN SUSTAINABLE ENERGY NETWORK

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About Panel 2050 project

The PANEL 2050 project has the aim to create durable and replicable sustainable energy networks at local (municipality/community) level, where relevant local stakeholders collaborate for the creation of a local energy visions, strategies and action plans. The aim of these networks is to contribute to and actively work for the transition towards low carbon communities in 2050. The PANEL 2050 partnership will provide support for the creation of first successful local energy networks in the CEE countries. In the course of the project, organisations from 10 CEE countries will collaborate on creating regional energy strategies and action plans. For more information visit https://ceesen.org/panel2050/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696173.

The PANEL model

PANEL model is a comprehensive approach for implementing local long-term energy management, supported by the community. PANEL model consists of seven main elements: Stakeholder Engagement, Training Program, Guidebook, Long-term Energy Visions/Roadmaps/Action Plans and Central and Eastern European Sustainable Energy Network CEESEN. These elements are developed by PANEL 2050 project to support the CEE communities on achieving their sustainability goals.

The Roadmap at hand is the output of the long-term energy planning process with the aim of plotting the regional transition towards a low-carbon community.

Attached to the Roadmap 10 specific Action Plans were developed, representing the first steps on this road toward low-carbon community by 2050.

Roadmapping process
Podravje region, Slovenia

Stage 1

Baseline – Regional Energy Profile *Podravje*

Stage 2

Vision

In 2050, Podravje will be a **Smart region** that exploits in a maximum and sustainable way the local available renewable energy sources, transforming the energy using **innovative technology** and distributing it through **active networks**. People in Podravje region will live in a **clean and healthy environment**.

Stage 3

Roadmap

Stage 4

— RES for heat and electricity production —

Action 1
The implementation of RES in existing district heating systems

Action 2
RES for heating of public buildings

Action 3
Micro district heating systems in small municipalities

Action 4
Solar roofs in Podravje

— Improvement of the energy infrastructure and the production of smart communities —

Action 5
Improvement of the electricity grid and the implementation of smart measures

— Energy efficiency and RES in public buildings and households —

Action 6
Energy renovation of school buildings

Action 7
Promotion of energy efficiency and RES

Action 8
Mitigating energy poverty in Podravje

Action 9
Renov. of public buildings and the mobilizing of investors

— Sustainable mobility —

Action 10
Regional charging network for e-vehicles

1 Introduction

In 2050, Podravje will be a Smart region that exploits in a maximum and sustainable way the local available renewable energy sources, transforming the energy using innovative technology and distributing it through active networks. People in Podravje region will live in a clean and healthy environment.

The Vision statement consists of two priority focus points for the Podravje region for the next decades – to become a Smart region and to promote and use the local available renewable energy sources. According to the Regional energy profile (REP), Podravje region is excellent in electricity production from RES, since the river Drava has a great Hydro-energy potential, that is already by 97 % exploited. In addition to water, solar energy is also used for the production of electricity, while other renewable resources are virtually not present. Heat production is dominated by wood biomass in Podravje. Research shows that around 30 % of the theoretical potential of wood biomass is currently used, so we still have room for a strong growth. The problem that arises is that currently wood biomass is used to a greater extent for household heating, where outdated and energy-inefficient technology stands out. In the area of transport there is a good potential for the spread of electric vehicles, but it is necessary to ensure a sufficient number of charging stations and, which is very important, to ensure that the power grids will be able to provide additional loads that will result from an increase in the number of electric vehicles.

EU guidelines on energy infrastructure predict that in the future the Electricity grids will need to be upgraded and modernized to meet increasing demand due to a major shift in the overall energy value chain and also because of the multiplication of technologies relying on electricity as an energy source. The grids must also be extended and upgraded to foster market integration and maintain the existing levels of system security, but especially to transport and balance electricity generated from renewable sources. At the same time the grids also need to become smarter. Reaching the EU's 2020 energy efficiency and renewable targets will not be possible without more innovation and intelligence in the networks at both transmission and distribution level, in particular through information and communication technologies. These will be essential in the take-up of demand side management and other smart grid services. Projects that are dealing with demand side management are already running in the Podravje region.

According to the energy Vision and the Regional Energy Plan, the main challenges for the next years will be:

- To create and maintain a supportive environment for improving the energy performance of buildings and to introduce new green technologies;
- To ensure local energy supply;
- Development of smart energy distribution networks;
- To ensure environmental sustainability and combating climate change;

The Roadmap does not replace national, regional and local efforts in terms of energy efficiency and modernizing the energy supply, but seeks to develop a long-term regional framework in which these policies will be more effective. The approach of the roadmap will increase security and solidarity and lower costs compared to parallel national schemes by providing a wider and flexible market for new products and services.

2 Priority areas

Energy efficiency priority areas

- **Households**
- **Public buildings**
- **Transport sector**

Renewable energy priority areas

- **Bioenergy**
- **Solar**
- **R&D**

Stakeholder engagement priority areas

- **Co-creation**
- **Partnership**
- **Participation**

To move forward and become a low carbon society until 2050, public sector, households and the transport sector will play an important role, after all they are covering about 70 % of the overall energy consumption. Given to the regional RES potential Bioenergy and Solar power will be the main drivers of RES in the region.

Following priority areas will be important for the region of Podravje to achieve the set goals for 2050:

- **RES for heat and electricity production**

HEATING - As indicated in the Regional Energy Profile, the region has a high potential of wood biomass and according to the researches it is only by 30 % exploited. Heating with renewable sources is extremely important for the decarbonisation process. It is necessary to switch energy consumption to low-carbon and locally produced energy sources (including heat pumps) and renewable energy (geothermal energy, biomass). Also needed is the modernization of existing district heating systems with the upgrade to renewable sources and the construction of new such systems. The decarbonisation will require a large quantity of wood biomass for heating. This represents an opportunity for local supply of wood biomass, what offers a positive effect on regional economy.

ELECTRICITY - There is a requirement that from 2020 on all new buildings will have to be near zero energy buildings. This will be reached not only with overall energy efficiency and the use of RES for heating but also with electricity production. In last few years, photovoltaics has experienced a new upswing due to the introduction of net metering. It is to expect that due to the requirement for near zero energy construction after 2020, this trend will continue.

- **Improvement of the energy infrastructure and the production of smart communities**

Some of the more important actions until 2050 will affect the electrical infrastructure. In order to be able to handle all additional loads that will arise from individual electricity production or from the transport sector that will promote the use of e-vehicles, the electrical grid will have to be improved and at the same time it will be needed to implement smart grids, which will be able cost effectively include the characteristics and activities of all users connected to it - producers, customers and those who are both at the same time, in order to provide an economically efficient, sustainable low-loss network of energy networks, a high level of quality and security of supply.

- **Energy efficiency and RES in public buildings and households**

In terms of energy efficiency and the use of RES, the public buildings serve as an example to others buildings like residential buildings. This means, the level of energy efficiency should be at least at the level of requirements from the Rules on the efficient use of energy in buildings (PURES). In the last years, most public buildings have already been energy renovated and they are in a quite well condition. However, a minimum level of these renovations has been comprehensive and as a result most of the energy systems have not been replaced. In most cases they still use non-renewable fuels for heating. In this area there is still a great potential for improvements.

As already mentioned, public buildings have to be a good practice example for residential buildings. In the past years an extensive renovation of more apartment buildings in the region has started and in the next years these renovations will be completed. However, the promotion of renovation of single family houses will be necessary to achieve the desired level of energy efficiency of buildings.

- **Sustainable mobility**

Due to the increasing negative effects of traffic on the environment, health and human well-being, solutions in the transport system have become a necessity. These solutions are covering all transport subsystems such as walking, biking, public passenger transport, motorized and stationary traffic. Actions within this roadmap will be dealing mainly with the motorized traffic, focusing on e-mobility.

In the last year's electric vehicles have experienced a breakthrough on the vehicle market. Years ago the biggest problem has been the range of an electric vehicle. The batteries are improving and charging networks are expanding and the consumers are overcoming the "range anxiety". Over the last six years, the median range for EVs has extended to 56 %. It is to expect that the share of electric cars in the near future (after 2021) will increase not only on a voluntary basis but to a large extent due to the mandatory use of electric / prohibited use of petrol and diesel-powered vehicles. In the Podravje region there is still a lot of work to be undertaken in terms of e-mobility infrastructure. A network of charging stations has to be built through the whole region in order to meet the needs of e-vehicles.

All above described areas contribute not just to energy savings that are important for reaching national goals and other requirements set by the EU, but also for the regional and local economy.

3 Actions and development scenarios

On top of this roadmap stands the Energy vision for the Podravje region. The roadmap gives the general direction and concrete steps how to move towards to this vision. The development scenario or several different scenarios described in the roadmap gives the pathway from the status quo (baseline analysis) to the regional vision.

The analysis of several scenarios constitutes the basis for energy-related decisions to be taken and related actions planned. Using scenarios, the influence of long-term decisions can be validated against their contribution to the agreed regional vision.

Action Plans as integral part of the roadmap, contribute step-by-step to reaching the vision and making the development path concrete and realizable.

The national policies require a 25 % share of renewables by 2020 and 30 % by 2030. As can be seen after 2020 the share of RES will not have to increase so highly than until 2020. This is also the case with the EU forecast for the use of RES. With the proposed actions in this roadmap, the Podravje region will strive for that after 2020 the growth of the share of RES will not decline, as foreseen by national policies.

The analysis of the described actions of this roadmap shows that the biggest share of energy supply technologies in 2050 comes from renewables. Thus, a major pre-requisite for a more sustainable and secure energy system is a higher share of renewable energy beyond 2020. After the year 2030, renewable sources will represent the centre of the energy mix and these changes will require policy development based on given trends.

According to the given direction, it is to expect that in 2050 electricity will have to play a much more important role than now. Some of the actions towards low carbon society will be connected with electricity production, what highlights the importance that the energy transition is already happening at this moment. Individual electricity production will contribute a significant share to the overall electricity production and energy storage will have an important role in distribution of the load on the power grid. At the same time the grid will have to be modernized to withstand these additional loads and at the same time, they will have to become smarter. All this will attract new investments and will have a positive impact on the regional economy.

We are estimating that financial incentives will be necessary for the next years (up to 2030) and after that as the new technologies will mature, costs will decrease and financial support can be reduced.

3.1 Status of R&D, innovations and technology

The implementation of the Roadmap is focusing at the implementation of RES technologies like Photovoltaics for electricity production and Biomass and Heat pumps for heating.

Photovoltaics

Photovoltaics are becoming more and more established and affordable. In Slovenia, the first one was installed in 2001. Seven years later, solar power plants installed in Slovenia had a total power of 1.243 kWp and in 2009 6.396 kWp. After the exponential growth, this area has experienced stagnation in 2013, but now the trend is rising again. In 2017 there

were set up about 718 solar power plants, with which the country saved about 157 kiloton CO2. Most of them were installed for the purpose of self-sufficiency. The reason for such an increase can be found in the net metering scheme, which allows the construction of solar power plants for self-sufficiency.

Heat pumps

Annually between 6,000 and 8,000 heat pumps are being sold and installed in Slovenia. Slovenia has several manufacturers of heat pumps that have their own development. The products of our producers achieve remarkable success at the European level, such as the multiple title "the most efficient heat pump in Europe" for the heat pump of the Slovenian manufacturer Kronoterm.

Biomass

In Slovenia more than 30% of households are heated to wood biomass, according to some data, this share is even about 42%. But as already described the problem here is that most of the technology used is inefficient and outdated. Like in the case of heat pumps, in Slovenia there are many manufacturers of wood biomass boilers that offer equipment as product of their own research and development.

However, many renewable technologies need further development to bring down costs. There is a need to invest in new renewable technologies, such as 2nd and 3rd generation biofuels. There is also a need to improve existing ones, such as to improve photovoltaic panels to harvest more solar power.

3.2 Business-as-usual scenario

According to the Regional Energy Profile, Podravje is following well the requirements set at the national level. The total energy consumption in the region is 8.469,9 GWh which is 15,5% of the total country consumption. In the region, about 2.800 GWh of renewable energy is being produced annually which is around 20 % of the total national renewable energy production. It can be said that in the renewable energy production the region is doing well and contributes a significant share to the total national energy production from RES. The main RES contributor in the region is the river Drava and her hydro potential. Since the potential of Drava is already to a greater extend exploited, in the future the region has to focus mainly on biomass and solar energy.

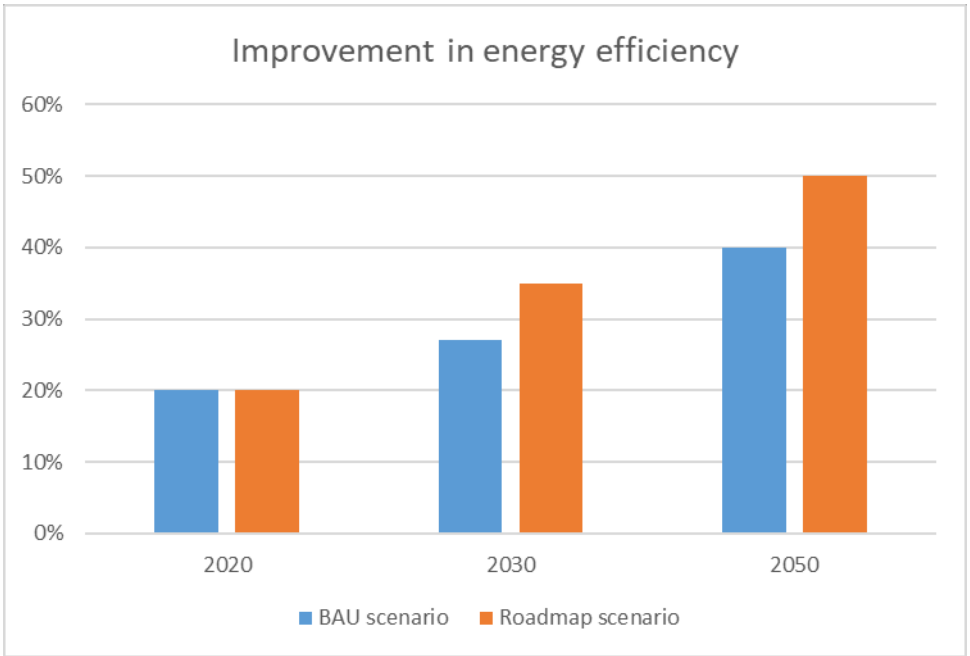
Slovenia has no specific targets at regional level, so for the comparison of targets and development of BAU scenario national targets are used. Some of the national targets until 2020 and 2030 compared to 2008 are:

- 20 % improvement in energy efficiency by 2020 and 27 % improvement by 2030;
- 25 % share of renewable energy sources (RES) in the use of gross final energy by 2020 and a 30 % share by 2030;
- reducing energy intensity by 29 % by 2020 and by 46 % by 2030;
- to provide a 100 % share of almost zero energy buildings (new and renovated buildings) by 2020 and in the public sector by 2018;
- a reduction in import dependency to a level of no more than 45 % by 2030 and the diversification of sources of energy supply at the same or better level than the present;

- improving the international energy connection of Slovenia for greater diversification of energy sources, supply routes and suppliers, and further integration with neighbouring energy markets.

In a business as usual scenario, the region continues to provide a great contribution to national targets, what is to expect due to its favourable potential of RES. The progress in energy renovations will continue as long as funds will be available.

Unlike the BAU scenario, energy renovations of buildings will continue in the region, and for this purpose new investors will be sought. **The region will aim to improve the energy efficiency by 2030 by 35 % and by 50 % until 2050**.



The share of RES in the use of gross final energy is a key indicator at the national and EU level. But since the regional produced energy (especially electricity) is not only used in the region, are the values of this indicator impossible to elaborate at the regional level. The aim of this roadmap is to provide the background and actions in order that the Region successfully moves to RES and therefore significantly contributes to national targets.

The main goal of the region will be the reduction of greenhouse gas emissions of 90% by 2050 compared to the year 1990, what is an optimistic prediction but it also follows the direction of the EU and the new Energy concept of Slovenia that is still under preparation.

3.3 Development scenarios

Business as usual will not be enough to reach the regional vision in the planned timeframe. Several "corrective actions" have to be implemented in order to reach the agreed vision. Each of the below described actions represents a step towards reaching the goal of the region.

RES for heat and electricity production

Action 1: The implementation of RES in existing district heating systems

Objective: This action closely presents the renovation project of the district heating system of Ptuj, with the implementation of RES. Municipality of Ptuj aims to renovate and upgrade the local district heating system with the transition to renewable sources. Because of the decline in the heat consumption due to the renovation of buildings connected to the district heating system, the expansion of the network has been shown to be economically justified. With the reconstruction of the district heating on natural gas an additional wood chip boiler will be installed in order to meet the requirements of the Energy Act of Slovenia, which imposes at least 50 % of heat generated from renewable sources or waste heat, or 75 % of heat produced from CHP or 75 % as a combination of all above. The project implementation and the financing could serve as a good practice for other similar district systems and could be easily transferred.

With the upgrade a reduction of 2.016 tons of CO2 emissions per year is foreseen, what is a reduction of 60 %. The costs of the project are estimated at 2,9 million EUR.

Timeline: The documentation for this project have to be finalized and the implementation could start already in 2019.

Action 2: RES for heating of public buildings

Objective: In the past years, municipalities have done a great work in terms of energy renovation of public buildings. One of the main reasons have been favourable conditions of co-financing of such measures. However, these renovations often included only measures to increase the overall energy efficiency of a building, like the insulation of the façade, ceiling, replacement of windows and others, but in many cases, the heating system was not replaced. So most of these buildings still have old inefficient heating systems on fossil fuels. This Action will closely present a project that addresses this particular issue and provides a solution in the form of a district heating system on wood biomass. Such a project could serve as a good practice, in terms of implementation and financing of such a project, and could be transferred into other local environments in the region of Podravje.

- *District heating on RES in the Municipality of Ormož*. In order to replace the fossil fuel heating systems of public buildings, the municipality of Ormož is planning the construction of a district heating system on wood Biomass. By setting up a boiler room and constructing a hot water network, the municipality wants to provide heat supply for 14 public buildings and offering the possibility of connecting to the district heating for residential buildings in the city centre. The investment is estimated at 3,5 million EUR.

Timeline:

Preliminary analyses have already been carried out and the preparation of all

necessary implementation plans and other documents could start in 2019.

Action 3: Micro district heating systems in small municipalities

Objective: Podravje region consists of 41 municipalities and 28 of them have less than 5.000 inhabitants. Usually the main town centres of this municipalities includes public buildings like the municipal building, primary school buildings, kindergartens, community halls, health centres etc. These public buildings could be connected with micro district heating systems on RES, preferably wood biomass, in order to replace the individual heating systems of this buildings that are often still using fossil fuels. The supply of biomass for such systems could be supplied regionally/locally and in that way contributing to the local economy.

Hereinafter, this action plan presents a project that has a high potential for replication and can be implemented in most of the smaller town centres in the Podravje region:

- *Micro district heating system in the municipality of Cirkulane*. In order to replace the fossil fuel heating systems of public buildings, the municipality of Cirkulane is planning a district heating system on wood pellets. The idea is to use the pellet boiler installed in the boiler room of the Primary school of Cirkulane building and construct a hot water network to connect additional public building. With this action the municipality wants to connect 5 buildings with a micro district heating system. The costs of the investment are estimated at 100.000 EUR.

Timeline:

The Municipality have to obtain all the necessary permissions and the start of the implementation could be already in 2019.

Action 4: Solar roofs in Podravje

Objective:

From the year 2020 on, every new constructed building or comprehensive renovated building will have to be near zero energy building. Reaching the target will require not only good insulation of the building and the use of renewable sources for heating, but it will demand also on spot electricity production. This will be a great opportunity for the regional economy. The NET-METRING system has been developed and the conditions for the production of electricity for the needs of self-supply are in place. In this sense conditions are provided for the exploitation of the potential of individual buildings and their roof surfaces for the installation of solar PV.

At present, the coverage with solar power plants of less than 10 kWp is very low, which is only 0,8 W/per capita. With a more intensive introduction of solar power plants the calculated value of possible annual savings is expected to be just under 60 % of the Slovenian nuclear power plant electricity production (approximately 2,9 TWh)

Timeline:

Continuous process.

Improvement of the energy infrastructure and the production of smart communities

Action 5: Improvement of the electricity grid and the implementation of smart measures

Objective:

Some of the more important actions until 2050 will affect the electrical infrastructure. In order to be able to handle all additional loads that will arise from individual electricity production or from the transport sector that will promote the use of e-vehicles, the electrical grid will have to be improved and at the same time it will be needed to implement smart grids, which will be able cost effectively include the characteristics and activities of all users connected to it - producers, customers and those who are both at the same time, in order to provide an economically efficient, sustainable low-loss network of energy networks, a high level of quality and security of supply.

At the national level there are to be expected some changes in the use of electricity in terms of requirements for smart devices and integrated and centrally managed cloud solutions. In the region there is already running a demonstration project in which more than 700 households connected to the same distribution station are participating in the pilot demonstration of limiting and time delay peak shaving, where users, the electricity distribution network operator and energy suppliers demonstrate that with improved communication and co-operation, pick loads can be managed, thus reducing the peak load in the use of electricity.

The result of this project will be an advanced infrastructure that will help to fulfil the legally required obligations and improve the quality of services for electricity consumers using sustainable and environmentally friendly solutions.

Timeline:

It is to expect that after the demonstration activities the results will be implemented at the regional and national level. These activities will start approximately after 2020.

Energy efficiency and RES in public buildings and households

Action 6: Energy renovation of School buildings

Objective: In the past years, Municipalities in the Podravje region have already renovated most of their school buildings but there are still some left that need to be energy renovated in order to ensure favourable conditions for pupils and students in terms of the education and training process. This action plan is presenting two projects that could be implemented in the near future and the responsible bodies have already show great interest for this projects and already started the planning phase. The approach of this projects, especially the financing part, could be easily transferred into other such projects across the region.

- School Centre of Ptuj consists of 5 buildings (School centre, Mechanical shop, Gymnasium, High school and student dormitory), recognized as energy inefficient. The energy renovation project foresees the implementation of

measures on the building envelope (facade, ceiling, window replacement), replacement of lighting, renovation of the ventilation system and the replacement/renovation of the heating system. The provision of renewable resources is envisaged with the renovation of district heating of the Municipality of Ptuj (Action 1) or by the installation of heat pumps. It is planned that the renovation will be partly carried out through a public-private partnership and partly through a public contract. The costs of the energy renovation are estimated at 4.150.161 EUR + VAT. With the project, total savings of 1.531.979 kWh per year are expected.

Timeline: The implementation project are being prepared and the start of the works is foreseen for the year 2020.

Action 7: Promotion of energy efficiency and RES

Objective:

Consumers play an important role in energy consumption and can, with their behaviour based on avoiding unnecessary energy expenditure, significantly affect the reduction of energy and emissions in the municipality.

The way people use energy at home, at work, and traveling from one place to another represents a potential that allows up to 20 % savings in final energy consumption. 5 to 10% savings are available without any compromises on the quality of life.

A change in behaviour plays an important role in raising awareness and promoting a sustainable lifestyle, in which people are aware of the importance of using sustainable modes of transport, switching off lights, televisions, computers and other equipment when they are not needed, etc.

With this Action two types of measures are provided:

1. *Educational and advisory activities for citizens*

Information and educational activities for different target groups (primary school pupils, students, general public, etc.) are carried out in order to raise people's awareness of the opportunities offered by reasonable use of energy and to influence the introduction of RES measures. Advisory activities are intended to inform people about the possibilities of obtaining grants from the Eco Fund, energy efficient renovation of buildings, etc. The examples of good practices and examples from the public sector are further encouraged to invest in EEU and RES in households.

2. *Educational events for public institutions*

There is a lack of education and awareness of the importance and relevance of energy efficiency in public buildings. With non-investment measures in the field of organization and operation of existing energy systems, which enable the use of the available energy saving potential in a particular building, it is possible to achieve a 5-10% reduction in energy consumption and, consequently, lower energy costs, and a higher level of comfort impact on productivity of employees and reduction of environmental impact. The level of awareness of public building users is significantly

affected by the achievement of the desired savings.

On the other hand, after the implementation of an energy renovation project, often the desired and required energy savings are not being achieved. The reason can be found in a lack of knowledge of public buildings maintainers. Since the overall energy conditions after a renovation are changed, it would be extremely useful to conduct such trainings to the maintaining staff of public buildings.

Timeline: Promotion of energy efficiency and the use of renewable energy sources is a continuous measure.

Action 8: Mitigating energy poverty in Podravje

Objective

It has been well established that energy poverty is an issue of rising concern for whole Europe. To date, efforts to address energy poverty have been deficient for several reasons. Traditional outreach methods are inadequate, as, potential beneficiaries need to be approached because they will not come themselves due to lack of information, motivation, stigma attached to energy poverty among other reasons.

Energy poverty is a complicated problem that results from at least three groups of factors: Energy affordability (income level, energy prices, energy consumption), Energy use patterns (Energy consumption, Type of heating system and share of central heating) and housing patterns (tenure system housing characteristics). Secondary factors, such as social aspects (gender, household composition, disability status) have also been found to be relevant as well.

These factors often occur at the same, time, meaning that addressing only one aspect of the issue will most likely not solve the problem. The co-occurring issues associated with energy poverty often are of a technical, financial and social nature – requiring solutions that improve energy infrastructure (i.e. change of building systems) as well as addressing needed behaviour change of (often low-income) end users. However, many interventions that have been developed to try and reduce energy poverty have focused primarily on the technical aspects, for example through the use of energy advisors who make household visits/audits. Moreover, energy advisors often lack expertise in communications and are not connected to other social support actions, thus making it more difficult for them to identify at-risk or current energy poor households. Even when they do identify energy poor, they have found it difficult to achieve lasting behaviour change among their key target group. As a result, one-size will not fit all when it comes to addressing energy poverty in Europe. Tailored approaches must be taken to consider unique circumstances of different subsets of the energy poor.

Energy advisers from ENSVET energy advising network funded by the ECO Fund have been engaged in energy counselling to households receiving social assistance since 2016. They already possess expertise in implementing energy saving solutions in such households but require additional knowledge on the social aspects of working with energy poor people.

The aim of this action is to support and improve existing measures in order to achieve a greater impact. This support is provided through trainings for staff working with this vulnerable group of people (Energy advisers, social workers, etc.), workshops for the promotion of soft measures and other investment measures intended for energy poor households, home visits, etc.

Regional analysis has shown that with activities related to the prevention of energy poverty in Podravje region, it is possible to achieve energy savings of at least 150.000 kWh/year and CO2 reduction of 40 tons/year.

Timeline:

Energy poverty is a complex issue and actions for reducing and maintaining a favourable level in terms of energy prosperity have to be continuous. The timeline for this action will be 2019 and until 2050, with several checkpoints and corrective actions if needed.

Action 9: Renovation of public buildings and the mobilizing of investors

Objective

In the period from 2008 to 2014, many public buildings were renovated in Slovenia, mainly due to favourable conditions for co-financing. In the first perspective, 100 % co-financing could be obtained for energy renovations, while in the second period it was 85 % of eligible costs. At present, a 40 % subsidy is available for the renovation of buildings, with additional conditions to be meet such as the minimum size of investment (at least EUR 500.000). As a result, municipalities form consortiums in order to provide bigger projects (more public buildings in one project) to achieve the minimum required investment amount. Because in most cases their funding share cannot be covered, they decide to take the option of a public-private partnership.

In spite of the numerous renovations of public buildings, many of them still need to be energy renovated. The current national strategy and operational program for the restoration of public buildings and the utilization of cohesion funds covers the period up to 2023. Currently it is hard to say if the co-financing programs will continue at the end of this period.

Therefore, with this action, we are committed to encouraging municipalities to carry out as much energy projects as they can for their buildings and to connect with potential investors in public-private partnerships.

Timeline:

Until 2023 – the duration of the current energy renovations financial perspective. In the case that after this period there will be no new financial programs for energy renewal projects, new investors will have to be mobilized according to the principle of public-private partnerships.

Sustainable mobility

Action 10: Regional charging network for e-vehicles

Objective:

The basis of e-mobility are electrically powered vehicles, which are mainly being used for personal transport. In addition to cars, motorcycles belong to this group, as well as smaller freight vehicles that use electric power instead of fossil fuels.

Due to the fact that in Slovenia the most journeys are carried out at a distance of up to 30 kilometres, gives a great potential for the use of e-vehicles. A prerequisite for success in introducing e-mobility is a well-developed charging network. In Podravje we have a relatively well developed charging network in bigger city centres like Maribor and major transport links, while smaller municipalities are largely without charging stations. The aim of this action is to ensure a sufficient coverage of the charging network throughout the region.

Timeline: 2019 until 2030

To achieve the desired results, following conditions must be met:

- The energy system and society as a whole need to be more energy efficient. The co-benefits of achieving energy efficiency in a wider resource efficiency agenda should contribute to meeting the goals in a faster and cost-efficient manner.
- Particular attention should continue to be given to the development of renewable energy. Their rate of development, impact in the market and rapidly growing share in energy demand call for a modernisation of the policy framework.
- Higher public and private investments in R&D and technological innovation are crucial in speeding-up the commercialisation of all low-carbon solutions.
- Well-designed market structure instruments and new ways of cooperation are required for the internal energy market to deliver its full potential as new investments are coming into the energy market and the energy mix is changing.
- Special attention should be paid for the most vulnerable groups, for which coping with the energy system transformation will be challenging. Specific measures should be defined at national and local levels to avoid energy poverty.
- All involved need concrete and defined milestones.

3.4 Milestones

Most of the proposed actions will start already in 2019.

Most of the investment actions will be finished by 2025 and at that point the monitoring phase will begin, in some cases even earlier. At that time, it is also a recommended revision of some of the proposed action plans or the development of new actions.

At the national level 2030 will mean a milestone to check some of the achievements set in the national strategy. This is also a key point where the regional achievement should be analysed and compared with the results at the national level. Based on the results, corrective measures could be implemented. The same procedure is also recommended for the year 2040.

In 2050 the final result of a smart region that in a large extend uses its renewable sources and the main goal of 90 % of greenhouse gas emissions reduction will be achieved.

4 Impacts on regional economy

Talking about the impact on regional economy, we are talking about the social dimension of the energy roadmap, which is extremely important. The transition to a low-carbon society will affect employment and jobs, requiring education and training and a social dialogue. In order to efficiently manage change, involvement of social partners at all levels will be necessary in line with just transition and decent work principles. Mechanisms that help workers confronted with job transitions to develop their employability are needed.

Since energy cannot be supplied without infrastructure and technology, the first step will have to be the renovation and upgrade of energy infrastructure. New district heating systems and heat transport pipes will have to be built. Existing district heating systems will have to be renovated and moved to renewable sources.

At the moment, over 40 % of households are being heated on wood biomass. The problem and at the same time an opportunity is that most of the technology used is outdated and extremely inefficient and have a bad combustion. This is causing serous troubles – air pollution with dust particles. The technology needed is already placed at the market and for the following years it will be a good driver for the economy. In addition to the environmental aspect, this particular situation has also a very large social aspect. One of the key reasons why this outdated technology has not yet been completely replaced by the newer is that it is still much more affordable than the newer technology. Most of the socially weaker people cannot afford to replace their furnace with a more efficient one. At the same time, most Slovenian forests are privately owned, which means that wood is still the cheapest energy, which results in a lower interest for greater efficiency of technology. In order to resolve this situation, it is therefore necessary to take into account different aspects and to find suitable solutions so that substitution can be also carried out by socially weaker population.

With the new requirement of near zero energy buildings, RES will become the main source for heating and also individual electricity production which will have a positive effect on the regional economy.

5 Involvement of stakeholders

Within the PANEL 2050 project we have developed a network of stakeholders who can provide us valuable input in terms of energy visioning and development of action plans and who can be involved more intensively into the regional roadmapping process.

Through the project we have recognized more than 30 stakeholders, that could contribute valuable input for the creation of energy vision, the roadmap and related action plans. Some stakeholders have been recognized as new stakeholders of our

organization but the most of them are municipalities or organisations that we already worked with before. As a local energy agency we work mainly with municipalities from the Spodnje Podravje. Our contact with them is on a regularly basis, weekly or monthly. In this way, most of the involvement of stakeholders for the visioning process and roadmapping has been done by individual meetings and telephone conversations.

In the process of roadmapping and action plan development were mainly involved the following stakeholders: Municipality of Ptuj, Municipality of Ormož, Municipality of Cirkulane, RIC, School Centre of Ptuj, Javne Službe Ptuj, Centre for social work Ptuj, ENSVET – Energy adviser network.

Roadmapping process has been ensured mainly through our regular meetings with local communities. In the table below are listed some of the more importand roadmapping events and meetings.

Date, place	Participants	Content / Results / Conclusions
11.4.2018, **LEA Spodnje Podravje**	- Janez Petek (LEASP), - Roman Kekec (LEASP), - Simona Kučiš Pogorelc (Municipality Ptuj), - Tomaž Pristovnik (RIC)	Regional training, visioning and roadmapping workshop for forerunners. Through the training the participants received basic knowledge on energy visioning and roadmapping process and how to involve different stakeholders into that process. The regional training has been mainly linked to the outputs of WP3 and the training topic has led to an open discussion where the main challenges for Podravje until 2050 have been discussed. The result of the discussion was the initial version of Vision and defined regional challenges included in the roadmap.
3.08.2018 , **Municipality of Ptuj**	- mag. Andreja Komel (Municipality Ptuj), - Andrej Trunk (M. Ptuj), - Bogomir Širovnik (Primary School Mladika), - Anica Drevenšek (TMD Invest), - Gabrijela Šegula (TMD Invest), - Henrik Glatz (LEASP), - Mojca Horvat (M. Ptuj) - Damijan Plajnšek (M. Ptuj)	Meeting on the preparation of the action on energy renovation of school buildings – preparation on the renovation project of the Primary School Mladika. Discussion on funding possibilities, time schedule of the project implementation and technical matters.

31.01.2018, Municipality of Ptuj	Members of the Expert Committee for Energy in Ptuj: - dr. Janez Petek (LEASP), - Henrik Glatz (LEASP), - mag. Alen Hodnik - mag. Janko Širec, - Rajko Fajt - dr. Bojan Pahor, - Miran Kramberger - Janez Polanec	Meeting of the committee for energy on the preparation of the Action on the renovation of existing district heating systems and the presentation of the reconstruction project of the district heating system in Ptuj with the transition to RES.
5.11.2018, Municipality of Ormož	- Janez Petek (LEASP), - Alojz Sok, (Municipality Ormož) - Members of the municipal council	Meeting of the municipal council with the presentation of the project of district heating on wood biomass.
30.8.2018, Municipality of Cirkulane	Henrik Glatz (LEASP), Ivan Stopajnik (Municipality of Cirkulane) Milena Debeljak (director of the municipal administration – Municipality of Cirkulane)	Meeting on the preparation of the action on Micro district heating systems in small municipalities. Discussion on technical matters of the micro district heating system project in the Municipality of Cirkulane.
17.01.2018, School Centre Ptuj **06.02.2018, School Centre Ptuj** **10.04.2018, School Centre Ptuj**	- Oton Mlakar (director of School Centre Ptuj), - Dalibor Šoštarič (LEASP), - Matej Rogač (Fima projekti d.o.o.) - Oton Mlakar (director of School Centre Ptuj), - Dalibor Šoštarič (LEASP - Oton Mlakar (director of School Centre Ptuj), - Dalibor Šoštarič (LEASP) - Anže Kunovar	Meetings on the preparation of the action on Energy renovation of school buildings. Meeting on preparation of the project. Discussion on project funding and technical matters of the implementation. Meeting on preparation of the application for grants. Meeting on preparation of the application for the implementation of a public private partnership.
- August 2018, phone call	- Roman Kekec (LEASP), - Božidar Muršec (ENSVET)	Phone call on the preparation of the action on Mitigating Energy Poverty. The results is an overview of services that ENSVET and the ECO Fund are offering to energy poor citizens and about the success rates and possible shortcomings of this services.

Long-term engagement of stakeholder will be crucial to implement the actions needed to reach the set targets by 2050. This can be achieved with different approaches:

Co-ordination meetings of the working group

- Should take place on a regular basis
- To assess process of roadmapping
- Opportunity to invite external experts for specific thematic inputs

Disadvantage:

- Internal organisational meeting involves the risk of getting routine

Regular meeting of energy groups – regulars' table

- Takes place regularly
- Meeting with informal character
- Can features different focus areas for discussion
- Opportunity to exchange experience in a specific group of experts of the field

Disadvantage:

- Heterogeneous group with changing members

Thematic workshops

- Provides specific feedback to your questions
- Generates input from a wide range of stakeholders on expert level
- Possibility to have different thematic focuses

Disadvantage:

- Participants and speakers have to be well chosen to get representative results

Field trip and study visits

- Practical, tangible way to convey a message
- Gives best practice examples the opportunity to present
- Participants get insider knowledge and can engage in discussion with implementers

Disadvantage:

- More time and resource consuming than other event types

Awards and competitions

- E.g. energy conversation competition, awards for outstanding energy projects, "boiler exchange" program, "Ice-block challenge"
- Can be targeted at different user groups, e.g. individuals, households, businesses, schools, …
- Award events raise public awareness
- Award participants act role models and multiplicators
- Low-threshold methods to collect ideas and visions for regional energy future

Disadvantages:

- Resources for setup, marketing and prices have to be allocated
- Possibility of failure due to low public interest

Citizen action groups / DIY groups

- Mostly self-organized movement of citizen to apply renewable energy system on local level (e.g. solar thermal, PV)
- Development of common ownership model in the renewable energy sector
- Long-term commitment to a renewable energy future

Disadvantage:

- Depends on the commitment of individuals

This approaches will be needed to keep the stakeholders informed and engaged over a longer period.

6 Endorsement by implementers and political decision-makers.

Formal endorsement of the roadmap is key to ensure the continuity and implementation of the roadmap including the Action Plans.

Roadmap includes a wide range of actions that will need to be implemented, which also opens wide opportunities for encouraging local and regional economy, which naturally supports the efforts of energy planning itself.

Throughout the project, and especially in the process of roadmapping, we worked closely with the municipalities and other key organizations in the Podravje region. The creation of actions to achieve the set goals by 2050 has been of great interest, and for some of the proposed measures, their implementation has already been ensured.

7 Impact to National Regulations

The main sectoral law is the Energy Act, which was adopted by the National Assembly on February 24, 2014. The law regulates the field of the electricity and gas market, efficient use of energy and renewable energy sources. With the law, the requirements of European legislation have been transferred to the Slovenian legal order. The development of the Slovenian energy system must be in line with the commitments of European and Slovenian legislation.

The development of energy in Slovenia is given in the Resolution on the National Energy Program. Because it is outdated, a new one is being prepared - the Energy concept of Slovenia.

The Roadmap does not replace national, regional and local efforts in terms of energy efficiency and modernizing the energy supply, but seeks to develop a long-term regional framework in which these policies will be more effective. The Roadmap is made

according to detailed analyses of the situation in the Podravje region, following the national and EU guidelines and energy requirements. The Roadmap taking into account the actual state of the targeted region, could serve as a model for the remaining 11 statistical regions in Slovenia. It can be considered as an excellent example of good practice for developing the energy strategy of a region and thus represents a high potential for replication.

8 Financing

At the moment funding is ensured through different EU funding mechanisms, like the Cohesion fund, rural development programme, and other EU programmes like Interreg and Horizon 2020. This programmes are mainly intended for the public sector and to some extend to the Industry. Citizens can apply for subsidies for individual energy projects from the ECO Fund.

1. Cohesion funds

According to the Operational programme for implementing European cohesion policy, Slovenia has available more than 3,2 billion euros from the European structural funds and the Cohesion fund. There are various national tenders available, mainly aimed at:

- Energy renovation of public buildings.
- Renovation of old or construction of new District heating systems on RES.

At the moment there are no exact predictions for the period after 2020.

2. ECO Fund

Eco Fund's main purpose is to promote development in the field of environmental protection. It is the only specialised institution in Slovenia that provides financial supports for environmental projects. The financial assistance is offered mainly through soft loans from revolving funds and since the year 2008 through grants. In comparison with commercial banks, Eco Fund's principal advantages in the market for environmental financing are that it provides soft loans at lower interest rates than prevailing commercial market rates and it is able to lend for significantly longer periods than commercial banks. For citizens ECO fund offers subsidies which are covering in average 20 % of the investment into RES or energy efficiency projects. ECO Fund also supports the purchase of electric vehicles for public bodies and also for citizens. Financial resources for the implementation of programs for increasing the use of RES are guaranteed by all final customers with the addition to the price of heat or to the price of fuels for increasing the energy efficiency that they are obliged to pay to the heat supplier or the supplier of fuels

3. European programmes

European programmes like Interreg or Horizon 2020 have open calls for projects that are related to different actions like promotion activities, knowledge transfer, and also for policy development. Actions connected with mitigating energy poverty, promotion of energy efficiency and RES and the educational activities in this field could be financed through this EU programmes.

9 Roadmap Team

The core of the roadmap team is LEA Spodnje Podravje (LEASP). The focus of LEASP lies in enhancing sustainable energy development of Spodnje Podravje. The LEASP acts as a mediator among various stakeholders such as public entities, universities, institutes, companies and potential others. Strong cooperation is also established between other Slovenian LEAs, Energy Directorate at the Slovenian government, companies, research organizations and others. Therefore, LEA Spodnje Podravje acts as a coordinator in the visioning and roadmapping process. Involvement of other organizations in the process has been ensured through personal meetings and phone calls.

Local Energy Agency Spodnje Podravje is energy manager for the Spodnje Podravje municipalities. Main activities of the agency are: developing local energy concepts, energy management, energy bookkeeping, energy auditing of the buildings and lighting systems, developing feasibility studies for investments in public sector (energy renovation of buildings, public lightning systems, implementation of renewable energy sources) and energy certification. All activities are performed within 26 municipalities on the market principle.

Other activities:

- Reporting of the energy savings and renewable energy sources implementation to the local and national governments;
- Preparation of national and international energy projects targeting the decrease of energy consumption and acceleration of RES in public buildings as well in enterprises and private buildings;
- Technical assistance for accomplishing RES and rational use of energy objectives;
- Assisting the investors to find adequate stakeholders and locations for the implementation of versatile energy projects (biomass installations, biogas production, small hydro power stations, district heating systems, geothermal energy systems, photovoltaics, CHP, etc.);
- Consulting and supervision on the design and construction of the passive and low energy buildings;
- Providing adequate training and knowledge transfer to the public sector managers at various levels;
- Organization of training seminars for different target groups from the field of sustainable development, energy audits, RUE and RES;
- Continuation of awareness raising and similar activities.

Dr. Janez Petek is the Director LEA of Spodnje Podravje, Director of Steng - National Centre for Cleaner Production Ltd., the leader of the research group at the Institute for Sanitary Engineering and head of the research group Eco Design. He has 24 years of experience in the industry and the public sector in the field of cleaner production, preventive environmental protection, energy efficiency and renewable energy sources.

Roman Kekec, has graduated at the University of Civil Engineering in Maribor. Since 2014 he is working in the field of energy, and carries out energy audits, elaboration of building performance, cooperation in design, preparation of the documentation for energy renovation projects. He is also experienced in EU funded projects (Interreg, Horizon 2020).

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ANNEX: Letters of Commitment

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