Energy

Assessment of Latvia's renewable energy supply-demand economic potential and policy recommendations, VPP-EM-2018/AER-1-0001

Analysis on utilization policies and restrictions of renewable and local energy sources in energy supply and transport

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INTRODUCTION

The European Union (EU) has a consistent and interconnected climate, energy, energy efficiency and circular economy policy, marked by the 2020, 2030, 2050 goals.

Latvia is facing a major challenge to achieve the set goals for renewable energy, energy efficiency and climate. To achieve them, it is necessary to implement specific policies, which should be summarized in a five-dimensional block:

- **1st dimension.** Economic sectors: energy sector, transport, public sector, household sector, industrial sector, agricultural sector, commercial sector.
- **2nd dimension.** Five levels of renewable energy users: national, regional, county, parish and individual.
- **3rd dimension.** Wide range of technological solutions for the use of renewable energy resources: combustion technologies, turbines, generators, cogeneration plants, panels, collectors, reactors, heat exchangers, heat pumps, etc.
- **4th dimension**. Wide range of renewable energy sources: solar, wind, biomass, biogas, geothermal water, hydropower, hydrogen, etc.
- **5th dimension.** Wide range of policy instruments: support for research, investment support (low rates, loan guarantee), taxes and tax exemptions, support for producers, tenders and auctions, public procurement, certificates, emissions trading, environmental standards, voluntary agreements, subsidies, grants, etc.

One of the important issues in the implementation of policy instruments is the hierarchy or sequence of measures implemented in various national and international research projects.

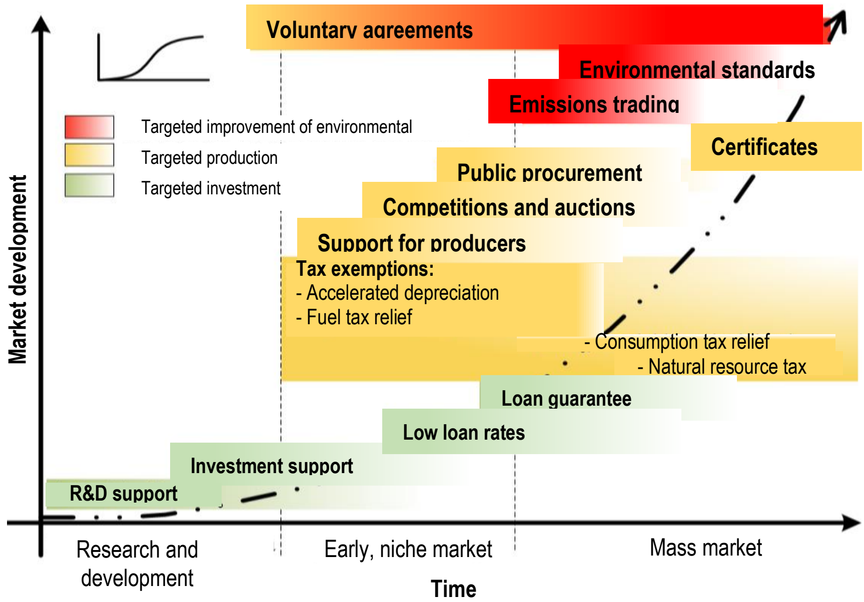

Fig. 1.1. Hierarchy of the use of policy instruments in the introduction of innovative products (Bunzeck et al., 2010)

One of the illustrative examples is the model of using policy instruments, which promotes the introduction of innovative fuels and vehicles with the lowest possible costs, which is shown in Fig. 1.1.

As part of a research project, experts from the Energy Research Centre of the Netherlands have developed a model (see Fig. 1.1) that shows that targeted investment is needed in the early stages of technology development, followed by production development. Finally, in the case of a mass market, the quality of the environment must be improved. In order to decide on the implementation of a particular measure, it is also necessary to properly assess the current state of technological development. This example illustrates the possibilities for countries to engage in different phases of market development according to the level of development of innovation. The Latvian transport sector needs to develop the instruments of electromobility policy in the final stages - the development of policy instruments for mass market introduction.

1. SHORT ANALYIS OF METHODOLOGY

Analysis of renewable energy and local resource use policies and constraints in the energy and transport sectors was based on the following information processing and research methods:

1. Compilation and grouping of binding regulatory acts, planning documents and reports;
2. Compilation, evaluation, classification and integration of international and local scientific articles, publications and reports on the selection, application and combination of policy instruments;
3. Two expert workshops created specifically;
4. Analysis of examples of applications of existing policy instruments.

The result of the analysis is a synthesis from the application of the information processing and research methods mentioned above.

1.1. Existing regular framework

The legal framework includes several levels (regulatory enactments and planning documents) that are applicable to the policy of using renewable energy resources and local resources in the energy supply and transport sector.

1.1.1. Directive

- Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (Text with EEA relevance).

1.1.2. Laws

- Energy law (adoption: 03.09.1998., entry into force: 06.10.1998.);
- Electricity market law (adoption: 05.05.2005., entry into force: 08.06.2005.);
- Subsidised Electricity Tax Law (adoption: 06.11.2013., entry into force: 01.01.2014.)
- Law on Regulators of Public Utilities (adoption: 19.10.2000., entry into force: 01.06.2001.).

1.1.3. Regulations of Cabinet of Ministers

- Regulation of Cabinet of Ministers of 29 March 2009 No. 221 "Regulations Regarding Electricity Production and Price Determination upon Production of Electricity in Cogeneration";
- Regulation of Cabinet of Ministers of 16 March 2010 No. 262 "Regulations Regarding the Production of Electricity Using Renewable Energy Sources and the Procedures for the Determination of the Price";
- Regulation of Cabinet of Ministers of 21 January 2014 No. 50, "Regulations Regarding the Trade and Use of Electricity";
- Regulation of Cabinet of Ministers of 14 July 2015 No. 395 "Regulation on how energy intensive processing manufacturing companies achieves the rights to increase the costs of participation in mandatory procurement component".

1.1.4. Policy planning documents

- Latvia 2030 – Sustainable development strategy of Latvia until 2030 (2010);
- Statement of Parliament about National development plan of Latvia for 2014–2020 (2012);

- Informative statement Long-term energy strategy of Latvia 2030 – competitive energy for the society (2013);
- Strategy of low intensive carbon development of Latvia until 2050 (2017);
- Latvian Bioeconomy strategy 2030 (2017);
- National energy and climate plan of Latvia (project, 2018).

1.2. Law

1.2.1. Energy law

Along with other objectives, the aim of the law is to promote the use of local, renewable and secondary energy resources, as well as to promote the environmentally friendly impact of energy and the use of environmentally friendly efficient technologies. The Law includes a definition of renewables and also local energy resources, that way creating a framework for the implementation of the right to support specified in the Electricity Market Law. In Article 84 of the "Energy Law" stipulated that the public service regulator, when implementing the regulation of energy supply, in addition to the provisions of the Law "On Public Service Regulators", also promotes the use of local and renewable energy resources in energy supply (Energy Law, 1998).

1.2.2. Electricity Market Law

MPC regulatory framework includes the Electricity Market Law (EML) adopted by the Parliament on 25 May 2005, which provides a definition of mandatory procurement in Article 1 (2) (21): mandatory procurement - a duty to procure electricity specified in this Law and other laws and regulations. EML also defines a public trader, for whom Article 28 (3), (5), (6) of the EML imposes an obligation to purchase and account for electricity produced from cogeneration, while Article 29 (4), (6) and (7) establish a procedure, which determines the procedure by which a merchant may qualify and receive support for the production of electricity using renewable energy resources. The deadlines of support within the framework of mandatory procurement are also defined in the regulations of the Cabinet of the Ministers.

Article 28 (2) of the EML stipulates that "the procedure for mandatory procurement and its supervision, the procedure for determining the price of electricity depending on the electric capacity of a co-generation plant and the fuel used, the procedure for covering the costs of mandatory procurement" are determined by the Cabinet of Ministers. Part (3) of Article 28 stipulates that "if a producer wishes to exercise the right to the mandatory procurement of the produced electricity and the cogeneration plant complies with the criteria set by the Cabinet of Ministers, all surplus of the produced electricity which is left after using the electricity for co-generation plant needs shall be procured by a public trader for a price laid down in accordance with the procedures provided in part two of this Article".

The support to RES is set out in Articles 29 and 30 of the EML. Article 30 (2) EML provides that "Electricity shall be procured from these producers following the principle of economic gradualness and in accordance with a contract in which the producer and the public trader have reached an agreement regarding the electricity production regime, electricity price and the time period of operation of the contract, which may not be less than five years and more than 10 years".

1.2.3. Law on Regulators of Public Utilities

Article 2 part (2) 2) of the Act stipulates that the state regulates the provision of public utilities as a commercial activity in the energy sector. The public utility regulator has an essential role in regulating the service tariffs of the sector, which also has an impact on the approach of local governments and the choice of merchants in favour of specific energy supply solutions, and thus also on the resources and technologies to be used.

The support system for energy production in Latvia has historically formed with two main objectives - to promote electricity production by 1) using renewable energy resources (RES) and 2) using efficient cogeneration technologies, including natural gas.

The aim of wider use of RES is to diversify the resources used in energy production, to promote distributed energy production, a gradual transition from the use of fossil resources to the use of RES, which promotes the local economy, reduces CO2 emissions in the energy sector, reduces dependence on imported energy resources. The aim of supporting efficient cogeneration is to ensure the availability of base power capacity and return on investment in modern and efficient cogeneration. In any energy system in which heat supply plays a significant seasonal role, the ability to produce heat is essential. The most technologically efficient solution is to produce the heat used in district heating in cogeneration - simultaneously producing both heat and electricity.

In Latvia, support for electricity producers has so far been and still is implemented through the mandatory electricity procurement system, when for electricity producers' production costs are compensated through the mandatory procurement component (MPC), and these costs are covered solidary by all electricity consumers.

1.2.4. Subsidised Electricity Tax Law

The wider objective of the Law is to reduce the impact of the mandatory procurement component on the payment for electricity resulting from the implementation of electricity mandatory procurement rights. The law determines the object of subsidized electricity tax, taxpayers, tax rate, the procedure for establishing and maintaining the register of subsidized electricity producers, the procedure for calculating, paying and administering the tax, as well as responsibility for violations of this law (Subsidised Electricity Tax Law, 2014).

The law acts as a barrier to support electricity generation, and it stipulates that taxable income (hereinafter - taxable income) derived from electricity sold within the framework of mandatory procurement and received guaranteed fees for electric capacity installed in a cogeneration plant or power plant shall be received. Taxpayers are merchants who have the right to sell electricity within the framework of mandatory procurement or to receive support for the installed electric capacity.

1.3. Regulations of the Cabinet of the Ministers

1.3.1. Regulation of the Cabinet of the Ministers No. 221 „Regulations Regarding Electricity Production and Price Determination upon Production of Electricity in Cogeneration"

The delegation of the Electricity Market Law is implemented by the Regulations of Cabinet of the Ministers (RCM) No. 221 "Regulations Regarding Electricity Production and Price Determination upon Production of Electricity in Cogeneration". 52.1 point of RCM defines the support term for cogeneration plants above 4 MW, stipulating that "a trader purchases electricity from cogeneration for 15 years from a trader who has received the right to sell the electricity produced within the framework of mandatory procurement" and point 53.1 defines the aid period for cogeneration plants, which does not exceed 4 MW, stipulating that "a trader shall purchase electricity from cogeneration for a period of 10 years from a trader who has been granted the right to sell the electricity produced under the mandatory procurement".

Point 9 of RCM states that "a cogeneration unit or a separate cogeneration unit with the installed electric capacity of 20 megawatts or more may qualify for the right to receive a charge for the electrical capacity installed in a cogeneration unit". An important aid qualification criterion is included in the Regulations - the number of hours worked per year - “a cogeneration unit or a separate cogeneration unit of this power plant qualifies for the right to receive payment for electric capacity installed in a cogeneration unit if the number of installed hours per year (T_{MAX}) exceeds 3000 hours” (Regulations No. 221 point 10.2 of Cabint of the Ministers on 10 March 2009).

On August 28, 2012, RCM No. 221 amendments were made that changed the qualification requirements regarding the number of hours of use of electric power, supplementing point 10.2 with the provision that “for cogeneration power plants belonging to one merchant located in the license area of one heat supply system operator, which are connected to the electricity transmission system and included in the dispatching schedule, the number of installed electricity capacity hours per year shall be determined by summing together” (Changes in the regulations No. 221 of Cabinet of the Ministers on 10 March 2009 “Regulations Regarding Electricity Production and Price Determination upon Production of Electricity in Cogeneration”, 2012). At the time of making the amendments, this norm was applicable only to the state-owned JSC Latvenergo thermal power plants TEC-1 and TEC-2, which supply heat to Riga on the right bank of the Daugava. The amendment highlights the trend that, due to the high cost of energy resources, it is not commercially viable for these power plants to generate electricity if the price of electricity on the Nordic-Baltic power exchange Nord Pool is low. Consequently, in seasons when, due to climatic conditions, the heat demand in district heating is low, TEC-1 and TEC-2 do not work separately for the number of hours initially incorporated in the regulations of the Cabinet of Ministers. For these reasons, the load qualification norm included in the regulations of the Cabinet of Ministers was applied to the actual conditions.

1.3.2. Regulation of Cabinet of the Ministers No. 262 “Regulations Regarding the Production of Electricity Using Renewable Energy Sources and the Procedures for the Determination of the Price”

Point 37 of regulation of the Cabinet of the Ministers stipulates that the duration of aid is 10 years for all types of power plants except solar power plants - 20 years for solar power plants. The duration of the aid is determined on the assumption that such duration of aid corresponds to the power plant operator's ability to recoup the funds invested in the construction of the power plant.

1.3.3. Regulations regarding the trade and use of electricity

Regulation of the Cabinet of the Ministers “Regulations Regarding the Trade and Use of Electricity” point 1.6 sets out the procedure by which a household user agrees with the distribution system operator on the application of the net electricity billing system and the procedure by which it is applicable. In turn, point 2.15 defines net consumption as the difference between the amount of electricity received from the grid and the amount of electricity transferred to the grid within one billing period. The purpose of the norm is to promote microgeneration and distributed generation of electricity.

Expert workshops on barriers and policy instruments have repeatedly stated that point 17 of this regulation of the Cabinet of the Ministers is unfair to the micro-generator and acts not as an incentive but as a barrier, as under point 17, the household user is obliged to pay net electricity according to the trader's bill. In the amount of consumption and system services, as well as in the mandatory procurement components for the entire amount of electricity received from the electricity grid during the billing period.

1.3.4. Regulation of Cabinet of Ministers on 14 July 2015 No. 395 “Regulation on how energy-intensive processing manufacturing companies achieve the rights to increase the costs of participation in mandatory procurement component”

The aim of the Regulation is to reduce the electricity costs of energy-intensive manufacturing companies, thus ensuring higher international competitiveness for the products of these companies. Paragraph 5 of the Regulations defines the criteria that a merchant must meet in order to qualify for the following support: the right to a reduction of the mandatory procurement component for one calendar year can be acquired if the merchant simultaneously meets four criteria - the merchant's average electricity cost intensity in the previous three calendar years is 20% or higher; the total electricity consumption for the needs of the merchant at one connection point in the previous calendar year was more than 0.5 gigawatt-hours (GWh); the merchant has implemented an energy management system that complies with the standard LVS EN ISO 50001: 2012 "Energy management systems. Requirements and instructions for use (ISO 50001: 2011)"; the turnover of the merchant from the economic activity, which corresponds to the sectors referred to in Annex 1 to the Regulations, is at least 30% of the total turnover of the merchant in the previous calendar year (Regulations of MC No. 395).

1.4. Policy planning documents

1.4.1. Latvia 2030 – Sustainable development strategy of Latvia until 2030

Innovation and the transition to low-carbon and energy-intensive goods and services, the use of renewable energy sources and technological development, healthy food and ecosystem services mark the transition to 'green economy'.

Energy security and independence, the use and innovation of renewable energy sources, energy efficiency measures, and energy efficiency and environmentally friendly transport policy are highlighted as key priorities in the content of Chapter 4 - Innovative and eco-efficient economies.

1.4.2. Statement of Parliament about National development plan of Latvia for 2014–2020

The Statement of Parliament on the National Development Plan of Latvia includes a section on Energy Efficiency, which refers to the transition to local renewable energy sources, as well as a vision that Latvia has created a favourable, long-term and economically justified environment for investments in green energy, which does not impose an excessive burden on society and the state budget. The Latvian energy system is developing stable and flexible, successfully integrating into European energy systems, combining efficient high-capacity energy production with small-scale distributed energy production, supported by the development of smart grids.

The description of the action line Energy efficiency and energy production indicates that energy has now become one of the essential providers of competitiveness and independence of the national economy. Latvia is rich in renewable energy resources, which are currently not used to a sufficient extent for energy production in the country. Therefore, this action aims to promote the use of indigenous energy sources in energy production. While this does not mean the possibility of abandoning energy imports immediately, it does help to balance the structure of energy production and imports.

The aim of the action is to provide the sustainable use of energy resources needed by the national economy by promoting the availability of resource markets, reducing the energy intensity and emission intensity of sectors and increasing the share of local renewable energy resources in total consumption, focusing on competitive energy prices. In its turn, the development of municipal energy plans, envisaging complex measures for the promotion of energy efficiency and the transition to renewable energy resources, is defined as one of the tasks to be performed within the framework of the action (National development plan of Latvia for 2014–2020, 2012).

1.4.3. Informative statement Long-term energy strategy of Latvia 2030 – competitive energy for the society

To reduce the import of energy resources (for example, fossil fuels, natural gas) and to promote the development of local energy production, the Strategy 2030 also pays great attention to promoting the use of RES in the production of electricity and heat and in the transport sector. Latvia's goal is to achieve a 40% share of energy produced from renewable energy sources in gross final energy consumption by 2020. By introducing market-based, technology-neutral support and ensuring appropriate tax and emissions trading policies, a non-binding 50% RES threshold for total final energy consumption is achievable by 2030 (Ministry of Economics, 2013).

1.4.4. The strategy of Low intensive carbon development of Latvia until 2050

The objectives of the strategy of Low intensive carbon development of Latvia until 2050 (also called – OMA) refer to the section on energy efficiency in the National Development Plan of Latvia for 2014–2020, which also refers to the transition to renewable energy sources, a stable and flexible energy system combining efficient high-capacity energy production with small-scale energy production supported by smart grids development.

Among the tasks of OMA are the reduction of GHG emissions from transport and the gradual transition from the use of fossil energy resources to renewable energy resources and introduction of alternative means of transport; provide introduction of innovative and renewable energy technologies in order to phase out the use of fossil fuels (The strategy of Low intensive carbon development of Latvia until 2050, 2017).

1.4.5. Latvian Bioeconomy strategy 2030

The strategy includes a section on Energy, which describes the use of bioresources for energy production (Latvian Bioeconomy strategy 2030, 2017). In Latvia, bioresources in the energy sector are mainly used for heat production by burning them. Although heat production is an essential area of energy production and has favourable market conditions, it is production of product with a low value-added. In the future, it is necessary to promote the creation of greater added value from bioresources. Biofuel production is generally seen as a transitional resource, while vehicle electrification is developing. At the same time, biofuels could be used in the future in cases where electrification is difficult to implement.

The share of renewable energy resources in total final energy consumption in Latvia in 2015/2016 was 37.6% (target in 2020 - 40%, but the EU-28 target is 20%). The largest contribution to the structure of Latvia's RES target in 2015, with 76.49% (47.76 PJ), was made by solid or wood biomass, which is ensured by the use of biomass in energy production (accounting for 28.73% of the country's gross final energy consumption). It is followed by hydropower with 16.87% (10.53 PJ), biogas with 4.27% (2.67 PJ) and biofuels with 1.53% (0.95 PJ). Thus, in 2015, bioenergy with a total of 51.38 PJ has accounted for 82.29% of investment (incl. Solid biomass in heat supply) in the current RES target. In accordance with the Latvian Energy Long-Term Strategy 2030, the nationally set indicative target for the share of renewable energy is 50% in 2030.

1.4.6. National energy and climate plan of Latvia (NECP)

NECP 3.1.2.3. point refers to a support for electricity generated from RES, stipulating that in order to promote electricity production from RES and high-efficiency cogeneration, until the submission of the NECP project to the EC, the mandatory procurement of electricity and the capacity fee for the electric capacity installed in the power plant are used as a support instrument in Latvia. At the same time, it is indicated that steps have been taken to prevent the mandatory procurement component and, consequently, the price of electricity from rising sharply. With the change in mandatory procurement component financing, which came into force on 1 January 2018 in accordance with the amendments to the Electricity Market Law, the division of Mandatory procurement component payments into two parts had introduced - according to electricity consumption and according to the required connection capacity. The introduction of the new model provides a competitive electricity price for energy-intensive manufacturing companies in the European region, thus contributing to reducing the impact of Mandatory procurement component on the manufacturing industry's variable production costs and stimulating the long-term competitiveness of the industrial sector. Differentiation of MPC promotes the development of manufacturing industry also in sectors with lower energy intensity. Overall, the new Mandatory procurement component model reduces MPC payments to consumers who use electricity connection capacity efficiently (National energy and climate plan for 2021–2030 project, 2018).

2. CLASSIFICATION OF POLICY INSTRUMENTS FOR UNIFORM IMPLEMENTATION OF THE USE OF RENEWABLE ENERGY RESOURCES AND ENERGY EFFICIENCY

In Latvia, the use of renewable energy resources and the introduction of energy efficiency measures throughout the country are equally important. Two sets of measures are closely linked, and their implementation is a task for the continuous improvement of the complex system.

In this report, energy efficiency measures are given a secondary role, as they are seen more through the prism of energy efficiency in the extraction and use of renewable energy sources. For example, it is always important to find, as far as possible, mutually reinforcing policy instruments to initiate the use of biomass to replace fossil fuels, as well as to increase the energy efficiency of biomass by preventing it from being burned with an efficiency of less than 80-85%. And at the same time support the use of biomass to create high value-added products or services.

To successfully fulfil all Latvia's commitments in the field of increasing the share of renewable energy resources and increasing energy efficiency, the policy instruments for replacing fossil energy resources using renewable energy resources had been analysed in a detail, which must be used simultaneously to achieve the set goals:

1. **Horizontal policy instruments** - applies to all energy consumer sectors - household, industrial, agricultural, public, service and transport:
    - Policy processes: strategic planning, improvement of existing policies and regulations, institution building.
    - Fiscal instruments: tax refunds, tax discounts or exemptions.
    - Financial instruments: grants, subsidies and soft loans, third-party financing based on the principle of providing energy efficiency services (known as ESCOs);
    - State and municipal investments: government procurement program, building energy communities.
    - Science and development: pilot projects, demonstration projects, research programs.
    - Regulatory enactments: auditing, monitoring, standards. Emissions trading: white certificates trading, green certificates trading, emissions trading.
    - Voluntary agreements: agreements between the private sector and government institutions.
2. In addition to horizontal instruments, the following policy instruments need to be used in the **household sector**:
    - Financial instruments: grants, subsidies, third party funding and project-based programming.
    - Education: advice/assistance with the implementation process, demonstration of best practices, energy labelling, advice, information campaigns and campaigns.
    - State and local government investments: restructuring of social benefits.
    - Regulatory enactments: monitoring.
3. **In the services sector**, in addition to horizontal instruments, the following policy instruments need to be used:
    - Financial instruments: grants, third party financing.
    - Education: information campaigns and campaigns, demonstration of best practices, energy labelling, green and white certificates.
    - State and municipal investments: green procurement.

4. **In the industrial sector**, in addition to horizontal instruments, the following policy instruments need to be used:
    - Financial instruments: soft loan, energy audit payment.
    - Education: information campaigns and campaigns, development of a training system.
    - Regulatory enactments: benchmark method.
    - Combination of tools.
5. **In the transport sector**, in addition to horizontal instruments, the following policy instruments need to be used:

- Fiscal instruments: tax rebates.
- Financial instruments: grants, third party financing.
- Education: information campaigns and campaigns, development of a training system.
- Regulatory enactments: advantages for electric transport.
- Combination of tools.

The directions of the necessary activities for the implementation of renewable energy resources and energy efficiency measures are summarized in three blocks:

- In the block of regulatory enactments,
- Information block,
- In the financial block.

Each block (see Fig. 2.1) includes a set of measures, which includes a detailed action to be included in the Renewable Energy and Local Resources Policy Action Plan for both energy supply and transport.

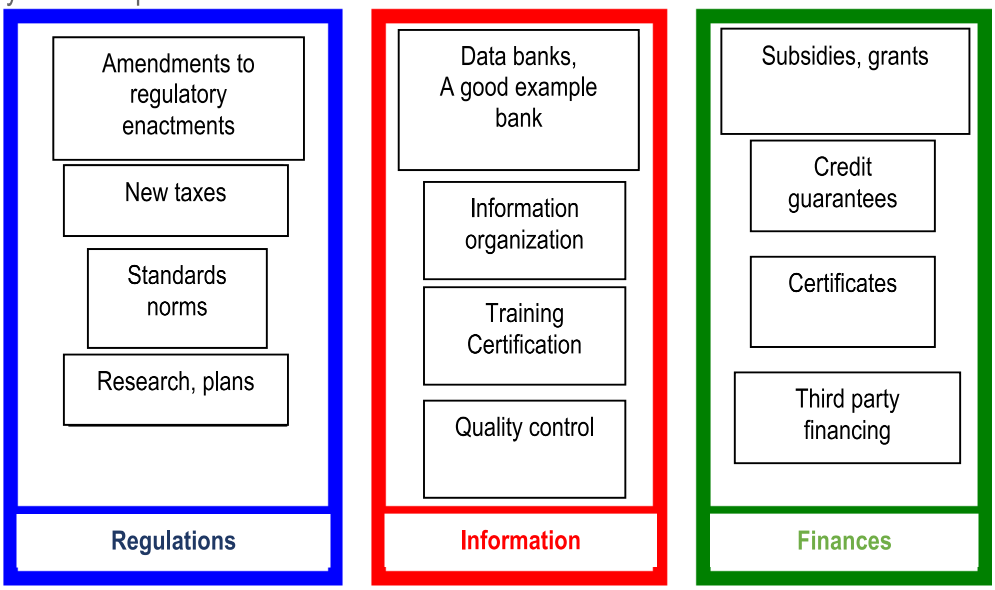

Fig. 2.1. The sets of measures included in the action plan

Each block contains measures that can be implemented immediately to improve the economic situation in the country, and some of the measures included in the modules of the action plan do not require large investments.

2.1. Simultaneity, coordination and sequence of policies

An analysis of the literature and applied research on barriers and policy instruments for introducing renewable energy sources and increasing energy efficiency shows that the three main factors determining the success of measures are:

1) simultaneous use of several policy instruments;
2) mutual coordination of different policy instruments;
3) the correct sequence of planning and use of policy instruments.

When it comes to the simultaneous or sequential implementation of different policies, the targeted or random combination of different instruments must be taken into account. Combinations of policy instruments can be divided into four groups (Rosenow et al., 2017):

1) combinations of policy instruments in which the instruments are incompatible or weakening;
2) combinations of policy instruments in which the instruments are mutually reinforcing;
3) combinations of policy instruments in which the instruments are mutually reinforcing if implemented in the correct order;
4) combinations of policy instruments, in which the mutually reinforcing or weakening interaction of instruments depends on the context of use.

The literature also analyses the conditions and stages of implementation, emphasizing that policies are not developed and policy instruments are not planned from scratch, where policymakers and decision-makers can build an ideal renewable energy policy model. Decisions on policy-making are made and policy instruments are implemented in an environment that is always politicized in nature, other pre-decided policy instruments are already being put in place, involving the various stakeholders who have already developed the idea that which policy instruments are good or invalid, or what should be done in the future.

For example, the instruments listed in the White Paper and other policy communication documents that have the potential to reduce greenhouse gas (GHG) emissions (see Fig. 2.2).

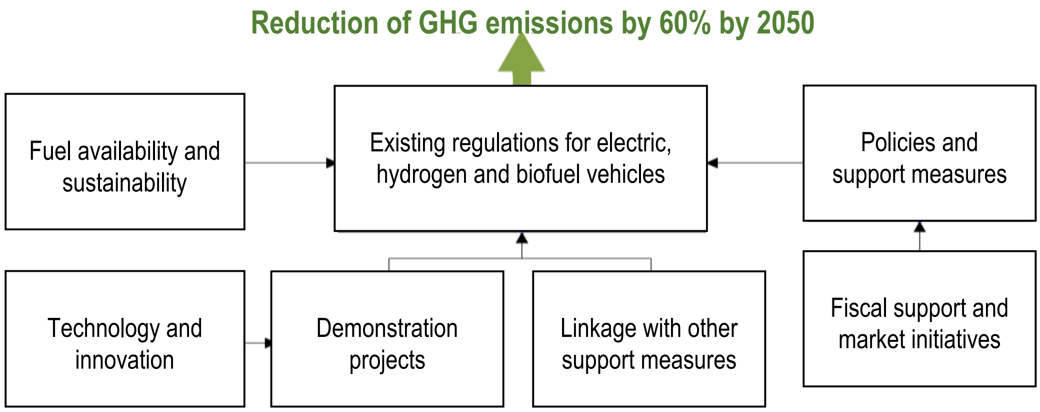

Fig. 2.2. The main elements influencing the current regulations

Combinations of policy instruments are considered to be neither good nor bad in themselves, the context and the analysis of the interaction of the policy instruments, individuals and organizations involved are important (Rosenow et al., 2017).

Similar findings were obtained during discussions and interviews with renewable energy extraction and use specialists and field experts.

3. THE ANALYSIS OF POLICY INSTRUMENTS

The next chapters describe and evaluate the use of various policy instruments so far. The evaluation is done based considering their use in various sectors (e.g., industrial and energy production), as well as on renewable energy resource, for example, biomass.

3.1. Implementation of the Solar pv project in Ltd. "Jurmalas Siltums"

The use and implementation of solar energy possibilities in the real objects is being analysed based on the central heat distribution company Ltd. "Jurmalas Siltums" experience. The algorithm of the project implementation methodology is shown in Fig. 3.1.

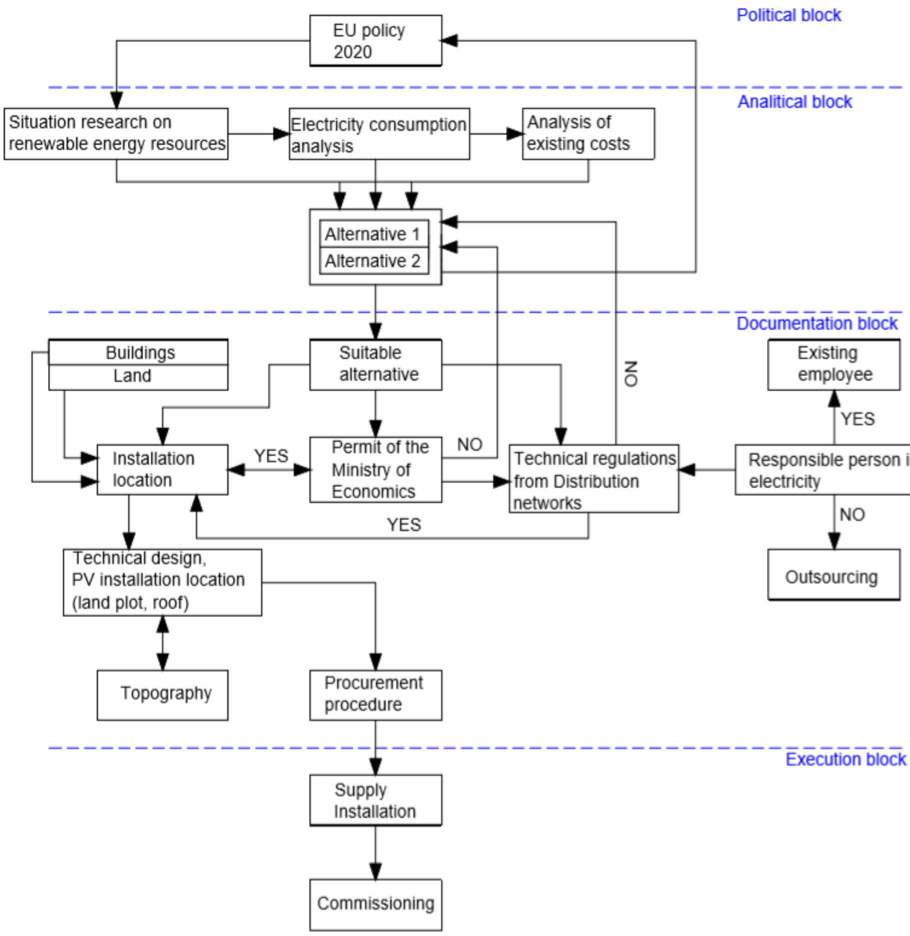

Fig. 3.1. Analytical algorithm for solar PV panel implementation (Čivčiša, 2019)

The algorithm is divided into four blocks: the policy block; analytical block, documentation block, execution block.

Policy block: district heating is an energy sector regulated by the Government, and Governments, in turn, integrate regulations which are negotiated and agreed upon among EU countries within the EU, which include energy efficiency requirements, availability and environmentally friendly heat production. Each municipality organizes district heating in its administrative territory.

Block of analysis: considering the common state and European Union policies and objectives, the company conducts theoretical research on the possibilities of introducing renewable energy resources in a district heating company. While analysing renewable energy resources, all renewable energy types are being evaluated to develop and implement solar, wind, hydro and bioenergy. Also, energy consumption and costs in the company are being evaluated from various aspects (daily and seasonal perspective, and equipment load). In the result of analysis, various alternatives have been chosen.

Table 3.1

Time required to install solar panels (Čivčiša, 2019)

Actions/documents for 30 kW PV panels	**Time for implementation**
Documents certifying property rights (Land Register Certificate, Land Boundary Plan)	4 weeks
Application to the Ministry of Economics for permission to increase electricity production capacities or implementation of new production equipment based on Cabinet of Ministers Regulation No. 883 of 11 August 2009 "Regulations Regarding Permits for Increasing Electricity Production Capacity or Introduction of New Production Equipment" point No. 2	2–4 weeks
Requested and receive permissions from the Public Utilities Commission	4 weeks
Request and receive technical regulations from JSC "Sadales Tikls"	4 weeks
Development of a topographic plan	4 weeks
Responsible person for electricity system	Electrician qualification required
Design started (if PV constructions are placed on the load-bearing structures of the building, at least 6 extra weeks must be provided for project examination)	4-6 months
Procurement process	6 weeks
Equipment delivery and installation	2-3 months
Equipment inspection	2 weeks
Equipment commissioning	3 weeks

Documentation block: when choosing the appropriate alternative, the company must make a decision about where the solar panels will be placed (roof or on the ground-level). If parts of the building supporting structure (roof, walls) are chosen as the place of project implementation, it is necessary to plan the development of a full technical project. Regardless of the chosen location of the project, it is necessary to order current topography of the area. In order to implement the project, a permit from the Ministry of Economics is required (appendix form No. 1 in the application permit). At the same time, it is necessary to receive technical regulations from JSC "Sadales Tikls". JSC "Sadales Tikls" will not issue technical regulations if the company does not specify the responsible person for the electrical management with the appropriate qualifications (if there is no specialist, an outsourcing contract has to be concluded). When technical regulations and the permission of the Ministry of Economics have been approved, the project's development and procurement procedure can commence.

Execution block: signing contract for solar panel installation. Install solar panels. Preparation of documentation and operation of solar panels in cooperation with JSC "Sadales Tikls" and, if necessary, the municipal building board.

Table 3.1 demonstrates that installing solar panels in a district heating company takes 10–12 months. However, the longer time period is necessary. During this time, it is possible to implement the project if several activities are performed simultaneously.

3.1.1. Conclusions

As a matter of urgency, review and facilitate the bureaucratic burden for RES introduction (not only in the central heating companies). It is necessary to pay additional attention to the substantive part of the new support programs in order to increase the intensity of local renewable energy resources use.

3.2. “Jurmalas Siltums” solar power system with capacity of 30 kW

On February 2018, the district heating company of Jurmala city municipality has decided to install solar PV panels with total capacity of 30 kW. While planning the equipment of photo elements and system, the company defined equipment that counts and register the amount of energy consumed and produced as important.

When deciding on the total capacity of photovoltaic installations required, one of the most important arguments was to choose the capacity of the installation in order to ensure the self-consumption of electricity produced by its solar power system and not to transfer electricity into the distribution network.

The installed photo element equipment in the Jurmala city municipality complies with LVS EN 50438 and they stop to produce energy when the voltage in the distribution network fails or falls below 207 V and does not apply with necessary 230 V (+/- 10 %), providing additional safety if the produced electricity is transferred into the distribution networks.

The geographical location of the central office of Jurmala city district heating company and the largest boiler house in Dubulti district is very advantageous, so that in the future the company would be able to use not only solar energy, but also hydro energy, because as shown in Fig. 3.2, the company's territory has a boarder with Lielupe.

Fig. 3.2. Location of Ltd. “Jurmalas Siltums”

Solar panels have been installed on the roof of district heating plant of Dubulti boiler house in Jurmala city and started producing energy on 25 April 2019.

Fig. 3.3. Installed solar panels in Jurmala (Čivčiša, 2019)

The operation processes of the installed solar panels are being monitored in order to prevent downtime of solar panels and equipment and to allow the user to timely notice fall or decrease in performance that are possible due to a fault in the installed equipment or system, or artificial shading caused by snow, leaves, birds and other conditions such as power quality. District heating company of Jurmala city, while making procurement, set a requirement with solar panel supplier to provide equipment with which user would be able to remotely follow and react quickly and perform equipment operations and data analysis in various sections.

On May 2 2019, it was raining and snowing, as well overcast all day long, as Fig. 3.4 shows, the performance of solar panels decreased, however downtime of panels did not occur.

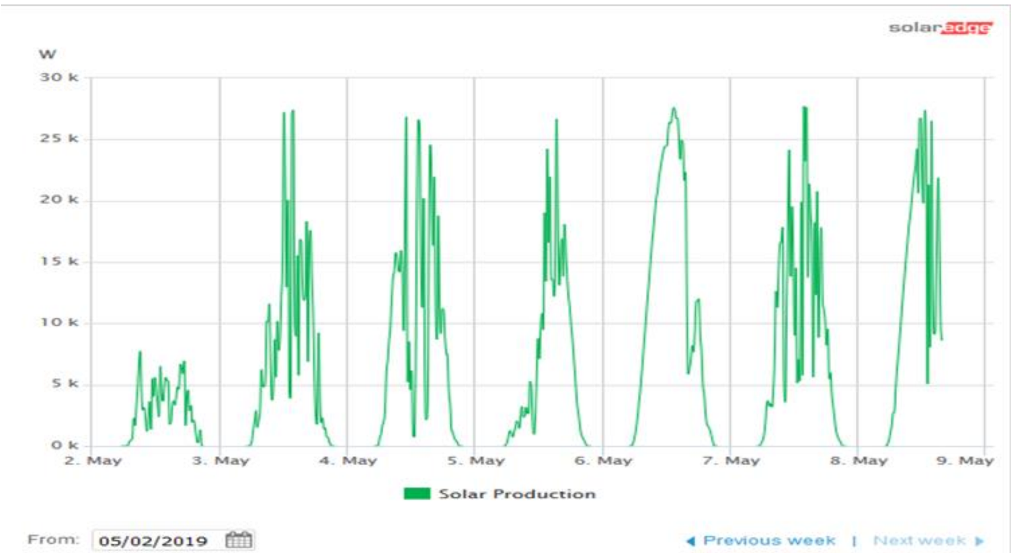

Fig. 3.4. Operation of solar power panels in rainy and cloudy days (Čivčiša, 2019)

When choosing the location of solar panels to be installed on the roof of the boiler house, the central heating company of Jurmala City Municipality mainly focused on keeping the panel placement area as unshaded as possible, so that the angle of the panel plane position is DA, D, DR azimuth (Fig. 3.5).

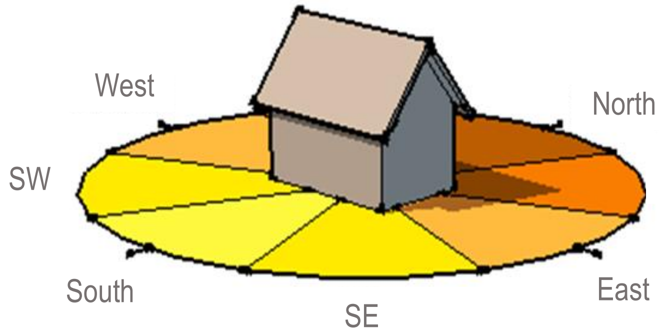

Fig. 3.5. Example on placement of Solar PV panels

The same amount of solar energy is not available in all months of the year, it is different each month and each month has its own optimal angle. In Summer there is a flat angle 22, but in Winter there is a very steep angle 70, the calculation assumes an annual angle of 39.

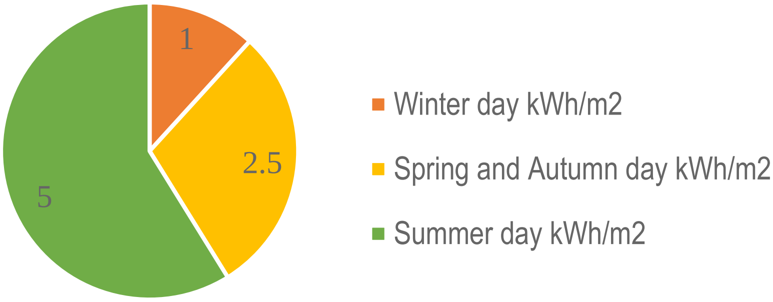

Fig. 3.6. Total solar energy available based on the season

Performing the cost and equipment installation analysis, the central heating company of Jurmala city municipality assumed that the total daily solar energy in Jurmala at the optimal angle on average is 3.2 kWh of solar energy per m² of area per day. In the vertical plane, Jurmala has an average of 2.3 kWh of solar energy per m² per day. Fig. 3.6 shows how the possibilities of using solar energy change depending on the time of year, but technologically correctly installed solar panels in downtime are not possible. Of course, it must be considered that solar energy consists of scattered and direct radiation, which is a variable part depending on the time of year.

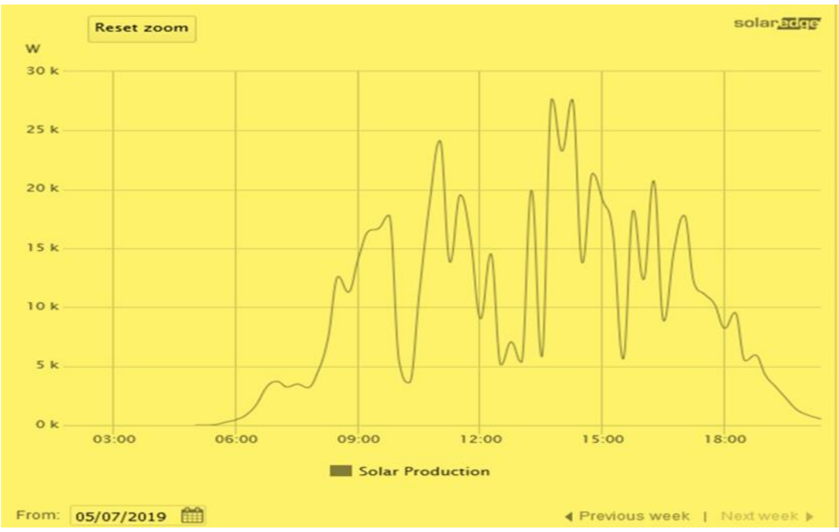

Fig. 3.7. Performance of solar panels in a sunny day of Spring (Čivčiša, 2019)

Fig. 3.7 shows the real performance of the solar panels installed by the central heating supply of Jurmala city municipality on a sunny day, the solar panels are stationary and installed at the optimal angle. It can be seen that the highest performance of solar panels is from 2 PM to 3 PM. If the company would had chosen to install solar tracking equipment, the company would have received an additional 35 % of solar energy. When calculating the selection and cost of the equipment, the company took into account the total cost of the equipment, the estimated annual performance and the payback time of the performance of each individual equipment, and the decision was made to install the existing equipment. The cost of the installed equipment is approximately 1000 EUR/kW. The cost of equipment that can follow to the movement of the Sun is about three times higher.

3.3. SWOT analysis of solar energy project in Jurmala

SWOT analysis is the most commonly used method for analysing and positioning organizational resources and environment in four aspects: strengths, weaknesses, opportunities and threats. Strengths and weaknesses are internal (controllable) factors that support and prevent organizations from achieving their mission and opportunities and threats are external (uncontrollable) factors that allow and disable organizations in their tasks. By identifying factors in these four areas, an organization can recognize its key competencies in decision-making, planning and building strategies.

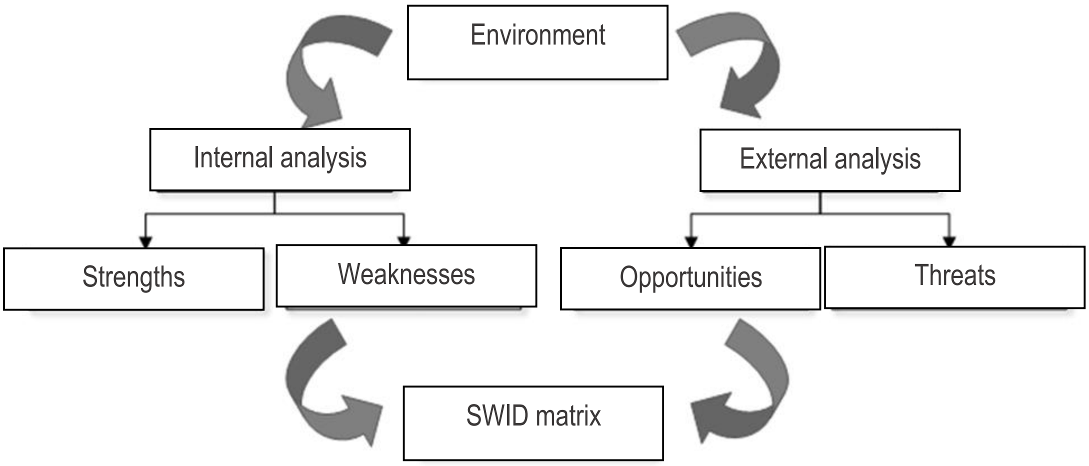

Fig. 3.8. The principle SWID analysis

SWOT analysis is one of the tools that can be used in the organization's strategic planning process. The main advantage of SWOT analysis is its simplicity.

Each aspect of SWOT analysis is evaluated as a product of relevance and performance. More specifically, aspects of strengths and opportunities are given a positive performance value because these factors have a higher performance or equal to its results. On the other hand, the aspects to be analyzed for weaknesses and threats are assigned a negative performance value, as these factors have lower performance than the overall performance.

Table 4.1

SWOT analysis of algorithm for solar PV panel implementation policy block

	Oppurtinities (O): **Main objectives of the European Union, which are the reduction of greenhouse effect, that is, to reduce global warming gas emissions and to increase use of renewable energy resources**	**Threats (T):** **Republic of Latvia adopts laws without consultations, fact-based thinking and without considering all interested parties. This can negatively affect businesses**
Strengths (S): **1. Experience and competence of employees** **2. Stable financial situation** **3. All necessary certificates and permits**	1. How to use opportunities? (S.O.) • Using the qualification level of the employees can benefit the process of reaching the set goals for the company • Resources available to the company, as well as certificates and permits, make it easier to leverage EU funds and act to reduce the greenhouse effect	2. How to reduce or avoid threats? (S.T.) • Introduce the ISO 5001 Energy Management System
Weaknesses (W): **Relatively week effect on the Government's regulatory act procedures and the process of regulation's adoption** **100 % owned by the municipality** **Regulated related services and other interested party activities**	3. How market opportunities can help overcome weaknesses? (W.O.) • Using company engagement in associations, actively participate in the preparation of the relevant normative acts • Fossil fuels can be reduced and RES can be implemented through EU funds	4. How to avoid threats and level out weaknesses? (W.T.) • Actively participate in discussions on regulatory changes • Opportunities to offer new, innovative services and products

Summarizing the SWOT analysis data for the policy block of the algorithm, it can be concluded that the company has several options that can be used, for example, use employee qualifications and experience, engage in policy planning through relevant associations, improve and analyse the business of the company with regard to planned policy documents, such as the introduction of the ISO 5001 energy management system. The resources available to the company, as well as certificates and permits, make it easier to attract EU co-financing.

Table 4.2

SWOT analysis of algorithm for solar PV panel implementation analytical block

Opportunities (O): 1. Development and modernization of technologies for the integration of RES into existing systems 2. Improvement/Arrangement of the Jurmala heat supply area, expansion 3. A larger proportion of the population in the district is connected to central heating 4. Attract EU funds to development projects		**Threats (T):** 1. Threat of substitutes (introduction of different types of alternative heating, such as solar) 2. Decrease in the number of residents (customers) 3. Negative impact of political processes and natural disasters on production prices and energy production industry 4. Decrease in population solvency 5. Renovation of the buildings will reduce the heat load and increase tariffs for thermal energy
Strengths (S): 1. High qualification of employees 2. Quality of services offered and responsibility for timely delivery of services provided 3. Company's good reputation among existing consumers and partners 4. Stable financial situation	1. How to use opportunities? (S.O.) • Attract new customers through good reputation and employee qualification levels • Maintain good reputation by improving technological capabilities • Resources available to the company, as well as certificates and permits, make it easier to leverage EU funds and integrate RES facilities into existing heating systems	2. How to reduce or avoid threats? (S.T.) • Improve the quality of service provided • Overcome substitutes • Employee qualification and product quality will keep existing customers • Stable financial situation and the unrestrained integration of RES equipment into existing systems makes it possible to build up reserves
Weaknesses (W): 1. Relatively high heat losses, long tracks 2. Most boiler houses use natural gas 3. High depreciation of existing fixed assets 4. High level of public debt	3. How market opportunities can help overcome weaknesses? (W.O.) • Reduce heat loss through new technologies and infrastructure improvements • Technologically developing and reducing losses, as well as attracting new customers, may increase net turnover • Using EU funds can replace the use of natural gas with RES	4. How to avoid threats and level out weaknesses? (W.T.) • Increasing the cost of raw materials and high heat losses can have a significant impact on the company's operations, but can be offset by renewing technologies and introducing RES options • Net turnover and decrease in population will cause the company losses • Opportunities for offering new services and products

The SWOT analysis shows that the company can use its various strengths to mitigate its weaknesses, for example, by improving existing infrastructure so that it can integrate RES to reduce fossil fuels, heat losses. An environmentally friendly and secure company will create the opportunity to attract new customers who will naturally improve the company's net turnover and reputation. By actively participating in the use of EU funds, it is possible to replace gas-fired houses with biomass boiler houses. Selling surplus emission allowances during the planning period allows a large part of the electricity used in the company to be produced by solar photovoltaic panels.

Table 3.3

SWOT analysis of algorithm for solar PV panel implementation documentation block

<table>
<tr><td colspan="2"><u>Opportunities (O):</u>
There are several options for choosing the right RES alternative, or for implementing several alternatives simultaneously</td><td><u>Threats (T):</u>
Refusal of the Ministry of Economics
Technical regulations of JSC "Sadales Tīkls"
Municipal refusal to implement the project</td></tr>
<tr><td><u>Strengths (S):</u>
1. Ownership of the property in which it is planned to implement the projects for RES
2. Stable financial situation
3. Qualified staff</td><td><u>1. How to use opportunities? (S.O.)</u>
• Using qualification levels of employees, it is possible to implement several stages simultaneously
• Resources available to the company, as well as certificates and permits, and collaboration allow you to get the required permissions faster</td><td><u>2. How to reduce or avoid threats? (S.T.)</u>
• Promulgate procurement and perform market feasibility studies timely</td></tr>
<tr><td><u>Weaknesses (W):</u>
1. Company is 100 % owned by the municipality
2. Regulated services and activities that may interfere with the introduction of new technologies in the company</td><td><u>3. How market opportunities can help overcome weaknesses? (W.O.)</u>
• Submit procurement documentation and get permissions simultaneously</td><td><u>4. How to avoid threats and level out weaknesses? (W.T.)</u>
• Perform analysis and feasibility studies before project implementation</td></tr>
</table>

In the SWOT analysis in the documentation block it became clear that the company has to carry out a deep feasibility study when starting the practical implementation of the project, the biggest risk is the municipality's refusal to implement the project, which the company can prevent by receiving the municipal permit already at the stage of the analytical block.

Table 3.2

SWOT analysis of algorithm for solar PV panel implementation execution block

	Opportunities (O): **Choose the appropriate RES alternative, or the implementation of several alternatives at the same time**	**Threats (T):** **Equipment delivery and assembly compliance** **JSC "Sadales Tikls" negative opinion about installed photovoltaic panels** **Weather conditions**
Strengths (S): **1. Experience of the company employees in the implementation of the RES documentation** **2. Stable financial situation**	**1. How to use opportunities? (S.O.)** • By using the qualification level of the employees, it is possible to monitor the progress of the project and its compliance with the procurement	**2. How to reduce or avoid threats? (S.T.)** • Prior to the project implementation, the employees should be informed in detail about the project's progress
Weaknesses (W): **Company has only one electrician who can react quickly and evaluate whether the equipment is technologically compatible with the offer**	**3. How market opportunities can help overcome weaknesses? (W.O.)** • Planned photovoltaic power company can use 100 % for its own consumption all year round	**4. How to avoid threats and level out weaknesses? (W.T.)** • Carry out analysis and feasibility studies before the implementation of the project, to invite experts in the field

Every company should perform SWOT analysis before the start of the project in order to reduce realization time. In the SWOT analysis of the Execution Block it was concluded that it is possible to start preparing for the implementation of the project timely:

- To avoid the biggest risks in this part of the project, the company should provide necessary training for additional staff members for electrician position or contract outsourcing services;
- The company has to carry out a deep feasibility study before starting practical implementation of the project. The highest risk is decline of municipality that company can be avoided by receiving a municipal permit already at the stage of the analysis block;
- Instructing specialists of JSC "Sadales Tikls" in the period of project execution, the company eliminates the threat of technical acceptance of equipment.

4. ANALYSIS OF POLICY INSTRUMENTS IN MUNICIPALITIES

In this chapter the use of available renewable energy policy instruments and the role of the municipality in the implementation of them in medium size municipalities (city: 5000–10000 citizens, in the district 20000–30000 citizens) are analysed.

To achieve the country's renewable energy targets, the implementation of policy instruments at the municipal level is required. Municipalities play a key role when implementing the main national strategic directions, considering technological and socio-economic aspects. Local governments are making great efforts to develop and implement energy strategies and are facing economic and technological challenges when changing to renewable energy systems.

Studies by Allman et al. (2004) un Bale et al. (2012) show that one of the main barriers to a successful transition to renewable energy is a lack of public funding for local strategic energy planning. Lack of funding is often an important factor for less successful municipalities, as insufficient budgets mean that there are not enough competent staff to develop strategic plans. In addition, due to a lack of funding, local authorities consume large amounts of funding for pilot projects, but there is a lack of a coordinated strategic vision for the further development of the sectors. Therefore, providing long-term funding to local authorities for strategic energy planning could ensure a more homogeneous level of quality in the development of local strategic energy plans.

Another barrier identified for the transition to renewable energy systems, which has proved difficult to overcome in energy planning processes, is local resistance to the construction of larger power generation units, such as the installation of wind turbines, biogas plants, etc. Additional barriers identified include the lack of action implementation plans, the lack of interaction between local and national energy goals and policies, and changes in policy agendas that require short-term planning when long-term planning is desired (Krog & Sperling, 2019). The transition to 100 % renewable energy systems still requires major changes in the planning, organization, and technological execution of energy systems, so without long-term strategies at the municipal level, no significant changes will ever take place.

The municipality can make a significant contribution by bringing together different stakeholders (companies, citizens, NGOs, etc.) and seek compromises to solve various problems. The municipality can act as an independent unifying party by setting up working groups in which mutual exchange of views and experiences is possible. Such interconnection is very important in the implementation of various innovative energy supply solutions, for example, in the integration of surplus heat from industrial companies into district heating.

There are several local governments in Latvia that are purposefully moving towards an increasing share of renewable energy resources in the total energy balance. Fig. 4.1 shows transition from heat production in the boiler house using wood chips and liquefied petroleum gas (LPG) to the purchase of heat from a wood cogeneration plant and additional production with wood chip boilers for district heating in the medium sized municipality. Since 2015, all the heat consumed by the city has been produced using biomass. In the villages of the municipality, heat is also produced from firewood, wood chips, pellet boiler houses or purchased from a wood cogeneration plant.

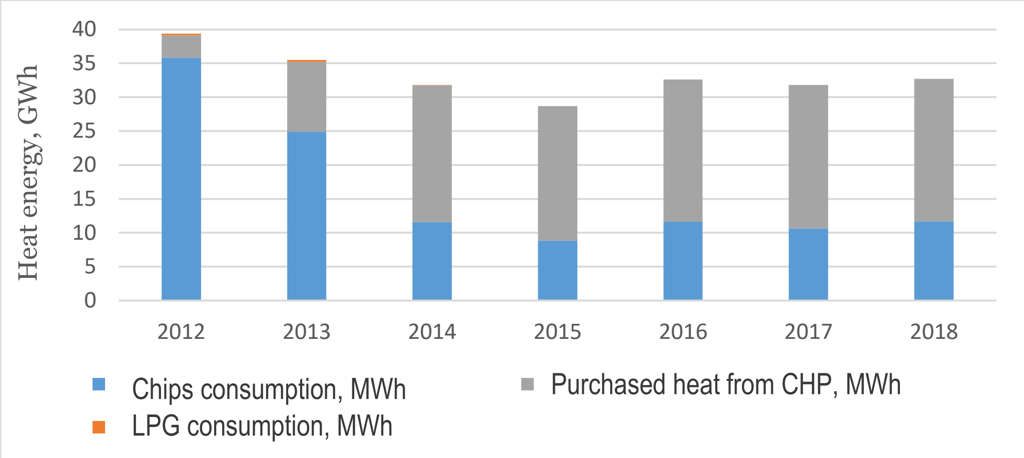

Fig. 4.1. Changes in energy sources in the city district heating (DH) energy balance

In a particular municipality, the transition to the use of renewable energy resources in heat supply was facilitated by both strategic long-term planning and the lack of cheaper fossil energy resources because there was no natural gas infrastructure nearby. The local government's sustainable development strategy identifies a sustainable energy efficient economy as one of the long-term priorities of the strategic direction of the economy. In turn, the development program of the region states that one of the tasks of achieving the goal of energy efficient management is to improve utilities (evaluate the central and local heat supply system, renovate heating systems, install heat meters). In addition, tasks related to increasing the energy efficiency of buildings and developing an energy efficiency plan have been defined, as well as planned investments for various building renovation measures have been defined, including increasing energy efficiency and improving heating systems. The investment plan also includes the renewal of heat supply infrastructure. The municipality continues to voluntarily implement an energy management system that will increase the energy efficiency of heat production and distribution and reduce the consumption of wood resources.

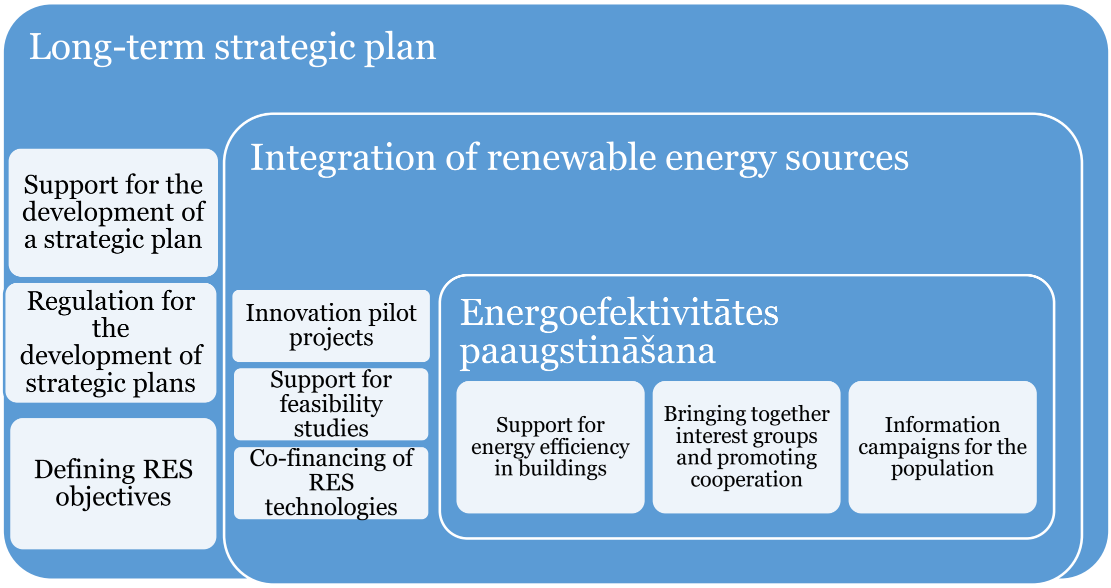

Fig. 4.2. Implemented policy tools in the municipality

The municipality is also purposefully increasing the use of solar energy by installing solar panels and solar collectors on the roofs of municipal buildings. The integration of solar energy technologies uses external state and European Union funding to reduce the amount of investment required.

To promote the implementation of innovative technological solutions in district heating, the municipality has developed a strategy for the implementation of a low temperature district heating system. Given the high level of investment in innovation feasibility studies, such a publicly available strategy allows to take more precise steps in the choice of technological solutions for energy companies.

One of the pilot projects for increasing the energy efficiency of municipal energy supply has been implemented using external European Union funding, promoting the implementation of an innovative low-temperature heat supply concept.

In the summer of 2018, a reconstruction project of the district heating system of the municipal village was implemented, within the framework of which the heating networks were rebuilt and optimized, reducing the total length of the heating main and increasing the density of heat consumption. Within the framework of the system reconstruction, a reduced flow and return temperature was ensured for five buildings connected where two of them were insulated buildings. The outdated wood boiler house was replaced with a new pellet container boiler house with an accumulation tank. The buildings are equipped with individual heating units, which are adapted to the temperature schedule.

The specific heat costs of district heating are significantly reduced by the connection of new heat consumers, but consumers are often discouraged by high investment costs and societal prejudices against district heating. In order to attract new consumers and increase the overall cost-effectiveness of the system, it is possible to conduct information campaigns on the benefits of CDH, as well as to attract external sources of funding for the construction of internal heating systems.

5. ANALYSIS OF POLICY INSTRUMENTS IN PRODUCTION COMPANIES

The example under consideration is based on a pellet production company, which has significantly saved resources and increased technology efficiency by combining different existing policy instruments.

The policy instruments used at the company cover the consumption and production of renewable energy, the reception of financial support (in this case – MPC) and the implementation of an energy management system.

Energy management is a form of resource management that, when properly implemented, provides significant resource savings and increases the amount of energy consumed efficiently, as well as reducing specific energy consumption. All combined contributes both to the company itself and to the country as a whole, moving closer to sustainable development. The energy management system is based on an international standard which integration in companies provides results in both the short and long term. It is based on:

- Resource monitoring by observing and maintaining data on resource consumption, changes in flows;
- Goal setting and improvement development;
- Analysis of the obtained data, drawing conclusions, showing the current use of resources in the company.

An example of a pellet company will be discussed further (Vīgants, 2016). This company is a good example to show how the implementation of energy management in a company reduces resource consumption. Specific company:

- Complies with LVS EN ISO 50001 Energy Management Standard (The Latvian national standardisation body, Latvian Standard, 2012);
- Is a producer of renewable energy resources;
- Is a user of renewable energy resources;
- Receives a financial support – in the form of a mandatory procurement component (Ministry of Economics, 2019).

Fig. 5.1 shows that energy management in the specific example - a pellet production company - consists of several factors that interact with each other.

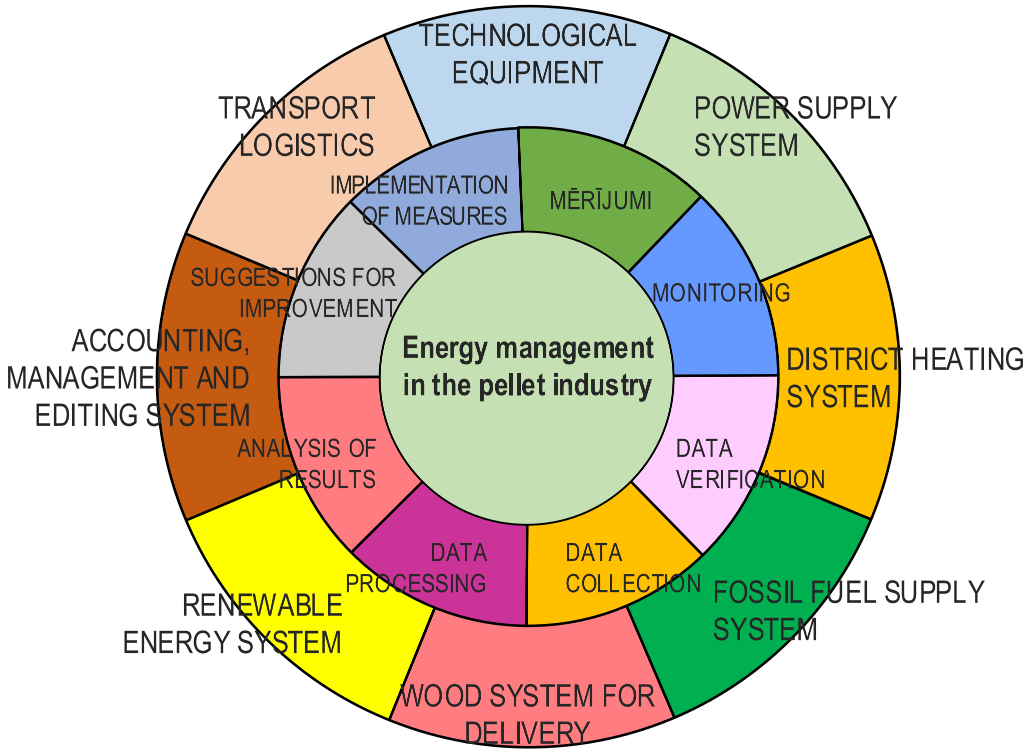

Fig. 5.1. Scheme of linked integrated pellet production factors

Wood waste is used as the main raw material in the production of pellets. Pellet production consists of several important processes, they are:

- Preparation of raw materials;
- Preparation of materials necessary for the production of wood chip pellets;
- Drying of materials;
- Shredding of materials;
- Pressing of materials, pellet production.

One of the first tasks in energy management is to monitor data. Within data analysis, data is obtained and analysis of several important parameters is done for the characterizing industrial activities, such as electricity consumption (see Fig. 5.2) and heat consumption in a cogeneration plant (see Fig. 5.3).

As an industrial plant has a number of equipment that consumes significant amount of electricity, such as press, mill, chiller and others, it is important to collect data on electricity consumption and perform analysis to see how electricity consumption changes depending on the amount of pellets produced (see Fig. 5.3). As the obtained data shows – as the volume of produced pellets increases, the amount of electricity consumed increases linearly.

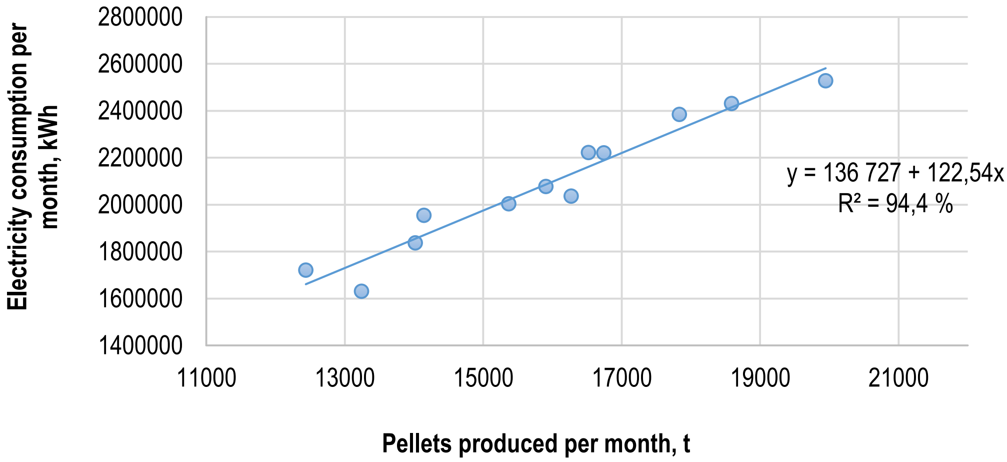

Fig. 5.2. Electricity consumption of equipment per produced amount of pellets

Fig. 5.3 shows how the amount of heat produced in a cogeneration plant changes depending on the amount of pellets produced. The obtained data shows that as the amount of produced pellets increases, the amount of produced heat energy also increases linearly.

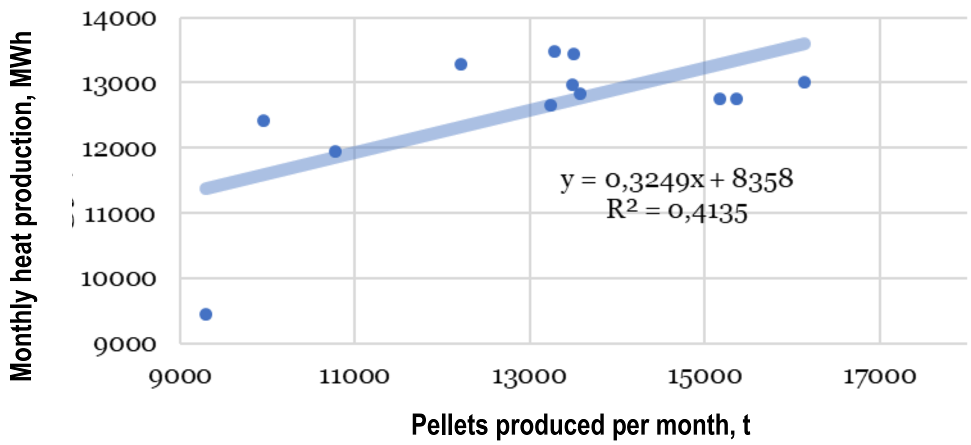

Fig. 5.3. Produced heat in cogeneration plant depending on production volume

By analyzing the data obtained during monitoring on industrial processes, it is possible to determine which production processes need and can be improved. The roller dryer was identified as one of the technologies where improvements could be made. The existing system works manually, so the combustion processes are incomplete, and for this reason it is not possible to control the quality indicators in the pellet production process. In the current situation, in order to achieve the appropriate quality indicators, it is necessary to re-process the raw materials, thus consuming unnecessary resources, including time.

In order to be able to control and determine the necessary parameters in the production of pellets the most effectively, one option is to optimize the dryer by introducing an automatic control system, thus allowing to control and change important parameters in production, such as air supply at the appropriate pressure and temperature in the furnace. This improvement eliminates the influence of the human factor and improves the efficiency of the system. This type of system would improve combustion processes by making them more complete and reduce the amount of products produced during the incomplete combustion process. It is also important to ensure the temperature of the hot air supplied to the furnace in accordance with the specified values. If the temperature is too high, unnecessary energy resources are consumed, while if the temperature is too low, the combustion process will be incomplete.

Important components of the roller dryer system are the boiler and the rotary or roller dryer, the main task of which is to ensure the functioning of the dryer. Flue gases are used as heat transfer agent roller driers; the drying process itself takes place when the raw material comes into direct contact with the hot flue gases. This particular type of dryer has a high efficiency, as it is possible to dry large volumes of sawdust in a short period of time. Mainly bark and wood chips are used as fuel for the operation of the boiler, however, this does not exclude the possibility of using different types of biomass.

The drying process is divided into several parts:

- Hot flue gases are discharged from the furnace to the roller dryer;
- In the dryer roller cylinder, wet sawdust is dried with hot flue gases - using the plates built into the roller and the flowing flue gas flow;
- Sawdust is moved from the entrance of the dryer to its exit;
- Flue gases and dried material enter the cyclone filter - it separates dry sawdust from flue gases and vapors;
- Dry sawdust enters the dry sawdust hopper.

The energy efficiency ratio of the furnace η shows how efficiently the heat produced is used. To calculate this, the inverse heat balance equation is used:

$$\eta = 100 - q_3 - q_4 - q_5,$$

where

q_3– chemically incomplete combustion losses, %;

q_4– mechanically incomplete combustion losses, %;

q_5 – heat loss in the environment, %.

The equation shows that in order to have a higher energy efficiency ratio, it is necessary to reduce losses of both combustion and heat. To reduce the losses of chemically incomplete combustion, a prototype with an automated control system was developed, which includes fuel supply to the furnace and air supply equipment.

This example shows that the transition to automated systems reduces the impact of the human factor on the production process, resulting in reduction in the total amount of defective product and energy consumption for the process, which also leads to an increase in production, taking into account that resources are being used more efficiently than before.

By improving the roller system, it is also possible to reduce CO_2 emissions. As the drying process in this case is provided with heat from the cogeneration plant and the roller dryer, it was calculated how much CO_2 emissions are generated in each process. The results showed that the obtained emissions from the cogeneration plant are significantly lower than for the roller dryer at higher production volumes. A cogeneration unit is more efficient than a roller dryer, so it is important to improve this technology by automating it in order to be able to increase its efficiency.

Another way to improve the performance of an industrial company is to find a way to reduce electricity consumption. Experiments are being done to determine which would be the most effective way. For example, in order to analyze the operation of the mill, an experiment was carried out in connection with the use of the mill – a pre-milling process was introduced in the current process. In the first round of the experiment, the hammer mills operated in pre-grinding mode, installing two sieves, one sieve with openings of 10 mm and the other of 20 mm. A total of 10 500 kg of grounded chips were produced in 38 minutes. In the second round of the experiment, the hammer mill worked in grinding mode with two sieves, one sieve openings were 6 mm, and the other of 7 mm. In the grinding mode, the mill used the material previously obtained in the pre-grinding process. This time 10 500 kg of grounded chips were produced in 16 minutes.

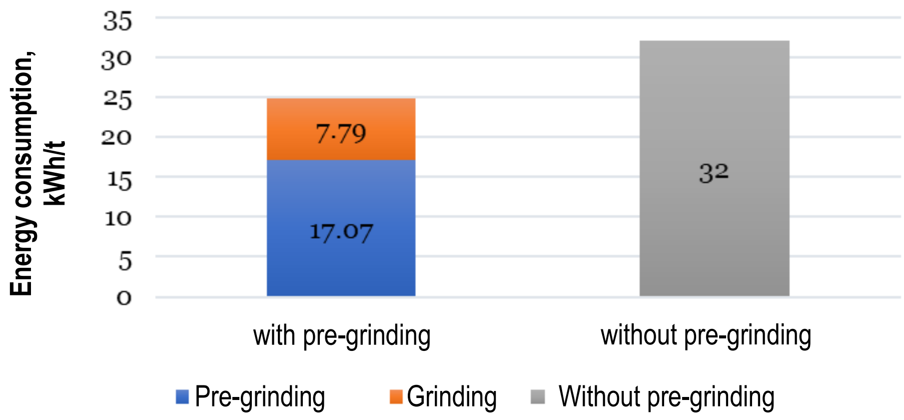

Fig. 5.4. Electricity consumption with pre-grinding and without pre-grinding

Fig. 5.4 shows how the electricity consumption per tonne of grounded amount changes in the case of pre-grinding and without pre-grinding – the total electricity consumption will be lower if the pre-grinding process is used.

Another significant improvement in the company could be the efficient use of surplus heat from the cogeneration plant, using it for cooling. The use of surplus heat for local cooling allows to increase the electricity capacity of the cogeneration plant, which is best used as a base power plant, producing electricity at full capacity all year round and obtaining maximum profits. Part of the revenue would also come from the savings of cooling costs, as otherwise the cooling process would be done with an electrically driven cooler. Another significant benefit from the efficient use of surplus heat would be a reduction in primary fuel consumption. Of course, when looking at the operation of cogeneration and the further use of useful heat, it is also necessary to assess fuel costs, cogeneration capacity and other relevant factors.

6. ANALYSIS OF POLICY INSTRUMENTS FOR ENERGY PRODUCTION

The EU Renewable Energy Directive stipulates that at the national level, countries may develop various national support measures for the implementation of RES policy and establish cooperation mechanisms with other EU Member States. However, the efforts of EU countries to set up state aid mechanisms to meet the targets set in the RES Directive show that special attention needs to be paid to cost-effectiveness. The European Commission has conducted that EU Member States needs to create state aid mechanisms based on market-based principles.

Latvia has chosen a support mechanism for renewable energy resources and energy efficiency improvement in the form of a mandatory procurement component (MPC) for electricity. The aim of the MPC was to increase the share of renewable energy resources in the balance of electricity users. It is relatively easy to implement by financially supporting the use of local renewable energy sources to replace fossil natural gas. However, MPC is only a political instrument that can affect the development of the energy sector both positively and negatively: by introducing MPC and other subsidies, it is possible to develop, stop or destroy the sustainability of the national economy. Therefore, the challenge for the country is to see the directions of sustainable development and support them.

7. ANALYSIS OF POLICY INSTRUMENTS FOR BIOMASS AS A SOURCE OF RENEWABLE ENERGY

The use of biomass as an energy source has a key role to play in increasing the use of renewable energy sources (Scarlat et al., 2015). The use of local renewable biomass is already one of the important cornerstones in the consumption of renewable energy resources in Latvia. Currently, wood is the most widely used RES in Latvia, and in 2018, fuel wood accounted for 80.9% of RES consumption (Central Statistics Bureau, 2018). Considering that biogas, bioethanol, liquid biofuels, solid fuels and biodiesel are also produced from different types of biomass, 94.2% (2015 data) of all renewable energy is obtained using bioresources (Eurostat, n.d.). The share of biomass in the balance of Latvia's renewable resources tends to increase, because, for example, in 2010 it was 88.2%, so Latvia's energy development is slowly moving in the right direction, as the consumption of fossil energy resources is reduced (Barisa et al., 2018). A beneficial condition for the use of wood to increase the share of RES are also provided by its relatively wide use in the heating sector, where there is also a high GHG emission reduction potential (Kranzl et al., 2012). A heating system based on renewable energy sources is a very important element in securing fossil fuel-independent energy systems in the future (Sperling & Moller, 2012). However, in a study on the promotion of energetic wood in Latvia (Romagnoli et al., 2014) is concluded that local biomass resources are not fully used for heat production in district heating, although this is important not only from the point of view of energy security and energy independence, but also due to fuel diversification. However, despite the already existing level of biomass use, Latvia still has significant local potential that has not been fully exploited.

At local level, increasing the use of bioresources for energy is needed to replace fossil fuels, reduce GHG emissions from the energy sector, promote the use of indigenous energy sources and reduce imported energy resources, leading to greater social, economic, environmental and climate benefits at national level. It is estimated that in 2030, approximately 54.8% of the available wood biomass will be used for energy, which is 11.8% more than in 2010 (Mantau, 2012). Various data are available on the future trend of biomass use for electricity and heat, but in every case the volumes are expected to increase. Which means that more biomass will have to be produced and extracted. However, it must be kept in mind that the possibilities for the production and extraction of bioresources are limited. It is determined by the areas of land used for agriculture and forestry, the fertility of these lands and the climatic conditions. This raises the question of the limits of the sustainable use of bioresources, in particular the use of bioresources in energy, so that consumers' basic needs for bio-based products are not adversely affected (Barisa et al., 2018).

It can be concluded that the use of wood will continue to be one of the main drivers for promoting the use of RES in Latvia. On the one hand, it is positive because local bioresources are used. However, on the other hand, another particularly relevant goal of economic development is the development of the bioeconomy. The bioeconomy approach involves the sustainable use of bioresources and the production of products and energy resources from bioresources and biotechnology that have high added value and are able to replace products and energy produced from fossil resources. In this case, a dilemma arises between the demand for bioresources in energy and the bioeconomy, because in terms of sustainable use of bioresources, on the one hand, the use of bioresources in the energy sector must be increased, on the other hand, bioresources must be used sustainably (Muizniece & Blumberga, 2017).

Depending on the type and quality of bioresources, different strategies can be used to valorize them. Different conversion technologies are available for each type of bioresource, both those that ensure the quality of the material in high value-added products and approaches that are less sustainable, such as the use of valuable wood for energy. The benefits of valorisation of bioresources are most often an additional economic benefit. However, it is also important to consider the environmental impact of increasing the value of bioresources (Lopes et al., 2015), or, for example, carry out an integrated economic and environmental assessment of valorisation alternatives (Beloborodko & Rosa, 2015).

The economical and rational consumption of resources and means are predicting that different quality bioresources can be used for different applications. In order to ensure efficient and full use of bioresources, it is necessary to focus primarily on the production of more valuable products, including the production of medicines, biologically active substances, feed and food ingredients, then the use of cellulose fibers and remaining fractions for bioenergy production (Latvian State Forests, 2016).

The fact that bioresources should firstly be used to produce potentially higher value-added products has also been analyzed in the scientific literature. Mathiesen et al. (2012) points to the availability of biomass sources in the EU and calls for a reduction in the demand for biomass for heat production by replacing them with other renewable resources. Mantau (2015) also points out that there is increasing competition between different uses of resources, and therefore analyzes cascades of timber flows. Cascades involve the gradual reuse of resources (as well as residues and scrap): starting with the production of higher value-added products and moving towards lower quality uses of biomass, i.e. the value of the products produced decreases with each passing step as the quality of bioresources decreases. Mantau defines two different types of cascades:

1. In the microeconomic context – the use of biomass in products that will be used for at least one more time after the end of their life cycle, for example, as a material or for energy production;
2. In the macroeconomic context – as a cascade of industrial sectors or reuse of biomass co-product or reuse of residues (Mantau, 2015).

In the long term, it is important to harmonize the availability and use of biomass for various nationally important development goals, including both increasing the share of RES and developing the bioeconomy. Accordingly, high-quality biomass is primarily used for the production of high value-added products (macroeconomic context cascades), while to increase the share of RES in the total energy balance, low-value wood and wood resources are no longer used in higher value-added products (e.g., waste, shavings). An example would be the use of sawmill scrap of appropriate quality for the production of various household items, such as wooden toys or kitchen items, and only then the resulting waste, which can no longer be used in products, can be used for energy recovery.

To illustrate the above, an example is analysed of the impact of energy on the sustainability of bioresource use. In the context of the bioeconomy, climate change and the sustainable use of resources, there is an increasing emphasis on the use of bioresources to replace fossil resources not only in energy but also in industry. It is therefore necessary to raise the issue of the limits and preconditions for the sustainable use of bioresources in order to meet the climate goals of the energy sector on the one hand and to maximize the use of bioresources in the production of high value-added products on the other. A large part of firewood produced in Latvia is still firewood (42% in 2014), but in the last decade there has been a sharp decline in the share (in 2005 it was more than 60%). The volumes of wood pellets (19% in 2014) and fuel chips (22% in 2014) are also significant, as a result of which Latvia has become a leader in the export of wood pellets on European scale (Central Statistics Bureau. Environment and Energy). Although the share of forest sector products in Latvia's total exports in 2015 was 20%, which is a very low share compared to 2000, when it was 43% (Central Statistics Bureau. Foreign trade in goods), the share of value added in the forest sector in GDP has remained almost unchanged with slight changes (5.2% in 2015) (Central Statistics Bureau. Economy and Finance), (Barisa et al., 2018).

With regard to the use of forest biomass, it is also important to understand whether the conversion of forest resources into energy resources and burning is the most sustainable solution, especially compared to the use of these resources in production. In order to find an answer to this question, it is first necessary to understand the preconditions for the sustainable use of forest resources in the energy sector. Sustainable forest management means the management and use of forests and forest land in such way and to such an extent that their biodiversity, productivity, resilience, vitality and potential to perform important ecological, economic and social functions at local, national and global levels now and in the future are maintained, and endangering other ecosystems is avoided (General Guidelines for the Sustainable Management of Forests in Europe, 1993). Considering the sustainable use of forest resources in the energy sector in the context of the bioeconomy, the main precondition is that only wood resources or their processing residues that cannot be used for the production of other higher value-added products are used as fuel or energy production (Fig. 7.1) (Barisa et al., 2018).

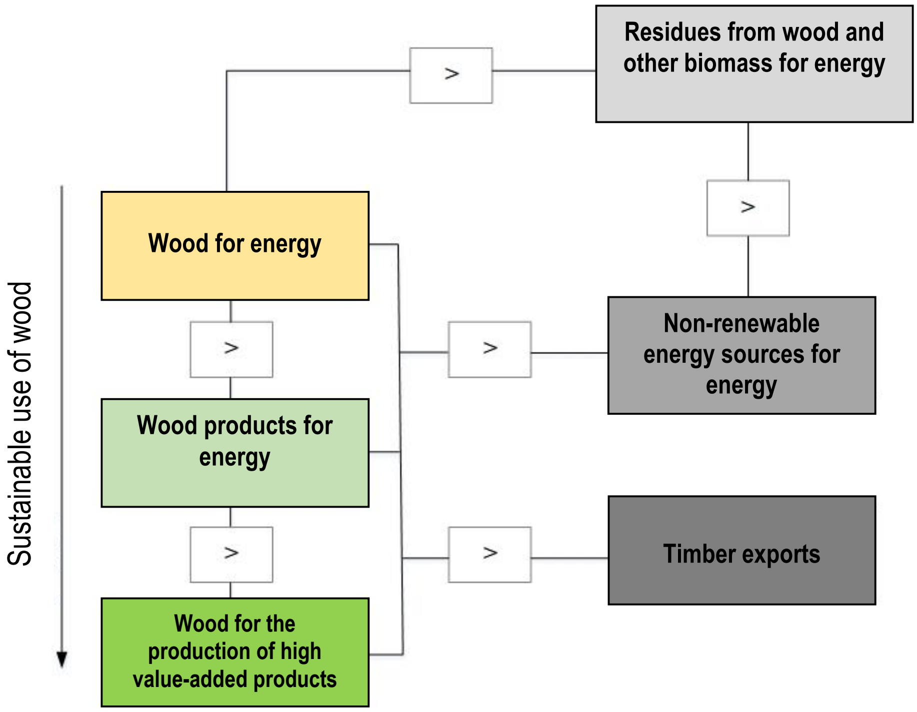

Fig. 7.1. Sequence of sustainable use of wood resources (Barisa et al., 2018)

At the same time, it should be taken into account that the use of wood products and processed residues in the energy sector should be higher than the use of fossil resources and should be exported not as raw wood, but finished products, which would ensure the development of Latvia's economy would be based on principles of bioeconomy. In order to comply with the principles of sustainable forest management and to avoid depletion of forest soil through intensive use of forest biomass, biomass ash left over from production of energy from wood should be returned to the forest. If all the above preconditions are met, it would be possible to create a closed cycle of forest bioresources, to meet the demand for renewable bioenergy resources and higher value-added products in order to reap greater economic and social benefits without harming the environment and ensuring long-term resource availability. Therefore, logging residues (branches, tops, stumps, roots, grass, leaves), low-quality wood, wood processing residues, care felling residues and high value-added wood processing products should be used as energy resources or raw materials for the production of energy products from forest bioresources. Biomass remaining in the production process which, for economic or environmental and climate reasons, is not justified for the production of a higher value-added product. In order to comply with the principles of bioeconomy, it is recommended to produce products with higher value-added from wood resources, instead of the now traditional fuels -

chips, pellets, briquettes and charcoal. For example, bio-oils, biofuels, bioethanol, bio-butanol, torrefied wood and syngas. Some of these products can be used as end products in the energy sector or as raw materials for the production of higher value-added products. For example, for the release of chemical compounds, which are then widely used in various industries. The main benefit of sustainable use of forest resources in the energy sector is that the maximum amount of forest resources is used for the production of high value-added products, as a result of which fossil resources are partially replaced for production, and carbon storage in wood products reduces GHG emissions from forestry, the use of local resources and the reduction of imported resources and products are promoted, as well as the increase of exports of wood products with higher added value, as a result of which the social, economic, environmental and climate benefits at the national level are promoted (Barisa et al., 2018).

8. EU GREEN DEAL FOR THE DEVELOPMENT OF RENEWABLE ENERGY

The goal of European Green Deal is to become the first emissions-neutral continent in the world with resource efficiency and economic growth by 2050 and it is a part of strategy to achieve the United Nations (UN) 2030 agenda and targets. To achieve set goals, a compromise between economic, environmental and social goals needs to be found. There is a need to improve policy instruments affecting cleaner production, energy efficiency, infrastructure and the transport sector, as well as the food, agriculture and construction sectors, through changes in the tax system and social benefits. Increasing values of nature protection and ecosystem renewal in order to make more sustainable use of resources in the future, as well as using digital tools to monitor pollution levels, energy and natural resource use.

Comparing 1990 and 2018 data of GHG emissions, an indicator has fallen by 23% and economy has grown by 61%, showing that reduction of emissions has no impact on economic growth. Without changes by 2050, GHG emissions will only fall by 60% and will not reach the target, thus changes in political instruments need to be made now. As one of the political instruments of the Green Deal is the Climate Law, which sets the legal framework for achieving the carbon neutrality target by 2050. It is planned to establish a monitoring system that ensures oversight of the transition to carbon neutrality and is an irreversible process. In order to reach the target by 2050, the necessary steps should be taken (Fig. 8.1).

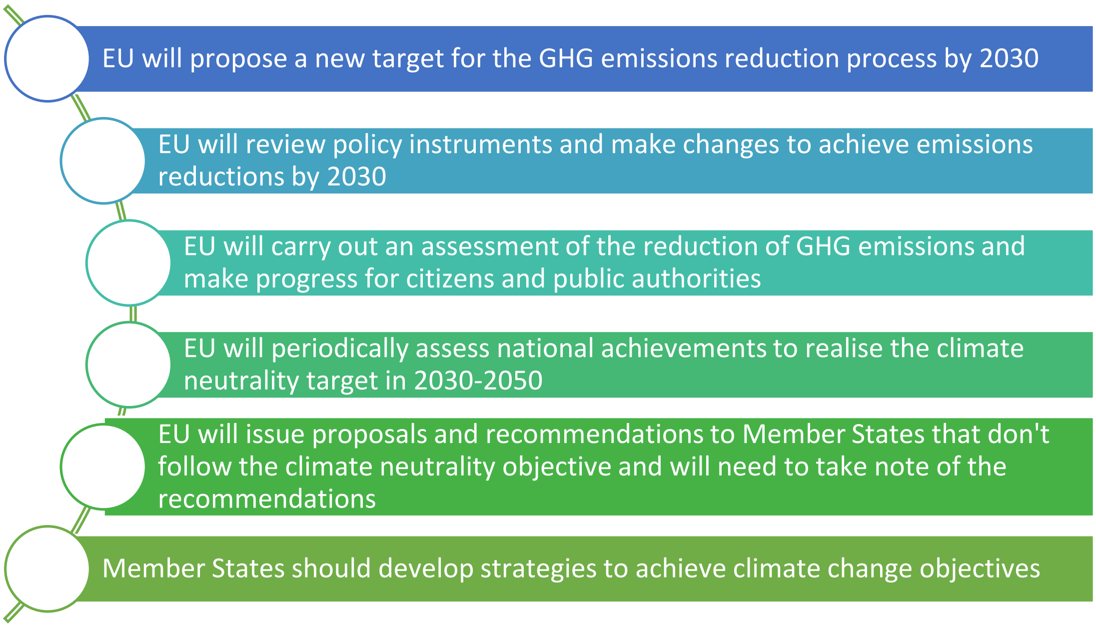

Fig. 8.1. Steps to achieve climate neutrality

Changes will be made to the Energy Tax Directive and it will focus more on environmental issues in order to speed up the integration of low carbon fuels into the market and make it possible to harmonize fuels prices through the EU and introduce CO_2 tax. Also, changes in the Emissions Trading Scheme will be made – the extension of emissions trading to new sectors and the regulation on land use and forestry. With changes in policy instruments and taxes, there is a risk that large manufacturers may relocate their production processes outside the EU, where emission reductions will not be as high as in the EU, to prevent this, it is possible to introduce an emission limit for each sector to prevent such practices.

More than 75% of GHG emissions come from energy production processes – energy efficiency and the development of renewable energy sources must be a priority. Smart RES integration, energy efficiency and sustainable technology solutions will help to achieve the goal of decarbonisation. Decarbonisation of the gas sector is also being promoted in order to reduce GHG emissions.

It takes 25 years to transform industry and to achieve the goals by 2050, industry needs to start integrating changes very soon, however changes made so far are slow and uneven. It is essential to decarbonise the energy-intensive sector and to support the production of circular products, as this reduces the amount of raw materials needed and reuses resources.

To achieve the energy efficiency target, it requires doubling the rate of building refurbishment, which currently stands at 0.4 to 1.2 %, and work is under way to address the risk of energy poverty for households. Improving the energy efficiency of buildings, energy consumption will be reduced which will also reduce costs for consumers. Emissions from buildings can be included in the European Emissions Trading Scheme.

The transport sector is one of the largest emitters and in order to achieve the target, emissions must be reduced by 90% till 2050. For emission reductions to happen, more sustainable vehicles and clean energy alternatives to existing vehicles is needed. The efficiency of the transport system can be improved with multimodal transport, but it needs a lot of support. It it forecasted a large increase in energy demand in the transport sector, so it is necessary to offer a wide range of alternative fuel options, as well as to invest in making the transport sector greener and more efficient. One way to reduce emissions is to transport 75% of land freight by inland waterway or rail, but it will be necessary to improve the infrastructure for these modes of transport. Also, there will be changes to the Combined Transport Directive to make it an effective tool, and a proposal for a Single European Sky to reduce aviation emissions will be considered.

The Alternative Fuels Infrastructure Directive and the TEN-T Regulation will be reviewed to speed up the conversion of vehicles and ships to zero or low-emission vehicles and ships. Tax breaks for aviation and marine fuels will be changed, and it is proposed to extend European emissions trading to the maritime sector and to reduce quotas for airlines that were allocated free of charge. There is also a need to improve air quality around airports and to regulate access to EU ports for the most polluted ships.

Stricter standards for air pollution from vehicles have been proposed, and legislation on CO_2 emissions from passenger cars will be reviewed by June 2021. Emissions from vehicles can also be included in European emissions trading. Traffic management needs to be developed to support new and sustainable mobility services that will reduce environmental pollution. Achieving reduction of emissions from the transport sector would require around 1 million recharging points and service stations in Europe by 2025, which would require 13 million zero- and low-emission vehicles.

To resolve climate change and environmental changes, it requires a global response to a global challenge. The EU is promoting and continuing to pursue environmental, climate and energy policies around the world, with the aim of convincing everyone that they have to take responsibility and start thinking more sustainable. The EU will continue to step up its collective efforts to ensure that global ambitions are cooperated with the G20 continues, despite the fact that these countries account for 80% of global GHG emissions, and need to develop an international carbon market as a tool to tackle climate change.

Geographical strategy plays an important role, and the EU supports cooperation with its immediate neighbors. An effective transition to greener technologies and alternatives can be facilitated if neighbors are also involved. Such cooperation can change geopolitics, economic and trade interests, and pose new challenges for many countries and societies. Climate policy should become part of the EU thinking and action in foreign affairs, security and defense policy.

Changes in policy instruments will work, if all stakeholders are involved in order to achieve common success. A European Climate Pact is being launched, focusing on how to engage the public in tackling climate change and raising public awareness of climate change and potential environmental threats, and how to address them. There is a need for an open platform for expressing ideas to work together and achieve climate goals, as well as for sharing good practice. To set a good example, the European Commission, as an institution and an employer, will reduce its environmental impact and present an action plan to meet its 2030 climate target, and calls on other EU institutions to do the same. European funds will help rural areas to realize their potential and opportunities in the bioeconomy, and work will continue on "Clean Energy for the European Union's Islands" to accelerate the introduction of clean energy in all the islands of the European Union.

Member States need to ensure that policy instruments and legislation are implemented effectively and that progress towards the targets is monitored. The European Green Deal launches a new strategy to support the European Union's transition to a just and prosperous society capable of meeting the challenges of climate change and environmental impacts in order to improve the current situation and the quality of life of future generations.

8.1. An example of European country analysis. Comparison of the impact of emission reduction policy instruments

Each EU Member State must prepare goals and objectives of the Green Deal. It is important to identify and highlight strengths and weaknesses in current policy in order to identify measures that need to be addressed first and that can be postponed.

Using the multi-criteria analysis method AHP, the importance or weight of the selected criteria is determined, and with the help of TOPSIS method, the result of each country is evaluated according to the criteria and input data. European countries – Denmark, Estonia, Ireland, Latvia, Lithuania, Slovenia, Finland and Sweden – were compared according to the six set criteria and their importance (Table 8.1).

Table 8.1

Importance of criteria

Criteria		Criteria weight	Best values
C1	GHG emissions per capita, t CO_2 eq./capita	32 %	MIN
C2	Income from environmental taxes, %	19 %	MAX
C3	Household energy consumption per capita, kgoe	15 %	MIN
C4	Investment share of GDP, %	13 %	MIN
C5	Consumption of solid fossil fuels, thsd. t	13%	MIN
C6	Renewable energy consumption, %	8%	MAX

After comparing the pairs of criteria, the most important criteria were GHG emissions per capita (32%) and revenue from environmental taxes (19%), with renewable energy consumption (8%) being the least important criteria.

After performance of TOPSIS method, Sweden got the best results out of all countries. In most important criteria GHG emissions per capita Sweden got one of the lowest indicator and a good indicator of renewable energy consumption. In the other criteria, Sweden performed on average compared to the selected countries. The distribution of all selected countries is in Table 8.2 and Ireland and Slovenia show good results after evaluation, but Latvia and Lithuania have poor results.

Ireland has good result and has a high score in the criterion of environmental tax revenue, which is the second most important criterion and has low indicator in the consumption of solid fuels, although in criteria GHG emissions per capita Ireland had the highest indicator it did not bother to get high in ranking.

Table 8.2

Country comparison

Denmark	Estonia	Ireland	Latvia	Lithuania	Slovenia	Finland	Sweden
0.463	**0.497**	**0.538**	**0.424**	**0.457**	**0.499**	**0.481**	**0.644**
6	4	2	8	7	3	5	1

Latvia has the best indicator in criteria GHG emissions per capita, but this did not help to be one of the best countries in this comparison. In the criteria for energy consumption per capita in households, Latvia had high indicators, which affected the result and therefore the overall indicator is so low in this comparison.

Lithuania ranks the second worst among countries and has a slightly higher ratio than Latvia. Lithuania had the best GHG emissions per capita, but the weakest indicator was the income from environmental taxes and renewable energy consumption, which could be the reason for the low position.

Denmark ranks relatively low in comparison because of criteria GHG emissions per capita was high indicator from all countries and the rather average values of the other criteria among these selected countries.

Results show that Estonia and Slovenia are almost the same in terms of GHG indicators. In both countries criteria indicators have similar values. Slovenia has higher household energy consumption and solid fossil fuel consumption, while Estonia has the second lowest per capita energy consumption.

After this type of comparison is possible to assess each country's strengths and weaknesses in order to reduce GHG emissions and how to improve policy instruments. In order to achieve the European Green Deal goal of becoming an emission-neutral continent by 2050, many improvements are needed, and to regularly monitor how the changes made affect emissions and the use of RES.

8.2. NECP 2030 renewable energy setting

In order to achieve goal, set up by the Latvian National Energy and Climate Plan 2021–2030, to improve energy security and public welfare, to promote the development of climate neutrality in a sustainable, competitive, cost-effective, safe and market-based manner (National energy and climate plan for 2021–2030 project, 2018). Renewable energy (RES) targets are in the energy generation and transport sector, as well as improving political instruments (Fig. 8.2).

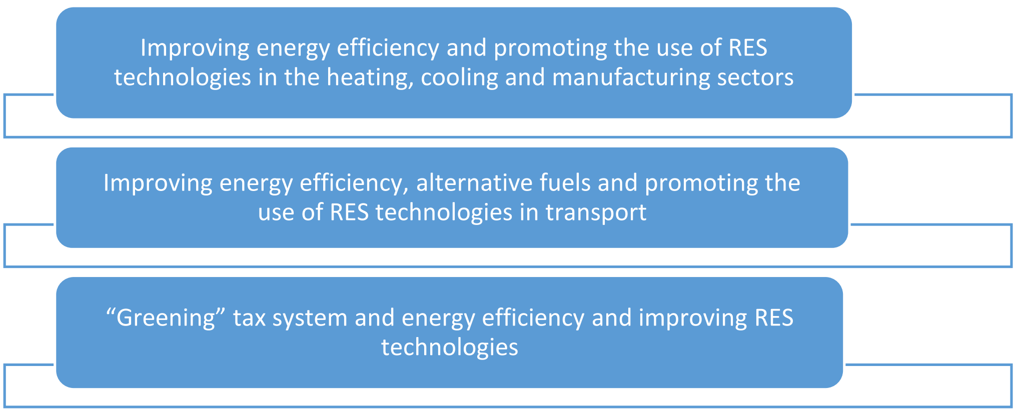

Fig. 8.2. RES goals

In order to better integrate the objectives, changes are also made to European Union legislation and help to achieve the objectives pursued:

- Directive 2009/28/EC Article 22 – report every two years on the achievement of the energy target produced by the AER;
- Directive 2018/2001136 sets a binding target for all EU Member States for 2030 for a 32% share of RES in final energy consumption;
- Regulations 2018/1999 on the Energy Union and action in the management of climate policy;
- Directive 2018/2001 on the promotion of the use of energy from renewable sources.

Energy consumption in Latvia is dominated by RES and liquid fossil fuels in energy production and the largest energy consumption is in households, agriculture, forestry and fisheries.

The current situation in Latvia - the use of RES has increased by 25.6% compared time period from 2005 till 2018. The most widely used energy is wood and in 2018 represented 80.4% of the total RES producer in the country, as well as an increase in the consumption of biofuels and solar energy. Electricity generation from the RES decreased by 35.9% in 2018 due to low water levels during the summer period. Electricity from RES cogeneration plants accounted for 22.6% of total energy in 2018. The acquisition of thermal energy from the RES was 46.7%, where the majority is composed of solid biomass 93.5%, according to 2018 data.

The use of RES and electricity in the transport sector has only increased by 3.06%, although the increase compared to 2005 is made by 2.5 times. In 2009 the mandatory addition of 5% of biofuels to fossil fuels has been introduced in Latvia, but these requirements do not apply for fuel sold from 1 November to 15 April, as well as fuel used in aviation vehicles and ships. According to data from 2019, there are 658 electric vehicles in Latvia, of which 518 are passenger cars and 19 buses or trucks. The growth of such vehicles is 37.4% compared to 2018.

In 2017, the share of RES in total final consumption was 39%, an increase of 20.9% compared to 2005. The share of RES has remained above the indicative curve in order to reach the 2020 targets in order for Latvia to reach the required share of RES in the transport sector, it has to be increased by 7.5%. Following the baseline scenario in 2020, the electricity and transport sectors of RES and the RES central heating will continue to grow and decrease in the RES local heating and individual heating industry.

Latvia has a high dependency on imported energy resources, while wood biomass is the most important local fuel used in central heating and local heating, as well as individual heating. The energy share of RES in heating was 40.7% in 2010 and 54.6% in 2017. Heating and cooling is not particularly distributed from non-emission technologies and small amounts of individual heating are used by solar collectors or heat pumps.

Targets for more frequent use of the public transport and reducing the number of private vehicles can be achieved if the public transport, bicycle and pedestrian infrastructure is improved. Lower oil imports and higher consumption of RES in the transport sector in Latvia will give greater independence from energy imports and reduce emissions, as the share of alternative fuel and non-emission energy use will continue to increase.

The deployment of new electricity generation capacity has been stagnating in Latvia for a long time and the potential for electricity generation from non-emission technologies has not been used. Costs of RES technologies have decreased and are more cost-effective than fossil fuel technologies. In order to develop wind parks, there are many restrictive factors that hamper and hinder the development of projects, as well as it is possible to develop high-capacity electricity generation from solar energy in Latvia, because Latvia has similar potential as others European countries where this energy is already in use. Currently, the electricity system is able to absorb up to 800 MW in addition to RES capacity, which is about a third of the total electrical capacity installed in Latvia.

Developed mechanism in electricity generation has raised energy costs and affected consumers, and the industry has been adversely affected. The electricity mandatory procurement component is expected to be reduced after 2021. The burden of electricity costs should be reduced, as comparing the average and small costs for electricity in Latvia is the highest in all Baltic States.

In general, electricity costs in the Baltic States are expected to grow due to increased demand for higher electricity capacity and costs for allowances, but these costs may be reduced if the types of generation of RES are improved. It is planned that households producing electricity will be able to transfer unused energy over the grid and, if necessary, receive energy from the grid and pay for the components of the mandatory procurement component, distribution and management.

The implementation of "polluter pays" principle and the largest GHG emitters have a higher tax burden, and it is planned to assess the relationship energy production against energy consumption. It is encouraged to increase the tax on natural resources for new plants where only fossil fuels can be used, unless it is considered as a backup for capacity supply at critical times.

Tax incentives are granted for energy efficiency measures taken or the use of RES technologies is also an option, a temporary incentive to support GHG reduction processes. Currently, thermal energy has a reduced tax rate and household electricity does not have a tax rate, but those who have taken energy efficiency measures or use RES technologies that do not create any tax incentives and do not encourage the use of RES technologies.

Sufficient energy capacity is provided and energy dependency is reduced, but Latvia needs to be specifically considered as additional capacity for the production of thermal energy during the cold months of the year. As well as the demand for electricity will only increase and energy security will need to be improved. Provide electricity between the interconnection capacities with neighboring countries and improve infrastructure, as electricity trade in the Baltic States will be limited and will reduce capacity for all Baltic States. During the period 2016–2017, Latvia had a large share of RES, a third larger in the European Union and a significant increase in energy is a cumbersome process. The share of RES in final energy consumption cannot be less than 40%. The RES performance in the energy, heating and cooling and transport sectors should be improved by 2030 (Fig. 8.3).

Electricity sector

- Share of RES at least 60%

Heating and cooling sector

- Annually increase of RES by 0,55%

Transport sector

- RES growth of at least 7%

Fig. 8.3. Increase of RES by 2030

Latvia plans to increase its share in the electricity sector, although the legislation does not set new targets. By 2030, wind energy generation capacity and available infrastructure capacity have been exhausted. In order to ensure energy security, Latvia intends to increase installed wind generators and solar photovoltaic capacity. However, the increase in electricity capacity will not take place from biomass and biogas energy plants. The share of RES in heating and cooling supply is increased by increasing the capacity of biomass installations.

The share of RES in transport will be ensured as an obligation on fuel suppliers to dispose of it from RES energy, as well as by ageing the production and use of biomethane in public transport and to develop non-fossil fuels. In the transport sector, the share of modern fuels is expected to be 0.2% of the total RES in the transport sector by 2022, rising to 3.5% by 2030. The electrification of the railway and the rapid development of electro mobility are also planned.

The planned measures will meet the energy efficiency target and the share of RES in total final energy consumption will reach 50%. By 2030, the benefits of the objectives achieved will be:

- Improved performance of central heating and individual heating systems, reduced costs for heating;
- Reduced environmental impacts due to the decarbonisation process;
- Ensuring more convenient transport, reducing travel time, improving mobility and reducing the environmental impact of vehicles;
- The tax system promotes the use of RES and non-emission technologies and reduces the use of fossil energy;
- Do not increase taxes on real estate in the case of energy efficiency measures and the use of RES technologies;
- Supporting financial energy efficiency measures and the deployment of RES technologies;
- Rational use of energy resources and lower energy costs;
- Energy dependency on imported energy is decreasing and demand from local energy sources is increasing.

Transport and households are projected to be the largest energy consumers in 2030, representing around 27.1% and 28.6% of total energy consumption and 21.2% of total energy in industry.

REFERENCES

Allman L., Fleming P., Wallace A. The progress of english and welsh local authorities in addressing climate change Local Environment, 9 (2004), pp. 271-283;

Bale C.S.E., Foxon T.J., Hannon M.J., Gale W.F. Strategic energy planning within local authorities in the UK: A study of the city of Leeds. Energy Policy, 48 (2012), pp. 242-251.

Barisa, A., Blumberga, A., Blumberga, D., Grāvelsiņš, A., Gušča, J., Lauka, D., Kārkliņa, I., Muižniece, I., Pakere, I., Priedniece, V., Romagnoli, F., Rošā, M., Seļivanovs, J., Soloha, R., Veidenbergs, I., Vīgants, E., Vīgants, Ģ., Ziemele, J. Energosistēmu analīze un modelēšana. Rīga: RTU Izdevniecība, 2018. 144 lpp.

Beloborodko A., Rošā M., "The Use of Performance Indicators for Analysis of Resource Efficiency Measures," Energy Procedia, vol. 72, pp. 337-344, 2015.

Bunzeck, I., van Bree, B. un Uyterlinde, M. Strategies for the introduction of alternative fuels and automotive technologies, Analysis of effective policy instruments. the Netherlands: Energy research Centre of the Netherlands (ECN), 2010. lpp. 102.

Centrālā Statistikas pārvalde. Atjaunīgo energoresursu patēriņš 2018. gadā samazinājās par 4,5 %. Available: https://www.csb.gov.lv/lv/statistika/statistikas-temas/vide-energetika/energetika/meklet-tema/2485-atjaunigo-energoresursu-paterins-2018-gada

Centrālās statistikas pārvaldes datubāze. Ekonomika un finanses. Available: http://data.csb.gov.lv/pxweb/lv/ekfin/ekfin__ikgad__ikp/?tablelist=true&rxid=cdcb978c-22b0-416a-aacc-aa650d3e2ce0.

Centrālās statistikas pārvaldes datubāze. Preču ārējā tirdzniecība. Available: http://data.csb.gov.lv/pxweb/lv/atirdz/atirdz__ikgad__atirdz/?tablelist=true&rxid=cdcb978c-22b0-416a-aacc-aa650d3e2ce0.

Centrālās statistikas pārvaldes datubāze. Vide un enerģētika. Ikgadējie dati. Available: http://data.csb.gov.lv/pxweb/lv/vide/vide__ikgad__energetika/?tablelist=true&rxid=cdcb978c-22b0-416a-aacc-aa650d3e2ce0.

Čivčiša I. Saules PV elektroenerģijas integrēšana centralizētās siltumapgādes sistēmās. Maģistra darbs. 2019

Ekonomikas ministrija. Atbalsts energoietilpīgiem apstrādes rūpniecības uzņēmumiem (2019). Available: https://www.em.gov.lv/lv/nozares_politika/atjaunojama_energija_un_kogeneracija/atbalsts_energoietilpigiem_apstrades_rupniecibas_uznemumiem/

Ekonomikas ministrija. Informatīvais ziņojums Latvijas Enerģētikas ilgtermiņa stratēģija 2030 – konkurētspējīga enerģētika sabiedrībai, 12. lpp., 21.-34. punkts, 16.05.2013. Available: http://tap.mk.gov.lv/mk/tap/?pid=40263360

Enerģētikas likums (1998). Pieejams: https://likumi.lv/doc.php?id=49833&version_date=09.06.2010

Eurostat database. Supply, transformation and consumption of renewable energies - annual data. Available: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_107a&lang=en.

General Guidelines for the Sustainable Management of Forests in Europe. Second Ministerial Conference on the Protection of Forests in Europe 16-17 June 1993, Helsinki/Finland

Grozījumi Ministru kabineta 2009. gada 10. marta noteikumos Nr.221 "Noteikumi par elektroenerģijas ražošanu un cenu noteikšanu, ražojot elektroenerģiju koģenerācijā" Ministru kabineta 28.08.2012. noteikumi Nr. 604 /LV, 142 (4745), 07.09.2012./ Stājas spēkā 08.09.2012.

Kranzl Lukas, Kalt Gerald, Muller Andreas, Hummel Marcus, Egger Christiane, Ohlinger Christine, et al. Renewable energy in the heating sector in Austria with particular reference to the region of Upper Austria. Energy Policy 2013;59, pp. 17–31.

Krog L., Sperling K. A comprehensive framework for strategic energy planning based on Danish and international insights.Accept. Publ. Energy Strategy Review (2019)

Latvijas bioekonomikas stratēģija 2030 (2017). Informatīvais ziņojums. Available: https://www.llu.lv/sites/default/files/2018-07/Bioeconomy_Strategy_Latvia_LV.pdf

Latvijas ilgtspējīgas attīstības stratēģija līdz 2030. gadam (2010). Available: https://www.pkc.gov.lv/sites/default/files/inline-files/Latvija_2030_7.pdf

Latvijas Nacionālais enerģētikas un klimata plāna 2021. – 2030. gadam projekts (2018). Available: https://em.gov.lv/files/nozares_politika/LATVIA_NECP2021-2030_PROJECT_19122018.docx

Latvijas Nacionālā standartizācijas institūcija „Latvijas standarts" (LVS). LVS EN ISO 50001:2012. Available: https://www.lvs.lv/lv/products/31277

AS "Latvijas valsts meži" pētījuma pasūtījuma "Meža biomasa – jauni produkti un tehnoloģijas" atskaite. 2016. 212 lpp. Available: https://www.lvm.lv/petijumi-un-publikacijas/petijums-meza-biomasa-jauni-produkti-un-tehnologijas

Lopes C., Antelo L. T., Franco-Uría A., Alonso A. A., Pérez-Martín R. "Valorisation of fish by-products against waste management treatments – Comparison of environmental impacts," Waste Management, vol. 46, pp. 102-112, 2015.

Mantau U. Wood flow analysis: Quantification of resource potentials, cascades and carbon effects. Biomass and Bioenergy, vol. 79, p. 28-38, 2015.

Mantau U. Wood flows in Europe (EU27). Project report. Celle, 2012, 24

Mathiesen BV, Lund H, Connolly D. Limiting biomass consumption for heating in 100 % renewable energy systems. Energy 2012;48:160–8.

Ministru kabineta 2015. gada 14. jūlija noteikumi Nr. 395 "Kārtība, kādā energoietilpīgi apstrādes rūpniecības uzņēmumi iegūst tiesības uz samazinātu līdzdalību obligātā iepirkuma komponentes maksājumam". Available: https://likumi.lv/doc.php?id=275666

Muizniece I., Blumberga D. Wood resources for energy sector in Latvia. Is it a sustainable solution? Energy Procedia, Vol.128, p. 287-291, 2017.

Par Latvijas Nacionālo attīstības plānu 2014.-2020.gadam, 24., 25., 191., 194., 196., 201., 203., 205., 206. punkts (2012). Available: https://likumi.lv/doc.php?id=253919

Par Latvijas Nacionālo enerģētikas un klimata plānu 2021.-2030. gadam. Ministru kabineta rīkojums Nr. 46. Pieņemts 04.02.2020.

Par sabiedrisko pakalpojumu regulatoriem (2001). Available: https://likumi.lv/doc.php?id=12483

Romagnoli F., Barisa A., Dzene I., Blumberga A., Blumberga D. Implementation of different policy strategies promoting the use of wood fuel in the Latvian district heating system: Impact evaluation through a system dynamic model. Energy, vol. 76, p.210-222, 2014.

Rosenow, J., Kern, F., & Rogge, K. (2017). The need for comprehensive and well targeted instrument mixes to stimulate energy transitions: The case of energy efficiency policy. *Energy research & social science*, *33*, 95-104.

Scarlat N, Dallemand JF, Monforti-Ferrario F, Nita V. The role of biomass and bioenergy in a future bioeconomy: Policies and facts. Environmental Development 2015;15:3-34.

Sperling K., Moller B. End-use energy savings and district heating expansion in a local renewable energy system e a short-term perspective. Appl Energy 2012; 92:831–42.

Stratēģija Latvijas oglekļa mazietilpīgai attīstībai līdz 2050. Gadam. Available: http://tap.mk.gov.lv/mk/tap/?pid=40462398

Subsidētās elektroenerģijas nodokļa likums (2014). Available: https://likumi.lv/doc.php?id=262304

Vīgants H. Granulu ražošanas ilgtspējīga attīstība. Promocijas darbs. Rīga: RTU Izdevniecība, 2016, 100 p.