

INSTALLATION OF ALTERNATIVE ENERGY SOURCES AND EQUIPMENT IN RESIDENTIAL BUILDINGS IN LATVIA

A. Cimbale*¹, I. Amolina², A. Elsts³, I. Geipele², N. Zeltins⁴

¹ Ltd. "Juridiskā koledža"

Kr. Valdemāra Str. 1c, Riga, LV-1010, LATVIA

² Riga Technical University,

Institute of Civil Engineering and Real Estate Economics,
6-210 Kalnciema Str., Riga, LV-1048, LATVIA

³ Ltd "PRO DEV 24"

Drustu Str. 1D, Riga, LV-1002

⁴ Institute of Physical Energetics,

14 Dzerbenes Str., Riga, LV - 1006, LATVIA

*e-mail: a.cimbale@inbox.lv

At the end of 2019, the EC presented the European Green Deal – a set of policy initiatives with the ultimate goal of making Europe climate-neutral by 2050. This means that all EU member states must reach climate neutrality. Emissions in all sectors shall be substantially reduced to achieve this goal. Most of the energy is produced using fossil fuels, which contributes to climate change, water and air pollution, as well as the depletion of natural resources. Individual and district heating systems, which supply residential buildings with heat and hot water, are responsible for a part of global emissions.

Electricity generation also produces emissions. The EU recognises the mitigation of climate change as one of the main challenges that must be overcome to ensure sustainable development of the European Union, which is why it has defined ambitious goals to promote decarbonisation and is deliberately moving towards the implementation of renewable energy.

This article aims at analysing the opportunity of using renewable energy resources in multi-apartment residential buildings in the context of sustainability.

Keywords: Construction costs, energy efficiency, heat pumps, renewable energy sources, renovation of residential buildings, solar panels.

1. INTRODUCTION

The EU must address the pressing issues of making buildings sustainable, more energy efficient and reducing their carbon footprint throughout the entire life cycle. The application of circular economy principles to building renovation will reduce greenhouse gases (GHG) associated with materials. The EU renovates residential buildings every year, also by implementing the measures associated with the introduction of renewable energy sources. It is more than just a reduction of energy bills and emissions. Renovation can open up many opportunities and bring a wide range of social, environmental and economic benefits. The renovation process may simultaneously introduce several improvements, such as making a building healthier and greener, more accessible and more resistant to extreme natural conditions, connecting it to other neighbourhood buildings, as well as equipping it with recharging points and bicycle stands as a part of the e-mobility concept. In addition, investment in building renovation can boost the construction ecosystem and the economy as a whole. Renovation is a labour-intensive process, which creates jobs and investments that are often rooted in local supply chains; it can also create a demand for energy- and resource-efficient equipment as well as ensure the long-term value of a property.

Based on projections of climate change [1], the current GHG emission mitigation scenario states that the net GHG emissions shall be reduced by 43 % over the next eight years compared to the net GHG emissions in 2019 [1].

The ever-increasing demand for renewable energy sources (RES), the depletion of fossil energy resources and the need to take care of the environment have made the

principles of sustainable development one of the focal points for future development. Adherence to and implementation of such policy ensures economic development, increases competitiveness and promotes employment. At the same time, it preserves and does not disrupt the environmental quality.

Modern energy development involves a widespread use of power plants based on RES, such as hydropower, solar, wind, geothermal, tidal, wave, etc. This direction is associated not only with the struggle for carbon neutrality, but also with ensuring the energy security of territories that provide themselves with energy from their own energy resources, and renewable energy sources in one ratio or another are available in any country in the world. However, the modern view of the use of renewable energy sources is mostly related to the gross potential of energy resources [2].

The growing role of renewable energy sources in the world energy balances contributes to a more efficient use of energy resources and their long-term preservation. At the same time, it positively impacts the environmental quality due to a decrease in emissions that pollute the atmosphere and water. Therefore, supporting the development of renewable resources is becoming an increasingly important and urgent task for all countries of the world, including Latvia. Supporting the use of renewable resources has become an essential part of the European Union (EU) policy. Wider use of renewables can make a significant contribution to the energy balances of particular regions as well as Latvia in general. The use of these resources can increase the security of energy supply, especially in regions with less developed energy infra-

structure. Successful implementation of RES requires an integrated approach, and the enactment of renewable energy policies will have an impact on many areas of the economy and life in general. The set targets can be achieved only by coordinating and amending existing policies in key sectors of renewable energy sources.

The present article aims to analyse the opportunity of using renewable energy resources in multi-apartment buildings in the context of sustainability.

To achieve the aim, the following tasks have been set:

- to determine the role of renewable energy resources and their function in the context of the climate neutrality

policy of the European Union and the development of the national economy of Latvia;

- to carry out a SWOT analysis of the use of alternative energy sources in the building renovation process;
- to analyse the processes of installation and operation of renewable energy equipment in Latvia.

The authors of the research have applied the analytical, statistical, and comparative analysis methods. Since the research topic is vast in scope, the authors have narrowed down the time period to 2017–2022, and the research object – to residential buildings.

2. THE ROLE OF RENEWABLE ENERGY SOURCES

The importance of RES in ensuring sustainable development can be attributed to the positive impact it has on various areas. Using RES can help:

- replace fossil energy sources, diversify and encourage using local resources, thereby increasing energy security and reducing dependence on energy imports;
- reduce the emissions polluting the atmosphere and water;
- promote regional development by creating new jobs, aiding the development of agriculture, forestry, manufacturing and research related to renewable energy technologies.

As investments in renewable energy resources replace the investments in fossil energy resources, a restructuring in the cost of energy production and a shift between economic sectors take place. Currently, the main stimulus for the support of renewable resources in Latvia is the energy security

issues, as well as the possible increase in the prices of fossil energy resources in the future. The policy promoting environmental protection and climate change mitigation also acts as a motivational factor [3].

Renewable energy sources are expanding opportunities for industrial development and can boost economic growth and create new jobs. It is possible to use renewable energy resources cost-effectively in all EU countries. The world is now at the beginning of the global energy transformation. Cost-effective renewable energy technologies provided an opportunity for sufficient development to reach ambitious climate targets of the EU Directive 2018/2001 of the European Parliament and of the Council of 11 December 2018 on promoting the use of energy from renewable sources [4].

RES driving forces can be divided into three main groups: economic, environmental and social. Economic drivers that are optimising the energy supply system are the main rationale for the use of renewable

energy resources. It is especially topical in areas, where connecting to a centralised electricity grid is troublesome. Often in such cases, opting for the use of renewable resources is cheaper than trying to connect to the grid. Renewable resources can be used in decentralised systems, which reduces the need to expand the existing power distribution network and allows for money savings. Security of supply: since energy consumption continues to increase, and Latvia has limited fossil fuel reserves, it heavily depends on imported energy resources. The use of renewable resources reduces reliance on imported resources, increasing the security of supply. Thus, the country decreases the dependency on fossil fuel price changes, which in turn increases the socio-economic stability of the country. The energy supply security issues are very topical, as proven by recent events in the oil supply sector. Environmental drivers – reducing emissions. The use of renewable energy resources (excluding biomass) does not directly lead to emissions. Generating

energy from the wind or the sun energy does not directly cause emissions. The use of biomass and waste does produce emissions; however, they are controlled by pertinent legislation and regulations [3].

Environmental benefits of renewables include less pollution, socio-economic benefits, and increased credibility for renewable energy as ideas are implemented locally and create new work opportunities. Renewable energy, new technological innovations and efficient energy use are the way to meet climate targets set in Directive (EU) 2018/2001 of the European Parliament and the Council of 11 December 2018 on the promotion of the use of energy from renewable sources [5].

RES have a large share in energy production. Energy resources produced in Latvia are fuel wood, electricity from hydro and wind stations, biogas, straw, biodiesel, and bioethanol. Heat plants produce thermal energy by burning not only natural gas but also in some cases oil products, coal and peat.

3. THE OPPORTUNITY OF INSTALLING ALTERNATIVE ENERGY SOURCES AND EQUIPMENT IN RESIDENTIAL BUILDINGS IN LATVIA

In the current economic climate, the characteristics of a house correspond to the financial status of the homeowner and their expense priorities – how high on the list of expense priorities are the expenses associated with housing and how much the homeowner is willing to invest in their property. Nowadays, it is important for housing to be comfortable, economic in terms of maintenance and energy consumption, as well as to be architecturally and aesthetically pleasing and fit into the surrounding environment. There are three possible ways to achieve a significant reduction in energy

consumption:

- to carry out renovation of a building;
- to use alternative energy sources in the energy balance of a building;
- to use both renovation and alternative energy options.

Various RES can be used to produce heat and electricity for households, for example, solar, wind energy, biogas, and geothermal energy.

Although GHG emissions currently align with the set GHG reduction targets,

it should be noted that the EU actively discusses raising the GHG reduction target for 2030. It is worth noting that if the climate targets are to be raised at the level of the EU, the national targets will have to be raised as well. The results and actual benefits (reduction of emissions and heat energy) of the current state policy promoting the energy efficiency of buildings will only be seen in the coming years. The same applies to renovation projects that are currently being carried out on residential, and non-residential buildings, including factories and public buildings as well as renovation projects that are still pending. Thus, it is projected that the heat consumption in the household sector and GHG emissions will reduce in the coming years.

As stated in the Strategy of Latvia for the Achievement of Climate Neutrality by 2050, the following objectives would be a part of an overarching policy in 2050:

- construction of all new buildings conforms to the requirements of zero-energy buildings. Citizens are aware of the advantages of zero-energy buildings, both in terms of providing energy

savings and a healthy indoor microclimate. Strict energy efficiency requirements are applied to the construction of new buildings. By 2050, it is ensured that all new buildings are zero-energy. During the construction of zero-energy buildings, the location of buildings, the materials used, and the internal engineering networks are also carefully considered;

- all renovation and rebuilding projects meet the requirements of zero-energy or nearly zero-energy buildings. Reducing emissions is unattainable without improving the energy efficiency of existing buildings, while also preserving historic buildings. Renovation and rebuilding projects are carried out qualitatively, using sustainable materials as well as effective technologies and methods. All existing buildings have been renovated or rebuilt following energy performance standards. As one of the biggest challenges to date hindering the holistic renovation of buildings, is limited funding, additional financial instruments are introduced [3].

3.1. Solar Batteries

Solar radiation warms the atmosphere, the soil, and bodies of water. The sun's radiation energy is the foundation of all processes occurring on the Earth. Photosynthesis is a biological process of storing solar energy that creates biomass. All fossil energy sources (coal, oil, natural gas) are essentially the converted and stored solar energy from millions of years ago.

The sun's chemical composition is 81.76 % of hydrogen in the gaseous state, 18.14 % of helium, and 0.1 % of nitrogen. Continuous thermonuclear reactions occur inside the sun turning hydrogen into helium and releasing solar radiation. The temperature on the surface and corona of

the sun reaches around 5 900–60 000 °C. Passing through the earth's atmosphere, the intensity of solar radiation continuously decreases. On a clear sunny day, the intensity of solar radiation on the surface of the Earth in our region is 800–1 000 W/m². The average solar radiation in Latvia is around 130 W/m². Within a year, 10 000 times more thermal energy is projected to the earth's surface than people consume. Even in a city centre with high-density housing, the amount of energy used for heating and hot water is five times less than the amount of solar energy emitted annually to this area. It is clear that the solar energy has enormous potential. However, the intensity of solar

radiation greatly varies depending on the time of the year. In the European climate, a solar collector can cover most of the hot water consumption in summer [6].

Solar systems use solar radiation rather than heat to generate electricity, so regardless of air temperature, solar panels operate even in cloudy or rainy weather, as well as on sunny winter days, when the outdoor temperature is as low as -20°C . The part of the electromagnetic radiation of the Sun with a wavelength of 100–400 nm is what we call solar radiation [6].

Since 2021, there has been a considerable increase in the number of solar panels installed on the roofs of residential buildings in Latvia. However, there is an issue which arises from an applied restriction. A low threshold for the production of green energy has been set, restricting the installation of solar batteries above 11 kW for household needs since neither JSC Sadales tīkls nor JSC Augstsprieguma tīkls is capable of transmitting greater amount of power. As a result, renewables cannot be used to their fullest potential and homeowners cannot use the energy the way they would want to.

Solar batteries have the highest efficiency from March to September. During the remaining period – in autumn, spring and winter – only 10 % of the total annual amount of electricity is produced. From November to March, the solar energy potential is minimal and cannot ensure a sufficient, uninterrupted supply of electricity without an additional power source, such as a diesel generator.

To ensure the most efficient operation of a solar power system, it is recommended to make sure that the solar panels are free-standing and installed at an angle that suits the particular region. For example, given the climate conditions of Latvia, panels installed at the wrong angle could contribute to energy losses of about 28 %. If the

panels do not have power optimizers, the power of the entire chain decreases if one of the panels is in the shade. Solar panels can be installed on the roof or the ground, and are suitable for all types of surfaces, except for thatched roofs.

In the current environment of high energy prices, many are tempted to try producing their own electricity for their household needs – more and more solar panels appear on the roofs and in the courtyards of Latvian houses. However, the proper maintenance of these panels is crucial. If solar panels are installed on the roof, all fasteners and fixtures holding the structural parts of the panels as well as mounts should be inspected each spring. In winter, the accumulation of snow and ice can affect the functionality of mounting components. If the air temperature fluctuates around 0 degrees, metal fasteners are also affected.

Installing solar panels on a joint property also poses a challenge. The co-owners must agree on several aspects – whether to install the panels on the roof (sloping or flat) or on the parcel of land, what type of equipment to choose, how to cover the installation costs, what type of mounting to use, etc. Solar batteries can produce electrical energy for common use – provide indoor and outdoor lighting, power elevators, pressure boosting systems, etc. At a sufficient capacity, electricity can be supplied not only to common areas but also to individual spaces, for example, apartments, non-residential areas, and workshops. The simplest way to install solar panels on a joint property, besides reaching a collective agreement, is to install the panels or any other unconventional energy-producing equipment during the construction phase if it is proposed by the contractor. However, the apartment owners can also make such a decision. In this case, the benefits of such a solution must

be well-defined and the bearing capacity of existing structures or the suitability of the territory of the house must be evaluated. In a densely built city centre, courtyards are not spacious enough and there is a risk that the panels will be shaded by neighbouring houses all the time.

Solar battery suppliers and power companies often offer a calculator of the required area and capacity of the equipment, which takes into account the technical parameters of the particular solution provided by the manufacturer. For example, in a two-section 5-storey house, serial number 464, with 2 staircases and 30 apartments in Riga about 2500 kWh of energy is consumed annually for common use, since there is no elevator and no pump station. While a single apartment consumes about 1200 kWh/year, all apartments together – 36000 kWh/year. In this case, when the roof is flat, 9 panels with a total area of 18 m² would be enough to cover the use of electricity in common areas. According to the manufacturer, the power of such a solar system would be 3.69 kW and it would produce more than enough electricity per year – 3 440 kWh. If the goal is to cover the entire electrical energy consumption of the building, 37 panels with a total area of 180 m² are required to provide 38500 kWh/year. Theoretically, there is enough roof area, however placing that many panels would make it difficult to maintain and clean the ventilation system, as well as access electrical cables and low-voltage networks. If the equipment is to be installed on the ground, one would have to consider the area of the available space, and how it is currently used as well as take into account pertinent safety requirements. It is worth noting that the calculations are made supposing that the panels are installed facing the south,

which is usually possible on a roof but can often be challenging on the ground, especially in densely built-up areas.

Similar calculations can be applied to an apartment building, which also has two sections, but corresponds to serial number 602, has 2 elevators, and 72 apartments in total. 10000 kWh are consumed annually in common use areas, while apartments use up 86400 kWh/year, provided that again we suppose that the average consumption is 1200 kWh/year per apartment. 25 panels with a total area of 48 m² would be enough to cover energy consumption in common use areas. The capacity of such a solar system would be 10.25 kW, and the amount of electricity produced per year would be 9.556 kWh – slightly less than required. To ensure that the entire electrical energy consumption of the building is covered, 236 solar panels with a total area of 251 m² would have to be installed. Although the roof on this type of building is also flat, the mass of the entire system would certainly form a considerable load, which should be taken into account and evaluated separately.

Households generating electricity from RES can reduce the cost of electricity and the variable part of the MPC. If the net electricity use during the monthly billing period was negative (the customer transferred more kWh to the distribution system operator than consumed), the accumulated net amount of electricity would be added to the following billing period as the electricity transferred to the electrical power network. On the other hand, if the net use was positive (the customer consumed more kWh than they transferred to the distribution system operator), the kWh accumulated in the previous billing period would be used to compensate it or an additional amount of electricity would be supplied from the power network.

3.2. Heat Pumps

A heat pump is a specialised piece of equipment that is used to produce heat and is subject to all energy-related laws. Like other types of heating systems, the heat pump has its distinct features. However, the laws of thermodynamics in this equipment work in the same way as in refrigerators and conditioning units used in households. The main aspect that differentiates heat pumps from other types of heating systems is that they use the energy of heat sources present in the environment, which is free, however, there must be a certain amount of energy at the input to initiate the thermodynamic cycle. A heat pump is considered efficient if the amount of input energy, usually electric, is smaller than the output energy, i.e., the heat that is produced by operating the equipment. A heat pump is heating equipment that uses solar energy stored in soil, water bodies, groundwater and air.

A heat pump system consists of a heat pump unit that stores heat and prepares hot water, a collector that collects heat from a heat source, and a system that transfers heat to the desired rooms. Currently, the most commonly used type of heat pump is the so-called phase-change heat pump, which operates by circulating freon, which has a

low boiling point, in a closed system. Freon can be in either liquid or gaseous state depending on the temperature and pressure.

Modern heat pumps use the latest technologies and materials, which significantly improve their efficiency. Heat pumps also utilize subcooling to lower the temperature before the expansion valve, and a compressor with a higher efficiency [7].

Freons with a low boiling point are used as refrigerants in heat pumps. The most commonly used ones are R404 and R407C as they do not contain chlorine, which is harmful to the environment. The heat required for evaporation is transferred from the heat collector. The cooled liquid is transferred to the utilised heat source (soil, groundwater, body of water, etc.) where it heats up again.

A heat pump diagram intended for heating (or cooling) and simultaneous production of domestic hot water (DHW) is presented in the patent of Mitsubishi Denki Kabushiki Kaisha (US4592206) in 1986. In this configuration, there are three types of heat exchangers: two internal air exchangers, one external air exchanger and a coil exchanger for the DHW production (Fig. 1) [8].

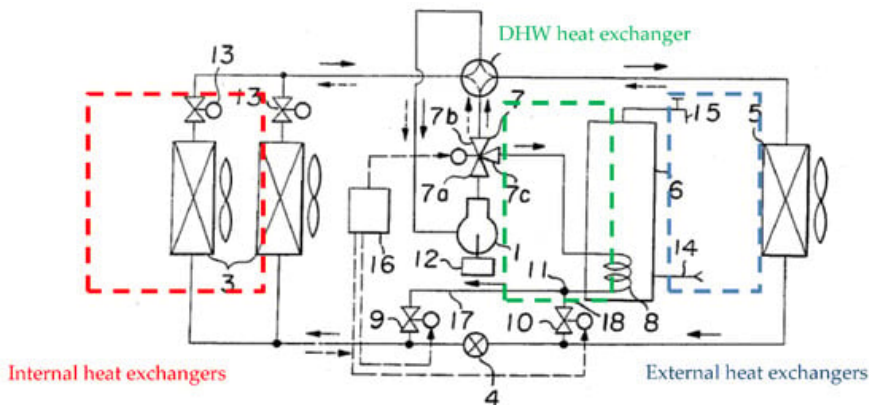


Fig. 1. Schematic diagram of the patent of Mitsubishi Denki Kabushiki Kaisha [8].

A three-way valve at the compressor outlet distributes the vapour, depending on the mode, to the DHW heat exchanger or to a four-way valve. The combination of the two valves allows one to switch between the different operating modes. There are four operating modes:

- Heating only mode (condensation in the internal exchangers and evaporation in the external air exchanger);
- Heating and DHW production mode (condensation in the internal exchangers as well as the coil and evaporation in the external air exchanger);
- Cooling only mode (condensation in the external air exchanger and evaporation in the internal exchangers);
- Cooling and DHW production mode (condensation in the coil and evaporation in the internal exchangers) [7].

The use of heat pumps is topical in the private housing sector in Latvia. There are multiple reasons for that. First, the growing utility bills; second, people have started to think about the environment, how they affect it and how they can protect it. Third, currently, Latvia imports a lot of energy resources. This issue has to be addressed to reduce imports and improve the economy of Latvia. It is not usual in Latvia for heat pumps to be used for the production of energy in heat plants.

3.3. SWOT Analysis

Latvia is facing a major challenge – the use of renewable energy resources in residential buildings holds great potential; however, before initiating any processes associated with the use of renewables, several aspects must be evaluated. The authors of the article have conducted a SWOT analysis, evaluating the strengths and weaknesses of RES.

Strengths:

1. A high share of RES in total energy production. The majority (over 99 %) of the energy resources produced in Latvia is RES – fuel wood, electricity from hydro and wind stations, biogas, straw, biodiesel, and bioethanol. RES play an important role in the production of electricity in Latvia.
2. The share of natural gas used in heat plants for the production of heat energy is less than 54 %, small amounts of oil products (3.8 %), coal (1.1 %) and peat (0.1 %) are also used. The use of woody biomass is in second place after natural gas – about 41 %.
3. The current tendency to use RES and its relatively high share in gross energy consumption [9].
4. The analysis of the situation reveals that the development of renewable energy communities cannot rely solely on citizen investments. Other financial instruments should also be utilised (including investment support programmes and low-interest loans).
5. The most effective incentive to promote the use of renewable resources is the grant programme that is currently implemented to support the reconstruction and increase of efficiency of district heating systems. Its success is indicated by the efficiency of this solution and the positive impact it has on the use of renewable energy. The state and local governments have at their disposal highly qualified specialists with experience in the areas related to the construction and maintenance of residential buildings. Owners of apartments in multi-apartment buildings have access to municipal and state co-financing

for the improvement of the building's energy efficiency.

6. The use of RES and the increase in their share in total energy consumption have a positive impact on the reduction of GHG emissions.
7. According to the Final Report of the Saeima Parliamentary Inquiry Committee on the objectives, impact, criteria for aid implementation, aid intensity, Decision of the European Commission of 24 April 2017 in Case SA.43140 (2015/NN), and damage and action by law enforcement institutions, Latvia's aim was to introduce and subsequently adjust state aid and support mechanisms for electricity producers (including state support programmes for the production of electricity from RES and its use in cogeneration plants).
8. In 2016, the gross energy consumption in Latvia was 184.5 PJ, which was only 0.3 % more than in 2015, while in 2017 it was 194.9 PJ, which was 5.5 % more than in 2016. From 2013 to 2017, the gross energy consumption did not change significantly, but the share of renewables meanwhile increased by 2.55 % [10].
9. Latvia's National Energy and Climate Plan defines the following goals for 2030 – promoting energy independence by increasing self-sufficiency of energy resources and integrating the EU power distribution networks, ensuring sustainable use of energy resources necessary for the development of the national economy, promoting the availability of resource markets, reducing industrial energy consumption and amount of emissions, as well as increasing the share of local renewables in the total amount of consumed energy, while offering competitive energy prices [11].

Weaknesses:

1. The low rate at which the implementation of RES in the electricity sector is developing. Most of the renewable energy – almost 95 % is produced by the cascade of hydroelectric power plants on the Daugava River, which have been operating for several decades, while the remaining part is produced by small hydroelectric power plants, wind power stations, biogas plants, biomass power plants and RES-fuelled CHP plants.
2. In 2017, gross electricity consumption in Latvia amounted to 7500 GWh – 3635 GWh were generated using RES, 873 GWh were imported, while 2992 GWh or almost 40 % of the electricity consumed in the country in 2017 was generated using natural gas. Approximately 80 % of heat energy in the district heating sector is produced by burning natural gas.
3. Flaws in the current RES policy. The current RES energy support scheme has proved to be inefficient, because, despite receiving one of the strongest supports from the EU, the consumption of green energy in Latvia has been growing slowly. Although Latvia has had a relatively wide range of support mechanisms for RES (especially in the electric power sector) for several years now, the share of renewables in gross energy consumption, electricity, and heat generation sector as well as in the transportation sector has been growing very slowly. Biofuel production incentives have aided the development of production sites; however, they have not affected local energy consumption.
4. Inefficient use of RES. The efficiency of a heating plant producing heat energy is less than 80%. Since the efficiency of a natural gas power plant is 92–95 %,

and that of a solid fuel power plant is 85–88%, it can be concluded that fuel, including renewable fuelwood, is still used inefficiently in Latvia. There are no statistics available on the efficiency of fuel use in households as well as commercial and public sectors, but it is unlikely that it would be higher than the aforementioned indicators. Considering that many households still use stove heating or wood-burning boilers, the efficiency is estimated to be lower than in district heating plants.

5. Limitations on the development of cogeneration. Cogeneration is efficient in terms of primary energy use. However, in Latvia, its development is hindered by the seasonality of efficient use of the generated heat, as well as the lack of a substantial industrial heat load.
6. Many homeowners are unwilling or do not have the means to restore hazardous and unsafe buildings. Some apartment buildings are in poor technical condition.

Opportunities:

1. Increasing the share of RES in the total energy consumption. Latvia aims to increase the share of renewable energy in the total gross final energy consumption to at least 40 % and to continue gradually increasing it in the future.
2. Using RES more efficiently. By introducing modern technologies that are compatible with RES, especially in the production of heat energy, it is possible to achieve a more efficient use of these resources.
3. Developing and producing technologies in Latvia. Currently, a relatively small number of power generation equipment is produced locally. Usually, projects that implement the use of RES, utilize imported equipment; therefore, the gov-

ernment should consider providing support to local equipment manufacturers, as this would promote employment and reduce imports.

4. Having a purposeful state aid. It should be carefully considered which renewables to focus on, as it determines the potential state aid programmes that could be implemented. The requirements of the Law on Residential Properties are partly related to the discrepancies between solar panel owners and energy consumers. Households that obtain electricity from solar panels, can store the excess energy by transferring it to the distribution system operator “Sadales tīkls” according to the net metering principles. In the off-season, for example, during winter, when the efficiency of solar panels is lower, households can use up the previously produced and stored electricity, covering only the costs of the distribution service. However, at this moment this model only applies to individual customers using solar panel solutions. In a multi-apartment building, where each apartment has its own commercial energy metering system, the energy generated from solar panels installed on the shared roof must be used immediately. It is intended for all residents of the building and covers only the electricity consumption in common use areas. For this group of customers, the option of transferring the generated energy to the power network and getting it back later is not available. This creates unequal conditions, which the Saeima intends to address by proposing amendments to the Energy Law and including the notion of energy community in it, similar to that in Estonia.
5. According to the European Commission’s proposal, the main objectives

for years 2030 and 2050 in the building renovation sector are decarbonisation and the integration of renewables. Renovation of buildings should accelerate the integration of renewables, in particular the local ones, and promote a wider use of waste heat. Moreover, it should help integrate energy systems at local and regional levels and thus decarbonise the transportation sector as well as the heating and cooling sector [9].

Threats:

1. Improper use of RES – soil depletion, deforestation. The tendency to use biomass and biogas for energy production brings up the issue of sustainability of raw materials, and the impact that exploiting forests and agricultural land has on the environment and the living conditions.
2. Ill-considered state aid – excessive support/double support. For example, certain initiatives (i.e., using renewable energy sources to generate electricity) can simultaneously receive two types of support – in the form of mandatory procurement of electricity (the costs of which are covered by electricity consumers) as well as in the form of financing from the EU funds and other support instruments. The mandatory electricity procurement allows for escalation of purchase prices since this purchase price is determined by using formulas linked to the price of natural gas or certain coefficients. Thus, the purchase price of electricity exceeds the electricity exchange price several times and is also significantly higher than the final tariff for consumers.
3. Only a small number of merchants benefit, not the whole population. Some support programmes benefit only a small number of merchants, as they

receive income from mandatory procurement programmes and/or financial aid, while the support provided to society as a whole is negligible – the amount of electricity produced is small, there is only a small increase in employment or no increase at all, and besides, the equipment and spare parts thereof are imported. There is no clear vision or policy on goals in the housing sector, which is characterised by:

- deterioration of residential buildings built during the Soviet era;
- population decline;
- rising construction, renovation, and real estate development costs as a result of price harmonisation across European markets;
- tax law changes;
- poor quality construction, and skilled labour shortage;
- apartment owners experiencing financial distress, resulting in an increase in debt.

If solar panels are to be installed on an existing building, the technical condition of this building plays a crucial role in the entire process of implementing the RES. Therefore, it is important to carry out an initial building survey and evaluation, to be able to successfully choose and install suitable solar panels. A personalised technical and financial evaluation must be carried out before the installation of solar panels and/or heat pumps. When choosing solar panels, one should consider not only the monthly costs but also the cost of one kilowatt of power compared to other solar panel systems with the same total area.

To evaluate the costs and benefits of this investment, the amount of annual electricity consumption should be determined before solar panel installation. If the average monthly electricity consumption is

below 300 kWh, there is a relatively high chance that the solar panels will not pay off or pay off rather slowly. When installing solar panels, it is particularly important to know the annual consumption. During the sunniest months of the year, solar panels should produce enough electricity to cover all electricity needs and compensate for the winter months when the sun shines much less. Solar panels typically pay off in 6–7 years, and last for 25–30 years.

Professional management and supervision from the beginning to the end shall be ensured for such projects.

To promote faster implementation of renewable energy resources in Latvia, on

1 March 2022, the Cabinet of Ministers adopted Regulations No. 150 “Regulations of the Open Tender “Reduction of Greenhouse Gas Emissions in Households – Support for the Use of Renewable Energy Resources” of Projects Financed by the Emission Quota Auction Instrument”. The objective is to reduce greenhouse gas emissions and improve energy efficiency in households by supporting the purchase of new heat energy or electricity-generating equipment to produce power for household needs, or the connection of households to the district heating system [13].

4. CONCLUSION

The potential of renewables is not to reduce energy consumption but rather to provide energy with a lower environmental impact. RES has great potential in Latvia, but it has not been fully exploited yet. The factors that have impeded the use of RES are inadequate planning, insufficient knowledge, and restricted access to the latest technologies. In addition, the use of renewable energy resources is hampered by socio-economic factors, such as the proximity to Russia’s abundant fossil fuel resources, which a few years ago were available to Latvia at very low prices. It is worth noting that local coastlines are technically suitable for the development of wind energy generation and in Latvian conditions wood chips and shavings are considered to be the cheapest types of fuel.

The government has adopted a state support programme to reduce and compensate the costs of energy for the population of Latvia during the rise in energy prices. The state grants support to those transitioning from existing heating equipment that utilises fossil energy sources (natural gas, coal, diesel) to new heating equipment that utilises renewables (biomass pellet boilers, solar panels, heat pumps) and those purchasing new renewable energy equipment (solar panels, wind generators) to produce electricity (regardless of the currently employed heating system). This decision is also a step towards energy independence. This will increase the power output of renewable energy resources and provide citizens with the support they need to reduce the electricity and heating bills in the long term.

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