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## SUNRISE Project

*Needs assessment of homeowner associations (HOAs) and homeowners for implementation of smaller RE measures in Lithuania*

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## **1. Executive summary**

This assessment aims to determine the needs and demands, and financial potential of the HOA's for implementation of smaller RE measures.

Lithuania has committed and already made significant progress in achieving a climate-neutral economy by 2050, with a strong emphasis on transitioning to renewable energy sources (RES). However, the study highlights some legal and regulatory barriers hindering more rapid and large-scale implementation of renewable energy measures in Lithuania.

Multi-family buildings, representing almost 50% of dwellings in Lithuania, present both opportunities and challenges for implementing smaller RE measures. Most of these buildings need energy renovations creating a need for energy-efficiency upgrades and smaller RE solutions like solar water heaters or heat pumps. However, decision-making for energy renovations in multi-family buildings is complicated while reaching consensus among multiple owners and navigating legal requirements can be challenging.

Lithuanian homeowners may have existing and future demands for smaller RE measures, driven by the desire for lower energy bills, reduced environmental impact, and increased property value. Factors deterring homeowners from adopting RE include economic factors, lack of accessible information, and policy and regulatory challenges. Upfront costs associated with renewable energy technologies can be prohibitive, and there is a lack of awareness regarding potential financial incentives and subsidies. Complex permitting processes and grid infrastructure limitations further complicate project implementation.

Interview results indicate that while general awareness of RES is growing, specific knowledge of technologies, technical parameters, and cost-effectiveness is lacking. Targeted information and training are needed, particularly for HOA chairs, who can then disseminate information to homeowners. Financial benefits are the primary motivator for homeowners to invest in RES, especially reducing energy costs. However, the relatively low cost of electricity for general building needs can make it difficult to convince residents of the value of such investments without state support. State support is crucial but must be easily accessible with a simple procedure.

Addressing these challenges requires a comprehensive approach involving grid infrastructure improvements, streamlined administrative procedures, clear and consistent policies, and effective communication and collaboration among stakeholders.

## **2. Introduction**

The legal acts and historic trend highlight Lithuania's commitment to achieving a climate-neutral economy by 2050, with a strong emphasis on transitioning to renewable energy sources (RES) (Lithuanian Ministry of Energy, 2018). Lithuania had heavily relied on imported energy sources, primarily oil and natural gas, making it vulnerable to price fluctuations and geopolitical risks. This dependence has spurred the country to prioritize energy independence through the development of RES.

According to Lithuania ministry of Energy, over the last three years, Lithuania has seen a threefold jump in green energy growth. The installed capacity of wind and solar power plants has exceeded 3 GW, and today the country's total energy production already accounts for almost half of the country's electricity consumption (LR energetikos ministerija, 2024).

A clear energy direction and investment from the European Union have led to a significant breakthrough, with €276 million allocated in 2023 alone for solar power plants, boiler replacements, private charging stations for electric vehicles, storage tanks and other projects. €1.3 billion has been earmarked for

companies and communities in 2024, and €175 million for energy self-sufficiency for citizens (LR energetikos ministerija, 2024). Currently available and upcoming support measures are as follows (APVA, 2024):

- Developing individual energy storage solutions for electricity generators;
- Implementation of energy efficiency measures by private legal entities;
- Renovation/modernisation of multi-family buildings;
- Modernisation of domestic heating and hot water systems in multi-family buildings (mini-renovation);
- Installation of solar power plants on households and electricity consumption in the Capital Region by natural persons (for increasing the capacity of an existing power plant);
- Installation and development of publicly accessible charging infrastructure for electric vehicles on a private initiative (in municipalities that have not prepared urban mobility plans, along arterial and national roads, as well as at petrol stations, railway and bus stations, airports, inland waterways and seaports.

While Lithuania has made significant progress in increasing the share of RES in its energy mix, particularly in electricity generation, there is still a long way to go. In 2023, the share of RES in total final energy consumption was 32.2% (Viešoji įstaiga Lietuvos energetikos agentūra, 2024). This was mainly driven by the share of RES in the heating sector, which was 54.3%, the share of RES in electricity generation, which was 36.2%, and the share of RES in the transport sector, which was 7.2% (Viešoji įstaiga Lietuvos energetikos agentūra, 2024). However, this is still a small portion of the total energy consumed in Lithuania.

A key obstacle identified is the limited public understanding of the concept of a climate-neutral society and the benefits of RES (Pažėraitė et al., 2021). Many citizens perceive innovative climate-neutral solutions as expensive and unreliable. This perception can hinder the widespread adoption of RES. For example, 63% of Lithuanians in a survey, made by Lithuanian energy institute, indicated they would not be willing to pay more for electricity generated from RES.

Nevertheless, Lithuania has ambitious goals for a green future of its energy sector, with specific targets and initiatives aimed at increasing the adoption of RES (Lithuanian Ministry of Energy, 2018):

- **100% Climate-Neutral Energy:** The goal is to transition to 100% climate-neutral energy sources by 2050. This will involve a significant increase in the use of RES, including wind, solar, and biomass.
- **Focus on Electrification:** With electricity becoming the primary energy source in the future energy system, its consumption is projected to increase from 12 TWh to 74 TWh by 2050. This will require a substantial expansion of RES-based electricity generation.
- **Offshore Wind Energy:** Lithuania aims to develop 4.5 GW of offshore wind farms in the Baltic Sea by 2050. This ambitious project will contribute significantly to achieving climate-neutral energy goals and could position Lithuania as a regional energy exporter.
- **Green Hydrogen:** Recognizing the potential of green hydrogen, Lithuania plans to install 8.5 GW of electrolysis capacity by 2030, capable of producing 732,000 tons of green hydrogen annually. The aim is to use green hydrogen in the energy sector to balance fluctuations in RES generation and potentially export it to neighboring countries.
- **District Heating Transformation:** While Lithuania has made progress in transitioning its district heating (DH) sector towards biomass, future plans include diversifying the energy mix with RES-

based solutions like solar thermal and large-scale heat pumps. This will further reduce the reliance on fossil fuels in DH.

- **Small Nuclear Power:** The sources also explore the potential role of small modular reactors (SMRs) in ensuring a stable electricity supply alongside RES. This suggests that nuclear power could be considered as part of a broader strategy to achieve energy independence and climate neutrality.
- **Engaging the Public:** Recognizing the importance of public support for the successful implementation of these plans, the sources emphasize the need for proactive and interactive communication strategies to educate and engage the public. Initiatives to encourage community energy projects and empower active consumers are also highlighted.

The regulatory environment sets down a clear picture of Lithuania's commitment to a sustainable energy future powered by RES. The future ambition emphasizes a comprehensive approach involving technological advancements, infrastructure development, policy support, and public engagement. Successfully navigating these interconnected aspects will be crucial for Lithuania to achieve its ambitious energy goals and establish itself as a leader in the transition towards a climate-neutral economy.

### 3. Background and context

Multi-family buildings represent a substantial portion of Lithuania's housing stock, accounting for almost 50% of all dwellings. This makes them a significant segment within the country's residential building sector. A majority of these multi-apartment buildings have not undergone energy renovations. This implies that a large portion of the multi-family housing stock likely exhibits poor energy performance.

A significant portion of Lithuanian buildings, including multi-family units, were constructed during the Soviet period. These buildings are characterized by poor insulation and limited consideration for energy efficiency, resulting in higher energy consumption and associated costs for residents. A considerable number of multi-family buildings in Lithuania are connected to district heating networks. This interconnectedness offers opportunities for implementing energy efficiency upgrades and integrating renewable energy sources at a larger scale. However, it also presents challenges, as discussed in our conversation history, regarding homeowner autonomy and flexibility in choosing energy sources.

Multi-family buildings consist of privately owned apartments and the common use spaces are of joint ownership. Some of the multi-family buildings have established homeowner associations. All that complicates decision-making processes for energy renovations. Reaching consensus among multiple owners, navigating legal requirements for approvals, and distributing costs can be challenging.

The RenOnBill (Residential building energy renovations with on-bill financing) project explored the attractiveness of investments towards deep energy renovations of residential buildings by promoting the development and implementation of on-bill schemes, based on the cooperation between energy utilities and financial institutions (RenOnBill, 2022).

The project results show that Lithuania exhibits a strong potential for RenOnBill schemes within the owner-occupied multi-family housing segment. This is largely due to governmental support for renovating these buildings, their prevalence, and the considerable need for energy efficiency improvements in this sector.

The emphasis on multi-family buildings in Lithuania mirrors similar trends observed in Germany and Italy, where these structures are also seen as key target segments. However, it's important to acknowledge some limitations faced by district heating utilities, which are widespread in Lithuania. These utilities are

not interested in offering energy efficiency services, potentially affecting the feasibility of RenOnBill schemes in buildings reliant on district heating.

The results also highlight the sensitivity of costs when implementing any new solution. As more than a half of Lithuanians surveyed would not agree to pay more for electricity from renewable energy sources, this suggests a potential sensitivity to increased costs, which could translate into reluctance to participate in RenOnBill schemes if perceived as financially burdensome. Moreover, a general perception that innovative, climate-neutral solutions are often seen as more expensive and less reliable. This perception could extend to RenOnBill schemes, particularly if they are perceived as complex or untested. This underlines the need for clear communication and education efforts to address these concerns and build trust in the reliability and affordability of these schemes. This suggests that a lack of awareness and understanding among end-users could be a significant barrier to participation. People need clear and accessible information about the benefits, costs, and processes involved in these schemes to make informed decisions.

If to focus on barriers to solar energy development in Lithuania, it can be identified “shortcomings in informing and lack of public and institutional awareness” as a significant obstacle (Pažėraitė & Brandišauskas, 2022). While this source primarily addresses solar energy, the findings could also apply to other RES, implying that homeowners might not have access to sufficient information about the benefits and practicalities of implementing renewable energy measures. On the other hand, these associations could act as intermediaries, disseminating information about RES benefits and encouraging collective action among homeowners. Creating attractive financial incentives and reducing investment risks can encourage greater private sector participation in renewable energy projects.

The findings of RenOnBill project adds that master servicers, potentially acting in collaboration with homeowners’ associations, could contribute significantly to promoting energy renovations, including those involving RES, by providing comprehensive services, including management, financing, and information dissemination.

### **3.1 Needs and Demands of Lithuanian Homeowners for Smaller RE Measures**

The sources suggest that Lithuanian homeowners may have both existing needs and potential future demands for implementing smaller renewable energy (RE) measures. These are shaped by the specific context of Lithuania’s energy landscape, including the prevalence of district heating, potential interest in solar energy, and existing barriers to wider RE adoption.

As a significant portion of Lithuania’s housing stock requires energy-efficiency upgrades. Homeowners likely need solutions to reduce energy consumption, lower heating costs, and enhance their living comfort. Smaller RE measures, such as solar water heaters or heat pumps, solar PVs could contribute to meeting this need. While district heating is common in Lithuania, it can limit individual choices regarding energy sources. Some homeowners might seek greater energy independence and control over their heating systems, creating a potential need for smaller RE solutions that complement or partially replace district heating. However, this does not prevent the expansion of solar PVs. Lithuanian homeowners, like those in other countries, might need access to affordable and reliable smaller RE technologies that fit their budgets and housing types. This includes readily available information, trustworthy installers, and financing options that make these technologies more accessible.

As information and awareness campaigns become more effective, homeowners could increasingly demand smaller RE solutions driven by a desire for lower energy bills, reduced environmental impact, and increased property value.

Barriers related to spatial planning, permitting, and grid connection can deter homeowners from adopting RE. As the government and municipalities streamline these processes, homeowners are likely to demand easier pathways to implement smaller RE measures. Moreover, when homeowners' associations gain more knowledge and resources related to RE, homeowner demand for their support in implementing smaller RE measures within multi-family dwellings could increase.

Given Lithuania's climate, solar water heaters could be an attractive solution to supplement existing heating systems or provide hot water during warmer months, potentially reducing reliance on district heating for some homeowners.

Heat pumps offer efficient heating and cooling and can be suitable for various housing types. As energy prices fluctuate, homeowners might increasingly demand heat pumps to reduce their reliance on fossil fuel-based heating systems.

With the decreasing costs of solar PV technology and potential policy support, demand for smaller rooftop solar systems could rise among multi-family homeowners seeking to generate their own electricity and reduce energy bills. According to the Energy Distribution Operator, 64000 generating consumers install solar power plants on the same or an adjacent plot of land, usually on the roof of a building. They have an installed generating capacity of 895 megawatts (MW). The remaining 36000 generating customers are customers of remote solar parks with an installed capacity of 220 MW and a generating capacity exceeding 1 GW. It is important to note that the vast majority of generating consumers who install rooftop solar PV do so on the roofs of individual houses.

### **3.2 Obstacles to Widespread Renewable Energy Adoption in Lithuania: An End-User Perspective**

Some sources highlight the **significant influence of economic factors** on consumer choices regarding innovative solutions, particularly in the energy sector (Pažėraitė et al., 2021; Repovienė & Pažėraitė, 2023). This price sensitivity can create a barrier to renewable energy adoption, as the upfront costs associated with technologies like solar panels can be perceived as prohibitive, especially when compared to seemingly cheaper traditional energy sources. This suggests a strong emphasis on immediate cost savings, potentially overshadowing the long-term economic and environmental benefits of renewable energy options. The **high upfront investment costs and potentially lengthy payback periods** associated with renewable energy technologies can deter individual consumers and communities from adopting them.

The lack of accessible information regarding **potential financial incentives, subsidies, or innovative financing mechanisms** for renewable energy projects further exacerbates this economic barrier. This information gap prevents consumers from fully understanding the economic viability and potential cost savings associated with renewable energy in the long run. Financial institutions may act more actively in this regard if creating attractive financial incentives and reducing investment risks can encourage greater private sector participation in renewable energy projects.

One more very important thing is the **critical role of information accessibility and public awareness** in promoting sustainable practices, including renewable energy adoption. Deficiencies in these areas create a significant obstacle for the general public to make informed decisions and embrace renewable energy solutions. Easily accessible and comprehensible information may add to homeowners' ability to evaluate the potential benefits of renewable energy development options. Therefore, it underscores the importance of providing comprehensive and readily accessible information from trusted sources, such as official institutions and online media, to encourage pro-environmental behavior.

**Policy and regulatory challenges** act as significant barriers to both solar energy development and broader renewable energy adoption in Lithuania. These challenges create uncertainty, increase administrative burdens, and can discourage investment in renewable energy projects. **Complex and lengthy permitting, licensing, and approval processes** are seen as significant obstacles for solar energy project developers. This administrative burden, coupled with **restrictive spatial planning and zoning rules**, further complicates project implementation and discourages investment. On the other hand, financial institutions express **limited will for adoption of innovative financing mechanisms for renewable energy projects** in Lithuania, indicating a potential regulatory gap that could hinder the growth of the sector.

It is worth noting the crucial role of **robust grid infrastructure** in supporting the large-scale integration of renewable energy sources. Existing grid limitations in Lithuania present a technical and economic barrier to widespread renewable energy adoption. The existing grid struggles to accommodate the fluctuating nature of solar energy, leading to **constraints in connecting new solar power plants**.

These grid infrastructure limitations create a bottleneck for wider renewable energy implementation, as the lack of sufficient capacity and unclear regulatory frameworks discourage investment and slow down the transition to a cleaner energy system.

**Individual consumers often perceive themselves as having limited responsibility for environmental issues**, attributing the primary responsibility to institutions and companies. This perception can create a barrier to proactive engagement in sustainable practices, including adopting renewable energy solutions. The reliance on **traditional energy sources** and the perceived **convenience of existing energy systems** might contribute to a reluctance to embrace new and potentially disruptive renewable energy technologies.

There are generational differences in the types of information that motivate action toward climate neutrality. The reason lays in the fact that different generations focus on different values. The study made for Twin-Peaks project (TWINning for Promoting Excellence, Ability and Knowledge to develop advanced waste gasification Solutions) identifies that **Gen Z prioritizes emotional/social elements, while Gen Y and Gen X focus on economic elements**. Functional value elements play a supplementary role for all three. For example, **Gen Z**: Might be motivated by messages emphasizing the positive social impact of their actions. **Gen Y and Gen X**: Might respond better to arguments about cost savings or financial incentives.

The sources (Grigaliūnaitė et al., 2023) offer additional insights into consumer behavior that go beyond generational differences. Fear appeals can be interesting, but joy appeals have a greater impact on attitudes and the desire to act. This suggests that positive messaging may be more effective than negative messaging. People need to be educated and engaged. Providing clear, factual information about the benefits of innovative solutions is essential. It's not enough to just provide information; communication needs to be proactive and interactive. This could involve using social media, online forums, or other platforms that allow for two-way communication. The benefits and needs of individuals should be at the core of communication. People are more likely to take action if they feel that they will personally benefit from it.

Overcoming these barriers requires a comprehensive approach that addresses the economic, informational, regulatory, and infrastructural challenges hindering renewable energy adoption in Lithuania. Clear and consistent policy support, improved information dissemination, innovative financing mechanisms, grid modernization, and targeted efforts to shift public perception and encourage proactive

engagement are crucial for achieving a faster and more widespread implementation of renewable energy measures in Lithuania.

#### **4. Methodology of the assessment**

Benefits of the Renewable Energy (solar) measures, RE measures needs and demands, HOA's financial potential, and Awareness of RE financial products and services available on the market will be explored applying a qualitative approach. Experience from previous projects has shown that semi structured interviews are the most effective way to collect data. The reason for this is the low level of engagement of Lithuanian homeowners with the subject of the study. Therefore, knowledge saturation would be ensured primarily through a combination of analysis of secondary data and interview results. As the interview method is understood as a qualitative research method, there are no strict requirements regarding the sample size. Some authors (Grisham, 2009) believe that a proper number of participants (Mullen, 2003) could be as few as 3 or as large as 80. Most authors indicate that such research should include no less than three participants (Libby and Blashfield, 1978). Considering the specificity of the object of the study, it is expected to have at least 5-7 interviews with HOA's representatives and homeowners or until saturation of knowledge will be reached. This figure also includes experts in renovation and its management. The final number of 8 interviewees was distributed as follows: 5 HOA's representatives and homeowners and 3 experts in renovation and its management.

The personal data of all interviewees has been anonymised so that it is not possible to identify them now or at any time in the future. In addition, all interviewees have been informed of the possibility of the interview stopping at any time.

The interview questionnaires were designed in line with the requirements of the contract and the needs expressed during the discussions with the client. The following interview questions have been translated into English as the interviews were conducted in the informants' native language, Lithuanian. The questions are following:

##### **Generic questions:**

1. What is your opinion on the knowledge of the HOA and homeowners about the benefits of renewable energy measures?
2. In your opinion, what are the needs and preferences of HOAs and homeowners in relation to renewable energy measures?
3. What is your opinion on the ability of HOAs and homeowners to finance the installation of renewable energy measures themselves?
4. What is your opinion on the knowledge of HOAs and homeowners about the financing solutions available on the market for renewable energy measures?

##### **The following questions are related to solar PV:**

5. Are households/households willing to invest in plug-in PV on their balconies to reduce electricity costs and to what extent?
6. Are households and/or HOAs willing to invest in plug-in PV on the shared areas of the apartment building to reduce electricity costs?
7. If the state/municipality provides a subsidy for grid-connected plug-in PV, are households willing to apply for support/subsidy?
8. If there is an appropriate bank loan product available on the financial market, are households and/or HOAs willing to take out a loan?

9. Would households be willing to surplus electricity for free?
10. Is there anything worth to add what was not asked?

The biggest limitation has been time, as it is difficult to reach the right people and arrange the right time. Nevertheless, the required minimum number of informants and knowledge saturation were achieved.

## 5. Findings

Analysis of the results are presented by question and by informants' affiliation to one of the two groups.

### ***What is your opinion on the knowledge of the HOA and homeowners about the benefits of renewable energy measures?***

All informants agree that information on RES is available and spread across many different narratives *“Green technology is “trendy” today, and most people living in multi-family housing have heard about it.”* However, there are some important points to note. First, people must accept the information provided. In this respect, most people agree that it is worth starting with HOA chairs, who would be provided with training and detailed information on the cost-effectiveness of RES solutions and the functional applicability to multi-family buildings *“<...> specific knowledge of specific technologies, their technical and economic parameters, is severely lacking. It takes effort and time for an HOA chair to gather specific information.”* Several informants also mentioned that the interest of the general audience may also depend on age, as younger people are more inclined to innovate.

This common opinion expressed by the informants is well known and is one of the reasons why Kaunas City Municipality has established a body dedicated to the preparation and dissemination of targeted information. The target audience chosen is HOA chairs.

### ***In your opinion, what are the needs and preferences of HOAs and homeowners in relation to renewable energy measures?***

In response to this question, half of the informants pointed to financial benefits as the first and main incentive to install a RES measure *“<...> the main need is to reduce energy costs.”* Moreover, given that the cost of electricity for the general needs of the building per apartment is relatively low *“<...>3-5 euro per apartment” <...> “residents would simply not understand the point of such an investment and would not approve of it.”* Investment in solar PV is considered when state support is available. Several informants mentioned that state support should not only be accessible, but also that it should be a remarkably simple procedure.

One informant pointed out that, for example, balcony solar PV could be considered with support, but primarily for those living in single-family houses. This view is driven by the experience of the complexity of collective decision making *“In our building of 100 flats, it was hard enough to get that many people to agree to renovate a building that was clearly falling apart, so it would be difficult to persuade people to take up solar PV for a non-refundable price.”*

Another important aspect is the current state of the electrical wiring in the multi-family building. Unrenovated houses are usually in poor condition. Even renovated houses may have problems with the installation of solar energy or other RES measures because they were not considered during the renovation *“<...> the first step is to find out how safe and reliable it is to install solar power plants in multi-family buildings.”*

***What is your opinion on the ability of HOAs and homeowners to finance the installation of renewable energy measures themselves?***

Most informants believe that without state support there will not be sufficient incentive to invest in RES in multi-apartment buildings that have already been renovated or are not being considered for renovation. As one informant said: *“There is little incentive to carry out projects on your own.”* On the contrary, personal initiative and willingness to invest is much more widespread among owners of individual houses. This is reasonable, because *“If we are talking about individual household solutions, those individual options are a little bit better, but of course it's higher income people.”* In the case of multi-family buildings, when the choice is made to carry out a deep high-class renovation, only then is solar PV included in the project as a necessity. However, this is still not the dominant renovation method. So far, only state support is available for the deployment of RES measures in a multi-family building. Municipalities do not provide support and are not yet considering it. As the HOA professional chair pointed out, *“there is no municipal support for solar PV development, and I have heard of the Environment Project Management Agency program, but it is not popular due to lack of support funds.”* When discussing the possibility for associations of owners of multi-family buildings and homeowners to self-finance the installation of renewable energy measures, several informants repeatedly stressed the importance of clarity of the conditions and the ease of applying for a permission and/or support.

***What is your opinion on the knowledge of HOAs and homeowners about the financing solutions available on the market for renewable energy measures?***

In response to the above question, the views expressed by the informants were divided into two trends. One direction clearly identifies a difference in the amount of information available to individual homeowners, which is higher. Also, the informants' discussion on this topic highlighted the much greater proactivity of individual homeowners in their ability to seek information, even if it is not particularly convenient and easily accessible. As one of the informants pointed out *“Whoever is interested finds it.”*

On the other hand, owners of multi-family buildings are strongly discouraged from taking any individual initiative to install their own personal solar PV on the roof of a shared building because any such action requires the consent of the majority of the building's co-owners. The latter is difficult and time-consuming to obtain. This is illustrated by the words of one of the informants quoted above that *“In our building of 100 flats, it was hard enough to get that many people to agree to renovate a building that was clearly falling apart, so it would be difficult to persuade people to take up solar PV for a non-refundable price.”*

It is clear from the answers given by the informants that widespread but more general knowledge is not sufficient for decision-making for those who see a change in the current situation as an additional challenge that is unclear whether it will be valuable.

***Are households/households willing to invest in plug-in PV on their balconies to reduce electricity costs and to what extent?***

In response to this question on balcony solar PV, informants mentioned functional, economic and consensus aspects. The latter echoes the previously expressed lack of optimism about a breakthrough in deployment, which is based on the need for consensus and the low probability of deploying a solution when a full deep renovation of the building is not carried out *“Most people won't lift a finger for the idea of “going green.” There may be one or two people who care, but it doesn't have a chance to be approved in a*

*houseowners meeting.*” It is important to note that the pessimistic view of individual solutions in a multi-family building is also due to the fact that such changes to the façade of the building also require the permission of the city's architect.

Importantly, even if the bureaucratic side of the decision is easy to resolve, it is necessary to prove the return on investment. An informant with an expert opinion thought that an attractive investment to start considering could be in the range of €200-300 per balcony. In addition, electricity in Lithuania is currently relatively cheap and is expected to get cheaper, mainly due to the development of RES. This further reduces the interest of the population, coupled with all the decision-making and deployment difficulties.

On the functional side, it should be noted that balcony solar PV may only be relevant for households with balconies that are not north-facing.

***Are households and/or HOAs willing to invest in plug-in PV on the shared areas of the apartment building to reduce electricity costs?***

According to the informants, solar plug-in PV are most likely to be installed on the roofs of houses in deep renovation projects, after convincing households in multi-family buildings of the financial benefits of reducing electricity bills. Balcony solar PV is unlikely to be attractive for the reasons mentioned above. It should also be kept in mind that the useful roof area will be shared between the ventilation system with heat pump ducts and the plug-in PV, which is not considered among the priority things.

One informant pointed to public behaviour which shows that *“The best advertisement is an installed system in your neighbours' homes. Successful projects are highly visible to neighbours. With the addition of information on the obvious economic benefits, we can expect serious expansion.”* This suggests that, given the obvious economic benefits and simple procedures for obtaining support and installing solar PV, pilot projects would have a significant impact.

***If the state/municipality provides a subsidy for grid-connected PV plug-in PV, are households willing to apply for support/subsidy?***

The vast majority of informants noted that the intention to use the support depends very much on the level of support and the level of bureaucracy involved *“In a big house, we can only reach an agreement with a lot of support and noticeably clear benefits. People are not against innovative technologies, but the benefits must be obvious.”* One of the informants supports his opinion with the example that *“<...> state support for charging stations for electric vehicles is now 80%. With such support we can expect interest. With less, it is unlikely.”* The conditions for granting support are also very important. However, *“A subsidy is in any case more attractive and more reliable than a loan, because older people are very scared by all kinds of Euribor rates and if you have to negotiate a loan with a multi-family community, it is potentially a big hassle.”* Another informant points out that both the attractiveness of the level of support and the intention to take a decision based on it should be analysed on a broader scale. This is reasonable, as experience shows significant differences in opinions of HOAs with regard to the condition of the building, the demographics of the population, the city, the region, etc.

***If there is an appropriate bank loan product available on the financial market, are households and/or HOAs willing to take out a loan?***

In response to the above question, many informants emphasised that people in Lithuania, especially older ones, are not willing to take out loans. It would be even more difficult to persuade people who already have a loan (housing, car etc.) to take out another loan. One informant mentioned that *“Our multi-family building is undergoing a deep renovation project, and the owners of those apartments who already have a loan to buy an apartment have been very careful to calculate the size of the renovation loan for their apartments and how it will affect their family budget.”* The attractiveness of the loan would be enhanced by the obvious economic benefits of the investment, the simplicity of the conditions, the fact that the loan is not made through a bank but through a government agency, and the absence of a requirement to mortgage the property.

**Would households be willing to give surplus electricity for free?**

Informants felt that simply giving away surplus electricity for free would not be seen as attractive. Unless the attractiveness of the project is obvious (support, economic benefits, ease of installation and maintenance, etc.) and one of the conditions is the giving away of surplus electricity. Only then would it be acceptable *“It would not be difficult to give away surplus electricity for free if the project itself is economically viable.”*

**Is there anything worth to add what was not asked?**

In response to the last question, 6 informants gave their views, which can be summarised in the following main points:

- The most important thing for the development of this idea is the bureaucratic requirements that will have to be faced in developing these solutions;
- The attractiveness of such solar power plants depends directly on the price of electricity. *“If the projects can be carried out, even with significant state support, but only reduce people's monthly electricity bills by a few euros, it is not worth”*;
- It's worth considering renting the roof of your building to solar electricity producers. The HOA would buy the electricity it needs, and the rest would be at the disposal of the generator;
- Communication on such projects needs to be particularly well designed and carried out through audience-tailored tools and clear messages;
- In addition to solar PV, such a project should also consider the installation of electrical storage.

This should be interesting, but the solutions must in any case be based on economic benefits.

Here is a summary table of the interview results regarding the needs and demands of HOAs for the implementation of smaller RE measures in Lithuania:

Category	Key Findings
Knowledge & Awareness	General awareness of RES is growing, but specific knowledge of technologies, technical parameters, and cost-effectiveness is lacking.
Motivations & Needs	Financial benefits are the primary motivator, especially reducing energy costs. Need for state support to make investments viable. Interest may depend on age, with younger people more inclined to innovate.
Financial Capacity & Support	Without state support, there is insufficient incentive to invest in RES in multi-apartment buildings. Personal initiative is more widespread among owners of individual houses.

	State support should be easily accessible with a simple procedure.
Financing Solutions	General knowledge is insufficient for decision-making. People, especially older ones, are generally unwilling to take out loans.
Barriers & Challenges	Complexity of collective decision-making in multi-family buildings. Poor condition of electrical wiring in unrenovated buildings. Bureaucratic requirements and the need for consensus.
Solar PV Specifics	Balcony solar PV may only be relevant for households with balconies that are not north-facing. Solar plug-in PV is most likely to be installed on roofs of houses in deep renovation projects. Giving away surplus electricity for free is not seen as attractive unless the project is economically viable, supported, and easy to install and maintain.

According to the interview results, economic benefits, availability of support, low administrative burden, targeted information and education, and a good living example are crucial for the expansion of solar PV solutions. Pilot projects demonstrating clear economic benefits and simple procedures for obtaining support and installing solar PV could also have a significant impact.

**6. Conclusions and recommendations**

Lithuania is committed to achieving a climate-neutral economy by 2050, with a strong emphasis on renewable energy sources. The country has made significant progress in increasing the share of RES in its energy mix, particularly in electricity generation. However, there is still a long way to go, and several obstacles hinder the widespread adoption of renewable energy.

Lithuania's multi-family housing stock, which accounts for almost 50% of all dwellings, presents both opportunities and challenges for implementing smaller RE measures. Most of these buildings have not undergone energy renovations and were constructed during the Soviet period with poor insulation and limited consideration for energy efficiency. This creates a need for energy-efficiency upgrades and smaller RE solutions like solar water heaters or heat pumps. However, decision-making processes for energy renovations in multi-family buildings are complicated due to the joint ownership of common spaces. Reaching consensus among multiple owners and navigating legal requirements can be challenging.

Lithuanian homeowners may have existing needs and potential future demands for implementing smaller RE measures, driven by the desire for lower energy bills, reduced environmental impact, and increased property value. However, several factors can deter homeowners from adopting RE, including economic factors, lack of accessible information, and policy and regulatory challenges. The upfront costs associated with renewable energy technologies can be perceived as prohibitive, and there is a lack of awareness regarding potential financial incentives and subsidies. Complex and lengthy permitting processes and grid infrastructure limitations further complicate project implementation.

Overcoming these barriers requires a comprehensive approach that addresses the economic, informational, regulatory, and infrastructural challenges hindering renewable energy adoption in Lithuania. Clear and consistent policy support, improved information dissemination, innovative financing mechanisms, grid modernization, and targeted efforts to shift public perception are crucial for achieving a faster and more widespread implementation of renewable energy measures.

The interview results reveal several key insights regarding the potential for expanding solar PV solutions in Lithuanian multi-family buildings. Informants generally agree that while awareness of renewable energy sources is growing, specific knowledge of technologies, their technical parameters, and cost-effectiveness is lacking. This highlights the need for targeted information and training, particularly for HOA chairs, who can then disseminate information to homeowners.

Financial benefits are the primary motivator for homeowners to invest in RES, with a focus on reducing energy costs. However, the relatively low cost of electricity for general building needs can make it difficult to convince residents of the value of such investments without state support. State support is seen as crucial, but it must be easily accessible and involve a simple procedure. Many informants believe that without state support, there is insufficient incentive to invest in RES in multi-apartment buildings.

The current state of electrical wiring in multi-family buildings is another important consideration, as unrenovated buildings may have problems with the safe installation of solar energy. Even renovated buildings may not have considered RES during the renovation process.

Informants emphasized that people in Lithuania, especially older ones, are generally unwilling to take out loans. The attractiveness of loans for RES investments would be enhanced by obvious economic benefits, simple conditions, government agency involvement, and the absence of property mortgage requirements.

Simply giving away surplus electricity for free is not seen as attractive. It would only be acceptable if the project is economically viable, supported, and easy to install and maintain.

Overall, the expansion of solar PV solutions for multi-family buildings is possible, but the following prerequisites must be met: economic benefits, availability of support, low and easily manageable administrative burden, targeted information, education, and a good living example. Pilot projects demonstrating clear economic benefits and simple procedures for obtaining support and installing solar PV could also have a significant impact.

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