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positive energy districts
driven by citizens

D.2.1.Evaluation of existing schemes supporting directly or indirectly investments at consumer level into assets that contribute to long-term changes in electricity production or consumption

November, 2024

DUT Driving Urban Transitions

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LIST OF ABBREVIATIONS

ACC — Collective Self-Consumption
ACI — Individual Self-Consumption
AFM — Administratia Fondului pentru Mediu (Environmental Fund Administration)
ALTUM — Development Finance Institution ALTUM (Latvia)
CEC — Citizen Energy Community
CECs — Citizen Energy Communities (EU Directive)
CER — Renewable Energy Community
CFCA — Central Finance and Contracting Agency
CSC — Collective Self-Consumption Scheme
DWH — Domestic Water Heating
DL — Decree-Law
DG — Distribution Grid
DGO — Distribution Grid Operator
ECom — Energy Community
EIF — Environmental Investment Fund (Latvia)
EV — Electric Vehicle
EU — European Union
GEO — Government Emergency Ordinance
IU — Installation of Use
KEV — Feed-in Remuneration at Cost (Switzerland)
KPI—Key Performance Indicator
MG — Microgeneration
NBS — Net Billing System
NMS — Net Metering System
NOK — Norwegian Krone
NVE — Norwegian Water Resources and Energy Directorate
PRTR — Plan de Recuperación, Transformación y Resiliencia
PV — Photovoltaic
REC — Renewable Energy Community
RED II — Renewable Energy Directive II
RES — Renewable energy sources
RESP — Renewable Energy Sharing Platform
SC — Self-Consumption
SCR - Self-Consumption Rate
SFOE — Swiss Federal Office of Energy
SME — Small and Medium-sized Enterprises
UPAC — Production Unit for Self-Consumption
WT — Wind Turbine
ZEV — Zusammenschluss zum Eigenverbrauch (Collective Self-Consumption in Switzerland)

LIST OF TERMS

LATVIA

Energy community[1]: A legal entity engaged in the production, trade, sharing, consumption, and storage of energy—primarily electricity and other renewable energy sources. It also provides services such as demand response, electrical vehicle (EV) charging, energy efficiency, or other energy-related services.

Support scheme[2]: An instrument or mechanism within the framework of commercial activity support, applied to promote the production, transmission, distribution, and use of renewable energy by reducing its costs, increasing its sale price, or boosting its purchase volume.

Active customer[3]: An end user who utilises self-generated electricity for their own consumption and can transfer or sell any surplus electricity to an electricity trader or use it for participation in flexibility or energy efficiency schemes.

Self-Consumption by active customers: The amount of electricity generated by an active customer that is consumed within the active customer's facilities, jointly acting active customers' facilities, or the facilities of members of an ECom.

Electricity sharing: The transfer of electricity produced and injected into the system by an active customer to other end users, including active customers, or the transfer of electricity produced and injected into the system by an ECom to its members or stakeholders.

SPAIN

Citizen Energy Community (Comunidad Ciudadana de Energía, CCE)[4]: A legal entity defined under EU Directive 2019/944, focused on allowing citizens to participate in the energy market. Its scope includes broader aspects of membership requirements and ownership compared to renewable energy communities.

Renewable Energy Community (Comunidad de Energía Renovable, CER)[5]: A legal entity based on voluntary participation, located near renewable energy projects. Its purpose is to provide environmental, economic, or social benefits rather than financial gains. Recognised and defined in Spanish legislation.

Energy Sharing [6] includes two mechanisms:

- Energy sharing through EComs, where members share energy within a 2 km radius.

---

[1] Amendments to the Energy Law: https://likumi.lv/ta/id/334150-grozijumi-energetikas-likuma (in Latvian)
[2] Amendments to the Energy Law 13.06.2024.: https://www.vestnesis.lv/op/2024/124.5 (in Latvian)
[3] Electricity Market Law: Elektroenerģijas tirgus likums (in Latvian)
[4] EU Directive 2019/944, Spanish recognition in Plan de Recuperación, Transformación y Resiliencia (PRTR), though not yet defined in national legislation ([BOE-A-2021-21343] https://www.boe.es/buscar/doc.php?id=BOE-A-2021-21343).
[5] EU Directive 2018/2001, Royal Decree-Law 23/2020 ([BOE-A-2020-6621] (https://www.boe.es/buscar/act.php?id=BOE-A-2020-6621)).
[6] Regulations in Spanish energy sharing systems ([BOE-A-2019-5089](https://www.boe.es/buscar/doc.php?id=BOE-A-2019-5089)).

- Shared self-consumption (Autoconsumo Compartido), where multiple users own parts of a renewable plant (e.g., PV systems) without forming a legal entity.

Active customer (Prosumer): While commonly used in energy discussions, there is no formal recognition or definition of "prosumer" in Spanish legislation. Users are referred to as "consumers," "producers," or both, depending on their role (not formally legislated, but commonly discussed in energy contexts)

Support Schemes and Incentives[7]: Mechanisms to promote energy efficiency and renewable adoption. Managed under the Plan de Recuperación, Transformación y Resiliencia (PRTR), which distributes EU funds and guidance to Spain's autonomous communities.

Electricity Transfer Mechanism (Feed-in Tariff)[8]: A regulated electricity market mechanism where the price is equal to the market rate. Instead of receiving direct payments, users benefit from cost reductions in their electricity bills.

ROMANIA

Renewable Energy Community (REC)[9]: A legal entity based on open and voluntary participation, autonomous, and effectively controlled by shareholders or members located in proximity to renewable energy projects owned and developed by the entity. Its primary purpose is to provide environmental, economic, or social community benefits to its members or the local areas where it operates, rather than financial profits.

Citizen Energy Community (CEC)[10]: A legal entity based on voluntary and open participation, effectively controlled by members or shareholders that are natural persons, local authorities, including municipalities, or small enterprises. Its primary purpose is to provide environmental, economic, or social community benefits to its members or shareholders or to the local areas where it operates, rather than financial profits.

PORTUGAL

In Portugal, the regulation of collective self-consumption (CSC), REC and CEC is governed by Decree-Law (DL) No. 15/2022[11]. While DL 15 does not define "active customer" (within the meaning of Article 2(8) of the Internal Electricity Market Directive), it provides a definition for "self-consumer" in Article 3(f), as follows:

[7] PRTR framework ([BOE-A-2021-21343, https://www.boe.es/buscar/doc.php?id=BOE-A-2021-21343.
[8] Spanish electricity market regulations REE PVPC Pricing, https://www.esios.ree.es/es/pvpc#.
[9] Government Emergency Ordinance No. 143/2021, which transposes Directive (EU) 2018/2001 (RED II) into national legislation.
[10] Government Emergency Ordinance No. 143/2021, aligning with Directive (EU) 2019/944.
[11] The full and consolidated version of DL 15 is available (in Portuguese only) at https://www.pgdlisboa.pt/leis/lei_mostra_articulado.php?nid=3536&tabela=leis. A summary in English is available at https://diariodarepublica.pt/dr/en/detail/decree-law/15-2022-177634016. Noteworthy, a revision of the DL 15 is currently in the works to incorporate the latest provisions from the Directives (EU) 2023/2413 and 2024/1711 (amending the RED II and the IMED) as well as of the revised National Climate and Energy Plan.

Self-consumer: a final consumer who produces renewable energy for their own consumption, on their premises located in the national territory, who may store or sell electricity from renewable sources of their own production, provided that, for non-domestic self-consumers of renewable energy, these activities do not constitute their main commercial or professional activity, and who may carry out this activity in individual self-consumption or ACI or collective self-consumption or ACC when, respectively, the self-consumption is for consumption in one electrical installation of use (IU), or in two or more IUs, and in both cases the UPAC(s) are installed in or near the IU(s) and are connected to each other via the RESP[12], and/or an internal network and/or a direct line, without prejudice to the right of ownership over the UPAC being held by a third party or parties

ACI (individual self-consumption scheme-ISC, in English), when the energy generated (or stored) by the UPAC(s) serves only one electrical IU; or

ACC (collective self-consumption scheme-CSC, in English), when the energy generated (or stored) by the UPAC(s) serves two or more IUs.

Self-consumption means the consumption of electricity produced by one or more UPACs and carried out by one or more self-consumers of renewable energy;

Production unit for self-consumption' or 'UPAC' means one or more production units whose primary source is renewable energy, whether or not including energy storage facilities, associated with one or more IUs, intended primarily to meet their own electricity supply needs, which are installed in the IU(s) and/or in the vicinity of the IU(s) they supply, and which may be owned and/or managed by third parties.

Renewable Energy Community is a legal person set up under the terms of the DL, through open and voluntary membership of its members, partners or shareholders, who may be natural or legal persons, of a public or private nature, including, in particular, small and medium-sized enterprises or local authorities, controlled by them.

NORWAY

Norway has not fully transposed the European Union (EU) directives concerning EComs into national legislation. However, the country has been exploring models similar to EComs, focusing on local energy markets and collective self-consumption.

Energy Communities: while not legally defined, EComs in Norway are understood as collaborative initiatives where local stakeholders, including residents, businesses, and municipalities, engage in joint energy production, consumption, and management to enhance local energy resilience and sustainability (ongoing discussions and pilot projects; no specific legislation as of now).

[12] According to Article 3, 'Public Service Electricity Network' or 'RESP' means 'all the public service installations for the transmission and distribution of electricity that make up the RNT (national transmission grid), the RND (national distribution grid) and the BT (low voltage) distribution networks (grid)'.

Plus Customer (Plusskunde)[13]: An electricity customer who produces electricity (e.g., via solar panels) and consumes it primarily for their own use, with the possibility to deliver surplus electricity back to the grid.

SWITZERLAND

While Switzerland has not formally defined "energy communities" in its legislation, the principles of the 2000-Watt Society[14] and the 2000-Watt Site certification align with the objectives of ECom.

[13] Norwegian Water Resources and Energy Directorate (NVE)
[14] https://www.2000watt.swiss/english.html

KEY POINTS

- In all by PERSIST covered countries, robust financing mechanisms target renewable energy deployment, including grants, subsidies, and tax incentives for photovoltaic (PV) panels, heat pumps, EVs and other technologies.
- Subsidies for energy storage systems and PV panels reduce payback periods (e.g., 5–12 years depending on the country).
- Challenges in integrating microgeneration systems require advanced monitoring and control tools.
- Energy communities are gaining traction as a tool for collective energy management, but require clearer regulations and stronger support to accelerate their development.

Energy Communities

- *Latvia*. Energy communities are defined, but lack specific operational regulations.
- *Spai*n. Strong regulatory framework with distinct definitions for Citizen Energy Communities and Renewable Energy Communities, supporting collective energy sharing and ownership models.
- *Romania*. Energy communities, such as ÎntreVecini, Grădina Apusului, Buteni Community, and Flamingo 50, showcase the potential of collective renewable energy initiatives.
- *Norway*. No formal definition; energy communities are understood as collaborative models for local energy management, with pilot projects promoting the concept.
- *Portugal*. Defined under Decree-Law No. 15/2022, enabling collective and individual renewable energy production with focus on local benefits and efficiency.
- *Switzerland*. Energy communities are not formally defined but indirectly supported through frameworks like the 2000-Watt Society and ZEV (collective self-consumption).

Self-Consumption

- *Latvia*. the Net Billing System requires households to achieve a minimum self-consumption rate of 80% to qualify for government support.
- *Spain*. Strong emphasis on shared SC models under the Royal Decree 244/2019, which enables communities within a 2 km radius to collectively self-consume energy.
- *Romania*. SC is growing rapidly, driven by national incentives like the "Green House" program for prosumers, but detailed regulations for collective self-consumption are lacking.
- *Norway.* SC is encouraged through grants for solar PV and storage systems, but collective SC models are limited due to regulatory framework gap.
- *Portugal.* Supports individual (ACI) and collective (ACC) models, allowing energy storage, sharing, and trading among consumers.

- *Switzerland*. Self-consumption is well-integrated into individual and collective frameworks (Eigenverbrauch and ZEV), with a strong focus on maximising local renewable energy use.

Support Schemes

- *Latvia*. Comprehensive support includes grants for residential renewable energy projects and specific funds (ALTUM, EIF, CFCA). Key requirements include high self-consumption rates and capacity thresholds.
- *Spain*. Broad incentives under the PRTR, with a focus on energy-efficient renovations, renewable energy systems, and collective projects (e.g., DUS 5000 for rural communities).
- *Romania*. Funding is available through programs like the "Green House" for households and the Modernization Fund for large-scale projects, but access remains complex.
- *Norway*. Enova grants provide robust support for active customers and energy efficiency, complemented by the Green Electricity Certificates scheme for renewable producers.
- *Portugal*. Investment grants for PV systems, energy storage, and efficiency; support programs for residential projects and green mobility. Focus is on decentralized energy, self-consumption, and renewable transport integration.
- *Switzerland.* Support schemes focus on feed-in tariffs, investment subsidies, and tax incentives for renewable energy projects.

Overall, the country profiles show that while some countries may be better performing in their rollout of energy communities and renewable energy support schemes than others, there are still significant barriers at national level which impede a higher uptake, and there are still lacking the right regulatory framework and enabling environment.

INTRODUCTION

The transition to renewable energy and the increasing decentralization of energy systems have underscored the need to evaluate regulatory frameworks that influence consumer investments in long-term electricity production and consumption assets. Understanding whether these frameworks promote or hinder such investments is critical to achieving national and global sustainability goals.

The report *"Evaluation of existing schemes supporting directly or indirectly investments at consumer level into assets that contribute to long-term changes in electricity production or consumption"* was developed by the project "Positive EneRgy diStrIctS driven by ciTizens (PERSIST)" Nr.2-04527. It aims **to assess the effectiveness of existing support schemes and regulatory mechanisms in encouraging consumer-level investments in renewable energy technologies and long-term energy assets**. The evaluation focuses on identifying barriers, opportunities, and potential improvements in regulatory and support frameworks across partner countries.

To achieve these objectives, the following tasks were undertaken:

1. A comprehensive review of relevant documentation related to existing and upcoming support schemes, including program guidelines, reports, and data on investments and outcomes.
2. Compilation and development of key evaluation findings, recommendations, and insights for stakeholders to improve the effectiveness of support schemes.
3. Creation and dissemination of a questionnaire targeting active customers and end-users via social networks and private contacts.
4. Preparation of interview questions for representatives of the distribution grid (Appendix 1)
5. Preparation of survey questions for active customers and and-users (Appendix 2 in Latvian, Appendix 3 in English).

This report comprises eight chapters, focusing on a specific country—Latvia, Spain, Norway, Romania, Switzerland, and Portugal—along with an introduction and conclusion, and includes a detailed evaluation of incentives, energy-sharing schemes, and energy communities, providing a comparative overview of their performance. By offering actionable insights and highlighting best practices, this report seeks to contribute to the development of robust regulatory and support frameworks that enable consumers to actively participate in the energy transition and invest in sustainable energy solutions.

1 LATVIA

Latvia has made significant strides in promoting renewable energy sources (RES) as part of its commitment to sustainable development and energy independence. The country's strategic approach combines various support schemes aimed at boosting the production and consumption of renewable energy.

The Latvian government has established a robust legal and regulatory framework to promote RES. The Energy Law and the National Energy and Climate Plan (NECP)[15] outline ambitious targets for renewable energy integration, aiming for at least 50% of the total energy consumption to come from renewable sources by 2030. These policies are aligned with the European Union's broader objectives for climate change mitigation and energy transition. Additionally, Latvia's "Long-term Energy Strategy"[16] outlines specific measures to increase the share of renewables, focusing on wind, solar, and biomass energy. This framework is essential for establishing clear guidelines and objectives for stakeholders in the energy sector.

Thereby, this subsection examines Latvia's policy and legal landscape regarding fundamental principles of active customers' self-consumption (SC) activities, restrictions and overall mechanism regarding mutual electricity sharing and transfer cooperation between active customers, consumers and distribution grid.

1.1 Electricity transferring mechanisms

According to Latvia's Electricity Market Law[17], national legislation distinguishes **four types** of generated electricity and excess electricity transferring mechanisms:

- net metering system (NMS),
- net billing system (NBS),
- electricity trade
- electricity sharing within energy community (ECom).

1.1.1 Net metering system

The NMS in Latvia is governed by the Electricity Market Law and specific regulations set forth by the "Public Utilities Commission (PUC)"[18]. These regulations outline the eligibility criteria for net metering, the technical requirements for installations, and the procedures for connecting to the grid.

[15] https://climate-laws.org/document/latvia-s-national-energy-and-climate-plan-2021-2030_3273
[16] Informative Report - Long-Term Energy Strategy of Latvia 2030 - Competitive Energy for the Society | Valsts valodas centrs
[17] Saeima of the Republic of Latvia, "Electricity Market Law" [in Latvian], 2024.
[18] https://www.sprk.gov.lv/en/content/about-us

In Latvia, the NMS has been partially phased out. Under this scheme, active customers (limited to households with a maximum RES capacity of 11.1 kW) can transfer surplus electricity generated after SC to the grid, converted into virtual electricity amount credits and be used to cover the imported electricity costs only in a household where electricity generation elements are installed. From 2020, systems below 11.1 kW no longer need a permit from the Ministry of Economics. In this scheme, active customers' SC is calculated by determining the ratio between total amount of generated electricity and total amount of consumed electricity within the metering interval (one month). It can be mentioned that new active customers have no longer been eligible to apply for this procedure since May 1. However, existing active customers operating under this system will have continued access until February 28, 2029. NMS are now exempt from the variable part of the mandatory procurement component fee for electricity fed into the grid and taken back.

Since the amendments to Latvia's Electricity Market Law on January 5, 2024, active customers (households, small-medium enterprises, as well as public and governmental buildings) have access the NBS and since May 1 it partially replaced NMS. In NBS, excess electricity fed into the grid is converted into virtual and non-taxable electricity value credits and they offset electricity consumption not only at the generation site but also at other properties owned by the active customer. These credit values are determined by the electricity trader using two pricing schemes[19] :

- If installed RES capacity does **not exceed 49.999 kW** then active customer can participate in the universal NBS scheme, i.e., the value of transferred electricity is determined according to the next day's hourly price of the Latvia's trading area of the Nord Pool electricity exchange by applying to it a reduction not exceeding 20 €os per megawatt hour.
- If installed RES capacity is **50 – 999.99 kW** then the universal net system cannot be applied and value of transferred electricity is determined by mutual agreement between electricity trader and the active customer.

In order to participate in this scheme, as well as to apply for state aid for the purchase of RES in a form of one-time grant[20] , SC rate (SCR) must be at least 80% and installed RES capacity must not exceed 999.99 kW. If these indicators cannot be met under this mechanism, active customer can either participate in electricity trading or increase overall generated electricity SCR by sharing the excess amount of electricity in the ECom.

[19] Cabinet of Ministers of the Republic of Latvia, "Regulation No. 635: Rules of sale and use of electricity" [in Latvian], 2024.

[20] Cabinet of Ministers of the Republic of Latvia, "Regulation No. 150: Regulations of the open competition "Reduction of greenhouse gas emissions in households - support for the use of renewable energy resources" funded by projects funded by the emission allowance auction instrument" [in Latvian], 2024.

1.1.2 Electricity trade

When active customers opt to sell their excess electricity to the electricity trader, a different SC calculation method applies. In this case, SC is determined based on the electricity generated and consumed within a trading interval (an hour). However, this approach is generally unpopular among active customers due to several reasons:

- Additional tax (personal income tax) must be paid on profits from electricity sales[21];
- Regardless of the installed RES capacity, additional tariff (monthly capacity fee for electricity producers) must be paid to the distribution grid operator[22];
- Active customers operating in electricity trading are ineligible to receive state aid on RES purchases.

1.1.3 Energy communities

To facilitate electricity sharing among all cross-sector active customers and potentially boost overall SC of generated electricity, the Cabinet of Ministers is developing and reconciliating regulation for the registration and operation of EComs[23], which are expected to take effect at the end of 2024. At the moment, there is no special regulation in Latvia for EComs or active customers who act jointly, which would provide for the conditions of sharing, the conditions of mutual relations between community members and shareholders, its representative and other electricity users, and for energy supply merchants, including system operators, registration conditions for EComs as well as other conditions. However, the content of the regulation is already included in the updated and accepted version of Latvia's NECP for 2021-2030 [24], thereby suggesting that the final version of the regulation will largely align with the current draft version.

The **primary purpose of the ECom is not to make a profit**. Moreover, total installed RES capacity within ECom must not exceed 15 MW[23]. This limitation is established to support small- and medium-scale projects that promote the decentralization of the energy system and the enhancement of energy efficiency.

1.2 Support schemes

In Latvia there are 3 major support funds for the RES development:

1. The Environmental Investment Fund (EIF)[25].
2. JSC Development Finance Institution ALTUM[26]. It is a state-owned Latvian company that facilitates access to financial resources for enterprises and households through

[21] Saeima of the Republic of Latvia "Law on personal income tax" [in Latvian], 2024.
[22] Sadales Tīkls, ""Sadales tīkls" electricity distribution system differentiated tariffs, starting from January 1, 2024 (without VAT)" [in Latvian], 2024. Available from: https://sadalestikls.lv/storage/app/media/uploaded-files/ST%20tarifu%20vertibas-01.01.2024.pdf [accessed August 8, 2024].
[23] State Chancellery of the Republic of Latvia, Cabinet of Ministers of the Republic of Latvia, "23-TA-691: Rules for registration and operation of energy communities" [in Latvian], 2024.
[24] Cabinet of Ministers of the Republic of Latvia, "Order of the Cabinet of Ministers No. 573: The updated National Energy and Climate Plan for 2021-2030" [in Latvian], 2024.
[25] https://ekii.lv/index.php?page=news
[26] https://www.altum.lv/en/about-altum/who-we-are/

supportive financial instruments in sectors deemed crucial and supported by the state, thereby fostering national economic development and enhancing the mobilization of private capital and financial resources.

3. The Central Finance and Contracting Agency (CFCA)[27]. It is a direct management institution subordinated to the Minister of Finance.

EIF increase the amount of funding for the support program for residents for the installation of RES production equipment to 45 million €. The CFLA has allocated 12.44 million € in support programs. ALTUM total fundings are equal to 5.37 million €.

Households will be able to continue to apply for state support to purchase and install **solar panels, wind generators, as well as heat pumps, solar collectors, wood biomass boilers, etc.** or to connect to the centralised heat supply system.

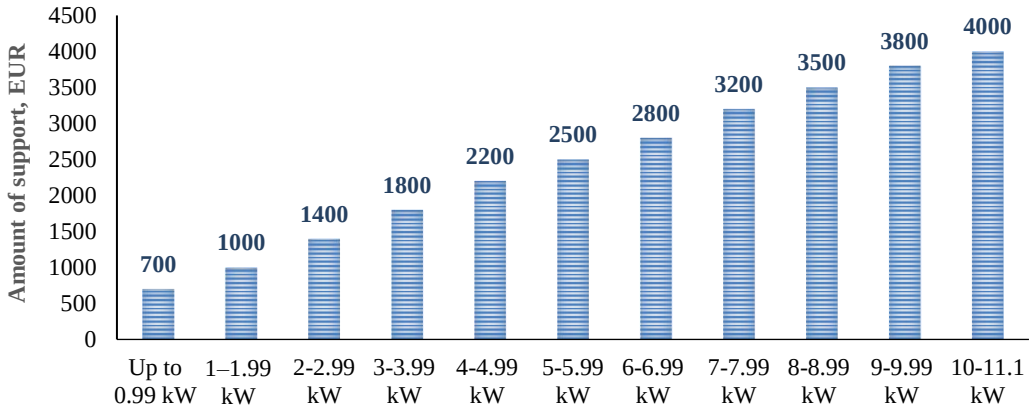
Along with the creation of the new NBS, which comes into force this year (2024) on May 1, there will be **no restrictions on the installed capacity of solar panels and wind power plants**. Until now, support could be received for the purchase of solar panels and wind generators, the installed power of which was up to 11.1 kW.

The primary requirement of support schemes is that **at least 80%** of the electricity generated annually must be utilised **for the SC needs** of residents.

The most significant changes in the state support program for the purchase of energy-producing equipment came into force on July 5, 2024, amendments to the Cabinet of Ministers' regulations of March 1, 2022 No. 150 "Regulations of the Open Competition "Reduction of Greenhouse Gas Emissions in Households - Support for the Use of Renewable Energy Resources" open tender for projects financed by the Emission Quota Auction Instrument" (hereinafter - amendments to the regulations of the Cabinet of Ministers'). Amendments to the regulations of the Cabinet of Ministers envisage expanding the scope of supported project activities, by determining that simultaneously with the purchase of solar power plants or wind power plants, citizens can also receive state support for the purchase of electricity storage equipment, if its capacity will be at least 5 kWh. The maximum support for an electricity storage device is 2 500 €, not exceeding 70% of the purchase cost of the device. State aid is not intended only for the purchase of a separate electricity storage device. Investing in energy storage solutions would help accommodate more distributed energy generation without compromising grid stability.

The maximum amount of photovoltaic panels (PV) and wind turbine (WT) is 4 000 €, no more than 70% of the cost amount. Looking at the smallest power above, the exact support will be as follows on the Figure 1.1.

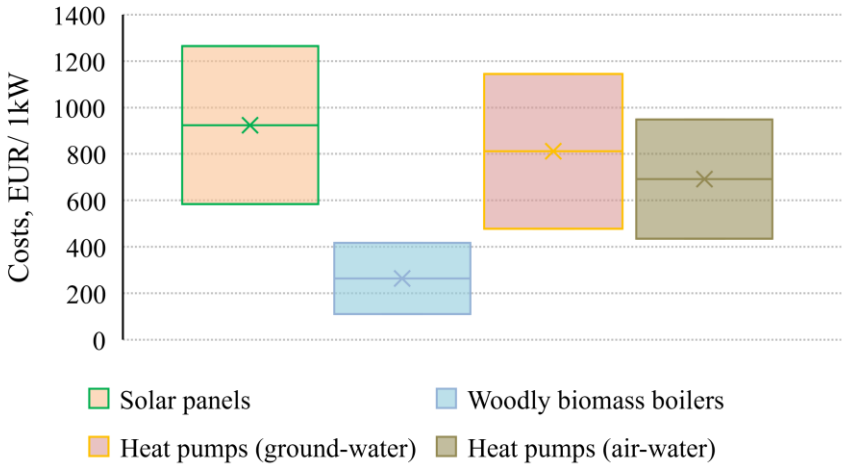
[27] https://www.cfla.gov.lv/en/about-us



1.1. Fig.. Support of RES equipment installation depending on capacity

Support for replacing heating system in 2024 is easily available. Considering the support ceiling, which is 15 000 €, it is recommended to install a high-quality heat pump. For example, a ground source heat pump (up to 16 kW) with the entire ground geothermal circuit, equipment and installation can cost around 20 000 €, of which you can get 70% back from the state.

Figure 1.2 displays the average costs (€ per kW) of various smart urban technologies utilised in support programs. The statistical data were sourced from EIF. This information will be essential for the subsequent phase of the PERSIST project, which involves modelling and calculating economic benefits.



1.2.Fig. Average equipment's cost in support projects

Table 1.1 summarises the key support programs in Latvia, including beneficiaries, funding sources, and eligibility criteria for renewable energy and energy efficiency projects.

1.1.Table Comprehensive Overview of Support Programs in Latvia

Criterion/ Organization	ALTUM	CFLA	EIF
Support programmes	Financing of Latvia EU funds	Financing of EU funds, Financing from the Recovery Fund	Auctioning instrument for emission allowances
Beneficiaries	Citizens	Citizens, Municipalities Public sector	Citizens, Municipalities Public sector
Activities to be supported	- Installation of solar and wind power systems - Improving energy efficiency in buildings - Installation of biomass boilers	- Connection to district heating systems - Installation of heat pumps and biomass boilers	- Installation of solar panels, wind turbines, energy storage systems, and energy-efficient heating technologies
Types of support available	- Guaranty - Technical assistance* - Grant* *only for families with at least 1 child or pregnancy	Grant	Grant
Maximum amount of grant (support)	Implementation of energy efficiency improvement measures – up to 5000 € Solar and wind power plants – up to 4000 €	Connection to the District Heating System: 95% of eligible costs. Heat Pumps: 85% of eligible costs. Pellet Boilers: 70% of eligible costs. Open Call: 50% of eligible costs, with €4,400 allocated per declared resident in the household of the residential house or apartment property.	Up to 15 000 € per project/residential house not exceeding 70% of the eligible costs The maximum support for an electricity storage device is 2 500 €, not exceeding 70% of the purchase cost of the device
Conditions	A reduction in primary energy consumption of at least 20% is achieved		Maximum support 2500 € of electricity storage equipment's, if capacity at least 5 kWh.
	At least 80% of the electricity produced per year is used for the needs of SC of residents living in a residential house, using the NMS or NBS. Maximum support 4000 € may be installed on a residential house, on the ground or other adjacent structure.		
Combination	Can be combined with other national programs if costs are not duplicated		

1.3 Opinion of the distribution network representative on microgeneration and ECom development in Latvia

An interview was conducted with a representative of the distribution network. Based on the questions raised and the answers received, sub-topics have been created to

reflect the essence of the issues and are presented in an easily comprehensible format. The list of questions is provided in Annex 1.

1.3.1 Network status and load caused by microgeneration in 2024

In the first nine months of 2024, approximately 3,800 new microgenerators (MGs) were connected to the distribution grid (DG), increasing the total number to 22,700, with the total generation capacity exceeding 190 MW. The growth in demand can be explained by the introduction of a new net settlement system in May 2024. In April, as the transition period from the net metering to the net settlement system approached, there was a surge in connection applications, with users rushing to connect to the previous system. This resulted in a high number of connections, but it did not significantly affect substation operations. Low-voltage issues were observed only in isolated locations.

Recent data (as of 28 October 2024) indicates that in some substations, the available generation capacity is less than 11 kW (e.g., Priedaine, Skulte, Valka, Inčukalns, and other regions). However, according to the DG representative, MG connections are not restricted by the capacity of 110 kV substations, although problems may occur in the 0.4 kV network due to generation at minimal load. DG's digital map does not include MGs connected to medium-voltage substations, as such connections rarely cause significant issues. Nonetheless, during capacity calculations, situations arise where MGs begin to occupy capacity in the range of megawatts.

1.3.2 Typical problems with MGs and their causes

The situation is complicated by the lack of control over MGs with capacities not exceeding 500 kW. While larger solar power plants can be monitored, MG management is currently not possible, leading to occasional network disruptions, especially under high generation and low consumption conditions. These problems are often associated with installation and adjustment errors, which cause system disturbances. In such cases, DG engineers require internal network calculations (e.g., voltage increase from the inverter to internal networks), but these are not always performed or adhered to. As a result, DG performs calculations from the transformer to the meter, while internal network calculations remain the responsibility of the client.

Another issue relates to the sensitivity of voltage protection devices. If the voltage at the transformer output is elevated, it can initially be 240 V, which is normal given that on the client's side, the voltage will be 230 V. In rare cases, the voltage may reach 248–250 V at the transformer output. If an MG operates without load, it may disconnect due to excessive voltage, and the operator may adjust the step to protect the client's network. This is the first step that can be taken if the problem lies with the DG. However, if the issue is within the client's internal network, it becomes more complex, requiring collaboration with contractors or the client addressing the disturbances.

In long overhead networks, insufficient wire cross-section can lead to voltage instability, particularly under low-voltage conditions. This can result in inverter disconnection. Inverters have a built-in automatic configuration function that monitors

network conditions When the voltage returns to acceptable levels, the inverter automatically reconnects to the network.. Depending on the situation, this process may take some time. Prolonged issues may result in extended generator disconnections, leading to occasional client complaints, although operators address these effectively. Compensation is usually granted only when equipment damage is directly related to overload problems in the DG. Evidence must confirm that damage resulted from network disturbances. Prolonged disconnection under low-voltage conditions does not justify compensation.

1.3.3 Issuance process of MG technical regulations

Approximately a year ago, the process of issuing technical regulations was digitised through the introduction of an automated application processing system on the portal, significantly accelerating the process. Clients now submit their applications via the portal, after reviewing the general technical regulations available on the DG website, and engineers quickly make decisions using the provided data. This process takes no more than three days.

After the application is reviewed, the client receives an invoice and has up to 30 days to pay it. Following payment, the client constructs the facility and submits the necessary documentation for connection. In cases where an engineer determines during calculations that the MG connection will cause a voltage rise above permissible limits, technical regulations for network reconstruction are then developed. Such cases are rare, and reconstruction costs are covered by the active customer.

It is important to note that the generation permit is linked to the inverter's capacity, considering how much power the inverter can feed back into the network and its impact on network stability. Solar panels are typically designed to be about 20% more powerful to ensure a smoother generation curve.

1.3.4 Determining the level of SC

DG operators base their calculations solely on meter readings at the distribution boundary, which reflect the amount of energy consumed. The energy generated by solar panels is not monitored, as the DG does not install meters at the inverter. Financing and oversight are provided by Altum/VARAM, which requires data on generated energy from owners. For the DG, only the amount of consumed energy is relevant, while the generated energy is not of concern.

1.3.5 Impact of Transition to a 15-Minute Settlement Period on Load

According to European Parliament and Council Regulation (EU) 2019/943, starting 1 January 2025, the balance settlement period will be reduced to 15 minutes. This transition will increase the load, including:

- Increased data volume transmitted via GPRS (data transmission and associated costs).
- Increased data storage requirements.
- Additional KPI indicators for data collection.

- System configuration for data exchange.
- Data validation and processing.

The increased GPRS data transmission volume will lead to additional costs. Furthermore, additional expenses may arise for data configuration and processing, for instance, if a power meter stops functioning and data must be recalculated based on historical records. Communication issues between the meter and the system may also arise due to increased data flow.

1.3.6 DG Involvement in Planning Support Schemes and Assessment of State Aid Impact on Solar Panels with Batteries

Currently, the DG is actively involved in a European-funded project related to active customers and service aggregation to balance the DG.

Many applications for solar panels include battery systems with a total combined capacity of approximately 7 MW, and this number continues to grow. However, adding batteries increases the complexity of calculations, as it is difficult to precisely forecast the amount of energy generated, and battery presence introduces additional uncertainties to be considered when assessing its impact on network operations.

One solution is to install an inverter for both solar panels and batteries, enabling more effective power distribution control and ensuring more accurate reporting. Alternatively, hybrid inverters may be used. Currently, existing system applications lack full clarity on the capacity of each piece of equipment. To improve this process, two additional fields are planned for the DG portal, allowing clients to separately enter the capacities of solar panels and batteries.

1.3.7 Potential Challenges and Benefits of Developing Energy Communities and Their Role in DG Balancing

Challenges occur because balancing, from the perspective of the transmission network, aims to maintain frequency, regardless of specific locations. However, the DG requires voltage stability, where the location of an object is critical.

The main issues stem from insufficient information about all network participants, complicating situation monitoring and raising numerous questions. Balancing is a separate task requiring an understanding of the sources and routes of energy delivery. To accurately determine the resources available at a specific moment, localization is essential for system management and forecasting.

A positive aspect is that new clients can be connected more quickly. Currently, no separate tariff is planned for EComs.

1.3.8 Assessment of Difficulties in Approving the ECom Act

To date, the ECom Registration and Operational Regulations Act has not been successfully approved, even after four attempts. The primary reason for delays is significant changes to the energy-sharing concept during the project's development. Initially, it was planned to use energy in a net metering system. However, recent versions

of the document propose a new model where all energy generated by the community is sold, and community members share the revenue from these sales.

The project involves many stakeholders, and each new version introduces various comments and suggestions, slowing down the approval process.

1.3.9 Evaluation of New Electricity Flexibility Service Implementation

A project aimed at developing a platform for electricity system participants to manage network load more effectively and improve stability faces several challenges. These include determining whether sufficient flexibility resources will be available at the required time and location, as well as questions about the activation of flexibility resources, network safety in the event of non-activation, and the need for amendments to the Energy Market Law.

Challenges may also arise from centralised procurement of flexibility resources, standardising communication platforms for end devices, high IT maintenance costs, and manual technical validation of end devices.

Nevertheless, this service has its advantages, such as faster client connections, the possibility of replacing network reconstruction and deferring investments, standardization of flexibility products at the Baltic States level, and the creation of a unified solution for implementing EU Regulation 2019/943 on the internal electricity market (Articles 59.1 and 19(c)).

1.3.10 Comparison with neighbouring country: ECom development in Lithuania

In Lithuania, EComs have been operational for some time, allowing residents to purchase shares in solar power plants and receive their share of the generated electricity. In Latvia, the process is developing more slowly, although solar parks in rural areas have already begun to emerge.

The challenge lies in the additional costs of transporting electricity from rural areas to large cities, such as Riga. In Latvia, solar power plants are predominantly installed in rural areas where energy consumption is lower. Theoretically, energy generation closer to consumption points is encouraged in Latvia to minimise network losses. However, virtual stations allow for remote connections, which have both advantages and disadvantages.

1.3.11 Conclusions

The interview with the representative of the distribution network has shown that microgeneration (MG) significantly impacts the operation of the distribution network, creating both opportunities and challenges. The main issues are related to managing voltage fluctuations and ensuring network stability, particularly in low-voltage networks.

To improve network performance, it is necessary to develop more precise calculation tools and monitoring systems to address the integration of MG and battery systems. Digital systems help accelerate the connection process; however, challenges remain in forecasting and accounting for energy production.

In Latvia, the main difficulties are associated with the slow implementation of regulatory changes and balancing energy demand and transportation. Nevertheless, Latvia is progressing toward the development of sustainable EComs and network flexibility, which will help maintain stability.

1.4 Survey on renewable energy support schemes and incentive programs

The primary goal of the survey was to gather insights from active customers and electricity end-users regarding their knowledge, motivations, and experiences related to RES support schemes and incentive programs. Specifically, the survey aimed to understand the motivations and challenges of active customers in these programs, identify the reasons why some active customers choose not to participate and explore potential motivators for future participation, assess the end-users knowledge of local renewable energy sources and their awareness of available support schemes and incentive programs, and explore potential motivators for installing RES and participating in future support schemes.

In order to provide comprehensive survey data analysis and easy "question-answer" navigation, survey was created using the freely available and open-access survey platform "Google Forms". This platform allows respondents to complete the survey without registration and implements data encryption to protect the privacy of participants.

To reach Latvia's active customers and end-users, the survey was created in Latvian and distributed through three primary communication channels: the Riga Technical University Study Portal ORTUS, as well as LinkedIn and Facebook (shared on relevant renewable energy blogs and community pages). Additionally, the survey was distributed through private communication channels using a randomised approach to ensure a diverse range of respondents, including even representation across age, gender and other demographics. Structure of the survey in Latvian can be seen in Annex 3, in English: Annex 4.

The survey was conducted from October 22, 2024, to November 12, 2024, with a total of 119 respondents. Among them, 19 respondents were participants in support schemes and/or incentive programs, 31 had installed renewable energy systems (RES) without participating in such programs, and 69 had neither installed RES nor implemented related measures.

To gain deeper insights from the survey data, the next subsections will delve into the analysis of demographic profile of respondents, as well as their responses according to determined survey target groups.

1.4.1 Survey results

1.4.1.1 Survey respondents demographics

In order to analyse overall respondent distribution across demographic profiles and criteria, justify the reliability of the survey and to prove unforced answering in any of the target groups, this subsection will delve into the analysis of total respondents according to their age, gender, education and households' average income rate.

Distribution across age groups show that respondents in the age group 31-50 were more responsive (64%) to filling out the survey than age groups of 18-30 (18%) and +50 (17%). As mentioned by [28], age variation between respondents is common practice and can be justified from the relevance of the survey topic, as well as chosen survey method.

A relatively equal distribution can be observed across respondents gender: 53% male, 45% female.

The majority of respondents (79%) possessed a university degree, a statistic consistent with Latvia's high rate of higher education [29] . Other respondents indicated their education level as secondary (12%), professional secondary (4%) and college (3%).

Respondents' monthly household income was relatively evenly distributed with 22% earning 1201-2000 EUR, 18% earning 2001-2800 EUR or over 3600 EUR, 13% earning 601-1200 EUR, 9% earning 2801-3600 EUR, and 3% earning less than 600 EUR.

Moreover, one respondent did not wish to disclose their age, two declined to specify their gender, three did not indicate their education level and nineteen did not provide information regarding their income level (including four who responded 'hard to tell'). D

Demographic distribution across survey target groups was similar without any significant criterial emphasis.

Overall, examination of the demographic characteristics of survey respondents reveals a diverse and well-represented sample. The data does not indicate any significant overrepresentation or underrepresentation of specific demographic groups, suggesting that the survey was not biased by forced inclusion. The following subsections will present the survey results for all target groups.

1.4.1.2 Active customers participating in RES support schemes and incentive programs

Participation in support schemes can provide a valuable perspective informed by their experiences and overall opinion of support mechanisms. Thereby, the primary focus of survey of active customers participating in support schemes and incentive programs was to explore the factors driving participation in support measures and to identify any challenges faced by active customers during the application process.

Of the 19 survey respondents (support scheme participants), all (100%) had installed solar panels. Furthermore, 53% had installed heat pumps, 21% had installed pellet boilers and a smaller proportion had installed recovery systems, home insulation, solar collectors or heating distribution systems.

Although Latvian support schemes encompass a wide range of property types[30], a majority (90%) of survey respondents who utilised these schemes installed RES in their private houses. Notably, this is despite a relatively even distribution of property locations among respondents, with 40% residing in urban areas, 25% in suburban areas and 35% in rural/semi-rural areas.

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[28] K. Quinn, "Methodological considerations in surveys of older adults: technology matters", International Journal of Emerging Technologies and Society, vol. 8(2), 2010. DOI: 10.13140/2.1.3897.9209.

[29] Centrālā statisktikas pārvalde, "Demogrāfija (in Latvian)", 2021. Available from: https://www.csp.gov.lv/lv/demografija (accessed 18 November 2024).

[30] EKII, "Atbalsta programmu iedzīvotājiem salīdzinājums (in Latvian)", 2024. Available from: https://ekii.lv/index.php?page=programmu-salidzinajums (accessed 18 November 2024).

Additionally, a majority of respondents participating in support schemes have indicated a preference for one-time state subsidies (63%) and partially discontinued net metering system (84%). This suggests a perceived lack of attractiveness in alternative schemes such as net billing (5%), bank loans with reduced interest rates (16%) and electricity trading (0%).

The respondents' decisions regarding RES investments and support scheme participation may be affected by their primary information source. Survey data suggests that unofficial information sources (social media and internet resources: 63%, friends and family members: 16%, advertisements and installers: 16%) were the predominant sources of information. This reliance on open and personalised information sources can expose individuals to both positive and negative experiences and opinions, potentially shaping and convincing their choices. In contrast, only 21% of respondents indicated that their primary information source was through official government channels (documents, press releases and informative messages). This suggests a necessity to improve dissemination of accurate and reliable information about support schemes, including targeted guidance and experiential insights to help potential RES installers and support receivers to understand the benefits and application processes.

Moreover, survey results showed that main motivation for application of support schemes or programs for most of the support receivers was economic in nature (energy resource cost savings: 84%, availability of subsidies: 63% and increased energy independence: 37%). To better align with the broader goals and objectives of support schemes and programs, future information dissemination efforts should place greater emphasis on highlighting the social and environmental benefits of support schemes, alongside the economic advantages.

A significant portion of survey respondents who had utilised support schemes to install RES indicated that they had engaged commercial companies for both the installation process (73%) and the application for support (63%). This finding suggests two key implications:

- The availability of a wide range of commercial installers, along with their ability to offer comprehensive packages like installation and support application services, can significantly and positively affect both the number of RES installations and the participation in support schemes.
- The relatively low proportion of self-installations and self-applications highlights the potential challenges associated with existing information dissemination efforts and bureaucratic hurdles within the support application process. These factors may discourage individuals from independently undertaking RES installations or applying for support.

Continuing on aforementioned, 21% of respondents pointed out that application for support was not accepted the first time due to non-compliance of installation criteria, lack of necessary information in the application form and inaccurate calculations. Moreover, 58% of respondents revealed that main challenges in applying process was directly related to bureaucracy and information availability (58%: long application process; 58%: difficulty understanding support application terms and conditions, 37%:

overcomplicated application process). Only two out of 19 respondents (11%) implied that there were no challenges or issues with application process. To further promote the adoption of RES technologies and measures, it is essential to address these issues by improving information accessibility, streamlining and easing the application process and fostering a supportive environment for both commercial businesses (installers) and homeowners.

The survey results indicated a positive perception of the support provided, with most respondents (84%) expressing high satisfaction and an additional 16% indicating moderate satisfaction. Additionally, the majority of respondents (89%) felt well-informed about the obligations associated with receiving support. However, a notable proportion (32%) remained uncertain about recommending support schemes to others, suggesting that further efforts may be needed to address potential concerns or doubts, including aforementioned official information availability and distribution, as well as related support application bureaucracy issues.

To identify the primary motivations behind active consumers' and end-users non-participation in support schemes or programs, the following subsection will will highlight the key issues and challenges that hinder their decision to skip participation in such economic support initiatives.

1.4.2 Active customers and end users not participating in RES support measures

As outlined in the preceding section, a total of 100 respondents comprised two distinct survey target group categories: 31 respondents with existing RES installations or measures who did not choose to participate in support schemes or incentive programs and 69 respondents without RES installations or related measures. The primary objective of this targeted survey was to determine the key factors affecting the decision-making processes of these respondents, specifically examining their reasons for not applying for RES support. Moreover, it allowed the identification of potential actions and improvements that could increase their acceptance of RES support schemes in the future.

Among active consumers who have not participated in RES support schemes, solar panels emerged as the most prevalent installed RES technology, accounting for 45% of installations. A significant interest was observed in heating infrastructure upgrades, with notable preferences for heating distribution systems (29%), heat pumps (23%), gas boilers (23%), and pellet boilers (19%). Conversely, there is small interest in installation of solar collectors, wind turbines and ventilation systems, with respective acceptance rates of 3%, 3%, and 6%. It is worth noting that, when excluding gas boilers (which were not eligible for existing support measures), the distribution of other RES technologies and measures among support receivers and non-receivers exhibits a notable degree of similarity. This suggests that the adoption of specific RES technologies and measures is affected not by the availability of the support, but more by the inherent advantages and alignment with the goals of energy-efficient and economically conscious consumers and perceived benefits in a long-term from the implementation of these RES technologies or measures.

Furthermore, even without participating in RES support schemes or programs, respondents demonstrated a high level of awareness about existing support initiatives.

Among active customers, 91% expressed a good or partial understanding, while 74% of energy end-users did the same. Moreover, a majority of active customers and energy end-users who were not familiar with existing support schemes and programs, would like to get more information about them (66% and 54%, respectively). Survey participants with partial or full knowledge of existing support schemes and programs exhibited a strong interest in learning more about these initiatives and their application processes (active customers: 72%, energy end-users: 76%). This suggests that both active customers and energy end-users are receptive to discussions about RES installations and indicates a high level of societal acceptance for RES.

While support-familiar active customers who are not participating in support measures identified some overlapping reasons with those who are (e.g., complicated application processes and lack of relevant information, each cited by 25% and 21% of respondents, respectively), a significant portion (36%) attributed their non-participation to non-compliance with specific support scheme terms and conditions, such as generated energy self-consumption levels or installations of RES prior to support adoption. Furthermore, 57% of support scheme familiar energy end-users have identified that the main reason for not participating in RES support scheme is associated with no corresponding property or need (rental apartments, satisfaction with existing electricity bills). Other considerable reasons for the energy end-users is financial restrictions (25%) and unclear support benefits (18%).

Active customers and end-users identified four primary motivators for increased willingness to discuss further RES installations under relevant support schemes: simplified support application processes (77% and 47%, respectively), detailed explanations of the advantages and benefits of participation (50% and 76%), testimonials and recommendations from existing participants (36% and 35%), and experiences shared by neighbors (14% and 20%). This diversity of motivators highlights the necessity for a multifaceted approach by policymakers to maximise both RES technology and measure installations, as well as participation rates in existing support scheme

1.4.3 Discussion, conclusions and recommendations

The survey provided valuable insights into the motivations, challenges, and knowledge levels of Latvian active customers and end-users regarding RES and associated support schemes.

The survey encompassed a wide range of respondents, including individuals from various age groups, educational backgrounds, and income levels. This diversity enhances the reliability and generalisability of the findings. However, the relatively small number of respondents, particularly among participants in RES support schemes, limits the scope of the conclusions. The results and the conclusions should be interpreted as indicative trends and potential insights rather than definitive statements. Moreover, during the PERSIST project, survey will be redistributed within the Task. 2.2 to include more respondents and obtain more accurate survey results and data coverage.

Survey results showed that economic considerations were the predominant motivators for Latvia's active consumers to participate in RES support schemes, including energy cost savings, availability of subsidies and increased energy independence.

Moreover, bureaucracy, such as complex application processes and insufficiently disseminated information, were identified as significant barriers for the support application. These challenges were compounded by low reliance on official sources for information and a preference for unofficial channels.

For active customers and energy end-users, the primary reasons for not participating in support schemes included non-compliance with terms, financial restrictions, and lack of property suitability. Some respondents were deterred by unclear benefits or the perception of inadequate support. While a majority of support scheme non-participating respondents were aware of RES support schemes, many expressed interest in obtaining clearer, more accessible information. This indicates an opportunity for policymakers to enhance communication strategies. Moreover, simplified application processes, detailed explanations of benefits, and testimonials from current participants were identified as key motivators for increased acceptance and participation in support schemes.

The survey findings underscore the critical role of effective information dissemination and user-centric policy design in enhancing participation in RES support schemes. Thereby, based on the results, recommendations for further enhancement and increased participation rate in RES support schemes can be suggested:

- Simplifying the application process and reducing bureaucratic hurdles are essential to encourage greater participation. Policymakers should consider digitalising application steps to make the process more user-friendly as well as to discuss changes application form towards more simplicity and reduction of required data and coordination requirements.
- Regarding information dissemination strategies, official channels must play a more prominent role in disseminating accurate, reliable, and easy-to-understand information about RES and relevant support schemes. Leveraging both traditional and digital media, coupled with targeted outreach campaigns, can significantly improve public awareness and trust.
- While economic benefits are a strong motivator, emphasising the environmental and social advantages of RES adoption could help align individual goals with broader societal objectives. Enhanced success story and testimonials dissemination could serve as effective tools in this regard.
- Policymakers should reevaluate the terms and conditions of existing support schemes to ensure inclusivity and relevance for diverse property types and consumer profiles. It could be beneficial for policy makers to discuss implementation of alternative schemes for those who do not meet conventional eligibility criteria may bridge participation gaps.
- Commercial installers play a pivotal role in the RES adoption process. Encouraging partnerships between installers and policymakers could enhance support scheme awareness and simplify the application process for potential participants.
- As preferences for receiving information vary, outreach efforts should combine digital platforms, community-based initiatives, and traditional media. This approach can ensure a wide-reaching and inclusive engagement strategy.

1.5 Conclusions

- NMS and NBS in Latvia play a pivotal role in advancing renewable energy adoption, particularly solar power, by enabling consumers to maximise the benefits of their energy production. These systems offer significant advantages, including cost savings, greater adoption of clean energy technologies, and a reduced environmental footprint, making net system a cornerstone of Latvia's renewable energy strategy. Despite these benefits, challenges remain in areas such as regulatory frameworks, infrastructure development, and public awareness.
- Due to Latvia's legal framework and economic conditions, active customers face limited options for feeding surplus electricity back into the grid. Their primary choices are utilizing the net billing system or participating in EComs. While electricity trading is legally permitted, it is subject to additional taxes and fees, and active customers engaging in trading are not eligible for state aid when purchasing RES-based electricity generation equipment.
- The establishment of EComs requires a robust regulatory framework, effective collaboration and communication among stakeholders, and a strong emphasis on transparency. Additionally, well-structured financial models are essential to ensure stability and accelerate the return on investments, fostering greater participation and long-term sustainability of EComs.
- Changes in regulations or tariff structures could impact the attractiveness of net metering. Stakeholders often express concerns about the potential for future adjustments that could diminish incentives.
- The interview revealed that MG significantly influences distribution network operations, presenting opportunities and challenges, particularly in managing voltage fluctuations and ensuring stability in low-voltage systems. Advancing precise calculation tools and monitoring systems is essential for integrating MG and battery systems. While digital solutions accelerate connections, challenges persist in energy production forecasting and accounting. Latvia faces slow regulatory implementation and energy demand balancing but is advancing towards sustainable EComs and network flexibility to enhance stability.
- While Latvia's renewable energy initiatives demonstrate promising progress, addressing the identified barriers and leveraging the outlined motivators can significantly enhance the adoption of RES technologies and participation in support schemes. Policymakers and stakeholders must collaborate to design and implement user-centric, transparent and inclusive strategies that align with both individual and societal energy goals.

1.6 Recommendations

Latvia has made significant progress in integrating renewable energy sources but faces challenges related to administrative complexity and rural energy access. To address these issues, Latvia should focus on creating microgrids for remote villages, supported by

grants tailored to the unique needs of these regions. This would improve energy access and reduce reliance on fossil fuels.

The EIF program provides a solid foundation for energy storage development, but increasing the maximum grant cap beyond €2,500 and expanding eligibility criteria would attract more participants. Additionally, supporting innovative technologies like second-life battery systems or vehicle-to-grid solutions could position Latvia as a leader in renewable energy storage integration.

The development of EComs remains a priority, particularly in areas with limited energy access. By learning from Lithuania's successful cooperative models, Latvia could implement virtual solar sharing systems to encourage participation from urban and rural residents alike.

Public engagement can be strengthened through targeted campaigns that highlight the economic benefits of renewables, especially for small households and agricultural communities. Simplifying platforms like Latvija.lv, adding features such as live chat and step-by-step application guides, would further increase accessibility.

By addressing these gaps, Latvia can establish a more comprehensive framework for renewable energy and energy storage integration. This would strengthen energy independence, enhance grid stability, and accelerate progress toward sustainability goals.

2 NORWAY

Norway's approach is different, as it has abundant hydropower, which dominates its energy mix. The country supports RES through the Certificate scheme, a market-based mechanism that promotes both hydropower and other renewables. Norway collaborates with Sweden under this system, allowing for cross-border trading of certificates to enhance the efficiency of renewable investments.

2.1 Evaluation of Existing Support Schemes in Norway

2.1.1 Support Schemes

Norway has implemented various support schemes that encourage consumer-level investments in assets contributing to long-term changes in electricity production and consumption[31,32,33]. These schemes target EComs, individual prosumers, and legal consumers, aiming to drive the energy transition through renewable technologies such as solar panels, wind turbines, heat pumps, EVs (EVs), and energy storage technologies.

2.1. Table. Summary of key support schemes for renewable energy and consumer-level investments schemes in Norway.

Criterion / Organization	**Enova**	**Green Electricity Certificates (joint with Sweden)**	**NVE**	**Municipal Support Schemes**
Financing	Norwegian Government	Market-based mechanism	Norwegian Government	Municipal budgets
Beneficiaries	Homeowners, municipalities, businesses	Renewable energy producers	Households, energy developers	Homeowners, public sector
Conditions	Solar panels, heat pumps, energy storage, EV chargers	Renewable electricity generation	Prosumers grid connection	Energy efficiency upgrades
Support Type	Grant, post-October 2023 is NOK 7,500 + NOK 1,250 per kW installed	Certificates	Technical assistance	Grants, technical support
Maximum Grant	Solar: NOK 32,500 for max 20 kW installed capacity; Heat Pumps: NOK 2,500 maximum	Market-dependent	N/A	Varies, often up to 50% of costs

[31] T. Langset and H. H. Nielsen, "The Norwegian Energy Regulatory Authority -RME"
[32] "Enova Reports First Quarter 2024 Results," Enova International, Inc. Accessed: Oct. 29, 2024. [Online]. Available: https://www.enova.com/newsroom/enova-reports-first-quarter-2024-results/
[33] A. Vavouris, F. Guasselli, L. Stankovic, V. Stankovic, K. Gram-Hanssen, and S. Didierjean, "Descriptor: A Norwegian Positive Energy Neighbourhood Dataset of Electrical Measurements and Interviews on Energy Practices (NorPEN)," *IEEE Data Descr.*, pp. 1–9, Oct. 2024, doi: 10.1109/IEEEDATA.2024.3483154.

Additional Information	Offers funding for home energy efficiency projects, such as solar PV and heat pumps. Consumers can receive up to NOK 32,500 for solar panel installation. Grants for energy-efficient upgrades, renewable technology, and smart energy management systems[34],[35]	Producers receive one certificate for each MWh produced incentivising investment in renewables. The scheme runs until 2035, but registration of new facilities expired in Dec 2021. Certificates encourage renewable energy production by establishing a market for tradable certificates[36]	Oversees regulations and technical standards for energy production and consumption in Norway. Encourages household engagement in energy efficiency through technical assistance and resources. [32,33]	Local municipalities provide additional financial support for energy efficiency upgrades. Provides grants and technical support for local energy efficiency projects and initiatives. [32,33]

The Norwegian Positive Energy Neighbourhood (NorPEN) data supports the effectiveness of these grants by showing that households with energy storage systems and solar PV installations can achieve a reduced payback period by 2-3 years[31]. This finding underscores the need for targeted subsidies that integrate storage solutions with renewables to enhance SC rates and reduce grid dependency[31].

2.1.2 Energy Communities

EComs in Norway foster collective investment in renewable energy. The government's alignment with the EU's Renewable Energy Directive (RED II) encourages these models, with Enova grants supporting pilot projects like shared solar installations and community heating. NorPEN data highlights the value of these grants, demonstrating how such communities achieve significant energy resilience and independence from the grid. The data also emphasizes the necessity of designing technical assistance and financial support to accommodate a range of demographic needs within communities, as some residents may face challenges in adopting and maintaining new technologies.

While existing frameworks are developing, **Enova** continues to support local energy initiatives, and upcoming support is expected to further align with EU legislation.

[34] "Norway increases support for residential PV – pv magazine International." Accessed: Oct. 29, 2024. [Online]. Available: https://www.pv-magazine.com/2022/02/02/norway-increases-support-for-residential-pv/

[35] "Norsk Hydro: Industry, Norwegian Government Agree On CO2 Compensation Scheme In Norway | Nasdaq." Accessed: Oct. 29, 2024. [Online]. Available: https://www.nasdaq.com/articles/norsk-hydro:-industry-norwegian-government-agree-on-co2-compensation-scheme-in-norway

[36] "Electricity certificates," Norwegian Energy. Accessed: Oct. 29, 2024. [Online]. Available: https://energifaktanorge.no/en/regulation-of-the-energy-sector/elsertifikater/

Norway's regulatory authority, **NVE**, also oversees the management of local energy production and its integration into the grid.

2.1.3 Prosumers

For individual prosumers, **Enova** and other Norwegian agencies offer multiple incentives to facilitate the adoption of renewable technologies:

- **Solar Panel Owners: Enova** offers rebates for installing rooftop solar PV systems, which typically cover up to 35% of the installation costs, capped at NOK 28,750. Additionally, homeowners can access subsidies for battery storage systems to enhance SC.
- **Wind Energy Prosumers:** Although small-scale wind investments are relatively niche in Norway, emerging programs provide grants for micro wind turbines, particularly in rural and coastal areas where wind resources are more viable.
- **Heat Pumps:** Homeowners can receive subsidies for energy-efficient heat pump installations. Rebates cover up to 25% of the costs, depending on the system type, which helps reduce household energy consumption significantly.
- Enova and the Green Electricity Certificates have significantly contributed to supporting energy projects in Norway. Enova, focused on energy system projects, has backed a total of 1,110 projects between 2012 and 2023, with an investment of approximately 4.55 billion NOK[37]. Additionally, the Green Electricity Certificates scheme, implemented jointly with Sweden, has facilitated a cumulative production of 28.4 TWh by 2019 across both countries. Of this, Norway's contribution includes an annual production of 2,267 GWh. Under this scheme, power producers are awarded one electricity certificate for every MWh produced, for a duration of up to 15 years[38].

2.1.4 Legal Consumers (Electric Cars and Energy Storage)

Norway is leading the world in EV adoption, with **battery EVs (BEVs)** accounting for over 82% of new car sales in 2023[39,40]. This transition has been driven by generous financial incentives, such as **VAT exemptions**, tax relief on EV purchases, and reduced tolls and parking fees[41]. Energy storage systems, such as **home batteries**, are also incentivised under Norway's grid resilience strategy, with subsidies available for installation, particularly for homes that already generate solar power.

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[37] "Oversikt over Enovas prosjektliste for 2012 til 2023," Enova. Accessed: Oct. 29, 2024. [Online]. Available: https://www.enova.no/om-enova/om-organisasjonen/prosjektliste-2012-2023/

[38] "elcertifikat-2015-en_web.pdf." Accessed: Oct. 29, 2024. [Online]. Available: https://www.nve.no/media/4750/elcertifikat-2015-en_web.pdf

[39] "4 out of 5 new cars in Norway are now fully electric - Nordic EV Summit." Accessed: Oct. 29, 2024. [Online]. Available: https://nordicevs.no/evs-continue-to-dominate-norwegian-car-sales-in-2023-4-out-of-5-new-cars-now-fully-electric/

[40] U. Berge, "4 out of 5 new cars now fully electric," Norsk elbilforening. Accessed: Oct. 29, 2024. [Online]. Available: https://elbil.no/4-out-of-5-new-cars-now-fully-electric/

[41] "Norwegian EV policy," Norsk elbilforening. Accessed: Oct. 29, 2024. [Online]. Available: https://elbil.no/english/norwegian-ev-policy/

To support this transition, the Norwegian government has invested in charging infrastructure, with approximately 17,100 publicly available charging points established nationwide. Ambitious goals aim for all new passenger cars and light vans to be zero-emission by 2025, along with similar targets for city buses and heavy vehicles by 2030[39,42]. The success of these initiatives depends on technological advancements that make zero-emission technologies competitive with traditional internal combustion engines. Additionally, energy storage systems, such as home batteries, are incentivised under Norway's grid resilience strategy, particularly for homes with solar power generation.

Moreover, Rajendran K. et al. (2019) analysed the effectiveness of decarbonization policies across Europe, highlighting Norway's substantial support for EVs. Notably, EVs receive up to sixteen times more financial backing per tonne of CO2 avoided compared to biomethane. Comprehensive policy support and incentivization are crucial for facilitating the transition to decarbonised transport and enhancing energy security, particularly when assessing financial incentives per tonne of CO2 avoided across various renewable technologies[43].

2.1.5 Stakeholder Engagement in support schemes

- **Government Agencies:** The Ministry of Petroleum and Energy and **Enova** oversee the development of policies and financial incentives for prosumers.
- **Regulators: NVE** (Norwegian Water Resources and Energy Directorate) regulates grid connections and electricity pricing to ensure a fair and accessible market.
- **Utilities and Industry Partners:** Companies like **Statnett** (Norway's transmission system operator) and local utilities help integrate distributed energy resources into the grid, providing infrastructure and market access.
- **Prosumers:** Active consumers who participate in schemes such as **NMS** and **peer-to-peer energy trading** are critical to scaling these initiatives.

2.1.6 General Assessment Criteria for Support Schemes

- **Financial Incentives:** Enova provides a range of incentives for renewable energy investments, with grants and subsidies for solar PV installations, heat pumps, and EVs.
- **Accessibility:** Most schemes are accessible to homeowners and businesses, but high upfront costs for certain technologies, such as energy storage, can be a barrier to low-income consumers.
- **Consumer Engagement:** There is growing participation in solar PV systems and EV purchases, but targeted outreach and education programs are needed to ensure broader involvement, especially in rural areas.

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[42] M. of Transport, "National charging strategy," Government.no. Accessed: Oct. 29, 2024. [Online]. Available: https://www.regjeringen.no/en/dokumenter/national-charging-strategy/id2950371/

[43] K. Rajendran, B. O'Gallachoir, and J. D. Murphy, "The combined role of policy and incentives in promoting cost efficient decarbonisation of energy: A case study for biomethane," *J. Clean. Prod.*, vol. 219, pp. 278–290, May 2019, doi: 10.1016/j.jclepro.2019.01.298.

- **Regulatory Framework:** Norway's regulatory framework ensures that prosumers are integrated into the national energy market, but further adjustments could allow for more flexible energy trading within local grids.
- **Market Development:** The renewable energy market in Norway is expanding, driven by increasing investments in solar, wind, and EVs.
- **Energy Efficiency:** Heat pumps and energy storage systems are essential technologies for reducing energy consumption and improving grid stability.

2.2 Analysis of Financial Aspects of Existing Schemes

2.2.1 Cost-Effectiveness of Investments

The cost-effectiveness of renewable energy investments in Norway varies by technology. Solar panel installations, with Enova's subsidies, typically have a **payback period** of 7-12 years. The inclusion of energy storage systems can reduce this payback time by an additional 2-3 years. Small-scale wind turbines, while supported in some rural areas, tend to have higher maintenance costs and longer payback periods due to limited wind resources.

2.2.2 Return on Investment (ROI) for Consumers

For prosumers who install solar PV systems, the **ROI** depends largely on their SC rates. Homeowners who install battery storage to optimise SC can see a significantly faster payback period, sometimes within 5-8 years. EV incentives, on the other hand, provide immediate returns through reduced fuel costs and tax savings.

2.2.3 Effectiveness of Financial Incentives

Norway's financial incentives have been highly effective in promoting the widespread adoption of **EVs**, **heat pumps**, and **solar panels**. However, gaps remain in the support for **energy storage** and **small wind technologies**, which could be expanded through additional subsidies. The administrative complexity of applying for some incentives, particularly for EComs, may also limit broader participation.

In response to rising electricity prices, the Norwegian government introduced two significant support schemes for consumers: a consumer scheme providing a 90% rebate on electricity prices over NOK 0.70 per kWh, capped at 5,000 kWh per month, and a separate scheme for industries offering a 25% rebate on similar pricing thresholds[44]. However, the implementation and accessibility of these schemes often encounter challenges, particularly for low-income households who may struggle to cover upfront costs or understand the application process[45].

While these schemes aim to alleviate immediate financial burdens, there are concerns about their long-term sustainability and effectiveness in promoting energy

[44] "Energy Laws and Regulations | Norway," GLI. Accessed: Oct. 29, 2024. [Online]. Available: https://www.globallegalinsights.com/practice-areas/energy-laws-and-regulations/norway/

[45] "Executive summary – Norway 2022 – Analysis," IEA. Accessed: Oct. 29, 2024. [Online]. Available: https://www.iea.org/reports/norway-2022/executive-summary

efficiency and transitioning to RES[42]. Stakeholders have noted that without adequate support for understanding and accessing these benefits, vulnerable populations may continue to face difficulties [43].

2.3 Detailed Summary of Support Schemes

The following table summarises the various Norwegian incentive schemes designed to promote renewable energy and consumer-level investments, aimed at transforming long-term energy production and consumption. Each scheme includes its target focus, eligibility criteria, primary benefits, and notable details.

2.2. Table. Summary of all key support schemes for renewable and decarbonization in Norway

Incentive Scheme	Description	Eligibility	Key Benefits	References
Enova Grants	Offers support for energy-efficient technologies, renewable energy projects, and home energy efficiency improvements.	Households, companies, public sector	Grants for solar PV, heating systems, electric car chargers, smart energy management tools	32, 46, 47
CO2 Compensation Scheme	Provides compensation to energy-intensive industries affected by carbon taxes to reduce emissions impact on competitiveness	Industry, especially aluminum, steel	CO2 compensation, covering up to 100% of direct and indirect costs due to CO2 taxes	33
Electricity Certificates	Market-based scheme for producers where producers receive certificates for each MWh of renewable energy produced	Renewable energy producers	Incentivises renewable energy by providing tradeable certificates, applicable for up to 15 years	32, 34, 44
Tax Deduction for Home Energy	Allows tax deductions for households investing in renewable and energy-saving technologies	Norwegian households	Tax deduction on installations like solar income	34, 44
Green Electricity Certificates	Joint Norway-Sweden system supporting renewable electricity production by mandating	Electricity	Renewable certificates traded in a market, supplementing	34, 44

[46] "Norwegian Solar Energy Incentives in 2023: A Comprehensive Guide," Solarstone. Accessed: Oct. 29, 2024. [Online]. Available: https://solarstone.com/blog/norwegian-solar-energy-incentives-in-2023-a-comprehensive-guide

[47] "Norway increases support for residential PV," pv magazine International. Accessed: Oct. 29, 2024. [Online]. Available: https://www.pv-magazine.com/2022/02/02/norway-increases-support-for-residential-pv/

	a minimum quota of renewable energy		revenue from electricity sales	
Eco-lighthouse Certification	Environmental certification for businesses and municipalities adopting sustainable practices	Private companies, municipalities	Grants access to green loans, enhances sustainability image, provides specific eco-requirements for industries	[32, 44]

These incentives collectively contribute to Norway's broader sustainability goals, ranging from consumer-level rebates and EV incentives to substantial support for industrial CO2 reduction and renewable energy projects. They illustrate Norway's holistic approach to fostering renewable energy development and promoting sustainable consumption habits across various sectors.

The following table presents an in-depth comparison of various financing schemes available in Norway, focusing on their funding sources, eligibility criteria, support conditions, and types of assistance offered. This comparative analysis aids in understanding how these schemes operate and the specific benefits they provide to their beneficiaries.

These financing schemes exemplify Norway's commitment to fostering a sustainable energy transition. By targeting various sectors and providing flexible support mechanisms, they facilitate the adoption of renewable energy technologies, encourage energy efficiency, and promote sustainable practices among individuals and organizations. As Norway continues to evolve its energy landscape, these initiatives play a crucial role in achieving national sustainability goals.

2.3. Table: Comprehensive Overview of Support Programs in Norway.

Criterion / Organization	**Enova**[48,49,50,51]	**Green Electricity Certificates (joint with Sweden)**[46]	**NVE (Norwegian Water Resources and Energy Directorate)** [46, 47, 48]	**Municipal Support Schemes**
Financing of Norway	State funding (Norwegian Government)	State funding and market-based mechanism	Norwegian Government budget	Municipal budgets (local)

[48] N. H. Prevljak, "Fifteen green ship projects get $113.5M in Enova support," Offshore Energy. Accessed: Oct. 29, 2024. [Online]. Available: https://www.offshore-energy.biz/fifteen-green-ship-projects-get-113-5m-in-enova-support/

[49] "ENOVA - Nordic Innovators." Accessed: Oct. 29, 2024. [Online]. Available: https://nordicinnovators.com/funding-programmes/norwegian-funding-programmes/enova/

[50] "Enova supports hydrogen projects in the maritime sector with NOK 1.12 billion | Enova." Accessed: Oct. 29, 2024. [Online]. Available: https://kommunikasjon.ntb.no/pressemelding/17941866/enova-supports-hydrogen-projects-in-the-maritime-sector-with-nok-112-billion?publisherId=17848299

[51] celina, "Short Hydrogen overview September 2024," Haavind EN. Accessed: Oct. 29, 2024. [Online]. Available: https://haavind.no/en/short-hydrogen-overview-august-2024-next-steps-under-the-eus-hydrogen-bank-and-enovas-support-schemes-for-hydrogen-2/

Beneficiaries	Citizens (homeowners, EV owners, energy efficiency upgrades), municipalities, businesses	Renewable energy producers (solar, wind), large-scale energy developers	Households, municipalities, energy developers	Citizens (homeowners), public sector
Conditions of the support program	- Regulations on energy efficiency upgrades in buildings, solar panels, heat pumps, EV chargers - Enova provides grants for home improvements aimed at reducing energy consumption	- Certificate system that awards renewable electricity producers based on their output - Can be used by large prosumers (home solar, wind), energy developers, or municipalities	-National regulations on energy transition, grid development, and incentives for prosumers to connect to the grid	- Support varies between municipalities but often includes local schemes for energy efficiency in buildings and small renewable energy installations
Total funding	Varies annually based on government budgets and program expansions[52]	Market-driven system, no fixed funding limit	Varies based on specific regulations and national budget	Varies, depending on the municipality
Activities to be supported	- Purchase of new electricity generation equipment (solar, heat pumps) - Construction of energy-efficient homes - EV charging infrastructure - Energy storage - Heating systems (biomass, district heating)	- New renewable energy installations (wind, solar) - Upgrading energy efficiency of buildings	- Upgrading energy systems in residential and commercial buildings - Investments in smart grid systems and flexibility	- Home insulation improvements - Solar panel installation - EV charger installation[53]
Types of support available	- Grant (for individuals and municipalities) - Guaranty for certain projects	- Green certificates (market-driven incentive)	- Technical assistance, policy support	- Grants, technical assistance
Maximum amount of grant (support)	Depends on the specific measure, e.g., solar panels up to NOK 28,750, heat pumps up to NOK 5,000.	- Certificates value determined by market demand and policy (not a direct grant to consumers)	N/A	Depends on the local municipality, often up to 50% of eligible costs.

[52] https://www.offshore-energy.biz/fifteen-green-ship-projects-get-113-5m-in-enova-support/

[53] https://haavind.no/en/short-hydrogen-overview-august-2024-next-steps-under-the-eus-hydrogen-bank-and-enovas-support-schemes-for-hydrogen-2/

Conditions for purchase of new electricity production equipment	- Solar panels, heat pumps, energy storage must meet efficiency criteria - Systems should support SC	- At least 80% of generated electricity to be consumed or fed into the national grid	- Equipment must comply with NVE's energy regulations - Must support grid stability and reduce overall consumption.	- Typically, must show a reduction in energy consumption and adherence to local standards.
Conditions for purchase of thermal energy technological equipment	Heat pumps, biomass boilers supported if aligned with national energy transition goals.	N/A	- Must replace or upgrade inefficient heating systems - Focus on RES.	- Local conditions apply for energy-efficient heating systems (heat pumps, biomass boilers)
Combination	Can be combined with other national programs if costs are not duplicated			

2.4 Microgeneration and ECom development in Norway

Norway has seen significant growth in microgeneration, particularly in household solar PV installations, driven by supportive policies and declining technology costs. By 2023, installed solar capacity reached 300 MW, with much of it on residential rooftops. The country aims for 8 TWh of solar generation by 2030[54], [55], [56]. While grid overload is not widespread, localized challenges occur during peak production when households feed excess energy into the grid, particularly in low-density areas where infrastructure is less congested [57].

Grid operators, such as Elvia, use advanced tools like Siemens' LV Insights X to optimize low-voltage network management and prevent future grid strain[58], [59]. However, further investments and grid upgrades are essential to sustain long-term stability and meet growing renewable energy targets.

Norwegian grid operators are actively addressing the challenges of rising microgeneration demand, particularly in rural and mountainous areas with limited transformer capacity and aging infrastructure. Efforts include grid upgrades, digitalization tools like digital twins, and automation to identify bottlenecks and optimize capacity. Projects such as Tensio AS's network expansion in Central Norway and the

[54] "Financing the energy transition: Solar sunrise in the Nordics?," DNV. Accessed: Nov. 25, 2024. [Online]. Available: https://www.dnv.com/article/financing-the-energy-transition-solar-sunrise-in-the-nordics/

[55] L. Thøring, "The Norwegian solar energy innovation system"

[56] "Norway deployed 300 MW of solar in 2023," PV magazine International. Accessed: Nov. 25, 2024. [Online]. Available: https://www.pv-magazine.com/2024/01/03/norway-deployed-300-mw-of-solar-in-2023/

[57] F. Førsund, "Wind power, network congestion and hydro resource utilisation in the Norwegian power market," Nov. 2007, Accessed: Nov. 27, 2024. [Online]. Available: https://www.academia.edu/119871668/Wind_power_network_congestion_and_hydro_resource_utilisation_in_the_Norwegian_power_market

[58] "The electricity grid," Norwegian Energy. Accessed: Nov. 25, 2024. [Online]. Available: https://energifaktanorge.no/en/norsk-energiforsyning/kraftnett/

[59] "Siemens and Elvia partner to increase grid capacity in parts of No ..." Accessed: Nov. 25, 2024. [Online]. Available: https://press.siemens.com/global/en/pressrelease/siemens-and-elvia-partner-increase-grid-capacity-parts-norway-2030-saas-solution

integration of energy storage solutions aim to balance supply and demand in regions with high solar PV penetration [60], [61], [62].

To manage connection bottlenecks caused by surging solar PV installations, grid operators are improving digital platforms and adopting flexible solutions like conditional connection agreements. These allow temporary or non-firm access to the grid while capacity is expanded. However, delays in processing technical conditions persist, often lasting weeks to months, particularly in areas with limited infrastructure. Licensing processes remain lengthy, influenced by factors such as case complexity and grid limitations [63], [64], [65].

Despite these challenges, Norway's focus on advanced grid management, energy storage, and flexibility services aligns with its renewable energy targets. These measures ensure grid stability and support the growing number of microgenerators while addressing localized constraints and future-proofing the energy system [66], [67].

2.4.1 SC in Norway

Self-consumption for users outside Norway's net metering system is calculated by comparing household electricity consumption directly from solar PV generation with the energy fed back into the grid. Smart meters track consumption and exported energy, enabling accurate calculations. Advanced systems also facilitate digital integration of data from multiple users in energy communities, offering greater efficiency and compliance with regulations. For rural areas without net metering, monitoring self-consumption is more complex, requiring advanced metering infrastructure to optimize usage and ensure

[60] "NIB finances upgrade and expansion of electrical grid in Norway - Nordic Investment Bank." Accessed: Nov. 25, 2024. [Online]. Available: https://www.nib.int/releases/nib-finances-upgrade-and-expansion-of-electrical-grid-in-norway/

[61] "Report published: Nordic Grid Development Perspective 2023," Statnett. Accessed: Nov. 25, 2024. [Online]. Available: https://www.statnett.no/en/for-stakeholders-in-the-power-industry/news-for-the-power-industry/report-published-nordic-grid-development-perspective-2023/

[62] "The electricity grid," Norwegian Energy. Accessed: Nov. 25, 2024. [Online]. Available: https://energifaktanorge.no/en/norsk-energiforsyning/kraftnett/

[63] "Executive summary – Norway 2022 – Analysis," IEA. Accessed: Nov. 25, 2024. [Online]. Available: https://www.iea.org/reports/norway-2022/executive-summary

[64] "Long-term market analysis," Statnett. Accessed: Nov. 25, 2024. [Online]. Available: https://www.statnett.no/en/for-stakeholders-in-the-power-industry/our-analyses-and-assessments/long-term-market-analysis/

[65] "Conditional connections make room for renewables and electrification - Thema." Accessed: Nov. 25, 2024. [Online]. Available: https://thema.no/en/news/conditional-connections-make-room-for-renewables-and-electrification/

[66] S. Yuen, "Modernising grids and substantial investments key to ease connection queues," PV Tech. Accessed: Nov. 25, 2024. [Online]. Available: https://www.pv-tech.org/modernising-grid-substantial-investment-ease-connection-queues/

[67] "Power Generation, Transmission & Distribution 2024 - Norway | Global Practice Guides | Chambers and Partners." Accessed: Nov. 25, 2024. [Online]. Available: https://practiceguides.chambers.com/practice-guides/power-generation-transmission-distribution-2024/norway/trends-and-developments

adherence to the Norwegian Energy Act, which allows surplus electricity to be sold to retailers based on grid operator rules[68] ,[69], [70], [71].

Despite robust methods, calculating self-consumption based on grid-fed energy can overlook demand-supply imbalances, particularly with intermittent solar generation. Such discrepancies risk planning inaccuracies and localized grid overloads, especially during peak sunlight hours. To address these issues, Norway is investing in energy storage systems, like batteries, to manage fluctuations, ensuring stability by storing excess energy for later use. Advanced grid planning, including probabilistic modeling, further aids in predicting and mitigating voltage issues [72], [73], [74].

Prosumers producing at least 1 MWh annually benefit from incentives like reduced network charges, yet adoption remains limited. To meet self-consumption requirements, such as maintaining 80%, utilities may implement tariffs, penalties, or support system upgrades. These measures, coupled with grid upgrades, advanced forecasting, and energy storage incentives, are crucial as microgeneration grows. Norway's proactive strategies aim to integrate decentralized generation into a stable, efficient grid while meeting renewable energy goals[75], [76].

2.4.2 Norway's 15-Minute Electricity Trading

Norway's shift to a 15-minute electricity trading interval, implemented in May 2023, aims to enhance the integration of variable renewable energy sources like solar and wind by aligning supply and demand in real time. This transition, reducing the imbalance

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[68] "Sweden and Finland surge ahead of Norway for BESS deployment." Accessed: Nov. 25, 2024. [Online]. Available: https://www.energy-storage.news/sweden-and-finland-surge-ahead-of-norway-for-bess-deployments/

[69] "Increased Consumption Results in a Negative Norwegian Energy Balance From 2027," Statnett. Accessed: Nov. 25, 2024. [Online]. Available: https://www.statnett.no/en/about-statnett/news-and-press-releases/news-archive-2022/increased-consumption-results-in-a-negative-norwegian-energy-balance-from-2027/

[70] M. Peverini, R. Cavicchia, M. Friesenecker, L. Munson, A. Susani, and karen jesus, Greener housing, but affordable? A study of synergies and conflicts between environmental policy instruments and access to housing. 2023. doi: 10.13140/RG.2.2.36609.84325.

[71] "FACTSHEET_Norway_syn.ikia_.pdf." Accessed: Nov. 25, 2024. [Online]. Available: https://www.synikia.eu/wp-content/uploads/2023/05/FACTSHEET_Norway_syn.ikia_.pdf

[72] "Norway Electricity Security Policy – Analysis," IEA. Accessed: Nov. 25, 2024. [Online]. Available: https://www.iea.org/articles/norway-electricity-security-policy

[73] T. H. J. Inderberg, J. Palm, and E. H. Matthiasen, "Flexible electricity consumption policies in Norway and Sweden: Implications for energy justice - FNI." Accessed: Nov. 25, 2024. [Online]. Available: https://www.fni.no/publications/flexible-electricity-consumption-policies-in-norway-and-sweden-implications-for-energy-justice

[74] "Framework and methodology for active distribution grid planning in Norway," SINTEF. Accessed: Nov. 25, 2024. [Online]. Available: https://www.sintef.no/en/publications/publication/1826943/

[75] "Distributed-energy-production-and-self-consumption-20190607-1.pdf." Accessed: Nov. 25, 2024. [Online]. Available: https://www.nordicenergy.org/wordpress/wp-content/uploads/2019/06/Distributed-energy-production-and-self-consumption-20190607-1.pdf

[76] "Prosumer Legislation in Norway: A First Step for Empowering Small Energy Consumers (Chapter VIII) - European Energy Law Report XII." Accessed: Nov. 28, 2024. [Online]. Available: https://www.cambridge.org/core/books/abs/european-energy-law-report-xii/prosumer-legislation-in-norway-a-first-step-for-empowering-small-energy-consumers/1D966A67824639D4911B44BD79E43DB2

settlement period from 60 to 15 minutes, addresses challenges posed by renewable energy intermittency while creating new demands for data management and grid balancing [77].

The shorter trading interval requires utilities to handle significantly larger volumes of energy data with greater frequency and precision. Advanced data management tools, real-time monitoring, and automation are essential to optimize grid loads and prevent overloads. Improved forecasting tools and advanced grid management practices are also necessary to handle the variability introduced by distributed generation, such as household solar PV systems[78].

To support this transition, smart meters now measure electricity fed into the grid at 15-minute intervals, forming the basis for estimating household generation. The centralized Elhub platform aggregates this data, streamlining communication among grid operators, suppliers, and market participants. While Elhub enhances data accessibility and decision-making, gaps in directly measuring on-site generation and self-consumption remain. Advanced technologies, such as supplementary generation meters and energy management systems, are needed to improve accuracy, ensure efficient grid integration, and support Norway's renewable energy objectives[79].

2.4.3 DGOs Supporting Norway's Renewable Energy Integration

Distribution Grid Operators (DGOs) play a critical role in facilitating renewable energy adoption in Norway by managing the technical integration of solar panels, battery storage, and advanced energy systems into the grid. While financial incentives and grant schemes, primarily administered by agencies like Enova, promote household and business transitions to renewable energy, DGOs focus on grid stability. Their responsibilities include conducting assessments for new installations, ensuring compliance with standards, and assisting in the deployment of energy management technologies.

DGOs also actively support renewable energy adoption through initiatives like grants for energy management systems, tax exemptions for residential solar PV generation, and streamlined grid connection processes. These efforts aim to balance the rapid expansion of distributed energy resources with infrastructure development. As solar PV capacity reached 597 MW by 2023, DGOs are increasingly addressing challenges like intermittent generation and grid stability, particularly in rural areas with limited infrastructure [80].

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[77] "15 min Imbalance Settlement Period – nordicbalancingmodel." Accessed: Nov. 27, 2024. [Online]. Available: https://nordicbalancingmodel.net/roadmap-and-projects/15-min-time-resolution/

[78] "Norway Electricity Security Policy – Analysis," IEA. Accessed: Nov. 25, 2024. [Online]. Available: https://www.iea.org/articles/norway-electricity-security-policy

[79] "Norway completes smart meter rollout," IoT M2M Council. Accessed: Nov. 26, 2024. [Online]. Available: https://www.iotm2mcouncil.org/iot-library/news/smart-energy-news/norway-completes-smart-meter-rollout/

[80] solarman, "Government Support in Solar Panel System in Norway," Solar Home Ideas. Accessed: Nov. 26, 2024. [Online]. Available: https://solarhomeideas.com/government-support-in-solar-panel-system-in-norway/

To mitigate these challenges, DGOs, along with Statnett, are investing in smart grid technologies, predictive analytics, and regional flexibility markets. These advancements enable real-time energy management, enhance grid resilience, and accommodate peak renewable generation. Community-scale batteries and grid upgrades further stabilize the system, ensuring Norway's energy transition aligns with its sustainability goals while maintaining robust grid reliability [81].

2.4.4 Energy Communities and Policy Development

The growth of EComs in Norway presents significant opportunities and challenges for DGOs. ECs promote localized energy production and consumption, supported by technologies like solar PV systems and energy storage. These communities enhance grid stability by reducing reliance on centralized power generation, alleviating peak demand strain, and fostering local energy trading. Additionally, EComs provide flexibility services, such as storing surplus energy and balancing supply and demand during critical periods. Grid-friendly EComs can achieve peak power reductions of 23-55%, offering a cost-effective way to defer grid reinforcements [82].

However, integrating EComs into the grid requires substantial investments in modernizing infrastructure, including smart grids and advanced energy management systems, to manage the variable energy flows generated. Ensuring equitable cost allocation among ECom members and other grid users remains a critical policy challenge, requiring careful regulatory adjustments [83].

Discussions are underway about introducing tailored distribution tariffs for EComs. Currently, Norway's regulatory framework does not specifically address EComs, relying instead on fixed, energy-based, and load-based charges. While these tariffs cover general network costs, they are not optimized for the unique dynamics of EComs, such as their ability to reduce transmission losses and stabilize the grid during peak demand.

Tailored tariffs could incentivize ECom behaviors that support grid stability, such as using local storage during peak times or implementing demand-response measures. Proposals include capacity-based or dynamic tariffs that reflect EComs' variable impact on the grid. These models would ensure fair cost contributions while encouraging ECom growth and supporting renewable energy integration[84].

Although regulatory changes are yet to be finalized, such tariffs are a promising step toward maximizing EComs' potential in transforming Norway's energy landscape while addressing grid and policy challenges effectively[85].

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[81] K. Strupstad, J. Arnesen, S. Karlsen, H. Duus, and H. Sletta, "Practical experiences of battery operation in a Norwegian rural grid".

[82] P. Wijnen, "Local energy communities in Norway," Norway Today. Accessed: Nov. 26, 2024. [Online]. Available: https://norwaytoday.info/news/report-local-energy-communities/

[83] R. Egging and A. Tomasgard, "Norway's role in the European energy transition," Energy Strategy Rev., vol. 20, pp. 99–101, Apr. 2018, doi: 10.1016/j.esr.2018.02.004

[84] "(PDF) Engaging the public for citizen energy production in Norway," in ResearchGate. doi: 10.4324/9781032003092-11.

[85] D. Qiu, N. Chrysanthopoulos, and G. Strbac, "Tariff Design for Local Energy Communities Through Strategic Retail Pricing," in 2023 19th International Conference on the European Energy Market (EEM), Jun. 2023, pp. 1–6. doi: 10.1109/EEM58374.2023.10161888.

2.5 Conclusions

Norway has developed a comprehensive approach to support renewable energy and sustainable energy consumption, but it comes with both notable advantages and certain challenges. On the positive side, the country offers a wide range of well-funded incentives, such as Enova grants for energy efficiency projects, Green Electricity Certificates for renewable energy production, and significant tax exemptions for EVs, which have propelled EV adoption to over 82% of new car sales in 2023. Subsidies for solar panels and energy storage systems also reduce payback periods, encouraging prosumer engagement and renewable integration. However, challenges remain, including high upfront costs for some technologies, complex administrative requirements for collective energy initiatives, and disparities in municipal support schemes that can create unequal access across regions. Additionally, smaller-scale technologies like wind turbines receive less support, and the reliance on public funding raises questions about long-term sustainability. Addressing these challenges through simplified processes, enhanced municipal support, and diversified funding could further solidify Norway's leadership in the global energy transition.

EComs offer significant potential for local energy sharing and grid efficiency but are constrained by the absence of a formal framework. While Norway's reliance on hydropower provides flexibility, the variability of renewables like solar requires advanced grid management and planning.

2.6 Recommendations

Norway's renewable energy landscape benefits from robust support schemes, such as Enova's incentives for energy efficiency and renewable, the Green Electricity Certificates, and municipal-level initiatives. To maximize the impact of these schemes, Norway should focus on enhancing their accessibility and integration with emerging technologies.

The development of floating offshore wind farms offers a unique opportunity for Norway to solidify its leadership in innovative renewable energy solutions. Expanding Enova's funding to cover feasibility studies and pilot projects for offshore wind would encourage private-sector participation. Municipalities could also provide co-financing for smaller coastal wind projects to involve local communities in the energy transition.

Norway's hydroelectric storage capacity is a significant asset for managing renewable energy intermittency. Integrating storage solutions, such as batteries and pumped hydro, into existing support schemes like Enova would ensure better grid stability and optimize renewable energy use. Expanding eligibility criteria for Green Electricity Certificates to include hybrid projects (e.g., wind + storage) could further incentivize innovation.

Administrative barriers for small-scale producers remain a challenge. Streamlining application processes under municipal schemes and providing technical support for first-time applicants would encourage broader participation. For example, simplifying permits

for rooftop solar installations through digital platforms could significantly boost adoption among households and small businesses.

To support microgeneration and ECom development, Norway should focus on creating a regulatory framework tailored to EComs, enabling local energy trading and fair cost allocation.

Finally, Norway should enhance its cross-border energy collaboration by leveraging its surplus renewable energy production. Green Electricity Certificates could be expanded to support export-oriented renewable projects, ensuring Norway strengthens its role as a clean energy exporter within the European market.

3 SPAIN

Spain employs a combination of feed-in tariffs (FiTs), auctions, and renewable energy certificates. The government has set ambitious targets under the NECP to promote wind and solar power. In recent years, competitive auctions have been the primary mechanism, ensuring cost-effective deployment of renewables while providing fixed prices for energy over a set period.

Spain is at the forefront of transitioning to a sustainable energy model, with a comprehensive framework of policies designed to enhance energy efficiency, promote renewable energy, and facilitate energy sharing. These policies are critical for achieving the European Union's climate and energy targets and align with the national goals set under the Integrated NECP. The implementation of these policies has a profound impact on innovative concepts like Positive Energy Neighborhoods (PENs), which aim to generate more energy than they consume at a community level, leveraging collective SC, renewable energy integration, and enhanced efficiency measures.

The country has been actively investing in renewable energy and energy efficiency projects to align with its ambitious climate and sustainability goals. The data highlights significant financial and resource commitments aimed at enhancing the country’s energy infrastructure.

The investment initiatives include funding for EComs, renewable energy generation, and the development of storage and electric power capacities. Key metrics such as the number of projects, total economic support, budget allocation, and technical capacities (electric and thermal power generation, as well as storage capabilities) provide a comprehensive overview of Spain's efforts to transition towards a more sustainable energy model.

With over €58 million in budget allocation, 37 MW of electric power capacity, and 160 kWh of storage installed across 25 projects, these investments emphasise Spain's commitment to reducing carbon emissions and promoting renewable energy integration. Such efforts not only benefit local communities but also strengthen Spain's leadership in the global renewable energy landscape[86].

Below will be provided a detailed exploration of national and local policies, as well as the legislative frameworks that support energy efficiency, renewable energy adoption, and circularity in Spain. It is also highlighted the barriers to implementation and suggests policy recommendations to enhance the effectiveness of these initiatives.

[86] Data from supporting projects call of 2023

3.1 National and Local Policies for Energy Performance

One of the cornerstones of Spain's energy policy is the Technical Building Code (CTE-DB HE Energy Saving), a national regulation that governs energy use and demand in buildings. Applicable to new and retrofitted structures, the code mandates minimum standards for renewable electricity generation. Following its 2019 update, the NZEB (Nearly Zero Energy Buildings) standard became mandatory for new constructions and major renovations from January 2020. These measures aim to ensure that renovations contribute to achieving a positive energy balance at the neighborhood level, preparing Spain for the adoption of zero-emission building standards under the 2023 EPBD recast[87].

The Royal Decree 178/2021, which regulates thermal installations in buildings (RITE), complements this framework by setting minimum requirements for energy efficiency and safety in thermal systems. This supports the PNIEC goal of reducing primary energy consumption by 39.5% by 2030, encouraging the transition to sustainable heating systems while disincentivising the use of fossil fuels[88].

Spain also promotes large-scale residential renovations through policies like Royal Decree 853/2021, which facilitates financial aid for private and social housing rehabilitation under the Recovery, Transformation, and Resilience Plan. This program aligns with PEN objectives by enabling economies of scale and fostering community engagement[89].

Further support for energy efficiency comes from Law 10/2022, which lowers approval thresholds for homeowner associations undertaking energy-efficient upgrades. This law also provides tax incentives and facilitates access to private loans, ensuring broader participation in renovation initiatives essential for PEN implementation[90].

At the local level, heritage conservation laws, such as the Special Protection Plan and Interior Reform of the Old Town (PEPRI), pose unique challenges. In areas like Pamplona's historic district, the installation of PV panels is prohibited. Despite these restrictions, the PEN framework emphasises adaptive technology solutions to integrate renewable energy while respecting heritage protection[91].

3.2 Policies for Energy Sharing and Flexibility

Spain's energy-sharing policies are designed to empower communities and individuals to collectively benefit from renewable energy. The Royal Decree-Law 15/2018[92] establishes the framework for SC, exempting renewable energy users from charges and tolls. It also simplifies administrative procedures for installations up to 100 kW, encouraging the adoption of shared SC models, which are foundational for PENs.

[87] CTE Documentation, https://www.codigotecnico.org
[88] RITE Regulations, https://www.boe.es
[89] Spanish Recovery Plan, https://planderecuperacion.gob.es
[90] Law 10/2022, https://www.boe.es
[91] PEPRI Policies, https://www.navarra.es
[92] Royal Decree-Law 15/2018, https://www.boe.es

Building on this, the Royal Decree 244/2019[93], amended by Royal Decree 20/2022, provides a detailed structure for Collective SC (CSC). It allows communities within a 2 km radius or with shared cadastral codes to jointly access and benefit from renewable energy installations, while exempting PV users from taxes. This framework reduces administrative barriers, enabling neighborhoods to implement PEN concepts effectively.

The introduction of Renewable Energy Communities (REC) through Royal Decree-Law 23/2020[94] facilitates collective energy projects by establishing them as legal entities. Although REC participants cannot sell energy between themselves, this policy encourages shared ownership and market participation, paving the way for PENs to evolve as integral components of Spain's energy transition.

To further promote collective renewable energy investments, Royal Decree 19/2021 [95] modifies property laws, making it easier for residential communities to approve the installation of shared renewable energy systems. These changes foster community engagement and collective investment in renewable energy systems.

3.3 Circularity and whole-life carbon policies

Spain's commitment to sustainability extends to reducing the carbon footprint of buildings throughout their lifecycle. The Spanish Urban Agenda[96] emphasises the use of efficient building techniques and materials that ensure durability and facilitate reuse. This aligns with the PEN philosophy by advocating for sustainable construction methods that minimise environmental impacts.

Despite these progressive measures, several barriers remain, including a lack of expertise in sustainable construction, high costs associated with recycled materials, and the absence of a national methodology for calculating whole-life carbon. Addressing these issues requires capacity-building initiatives and the development of material registries to streamline the use of secondary materials.

3.4 Support programmes in Spain

The following table summarises the various Spanish incentive schemes designed to promote renewable energy and consumer-level investments, aimed at transforming long-term energy production and consumption. Each scheme includes its target focus, eligibility criteria, primary benefits, and notable details.

[93] Royal Decree 244/2019, https://www.boe.es.
[94] Royal Decree-Law 23/2020](https://www.boe.es
[95] Royal Decree 19/2021, https://www.boe.es
[96]Spanish Urban Agenda, https://www.mitma.gob.es

3.1. Table. Comprehensive Overview of Support Programs in Spain.

Criterion/ Organization	PRTR	PRTR	PRTR
Support programmes	Programa de Incentivos a proyectos piloto singulares de comunidades energéticas (CE IMPLEMENTA)	PREE 5000. Rehabilitación energética de edificios en municipios de reto demográfico	Programa DUS 5000. Ayudas para inversiones a proyectos singulares locales de energía limpia en municipios de reto demográfico
Beneficiaries	Any interested group that classifies as a possible energetic community	Municipalities of less than 5000 inhabitants	Municipalities of less than 5000 inhabitants
Conditions of the support programme	Different for each call, they come in pairs. One of maximums of 1000000€ and one that has a minimum of 1000000€	Monofamily buildings, collective residence buildings, other buildings. Focus on collectives at risk of energy poverty.	Municipalities of less than 5000 inhabitants.
Total funding	70,300,000 €	201,485,731 €	675,000,000 €
Activities to be supported	REC or CEC	Renovations only. Upgrading of: façade, thermal installations, lighting installations.	Demand reduction, electricity generation installation, heat/cold generation installations, lighting installation interventions, sustainable mobility technologies
Types of support available	Economic, technical, consulting	Economic, technical, consulting	Economic, technical, consulting
Maximum amount of grant (support)	1000000€ for the "small" type call and 60% to 40% for "big" types (more than 1000000€ of investments)	5,000,000 €	6,000,000 €
Residential house	Possible	Yes. Both individual and collective	Yes, it is included
Conditions for the purchase of new electricity production equipment	None	Only if it ends in "energetic rating" of A, B or +2 from original	PV. 1.100(€/kW); Eolic. 3.884(€/kW); Hydro. 4.531(€/kW); Electric Storage. 500xC(€/kW) where C is electric capacity in kWh
Conditions for the purchase of thermal energy technological equipment	None	Only if it ends in "energetic rating" of A, B or +2 from original	Solar Thermal. 1.295 (€/kW); DHW geothermal closed circuit. 3.237 (€/kW); DWH geothermal open circuit. 2.460(€/kW) Aerothermal. 1.295 (€/kW); Hydrothermal closed circuit. 2.330 (€/kW); Hydrothermal

			open circuit. 1.685(€/kW) Biomass. 647(€/kW)
Combination	No	Yes if limits in Reglamento (UE) n.º 651/2014, de 17 de junio de 2014	Yes if limits in Reglamento (UE) n.º 651/2014, de 17 de junio de 2014

3.5 Barriers and Recommendations

Although Spain has established a robust policy framework, implementation challenges persist. For instance, the lack of transposition for Citizen Energy Communities (CEC) into Spanish legislation limits the ability of PENs to sell excess energy or provide flexibility services. Additionally, frequent regulatory changes create uncertainty for long-term investment and planning. Recommendations include:

1. Transposing the CEC framework and revising Royal Decree 244/2019 to allow PENs greater market participation.
2. Establishing one-stop-shops to provide guidance on energy-sharing models.
3. Collaborating with stakeholders to ensure stable and supportive regulatory environments.

Spain should focus on tailoring its support schemes to regional needs, optimising administrative processes, and integrating innovative solutions.

3.6 Conclusion

Spain's energy policies provide a solid foundation for fostering PENs, but their full potential can only be realised through targeted enhancements and effective implementation. By addressing existing barriers, integrating advanced energy-sharing frameworks, and promoting sustainable construction practices, Spain can position PENs as a cornerstone of its energy transition. These initiatives not only advance national energy and climate goals but also serve as a model for community-based energy solutions globally.

While Spain's support programmes and investments in the energy transition demonstrate strong commitment, they face several challenges that could hinder their effectiveness. Complex eligibility criteria and administrative burdens discourage participation, particularly from small municipalities and individual homeowners. The programmes' strong focus on rural areas often overlooks the pressing energy needs of urban centers, while insufficient funding limits scalability to meet national energy demands. Additionally, small stakeholders face barriers such as high initial costs and legal hurdles, particularly in collective energy projects. Reliance on public funding raises concerns about the sustainability of these initiatives, and a lack of focus on integrating various energy components into broader systems could lead to inefficiencies. Addressing these challenges will require simplifying procedures, expanding programme scope, increasing financial incentives, diversifying funding sources, and enhancing system-wide integration.

4 ROMANIA

Romania primarily uses green certificates as its support mechanism. This system mandates that electricity suppliers purchase a certain number of certificates corresponding to their renewable energy output. The government also holds auctions for large-scale renewable projects to encourage investment. Romania aims to increase its renewable energy capacity significantly, particularly in wind and solar.

The emergence of the EComs concept in Romania marks a notable development, prompting discussions within academic circles, research institutions, and various stakeholders primarily engaged in European projects and initiatives. Despite the liberalization of the energy market in 2017, public awareness and understanding of the active roles that citizens, public authorities, and companies play in the energy sector remain nascent.

The recent escalation of energy prices, compounded by geopolitical tensions, has served as a catalyst, prompting heightened awareness and knowledge acquisition among the populace. Concurrently, the burgeoning interest in EComs has determined national authorities to amend current energy legislation, aiming to provide clarity on the establishment and operational procedures for such communities (an initial step toward realising these energy-focused efforts).

In terms of EComs, community engagement and participation are currently lacking in Romania, as previously mentioned. However, several active ECom initiatives are emerging, which will help overcome most of the challenges involved in their establishment.

In Romania, over the past 24 months, the number of prosumers has increased by 400%, resulting in a current tally exceeding 200,000 individuals with an aggregate installed capacity of 1,400 MW—equivalent to more than one nuclear reactor[97]. This remarkable growth can be attributed to the unprecedented public acceptance of renewable energy projects, buoyed significantly by the European and national grants. Notably, 'The Green House' stands out as a highly favored financing program exclusively created for households, facilitating the realization of over 80,000 PV projects to date. Meanwhile, within the commercial and public sectors, the landscape is characterised by a proliferation of financing programs. In the preceding 12 months alone, governmental investments in PV projects and energy efficiency enhancements in buildings have surpassed €800 million, reflecting a robust commitment to sustainable energy initiatives. Considering the information presented, it can be stated that Romania is on the right track in terms of developing EComs.

[97] https://www.green-forum.eu/energy/20240401/romania-to-achieve-approximately-200000-prosumers-by-the-end-of-2024-991

4.1 Funding programs in Romania for Renewable

Despite significant investments by the European Commission and national government in renewable energy projects and energy efficiency, current funds fall short of meeting market demands due to rapid sector growth, complex funding access, and regulatory uncertainties. The evolving nature of renewable energy technologies in Romania and the diverse array of stakeholders involved present challenges in effectively distributing available funds. Additionally, market fluctuations and regulatory frameworks deter investors, further limiting the pool of resources and in distributing the funds where necessary. At the moment of elaborating the present deliverable, there are several funding opportunities at national level as follows: dedicated to providing support for installing renewables, refurbishment of buildings, storage capacities, charging stations for EV and green mobility for public authorities:

- For households: "The Green House" program[98] supporting the citizens to install PV panels on their roofs.
- For public authorities: The Modernization Fund[99], The National Recovery and Resilience Plan[100], Just Transition Program, Large Infrastructure Operational Program.
- For companies[65, 66]: The Modernization Fund, The National Recovery and Resilience Plan,Just Transition Program, Large Infrastructure Operational Program.

A summary of the programs is highlighted in 4.1. Table:

4.1. Table. Comprehensive Overview of Support Programs in Romania

CRITERION/ ORGANISATION	ADMINISTRAȚIA FONDULUI PENTRU MEDIU(AFM)	MINISTRY OF ENERGY	ADMINISTRAȚIA FONDULUI PENTRU MEDIU(AFM)	ADMINISTRAȚIA FONDULUI PENTRU MEDIU(AFM)
Financing programs	Program on the installation of PV panel systems for the production of electricity to coverthe consumption needs and to deliver the surplusto the national grid(Casa Verde)	Electric UP 2	National Recoveryand Resilience - Industrial chain of production and/orassembly and/or recycling of batteries, cells andPV panels, new electrical energy storage capacities for sub-measure 4.1 - Support investments in the entire battery value chain	The program regarding the installation of PV panel systems for places of worship, public institutions/non-profit legal entities in the field of social assistance
Financing type	State budget	State budget	Next Generation EU funds	State budget

98 https://www.planup.eu/en/resources/policies/casa_verde_%E2%80%93_the_green_house_[romania]/937

99 https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/modernisation-fund_en

100 https://commission.europa.eu/business-economy-euro/economic-recovery/recovery-and-resilience-facility/country-pages/romanias-recovery-and-resilience-plan_en

Beneficiaries	Citizens	Small and medium-sized enterprises and economic operators in the Hospitality sector	Large enterprises,SMEs, Start-ups	Units of worship, institutions, public authoritiesfrom the nationalsocial assistance system, accredited non-profit legal entities for the provision of social services
Conditions of thesupport program	Regulations of the Ministry of Environment, Water and Forests: Government OrderNo. 1063/2023 forthe approval of the Financing Guidelines of the Program on the installation of PV panel systems to produce electricity to cover the consumption needs and to deliver the surplusto the national grid[101]	Regulations of the Ministry of Energy: Emergency Government OrderNo. 159 released on the 3rd of September 2020 regarding the financing of the PV panel system to produce the required for own consumption[102].	Regulation (EU) 2021/241 of the European Parliament and of the Council of February 12, 2021 establishing the Recovery and Resilience Mechanism 2021- 2027, as well as inthe Implementation Decision of Council of November 3, 2021 approving the evaluation of the Recovery and Resilience Plan[103].	Regulation of the Ministry of Environment, Waters and Forests[104]
Total funding	402.2 mil. €	90.5 mil. €	149.25 mil. €	50.3 mil. €
Activities to besupported	Installation of PV systems (30-200 kW) for self-consumption, surplus delivery to the grid, improving energy efficiency, and reducing emissions.	Support for SMEs (27-150 kWp PV systems) with energy storage, EV charging stations (22 kW), and alternative heating/cooling systems.	Establishment of battery production, assembly, and recycling capacities, including equipment procurement.	Installation of PV panel systems (30-200 kW) for self-consumption, with surplus energy delivered to the national grid; aims to increase energy efficiency, improve air quality, and reduce greenhouse gas emissions.
Types of support available	Grant	Grant	Grant	Grant

101 https://www.afm.r o/main/programe/sisteme_fotovoltai ce/2023/ordin_10 63-26_04_2023-aprobare_ghid_finantare- 2023_05_03.pdf

102 https://energie.go v.ro/wp- content/uploads/2024/03/Ghid- finantare-Electric- Up-2-1-2.pdf

103 https://oportunita ti- ue.gov.ro/en/apel/pnrr-c6-i4-ghidul- solicitantului-lant- industrial-de-productie-si-sau- asamblare-si-sau- reciclare-a- bateriilor-a- celulelor-si- panourilor- fotovoltaice-inclusiv- echipamente-auxiliare/

104 https://oportunitati- ue.gov.ro/program /programul- privind-instalarea-sistemelor-de- panouri- fotovoltaice- pentru-unitatile- de-cult-institutiile-publice-entitatile- juridice-non- profit-din- domeniul- asistentei-sociale/

Maximum amount of grant(support)	Up to 6000 € per residential house that is eligible to join theprogram.	Up to 150 000 € for small and medium-sized enterprises that operate in the Hospitality sector.	Not specified	Up to 202.000 €
Residential house	The buildings that are eligible for this program must not have common and individual properties, in the form of a block/condominium with more than two apartments.	Not mentioned	No	No
Conditions for the purchase of new electricity production equipment	- 10% of the grant must be paid by the beneficiary - the beneficiary must own the residential building and live inthe house proposed for the project - must not have any overdue stateor local budget obligations	- must be a small tomedium-sized enterprise that activates in the Hospitality sector - supporting 25%of the total investment	No	- purchase, installation and commissioning of the PV panel system witha minimum installed power ofat least 30 kW anda maximum installed power of200 kW.
Combination	Be combined withother support programs withoutreceiving support for the same actions (costs)			

4.2 Energy Communities in Romania

A vibrant citizens' movement aimed at establishing EComs has emerged across the country. The research referenced in Greenpeace[105] report has identified 21 ECom projects, of whichtwo have successfully been established and are operating within the existing legal framework (The Energy Cooperative and InterNeighbors). More than half of these identified projects have been initiated by local public authorities. While only two communities are currently operational, an additional 10 projects are in an advanced conceptual stage, with the remaining projects in their initial phases. The predominant technology preferred by ECom initiators in Romania is PV panels,although one project utilises biomass to meet local thermal energy needs. Despite being spearheaded by individuals with strong entrepreneurial drive and significant technical expertise in the energy sector, Romanian EComs currently face challenges related to weak advocacy and representation.

Tables below preset some details about these two energy initiatives. More than half of the ECom projects identified are initiated by local public authorities. Although only two communities are currently operational, another 10 projects are at an advanced

105 https://www.greenpeace.org/romania/articol/9585/comunitatile-de-energie-o-solutie-pentru-reducerea- facturilor-la-energie/

conceptual stage, and the remaining up to 21 are at an early stage.

Also, the same report emphasised PV panels as preferred technology by the initiators of EComs. There is only one project that uses biomass to cover thermal energy consumption at the local level entitled Green Energy Cluster originating in Covasna County.

4.2. Table. Cooperativa de energie (The Energy Cooperative)[106] in Romania

Name of Positive Energy District (ECom)	*Cooperativa de Energie*
Type of District (Residential/Commercial/ Industrial)	Commercial
Location (City/Region)	Bucharest, Romania
Year Established	2019
Number of Members	984 members
Description	It operates as a consumer community, able to supply energy to its members, but also to sell the energy surplus on the market, through the purchase of a supplier, made in order to obtain a supply license.
Technology & Infrastructure	Electricity supplier which provides 100% green energy, with certificatesof origin.
Funding	Through the contribution of its members, the Cooperative acquired an existing energy company *Apuron Energy SRL* and entered in the market as the first 100% green energy supplier in Romania, with certificates of origin.
Governance Structure	Electricity supplier
Challenges & Successes	Challenges: - The energy market in Romania is dominated by a number of large companies, which limits competition; - Although Romania has significant potential for green energy, accessto it is still limited, especially for domestic consumers - In order to start the project, over 100 cooperative members chose to invest 2 million lei in green energy, supporting the Cooperative'sentry into the market. Successes: - The Cooperative exclusively supplies electricity from renewable sources (solar, wind, hydro), contributing to the reduction of CO2 emissions and combating climate changes - The cooperative is a democratic organization, owned and controlled by its members. The democratic model allows citizens toplay an active role in the energy transition, participate in decision-making and invest in green energy projects - The Energy Cooperative organizes energy education campaigns and programs, making the population aware of the importance of green energy and responsible consumption.

Currently, the cooperative consists of 984 members and supplies 412 consumers withgreen energy. In 2023, the electricity supplied was 2 GWh.

[106] https://cooperativadeenergie.ro/

4.3. Table ÎntreVecini (InterNeighbors)[107] in Romania

Name of Positive Energy District (ECom)	*ÎntreVecin*i
Type of District	Residential
Location (City/Region)	Bucharest, Romania
Year Established	2021
Number of Members	9 communities
Description	It is a non-governmental organization, non-political, non-profit, without patrimonial purpose. Within the IntreVecini project, tenants' associations are financially supported for the installation of PV covering its consumption exclusively with the common parts and recording a small financial surplus, which constitutes the association's income.
Technology & Infrastructure	PV panels installed on the rooftop harness solar energy. However, due to regulatory limitations, the energy generated from RES is currently allocated solely for the shared areas. These spaces primarily utilise electricity for lighting and powering the elevator. Any excess green energy is fed back into the national grid, resulting in financial compensation to the owners' association from the energy provider.
Funding	The funding was provided by the BRD Société Générale Bank, through the NGO "IntreVecini". The NGO organised a proposal contest, firstly available just for one particular area in Bucharest (now covering the entire country). The value of the grant of 10,000 €os is mainly used for covering the PV system costs and also for organising educational campaigns among the neighbors.
Governance Structure	From a legislative point of view, Romania transposed the RED II Directive in December 2022, through GEO
Challenges & Successes	According to the project initiators the following challenges were encountered: - The ambiguity of the legislation, in terms of EComs and shared consumption. Nowadays, the Romanian law allow theformation of EComs however considering many restrictions, which are not necessary imposed by the law but rather due to lack of the legislative normative. - The owners' opposition to being part of an organization with their neighbors. Such phenomena are widespread in all local communities for cultural and historical reasons. Successes: - Reducing the energy costs of the owners related with the common spaces; - Social benefits: the energy project brought together neighbors that would not have interacted in other circumstances. - Environment benefits: by producing green energy using local sources, the carbon footprint of the building has considerably been reduced.

In 2022, ÎntreVecini organization transformed an ordinary block into a community of energy entitled Grădina Apusului, highlighting the potential for change and unity in localcommunities.

[107] https://intrevecini.ro/

4.4. Table. Grădina Apusului (Sunset Garden) founded by ÎntreVecini Association in Romania

Name of Positive Energy District (ECom)	*Grădina Apuslui, Sector 6, București*
Type of District	*Residential*
Location (City/Region)	*Bucharest, Romania*
Year Established	*2022*
Number of Members	*60 dwellings*
Description	In 2021, the Tenant's Association applied for a grant offered by the ÎntreVecini Association - technical assistance and financial support for the search and installation of PV panels on the block. In 2022, the initiative has brought significant benefits to the community. In addition to generating its own energy, the community was able to bring people together. Significantly, the garden set up in thecourtyard of the block where vegetables and shrubs were planted, generated a common interest. In the same year the community acquired the state of prosumer, producing green energy and injecting it into the grid.
Technology & Infrastructure	PV panels installed on an area of 40m^2 on the rooftop produces an average of 729kW/h monthly.
Funding	Grant offered by ÎntreVecini provided the necessary budget for the panels, approximately 5,500 €.
Governance Structure	Prosumer
Challenges & Successes	Challenges - The ambiguity of the legislation, in terms of EComs and shared consumption. - The owners' opposition to being part of an organization with their neighbors. Such phenomena are widespread in all local communities for cultural and historical reasons. Successes: - Reducing the energy costs of the owners. - The ECom brought together neighbors - The carbon footprint of the building has considerably been reduced.

Moreover, the significant rises of the organization are visible by projects implemented in new communities. ÎntreVecini Association developed new communities in 2023. Five of them Blocul Liric, Rose Garden, Vlaicu Vodă, Pridvorului, Broscuțele from Bucharest werefounded and another two: AM Social Space and AM Social Space were facilitated. In 2024,another founded community was Infinitului, Târgu Jiu.

Despite its early stage, the movement of EComs in Romania is characterised by a lot of enthusiasm, multiple ideas, a good anchoring in the local context and in the needs of the community, of relations with similar initiatives in Romania and outside Romania. This enthusiasm is also visible in the initiators who have a strong entrepreneurial profile, identifying solutions and overcoming obstacles in an attempt to find support for their idea. This type of Positive Energy District founded by Green PV House program are described below.

A rural community that has proposed climate neutrality is Buteni which includes fourvillages with approximately 3,100 inhabitants and 900 households

4.5. Table.Buteni community[108] in Romania

Name of Positive Energy District	*Buten*i
Type of District	Residential
Location (City/Region)	Buteni, Arad
Year Established	2020
Number of Members	900 households
Description	In 2020, 107 houses in the commune have installed PV panels through the Green PV House program, but also from their ownfunds. Another 80 files have been approved and are awaiting the releaseof funds related to the 2023 edition of the program. Thus, approx. 20% of the commune's households are or will be prosumers in the immediate future. The City Hall team mediated the application for the funds for the citizens, explaining in advance the entire procedure, roles and responsibilities, as well as the short- and long-term benefits. To date, PV panels have already been installed with a total capacity of approx. 800 kW, these producing approx. 900 mWh/year. For this investment, € 720,000 was accessed from the AFM programs to this amount was added an own contribution of € 280,000. The community's calculations indicate a recovery of the investment in about three years.
Technology & Infrastructure	PV systems installed on each household roof. Regarding the grid infrastructure, the future ECom will use the national distribution grid to deliver green energy into the system and, when the legislation allows it, to share energy within the community.
Funding	Green PV House program
Governance Structure	From a legislative point of view, Romania transposed the RED IIDirective in December 2022, through GEO 163/2022. The definitionoffered to EComs by this normative act is a sum of thecharacteristics of the communities provided by the European directive.The national legislation does not opt for a specific legal form and does notbring additional clarifications to the general enumeration in the European directive regarding the characteristics of EComs.Thus, according to the definition in Romanian legislation, energycommunities are all legal entities that are based on open and voluntaryparticipation and are effectively controlled by their members, having asshareholders or members natural persons, SMEs or municipalities andhaving as their main objective the provision of " community benefits economic, social or environmental benefits to shareholders / members / local areas in which they operate rather than financial profits".

[108] The Establishment Of The First Energy Community In Romania And The Transition To Green Energy, Using Renewable Resources, In Buteni Commune, Arad County - Cities of Tomorrow #12

Challenges & Successes	Challenges were encountered: - The ambiguity of the legislation, in terms of EComs and shared consumption. Nowadays, the Romanian law allow theformation of EComs however considering many restrictions, which are not necessary imposed by the law but rather due to lack of the legislative normative. - The lack of awareness and basic technical knowledge among the owners. Successes: - Reducing the energy costs of the owners; - Social benefits: the energy project brought together neighbors that would not have interacted in other circumstances. Environment benefits: by producing green energy using local sources, the carbon footprint of the buildings has considerably been reduced.

The PV panels with a total capacity of approx. 800 kW, have already been installed, producing approx. 900 mWh/year. For this investment, € 720,000 was accessed from AFM programs to this amount adding an own contribution of € 280,000.The community's calculations indicate a recovery of the investment in about three years.

The new ECom developed together with the neighborhood was Flamingo 50, Baloteşti, Ilfov. The initiative was to create an ECom where members can share their generated energy. With a single distributor and being geographically isolated,the crucial factor was to ensure resilience and grid independence.

4.6. Table.Flamingo 50, Baloteşti, Ilfov, in Romania

Name of Positive Energy District (ECom)	*Flamingo 50*
Type of District	Residential
Location (City/Region)	Baloteşti, Ilfov, Romania
Year Established	2022
Number of Members	27 members from 30 households with 5 more members in the joining process
Description	This community is represented by the homeowner's association. Members were inspired by the Greenpeace Community Guide, looking for ways to implement sustainable solutions and to reduce dependence on traditional sources. 25% of the houseowners managed to receive funding from the financing program "Casa Verde" and 75% have financed the installation of the panels on their houses from their own sources. The energy generated is used for heating, charging electric carsand of the 51 adult permanent residents, the majority work from home and therefore energy consumption during the day is higher than in the evening/at night.
Technology & Infrastructure	PV panels installed on the roof of each household, and electriccar charging stations.
Funding	Green PV House program and own sources.
Governance Structure	Electricity supplier
Challenges & Successes	Challenges: - They are situated in a remote area thus the access to essential services such as quick repairs in the event of power outages is limited. - This community is in a stage of discussion and documentation, with difficulties in interconnecting members. - The ambiguity of the legislation, in terms of EComs and shared consumption. Nowadays, the Romanian law allow the formation of

	EComs however considering many restrictions, which are not necessary imposed by the law but rather due to lack of the legislative normative. Successes: - Supplying the energy required for the house heating and chargingof the electric cars Diversifying of the energy portfolio to reduce the reliance on theonly supplier in the region.

Is notable the existence at an early stage of similar ideas of EComs in Petroşani, (Hunedoara Country), Râmnicu-Vâlcea (Vâlcea Country), Mediaş (Alba Country), Cluj-Napoca(Cluj Country) as well as in other localities.

4.3 Conclusion

While Romania lacks a secondary legislative framework for EComs, existing regulations in energy, construction, energy efficiency, and mobility offer a starting point. This suggests that policymakers have laid some groundwork for sustainable practices. However, the lack of a cohesive framework tailored to EComs creates ambiguity and potential roadblocks for these initiatives. A more comprehensive legal framework could provide clarity, streamline processes, and unlock the full potential of EComs in Romania.

The emergence of 21 ECom projects across Romania, despite legislative hurdles, demonstrates a strong bottom-up demand for community-based energy solutions. This primary movement indicates a desire for greater energy autonomy, local economic benefits, and participation in the transition to renewable energy. Nurturing this enthusiasm through targeted support and policy changes could lead to a significant expansion of EComs in the country.

The operational success of Energy Cooperative and InterNeighbors, even within the limitations of the current legal framework, provides valuable lessons and a replicable model for aspiring EComs. These pioneers likely navigated complex regulations and technical challenges, offering insights that can guide future projects andinform policy adjustments. Documenting and disseminating their experiences can accelerate the growth of the sector.

The lack of strong advocacy and representation for Romanian EComs hinders their ability to influence policy, access funding opportunities, and raise public awareness. Establishing a unified voice, potentially through an industry association or advocacy group, is essential to overcome these challenges. A collective voice can effectively communicate the benefits of EComs to policymakers and the public, creating a more supportive environment for their growth.

4.4 Recommendations

Romania's growing reliance on renewable energy sources, such as wind and solar, highlights the need for a stronger focus on energy infrastructure. The country should prioritize expanding its grid capacity and enhancing energy storage solutions to manage the intermittency of renewable sources. Targeted incentives, such as grants for large-scale battery systems and pumped storage projects, would address current infrastructure challenges and ensure greater stability for the energy grid.

Administrative barriers remain a significant hurdle in Romania's renewable energy sector. Lengthy and complex permitting processes for solar panel installations and wind projects discourage participation from both small producers and large investors. Simplifying these procedures by introducing online platforms, pre-approved project templates, and standardized documentation requirements could attract more stakeholders to invest in renewable energy.

Romania's industrial potential presents a unique opportunity to position itself as a leader in battery production and recycling. Leveraging its existing manufacturing capabilities, the country could develop facilities for producing and recycling batteries to meet growing demand across Europe. Offering tax breaks, direct subsidies, and research grants would incentivize private sector participation and help Romania establish itself as a regional hub for green technology.

Finally, Romania should focus on integrating renewable energy with its existing energy mix by upgrading its grid infrastructure. Investments in smart grid technologies, enhanced interconnectivity with neighboring countries, and advanced forecasting tools for renewable energy generation would ensure better utilization of resources and support Romania's path toward energy independence.

5 PORTUGAL

Portugal is recognised as one of the first countries in the world to adopt a national strategy for climate change, setting ambitious goals for carbon neutrality. Over the years, the country has introduced a diverse range of support schemes aimed at promoting renewable energy and enhancing energy efficiency.

Currently, most of these support schemes are structured as investment aid, grant programs or competitive tendering processes.

Portugal offers several investment aid and grant programs [109], especially through the Portugal 2030 initiative and the Recovery and Resilience Plan (RRP).

The Portugal 2030 program is primarily financed by the €opean Regional Development Fund (ERDF) and encompasses 12 distinct programs that allocate funding based on specific activity areas and regions[110]. Amongst these are the Sustentável 2030 and COMPETE 2030 programs.

The Sustentável 2030 program has a budget of €3.1 billion, funded by the Cohesion Fund, and focuses on interventions related to energy transition—primarily through decarbonisation—as well as initiatives that promote resource sustainability and urban mobility. This aligns with the objective of creating A Greener Portugal and includes investments in transportation, particularly in railways and the maritime-port sector, under the A More Connected Portugal aim.

The COMPETE 2030 program has a funding total of €3.9 billion, sourced from the ERDF and ESF+. It aims specifically at the least developed regions of mainland Portugal and the Autonomous Regions. It supports innovation, competitiveness, energy transition and skill development for small and medium-sized enterprises (SMEs). Under the A Greener Portugal objective, this program assists companies in their decarbonisation projects and boosts the production of renewable energies.

The Recovery and Resilience Plan[111] is primarily funded by the EU's Recovery and Resilience Facility (RRF) and is designed as a nationwide initiative, set to be implemented

[109] See, e.g., https://www.portugalenergia.pt/financiamento/

[110] According to the Portugal 2030 website. General information is available in English at https://portugal2030.pt/en/portugal-2030/o-que-e-o-portugal-2030/ and https://portugal2030.pt/en/programmes/

[111] General information on the RRP can be found at https://recuperarportugal.gov.pt/prr/ and https://recuperarportugal.gov.pt/transicao-climatica/ (version in English available).For more detailed information, see https://recuperarportugal.gov.pt/wp-content/uploads/2024/04/Analysis-of-the-recovery-and-resilience-plan-of-Portugal-ammending-of-the-implementing-decision.pdf. Detailed information on the more than 200.000 projects funded in 2021 and 2022 can be found at https://recuperarportugal.gov.pt/monitorizacao/. A complete list of PRR Beneficiaries with Payments over €1M is available at https://recuperarportugal.gov.pt/monitorizacao-relatorios-de-monitorizacao/. *Some* projects are also in the Commission's Map of projects supported by the Recovery and

until 2026. Each of the six pillars underpinning the Plan is associated with specific investment allocations[112].

In relation to the Climate Transition pillar, allocations reach approximately €4 billion, distributed across six components: C.10-Sea [113]; C-11 – Decarbonisation of industry[114]; C-12 – Sustainable bioeconomy[115]; C-13 – Energy Efficiency in buildings[116]; C-14 – Hydrogen and renewables [117]; C-15 – Sustainable mobility [118]; and C-21 – REPowerEU[119].

The Portuguese "Fundo Ambiental"[120] (Environmental Fund) currently oversees a significant portion of the RRP funds. Its goal is to support environmental and climate action policies that aim to achieve sustainable development objectives. This includes, amongst others, initiatives focused on RES, energy efficiency, water resource management, waste management, nature conservation and biodiversity.

Recently, under the C-21 – REPower EU component, the ministries of Economy and Environment and Energy have implemented a new incentive system called 'Support for the Development of an Ecological Industry' as per Ordinance n.º 160/2024/1. The first call for applications[121] was launched in July, offering a total of €50 million in grants for projects that contribute to enhancing energy efficiency, decarbonisation and the production and storage of renewable energy. These grants support technological projects aimed at achieving these objectives and are managed by IAPMEI – the Agency for Competitiveness and Innovation.

In relation to competitive tendering procedures, there have been numerous RES-E tenders, especially since 2019. Special provisions exist for specific sectors, depending on the primary energy source and installed capacity. For example, Decree-Law No. 105/2023 provides a competitive process for the allocation of TRCs (injection capacity reserve titles) up to a maximum injection power limit of 60 MW for the grid-connected

Resilience Facility, available at https://commission.europa.eu/business-economy-euro/economic-recovery/recovery-and-resilience-facility_en#map

[112] More information, comprising the implementation of key reforms and investments using EU instruments, can be found in 2024 Country Report – Portugal (https://economy-finance.ec.europa.eu/document/download/c6e61ba3-868f-4de4-833b-a398213472b6_en?filename=SWD_2024_622_1_EN_Portugal.pdf) and 2023 Country Report – Portugal (https://economy-finance.ec.europa.eu/document/download/0da9e8f7-09fb-44d1-8f37-ccaa575b1c3c_en?filename=PT_SWD_2023_622_en.pdf).

[113] See https://recuperarportugal.gov.pt/transicao-climatica/mar/ for more detailed information on the grants available and amounts funded thus far.

[114] Idem at https://recuperarportugal.gov.pt/transicao-climatica/descarbonizacao-da-industria/tc-c11-i01-descarbonizacao-da-industria/

[115] Idem at https://recuperarportugal.gov.pt/transicao-climatica/bioeconomia-sustentavel/

[116] Idem at https://recuperarportugal.gov.pt/transicao-climatica/eficiencia-energetica-em-edificios/

[117] Idem at https://recuperarportugal.gov.pt/transicao-climatica/hidrogenio-e-renovaveis/

[118] Idem at https://recuperarportugal.gov.pt/transicao-climatica/mobilidade-sustentavel/

[119] Idem at https://recuperarportugal.gov.pt/transicao-climatica/repowereu/

[120] https://www.fundoambiental.pt/

[121] https://www.iapmei.pt/PRODUTOS-E-SERVICOS/Incentivos-Financiamento/Documentos-Incentivos/Aviso-C21-i05-Apoio-ao-desenvolvimento-industria-E.aspx

system on the continent and 10 MW for each individual plant[122]. Additionally, the first electronic auction for the centralsed purchase of biomethane and hydrogen has recently been launched[123].

The subsequent sections provide an overview of support schemes in three sectors: **electricity, energy efficiency and transport.**

5.1 Key Support Schemes for Renewable Electricity (RES-E)

5.1.1 Investment Aid and Grant Programs:

- **Support for CERs and CSC:** Administered under the Environmental Fund, these programs are pivotal in promoting renewable energy projects for community and collective use. The 2023–2024 calls allocated €75 million to deploy 93 MW of new capacity[124].
- **Programa de Apoio a Edifícios Mais Sustentáveis (Support Program for More Sustainable Buildings).** This program incentivises the installation of renewable energy systems and energy efficiency measures in residential buildings, with funding up to €7,500 per project[125].
- **SITCE (Incentive Scheme for Climate and Energy Transition):** Allocated €300 million to businesses for renewable energy adoption and decarbonization efforts, especially in northern, central, and Alentejo regions[126].
- **Competitive Tenders**[127].

5.1.2 Energy Efficiency Programs

- **Programa Vale Eficiência (Efficiency Voucher Program):** Targeted at low-income families, this program distributed €130 million in vouchers to support energy efficiency upgrades in residential buildings[128].
- **Support Program for Residential Condominiums:** Focuses on funding energy retrofits for multi-family buildings with grants capped at €150,000 per condominium[129].

[122] In January 2019, the European Commission approved the support scheme for biomass plants, which includes a 15-year feed-in premium and has a total budget of €320 million. For biomass harvested in critical forest areas, an additional environmental tariff premium (PDIF) may be applicable.

[123] See https://www.dgeg.gov.pt/pt/areas-setoriais/energia/combustiveis/procedimentos-gases-renovaveis/1%C2%BA-leil%C3%A3o-compra-centralizada-biometano-e-hidrog%C3%A9nio/

[124] Environmental Fund (Fundo Ambiental), aligned with Decree-Law No. 162/2019, which implements EU Directive 2018/2001 on renewable energy, https://diariodarepublica.pt/dr/home

[125] Environmental Fund Annual Reports (2021–2023), focused on increasing energy efficiency and reducing energy poverty.

[126] PNEC 2030, Section on Funding Allocation for Green Transition

[127] Renewable Energy Auctions Report (DGEG, 2020).

[128] Implementation guidelines outlined by the Portuguese Environmental Fund, 2022

[129] Energy Transition Funding Reports (2021–2024)

5.1.3 Renewable Integration in Transport

Portugal's decarbonization strategy for the transport sector integrates renewable energy through biofuels and electric mobility[130]:

- **Biofuel Quotas**: Mandated blending of renewable fuels in the transport sector to reduce reliance on fossil fuels.
- **Electric Mobility Initiatives**: Subsidies for EV purchases, alongside grants for installing charging infrastructure, have made EVs a popular choice among Portuguese consumers.

Portugal's support programs face challenges and opportunities in the transition to renewable energy. High upfront costs remain a barrier, particularly for vulnerable populations, despite the availability of grants. Administrative hurdles and complex application procedures further deter smaller stakeholders, while reliance on EU co-financing raises concerns about long-term sustainability. However, the success of renewable energy auctions demonstrates the potential for scaling cost-effective renewable projects. Expanding REC can enhance local energy resilience and reduce grid dependency, while the integration of smart grid technologies offers opportunities for improved energy efficiency and advanced energy storage solutions.

The tables 5.1-5.3 summarise Portuguese incentive schemes promoting renewable energy and consumer investments, highlighting their targets, eligibility, benefits, and key features to drive long-term energy transformation.

5.1. Table . Comprehensive Overview of Support Programs in Portugal

Support programmes	**C13 i01, i02 e i03: Apoio à concretização de Comunidades de Energia Renovável e Autoconsumo Coletivo**	**06/C13-i01 Programa Vale Eficiência II**	**C13-i01: Programa de Apoio a Edifícios Mais Sustentáveis**
Beneficiaries	Renewable EComs (article 189 of Decree-Law no. 15/2022) Self-consumers (Article 3 (f) of Decree-Law no. 15/2022) Managing Entity for Collective Self-Consumption (Article 3 (gg) and article 86 (2) of Decree-Law no. 15/2022)	Natural persons who meet the following conditions: 1. Beneficiaries of the social electricity tariff 2. Non-beneficiaries of the social electricity tariff, but with at least one of the members of the household being beneficiary of a social benefit 3. Owners, usufructuaries or tenants and permanently residents in the dwelling for which they are applying for the support Vale Eficiência.	Natural persons who are owners and permanent residents of the dwelling. Natural persons who can prove that they are entitled of any rights that allow them to carry out the interventions on the properties referred to in points 2 and 5 of the call.

[130] Reports from the Portuguese Institute for Mobility and Transport (IMT) and MOBI.E annual updates.

Conditions of the support programme	2nd call of the support for implementation of renewable EComs and collective SC https://www.fundoambiental.pt/ficheiros/2024/2-aviso-cer_v11.aspx	Call for the 2nd phase of the program "Vale Eficiência" https://www.fundoambiental.pt/ficheiros/2024/c13-aac_pve2_2repub_facil-admin_05junho_final1.aspx	Call for the 'More sustainable buildings' 2023 https://www.fundoambiental.pt/ficheiros/2023/paes-aac_paes2023_2republicacao_130920231.aspx
Total funding	€ 75.000.000,00	€ 104.000.000,00 for the 2nd phase	€ 30.000.000,00
Activities to be supported	The installation of renewable electricity production units for SC, with or without energy storage, as part of Renewable EComs or Collective-Self Consumption, in residential buildings, central administration buildings or commerce and service buildings.	1. Replacement of non-efficient windows for efficient windows (with an energy rating of "A" or higher and external solar protection) 2. Heating and/or cooling systems for space and domestic hot water that use renewable energy, with an energy rating of "A" or higher a) Heat pumps b) Solar thermal systems c) High-efficiency biomass boilers and recuperators 3. Installation of PV systems and other renewable energy production equipment for SC, with or without storage.	1. Replacement of non-efficient windows for efficient windows (with an energy rating of "A+"); 2. Installation or replacement of thermal insulation on roofs, walls or floors; 3. Heating and/or cooling systems for space and domestic hot water that use renewable energy, with an energy rating of "A+" or higher; 4. Installation of PV systems and other renewable energy production equipment for SC with or without storage; 5. Interventions aimed at water efficiency.
Types of support available	Grant	Grant (energy vouchers for families) Technical and administrative support	Grant
Maximum amount of grant	200.000 € per production unit for SC, including storage 500.000 € per Renewable EComs or Collective-Self Consumption	1.300 € per voucher, up to 3 vouchers per beneficiary	7.500 € per beneficiary
Residential house	Regarding residential buildings, Renewable ECom or Collective SC projects apply to existing private sector housing, single-family buildings, as well as multi-family buildings or their autonomous fractions in private properties.	Single-family and multi-family buildings under a situation of energy poverty	Existing single-family housing buildings, as well as autonomous fractions of multi-family buildings licensed for housing up to and including December 31, 2006.

Specific conditions (for the intervention covered by the supporting schemes)	- Installers and manufacturers of the solutions must have license or other applicable document that enables them to carry out the intervention, and a valid registration on the DGED portal; - The energy produced by the project may not be sold in excess of 20% through the electricity markets outside the scope of the Renewable ECom or Collective SC. - The storage component of the project, if existing, must be at least 120% and no more than 250% of the peak power of the energy production system to be installed under this notice and be directly connected to the production unit for SC - In the case of residential buildings, the project must have a minimum of 4 delivery point codes and each SC member must reduce their annual electricity bill by at least 20% (in €).	The measures supported as well as their installation must comply with the national and the EU legislation and regulations in force in the respective areas and must present better energy performance than the original solutions installed or provide an improvement in the overall energy performance of the building or autonomous fraction. In particular, it must be ensured that the interventions comply with the principle of "do no significant harm"	- Installers and manufacturers of the solutions must have license or other applicable document that enables them to carry out the intervention, and a valid registration in the portals connected to every type of intervention; - The measures supported as well as their installation must comply with the national and the EU legislation and regulations in force in the respective areas and must present better energy performance than the original solutions installed or provide an improvement in the overall energy performance of the building or autonomous fraction. In particular, it must be ensured that the interventions comply with the principle of "do no significant harm"
Combination	Applications for operations already approved under the Environmental Fund's Notices are not eligible	Costs covered by other fundings are not eligible.	Beneficiaries have the option to reapply; however, there are specific limits and discounts that apply to second or third applications.

5.2. Table. Detailed Overview of Support Schemes in Portugal (Programa de Apoio a Condomínios Residenciais and Introdução no consumo de veículos de emissões nulas no ano de 2024 - Mobilidade Verde Passageiros)

Support programmes	**04/C13-i01: Programa de Apoio a Condomínios Residenciais**	**Introdução no consumo de veículos de emissões nulas no ano de 2024 - Mobilidade Verde Passageiros**
Beneficiaries	Residential condominiums and individual owners in the case of buildings under sole ownership.	For typology 1, only individuals, Private Institutions of Social Solidarity (IPSS), and other social institutions are eligible for the incentive. For Typologies 3, 4, 5, and 6, individuals and legal entities are eligible for the incentive to introduce zero-emission vehicles into

		use. For Typology 7, only applications for support for the acquisition and installation of EV charging stations, properly connected to the Mobi.E Network [Managing Entity of the Electric Mobility Network], in common private areas associated with multifamily housing units under condominium ownership, submitted by residents or condominium administrations for parking spaces within the same condominium, are eligible for the incentive.
Conditions of the support programme	Call of the support for residential condominiums https://www.fundoambiental.pt/ficheiros/2024/c13-aac_-condominios_28mar24_2rep1.aspx	Call No. 22989/2024/2 https://www.fundoambiental.pt/ficheiros/2024/aviso-n-22989-2-2-mobilidade-verde-passageiros1.aspx
Total funding	€ 12.000.000,00	€ 10.000.000,00
Activities to be supported	The implementation of passive measures at the level of the opaque envelope of residential condominiums (installation or replacement of thermal insulation on roofs, walls, and floors).	Introduction of a 100% new EV into use and scrapping of a fossil-fuel vehicle that is over 10 years old; introduction of carbo bicycles, new, whose first acquisition was made in the name of the applicant after January 1, 2024; introduction of electric bicycles for urban use, new, whose first acquisition was made in the name of the applicant after January 1, 2024; introduction of motorcycles, mopeds, tricycles, quadricycles, and electric personal mobility devices, new, whose first acquisition and registration, if applicable, was made in the name of the applicant after January 1, 2024; introduction of a new conventional urban bicycle, whose first acquisition was made in the name of the applicant after January 1, 2024; and chargers for EVs in multifamily condominiums connected to the Mobi.E Network
Types of support available	Grant	Grant
Maximum amount of grant (support)	€ 150.000	Introduction of zero-emission passenger cars: 4.000 € incentive for individuals; 5.000 € for IPSS and other social institutions. Introduction of cargo bicycles, with or without electric assistance: an incentive amounting to 50% of the acquisition value of the vehicle, up to a maximum of 1.500 € for cargo bicycles with assistance or 1.000€ for cargo bicycles without assistance. Introduction of urban electric bicycles: an incentive amounting to 50% of the acquisition value of the vehicle, up to a maximum of 500 €. Introduction of motorcycles, mopeds, tricycles, quadricycles, and electric personal mobility devices: an incentive amounting to 50% of the acquisition value of the vehicle or device, up to a maximum of 500 €. Introduction of conventional urban bicycles: an incentive amounting to 50% of the acquisition value of the vehicle, up to a maximum of 150 €. Chargers for EVs: An incentive amounting to 80% of the acquisition value of the charger, up to a maximum of 800 € per charger installed in 2024.

Residential house	Existing multi-family housing buildings, under total ownership with floors or rooms that can be used independently or under horizontal ownership, licensed for housing up to and including December 31, 2006, throughout the national territory	For Type 7 interventions, chargers for EVs in multi-family condominiums with connection to the Mobi.E. Network
Specific conditions	- The interventions must ensure that the components (roof, wall, or floor) of the envelope of the common areas of the building are fully insulated, and applications that only target part of the work on the components to be intervened upon will not be accepted. - The installation or replacement of thermal insulation on roofs, walls, or floors must meet the following technical requirements: a) Work must be carried out by companies duly qualified for this purpose, holding a valid construction license or contractor's certificate, and registered on the Portal Casa Eficiente 2020 or the Portal CasA+ (https://portalcasamais.pt/). b) Thermal insulation materials used in the interventions must have a product datasheet, CE marking, or declaration of conformity. c) The renewed elements of the opaque envelope (roofs, walls, or floors) must comply with regulatory requirements for overall energy performance, particularly with the thermal transmission coefficients listed in section 1.2 of Annex I of Ordinance No. 138-I/2021, of July 1st. d) Thermal insulators made from natural base materials (eco-materials) or incorporating recycled materials are considered if they have at least one of the following documents: i. Type I ecological labeling, defined based on ISO 14024 standard; ii. Type III ecological labeling, defined based on ISO 14025 standard; iii. Product datasheet or a declaration signed by the manufacturer, supported by information on the composition of the product and the origin of raw materials,	- For new EV: a '100% new EV' refers to any new passenger vehicle, exclusively electric, of category M1 according to the classification of the Institute of Mobility and Transport, I.P. (IMT), duly approved, and whose first acquisition and registration were made in the name of the applicant after January 1, 2024. - For cargo bicycles: a 'new vehicle' is understood to be any cargo bicycle, with or without electric assistance, specially designed by the manufacturer to transport passengers or bulky items, or the trailers intended for that purpose. - For urban electric bicycles: any electric-assist bicycle designed by the manufacturer for urban use, excluding bicycles intended for sports use, namely for cross-country or mountain biking, as well as scooters or other types of cycles. - For motorcycles, mopeds, tricycles, quadricycles, and electric personal mobility devices: any two-wheeled motorcycle or moped that is exclusively electric, has €opean certification, and is subject to registration, excluding those classified as enduro, trial, or with sidecars, according to the classification of the IMT; any new tricycle or quadricycle with exclusively electric propulsion, from categories L5e, L6e, or L7e, that has €opean certification, according to the IMT classification, and whose first acquisition and registration, if applicable, were made in the name of the applicant after January 1, 2024; any device intended for the mobility of people or goods, specially designed by the manufacturer to transport passengers or bulky objects in public spaces, including scooters and monowheels, with electric propulsion, not included in the previously mentioned categories, new, and whose first acquisition and registration, if applicable, were made in the name of the applicant after January 1, 2024. - For conventional urban bicycles: "A 'new bicycle' is understood to be a conventional bicycle, without electric assistance, designed by the manufacturer for urban use, excluding bicycles intended for sports use, namely for cross-country or mountain circuits, as well as scooters or other types of cycles.

	proving that it is composed of more than 70% of its mass from natural materials; iv. Product datasheet or a declaration signed by the manufacturer, supported by information on the composition of the product and the origin of raw materials, proving that it is composed of more than 50% of its mass from recycled materials.	
Combination	Costs covered by other fundings are not eligible.	

5.2 Conclusion

Portugal's renewable energy support schemes represent a robust framework for driving its energy transition. Programs such as CER and CSC initiatives, solar auctions, and energy efficiency vouchers address multiple facets of sustainability, from reducing greenhouse gas emissions to promoting economic inclusivity. Challenges like administrative complexity and unequal access need attention to ensure equitable benefits across all regions.

By leveraging EU support and building on successful domestic policies, Portugal is positioned to achieve its renewable energy goals and serve as a model for other nations. Continued focus on simplifying regulations, modernising the grid, and expanding public awareness will be crucial in sustaining momentum.

5.3 Recommendations

Portugal's unique position as a renewable energy leader offers opportunities to address its specific challenges and enhance its transition to clean energy. One key area is the development of offshore wind energy. With its extensive coastline and access to deep-water technologies, Portugal has the potential to become a global hub for offshore wind. Streamlining permitting processes, offering financial incentives, and encouraging international partnerships could accelerate the deployment of floating wind farms, particularly in the Atlantic.

Expanding solar energy adoption remains crucial, especially in regions with high solar potential. Although Portugal has made significant progress in solar self-consumption, there is room for improvement in simplifying access to subsidies and expanding support for small-scale installations. Tailoring incentives for households and businesses in sunny regions, along with educational campaigns about solar benefits, would drive further adoption.

Energy storage is another area where Portugal can strengthen its renewable energy system. Introducing targeted support for battery installations at residential and commercial levels would help manage the intermittency of solar and wind power. Portugal could also explore pumped hydro storage, leveraging its mountainous terrain to expand existing infrastructure for large-scale storage solutions.

Rural areas in Portugal often face slower renewable energy adoption due to financial and logistical barriers. Addressing this requires tailored solutions, such as

microgrids powered by solar and wind, supported by localized energy storage. Promoting EComs in these regions would empower residents to collectively manage and share renewable energy resources, ensuring equitable access to clean energy benefits.

6 SWITZERLAND

Switzerland has established a comprehensive regulatory framework to promote renewable energy production and SC, aligning with its Energy Strategy 2050 goals. Key components of this framework include provisions for individual and collective SC, as well as the formation of EComs.

6.1 Renewable Energy and Self-Consumption Framework

6.1.1 Individual Self-Consumption (Eigenverbrauch)[131]

Swiss legislation permits individuals and businesses to produce and consume their own renewable energy, primarily through PV systems. Excess energy can be fed into the grid, with compensation rates varying by canton and utility provider. This approach encourages decentralised energy production and reduces reliance on traditional energy sources.

6.1.2 Collective Self-Consumption (Zusammenschluss zum Eigenverbrauch, ZEV)

The ZEV[83] model allows multiple consumers, such as residents of an apartment building or neighboring properties, to collectively produce and share renewable energy. Participants can jointly invest in a shared energy production facility, like a rooftop solar installation, and distribute the generated electricity among themselves. This model promotes efficient use of resources and facilitates access to renewable energy for those who may not have suitable individual installations.

6.1.3 Energy Communities[132]

While Switzerland does not have a specific legal definition for EComs akin to the €opean Union's RECs or CECs, the concept is gaining traction. EComs in Switzerland are typically cooperative ventures where members collaboratively invest in and manage renewable energy projects. These initiatives aim to provide environmental, economic, and social benefits to their members and the local community.

6.1.4 Regulatory Framework

The Swiss Federal Office of Energy (SFOE)[133] oversees the implementation of energy policies, including those related to SC and EComs. The regulatory environment is designed to encourage renewable energy adoption while ensuring grid stability and fair

[131] https://www.research-collection.ethz.ch/bitstream/handle/20.500.11850/381734/PM_MasterThesis_Report_FINAL.pdf

[132] https://main.compile-project.eu/wp-content/uploads/COMPILE_Collective_self-consumption_EU_review_june_2019_FINAL-1.pdf

[133] https://www.bfe.admin.ch/bfe/en/home/supply/electricity-supply/federal-act-renewable-electricity-supply.html/

market practices. Recent legislative amendments have streamlined approval processes for renewable energy projects, facilitating faster deployment.

6.2 Support Mechanisms

Switzerland offers various support schemes to promote renewable energy:

6.2.1 Feed-in Remuneration at Cost (KEV)

Introduced in 2009, the KEV program was designed to support electricity generation from renewable sources by offering cost-based compensation to producers. This system covered the difference between production costs and market prices, ensuring producers received a fair return. However, as of February 2024, subsidies under the KEV program are no longer available for new installations.

6.2.2 One-Time Investment Subsidies

To encourage the deployment of PV systems, Switzerland offers one-time investment grants. These subsidies are available for PV installations ranging from 2 kW to 50 MW, covering a portion of the initial investment costs. This approach aims to reduce the financial burden on investors and accelerate the adoption of solar energy.

6.2.3 Support for Large-Scale PV Systems

In response to amendments to the Energy Act adopted on September 30, 2022, Switzerland has facilitated the approval of large-scale PV plants. The legislation establishes a subsidy providing a one-time remuneration of up to 60% of the investment costs for these projects, promoting the development of substantial solar installations.

6.2.4 Tax Incentives

Certain cantons in Switzerland offer tax deductions or credits for investments in renewable energy systems. These incentives aim to further reduce the financial burden on individuals and organizations investing in RES, encouraging broader participation in the energy transition.

6.2.5 Regulatory Measures

Switzerland has streamlined administrative procedures to facilitate the faster rollout of renewable energy projects. Efforts to reduce permitting timelines and address legal bottlenecks are underway to ensure that renewable energy projects can be deployed more efficiently, supporting the country's climate and energy goals.

These support schemes reflect Switzerland's commitment to enhancing renewable energy capacity and transitioning towards a sustainable energy system. By combining financial incentives with regulatory reforms, Switzerland aims to create a conducive environment for the growth of RES.[134]

The table 6.1 summarises Swiss incentive schemes promoting renewable energy and consumer investments.

[134] https://www.bfe.admin.ch/bfe/en/home/research-and-cleantech/funding-program-sweet.html

6.1. Table. Comprehensive Overview of Support Programs in Switzerland

Support Programme	One-Time Investment Subsidies	Support for Large-Scale PV Systems	Tax Incentives	Feed-in Remuneration at Cost (KEV)	Solar Thermal Grant Programme
Total Funding	Annual budget varies; CHF 450 million allocated in 2023	Up to 60% of investment costs covered	Varies by canton	Historically supported large-scale renewables; no longer available for new installations as of February 2024[135]	Varies by canton
Activities Supported	Installation of PV systems and energy storage solutions	Installation of large-scale solar PV systems	Investments in renewable energy systems	Renewable electricity generation from PV, wind, and hydro	Installation of solar thermal systems for heating and hot water
Types of Support Available	Fixed one-time subsidies for PV installations	One-time grants	Tax deductions	FiTss (historical programme)	Grants for system installation
Maximum Amount of Grant	CHF 300 per kW for PV systems	60% of project investment costs	Depends on cantonal policy	Based on cost of production	Up to 30% of installation costs
Residential House Eligibility	Available for rooftop PV installations and battery systems	Not applicable	Deductions available for rooftop PV or solar heating systems	Applicable for residential and small-scale producers in earlier years	Grants available for homeowners to improve heating efficiency
Conditions for Purchasing New Electricity Production Equipment	Equipment must meet Swiss energy efficiency standards and be installed by certified professionals	Equipment must comply with grid connection and efficiency standards; project must be approved by relevant authorities	Equipment must comply with Swiss certification and tax eligibility criteria; installation must be documented for tax purposes	Equipment had to meet technical and efficiency standards; programme is now closed to new applicants	Not applicable
Conditions for Purchasing Thermal Energy Technological Equipment	Not applicable	Not applicable	Must meet energy efficiency criteria established by the canton; installation must be	Not applicable	Thermal systems must meet certification requirements; installation must be performed by

[135] https://www.iea.org/countries/switzerland/renewables

			documented for tax purposes		certified professionals
Combination	Can be combined with other programmes, provided total subsidies do not exceed 100% of project costs	Can be combined with other programmes, such as cantonal tax incentives, subject to specific conditions	Can be combined with other programmes, but subject to canton-specific regulations	Not combinable due to its historical fixed-payment structure; programme is now closed to new applicants	Can be combined with other programmes, provided total grants do not exceed full project costs

6.3 Conclusions and recommendations

Switzerland's support schemes for renewable energy demonstrate a well-rounded approach to promoting the transition to a sustainable energy system. Key initiatives such as one-time investment subsidies for PV systems, grants for large-scale solar projects, and tax incentives for renewable energy investments provide significant financial support to accelerate the adoption of clean energy technologies. These measures are complemented by streamlined administrative processes and regulatory frameworks that aim to reduce barriers to implementation.

The historical Feed-in Remuneration at Cost (KEV) programme played a vital role in the early adoption of renewable energy, although it is no longer available for new installations. Current schemes, like grants for solar thermal systems, further diversify support options, targeting both residential and commercial sectors. However, challenges remain, including disparities in funding and tax incentives across cantons, the high initial costs of renewable technologies, and the need for improved infrastructure to integrate renewable energy into the grid.

To address these challenges, Switzerland must continue to refine its support mechanisms, particularly by ensuring equitable access across regions and expanding funding for emerging technologies like energy storage and flexibility solutions. By maintaining its commitment to sustainability and innovation, Switzerland is well-positioned to achieve its ambitious energy and climate goals while serving as a model for other nations transitioning to renewable energy.

7 OVERALL CONCLUSIONS

The report provides comprehensive insights into the development of renewable energy frameworks, EComs, self-consumption models, and support schemes across multiple countries.

The document highlights significant progress and varied levels of maturity across countries in renewable energy integration, self-consumption models, and ECom frameworks. Spain stands out as a leader with a well-developed regulatory framework fully aligned with EU directives, enabling robust support for Citizen EComs CECs and RECs. These frameworks encourage collective self-consumption and community energy-sharing initiatives, supported by financial programs like the PRTR, which targets both rural and urban areas. Latvia demonstrates considerable advancements through its structured support schemes such as ALTUM and EIF, which incentivise self-consumption and renewable energy adoption. However, Latvia's ECom regulations remain under development, limiting the scope of collective energy-sharing mechanisms. Norway and Romania are in earlier stages of adopting comprehensive frameworks, with Norway focusing on pilot projects and household-level incentives through Enova, and Romania leveraging initiatives like the "Green House" program. Despite this, administrative complexity and funding access challenges hinder broader participation, particularly for vulnerable and low-income groups.

Technological and operational barriers are common across countries. Latvia and Norway face grid management challenges, such as voltage instability and difficulties balancing increased microgeneration. Innovations like hybrid inverters and smart energy systems offer solutions but require further investment and standardization. Rural-urban disparities also persist, with rural areas often receiving more targeted incentives while urban centers struggle with pressing energy demands. Social engagement and public awareness campaigns vary widely. Spain and Latvia emphasise education and stakeholder inclusion, while Romania and Norway face gaps in citizen awareness and engagement in energy projects. Across all countries, promoting equity and inclusivity remains a challenge, as many programs favor property owners and higher-income groups, leaving renters and marginalised populations with limited access to renewable energy benefits.

8 OVERALL RECOMMENDATIONS

Each country has unique characteristics and resources, but common challenges, such as energy storage, grid integration, and equitable access, require tailored solutions. The following recommendations provide actionable insights based on regional and national contexts:

Expand energy storage solutions tailored to local conditions. Energy storage is critical for managing renewable energy intermittency, but its application varies by region. In *Norway*, leveraging existing hydropower for pumped hydro storage could ensure grid flexibility, while in *Portugal,* battery storage should complement its high solar penetration, especially in regions like Alentejo. *Romania* has industrial potential for battery production and recycling, which could support domestic demand and exports. *Spain*, with its advanced self-consumption framework, could incentivise household batteries to pair with rooftop solar systems, reducing peak load pressures.

Simplify administrative and regulatory barriers. Countries like *Romania* and *Portugal* face delays in renewable energy project approvals due to complex permitting systems. For example, Romania's lengthy grid-connection processes hinder small producers. Digitizing applications and introducing pre-approval mechanisms would significantly reduce waiting times. In *Spain*, integrating all subsidies (regional and national) into a single application portal could streamline processes, particularly for SMEs.

Promote energy communities and localised solutions. EComs are a powerful tool for regional energy equity. *Latvia* could use small-scale cooperatives to promote wind and PV installations in rural areas, similar to successful models in Denmark. *Portugal*, with its strong tradition of local governance, could pilot microgrids in remote regions like Madeira. In *Spain*, EComs could focus on urban areas by integrating shared rooftop solar and EV charging infrastructure, especially in apartment complexes.

Targeted public awareness campaigns with regional emphasis. Public awareness must address specific demographics and needs. In *Romania*, campaigns could emphasize cost savings and energy independence in rural areas, where many households still use inefficient heating systems. *Spain* could highlight the benefits of SC laws in urban areas, which allow residents to offset electricity costs through rooftop solar. *Portugal,* with its sunny climate, should focus on promoting rooftop solar as a long-term investment, especially in regions like the Algarve, where solar PV adoption is still underutilised.

Encourage collaboration between funding programs. Improving coordination between funding sources would maximise impact. *Norway* could align municipal and national programs to support large-scale projects like offshore wind farms, while *Spain* could integrate rural electrification subsidies with solar incentives to expand coverage in agricultural areas. *Portugal* might benefit from combining EU and domestic funds for offshore wind projects, accelerating their deployment in the Atlantic.

Invest in innovative technologies for strategic advantage. Innovation offers unique opportunities for each country. *Norway* could pioneer floating wind farm technology in its deep coastal waters, while *Portugal* could lead in developing wave energy, leveraging its strong Atlantic currents. *Romania*, with its manufacturing base, could establish battery recycling facilities, creating a circular economy around energy storage. *Spain* could focus on green hydrogen production, given its vast renewable potential and access to export markets.

Improve access for rural and low-income communities. Energy inequality persists, particularly in rural areas. *Latvia* could deploy subsidised microgrids to remote villages, improving access while reducing reliance on fossil fuels. *Romania* could target rural households with combined programs for solar panels and energy-efficient heating systems. *Portugal*, where rural regions still face higher electricity costs, could prioritize incentives for agricultural communities to adopt renewable energy.

Modernize grid infrastructure for renewables integration. Grid upgrades are essential for all countries. *Norway* should enhance interconnectivity with neighboring countries to export excess renewable energy, while *Spain* and *Portugal* need smart grids to handle high solar penetration. *Romania* could focus on upgrading aging grid infrastructure to reduce losses and improve reliability in rural regions. Advanced forecasting tools for renewable generation would help all countries optimize resource use.

Develop robust monitoring and evaluation systems. Effective monitoring ensures programs deliver results. *Portugal* could track the performance of solar SC schemes, identifying gaps in urban adoption. *Romania* should monitor the impact of rural energy programs, ensuring equitable distribution of funds. *Spain* and *Norway* could focus on evaluating the economic and environmental returns of large-scale offshore wind projects to inform future policies.

APPENDIXES

Appendix 1

1. In the first nine months of 2024, approximately 3.8 thousand new microgenerators were connected to the distribution network (DG), bringing the total number to 22.7 thousand as of the end of September, with a total generation capacity exceeding 190 MW. Is DG currently experiencing overload due to mass connections?
2. According to the latest data from the DG digital map (28/10/2024), there are transformer substations where the available capacity for electricity generation is below 11 kW (e.g., at Priedaine, Skulte, Valka, Inčukalns, etc.). What measures do you plan to take if there is a high demand for microgeneration connections in these areas?
3. How does the demand for microgeneration connections impact the process of obtaining technical conditions?
4. What is the average waiting time for receiving technical conditions for connecting microgeneration?
5. How is the level of self-consumption currently determined for active customers who are not connected to the net system?
6. Does the current methodology for determining self-consumption allow for an accurate assessment of the self-consumption level, or could its approximation lead to network overload and planning difficulties in the long term?
7. What measures will be applied to active customers connected to the net system if they do not meet self-consumption requirements (at least 80%)?
8. Will the transition to 15-minute trading create additional load, for example, from a data management perspective?
9. How does the DG operator determine the amount of electricity produced by households when only the data on the volume of electricity fed into the grid from smart meters is available?
10. To what extent is the DGO involved in planning and implementing support schemes among active customers?
11. How do you assess the impact of the national support for solar panel systems with batteries on DGO operations (e.g., network stability, energy production)?
12. What potential challenges or advantages does the DGO foresee in the development of EComs, and how do you see their role in balancing the distribution network?
13. Is there a plan to develop a specific distribution network tariff for EComs?
14. How would you explain the reasons why the regulatory act “Rules for the Registration and Operation of EComs” has not yet been approved, even after four attempts?
15. How do you evaluate the idea of introducing a new electricity flexibility service: the development of a platform prototype for electricity market participants, which

could manage grid loads more effectively and improve network stability? What potential challenges or advantages do you see in implementing this service?

16. In your assessment, is Latvia on track to meet the goal of the National Energy and Climate Plan for 2021–2030, aiming for a 44.3% share of renewable energy in gross final energy consumption by 2025?

Appendix 2

APTAUJA PAR AKTĪVO LIETOTĀJU PIEREDZI: ATSAUKSMES PAR ATBALSTA SHĒMĀM UN STIMULĒŠANAS PROGRAMMĀM

Kā daļa no "Driving Urban Transitions" (DUT) partnerības, projekts "Pozitīvās enerģijas rajoni vadīti ar iedzīvotāju līdzdalību (PERSIST)" veic aptauju, lai gūtu vērtīgas atziņas par elektroenerģijas aktīvo lietotāju un galalietotāju pieredzi un zināšanām atjaunīgās enerģijas atbalsta shēmās un stimulēšanas programmās. Jūsu atbildes mums palīdzēs noteikt esošo shēmu un programmu trūkumus un tos virzīt politikas lēmumu uzlabošanai, tādējādi veicinot atjaunīgās enerģijas izaugsmi.

Aptaujas aizpildīšana aizņems aptuveni 5–7 minūtes. Lai nodrošinātu Jūsu privātumu, atbildes tiks šifrētas un anonimizētas.

1. *Valsts:*
2. *Jūsu vecuma grupa:*

- 18 līdz 30 gadi
- 31 līdz 50 gadi
- Virs 50 gadiem
- Nevēlos norādīt

3. *Jūsu dzimums:*

- Sieviete
- Vīrietis
- Cits
- Nevēlos norādīt

4. *Jūsu iegūtā izglītība:*

- Pamatskolas izglītība
- Vidusskolas izglītība
- Profesionālās vidusskolas izglītība
- Koledžas izglītība
- Augstākā izglītība
- Nevēlos norādīt

5. *Jūsu mājsaimniecības vidējie ikmēneša neto ienākumi (pēc nodokļu nomaksas)?*

- Zem 600 EUR
- 601-1200 EUR
- 1200-2000 EUR
- 2001-2800 EUR
- 2801 - 3600 EUR

- Virs 3600 EUR
- Grūti pateikt
- Nevēlos norādīt

6. Vai Jūs šobrīd piedalieties kādās atjaunīgo energoresursu vai energoefektivitātes paaugstināšanas atbalsta shēmās vai stimulēšanas programmās?

- Jā (will throw out new questions from No. 7-21)
- Nē (will throw out new questions from No. 7a-9a)

7. Kāda veida īpašums tiek izmantots, piedaloties atbalsta shēmā/ās vai stimulēšanas programmā/ās?

- Privātmāja
- Divu dzīvokļu māja
- Trīs vai vairāk dzīvokļu māja
- Īpašums vai teritorija, kurā notiek uzņēmējdarbība (saimnieciskā darbība)
- Cits (lūdzu, norādiet)

8. Kur atrodās šis īpašums?

- Pilsētā
- Piepilsētā
- Laukos
- Ciematā vai pagasta centrā
- Citur (lūdzu, norādiet)

9. Kurās atbalsta shēmās vai stimulēšanas programmās piedalās Jūsu minētais īpašums? Izvēlieties vienu vai vairākus atbilžu variantus

- Neto uzskaites sistēmā (darbību uzsāka 01.05.2024.)
- Neto norēķinu sistēmā
- Elektroenerģijas tirdzniecībā
- Subsīdiju jeb valsts finansēto grantu programmas vienreizēja maksājuma saņemšanā
- Bankas aizdevuma saņemšanā ar pazeminātu procentu likmi
- Citās (lūdzu, norādiet)

10. Kāda veida iekārtas, tehnoloģijas vai darbības ir ieviestas/uzstādītas, piedaloties atbalsta shēmā/ās vai stimulēšanas pasākumā/os? Izvēlieties vienu vai vairākus atbilžu variantus

- Fotoelementu paneļi (saules paneļi) vai to sistēmas
- Fotoelementu kolektori (saules kolektori) vai to sistēmas
- Vēja turbīna/as
- Apkures sadales sistēma (uzstādīšana, nomaiņa vai modernizācija)
- Ventilācijas sistēma (uzstādīšana, atjaunošana vai modernizācija)
- Rekuperācijas sistēma
- Siltumsūknis
- Gāzes katls
- Granulu katls
- Mājokļa siltināšana (tai skaitā, jumta, pamatu vai sienu siltināšana)
- Iegādāts elektrotransportlīdzeklis (tai skaitā, elektroauto)

- Cits (lūdzu, norādiet)

11. No kuriem informācijas avotiem Jūs pirmoreiz uzzinājāt par atbalsta shēmu/ām vai stimulēšanas programmu/ām, kurā/ās Jūs pašlaik piedalieties? Izvēlieties vienu vai vairākus atbilžu variantus

- No sociālajiem medijiem vai internetresursiem (Facebook, blogi, forumi, ziņu portāli)
- No valsts iestādēm vai to preses relīzēm
- No draugiem, paziņām vai ģimenes locekļiem
- No informatīvajiem ziņojumiem e-pastā
- No reklāmām vai bukletiem
- No iekārtu vai tehnoloģiju uzstādītājiem
- No citiem informācijas avotiem avotiem (lūdzu, norādiet)

12. Kas Jūs motivēja iesaistīties atbalsta shēmā/ās vai stimulācijas? Izvēlieties vienu vai vairākus atbilžu variantus

- Ietekme uz vidi un atbalsts klimatneitralitātei
- Energoresursu izmaksu ietaupījums
- Enerģētiskā neatkarība
- Subsīdiju pieejamība
- Sociālā ietekme
- Personiskās intereses un motīvi
- Cits (lūdzu, norādiet)

13. Jūsu gadījumā - kas bija atbildīgs par tehniskās dokumentācijas sagatavošanu atbalsta shēmas/u vai stimulēšanas programmas/u saņemšanai?

- Komerciālais uzņēmums (piemēram, iekārtu vai tehnoloģiju uzstādītājs, būvkompānija, konsultāciju birojs un citi)
- Es personīgi
- Cits (lūdzu, norādiet)

14. Jūsu gadījumā - kurš veica iekārtu vai tehnoloģiju uzstādīšanu (vai arī veica ieviešanas darbības)?

- Komerciālais uzņēmums (piemēram, iekārtu vai tehnoloģiju uzstādītājs, būvkompānija un citi)
- Es personīgi
- Cits (lūdzu, norādiet)

15. Vai Jūsu pieteikums atbalsta shēmas/u saņemšanai vai dalībai stimulēšanas programmā/ās tika apstiprināts jau pirmajā tā iesniegšanas reizē?

- Jā (will throw out the question No. 17)
- Nē (will throw out the new question No. 16)

16. Kādi bija iemesli sākotnējā pieteikuma noraidīšanai atbalsta shēmas/u saņemšanai vai dalībai stimulācijas programmā/ās? Izvēlieties vienu vai vairākus atbilžu variantus

- Iesniegta/aizpildīta nepareizā pieteikuma veidlapa
- Kļūdaini aizpildīta finanšu informācija
- Prasīto dokumentu trūkums vai grūtības to iegūt
- Uzstādīšana vai darbības neatbilda prasītajiem kritērijiem

- Tehniskie sarežģījumi
- Citi (lūdzu, norādiet)

17. Ar kādiem izaicinājumiem vai sarežģījumiem Jūs saskārāties, piesakoties atbalsta shēmas/u saņemšanai vai dalībai stimulēšanas programmā/ās? Izvēlieties vienu vai vairākus atbilžu variantus

- Informācijas trūkumu
- Sarežģītu pieteikšanās procesu (birokrātiju)
- Ilgu pieteikuma apstiprināšanu
- Grūtības izprast noteikumus, nosacījumus un atbilstības prasības
- Citi (lūdzu, norādiet)

18. Kādi pienākumi Jums ir jāveic pēc atbalsta shēmas/u saņemšanas vai piedaloties stimulācijas programmā? Izvēlieties vienu vai vairākus atbilžu variantus

- Pāris gadus jāiesniedz atskaite
- Jānodrošina dati un informācija par iznākumiem un rezultātiem
- Jāapmeklē semināri vai darbnīcas
- Nav nekādu pienākumu
- Neesmu pārliecināts, ka ir kādi pienākumi
- Citi (lūdzu, norādiet)

19. Vai Jūsu kopējā pieredze atbilda Jūsu sākotnējām cerībām, piedaloties atbalsta shēmā/ās vai stimulēšanas programmā/ās?

- Jā
- Nē (norādiet, kāpēc)

20. Vai ir kādas citas svarīgas atziņas, kuras Jūs vēlētos pieminēt par Jūsu pieredzi atbalsta shēmu/as saņemšanā vai dalībā stimulācijas programmā/ās?

(open-ended response)

21. Vai Jūs ieteiktu citiem pieteikties Jūsu pieminēto atbalsta shēmas/u saņemšanai vai dalībai stimulēšanas programmā/ās?

- Jā
- Nē
- Grūti atbildēt
- Cits (lūdzu, norādiet)

Paldies, ka piedalījāties šajā aptaujā. Jūsu sniegtās atbildes palīdzēs uzlabot un veicināt ilgtspējīgas enerģētikas attīstību nākotnē.

<u>Jautājumi galalietotājiem:</u>

7a. Vai Jūs esiet dzirdējis/dzirdējusi/dzirdējuši par kādām atbalsta shēmām vai stimulēšanas programmām, kas atbalsta atjaunīgos energoresursus vai energoefektivitātes paaugstināšanu? Piemēram, atjaunīgo energoresursu tehnoloģiju ieviešanu, elektrotransportlīdzekļa iegādi u.c.?

- Jā (will throw out the new question No. 8a)
- Nē (will throw out the new question No. 8b)
- Grūti pateikt

8a. Kas ietekmēja Jūsu lēmumu nepiedalīties atbalsta shēmas/u saņemšanā vai dalībā stimulācijas programmā/ās? Izvēlieties vienu vai vairākus atbilžu variantus

- Informācijas trūkums
- Pieteikšanās procesa sarežģītība
- Neskaidri ieguvumi
- Neatbilstība atbalsta saņemšanai un/vai dalībai programmā
- Finansiālie apstākļi un ierobežojumi
- Uzticības trūkums atbalsta shēmām un stimulācijas programmām
- Nav atbilstoša īpašuma vai vajadzības
- Cits (lūdzu, norādiet)

8b. Vai Jums būtu vēlme uzzināt vairāk par atbalsta shēmu saņemšanu vai stimulācijas programmu dalības priekšnosacījumiem?

- Jā (will throw out the new question No. 9a)
- Nē (no questions more)
- Grūti pateikt (will throw out the new question No. 9a)

9a. Kāda papildus informācija Jūs motivētu apsvērt dalību atbalsta shēmās vai stimulācijas programmās? Izvēlieties vienu vai vairākus atbilžu variantus

- Atbalsta shēmu un stimulācijas programmu dalībnieku pieredzes stāsti un ieteikumi
- Kaimiņu pieredze
- Detalizētāks priekšrocību un ieguvumu skaidrojums
- Vienkāršāks pieteikšanās process
- Skaidrāki finansiālie ieguvumi
- Cits (lūdzu, norādiet)

Paldies, ka piedalījāties šajā aptaujā. Jūsu sniegtās atbildes palīdzēs uzlabot un veicināt ilgtspējīgas enerģētikas attīstību nākotnē.

Annex 3

ACTIVE CUSTOMER EXPERIENCE SURVEY: FEEDBACK ON SUPPORT SCHEMES/INCENTIVE PROGRAMS

As part of the Driving Urban Transitions (DUT) Partnership, the "Positive Energy Districts Driven by Citizens (PERSIST)" project is conducting this survey to gather valuable insights from active customers and electricity end-users. We are interested in your experiences with local renewable energy generation and the support schemes/incentive programs available. Your feedback on participation factors, challenges, and overall experience will help us identify areas for improvement and guide future policy decisions to promote renewable energy growth.

The survey will take approximately 5–7 minutes to complete. Your privacy is important to us—responses will be encrypted and processed anonymously.

1. Country?

(open-ended response)

2. *Age group?*
- 18 to 30
- 31 to 50
- 51 or over
- Prefer not to say

3. *Gender?*
- Female
- Male
- Other
- Prefer not to say

4. *What is your education level?*
- Elementary school education
- Secondary school education
- Vocational secondary school education
- College education
- Higher/University education
- Prefer not to say

5. *What is your households' average monthly net income rate?*
- Under 600 EUR
- 601-1200 EUR
- 1200-2000 EUR
- 2001-2800 EUR
- 2801 - 3600 EUR
- Over 3600 EUR
- Hard to say
- Prefer not to say

6. *Are you currently participating in any support schemes/incentive programs?*
   Yes (will throw out new questions from No. 7-21)
   No (will throw out new questions from No. 7a-9a)
7. *What category of property is utilised by you within the framework of the support schemes/ incentive programs?*
- Private house
- Two-apartment house
- Three or more apartments
- Commercial property
- Other (please specify)

8. *Where is your property located?*
- Urban (city)
- Suburban (outlying district of a city)
- Rural (countryside)
- Semi-rural (village, parish centres)
- Other (please specify)

9. *What type of support scheme/incentive program is implemented for your property?*

- Net metering system
- Net billing system
- Feed-in tariff
- Subsidies (one-time payment by the state-funded grant program)
- Bank loan with lower loan interest rate
- Other (please specify)

10. What type of technology have you invested in to get the support scheme/incentive program?

- Photovoltaic panels
- Solar collectors
- Wind turbine
- Renewal or upgrade of heating equipment
- Renewal or upgrade, of ventilation equipment
- Installation of recovery system
- Installation of heat pump
- Installation of a gas-type boiler
- Installation of a pellet boiler
- House warming (e.g., warming the roof, foundations, facades)
- Electrical vehicle
- Other (please specify)

11. How did you first learn about the support scheme/incentive program you participated in?

- Social media
- Government agencies
- Friends and family
- Email newsletter
- Commercials
- Installers
- Other (please specify)

12. What motivated you to participate in the support scheme/incentive program? (choose one or several)

- Environmental impact
- Energy cost savings
- Energy independence
- Subsidies
- Social impact
- Personal interest
- Other (please specify)

13. Who was responsible for the technical documentation preparation for support scheme/incentive program implementation?

- Commercial company
- Me personally
- Other (please specify)

14. Who was responsible for the installation of the technology?

- Commercial company
- Me personally
- Other (please specify)

15. Was your application approved on the first attempt?

- Yes (will throw out the question No. 17)
- No (will throw out the new question No. 16)

16. What issues were present in your initial application for the support scheme/incentive program? (choose one or several)

- Incorrect application form
- Incorrect financial information
- Missing required documents
- Unsuitable conditions for installation
- Technical issue
- Other (please specify)

17. What challenges have you faced while participating in these schemes/incentive programs? (choose one or several)

- Lack of information
- Complicated application process (e.g. bureaucratic hurdles)
- Long waiting time for approval
- Difficulty in understanding the terms, conditions and eligibility requirements
- Other (please specify)

18. What obligations are you aware of after completing the process?

- Reporting progress in few years
- Providing data on outcomes
- Attending post-support workshops
- There are no obligations
- I am not sure if there are any obligations
- Other (please specify)

19. Did your overall experience meet your expectations of participating in the support scheme/incentive program?

- Yes
- No (please specify)

20. Is there anything else you would like to share about your experience in participating in the support scheme/incentive program?

(open-ended response)

21. Would you recommend this support scheme/incentive program to others?

- Yes
- No
- Not sure
- Other (please specify)

Thank you for participating in this survey. Your feedback is valuable in improving and shaping sustainable energy investment schemes for the future.

For energy consumers

7a. Have you heard of any schemes or incentive programs that support investments in assets (renewable energy technology implementation, purchasing an electrical vehicle, etc.)?

- Yes (will throw out the new question No. 8a)
- No (will throw out the new question No. 8b)
- Not sure

8a. What factors have prevented you from participating in the existing support scheme/incentive program? (choose one or several)

- Lack of information
- Complexity of the application process
- Unclear benefits
- Eligibility requirements
- Financial constraints
- Lack of trust in the schemes
- No corresponding property and conditions
- Other (please specify)

8b. Would you like to know the benefits and opportunities to obtain a support scheme/incentive program?

- Yes (will throw out the new question No. 9a)
- No (no questions more)
- Not sure (will throw out the new question No. 9a)

9a. What information would encourage you to consider participating in a support scheme/incentive program? (choose one or several)

- Success stories from participants
- Neighbours experience
- Detailed explanation of benefits
- Simplified application process
- Financial profit
- Other (please specify)

Thank you for participating in this survey. Your feedback is valuable in improving and shaping sustainable energy investment schemes for the future.

This research was funded by the DUT Partnership Grant under the Positive Energy Districts project "Positive Energy Districts Driven by Citizens (PERSIST)", ES RTD/2024/03.

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