European Commission

INVESTORS DIALOGUE ON ENERGY

Financial instruments and models for services and prosumers

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List of acronyms

Acronyms	
CEF	Connecting Europe Facility
CEC	Citizen Energy Community
CfD	Contract for Difference
CfD	Cohesion Fund
DFI	Development Financial Institution
DG	Directorate General
DSM	Demand-Side Management
EaaS	Energy-as-a-Service
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EE	Energy efficiency
EIB	European Investment Bank
EIC	European Innovation Council
EIF	European Investment Fund
ERDF	European Regional Development Fund
ESCO	Energy Service Company
ETS	Emission Trading System
EU	European Union
FiP	Feed-in Premium
FiT	Feed-in Tariff
GBER	General Block Exemption Regulation
GDP	Gross Domestic Product
GHG	Greenhouse gas

HHI	Herfindahl-Hirschman Index
ID-E	Investors Dialogue on Energy
IEA	International Energy Agency
LCOE	Levelised Cost of Energy
MF	Modernisation Fund
NECP	National Energy and Climate Plan
NRRP	National Recovery and Resilience Plan
NZIA	Net-Zero Industry Act
P2P	Peer-to-Peer
PPA	Power Purchase Agreement
PV	Photovoltaic
RDI	Research, Development, and Innovation
REC	Renewable Energy Community
RES	Renewable Energy Source
RRF	Recovery and Resilience Facility
SME	Small and medium-sized enterprise
T&D	Transmission and Distribution
TRL	Technology Readiness Level
UK	United Kingdom
UoP	Use of Proceeds
US	United States
VPP	Virtual Power Plant
WACC	Weighted Average Cost of Capital

Executive summary

Energy services such as demand-side management and new self-consumption configurations are needed to deliver on the European Green Deal objectives. They play an important complementary role in the energy value chain by enabling other segments of the chain (generation, transmission and distribution, storage, heating, and cooling) to reach their decarbonisation objectives in a cost-efficient and effective manner.

Revenues in services and prosumers are driven by a number of factors based on the specific service or type of consumption, including energy prices, technological advancements, and government policies and incentives.

Investments in services and prosumers are affected by barriers of different nature, some stemming from market failures or prosumers engagement, others from technical or regulatory aspects.

Financial instruments can address some of the barriers to investment that are slowing down the decarbonisation of the EU energy sector. Through a range of instruments available at EU and Member State level, policy makers and investors can overcome some of the obstacles making energy projects, particularly innovative ones, too risky for the private sector alone. The presence of non-financial barriers affecting services and prosumers projects requires additional measures beyond financial instruments to create a truly enabling environment for investment.

A mapping of financial support schemes at Member State level resulted in the identification of 325 schemes available for services and prosumers in the 27 Member States.

In line with other segments of the energy value chain, several trends can be observed in the offering of financial support schemes for services and prosumers:

- Loans and grants are the most used types of financial schemes;
- Just ten schemes are designed specifically for services and prosumers only, whereas all others target at least one more energy segment, and 171 schemes target all segments of the energy value chain;
- Most of the mapped instruments target mature and market-ready projects (“roll-out stage”), and only to a lesser extent - less mature technologies;
- SMEs and larger companies are the most supported category of beneficiaries of th
- e mapped financial support schemes, but households received a higher support compared to other segments.

Five main factors were identified as key for a support scheme to be effective in the services and prosumers sector: being broad and flexible in scope, having long-term stability and visibility, easy and rapid application procedures, and effectiveness in mobilising private finance.

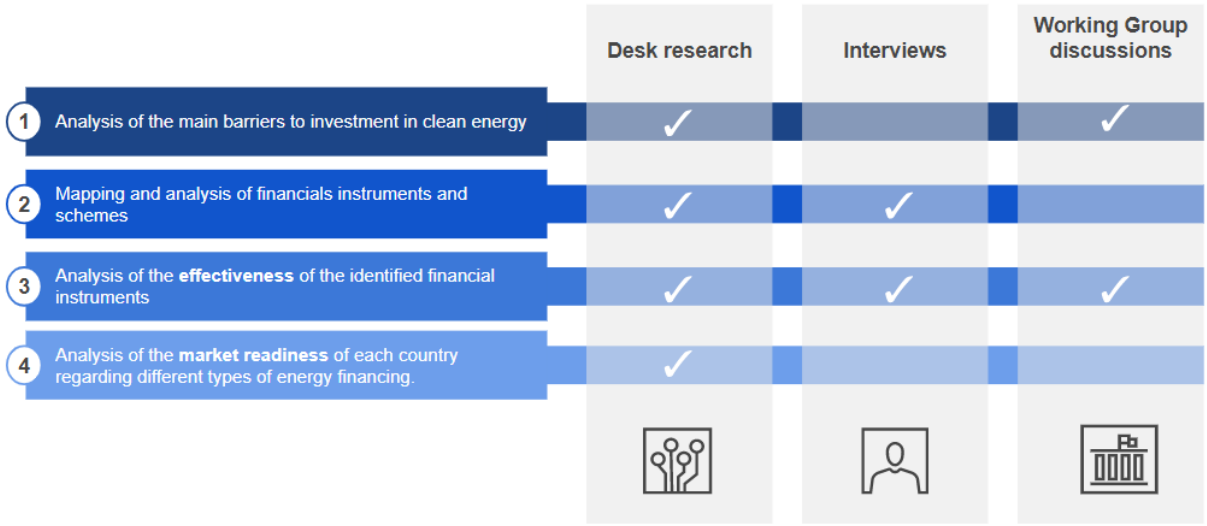
The availability of a comprehensive set of financial instruments for services and prosumers is particularly important in countries with low market maturity and a big investment gap to address RES 2030 targets. In general, availability of private finance indicates a healthy financial system, while public financing should serve specific policy goals and address market failures, avoiding supporting mainly mature technologies.

1. Introduction

The “Study on current energy sector investment instruments and schemes” in the Services and Prosumers sector in the EU has been carried out as part of the Investors Dialogue on Energy – an initiative launched by the European Commission, DG ENER in 2022. The ID Energy is a multi-stakeholder platform bringing together experts from energy and finance sectors in all EU countries to assess and upgrade financing schemes, with the aim of mobilising financing in the context of the European Green Deal and REPowerEU.

This study focuses on services and prosumers sector and is the fifth and last of a series of studies which cover energy production, transmission and distribution, energy storage, and heating and cooling. The study has been prepared on the basis of research carried out in 2022 and beginning of 2023 and incorporates data collected via desk research and interviews, as well as feedback from the stakeholders participating in the discussion of Working Group 5 of the Investors Dialogue for Energy, which focuses on services and prosumers.

Figure 1: Overview of main topics and data sources



This study will set the basis for further work under the Investors Dialogue on Energy, namely the identification of new or upgraded solutions for financing the decarbonisation of energy services and prosumers in order to support the achievement of the EU’s 2030 climate and energy targets.

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2. The investment context for Energy Services and Prosumers

2.1. The new macroeconomic conditions for energy investment

Over the last couple of years, Europe has experienced a period of profound macroeconomic and geopolitical change, characterised by often unpredictable events that have made it necessary to accelerate the energy transition process and to adapt funding flows to the evolving needs. The following four macroeconomic trends have been identified which will make the coming years, and the next MFF (Multi-annual Financial Framework) budgeting period, fundamentally different than the past decade.

1. Tackling the climate crisis

At the end of 2019, the European Union published the European Green Deal[1], which outlined its aim to become the first climate-neutral, resource efficient, and sustainable economy by 2050. As an intermediate step towards climate neutrality, the EU strengthened its commitments to climate and energy, pledging to reduce 55% of net GHG emissions by 2030, while ensuring Europe's security of energy supply. In order to align current laws with the 2030 and 2050 ambitions, the Commission tabled the Fit for 55 package[2] of legislative measures which, among other targets, proposed to increase the share of renewable energy sources in the overall energy mix from 32% to 40% to speed up the decarbonization of the energy system. These new and updated targets represent a major challenge and a necessary acceleration of green investments. The impact of these policy shifts is already being felt strongly in the European financial sector. Example of notable shifts include:

- The publication of the European Taxonomy, which provides companies, investors, and policymakers with appropriate definitions for which economic activities can be considered environmentally sustainable, thus helping the EU to scale up sustainable investment and implement the European Green Deal.
- The transformation of the EIB into the European Climate Bank, and the ensuing commitment to gradually increasing its share of finance dedicated to green investment to over 50% by 2025 and beyond.

The urgency of the climate crisis is increasingly reshaping the investment environment for energy production, with an ever-stronger focus on low carbon technologies.

2. Ending the EU's dependence on Russian fossil fuels

The energy crisis, intensified by Russia's unprovoked aggression in Ukraine in February 2022, has had a significant impact on the EU's energy system and the European financial sector. Turbulence in energy markets, the all-time high energy prices, and the risk of supply shortages across the EU have further exposed the EU's over-reliance on Russian fossil fuels, highlighting the need to accelerate the green transition under the European Green Deal and to ensure a

[1] The European Green Deal, European Commission, December 2019.

[2] 'Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality, European Commission, 2021.

more secure, affordable, resilient, and independent energy system[3]. To respond to these hardships, in May 2022 the European Commission presented updated energy targets in the REPowerEU plan[4] and the emergency electricity market design interventions. The REPowerEU plan, which aims to cut the EU's energy dependency on Russian gas well before 2030, confirms the EU's commitment to achieving the European Green Deal's long-term goal of climate neutrality by 2050 and fully implementing the Fit for 55 Package, proposing to increase the headline 2030 target for renewables from 40% to 45%.

Broadly speaking, the European Green Deal as an EU growth strategy, the war and the REPowerEU are expected to reshape the direction of financial flows. In particular, investments in gas-related projects are focused mainly on projects, which serve the objectives of the energy transition, Security of Supply and diversification of gas/energy supply. Examples of such projects may include directional changes to pipeline flows (e.g., establishing north-south pipeline connections), or the repurposing of gas infrastructure for transportation and storage of hydrogen or other low-carbon gases.

3. Rising interest rates in an inflationary context

The global economy is confronting a challenging situation not witnessed for decades, with inflation persistently high amidst increased economic and geopolitical uncertainties, as well as disruptions in energy and commodity markets and supply chains bottlenecks caused by the COVID-19 pandemic and Russia's ongoing invasion of Ukraine. In past years, in the aftermath of the global financial crisis, central banks maintained low interest rates for extended periods of time, leading to a low-volatility environment and easy financial conditions that investors grew accustomed to. In the coming decade, rising interest rates mean that capital is more expensive, and harder to get to, which could prove especially daunting for nascent clean tech industries attempting to establish themselves on the market. This adverse impact of rising interest rates is likely to be compounded by the related phenomena of inflation and supply chain bottlenecks. This is why it is important to create a favourable financing environment that prevents the energy transition and the development of clean technologies from slowing down.

4. Rising global clean tech competition

Europe's partners are increasingly introducing policies and stimulus programmes to seize the net-zero industrial opportunities. The prime example of rising competition for global clean tech dominance is the US Inflation Reduction Act (US IRA), which will mobilise over USD 360 billion by 2033. Japan, India, China, the UK, and Canada have also put forward their own national programmes to stimulate their own clean tech leadership. While competition is beneficial to the overall global climate race to net zero, the EU is also increasingly looking to cement its own positioning in the clean tech space and prevent the outflow of its own industrial champions overseas. Therefore, to facilitate the reaching of its climate objectives and enable the necessary greening and competitiveness of the EU industry, in January 2023 the Commission put forward the Green Deal Industrial Plan[5]. This plan will enable the EU to access key technologies, products, and solutions needed for a successful transition to net-zero, which will

[3] Progress on competitiveness of clean energy technologies, EU Commission, November 2022.

[4] REPowerEU: A plan to rapidly reduce dependence on Russian fossil fuels and fast forward the green transition, European Commission, May 2022.

[5] A Green Deal Industrial Plan for the Net-Zero Age, European Commission, February 2023.

in turn boost economic growth and generate quality jobs. The Green Deal Industrial Plan will thus attract investments in the net-zero industrial base, with a focus on innovative technologies, helping them to overcome the so-called 'valley of death' before commercialization[6]. In line with the Green Deal Industrial Plan, the European Commission has adopted a new Temporary Crisis and Transition Framework which, together with the amended General Block Exemption Regulation (GBER) will help to accelerate investment and financing for clean tech production within the European Union and allow Member States more flexibility to design and implement support measures in sectors that are key for the transition to climate neutrality[7]. In addition, a proposal for a Net Zero Industry Act (NZIA)[8] has been submitted with the aim of establishing a framework of measures directed at strengthening Europe's net-zero technology products manufacturing ecosystem and overcoming barriers to scaling up the manufacturing capacity in Europe. The Regulation encompasses products, components and equipment used in manufacturing net-zero technologies and it distinguishes between net-zero technologies and strategic net-zero technologies, whereby the latter is regarded as making a significant contribution to decarbonisation by 2030.

Meeting the objectives of the European Green Deal and REPowerEU will entail, among other things, an increase in the share of renewable energy in the energy mix, electrification of end-use sectors, shift to hydrogen and other type of low-carbon gas in the hard-to-abate sectors, growth in the share of grid-connected distributed energy, and an ever-larger customer engagement including via demand response.

2.2. The investments needed to reach European Green Deal objectives

The European Union's energy transition, driven by the decarbonisation targets for 2030 and 2050 under the European Green Deal and the Fit-for-55 package, opens the door to a range of new actors and energy services that will help accelerate the decarbonisation process, while bringing benefits to end consumers.

Delivering on the European Green Deal objectives will require the EU to develop, implement and scale-up innovative energy efficiency and renewable energy solutions[9]. The current geopolitical instability, the threat of supply disruptions and rising energy prices make it crucial to identify reliable, cost-effective, and deployable solutions to reduce the EU's energy dependency on Russian gas and lower costs for consumers. Energy services such as **demand-side management** and new **self-consumption** configurations can help achieve these goals. They play an important complementary role in the energy value chain by enabling other segments of the chain (generation, transmission and distribution, storage, heating and cooling) to reach their decarbonisation objectives in a cost-efficient and effective manner[10]. More specifically,

[6] Questions and Answers: Green Deal Industrial Plan for the Net-Zero Age, European Commission, 2023.

[7] Temporary Crisis and Transition Framework, European Commission, March 2023.

[8] Net Zero Industry Act available at the following link.

[9] Progress on competitiveness of clean energy technologies, European Commission, November 2022.

[10] Energy communities to increase local system efficiency, Smart Energy Europe, February 2022.

- **Self-consumption** (e.g., prosumers, energy communities): consists in the consumption of energy that is generated *in situ* from generation sources that are close or associated to consumption points (such as PV panels or mini wind generators). Self-consumption can enable consumers to play a pivotal role in accelerating the deployment of renewables in the EU energy system, also considering the current concerns on the security of energy supply. Self-consumption empowers consumers to become prosumers that generate and store on-site renewable electricity, and that share and trade renewable electricity within their local communities. Through self-consumption, consumers can also play a crucial role in managing the increasing flexibility needs of the energy system and should benefit from doing so in the decentralised, digitalised, clean energy transition. Self-consumption is specifically identified in EU energy legislation as one of the main objectives to unlock the full potential of energy services and prosumers. More specifically, the revised RED II calls upon Member States to adapt their regulations and introduce measures aimed at "increasing renewables self-consumption, renewable energy communities and local energy storage, in combination with energy efficiency improvements"[11]. The Internal Electricity Market Directive (IEM) adds that self-consumers "should be able to consume, to store and to sell self-generated electricity to the market and to participate in all electricity markets by providing flexibility to the system" and also assigns to the regulatory bodies of Member States the duty of "monitoring the removal of unjustified obstacles to and restrictions on the development of consumption of self-generated electricity"[12]. Finally, self-consumption is prioritized also in the EU Long Term Strategy which endorses what is also stated in the Clean Energy Package regarding "measures that will be put in place to facilitate the participation of citizens in the energy transition through self-consumption and energy communities"[13].
- **Demand-Side Management (DSM)**: involves shifting or shedding electricity demand to provide flexibility in wholesale and ancillary power markets, helping to balance the grid (IEA)[14]. Demand response has traditionally been provided by generation plants or energy-intensive consumers (e.g., industrial production plants). Yet, the development of the energy services segment, alongside with a higher need for DSM to help balance the grid, technological developments and their wide adoption (e.g., deployment of smart meters) as well as appropriate changes in the regulatory framework, will open the market of demand-response more and more also to operators such as households, offices, hospitals, schools, vehicles, and industries which can shift and shed energy consumption to reduce their energy demand in peak hours, when electricity is mainly produced by gas and prices are high. In this sense, consumers should be able to receive signals (e.g., through tariffs in energy bills) to consume more when energy is cheaper and renewable electricity is abundant in the grid. In a scenario of a strong expansion of variable renewables – where generation becomes largely weather-dependent – demand-side services will be increasingly required to provide the necessary flexibility to the electric grid to react to such variability.

The growing share of distributed generation, together with the increasing engagement of customers in energy generation, may unlock unprecedented benefits for the energy system,

[11] Proposal for a Directive of the European Parliament and of the Council amending Directive (EU) 2018/2001 of the European Parliament and of the Council, Regulation (EU) 2018/1999 of the European Parliament and of the Council and Directive 98/70/EC of the European Parliament and of the Council as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652.

[12] Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (recast).

[13] A Clean Planet for all A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy, European Commission, 28 November 2018.

[14] The definition of demand response by the IEA is available at the following link.

particularly in the provision of flexibility and efficiency services by resources connected to distribution networks. Flexibility and self-consumption from the demand side alone can lead to a 3.7% reduction in Russian gas imports and save €16 billion in total gas costs in 2023. In 2025, the potential savings are nearly double, amounting to a 7.1% reduction in Russian gas imports, equivalent to €31.4 billion saving[15]. To realise these benefits, it is essential to address in a timely manner emerging issues related to market design and operations, which may affect the provision of these services at the distribution level, as well as to ensure that adequate levels and models of financing are available for prosumers, energy services, and energy communities, so that their full potential can be deployed.

Given these premises, the following figures provide an overview of the size of the investment challenges foreseen for the next decade:

- In the "Fit for 55" core scenarios, the average annual investment needs (in energy systems, including transport) to achieve the 55% target are projected to reach €1,051 bn/year in the 2021-30 period and thus some €390 billion higher than what was needed in the past decade (2011-2020)[16].
    - **Investments in power distribution networks** in the range of €375-425 billion over the 2020-2030 period will have to be deployed to support the deep electrification of the energy system[17]. Electrification (and its related benefits) will require key investments focused on:
        - €180-210 billion for supply-side and demand-side management: referring to new power lines, additional transformer capacity, integration of increasing RES, and electrification of end-uses (building, industry, transport).
        - €145-170 billion for smart grids: referring to reinforcements and upgrading/renewal of existing assets, digitalisation of station/substations and advanced protection systems, smart meters to enable customers' monitoring and observability of grid.
        - €30-35 billion for resilience: referring to the management and control of the grid and load curve, predictive maintenance, and control.
        - €20-45 billion for storage and others: referring to investments in large scale storage connected to the distribution grid and other minor investments for grid activity.
    - Average annual **investments for end-use sectors** (i.e., transport, building, and industry) will increase from €914 billion in 2021-2030 to €1,172 trillion in 2031-2050 due to the need to reach decarbonisation targets in 2050, primarily driven by electrification[18].
        - Relevant electrification-related investments will be needed to decarbonise the building sector due to the increasing penetration of heat pumps. Annual investments in the building sector will be sustained after 2030 in order to achieve deep decarbonisation of the sector in 2050, due to the yearly renovation rate increasing from 3% to 4% (from

[15] Demand-side flexibility – Quantification of benefits in the EU, Smart Energy Europe, DNV, September 2022.

[16] Impact Assessment Report accompanying the Proposal for a Directive of the European Parliament and the Council, European Commission, 2021.

[17] Demand-side flexibility – Quantification of benefits in the EU, Smart Energy Europe, DNV, September 2022.

[18] Sustainable Paths for EU Increased Climate and Energy Ambition.

an average €287 billion/year in 2021-2030 to €349 billion/year in 2031-2050). Electrification-related investments will increase from €11 billion/year to €24 billion/year accordingly.

- Industry will see electrification-related investments increasing from a third in the 2020s to more than half the amount invested in the 2030s and 2040s (from €5 billion/year to €17 billion/year accordingly[19]). Annual investments in the industrial sector will increase significantly after 2030 in order to achieve deep decarbonisation in 2050, by means of fuel switching processes (from an average €16 billion/year in 2021-2030 to €27 billion/year in 2031-50).

- On top of that, meeting **REPowerEU targets** requires €210 billion of investments between 2022 and 2027.[20]

Unlocking the full potential of energy services and prosumers will require substantial investments. Estimations of investment needs at a Member State level rely on estimations provided by Member States themselves in their National Energy and Climate Plans (NECPs). These estimations have not followed a common methodology and have been, for this reason, subjected to criticism notably from the European Court of Auditors. Determining the precise amount of required investments in services poses a challenge due to the absence of expenditure items directly related to the development of self-consumption or demand-side response in Member States' NECPs. Instead, these projects are often briefly mentioned in expenditure items related to the development of renewables, storage services, flexibility and efficiency or renovation of buildings (both residential and commercial). For instance, energy communities' interventions are often under investments for "renewable energy"[21], whereas demand response is frequently included in funds allocated for market integration and infrastructure - such as transmission and distribution.

Because of this, drafting a table with precise data on energy services investment needs for each Member State would entail several difficulties related to incomplete data and double counting[22]. In an effort to provide a rough representation of the resources that could be directed towards the segment of energy services, we provide a summary of all investments planned under NECPs by Member States for two main categories of investments:

- Investments in **energy systems** comprising the following streams of the NECPs: "renewable energy", "transmission and distribution" and "storage";
- Investments for "**buildings**" and "**industry**" as identified in the NECPs, given the significant contributions that households and industrial buildings can make to reducing GHG emissions through energy efficiency measures and the adoption of renewable

[19] The assessment by the European Commission in the Impact Assessment accompanying the communication "Stepping up Europe's 2030 climate ambition" brings similar results, with average annual investments in the demand-side of ca. €900 billion in 2021-2030 and ca. €1 trillion in 2031-2050, compared to the average annual €627 billion invested in 2011-2020.

[20] REPowerEU: A plan to rapidly reduce dependence on Russian fossil fuels and fast forward the green transition, European Commission, 18 May 2022.

[21] For example, Croatia has an expenditure item of around €700,000 per year for various interventions including capacity building and enhancement for all market players (active customers, energy communities, renewable energy communities, energy suppliers, aggregators, system operators, installers).

[22] Because the NECPs do not classify energy services, and because estimations of investment needs are not accurately detailed in the NECPs, it is not possible to estimate with certainty the fraction of investments dedicated to energy services. Furthermore, the numbers illustrated in this table overlap with figures illustrated in estimations of financing gaps presented for WGs 1, 2 and 3 of the Investors Dialogue since energy services are not a stand-alone segment of the energy value chain, but rather a segment based on the interactions of the other segments of the energy value chain.

energy technologies for self-consumption, smart metres, demand-response systems, and decentralised production.

It should also be noted that these figures reflect investment needs of national contributions aimed at achieving pre-climate law EU climate targets and are, therefore, subject to modification in light of the forthcoming revision of the NECPs during mid-2023. Furthermore, they do not reflect investment needs for achieving a Paris-aligned target of a 55% emissions reduction to 2030, and do not factor in the new 'REPowerEU' strategy, which outlines more ambitious targets for several energy transition related investments, including the prioritisation of investments in energy efficiency, renewables, and the broader electricity infrastructure. By June 2023, Member States were required to submit updated NECPs, which are expected to be approved by June 2024[23].

[23] European Commission. National Energy and Climate Plans. https://commission.europa.eu/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting/national-energy-and-climate-plans_en

Table 1: Investments foreseen under the NECPs and the RRF for each EU member states in the segments of energy efficiency (buildings & industry) and the energy system (generation, transmission and storage) which contribute or could contribute to the proliferation of energy services and prosumers

	NECP			RRF		
Country	Buildings & Industry (€ bn)	Energy system (€ bn)	Notes	Buildings & Industry (€ bn)	Energy system (€ bn)	Notes
Austria	29.7	31.5-38.5	Investments in buildings include heating and cooling (buildings and industry), thermal renovations of buildings ,heating system renovation, industry (non-ETS) and energy efficiency and waste heat usage. Investments in the energy system include: expansion of electricity generated from renewable, biogas, expansion of electricity networks, development of hydrogen, district heating and networks	0.21	0.1	Within the renovation of buildings sector investments will fund the replacement of oil and gas boilers, thermal building renovations in municipal and city centres and projects aimed at sustainably reducing CO2 emissions in all buildings belonging to an arts and cultural institution in Austria (e.g.,. through climate-friendly heating, ventilation and cooling systems, use of renewable energy sources, energy-efficient interior and exterior lighting systems, thermal building renovation and measures to save natural resources and CO2 emissions). The energy system investment measure aims to accelerate the decarbonisation of energy intensive industries, increase their resource and energy efficiency, support industrial eco-innovations and advanced technology reducing the environmental impact of hazardous waste treatment.
Belgium	17	41	Major renovation of public buildings to make them intelligent and more energy efficient Investments in the energy system are focused on - electricity mix (guarantee security of supply at competitive prices, develop renewable energy, including for households) - Strengthening of systems (invest in T&D systems and support the development of smart grids) - Development of storage (storage capacity through vehicles, housing and businesses, development of pumped storage)	0.543		Measures for energy efficiency and renovation of social housing and public buildings.
Bulgaria	16	15.3	Investment in buildings to upgrade equipment and appliances in the household and service sectors, including direct investments to enhance energy efficiency. Investments in the energy system concern electricity plants, cogeneration plants, storage facilities, power to X, grid development		0.174	• Grant scheme for investments in renewable electricity sources for own use with local storage facilities • This scheme aims at promoting the green transition in the private sector. The scheme shall provide grants for investments for combining renewable electricity sources for own use with local storage facilities. Support for renewable energy for households
Croatia	6.8	4.5	Investments in buildings include: decarbonisation of the building stock, renovation of buildings and construction of nearly zero energy buildings, which stresses the importance of further reduction in greenhouse gas emissions, increasing the share of renewable energy sources, improving energy security and introducing innovation and smart technologies. Investments in the energy system include installations for electricity production (a major part of which will be investments in installations using renewable energy sources) and in the building sector, namely the construction of buildings and houses with nearly zero-energy consumption.	0.575		Measures for energy efficiency and renovation include: - Energy renovation of buildings (which also aims to increase the use of renewable energy sources) - Renovation of buildings damaged in earthquakes with energy renovation - Energy renovation of buildings with the status of a cultural good
Cyprus	0.7	1	Investments in residential and commercial buildings (energy efficiency and renovations) Investments in the energy system concern power generation and electricity storage technologies		0.110	• Promoting energy efficiency investments in SMEs, municipalities, communities and the wider public sector. The grant scheme shall also promote the execution of energy audits, as well as the adoption of digital technologies and the integration of renewables. • Promoting renewables and individual energy efficiency measures in dwellings and tackling energy poverty in households with people with disabilities • Encouraging the use of renewables and energy savings by local/wider public authorities as well as NGOs and facilitating the transition of local communities towards climate mitigation & adaptation • Mass installation and operation by the Distribution System Operator (DSO) of Smart Metering Infrastructure (Advanced Metering Infrastructure)

	NECP			RRF		
Country	Buildings & Industry (€ bn)	Energy system (€ bn)	Notes	Buildings & Industry (€ bn)	Energy system (€ bn)	Notes
Czech Republic	11	27	Renovation strategy Investments in the energy system: power plants and accumulation, distribution and transmission	0.857	0.200	Investment in the energy system: increasing installed capacity of sources of photovoltaic energy Projects shall include the construction of photovoltaic power plants on the roofs of companies' buildings including shelters as well as accumulation of energy aiming at optimizing the generation of electricity Investments in energy efficiency and buildings include: i) Improving the energy performance of state buildings ii) Improving the energy performance of public buildings iii) Support for the renovation and revitalisation of buildings in the housing sector iv) Support exchanges of non-compliant heat generators and installing renewable energy sources
Denmark	4-6	8-12	Investments in buildings and energy efficiency include: - Households: Energy efficiency and conversion of heat supply. - Industry: Energy efficiency and new technologies Investments in the energy system concern new renewable energy capacity installed.	0.114		Investments in the energy efficiency and buildings: - Energy efficiency in industry: the initiative aims to speed up energy efficiency measures and transition to green energy in industry - Energy renovations in public buildings: the measure shall support a subsidy scheme that shall target energy savings actions in public buildings. - Energy Efficiency in Households: the objective of this measure is to ensure that residential buildings are renovated and energy efficient and to speed up transition from oil burners and gas furnaces to heat pump
Estonia	1	0.3	Investments in the renovation of the building stock are envisaged	0.050		Investments in energy efficiency and buildings concern: - Support for the renovation of apartment buildings - Support for the renovation of small residential buildings
Finland	NA	NA	NA	NA	NA	NA
France	15-25	10	Investments in buildings: renovation of buildings Investments in the energy system: energy and electricity grids	5.825	0.050	Investments in the energy system concern, among others, strengthening the resilience of electricity networks and energy transition in rural areas by fostering renewables integration to the network, building storage facilities and electric charging infrastructure. It shall also accelerate the deployment of smart meters. Investments in energy efficiency are dedicated to mostly thermal renovation: - Energy renovation of private housing, including energy sieves - Energy renovation and major rehabilitation of social housing - Thermal renovation of public buildings - Energy renovation of very small enterprises (VSEs) and small and medium sized enterprises (SMEs)
Germany	145	77.4	Investments for energy efficiency include building renovation of private households, commerce trade and services, industry. Investments for the energy system include renewable energies equipment, networks and energy storage facilities.	2.500		Building renovation: federal funding for energy-efficient buildings. The measure shall be accomplished through bonuses for renewable energy and better classes of energy efficiency.
Greece	11	23.5	Investments in the energy system are dedicated to electricity generation from RES, electrical system infrastructure, new thermal electricity generation plants and central storage plants, works for the development of an electricity distribution network/digitisation, cross border natural gas pipelines, natural gas networks and storage	1.900	0.450	Investments in the energy system: Support of the installation of storage systems to enhance renewable energy (RES) penetration Investments in buildings and industry include: - Energy renovation on residential buildings for the digitalisation of final energy consumption through energy management systems and promote the deployment of e-mobility infrastructure, such as charging stations for electric vehicles. - Energy and entrepreneurship providing financial support to private companies for energy-efficient renovations of their buildings and processes. - Energy upgrade of public sector buildings: to increase their energy efficiency
Hungary	NA	NA	NA		1.038	Investments in the energy system include Classic and smart grid development for transmission system operator and distribution system operators, Support for the use of residential solar panels and heating modernisation, Installation of grid energy storage facilities for market participants, Dissemination of smart metering

	NECP			RRF		
Country	Buildings & Industry (€ bn)	Energy system (€ bn)	Notes	Buildings & Industry (€ bn)	Energy system (€ bn)	Notes
Ireland	NA	NA	NA	0.060		Investments in buildings and industry aim at: - De-risking a Low-Cost Residential Retrofit Loan Scheme. - Accelerate the Decarbonisation of the Enterprise Sector.
Italy	270	131	Investments in buildings concern the residential and the tertiary sector. Investments in the energy system refer to the electrical sector (power plants) and the electrical system (networks, storage)	12.356	7.209	Investments in the energy system: i) Agri-solar Park: support to investments on productive structures of the agricultural, livestock and agro-industrial sector, to renovate roofs including the installation of solar panels; ii) Green islands: financing and implementing projects in energy (such as renewables, grid and energy efficiency), water (such as desalination), transport (such as cycling paths, zero-emission buses and boats) and waste (such as separation of waste) in 19 non interconnected Small Islands; iii) Strengthening smart grids: transformation of the distribution networks and their management to enable new energy scenarios where consumers and prosumers can also play a role; iv) Development of agri-voltaic systems; v) Promotion of RES for energy communities and jointly acting renewables self-consumers Investments in buildings and industry: i) Strengthening of the Ecobonus and Sismabonus for energy efficiency and building safety; ii) Green ports: renewable energy and energy efficiency interventions at ports; iii) Construction of buildings, requalification and strengthening of real estate assets of the administration of justice
Latvia	3.32	1.8	Investments in buildings are aimed at improving energy performance of buildings and at improving energy efficiency and the use of RES technologies in heating and cooling Investments in the energy system are aimed at promoting the use of zero-emission technologies in electricity generation, energy security, reducing energy dependency, full integration of energy markets and modernisation of infrastructure	0.110	0.080	Investments in the energy system: modernisation of electricity transmission and distribution networks. Investments in energy efficiency and buildings are aimed at: i) Improving the energy efficiency of multi-apartment buildings and transition to renewable energy technologies; ii) Improving municipal buildings and infrastructure by promoting the transition to renewable energy technologies and improving energy efficiency; iii) Improving the energy efficiency of public sector buildings, including historical buildings
Lithuania	2.6	2.3	Investments in energy are dedicated to renewable energy development	0,218	0,136	Investments in the energy system include support for the construction of onshore RES plants (solar and wind power) and individual storage facilities: the measure shall include support provided to legal entities, farmers and renewable energy communities for the acquisition and installation of onshore solar and wind power plants and storage, prioritising self-consumption, farm or economic needs. Investments in energy efficiency and buildings include: - Update and testing in practice of building renovation packages and standards and creation of a methodology for the development of sustainable cities - Tools to facilitate building renovation coordination and technical - Support for faster renovation of buildings in line with up-to-date building renovation standards
Luxembourg	NA	2.1	RES development	NA	NA	NA
Malta	0.1 per year	NA	Energy efficiency investments are aimed at residential and service sector	0.075	0.003	Investments in the energy system include renewable energy investments in roads and public spaces Investments in buildings and industry include: i) Renovation and greening of public and private sector buildings, including deep retrofitting through energy and resource efficiency measures; ii) Renovation and deep retrofitting of public hospitals; iii) Renovation, deep retrofitting and renewable energy in public schools; iv) Construction of a pilot near carbon neutral school
Netherlands	5	16	Investments in energy systems include renewable energy, energy savings and networks	0.225		Subsidies for sustainable energy and energy savings aimed at owners of real estate for the implementation of energy savings interventions.
Poland	36.6	38.4	Investments for households and services: CAPEX on thermos-modernisation, retrofitting and replacement of heat sources, replacement of light sources with energy efficient ones, purchase of new energy efficient appliances.	3.012	0.054	Investments in the energy system will include RES installations operated by energy communities Investments in buildings ad industry shall include: i) Thermal modernization of schools; ii) Strengthening the energy efficiency of local social activity facilities; iii) Energy efficiency and RES in companies – investments with the highest greenhouse gas reduction potential; iv) Renovation to increase energy efficiency or energy efficiency measures of public infrastructure,

	NECP			RRF		
Country	Buildings & Industry (€ bn)	Energy system (€ bn)	Notes	Buildings & Industry (€ bn)	Energy system (€ bn)	Notes
						demonstration projects and support measures; v) Investment in energy-efficient housing for low- and average-income households"
Portugal	165-176	22.1-22.4	Additional investments to achieve climate neutrality: - Electricity sector: 1.2 – 2.2 - Buildings: 3.1 – 4.8	0.610	0.205	Investments in the energy system includes: i) Energy transition in the Azores with the objectives of installing new small photovoltaic electricity generation units for decentralised production and consumption for a total equivalent of 12,6 MW; ii) Business Reception Areas - Renewable energy production, storage and smart systems; iii) Business Reception Areas — Pilot interventions to improve energy stability Investments in energy efficiency include the following measures aimed at promoting energy and resource efficiency, to enhance self-consumption of renewable energy in i) residential buildings; ii) central government buildings; iii) buildings used by the services sector
Romania		21.8	Investments in power plants and electricity grids.	0.064		Investments in industry refer to ensuring energy efficiency in the industrial sector. The objective of the investment is to increase the energy efficiency of the industry.
Slovakia	1.66	4.3		0.735		Investments in energy efficiency and building shall include investment aimed at improving energy efficiency of family houses and investments dedicated to renovation of historical and listed public buildings.
Slovenia	15.2	6.3	Investments in energy efficiency are dedicated to households, services and industry. Investments in the energy system are dedicated to electricity transmission and distribution, central supply and local supply.	0,073	0,100	Investment in the energy system include: - Production of electricity from renewable energy sources (including investment concerning solar technology for public buildings) - Strengthening the electricity distribution network (low-voltage network) Investment concerning buildings and industry include: - Investments to increase energy efficiency in the economy (set-up and operationalisation of a digital platform for the renewable electricity market). - Sustainable renovation of buildings
Spain	45.1	150.4	Investments in energy efficiency are aimed at the residential and services sectors. Investments in the energy system are dedicated to renewable energy, networks and electrification.	4.908	3.046	Investments in the energy system include: i) Development of innovative renewable energies, integrated into buildings and production processes; ii) Digitalisation of networks, iii) New business models in the energy transition such as: support for the deployment of aggregators, support for demand management projects. Investments in buildings and industry include: i) Rehabilitation programme for economic and social recovery in residential environments; ii) Energy Rehabilitation of Buildings Programme; iii) Regeneration programme and demographic challenge, iv) Public Buildings Rehabilitation Programme
Sweden		14.5	Power production and distribution	0.060		Energy efficiency investments in multi-dwelling buildings

Source: National Climate Plans (NECP) and Recovery and Resilience Plans (RRP) of EU Member States

2.3. Specificities of investing in energy services

Energy services play an important complementary role in the energy value chain by enabling other segments of the value chain (i.e., generation, transmission and distribution, storage, heating and cooling) to reach their decarbonisation objectives in a cost-efficient and effective manner. As such, energy services are a broad umbrella concept because they enable interaction between various types of subjects (e.g., consumers, producers, prosumers, aggregators) across all elements of the energy value chain[24].

Overall, three main objectives can be identified in the broad segment of energy services, as follows:

- **Energy efficiency** as an effective method of reducing overall energy consumption and related emissions, and alleviating energy poverty.
- **Flexibility** as a way of optimising the overall system costs while increasing grid asset usage and efficiency, its resilience, and the ability to integrate intermittent renewable energy sources.
- **Citizen engagement** as a mean of promoting the active participation of consumers in the energy market, reducing their energy costs, and stimulating social consensus around a clean energy transition.

For the purposes of this study, energy efficiency services will not be included in the analysis, as they are covered by the work of EEFIG[25].

Energy services relating to flexibility and citizen engagement are vastly heterogeneous since they are provided in **different configurations and different types of actors** (e.g., consumers, prosumers, retailers, etc.). For example, the installation of rooftop PV modules which converts consumers to prosumers may be achieved either as a stand-alone solution, through individuals' investments and autonomous installation, or through solutions that are part of a wider bundle of services such as energy efficiency services provided by operators like ESCOs which may install PV panels alongside with works for the refurbishment and renovation of buildings. In addition, **technological development** has led to the emergence of different energy services and related business models. That said, obsolete or inadequate regulatory frameworks of Member States, which are not aligned with the provisions of the wider EU regulatory framework, may limit the emergence of new energy services and related business models[26].

For the purposes of this study, we have identified several relevant **layers of analysis** to assess in relation to the economics of the energy services segment. These layers refer to:

- **Financing of the upfront costs** necessary to set up projects that provide energy services.
- **Ensuring revenue streams** for the financial sustainability of the business cases.

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25 The Energy Efficiency Financial Institutions Group (EEFIG) comprises over 200 organisations which include financial institutions, investors, bank associations, energy efficiency practitioners, academia and other experts across the finance market. The EEFIG addresses barriers to energy efficiency financing through both policy design and market-based solutions to increase the scale of energy efficiency investments across Europe. More information is available at this link.

26 Notably, the Renewable Energy Directive (REDII) recast of 2018 alongside the Electricity Market Design Directive (IEM) of 2019 that introduces flexibility and citizen engagement into the EU energy legislative framework through the introduction of new actors and configurations in the energy market (e.g., energy communities and self-consumers).

- **Incentivising implementation** and adoption of business cases for energy services.
- The **scope of financing** activities i.e., if financing is channelled to **assets or revenues**.
- **Public costs and savings** relating to costs on the public budget, on the grid or on the wider public generated by incentive mechanisms or by the proliferation of Distributed Energy Resources (DER).
- **Impact on grid balancing** of the increased number of Distributed Energy Resources (DER) required to promote energy services.

The two layers of analysis are assessed below **for the six most relevant and commercially mature business models of energy services**. More in specific, based on the services provided, the six identified business models have been grouped into two categories of energy services, namely: Self-consumption and Demand response (DR), as reported in the table below.

Table 2: Categorisation of business cases for energy services

Class of energy service	Description of the energy service	Business models	Description of the business models
Self-consumption	Consists of the consumption of energy that is generated *in situ* from generation sources that are close or associated to consumption points (such as PV panels or mini wind generators)	Prosumers (individual)	Electricity consumers that produce part of their electricity needs from their own power plant and use the distribution network to inject excess production and to withdraw electricity when self-production is not sufficient to meet own needs.
		Citizen Energy Communities (CECs) (both in the cooperative and SPV forms)	Voluntary legal entities established at a local level for the purpose of sharing energy generation sources among different consumption points.
		P2P (prosumers)	Peer-to-peer energy (P2P) trading is the buying and selling of energy between two or more grid-connected parties. Any excess energy can be transferred and sold to other users via a secure platform.
		Energy as a Service (EaaS)	A category of business models whereby customers pay for an energy service(s) from a dedicated energy service provider (ESP) without having to make any upfront capital investment.
Demand response (DR)	Demand response involves shifting or shedding electricity demand to provide flexibility in wholesale and ancillary power	Direct C&I (commercial and industrial)	Demand response services provided by commercial and industrial operators.
		Aggregation - VPP (residential and C&I demand response)	Aggregation of distributed energy resources with the aim of participating to flexibility markets.

markets, helping to balance the grid (IEA)[27]

1.3.1 Self-consumption services: business models and economics

Among the most relevant business cases for energy self-consumption, are the following:

- **Prosumers**: referred in this study as individual units (e.g., households, small-medium sized enterprises, schools, hospitals, etc.) that are able to self-generate and consume energy within their premises. They represent the most simplified business case for self-consumption.
- **Citizen Energy Communities (CEC)**: are voluntary legal entities established at a local level for the purpose of energy "generation, including from renewable sources, distribution, supply, consumption, aggregation, energy storage, energy efficiency services or charging services for electric vehicles or provide other energy services to its members or shareholders"[28]. Energy communities organise collective and citizen-driven energy actions that help pave the way for a clean energy transition. They contribute to increasing public acceptance of renewable energy projects and make it easier to attract private investments in the clean energy transition. At the same time, they have the potential to provide direct benefits to citizens by increasing energy efficiency, lowering their electricity bills and creating local job opportunities.
- **Peer-to-peer (P2P)**: among the most promising self-consumption concepts and mentioned in the RED II (recast), it enables energy trading between prosumers and consumers, as well as the aggregation of prosumers, in view of creating **Virtual Power Plants (VPPs[29])** and offering the possibility of) participating in wholesale and ancillary services (balancing) markets. P2P trading gives the possibility for prosumers and consumers to negotiate better prices of electricity supply than those proposed by market suppliers.
- **Energy as a Service (EaaS)**: this business model allows for the creation of prosumers as part of bundle contracts that offer a vast array of other energy services, many of which pertain to energy efficiency.

Table 3 below provides a summary of the key elements for each self-consumption business model considered under the six layers of analysis, which are further detailed in the next sections.

Table 3: Summary of economics for self-consumption business cases

Self-consumption						
Business cases	**Financing of upfront costs**	**Scope of financing (assets/revenues)**	**Ensuring revenue streams**	**Incentivising implementation**	**Public costs and savings**	**Impact on grid balancing**
Prosumers (individual)	• Equity (own resources) • Debt • Public (EU/national) financing	• Assets (e.g. PV installations) • Revenues (e.g., FiTs / FiPs or other stable and	• Decreased costs of energy supply • Government support schemes (incentive schemes,	• Exemptions (on grid tariffs, taxes, levies, etc.) • Remuneration of grid export	• Economic burden related to incentive and support schemes	• Problem of grid congestion if grid injection is encouraged (FiPs, FiTs, net metering)

[27] The definition of demand response by the IEA is available at the following link.

[28] European Commission (2019). Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU.

[29] Please note that VPPs can also be an aggregated portfolio of assets participating in energy and ancillary services' markets.

Self-consumption						
Business cases	**Financing of upfront costs**	**Scope of financing (assets/revenues)**	**Ensuring revenue streams**	**Incentivising implementation**	**Public costs and savings**	**Impact on grid balancing**
		predictable return)	exemptions on grid tariffs/taxes) • Demand Side Flexibility monetisation	• Participation to demand flexibility • Shift the burden of initial investment away from the primary beneficiary • Favour low-cost financing	• Indirect costs in the form of increased grid costs	• Impacts on grid mitigated if self-consumption is encouraged
Energy communities	• Equity (community members) • Third party financing (ESCO or partnerships with other promoters) • Debt financing • Public (EU/national) financing Innovative financing (microcredits & crowdfunding)			• Competitive remuneration of exported energy into the grid • Participation in grid flexibility markets • Facilitate community access to capital • Enable innovative financing mechanisms • Encourage equity providers' participation		
P2P (prosumers)	• Financing of prosumers • Financing trading platforms: ○ Equity (including ventures) ○ Debt ○ Public (EU/national) financing	• Physical layer (users): Smart meters smart grids (including mini-, micro- or nano grids) • Virtual layer (platform developers): ICT network	PLATFORM • Participation and service fees MEMBERS • For buyer: through reduced costs of energy from a better trading outcome than on the traditional markets • For seller: through profits on the energy sold • Revenues from ancillary services (e.g. flexibility services on the balancing market)	• Clear definition of the rewarding mechanisms/schemes • Reflect community interests and expectations on remuneration mechanisms • Ensure better buy-back compensation • Favour low-cost financing	• Costs related to financing assets for both prosumers and platforms • Decreased use of revenue support schemes for renewable installations	• Avoid grid injection through local trading • Can lead to grid congestion if storage and V2G configurations are adopted
Energy as a Service (EaaS)	• Third party financing (ESCO or ESP)	• Installation of generation, metering and storage assets	• Energy asset services: margins on hardware, installations and, financing models • Energy management services: subscriptions-based/ performance-based contracts	• Possibility of participating to flexibility markets • Implementation of innovative pricing models	• Costs from mechanisms that support the generation of revenues like FiTs and FiPs	• Problem of grid congestion if grid injection is encouraged (FiPs, FiTs, net metering) • Impacts on grid mitigated if self-consumption is encouraged

Financing of the upfront costs varies according to the level of CAPEX as well to the number of parties involved in energy projects.

Prosumers can finance upfront costs using their own resources, or by external means such as debt (either from financing institutions like banks or from public loans) and public grants (either from governmental financing schemes[30] or EU programmes). Investments finance mainly the installation of solar panels, and storage systems.

Citizen Energy Community projects can take up different legal forms, as presented below, which in turn shape their possibilities to finance upfront costs:

- Community entities can rely on financing from their members in the form of equity through the acquisition of shares, in the case where communities are led by cooperatives or consumer/prosumer-owned private companies. Another form of **self-financing** for CECs derives from membership fees where communities are led by consumer/prosumer-owned companies, or by energy companies acting as ESCOs or partners that promote CECs. However, CEC projects may need large upfront investments, and communities' equity contributions might prove insufficient. In this case, external finance such as debt financing and grant financing from public sources is necessary. In addition to these sources, CECs can also access innovative financing instruments such as crowdfunding and microcredits which are especially effective in financing projects that target local communities.
- Project vehicles are relevant for large CECs, which can be structured as Special Purpose Vehicle (SPV) and financed through **project financing**, which is particularly suited to raise **long-term debt.** The debt is raised using the CEC's assets as collateral and citizens are partial or total owners of the SPV through the equity they initially invested. In this case, the terms and the success of project financing are highly influenced by the visibility and predictability of revenues throughout the maturity of the financing contract. Another option for communities is to make use of **joint-venture models** to access financing[31]: in this case the energy project partners with a private developer, which may raise capital for its share of the project through equity financing based on its track record and the income projections of its portfolio.

Although community-based CECs essentially operate in the same way as private businesses with respect to revenue and cost structures, the cost of capital may be higher than for fully private models, as CEC members have lower access to funding. This is due to the lack of clarity on long-term revenues generated by CEC projects. Indeed, unlike other renewable projects, a community ownership project often aims to achieve objectives in addition to maximising financial profits for its members (e.g., energy security, energy access, decarbonisation). This can make the business case less robust when trying to gain the support of traditional financiers and investors.

For **Peer-to-Peer** business models, the financing of upfront costs may come from two different sources: on one side, individuals that take part to P2P energy trading, thereby acting as prosumers[32], finance upfront costs independently as presented above. On the other side, third-party digital platforms (based on blockchain technologies) can be leveraged to allow prosumers to trade with each other, place buy/sell offers and define the settlement of trading operations. Due to the emerging nature of these business models, trading platforms are currently implemented mostly as pilots, primarily through start-ups, which implies that upfront costs for the necessary ICT components are financed mostly through public financing

[30] One example is provided by the Italian *Parco Agrisolare* financing scheme, financed through the country's NRRP. The scheme allows agricultural businesses, including independent entrepreneurs, to access funds aimed at requalifying roofs for buildings that are destined to agricultural activities, including the installation of roof solar panels, thus enabling agricultural business to locally self-generate energy and become prosumers.

[31] IRENA Coalition for action, stimulating investment in community energy: broadening the ownership of renewable, *IRENA*, 2020.

[32] P2P trading allows both prosumers and consumers to take part to trading operations.

programmes, crowdfunding and private financing originating from financing institutions and ventures[33].

Compared to prosumers, the presence of additional actors, both in type and in number, that characterizes the CEC and P2P business models leads to increased opportunities for financing upfront costs and for relying on additional technologies other than PV (e.g., district heating), as well as enhancing PV installations with storage systems that allow to combine self-consumption and demand response services, thereby diversifying revenue streams and offering increased security to investors and lenders.

Finally, the **Energy as a Service** business model promotes the proliferation of prosumers and self-consumption, enabling energy operators such as ESCOs or energy Service Providers (ESPs) to take on the burden of financing the installation of renewable generation, storage and measuring assets and components through the subscription of bundle contracts. Such contracts can provide several services, including installation of assets, supply of energy, energy efficiency services and participation to flexibility and balancing markets, as well as upgrades and retrofitting. In this model, individuals become prosumers without the need of undertaking an upfront investment, while paying a contractual fee to the promoter (ESCO/ESP) which is used to repay the investment. Project promoters, on the other hand, bear the burden of the initial investment with their own resources and often retain the property of the assets.

The **scope of financing** refers to the possibility of financing either revenues or assets making use of financing instruments. In detail, when referring to **financing revenues** we consider those financing instruments like Feed-in-tariffs (FiTs) Feed-in-premiums (FiPs), net metering, net billing or any other financing or support mechanisms fuelling the revenue streams of projects. Whereas when referring to **financing of assets** we consider financing instruments like loans, grants or private funding that target the acquisition of RES generation assets and other components necessary for the deployment of projects regarding energy services.

For **prosumers** and **energy communities,** financing instruments can target both revenues and assets. The former may be targeted to ensure stable and constant returns to RES operators, for example using FiTs/FiPs and net metering/net billing to incentivize exportation of excess self-generated energy to remunerate it in a competitive manner. The latter may consist in financing the acquisition and installation of components necessary for PV installations (e.g., solar panels, inverters, storage systems and smart meters), for example using subsidies or grants[34].

For **P2P** configurations the scope of financing can be classified into two layers, both referring to assets (hardware and software), as revenues are generated internally by trading activities:

- The physical layer such as smart meters that can help monitor real-time power production, and smart grids, including mini, micro or nano grids, as well as generation assets. These assets are detained by prosumers or, in general, by the members of a P2P configuration.
- The virtual layer refers to platform development and ICT networks to enable communication between participants, handle payments and monitoring of activities.

[33] One such example is the Piclo platform, promoted by UK-based startup Open Utility by attracting £ 500.000 worth of funding from the UK's Department of Energy & Climate Change, Nominet Trust and the EU Cimate-KIC facility in 2013, followed by funding from the UK Gov. Department for Business, Energy & Industrial Strategy (BEIS) in 2017, taking the total raised to Mln £1.9. Additional funding of £ 500.000 was awarded from BEIS in 2020 followed by two series A funding rounds between 2020 and 2021 from Mott MacDonald Ventures, Clean Growth Fund and Green Angel Syndicate.
Another example is represented by Drift, a start-up from Seattle in the USA, which launched a P2P platform that lets residential, business, and commercial customers buy power directly from local solar, wind, hydroelectric, and other sources. The company secured funding for Mln$ 7 in 2017 from a wide range of capital funds and ventures.

[34] The Italian *Parco Agrisolare* represents a relevant example. Another example is given by the Romanian *Casa Verde* scheme which, is currently subsidising the installation of solar panels by households up to 4,000€, upon a minimum contribution of 400 €.

Finally, for **EaaS,** business revenues are financed on the customer side according to the prosumer business model, while assets are financed entirely by project promoters which maintain their property and cure their maintenance and upgrade.

Ensuring revenue streams is of fundamental importance for the development and diversification of business models as it contributes to the development and consolidation of energy services as a stand-alone segment of the energy value chain. Regulation plays a key role in this, either favouring some business models with incentive schemes, or penalising others due to regulatory uncertainty or absence of regulatory rules altogether. For example, the rollout of energy communities in Italy has been a lengthy and slow process with Italy currently far behind much more virtuous EU counterparts such as Germany, Denmark and the Netherlands which have gathered significant experience in promoting energy communities[35].

Prosumers and energy communities benefit from three important types of revenue streams:

- Revenues in the form of **decreased costs** in relation to energy bills, originating from increased usage of **self-produced** energy as opposed to energy purchased from an ESP through transmission and distribution grids. In this case revenues are generated by time-of-use optimisation and the avoidance of periods of high tariffs and reducing peaks[36].
- Revenues generated by **government support schemes** in the form of:
    - **Incentive schemes** (e.g., Feed-in Tariff, Feed-in Premium, net metering, net billing) applied to the self-produced energy that prosumers inject into the energy grid, to guarantee a stable and predictable revenue.
    - **Exemptions** from energy system costs like grid charges, taxes and levies[37]. As highlighted by the EEA, such exemptions should be justified if prosumers reduce grid costs or provide balancing services, whereas in many support schemes, exemptions are not tied to any conditions thereby generating pressure on consumers that cannot or do not want to go off-grid[38].

  Although many prosumers in the EU that have benefitted from such schemes in the past[39] can still participate to Feed-in Tariffs and net-metering in some countries, these programmes are experiencing increasing phase-out as the price of electricity from renewable energy becomes more competitive.
- **Demand Side Flexibility monetisation,** which can be accessed mainly by aggregations of prosumers like energy communities or peer-to-peer configurations in the form of VPPs, due to its technical and regulatory complexity. For further detail on demand side flexibility please refer to Section 2.3.2.

For **P2P** business cases, revenue streams can be differentiated between those generated from the trading platforms and those of participants, as presented below:

- Revenues from the **trading platforms** are represented by participation and service fees charged to participants of the platforms with the aim of covering the initial investment in ICT and monitoring components sustained by the companies managing the trading platforms.

[35] Further details concerning this example is presented in Section 1.4.1 on Regulatory and Political Barriers.

[36] The SmartEn Mp: Prosumers, *SmartEn*, 2020.

[37] Grid charges, taxes and levies represented the lion's share of energy bills in most EU countries before the start of the energy crisis in 2021.

[38] Energy prosumers in Europe: Citizen participation in the energy transition, *European Environment Agency (EEA*), 2022.

[39] Governmental support has been the main reason for the emergence of energy communities in several EU countries, for example Germany, as reported by the European Regional Development Fund (Interreg Europe) in a policy brief on renewable energy communities of 2018.

- Revenues of **participants** can be further distinguished between revenues of sellers of energy, deriving from the energy sold to other users of the platform, and revenues of buyers, consisting in the lower cost of energy compared to that of purchased from an ESP.

Another category of revenue streams is related to the ability to aggregate P2P members into VPPs and thus provide flexibility services, especially to Distribution System Operators (DSOs). For further detail on the demand side flexibility please refer to Section 2.3.2.

Similarly to the P2P business model, **EaaS**' revenue streams can be divided as follows:

- **EaaS promoters' revenues** are generated by the fees paid by contract subscription through:
  - **Energy asset services** such as hardware and installations. This revenue stream represents a one-time opportunity per contract.
  - **Energy management services** which pertain specifically to the bundle of services offered to customers. This represents the core business of EaaS promoters and revenues vary according to type of contract that is stipulated[40]. For subscription-based contracts, customers pay a fixed fee to project promoters which enables the latter to absorb the price and quantity risk. For performance-based contracts, the fees paid to project promoters are influenced by energy savings of the projects.
- **Customers' revenues (prosumers)** derive from the savings they obtain from self-consumption, as explained above for prosumers and energy communities.

Incentivizing implementation is key to encourage the participation to energy services business models, leveraging on different **regulatory**, **economic** or **governance** instruments. Ultimately, incentivizing implementation should aim at counteracting the barriers that affect energy services and prosumers (see Section 2.2.4 of this study for more information of the identified barriers).

For **prosumers**, incentivizing implementation should be centred around the idea that prosumer projects must be profitable or **ensure at least cost neutrality** (EEA, 2022). To do this, regulatory regimes can make use of several political instruments:

- Introduce **exemptions** on grid tariffs, taxes and levies, although, as mentioned earlier, such exemptions need to be tied to actual benefits generated on the overall system in order to avoid increasing burdens on grid users.
- Open an additional revenue stream for prosumers, other than direct savings from less purchased energy, by **remunerating grid export**. This can be achieved with net metering / net billing schemes, thus also benefitting the overall system as prosumers would be incentivized to inject into the grid excess self-produced renewable energy. In absence of net metering / net billing schemes, regulation should allow for the implementation of any other incentive scheme (also through FiTs and FiPs) that is competitive enough with energy retail prices, or at least wholesale prices, to encourage energy export to the grid.
- Enabling the **participation to energy flexibility markets,** by easing technical requirement for participating in grid services (e.g., submetering, speeds of response, hardware required, etc.) and leveraging their participation to energy communities, P2P configurations and as part of aggregated portfolios in the form of VPPs.
- **Shifting the burden** of the initial investment in assets and components away from the primary beneficiary can notably incentivize the uptake of prosumer configurations. As

[40] Energy as a Service: Innovation and landscape brief, *IRENA*, 2020.

such, non-repayable grants, aimed at financing all or part of the initial investments, alongside business models such as EaaS that completely relieve the customer from the burden of the initial investment can prove very effective in increasing self-generation.

- In the absence or scarcity of grant financing, favour **low-cost financing** opportunities like public loans.

For **energy communities**, competitive **remuneration of exported energy into the grid** and **participation in grid flexibility markets** through aggregation can provide the same economic incentives to favour implementation, as presented above, even if at a larger scale. However, there are several additional incentivization instruments that become available to energy communities with respect to prosumers due to their aggregator nature and increased bargaining power:

- Facilitation of **community access to capital** through targeted public finance (e.g., grants, concessional loans, revolving funds) and tax relief, as access to debt and equity financing can be particularly challenging for smaller community energy projects, especially at the initial stages of project development.
- Enable **innovative financing mechanisms** taking into consideration the unique characteristics of energy communities (IRENA, 2020). Alternative financing mechanisms like crowdfunding and flexible payment schemes such as “pay as you go” (PAYG)[41] can support new partnerships between the energy community and private actors. Other innovative finance mechanisms include subscription-based models such as virtual net energy metering (VNM) that allow citizens who lack the means to invest in renewable energy to buy or lease a portion of an off-site renewable energy project and receive bill credits for their share of the electricity generated by the project.
- **Encourage equity providers** to participate through joint venture programmes and community aggregation schemes.

P2P configurations are still at the very beginning of the development path, with a few projects that have just recently attained commercial availability after several years of pilot status. Even so, several incentivization mechanisms to encourage participation of prosumers have been already identified thanks to surveys conducted on trial projects, where participants were consulted on the economic attractiveness of P2P configurations. One such survey highlighted **several economic incentives that can encourage participation to P2P configurations** (Wilkinson et al., 2020):

- Ensure **better buy-back compensation** than public incentive schemes. Adhering to a P2P configuration causes prosumers to lose the right of benefitting from public incentive schemes, in view of avoiding double remuneration of the self-produced energy, which implies that they cannot obtain remuneration in case they are unable to trade all the self-produced energy. Therefore, P2P configurations need to ensure buy-back compensation mechanisms in accordance with Energy Service Providers (ESPs) by which the latter agree to buy any self-produced energy that prosumers are unable to trade, in exchange for a sufficiently competitive compensation with what is guaranteed by alternative public incentive mechanisms[42].
- Favour **low-cost financing** opportunities for consumers (to obtain RES generation assets) and P2P platforms alike.

[41] Under a pay-as-you-go (PAYG) business model, a private partner leverages its access to equity to finance the community’s share of the project. The community can then direct project revenues (or cost savings realized from the project) to make regular payments to the partner over a mutually agreed time frame. (IRENA, 2020).

[42] In the study performed by Wilkinson et al., (2020), participants to the trial expressed dissatisfaction with the design of the P2P model as it ensured a lower buy-back rate compared to what was guaranteed by FiTs.

- Ensure clarity in the definition of the rewarding mechanisms/schemes and of participation/transaction costs in order to give a **clear view to participants** on the economic benefits of participating to P2P configurations[43].
- Design rewarding mechanisms/schemes and tariff schemes alongside participants to **reflect community interests and expectations** and avoid disadvantaging smaller prosumers[44].

Implementation of **EaaS configurations** can be incentivized by several regulatory measures such as ensuring the **possibility of participating to flexibility markets.** Regulatory measures could incentivise implementation of EaaS by giving the opportunity to project promoters to implement **innovative pricing models** that provide customers the ability to choose between different services based on their needs. For example, prices could be decoupled from units of electricity sold to incentivise utility providers to promote energy management efforts at the customer end (IRENA, 2020).

Public costs and savings originate from the implementation of public support schemes used by energy services business models to mitigate the risks deriving from novel regulation and emerging technologies. These are **costs supported directly** by the wider public as these schemes are often financed with revenues from energy bills of consumers or through public budget. However, public costs can also relate to **indirect costs** related to the proliferation of distributed self-generation in energy systems.

For prosumers and energy communities the most relevant **direct public cost** is the economic burden related to incentives and support schemes, which are fuelled mainly by two sources, namely:

- **Consumers** directly through their energy bills concerning support schemes that generally target revenue support (such as FiTs, FiPs, net metering/net billing);
- The **public budget** in relation to grants or low-cost financing for support schemes, that generally target asset financing. The public budget can also support revenues through exemptions on taxes or grid tariffs.

Although theoretically, increased self-generation and consumption can lead to a decrease in the usage of transmission and distribution grids (and therefore to a decrease in the customer base), in practical terms public resources still need to be directed towards maintaining and developing such infrastructures in order to guarantee system adequacy and security. This may lead to the manifestation of **indirect costs** in the form of increased grid costs for those consumers that cannot afford or do not wish to adopt self-generation business models. In addition, public incentives in the form of grid tariff exemptions for self-generation business models further increase grid tariffs on the remaining customer base. Because of this, **self-consumption could be considered as a better option for grid development** than injection into the grid of self-generated energy, because they promote the use of distribution grids and promote their expansion and capillarisation through the creation of micro, mini or nano grids.

The costs borne by the wider public for the incentivization of energy business models are significantly dependent on each Member State's energy policy. In other words, some Member

[43] In this particular trial (Wilkinson et al., 2020), the design characteristics of the P2P model were presented to interested participants in a first workshop and then changed in a second workshop, increasing trading fees and penalizing households with small PV installations which led to a drop-out of almost half of participants from the trial. Their main motivation was attributed to high levels of uncertainty and/or lack of alignment with their underlying values of the P2P design which no longer met their expectations following the first workshop.

[44] In the study performed by Wilkinson et al., (2020), many participants were dissatisfied with their ESPs and expected the P2P model to be less market driven and more community oriented. Indeed, the study reports that "Many of them (participants) thought that P2P trading should be subsidized to encourage uptake, as occurred previously with solar PV". The study further states that because "the initial design of the P2P trading model was developed with little consideration of user's input, the co-production process was weak, resulting in user critique of poor design with inappropriate pricing. These factors contributed to a high number of dropouts from the project. This result supports existing literature that points to the importance of collaborating with users-innovators to help co-create the innovation design and improve user acceptance".

States might favour some business models in opposition to others thereby directing more resources to support certain mechanisms rather than others[45].

P2P models may require public support for financing assets both on the consumer/prosumer and platform sides, but there is no need for mechanisms that support revenues, since P2P models generate revenues internally through their energy trading activities. Indeed, as mentioned above, participants to P2P models have to renounce the opportunity to receive FiTs or FiPs if they wish to participate in P2P models in order to avoid double monetisation. P2P models could also lead to reduced usage of the transmission grid in favour of the distribution grid which would serve as the backbone for local trading. Therefore, a proliferation of P2P models may shift the focus from the transmission to the distribution sector, with potential savings generated by exemptions grid tariffs that could be invested through P2P configurations in the development and capillarisation of distribution grids (e.g., implementation of digital solutions, investments in the modernisation of physical assets).

During WG meetings, participants noted that a big limit of P2P electricity trading is that using the grid to exchange electricity implies also paying a "stamp trading" cost, meaning that the transaction is not cost-free as a certain fee will have to be paid to cover the grid use. This means that a grid fee needs to be included in the price of electricity. Independent mini grids could be a solution but would imply a higher CAPEX cost to build such grid. However, independent mini grids could lead to a doubling of some infrastructures, with consequent risk of stranded asset.

As opposed to P2P models, **EaaS models** generate no effect on public costs from the financing of assets to promote self-generation. Indeed, ESPs or ESCOs take on the costs related to the installation, maintenance and upgrade of assets. Amongst the possible costs on the public generated by EaaS models we can mention the following:

- Direct costs stemming from those mechanisms that support the generation of revenues like FiTs and FiPs which are in turn used by customers to pay service fees established within EaaS models. This way, project promoters finance their costs using incentives perceived by customers.
- Indirect costs on the wider public related to the increase of the burden of financing grid tariffs (as more and more consumers rely less on the transmission grids) could stem from EaaS models, since they encourage the proliferation of self-generation.

Impacts on grid balancing[46] represent the final layer of analysis to explain the economics behind the identified business models, specifically with regards to the potential of DER to cause and mitigate imbalances in the grid through the provision of flexibility services.

During WG meetings, participants have also remarked **that the growing presence of prosumers will pose additional stress on the grid** due to increase in bidirectional flows. Because of this, local authorities will need to have the means necessary to upgrade the grid and ensure that the grid operator(s) have the staffing needed to conduct the works and maintain the grid. Nonetheless, an excessive reduction in grid usage could lead to higher grid fees.

[45] One example is Italy where individual prosumers benefit either from a net billing mechanism – *Scambio sul posto* – or a feed-in tariff mechanism – *Ritiro dedicato* – both of which guarantee a remuneration based on the market price that is formed in the geographic region where the generation assets are located. This price varied between 40 and 60 €/Mwh in pre-Covid times according to GME (*Gestore Mercati Energetici).* In comparison, the recent regulatory framework concerning energy communities, implemented by Decree 199/2021 states that self-consumers and energy communities are entitled to receive incentives of 100 €/Mwh and respectively 110 €/Mwh in addition to refunds on grid tariffs, which reflect minor usage of the grid, and in addition to the market price that is applied on the energy injected into the grid. Therefore, energy that is injected into the grid is valued in a widely different manner with respect to energy that is self-consumed.

[46] This layer of analysis is available only for business models related to the self-consumption energy service stream. For the demand-response energy service stream, grid balancing represents the main purposes of an activity aimed at increasing participation to energy balancing markets of DER sources alongside traditional sources. Therefore, this layer of analysis has been considered as non-applicable to demand response in order to avoid redundancy.

For **prosumers, energy communities and EaaS models**, impacts on grid balancing are related to the types of incentivization mechanisms that are set in place, since Member States might encourage either **grid injection** or **self-consumption** according to their different energy policies.

- If **grid injection** is encouraged, for example through net metering, the problem of grid congestion arises, particularly in cases where the distribution grids are not sufficiently developed to cope with increasing sources of DER (Distributed Energy Resources). In addition, support policies such as grid tariff exemptions or net metering schemes only worsen the problem as they do not remunerate grid investments. The problem can be partially solved by preferring net billing schemes to net metering, therefore guaranteeing remuneration to investment in grid development, while still providing remuneration to self-generated energy.
- If **self-consumption** is encouraged, for example with the use of FiTs and FiPs, the problem of grid congestion is mitigated as grid injection is seen as less remunerative. However, as previously explained, encouraging self-consumption excessively can lead to a decrease in the base of customers participating in the remuneration of grid investments, leading to the difficulties in adequately remunerating such investments without increasing pressure on the remaining customer base.

WG participants also see self-consumption as a better option for the management of the energy grids in comparison to grid injection, noting that **FiT systems should be designed to favour self-consumption** in view of reducing the burden on the central grid. WG participants noted that currently, FiT's remuneration systems are based on the amount of energy introduced in the grid by prosumers. However, this approach should be revised to also compensate prosumers for not using the grid, as by self-consuming the energy produced, they would actually reduce the pressure on the central grid and reduce possibility of congestions, hence decreasing grid management and maintenance costs.

P2P configurations can have two opposing effects on grid balancing: 1) although findings from pilot projects suggest that there are no significant impacts on the distribution grid operation from P2P configurations when only PVs are installed in the system, increased voltage fluctuations and losses have been reported in the case of P2P configurations that integrate decentralised batteries and V2G (vehicle-to-grid) systems[47]. yet, given the current scale of P2P projects, these effects are not significant[48]; 2) because P2P configurations rely on distribution grids, their development can be encouraged by the implementation of local and micro grids, which in turn can prevent excessive levels of injection into the wider distribution grids and enhance local self-consumption. In addition, as presented in the following section, P2P configurations can also lead to the implementation of demand response services at the distribution level.

1.3.1. Demand response services: business models and economics

We have identified two relevant business cases based on the types of end-users, pertaining to the demand response (DR) energy service class, as illustrated above, namely:

- **Direct commercial and industrial (C&I):** it concerns demand response services provided by commercial and industrial operators that possess the required assets[49], also in an aggregated manner. The service is requested by and provided to TSOs on

[47] Dynge, M., F., Crespo del Granado, P., Hashemipour, N., Korpås, M., Impact of local electricity markets and peer-to-peer trading on low-voltage grid operations, *ScienceDirect - Applied Energy*, 2021.

[48] Azim, M., I., Tushar, W., Saha, T., K., Investigating the Impact of P2P Trading on Power Losses in Grid-connected Networks with Prosumers, *ScienceDirect - Applied Energy*, 2020.

[49] These assets might refer to generators, storage systems, control systems (e.g., load control receivers) and digital communication systems.

energy balancing markets. This business model has been, and continues to be, the prevailing business model of demand response, with industrial consumers as the most relevant providers of demand response and demand-side flexibility, and monetisation from TSOs as the most easily accessible value stream for flexibility providers[50].

- **Aggregated (residential)**: it is an emerging demand response business model which coincides with the proliferation of DER generation and storage assets. It consists in the participation to energy balancing markets on behalf of self-generating operators not as individuals, but rather as aggregated configurations such as P2P or energy communities (also known as "residential"). Of particular importance is the emergence of **VPP (Virtual Power Plant) operators** which can virtually provide generation capacity or reduce demand by aggregating assets and consumption habits of individual distributed generation and storage assets[51]. More specifically, aggregated demand response extends the concept of demand response to distribution grids, as aggregated operators are connected to the low and medium voltage grids, thus attracting much interest in developing the distribution segment[52].

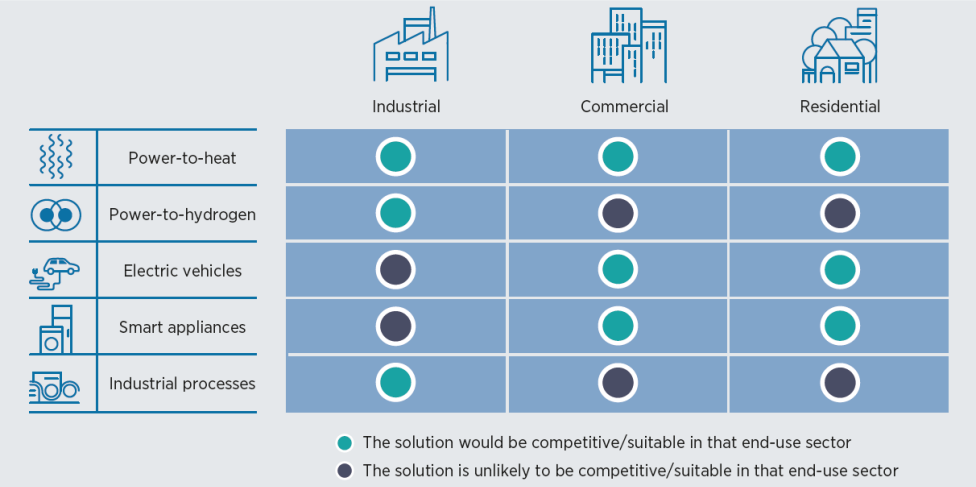
  For the purpose of this study, we consider energy communities and P2P as the most relevant configurations that can be aggregated into a VPP. Figure 2 presents which DR (Demand Response) technologies are most adequate considering the types of end-users that define the business models selected for this analysis.

Figure 2: Demand-side flexibility technology mapping by end-use sector

[50] Saviuc, I., Zabala López, C., Puskás-Tompos, A., Rollert, K., Bertoldi, P., Explicit Demand Response for small end-users and independent aggregators, *Join Research Centre*, 2022.

[51] As IRENA explains in its Innovation and Landscape Brief dedicated to aggregators (2019), "VPP operators aggregate DERs to behave like a traditional power plant with standard attributes such as minimum / maximum capacity, ramp-up, ramp-down, etc. and to participate in markets to sell electricity or ancillary services. The VPP is controlled by a central information technology (IT) system where data related to weather forecasts, electricity prices in wholesale markets, and the overall power supply and consumption trends are processed to optimize the operation of dispatchable DERs included in the VPP."

[52] Talks from Working Group 2 of the Investors Dialogue on Energy regarding Transmission and Distribution have identified Distribution as the focus of investment in this sector until 2030.



Source: IRENA (2019), Demand-side flexibility for power sector transformation

While Direct C&I can be considered a mature business model, it is only accessible by big commercial and industrial corporations that possess assets and consumption patterns able to meet what is demanded by TSOs or other balancing counterparts on the balancing markets. Considering the added value provided by aggregated demand response to individual self-generators by opening additional streams of revenue, and to the electric system overall by providing additional flexibility, the EU has introduced with the Internal Energy Market (IEM)[53] Directive, the concept of demand response aggregation into the regulatory context (Article 17 of the IEM Directive) mandating Member States to put in action all the necessary measures to "allow final customers, including those offering demand response through aggregation, to participate alongside producers in a non-discriminatory manner in all electricity markets"[54].

This section focuses on analysing these two selected business models under the same layers of analysis mentioned above. The table below summarises the main findings for each business model under each layer of analysis, which are further detailed in the next sections.

Table 4: Summary of economics for demand response business cases

Demand Response					
Business cases	**Financing of upfront costs**	**Scope of financing (assets/revenues)**	**Ensuring revenue streams**	**Incentivizing implementation**	**Public costs and savings**
Direct C&I (commercial and industrial)	Directly by implementing party (debt, equity, public funding) Third party financing (ESCO)	Equipment upgrades and modernisation of IT systems Smart meters Backup & storage systems	**IMPLICIT DR** Minor costs from alteration of consumption patterns according to flexible prices and tariffs **EXPLICIT DR**	**IMPLICIT DR** Implementation of dynamic tariff systems, flexible tariffs / levies **EXPLICIT DR**	Higher energy system costs driven by remuneration for DR services if grid injection is encouraged over self-consumption Lower energy system costs due to lower grid

[53] Internal Electricity Market Directive - Directive (EU) 2019/944 of The European Parliament and of The Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (recast).

[54] The IEM also encourages the uptake of smart meters across Member States (Article 20) to foster participation to balancing markets, alongside the provision of incentives on behalf of Member States for DSOs to procure flexibility services from providers of distributed generation in particular (Article 32).

Demand Response					
Business cases	**Financing of upfront costs**	**Scope of financing (assets/revenues)**	**Ensuring revenue streams**	**Incentivizing implementation**	**Public costs and savings**
			Payments from TSOs for: ○ Shutting down non-essential equipment; ○ Switching to back-up generators ○ Availability of DR capacity (capacity incentives) **IMPLICIT DR** Can be offered only by energy service providers Minor costs from alteration of consumption patterns according to flexible prices and tariffs **EXPLICIT DR** Can be offered both by energy suppliers/retailers and aggregators Payments from TSOs on the ancillary markets (contractual conditions determine member's remuneration)	Public funding or low-cost funding opportunities to establish aggregators, alongside regulatory provisions to enable their participation to flexibility markets Favour the introduction of innovative DR products	congestion if self-consumption is encouraged
Aggregated (residential demand response)	**MEMBERS** Prosumer financing (equity, debt, public funding) **PLATFORM** Equity (community members, ventures) Third party financing (ESCO or partnerships with other promoters) Debt financing EU / public financing Innovative financing (microcredits & crowdfunding)	**MEMBERS** RES generation assets and storage **PLATFORM** IT hardware and software Feasibility studies and technical consultancy			

Financing of upfront costs: For **Direct C&I**, upfront costs can either be financed directly by the implementing party through equity or debt, or they can be financed through a third party, usually an ESCO. In the latter case, the beneficiary directs the revenues from demand response services towards the third-party to repay the investment. This solution can prove particularly useful in those cases where regulatory updates might increase the costs for businesses and corporations to participate in DR programmes and thus discourage participation altogether. As an example, the US Environmental Protection Agency adopted regulatory measures which restricted DR participation to backup generators that met specific

standards, which in turn discouraged many organizations from participating in flexibility markets by operators using backup generators[55].

In **aggregated DR configurations,** VPPs assume a central role as they serve as connection between DR demand, expressed by grid operators and utility companies, and DR supply that can potentially be offered by sparsely distributed DERs. As such, upfront costs are borne by:

- **Members** of the VPPs, generally individual prosumers which can recur to equity, debt or EU/public financing.
- **The VPP platforms,** which can be community entities or SPVs in the case of energy communities, or start-ups in the case of P2P. Thus, financing of upfront costs is similar to the process mentioned above, and more specifically it can come from different sources, such as co-operative equity financing from members, third-party financing from project partners and promoters (including ESCOs and project promoters operating according to the EaaS business model), EU / governmental financing programmes, innovative financing mechanisms such as crowdfunding, or venture financing, according to the legal entity of the VPP.

The **scope of financing** for DR business models is mainly related to the financing of assets, as revenues are determined by national regulation related to the balancing market[56].

For **Direct C&I**, financing of assets refers to financing equipment upgrades and modernisation of IT systems in view of achieving the necessary digitalization to be able to provide DR efficiently in a timely manner. Other necessary assets relate to smart meters and backup systems to allow companies to function off the grid when required. Financing can also be directed to storage systems to increase DR capacity.

For **aggregated DR**, financing is directed towards the procurement of RES generation assets and storage for consumers that wish to become prosumers as well as roll-out of smart meters. Financing for IT hardware and software is also needed by operators that set up and manage VPPs. Given the novel and continually evolving regulation, as well as the emerging nature of DR aggregation, services such as feasibility studies and technical consultancy to access and navigate the market might also require financing.

For DR business models, **revenue streams are ensured** depending on the participation in different types of DR programmes, which can be categorized into two clusters[57]:

- **Implicit Demand Response** (also known as “price based”), refers to consumers choosing to be exposed to time-varying electricity prices or time-varying network tariffs (or both), thus leading users to change their electricity consumption behaviour during peak and valley consumption periods. Implicit DR does not allow customers to participate alongside generation in an energy market and does not provide the market

[55] In 2016, the US Environmental Protection Agency (EPA) adopted regulatory measures which restricted DR participation to backup generators that met the National Emissions Standards for Hazardous Air Pollutants for Reciprocating Internal Combustion Engines, which entail a number of airborne pollutants. Violation of these standards resulted in large fines, shutdowns, and potential prison sentences. The complexity in determining whether a generator was eligible for DR participation under the new standards and the capital required to implement eventual upgrades discouraged many organizations from upgrading at all, which caused them to lose access to DR programmes and related streams of revenues. This in turn caused a decrease in DR capacity and increased costs for grid operators that were passed down on to final consumers. To help bring this capacity back into the DR programmes—as well as help C&I energy consumers earn payments - Enel X began financing and implementing the equipment upgrades needed to bring generators into compliance with the EPA’s standards. Through these agreements, Enel X recovered the upfront hardware and installation costs from the DR earnings and uses the traditional DR revenue-share model to pass payments onto the customer after the project has been paid off.

[56] For example, in the case of flexibility services, TSOs remunerate energy operators based on the tariff set at the regulatory level when those operators are asked to modify their pre-programmed patterns of consumption or production in view of maintaining a balanced grid.

[57] Zancarella, P., Bertoldi, P., Kiss, B., Why Demand Response is not implemented in the EU? Status of Demand Response and recommendations to allow Demand Response to be fully integrated in Energy Markets, Joint Research Centre, 2017.

with a dispatchable resource. **Revenue streams** derive from dynamic tariffs which can lead to **lower bills**. This represents the most important incentive for customers to grant access to their technical systems to an external party[58]. In turn, energy suppliers/retailers or EMS/aggregators monetise this service with TSOs on the ancillary service markets by mitigating congestion or correcting their position. Access to this revenue stream depends on whether regulatory frameworks allow for the adoption of dynamic tariff structures[59]. Furthermore, access to this revenue stream can only be allowed through an energy supplier/retailer and not through other independent aggregators that are not qualified as energy suppliers/retailers[60].

- **Explicit Demand Response** (also known as "incentive based"), refers to consumers choosing to change their consumption pattern upon request (i.e., to consume more or less) in exchange of direct payments. This type of DR competes directly with supply in the wholesale and ancillary services markets through the services provided by aggregators or single large consumers, and through the control of load traded in electricity markets, providing a comparable resource to generation, and receiving comparable prices[61]. Both Direct C&I and residential operators can access explicit DR, both either through independent aggregators or through their energy suppliers.

To summarise, for Direct C&I, revenues from explicit DR are generated through:

- **Payments from TSOs for altering consumption patterns** by shutting down non-essential equipment or switching to back-up generators or storage.
- **Payments from TSOs for availability of DR capacity** (capacity incentives from programmes such as capacity markets) and mobilized energy.

Whereas, for aggregated DR, revenues are firstly received by their aggregators, which then redirect them to the aggregated resources on the basis of contractual agreements[62].

Incentivizing implementation can be achieved with different **regulatory**, **economic** or **governance** instruments, to incentivise operators, especially for aggregated DR, to provide implicit and explicit DR.

With concern to explicit DR for Direct C&I, several incentivizing actions have been identified, including:

- Expand **public funding for DR projects**, especially for long-term projects in order to increase visibility of revenues, as well as expand public funding to low-energy intensity sectors, as current DR programmes are primarily accessed by operators from energy-intensive sectors since they are the most effective in altering system consumption patterns.

[58] For some customers also non-financial incentives may be decisive – such as environmental considerations or enthusiasm (Leutgöb et al., 2017).

[59] Such as Time of Use Pricing (TUP), Critical Peak Pricing (CPP) and Real Time Pricing (RTP) (Chen S. et al., 2021).

[60] Saviuc et al. (2022) explain that retailers and energy suppliers are naturally well-positioned to access, collect, and utilize the flexibility resources of their customers efficiently, which gives them the ability of pooling small and distributed resources and thus act as natural aggregators. However, retailers may also lock in customers with price-based mechanisms (implicit DR) that are difficult to negotiate and prevent the small users in particular from realizing the value of their flexibility. An independent aggregator, on the other hand, can offer an alternative that empowers small users to understand the value of their flexibility better and engage in DR also through explicit programmes.

[61] Services provided through explicit DR include, among others, Direct Load Control (DLC), Interruptible Load (IL), Demand-Side Bidding (DSB), Emergency Demand Response (EDR), Capacity Market Projects (CMP), Auxiliary Service Projects (ASP) (Chen S. et al., 2021).

[62] The UK-based platform Piclo provides a useful example: Born as P2P platform, it evolved into a VPP where system operators can procure flexibility services from registered flexibility service providers which can be any organization possessing renewable energy generation assets.

- Promote **public funding of backup generators, storage systems or IT systems** to allow commercial and industrial assets to operate off the grid when needed or to provide additional load to the grid if requested.
- **Increase financial incentives for DR services** to make them competitive with other energy cost reduction options (e.g., energy efficiency). Indeed, many operators are concerned that participation in DR programmes might encourage consumers to deviate from optimal consumption patterns, thereby jeopardizing attractive energy efficiency rewards deriving from certifications (e.g., energy performance contracts).
- Provide **longer term visibility of returns** on DR investments through robust, harmonised and predictable regulation, covering the implementation of DR projects[63], as well as through capacity payments and/or floor remuneration mechanisms.

Because implicit DR can be provided only by energy suppliers/retailers, regulatory measures should act to implement the use of **dynamic tariff systems** in order to allow residential operators and businesses to tailor their consumption patterns in an optimal way, considering both their needs and the needs of the grid. Although the use of dynamic tariffs is necessary to provide implicit DR, this service can be furtherly incentivized if **flexible** taxes and levies are introduced. Fixed taxes and levies on power prices distort the market signal and, thereby, reduce revenues from DR measures because they do not reflect the situation on the grid[64].

With concern to explicit DR provided through aggregation, incentivizing measures relate mostly **to public funding or low-cost funding opportunities** to establish aggregators, alongside regulatory provisions to enable their participation to flexibility markets, as dictated by article 17 of the IEM. Regulation could also act to **favour the introduction of innovative DR products** and the development of **innovative pricing models**. The promotion of Public Private Partnerships is also seen as an incentivizing instrument to establish entities such as VPPs using private capital and public influence to speed up administrative and permitting requirements.

In terms of **public costs and savings**, DR generates energy system costs represented by remunerations given by system operators to providers of flexibility services, which are then passed down to final consumers through energy bills. Whether it is provided by the commercial, industrial or residential sectors, increased penetration of renewables and increased usage of DR services will inevitably imply higher energy system costs for the demand side. Yet, favouring the proliferation of aggregated systems can help save on DR expenses by making less use of DR in the first place, as requirements to balance grid loads may be settled internally by the aggregators. For example, within energy communities or P2P systems, excessive generation or consumption can be settled internally without interrogating system operators through DR programmes. In this way, energy peak and valley periods would be smoothened leading to less need for balancing. Other types of costs for the general public might come from public funding or low-cost financing mechanisms promoted to finance VPP configurations or from support schemes like tax or grid tariff exemptions, as described for self-consumption.

[63] Estimated between 10 and 12 years (Leinauer et al., 2022).

[64] Leinauer, C., Schott, P., Fridgen, G., Keller, R., Ollig, P., Weibelzahl, M., Obstacles to demand response: Why industrial companies do not adapt their power consumption to volatile power generation, *ScienceDirect - Energy Policy*, 2022.

2.4. Barriers to investment

This chapter provides an overview of barriers to investment affecting energy services (i.e., traders, retailers, aggregators, energy service companies, metering services) and prosumers. For the purpose of this study, the barriers have been identified following a two-step process:

1. **Literature review** to identify a long list of barriers, which were then grouped into three categories, namely:
    - **Political and regulatory** barriers, concerning compliance with the regulatory and policy frameworks, restricted or limited access to flexibility markets, as well as limited revenue generating mechanisms for energy services.
    - **Economic** barriers, deriving from economic factors like access to capital, off-taker risks, transaction costs, and price volatility.
    - **Technical** barriers, associated with risks arising from technical features of services like technology and resource availability.
2. **Deliberations of the Working Group (WG):** Working Group participants were asked, firstly during the WG meeting and subsequently via a follow-up survey, the following questions:
    - Select 5 barriers out of those identified in step 1 which you consider most relevant.
    - Provide examples of the barriers you found most pertinent in the market(s) where you operate and / or in specific Member States.

Table 5 provides an overview of the barriers identified as most acute, or most relevant by the WG members. In the sections that follow, we provide more detailed information about participant's views of the barriers, as well as several examples of the effect of barriers on investments in energy services and on prosumers.

Table 5: List of barriers to investments in energy transmission and distribution

Risk Group	Barrier	Scoring
Political & Regulatory	*Regulatory uncertainty*	77%
	Lack of or uncertain revenue generating mechanisms / revenue streams	69%
	Customer inertia	62%
	Restricted or limited access to flexibility and balancing markets	62%
	Standardisation	38%
Economic	*Availability of finance & access to capital*	54%

Technical	*Supply chain risk*	15%
	Technology risk	15%

1.4.1. Political and Regulatory Barriers

This section provides an overview of the political and regulatory barriers to investments identified in the services and prosumers sector that are perceived as the most acute and relevant by the WG members, namely:

- Regulatory uncertainty;
- Lack of or uncertain revenue generating mechanisms / revenue streams;
- Customer inertia;
- Restricted or limited access to flexibility and balancing markets;
- Standardisation.

Regulatory uncertainty risks concern the unpredictability of the impacts deriving from the eventual adoption of measures aimed at introducing and regulating energy services in national energy markets. In specific, during the WG meetings, the attending members reported that these risks are in large part related to late or incomplete **transposition into Member States' legislation** of EU regulation[65] which defines energy services and sets guiding principles for their implementation into national contexts. This generates issues concerning the following aspects:

- The **introduction and definition of novel providers** of energy services into national energy contexts (e.g., definition of self-consumers, energy communities, prosumers, etc.).
- The **definition of the roles for existing providers** of energy services (e.g., definition of cooperation between TSOs and DSOs concerning provision of flexibility services).
- The **definition and characterisation of energy services and products** (e.g., rights and obligations of the providers of such services, the needed technical requirements and the roles and responsibilities of the TSOs and DSOs involved in the procurement of the services[66]).

The WG discussions and survey results suggest that regulation and policy is seen by most WG members as a relevant barrier to investments in energy services, with 77% of the participants assessing it as relevant, including investors, developers, and industry associations. Of these, developers, representing the demand side of financing, are those that are most concerned, followed by industry associations, while investors represent a minor share. WG discussions revealed that stakeholders are also concerned about the fragmentation of regulation at sub-national level[67]. The lack of predictability and stability of

[65] Namely the Renewable Energy Directive – REDII (link), the Internal Energy Market Directive – IED (link) and the Energy Efficiency Directive – EED (link).

[66] Assessment and roadmap for the digital transformation of the energy sector towards an innovative internal energy market, European Commission, October 2019.

[67] An example of this is represented by the Italian region of Piedmont, which in 2018 has published a law (Regional Law N° 12 of 03/08/2018) which introduced the concept of energy communities in its regulatory framework, anticipating by far the adoption

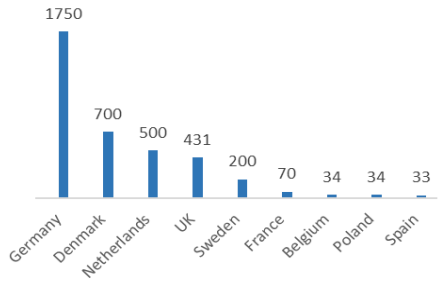
regulatory frameworks represents a problem, as participants argued that visibility over longer time horizons can help address customer inertia (see next sections for further details on this regulatory barrier) and facilitate the implementation of energy services (e.g., demand response). An association of regulators also reported that regulation can boost the uptake of energy services through well-defined and certain technical parameters.

Some developers argued that more incentives (financial and non-financial) for flexibility providers are needed in order to reach the ambitious targets defined by national or EU strategies (e.g., incentives for consumers to install rooftop photovoltaic panels). Developers also reported differences in the level of implementation of the relevant EU legislation by Member States, which could lead to uneven development and discrepancies between Member States with regards to energy services.

Regulatory uncertainty slows down the development of energy communities in Italy

The rollout of energy communities in Italy is still at an early stage of development compared to other EU Member States. As shown in the figure on the side, Germany, Denmark and the Netherlands are paving the way concerning the number of active energy communities, while Italy is lagging far behind with only 26 certified renewable energy communities. These projects are mostly experimental projects of limited power capacity (between 20 kW and 50 kW) aimed at identifying the best practices with the scope of maximizing benefits for future projects[68].

Figure 3: Number of Energy Communities in the EU



Source: Orange Book: Le comunità energetiche

Such slow development in Italy in comparison to other EU contexts is due to the lengthy process regarding the definition of clear regulatory rules. Indeed, energy communities were mentioned for the first time in the Italian energy Strategy of 2017[69]. In 2020, Italy adopted a transitory framework regulation for energy communities introducing in the Italian legislation the definitions of “Self-consumers of energy acting collectively” and “Renewable Energy Community”. Several decrees by the Ministry and the Italian NRA (ARERA) followed with the goal of defining technical aspects concerning energy tariff exclusions and incentive remuneration. In December 2021 Italy formally adopted the Renewable Energy Directive 2018/2001 (REDII) and the Directive on common rules for the internal market for electricity 2019/944 (IEM) thus implementing a definitive regulatory framework for energy communities and self-consumers. However, it is worth mentioning that

by the Italian Government of the provisions of the Renewable Energy Directive (REDII) recast and of the internal Electricity Market Directive (IEM) in 2021.

[68] Orange Book: Le comunità energetiche in Italia, Utilitatis, RSE, 2022

[69] In comparison, Germany’s has had a cooperative law since 1889 which covered all cooperatives, ranging from banking to agricultural. As energy communities appeared for the first time in the German legal context, the National Office for Energy Cooperatives, part of DGRV (the German Cooperative Confederation), was set up in 2011 to support the rapid emergence of ECs. The national office is currently offering support to comply with the changes made to the European Commission’s RED II directive in 2021, which now includes a legal definition of an EC. Another example of early energy community development is Denmark, where a feed-in tariff scheme was implemented for cooperatives based on wind power, leading the capacity of coop wind power to increase from 5 MW in 1985 to 840 MW in 1998.

without the relevant implementing decrees that will define the incentive and the technical rules for Energy Communities, the market uptake of Energy Communities will be limited.

During WG meetings, participants uncovered some examples of issues generated by regulatory uncertainty, particularly in the case of energy communities:

- **The Renewable Energy Directive imposes certain rules regarding who can control RECs** (Renewable Energy Communities), limiting it to local actors located near the renewable energy plants. The rationale for this **proximity requirement** ensures that the local community has ownership and a stake in the renewable energy projects, aiming to prevent larger, external investors from dominating these projects. This proximity requirement has been criticized by some WG members for making RECs less attractive to investors and companies, who are deterred by not being able to gain control over the assets if they are not close to it. This situation creates a challenge in balancing local ownership and empowerment with the need for substantial investments to sustain and expand energy community projects.
- Another regulatory issue which has implications on the governance of CECs, revolves around the **possible involvement of SMEs** (which are mentioned as potential participators to CECs by the RED II), which generates **issues regarding voting procedures**. Indeed, the approach "one member equals to one vote" in the governance of the CEC would not work anymore as SMEs will likely invest more resources compared to households, and will, therefore, require proportional decision power in order to participate in the CEC.
- Energy communities suffer from **different definitions** (e.g., administrative and legal requirements in terms of creation of an SPV, proximity of the RES systems, ownership structure, scope of the activities, and distinction between CEC and REC[70]) in EU Directives, according to WG members, making it more confusing for investors and project promoters to participate in them. WG participants suggested that a common and streamlined definition of an energy community across all EU Member States would help their uptake.
- EU Regulation provides for **limited adaptation to new type of service providers** on the demand side.

Lack of or uncertain revenue generating mechanisms / revenue streams is a barrier arising from the inadequacy of market mechanisms for valuing and monetising the additional service provided by energy services or the uncertainty regarding the likelihood that the investment will generate sufficient revenues over its lifetime to pay back the financing. This barrier is therefore closely interrelated to regulatory barriers, as remuneration mechanisms for services are often determined by regulatory measures. Outdated policies, originally designed

[70] Based on **Article 2(11) EMD 2019/944, CEC** means a legal entity that: (a) is based on voluntary and open participation and is effectively controlled by members or shareholders that are natural persons, local authorities, including municipalities, or small enterprises; (b) has for its primary purpose to provide environmental, economic or social community benefits to its members or shareholders or to the local areas where it operates rather than to generate financial profits; and (c) may engage in generation, including from renewable sources, distribution, supply, consumption, aggregation, energy storage, energy efficiency services or charging services for electric vehicles or provide other energy services to its members or shareholders.
On the other hand, based on **Article 2 (16) RED II, REC** means a legal entity: (a) which, in accordance with the applicable national law, is based on open and voluntary participation, is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity; (b) the shareholders or members of which are natural persons, SMEs or local authorities, including municipalities; (c) the primary purpose of which is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where it operates, rather than financial profits.

for traditional power sources, and specific market design parameters such as minimum bid sizes or excessive pre-qualification requirements[71], make it difficult for energy services to access potential revenue streams.

This barrier was the second most selected by WG members, with 69% of votes in the multiple-choice survey. As for regulatory and uncertainty risks, concerns were mainly expressed by the demand side of financing, compared to the supply side. More specifically, some developers reported that this barrier is the side effect of a decrease in the incentives for renewable energy sources (e.g., cut to PV incentives), which, in turn, hampers the bankability of such projects. Some WG members also expressed the need to rethink the remuneration mechanisms for DSOs. In specific, WG members suggested including new sources of income from flexibility services, in addition to the current system where DSOs are paid based on their CAPEX for expanding the grid. This change would diversify and potentially increase the revenue streams for DSOs, acknowledging their role in providing flexibility services as well as grid expansion.

In this regard, during the WG meetings, participants noted that **flexibility markets currently lack remuneration mechanisms**, which make flexibility services less interesting for the private sector and investors.

Customer inertia refers to the hesitance of customers in participating in the energy service market due to different reasons, including[72]:

- Low transparency and accessibility of regulatory frameworks, which do not provide information efficiently and effectively to customers. In turn, customers are unaware of the opportunities to participate in the market and are not motivated to participate in the energy service market, or find it too complex to access.
- Lack of information related to dynamic tariffs in the final bills, which in turn does not incentivise consumer to engage with the market through demand response services.
- Preference for status quo by customers due to lack of trust or negative perception of energy providers and new technologies, or due to apparently complex market regulation.

62% of survey respondents consider this barrier as relevant for investments in energy services and prosumers, with most of the concern originating from the demand side of financing. As a general remark, participants widely converged on the opinion that **more awareness on energy services is needed**. More specifically, they highlighted the need to explain to customers and businesses how and where value is created, and how it can be shared. They also argued that consumers often do not understand the necessary documentation required to participate in this segment of the energy value chain and highlighted that consumer awareness and knowledge is essential to scale up investments. WG participants also argued that **data availability** presents an additional obstacle that fuels customer inertia, as consumers require access to comparable data in order to understand what to invest in. WG participants also emphasized the importance of conducting awareness and information campaigns aimed at the general public about the **deployment of smart meters.** Smart meters, which track real-time energy usage and production on the grid, are crucial for the effective operation of flexibility services in energy systems. They enable more efficient energy management and support advanced energy services by providing detailed data on energy consumption and generation patterns. However, there are concerns that users may perceive

[71] To keep the electricity system in balance, Transmission System Operators (TSOs) procure balancing services from Balancing Service Providers (BSPs). EU rules require TSOs to develop prequalification processes for potential BSPs. This allows potential BSPs (such as generators or consumers) to provide proof that they fulfil the requirements for rendering one or more types of balancing services necessary to guarantee the grid frequency (ACER, 2021).

[72] Lewis, P., Granroth-Wilding, H., Napolitano, L., Zabala, C., Vékony, A., Felsmann, B., & Hirschbichler, F., European Barriers in Retail Energy Markets Project: Final Report, Publications Office of the European Union, Luxembourg, 2021.

smart meters as intrusive. This perception arises from the need to install these meters in homes and potentially requiring users to manage them through a smartphone app. To address these concerns and promote wider acceptance, the working group highlighted the vital role of digital literacy in encouraging the adoption of prosumer models, where consumers also become energy producers. By increasing digital literacy, individuals are more likely to understand and embrace the benefits of smart meters and actively participate in more sustainable and efficient energy systems.

From the investors point of view, participants argued that customers' perception of energy services as complex, together with their lack of trust in emerging services and related innovative business models, are important elements that discourage investors from investing in this segment. Some developers stressed that to ensure customer engagement and consequent investments in energy services, regulation needs to be stable and predictable in the long run.

During WG meetings, participants also noted that the creation of a CEC is burdensome as it often requires the creation of a new company, thus requiring dedicated accounting and reporting, which can disincentivise citizens and companies from entering into such type of projects. **Self-consumption communities were identified as an alternative solution**, as they are easier to manage from the administrative and bureaucratic point of view.

WG participants put forward **a range of solutions that might address the risk of customer inertia**, including: i) companies and ESCOs offering lower energy costs and dealing with permitting requirements; ii) applying a 'platform approach' to investing in energy services in order to empower citizens to make decisions through simplicity, transparency, and choice, thus preventing confusing, expensive, and intimidating experiences[73]; iii) integrating energy services into EPCs (Energy Performance Contracts). In an EPC, the service provider designs and implements energy-saving measures, and the client's payments are based on the achieved energy savings. This model shifts the risk of the project from the client to the service provider. By doing this, customers can take advantage of the EPC structure, which clearly defines who bears the risks (usually the service provider, as mentioned) and where the benefits (like energy savings or improved energy efficiency) are generated. This approach could help overcome customer inertia by providing a clear, risk-managed pathway to adopting new energy services. Customers might be more willing to engage with these services if they are part of an EPC, knowing that the risks are managed and the benefits are clearly outlined; iv) creating hubs and one-stop-shops where consumers can get greater access to information.

During the WG meetings, some participants also noted how energy communities implemented through **an EaaS model could address many of the barriers that energy community projects usually face**, namely:

- consumer inertia: EaaS simplifies the transition to renewable energy by providing a full-service solution. Customers don't need to worry about the complexities of setting up and managing energy systems, making it easier for them to adopt new energy practices.
- capital constraints: The EaaS model minimizes or eliminates upfront costs. The financial burden of installing and maintaining energy systems is borne by the service provider, making it financially feasible for more participants.
- adequate know-how: EaaS providers bring expertise in energy systems, handling the technical aspects and ensuring compliance with regulations. This expertise removes the need for consumers to have in-depth knowledge of energy systems.

[73] One stakeholder provides as example a US project financed by the government which pioneers a platform approach entitled Energy Sage. Link here: https://www.energysage.com/about-us/company/

- bureaucratic complexities: EaaS providers typically manage the bureaucratic aspects, streamlining the process and reducing the administrative burden on the community members.

Similarly, the joint venture model with ESCO companies was seen as an option to ensure a sufficient know-how and expertise in the project. In particular, WG participants see **ESCOs as central in the development and deployment of energy services** and community projects. Indeed, participants suggested that their technical and planning capacities should be further leveraged, as well as their ability to aggregate smaller projects. WG members raised the example of the Canadian "Super ESCO" model as a good practice in this field that should be explored further also in the EU[74].

Restricted or limited access to flexibility and balancing markets can severely limit the number, type and profitability of revenue streams potentially available to the energy services, and thus reduce the availability of related business models. Depending on different regulatory regimes at Member State level, some flexibility services (like demand response) might not be admitted participating in flexibility and balancing markets if provided by aggregators or energy communities.

Another element that can hinder the participation in balancing and flexibility markets of flexibility services are high pre-qualification limits for participation[75]. Finally, lack of participation in energy markets might not be only a matter of regulatory design, but it can also be the result of lack of knowledge (especially from DSOs).

62% of respondents to the survey (mostly actors operating in the demand side of financing) believe this to be an acute barrier for investments in energy services. More specifically, developers argued that some services, like demand response, should not be seen as a service only to be used in emergency situations, but should be allowed to enter other markets and become a more relevant source of revenue for operators. They affirmed that currently this is not the case as demand response services are supplied by TSOs together with other services, but it does not represent a structured revenue stream for the energy services providers (demand side of financing).

Limited access of energy services to energy markets across the EU

Access to energy markets for market players providing flexibility services is not uniform across the EU. In particular, direct access to the Wholesale Market (WM), Balancing Market (BM) and Capacity Market (CM), where available, is sometimes restricted to some market participants (Balancing Responsible Parties and also independent aggregators).

The University of Exeter analyses the most virtuous countries in terms of access to markets of demand side response (DSR) services provided by independent aggregators, identifying limits to participation in some energy markets. In Belgium, for example, aggregated DSR can access ancillary services markets, but not WM. Additionally, domestic customers cannot participate in DSR neither individually nor through an aggregator. In Finland, DSR and aggregation are legally possible in all markets, but are limited due to technical and operational constraints. In this regard, the Finnish TSO FINGRID is running pilot projects to

[74] A Super ESCO is an entity set up by public and/or private investors and that offers full energy performance contracting (EPC) services to its clients, including adapted financing, and subcontracts project implementation to private ESCOs that guarantee the expected savings to be realised-. The Super ESCO model is meant to address barriers to investment linked to the size of the projects being too small, and to limited interest and capacity of private ESCOs to attract and provide tailored financing. The Super ESCO can use its technical capacities to launch calls for tenders, evaluate proposals, aggregate smaller projects, and negotiate contracts. It can also provide market awareness activities and training to support the development of the market, for both potential beneficiaries and private ESCOs interested in being more active in the market. One example is the Société de financement et d'accompagnement en performance énergétique (SOFIAC), launched in the fall of 2020 as the first Super ESCO in Canada (more information is available at this link).

[75] In Spain for example there are still high requirements to enter the market (1 MW).

enable independent aggregators to participate in the BM. In Germany, the BM and ancillary services are open to demand response but, in the WM, demand response is only allowed via the Balance responsible partner (BRP) and independent aggregators cannot enter. In Denmark, demand response can enter the WM and ancillary services markets, but in a very limited manner due to scarce demand for these services from the TSOs and DSOs. Furthermore, payments in WM are not high enough to make a good business case.

Standardisation risks originate from the lack of commonly accepted standards and coherence in regulatory frameworks regarding interoperability, access to data, data processing and cybersecurity. EU Member States need to comply with such provisions as a first step towards creating common standards. **Failing to comply with such provisions would lead to the fragmentation of the market as different standards set a Member State level would coexist**. Concerning interoperability, the Electricity Directive[76] envisages smart metering systems interoperability as a fundamental requirement to promote the active participation of consumers in the electricity markets. Concerning access to data, the same Directive promotes the adoption of a regulatory framework also for data protection of smart meters, embedding relevant General Data Protection Regulation (GDPR) provisions tailored to the needs and specificities of smart meters. Concerning cybersecurity, the NIS Directive (Directive on security of Networks and Information Systems)[77] proposes a set of measures to boost the resilience and enhance cybersecurity preparedness of network and information systems in Europe as well as to build a culture of security across those sectors that are vital for the EU economy and society, where a cyberattack could disrupt an essential service, such as energy and digital infrastructure[78].

This risk has been considered relevant by 38% of respondents, with the majority represented by the demand side of financing. Developers highlighted the need to harmonise standards for the technologies which are subject to a direct investment by consumers (e.g., PV modules or storage systems), to simplify the investment decisions. Some developers highlighted that standardisation ought to be considered as the most relevant barrier, considering the challenges linked to the fragmentation of standards and requirements in countries including at sub-national and regional level (e.g., Italy). They argued that in order to boost business cases in energy services, standardisation is essential to reduce market fragmentation and complexity. In this sense, some developers pointed out that standardisation might require harmonisation of regulatory regimes.

1.4.2. Economic Barriers

In the following paragraphs, an overview of the economic barriers that are perceived as the most relevant by the WG members is provided, namely **availability of finance & access to capital**, together with possible solutions identified during WG discussions.

[76] Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (recast).

[77] Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union.

[78] Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (recast).

Economic barriers are caused by limited access to cost-effective capital and financing, also due to the lack of robust business plans as well as policy and regulatory changes. Unlike other segments of the value chain, the availability of finance affects not only energy services developers but also consumers and end-users as they take up an active role in the implementation of such projects.

This barrier has been identified as relevant by 54% of participants to the survey, with most of the votes coming from representatives of the demand side of financing and from industry associations. Developers highlighted that the high initial investment costs (CAPEX) for technologies (e.g., household and SME devices) are a major obstacle to expanding energy service projects. Because of this, developers reported the need to find solutions to alleviate the burden caused by initial investments, for example favouring **investments by third parties**. Additionally, to remove the barrier posed by high levels of initial investments, one solution suggested by developers for consumers and end-users is the **introduction of models to rent technological devices** as opposed to buying them. In this regard, some participants also noted that customers should receive support for the purchase of adequate and up-to date low-carbon devices via incentives or loans.

Concerning EU funding, WG participants noted that there is **sufficient financing available for mature technologies** such as solar, where economies of scale brought down the price of PV panels in a significant manner in the last two decades, making them more affordable and widely available for prosumers. Yet, participants pointed out the **need to reduce the time-to-grant,** as excessively lengthy processes can lead to delays in implementing project activities due to the lack of initial capital. Additionally, when discussing financial instruments, the WG participants identified **accessibility** as a significant obstacle, particularly for guarantee schemes in energy projects. They linked this challenge to excessive bureaucracy and lengthy negotiation processes. Additionally, they noted that confusion over State Aid rules for combining private and public funds and stringent sustainability criteria set by some financiers exacerbate these barriers[79]. Simpler and clearer guidelines on this matter would help to better combine different sources of financing.

Amongst the possible solutions proposed by the WG participants regarding the availability of finance for **energy community projects,** the following aspects were discussed:

- To ensure a certain level of revenues, some WG Members proposed the **creation of an explicit incentive** (for example in the form of dedicated FiT) that CEC members would benefit from, to further incentivise citizens and companies to enter into such types of projects. Such a solution is justified by the fact that the energy savings or possible revenues from being a CEC member are often unclear and/or uncertain, thus making CECs not sufficiently attractive for citizens and companies.
- Participants highlighted that **grants could help offsetting the high upfront cost investments for low-income households**. In this sense, grants should be leveraged to involve citizens from lower-income backgrounds in net-zero energy services and to support the set-up of energy communities.
- WG participants also suggested that **technical assistance should be provided to financial support programmes**, particularly those for energy communities and large scale projects.

[79] The Portuguese credit line for Decarbonisation and Circular Economy was used as an example of a scheme that, despite having attractive conditions (80% coverage rate), did not achieve the desired impact due to a high degree of bureaucracy during the application process.

- Participants noted that community models represent **an additional counterparty risk** for commercial banks providing loans, and to mitigate this risk they might charge higher interest rates and apply stricter financing conditions compared to standard loans offered to individual borrowers or more established businesses with a clearer credit history. This risk is likely to become more relevant and pressing with the ongoing decentralisation of production through self-production, as more and more users are going to request installation of small RES systems[80]. WG participants suggested that **guaranteed loans could address such issues**.
- WG participants also noted that external investors are not interested in CEC projects if the **ticket size** is too small. In this case, CEC projects should be aggregated as to achieve a sufficient "investment mass" that can interest investors. **The public sector could also play the role of aggregator**, in these instances.
- During the discussion, most WG participants agreed on the **complementarity between the public and private sector to support and incentivise energy community projects**. More specifically, the role of the public sector should be to define adequate regulation, facilitate the permitting and administrative procedures as well as to de-risk projects, as to allow the private sector to provide the necessary financing.

1.4.3. Technical Barriers

In the following paragraphs, we provide an overview of the technical barriers to investments identified in the energy services and prosumers sector, which are perceived as the most acute and relevant by the WG members, namely:

- Supply chain risk;
- Technology risk.

Supply chain risk refers to the disruption of the supply chain (e.g., lack of raw materials, lack of manufacturing capabilities or facilities, construction errors or faults etc.) needed for the underlying technologies and assets that form the basis of energy services.

This barrier is considered relevant by 15% of respondents, mostly by representatives of the demand side. In particular, developers are concerned by disruptions in the supply of materials and technologies caused first by the COVID-19 pandemic and then worsened by the war in Ukraine, which have also affected other segments of the energy value chain. Concern is equally expressed with regards to the supply of software.

Shortage of raw materials and IT components in the energy services sector

The energy services' reliance on RES generation technologies and digital technology for efficient energy generation, conversion, storage, management and distribution of renewable energy has been challenged by a severe shortage of raw materials, including copper, aluminium and steel, as well as IT components, such as semiconductors and microchips.

[80] The example of several Belgian companies was presented, where the companies installed PV panels on several households. Some of these households failed to fully pay for the installation/service, thus leading to the bankruptcy of some of the installing companies, but still leaving the PV panels with the households.

In specific, with regards to the supply of semiconductors and microchips, delivery times have surged due to shortage in semiconductors caused by disrupted supplies after Covid-19, as shown in the figures below. This problem has worsened with the war in Ukraine and now has the potential to delay projects across all the energy value chain.

Another consequence of the Russian invasion of Ukraine is the shortage in the supply of raw materials and components that are crucial for the construction and operation of decentralized renewable energy generation systems. For example, copper and aluminium are the primary conductor materials used in renewable energy systems (e.g., solar panels, wind farms) whereas steel is a key structural component of RES technologies (e.g., wind turbine towers, solar panel mounts). According to research commissioned by Eurometaux[81], Europe's plans for producing RES technologies will require 5 million tons of copper (increase of 35% of today's use) and 5 million tons of aluminium (an increase of 33% on top of today's use) by 2050. Sourcing these materials may become a challenge, considering that Europe relies heavily on Russia for the provision of these resources.

Figure 4: Euro area semiconductor imports - annual percentage changes of three-month moving averages

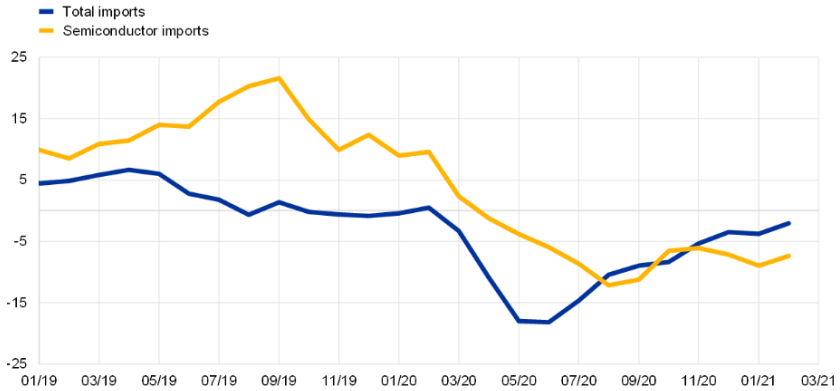
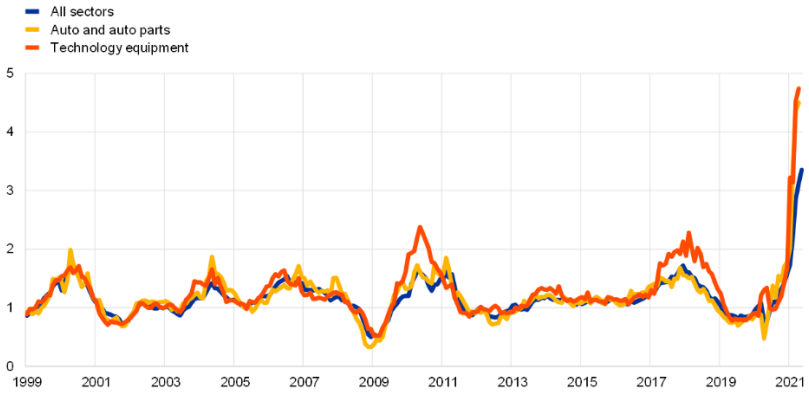


Figure 5: Euro area suppliers' delivery times - ratio of PMI new orders to suppliers' delivery times



Source: The semiconductor shortage and its implication for euro area trade, production and prices, ECB Economic Bulletin, 2021

Technology risk is associated with the following aspects:

- **uncertain future performance** of new and emerging technologies, over the lifetime and life cycle of the resource used to facilitate energy services;

[81] Metals for Clean Energy: Pathways to solving Europe's raw materials challenge, *KU Leuven*, April 2022.

- **technological obsolescence**, meaning that today's cutting-edge technologies may become outdated quickly considering the rapid pace of technological advancements.
- **system integration and interoperability**: as the energy sector moves towards more integrated and smart solutions, there's a risk associated with the ability of different technologies to work together seamlessly.
- **technical maintenance and support**: energy services technologies often require specialized maintenance and support, which can be costly and require skilled personnel. The lack of adequate technical support can affect the long-term sustainability of the technology.

This risk was considered relevant by 15% of respondents to the survey, mostly by representatives from the demand side of financing and by associations. In specific, participants expressed concerns on the high risk perceived by investors with respect to new technologies with lower-TRLs, which might reduce the propensity to invest into such projects.

In addition to the above-mentioned barriers, some WG participants mentioned the **lack of adequate expertise for REC/CEC large scale projects**, which require specific engineering and financial know-how, as a potential barrier to project implementation. Additionally, it was noted that sometimes companies invest considerable resources in the pre-construction phases for RES/CEC projects, but then the client decides to not proceed further with it. These cases disincentivise specialised companies from being more active in the sector, which could be addressed by providing grants covering the engineering/design phase of a RES/CEC project.

3. Mapping and benchmarking of energy financing schemes and investment products

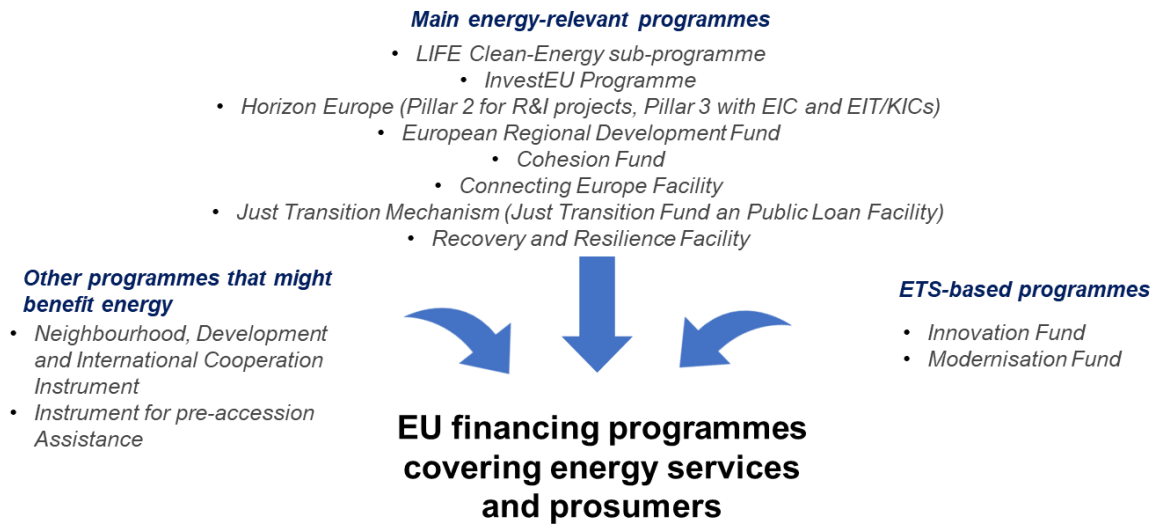
This chapter presents the financial schemes and programmes available for services and prosumers in the EU. The first section comprises funding programmes at EU level, both under centralised and decentralised management that can be used to support energy production projects. The second section presents the instruments and schemes identified at Member State-level that are available for services and prosumers based on the findings from the mapping exercise that was conducted.

3.1. EU financing programmes for Services and Prosumers

EU targets of climate neutrality and independence from Russian gas require an unprecedented level of investment. The European Commission has reported an overall investment need of €210 billion (until 2027) to reach REPowerEU targets, among which services and prosumers play a role as well.

To support the region's green transition, the EU has made it a priority to support the enhancement of development, construction, and operationalisation of energy production projects through several funds and programmes. Such programmes are either managed directly by the European Commission or by other EU bodies via *ad hoc* agreements. Starting from the 2014-2020 multiannual financial framework, the Commission has also adopted the **Climate Mainstreaming** approach, which requires all programmes – regardless of their policy area – to take climate issues into account. For the 2021-2027 period, the EU budget is expected to deploy €557 billion (31% of the overall budget) for climate investments across different sectors and programmes.

The purpose of this section is to provide an overview of some existing financing instruments at the EU level, as well as EU funds allocated to individual Member States on services and prosumers opportunities. The focus will be placed on instruments targeting and including services and prosumers to provide a view on available EU programmes and their disbursement practices.



All the programmes funded by the EU budget fall under one of three types of implementation modes depending on the nature of the funding concerned:

- **Direct management**: EU funding is managed directly by the European Commission
- **Indirect management**: funding is managed by partner organisations or other authorities inside or outside the EU
- **Shared management**: the European Commission and national authorities jointly manage the funding.

In addition to these three management modes, this Study analyses programmes that are not financed from the EU budget but through the **EU Emission Trading System** (ETS)[82].

Direct management

In direct management, the European Commission is directly responsible for all steps in a programme's implementation. These tasks are carried out by the Commission's departments, at its headquarters, in the EU delegations or through EU executive agencies; there are no third parties. Programmes implemented in direct management account for around 20% of the EU budget 2021-2027[83].

NextGenerationEU: the Recovery and Resilience Facility

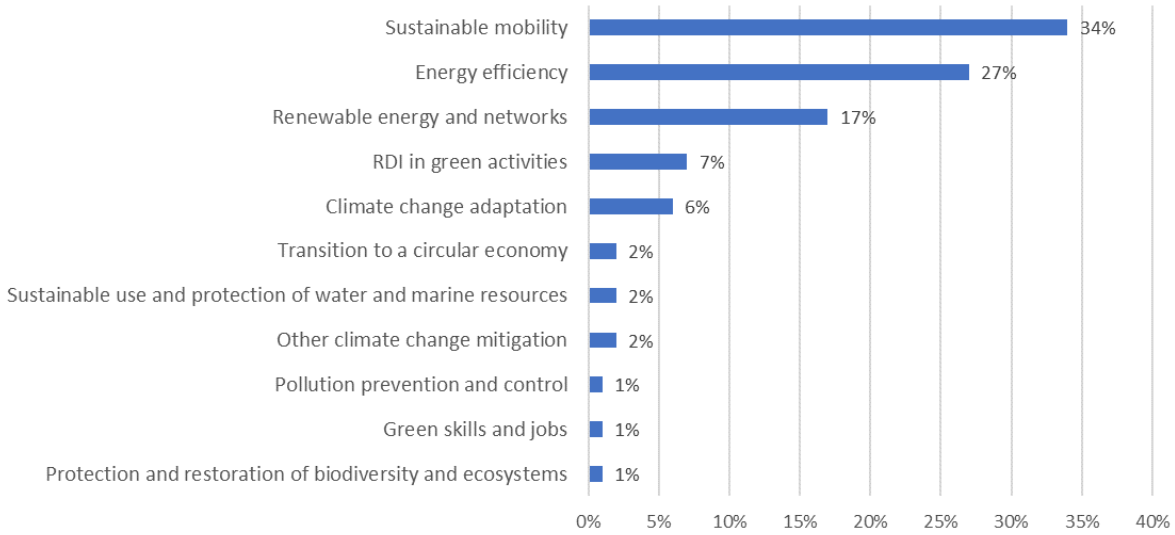
The **NextGenerationEU**, is a temporary recovery instrument with a budget of more than €800 billion aiming to support Member States in repairing the economic and social damage brought on by the Covid-19 Pandemic and build greater resilience to face incoming challenges. At its centre is the **Recovery and Resilience Facility (RRF)**, a programme providing financing to enable Member States to increase resilience and prepare for their digital and green transitions. It has a total budget of €723.8 billion, out of which €385.8 billion take the form of loans and €338 billion of grants. To access these funds, Member States prepared tailored **National Recovery and Resilience Plans** (NRRPs) reflecting the allocation of the funds in each country and detailing the investment and reforms they plan on undertaking with the RRF resources to make their economies more sustainable, resilient, and digital by end of 2026. All 27 Plans have been officially adopted.

The Facility is structured around **six pillars: green transition; digital transformation; social and territorial cohesion; health, economic, social and institutional resilience;** and **policies for the next generation**. Green transition is the pillar with the largest share of allocated RRF funds, amounting to 38.85% of the funds. Within the green transition pillar, sustainable mobility is the area with the largest share of allocated funds by the NRRPs, followed by energy efficiency, and renewable energy and networks (see Figure below).

[82] European Commission. EU Emission Trading System. https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets_en

[83] European Commission. Funding by management type. https://commission.europa.eu/funding-tenders/find-funding/funding-management-mode_en

Figure 6: Breakdown of expenditure towards climate objectives per policy area (Pillar 1)



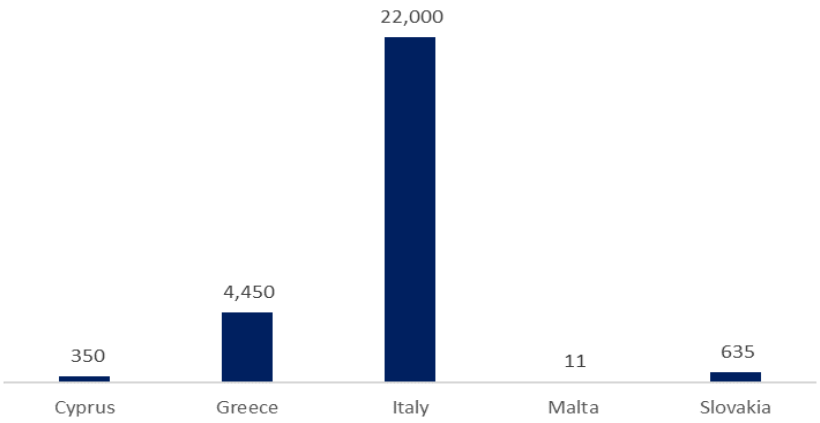
Source: RRF Scoreboard – Green Transition

The national recovery and resilience plans (RRPs), through which the RRF is implemented, have a strong focus on energy, investing €88.5 billion (17.9 % of their resources) in the policy area. Specifically, the RRF Regulation includes investment in boosting energy efficiency, in housing, SMEs, and other key sectors of the economy, and in the clean energy transition and networks. Additionally, it also supports Smart Energy Systems (including smart grids and ICT systems) and related storage.

The Commission is funding up to €250 billion (or 30%) of NextGenerationEU by issuing NextGenerationEU Green Bonds. This will make the Commission the largest green bonds issuer in the world. By analysing Member States' National Recovery and Resilience Plans, it is possible to observe that around **€3 billion of planned expenditures in services and prosumers investments/schemes are eligible to be financed through the UoP of NGEU Green bonds** (refer to Figure 7 and Figure 8 below).

As can be seen, Italy is by far the country with the highest eligible amount in services and prosumers expenditures to be financed with proceeds from the NGEU Green bond issuance. It is followed by Greece and Slovakia.

Figure 7: NRRPS Services and Prosumers expenditure eligible for NGEU Green Bonds proceeds by Member States (In € M)



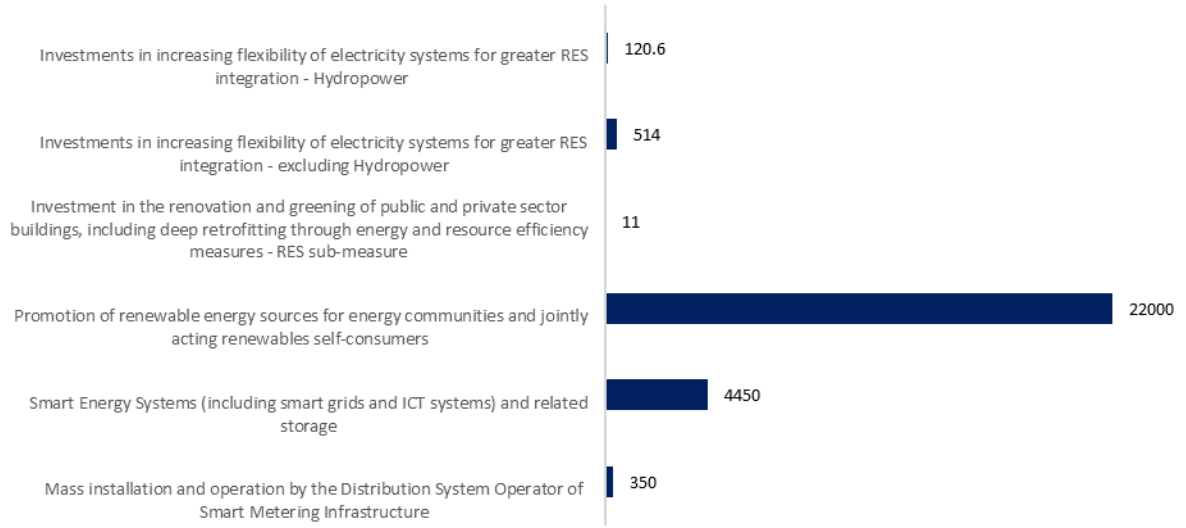
Box 1: Country focus: Italy

As part of its RRF (see Figure above), **Italy allocated a total of € 2.20 bn to improve and extend the energy production of energy communities.**

The project aims at favouring energy efficiency and promoting the development of renewable sources through prosumers communities. By June 2026, the goal is to **produce 2500 GWh per year** in municipalities with less than 5000 inhabitants, installing at least 2000 MW from renewable resources. The expected reduction of greenhouse gas emissions is expected at around 1.5 million tons.

According to available sources, such intervention should also have social benefits in terms of contrast to depopulation, social cohesions reinforcement and support the economy of the small centres.

Figure 8: NRRPs Services and Prosumers expenditures eligible for NGEU Green Bonds financing by type of measure (in € M)



Connecting Europe Facility

The **Connecting Europe Facility** (CEF) is one of the main EU funding instruments for infrastructure with grants to develop trans-European networks in the fields of transport, energy and digitalisation. In 2018, the CEF was renewed for 2021-2027 with a budget of €42.3 billion, 60% of is meant to contribute to climate objectives.

In the energy sector specifically, **CEF Energy** aims at funding infrastructure projects that support the interoperability of the EU transmission infrastructure, boost the internal market and competition, enhance the security of supply in the EU, and foster the **integration of renewables and smart grids**. Around €5.84 billion are dedicated to support investments in EU infrastructure networks for energy.

The first CEF Energy PCI call for proposal for the period 2021-2027 was launched in September 2021, making €785 million available to finance clean energy infrastructure projects. A second call worth €800 million was opened in May 2022 for works and studies in electricity,

gas, smart grids and CO_2 networks. A third call for €750 million in the same field was launched in April 2023[84].

Smart grids, recognised in the TEN-E Regulation as a trans-European energy infrastructure priority, play a key role in implementing digital communication technologies across the European Union to efficiently integrate large amounts of electricity generated from renewable or distributed energy sources, connecting all users for an effective demand response. There are currently four ongoing smart grids actions which have been co-funded by CEF Energy with a total Commission contribution of over €250 million. These projects are:

- SINCRO.GRID Phase I[85] and Phase II[86] aimed at implementing innovative solutions to increase capacity and flexibility of cross-border Slovenian and Croatian energy networks.
- ACON[87] to foster the integration of the Czech and Slovak electricity markets.
- Danube InGrid[88] aimed at improving the integration of the Slovak and Hungarian electricity markets.

Horizon Europe

Horizon Europe (HE), the largest research and innovation funding programme in the EU, has an overall budget of €95.5 billion for the 2021-2027 period. Its resources are divided into four pillars and fifteen components. The *Climate, energy and mobility* (Cluster 5) Work Programme (€15 billion) covers, inter alia, investments in the services and prosumers segments. In particular, it emphasizes the need for cross-sectoral solutions for the climate transition proposing an innovative and more digitalized approach to energy services.

Part of HE pillar 3 – Innovative Europe, the **European Innovation Council (EIC) can finance services related projects**. For spin-offs, start-ups, or SMEs with a disruptive technological proposal, the instruments created by the EIC are particularly recommendable. These are the EIC Pathfinder, the EIC Transition, and the EIC Accelerator. The most attractive – but also the most competitive – is the latter, with a total budget of €1.16 billion in 2023. As part of its Energy Storage challenge, the Accelerator recognizes the possibility to create *business models in the*

[84] European Commission. Funding & tender opportunities. https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-search;callCode=CEF-E-2023-PCI;freeTextSearchKeyword=;matchWholeText=true;typeCodes=0,1,2,8;statusCodes=31094501,31094502,31094503;programmePeriod=2021%20-%202027;programCcm2Id=43251567;programDivisionCode=null;focusAreaCode=null;destinationGroup=null;missionGroup=null;geographicalZonesCode=null;programmeDivisionProspect=null;startDateLte=null;startDateGte=null;crossCuttingPriorityCode=null;cpvCode=null;performanceOfDelivery=null;sortQuery=sortStatus;orderBy=asc;onlyTenders=false;topicListKey=topicSearchTablePageState

[85] European Commission. Implementation of the SINCRO.GRID – Phase 1. https://wayback.archive-it.org/12090/20221223072205/https://ec.europa.eu/inea/en/connecting-europe-facility/cef-energy/10.3-0022-sihr-w-m-16

[86] European Commission. Implementation of the SINCRO.GRID – Phase 2. https://wayback.archive-it.org/12090/20221223075252/https://ec.europa.eu/inea/en/connecting-europe-facility/cef-energy/10.3-0018-si-w-m-18

[87] ACON. https://www.acon-smartgrids.cz/

[88]

field of energy services and the involvement of end users, facilitating participative approaches to energy consumption, energy savings and the development of energy communities[89].

The **European Institute of Innovation & Technology is also an integral part of Horizon Europe**. It contributes to Pillar III with a budget of €3 billion. At the same time, through its nine Knowledge and Innovation Communities, it contributes to find meaningful solutions to societal challenges in areas with high innovation potential. EIT InnoEnergy is the Innovation Community dedicated to achieving a sustainable energy future for Europe and projects improving the provision of energy services are financed transversally across its thematic fields.

The LIFE Programme

The **LIFE Programme** was originally created in 1992 to fund environmental projects and climate action. For the 2021-2027 programming period it will receive a total budget of €5.45 billion, whereby 1 billion is dedicated to the *Clean Energy Transition* sub-programme, focused at facilitating the transition towards an energy-efficient, renewable energy-based, climate-neutral and -resilient economy. Funds are allocated through yearly calls for proposals managed by CINEA. Under the LIFE Clean Energy Transition sub-programme, projects are financed in the following five areas of intervention which also target energy services and prosumers:

- Building a national, regional and local policy framework supporting the clean energy transition.
- Accelerating technology roll-out, digitalisation, new services and business models and enhancement of the related professional skills on the market.
- Attracting private finance for sustainable energy.
- Supporting the development of local and regional investment projects.
- Involving and empowering citizens in the clean energy transition.

Indirect management

Some funding programmes are partly or fully implemented with the support of entities, e.g., national authorities or international organisations. The majority of the EU budget allocated to humanitarian aid and international development, for instance, is implemented under indirect management. Under this management mode, the Commission delegates budget execution tasks to different types of implementing partners.

The InvestEU Programme

The **InvestEU Programme** combines thirteen centrally managed EU financial instruments[90] and the European Fund for Strategic Investments (EFSI) into a single instrument. The program is structured around three blocks, of which one, as mentioned above, is under indirect management:

- *InvestEU Fund* (indirect management) which, through an EU budget guarantee of €26.2 billion, aims at raising more than €372 billion of public and private investments. The guarantee is deployed to back investments from selected implementing partners,

[89] European Innovation Council (EIC), Work Programme 2023

[90] *CEF Debt Instrument, CEF Equity Instrument, Loan Guarantee Facility under COSME, Equity facility for Growth under COSME, Innovfin Equity, Innovfin SME guarantee, Innovfin Loan Services for R&I Facility, Private Finance for Energy Efficiency Instrument, Natural Capital Financing Facility, EaSI Capacity Building Investments, EaSI Microfinance and Social Enterprise Guarantees, Student Loan Guarantee Facility, Cultural and creative sectors Guarantee facility*

with the EIB Group being the main one with 75% of the whole instrument. The guarantee supports investments in four policy windows: sustainable infrastructure, research, innovation, and digitalisation, SMEs, and social investments and skills.

- *InvestEU Advisory Hub* (direct management) providing support and technical assistance;
- *InvestEU Portal* (direct management) brings together investors and project promoters on a single EU-wide platform, by providing an accessible and user-friendly database of investment opportunities.

Shared management

In shared management, both the European Commission and national authorities in Member States, such as ministries and public institutions, are in charge of running a particular programme. Around 70% of EU programmes are run this way. For what concerns the energy production sector, the European Regional Development Fund is the main relevant shared-management programme.

European Regional Development Fund

The **European Regional Development Fund (ERDF)** aims to strengthen economic, social, and territorial cohesion in the EU and to enable investments in greener and smarter practices. It functions through financing programmes in shared responsibility between the European Commission and national or regional authorities of Member States. Member States receive support for investments aligned with one or more of the ERDF's five policy objectives aimed at making the EU:

(1) More competitive and smarter

(2) Greener, low carbon and resilient

(3) More connected

(4) More social

(5) Closer to citizens

The total budget of the ERDF is around €212 billion, to which around €97 billion of national co-financing by Member States should be added, for a total of around €308.8 billion[91]. A particularity of the fund is that less-developed regions will benefit from co-financing rates of up to 85% of the cost of the projects, while rates for transition regions and for more-developed regions will be up to 60% and 0% respectively.

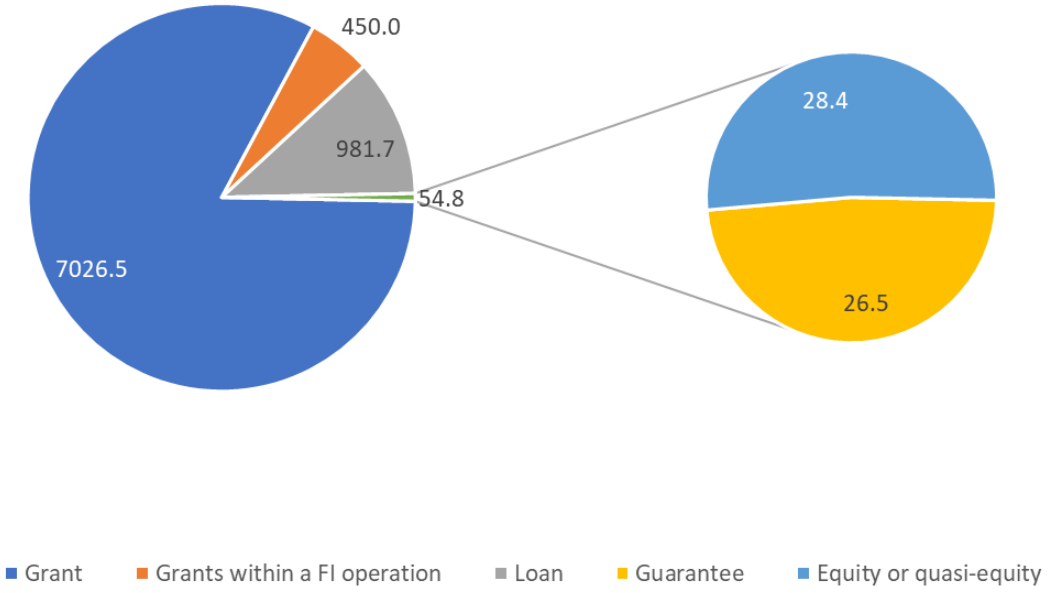
Greener Europe is the Policy Objective with the second highest share of ERDF resources, €102.9 billion, second only to Smarter Europe with €112.95 billion. Through these resources, a significant number of national programmes have been financed in different Member States. Some of these programmes have been financed in full with ERDF resources, others have combined ERDF with other public resources. The Member States' administrations choose which programmes to finance and take responsibility for day-to-day management.

Types of financing provided

[91] European Commission. Cohesion Open Data Platform. https://cohesiondata.ec.europa.eu/funds/erdf/21-27

ERDF resources are disbursed by Member States through different programmes and schemes, and thus through different types of financing. Figure 9 below shows how around €8.5 billion of ERDF resources in the current programming period 2021-2027 for renewable energy (RS02.2) are disbursed. Grants represent by a large margin the most used type of financing for the deployment of ERDF resources, accounting for almost €7.5 billion, of which €450 million for grant components of financial instruments operations, and over €7 billion for standalone grants. Loans account for around €980 million, whereas guarantees and equity represent the two least used types of financing, both respectively accounting for less than €30 million. Nonetheless, growing use of financial instruments is observed.

Figure 9: Amounts of ERDF financing provided by type of financing (in € M, excluding national contributions)[92]



Source: PwC analysis of cohesiondata.ec.europa.eu data

The Just Transition Mechanism

The **Just Transition Mechanism** supports the fair transition to climate neutrality across the EU. For the 2021-2027 period it is expected to mobilise nearly €55 billion targeting industries and workers in most affected regions. The programme is structured around three pillars:

- ***Just Transition Fund***, which aims to raise €25.4 billion of investments starting from a budget of €19.2 billion in current prices. The Fund has clean energy among its goals but there is no direct earmarking of budget for the sector.
- ***InvestEU "Just Transition" scheme***, providing – under InvestEU – a guarantee and an advisory hub with the objective of mobilising €10-15 billion, predominantly from private sector.
- ***Public Sector Loan Facility***, managed by CINEA, which combines resources from the EU budget (€1.5 billion) with those provided by the EIB (€10 billion). It will also provide technical assistance under the InvestEU Advisory Hub. By blending these resources, the Facility aims to raise around €18.5 billion of public investments to be used by public sector entities.

[92] Guarantee and equity and quasi-equity presented separately on the right for readability purposes.

ETS-based programmes

The EU ETS works on the 'cap and trade' principle. A cap is set on the total amount of certain greenhouse gases that can be emitted by the operators covered by the system. The cap is reduced over time so that total emissions fall. Within the cap, operators buy or receive emissions allowances, which they can trade with one another as needed. The limit on the total number of allowances available ensures that they have a value.

Revenues from the sale of allowances in the EU ETS mostly feed into Member States' budgets. Allowances are also auctioned to supply the funds supporting innovation in low-carbon technologies and the energy transition: the Innovation Fund and the Modernisation Fund.

Innovation Fund

The **Innovation Fund (IF)** is expected to provide €38 billion[93] between 2020 and 2030 for the first-of-its-kind commercial demonstration of innovative low-carbon technologies. This scheme is funded by the EU Emissions Trading System, so the exact amount of funding will ultimately depend on the carbon price. The fund is managed by CINEA and resources are allocated through regular calls for proposals for both large and small-scale projects[94], also revised in light of the REPowerEU strategy.

In addition to the existing grants programme, the European Commission is developing a new support mechanism of competitive bidding ('auctions'). Auctions are aimed at expanding the portfolio of support mechanisms, fostering faster and more cost-efficient support for the roll-out of low-carbon technologies needed for the green transition. On 30th August 2023, the European Commission published the conditions for the first pilot auction, which is planned to be opened in November 2023. This first auction has a €800 million budget[95].

Modernisation Fund

The **Modernisation Fund** was set up by the European Commission to support the ten lower-income Member States[96] in their transition to climate neutrality and to increase energy security. The Fund supports investments in energy production, energy efficiency, energy storage, modernisation of energy networks, and just transition in carbon-dependent regions.

The Modernisation Fund is an ETS-based instrument and not an EU budgetary programme. **It is funded from revenues from the auctioning of 2% of the total CO_2 allowances** for 2021-2030. At the price of €75/tCO_2, the total budget of the MF amounts to around €48 billion from 2021 to 2030, but this amount can change depending on carbon prices. In addition to the MF budget, beneficiary Member States can transfer additional allowances from other programmes under the ETS system. This can further increase the financial resources available to Member States to finance energy transition. To date, five Member States (Croatia, Czech Republic, Lithuania, Romania, Slovakia) have opted to do so. **Poland, Czech Republic, and Romania are the three biggest beneficiaries of the MF**, with shares of 43.4%, 15.6%, and 12% of the total allowances, respectively.

[93] Estimated assuming a carbon price of €75/tCO2

[94] For small-scale projects are intended all those with total capital costs under 7.5 million

[95] European Commission. Innovation Fund Auction Terms and conditions. https://climate.ec.europa.eu/system/files/2023-08/innovationfund_pilotauction_termsandconditions_en.pdf

[96] Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia.

While energy community, energy services, or prosumers are not Modernisation Fund categories, the Figures below show the amount and number of confirmed investments that combine two or more categories among: production and use of electricity from renewable sources, modernisation of energy networks, energy storage, improvement of energy efficiency.

Figure 10: Amount of approved MF resources in relevant categories (in € M)

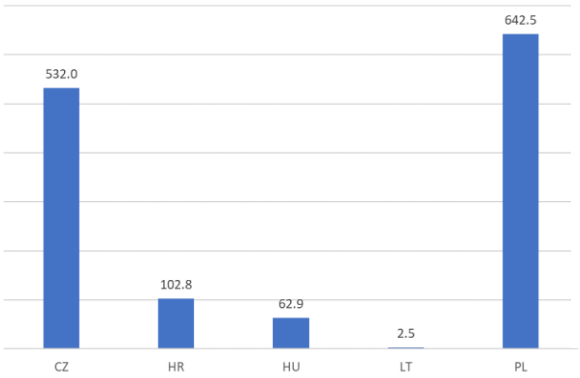
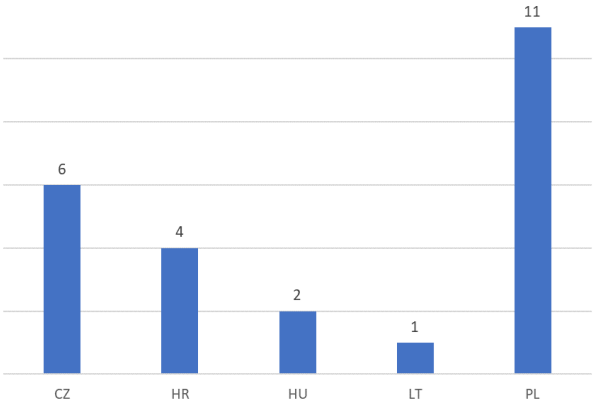


Figure 11: Number of approved investments in relevant categories by country



On May 2023, the revised EU ETS regulation was published in the Official journal of the EU[97]. The revised regulation strengthens the System and extends the ETS to new sectors of the economy, such as buildings, road transport and shipping, and to three additional Member States: Portugal, Greece and Slovenia. This will result in the Modernisation Fund to increase its size.

The European Investment Bank Group

Aside to the financing instruments of the EC and its agencies, the **European Investment Bank Group** (composed of European Investment Bank and European Investment Fund) also plays a central and key role in the energy financing landscape, including the energy services area. While the EIBG does not have specific investment programmes or schemes for energy, in its **energy lending policy**[98], one of the key areas of intervention is the **decarbonisation of the energy supply**. This consists of supporting the deployment of renewables as well as investing in new and more innovative technologies.

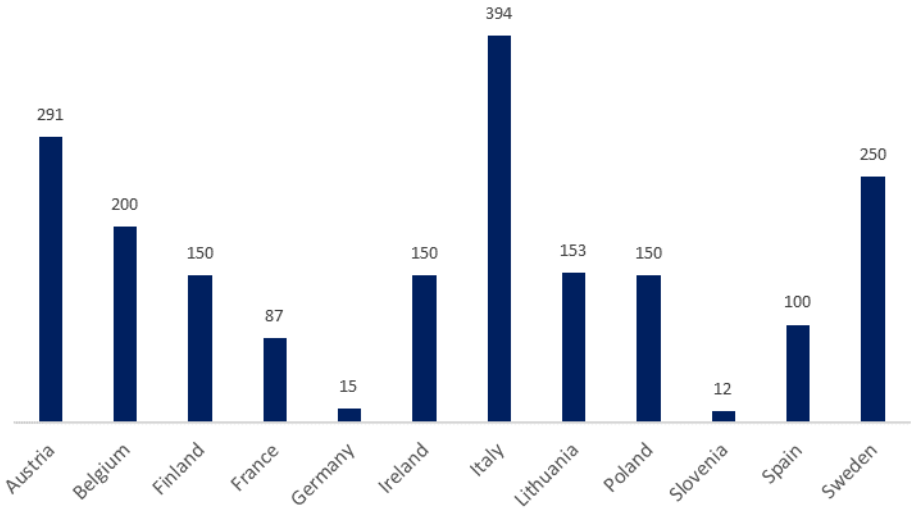
When looking at data from the energy projects financed directly by the EIB, most of them regards the installation of smart metering systems in the context of a general update of the grid. Similarly, a portion of them is allocated to ESCOs financing. None of them, however, have been allocated to either prosumers or energy communities.

The Figure below provides an overview of the volumes of direct financing provided by the EIB between 2017 and 2022 to energy services and prosumers projects. As can be noticed, Italy is the country that received the most direct financing, followed by Austria and Sweden.

[97] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L:2023:130:TOC

[98] EIB. Energy lending policy. https://www.eib.org/attachments/strategies/eib_energy_lending_policy_en.pdf

Figure 12: EIB direct financing to services and prosumers projects between 2017 and 2022 (in € M)



Source: PwC analysis of eib.org data

Another European Investment Bank programme run with the European Commission and centred on preparing energy efficiency projects is **ELENA**, the European Local ENergy Assistance facility. ELENA's grants pay for actions that help develop projects, such as feasibility studies, programme structuring, business plans, energy audits, and the preparation of tenders and contracts. It has already provided more than €168 million in grants for technical assistance on energy efficiency and renewable energy in buildings, homes and urban transport.

The EIF also invests in the energy sector, although not directly but thorough other funds. Under the InvestEU equity product, EIF seeks to increase the availability of risk capital across all stages of company development, accelerating growth of European scale-ups accompanying and supporting them in accessing public markets, as well as other EU policy objectives. **Under the InvestEU Climate & Infrastructure Product, the EIF provides equity investments to, or alongside, climate & infrastructure funds** investing in, among others, energy efficiency measures such as new investments that lead to energy savings and reduce the costs linked to energy consumption and projects based on Energy Performance Contracts [99].

The Marguerite Fund is a pan-European initiative worth mentioning. Marguerite is an equity fund launched in 2010 and **backed by the EIB and the five National Promotional Banks** of Italy, Poland, Spain, Belgium, and Germany. It acts as a catalyst for key investments in energy (renewables, hydrogen, low-carbon gasses, T&D, storage) and transport. It is the first fund of its kind launched by Europe's leading public financial institutions following an initiative endorsed during the second half of 2008 by the Economic and Financial Affairs Council and the European Council as part of the European Economic Recovery Plan[100]. The first fund, the Marguerite I, gathered €710-million worth of commitments, and the Marguerite II reached €745 million.

Maturity stages covered

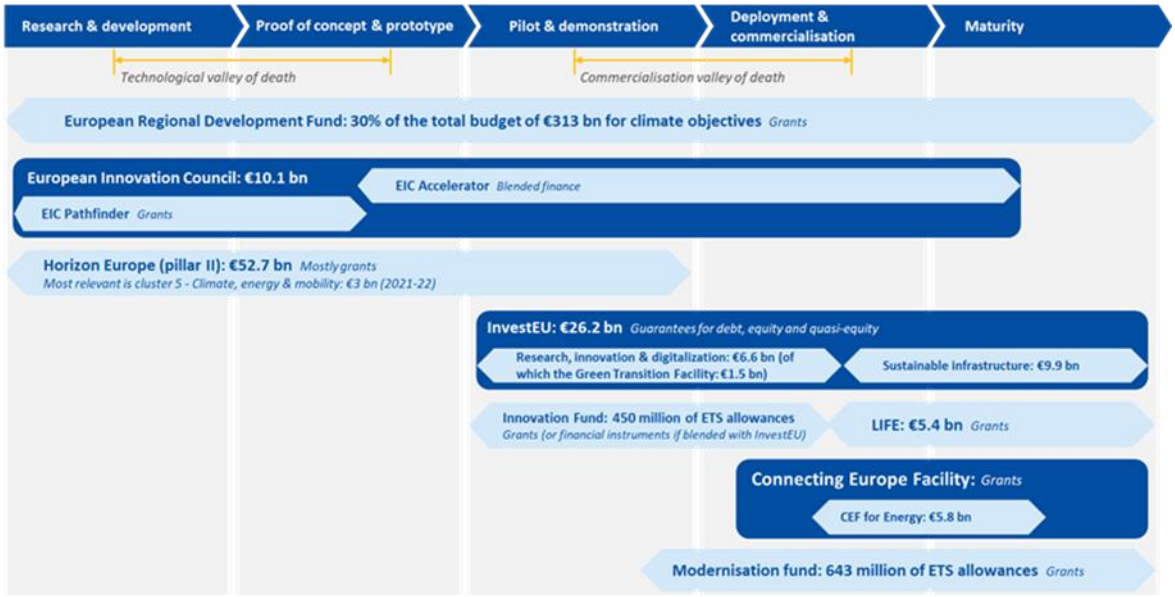
Centralised EU financing programmes target beneficiaries and projects at different levels of maturity and TRLs, aiming to address their specific barriers to investment. By

[99] EIF. Climate & Infrastructure Funds. https://engage.eif.org/investeu/climate-infrastructure-funds

[100] EIB. Marguerite Fund. https://www.eib.org/en/products/equity/funds/marguerite-fund

focusing on different TRLs, programmes can better address the barriers to investment relevant for different companies in the sector. As can be seen from the Figure below, EU financing programmes provide complete coverage across different stages of maturity. ERDF provides support across all maturity stages, based on how Member States decide to allocate such funding. For less mature technologies still in the research & development stage, Horizon Europe and the EIC Pathfinder provide support primarily in the form of grants, which tend to be the most suited type of financial support for technologies that are still far from commercial maturity. The Innovation Fund and InvestEU's RDI investment window provide then support for more developed technologies, which are nonetheless still not fully mature. This support comes in the form of blended finance, grants and guarantees for debt and equity financing. Equally the EIC Accelerator supports individual projects with a maturity level close to commercialisation (TRL 5 to 9). It funds highly innovative projects with very high risk and growth potential. Finally, InvestEU's Sustainable infrastructure window, the LIFE Programme, CEF and the Modernisation Fund (see below) provide financial support for mature technologies, in the form of grants and guarantees.

Figure 13: Overview of EU financing programmes according to their targeted TRL levels.



3.2. Financial support schemes at Member State Level

To address the challenges faced by services and prosumers projects and to enhance investments to achieve policy goals, the public sector can implement a series of financial support schemes. Financial instruments not only improve the financing conditions for a specific type of project (e.g., by de-risking it, increasing the financing available, improving the financing conditions, etc.), but also send a strong signal to market players about government and/or public authority commitment to that sector.

A mapping exercise was conducted to gather an overview on the existing financial support schemes available for energy projects, including services and prosumers. The purpose of the mapping was to assess the current availability of instruments and schemes to support services and prosumers projects, in order to assess to what extent they are effective in addressing barriers and mobilising additional finance. This will prove to be useful and functional for the development of future financial support schemes to support the energy transition in the EU, both new instruments or existing one being continued and improved.

Financial support schemes are not the solution for all barriers and bottleneck faced by energy projects. They are the most relevant to address barriers stemming from financial and market conditions, and less suitable for social and regulatory ones. This relevance is further explored in section 4.1.

The mapping was conducted through a combination of **desk research and interviews** with selected stakeholders to obtain complementary information. Instruments were categorised by segments of the energy value chain they can support, eligible beneficiaries, targeted development phase, and type of financing provided (see Annex 1). Some instruments have been flagged as **relevant for more than one single dimension**. These instruments were categorised under all the relevant categories, to reflect the scope of the instrument. This note should be kept in mind when reading the data presented below as, for instance, when it is stated that 100% of mapped instruments in Malta target services and prosumers, it does not mean that 100% of all the mapped instruments target only services and prosumers, but that they also target services and prosumers and none of the mapped instruments do not target it.

Instruments targeting solely energy efficiency (e.g., for the renovation of buildings, for industries, etc.) – albeit particularly popular – have been excluded from the analysis, as this is already covered by the work on the Energy Efficiency Financial Institutions Group. Energy efficiency instruments were mapped only if they included also support for transmission and distribution. For the purpose of the analysis and to identify regional trends, EU Member States have also been aggregated in four geographical areas, following the classification from EuroVoc[101]: Central and Eastern Europe[102], Northern Europe[103], Southern Europe[104], and Western Europe[105].

[101] Available on: https://www.researchgate.net/figure/European-subregions-defined-by-EuroVoc-Blue-Northern-Europe-green-Western-Europe_fig1_321354391

[102] Bulgaria, Czech Republic, Croatia, Hungary, Poland, Romania, Slovakia, Slovenia

[103] Denmark, Estonia, Finland, Iceland, Latvia, Lithuania, Norway, Sweden

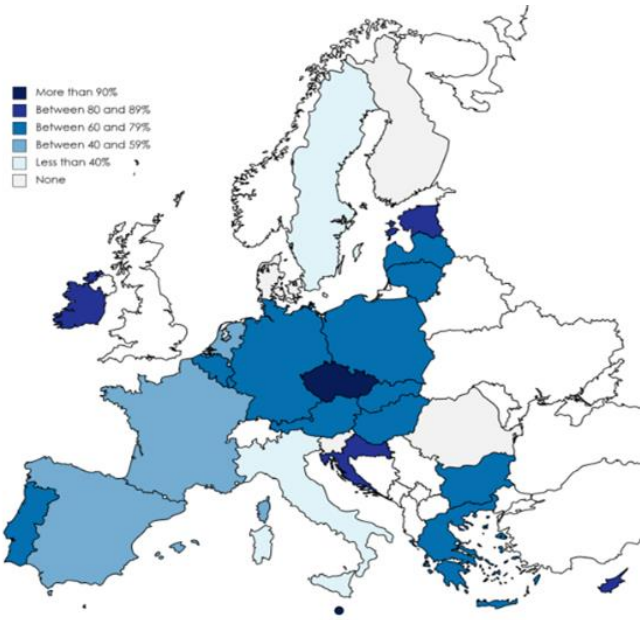
[104] Greece, Italy, Malta, Portugal, Spain

[105] Austria, Belgium, France, Germany, Ireland, Luxembourg, the Netherlands

General overview: services and prosumers instruments

The mapping has produced a database of 563 instruments across the 27 EU Member States. Poland (43), Italy (41) Germany (39), and France (35) are the three four countries in which the highest number of identified instruments. On the contrary, Denmark (10), Cyprus (10), and Finland (9) are the countries with the lowest number of identified instruments.

*Figure SEQ Figure * ARABIC 14: Share of services and prosumers instruments out of the total mapped*



On average, **around 58% of the mapped instruments support services and prosumers, 325 in total**. However, out of these that have been identified as relevant for this segment, **just 10 are targeting only services and prosumers**. Additionally, **62 of them support services and prosumers and another segment** (production 50 times, transmission and distribution twice, heating and cooling ten times). Finally, 171 instruments support all five segments (energy production, transmission and distribution, energy storage, heating and cooling, and services and prosumers).

All EU Member States except Denmark, Finland, Romania, and Slovenia present at least 1 instrument supporting services and prosumers. Six Member States (Croatia, Cyprus, Czech Republic Estonia, Ireland, and Malta) have a share of instruments supporting services and prosumers which is equal or higher than 80%. On the contrary, only in Italy and Sweden such a ratio is lower than 20%. **Instruments which only target services and prosumers have been found in 11 Member States, namely Belgium, Croatia, France, Germany, Ireland, Italy, Latvia, Malta, Poland, Slovakia, and Spain.**

The mapping also looked for information about the **volumes of financing** provided. Information about the total budget of the instruments as well as the amount already deployed have been collected where available, to understand what the available magnitude of financing for different target groups is and how it is channelled through different funding instruments/financial schemes. However, the mapping was able to gather only partial information on volumes, as such data was publicly available for around 45% of all instruments relevant for services and prosumers (146 instruments of the total 326 instruments) and information on deployment was missing in most of the cases.

Figure 15: Instruments mapped per Country

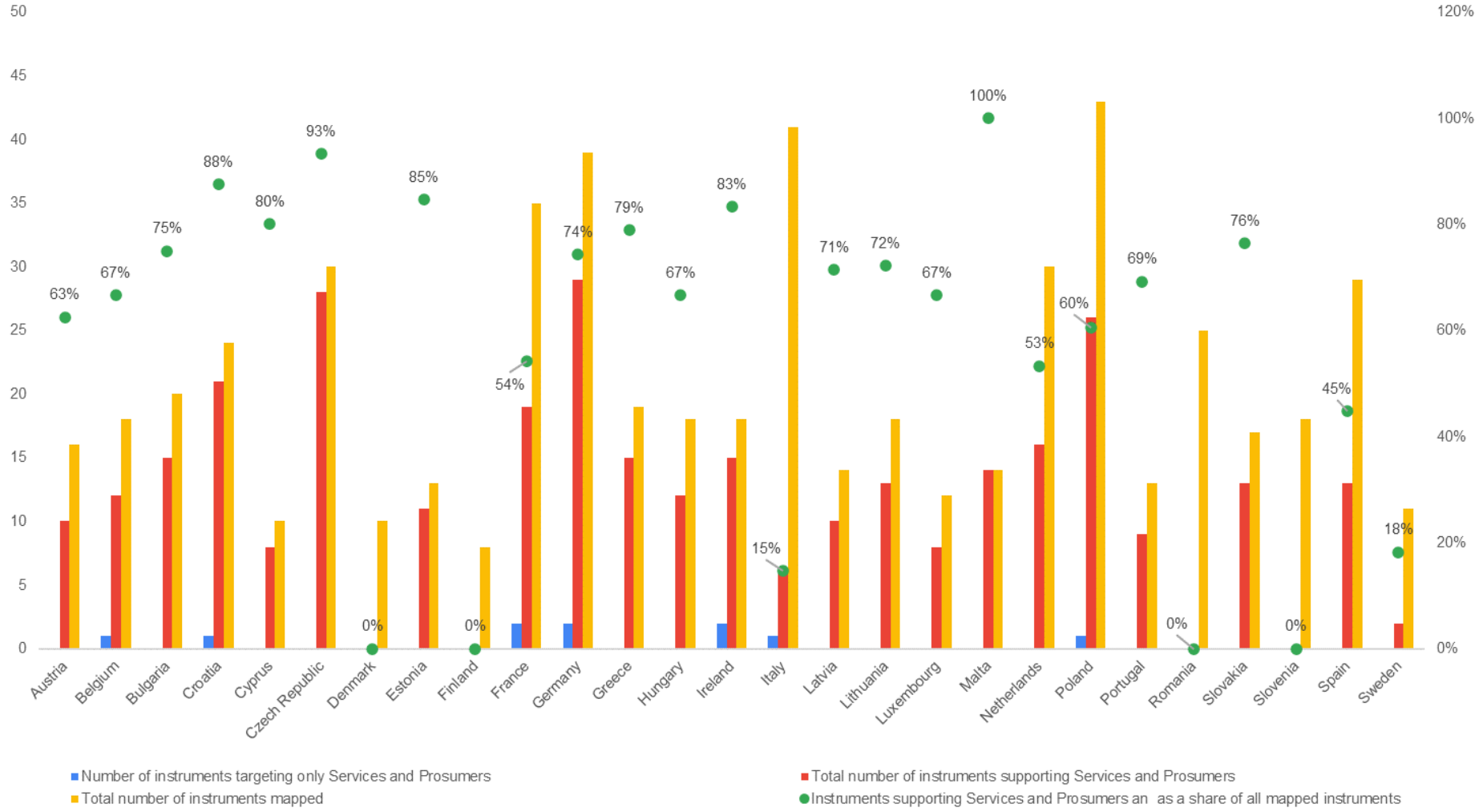
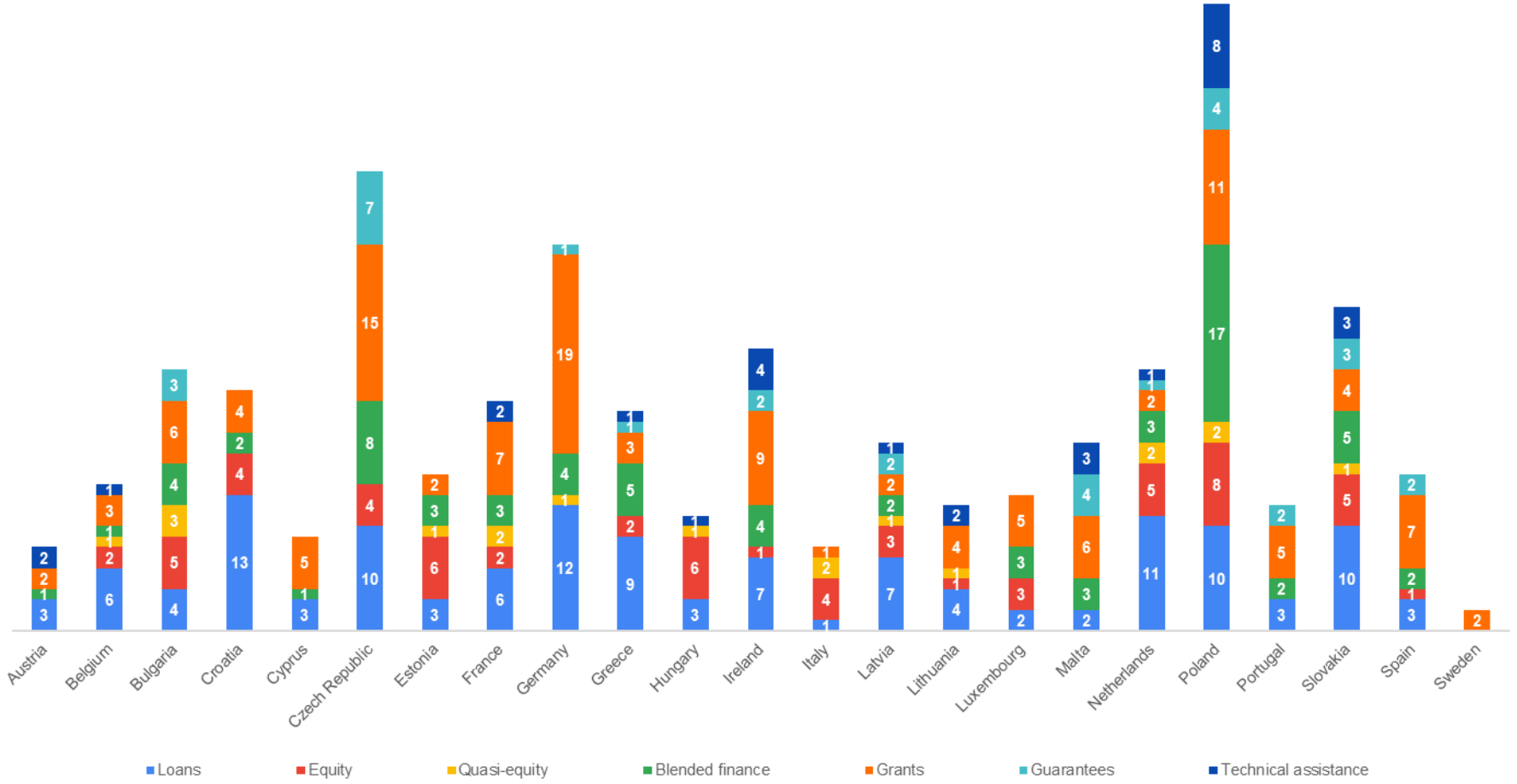


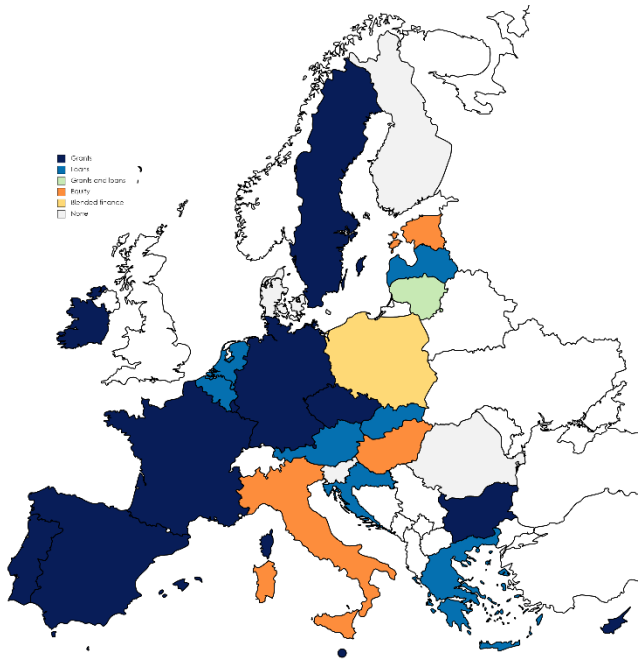
Figure 16: Number of financial instruments for services and prosumers per country and per type of instrument



Financing Instruments by type

Loans and grants are the most widespread across the set of 326 instruments that the mapping identified as relevant for services and prosumers. Only in Italy, Hungary, and Estonia equity instruments are the most widely available.

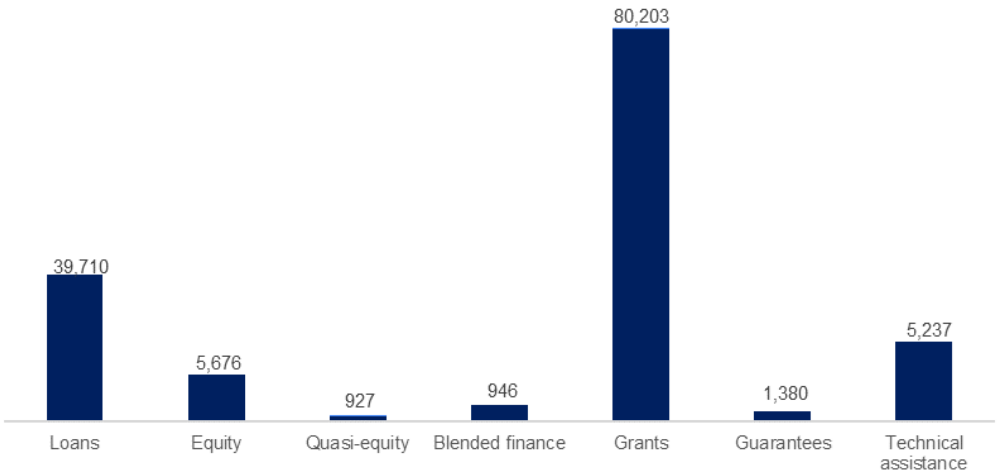
Figure 17: Most mapped type of instrument per country



On average, **a total amount of around €109 billion has been estimated to be available inter alia for services and prosumers projects by considering the resources coming from the EU, national public authorities, and private institutions.** As displayed in the figure below, overall, the amount allocated to grants, €80 billion, is twice the size of what is allocated to loans (€39 billion). **Out of these amounts, around €21 billion is channelled through services and prosumer-only instruments, mostly through loans and grants.** For guarantees, the maximum leveraged investments due to the respective guarantee has been considered for the calculation, and not the amount of guarantees disbursed, which was not available. These estimates are based on information for 146 instruments.

These volumes also include the total volume of instruments targeting also but not only services and prosumers, and for which there is no specific pre-allocation. This means that these volumes are not guaranteed to be spent in services and prosumers only. Additionally, some schemes for which it was impossible to determine the exact type of instrument through which money will be deployed are excluded from the break-down figure which follows.

Figure 18: Volume of financing per type of instrument (€ M)



The mapping identified a total of 124 grants supporting services and prosumers and **Germany is the country with the highest number of registered grant instruments** (19). This data is explained by the fact that many of these schemes come from the investment arms of the Länder, reflecting the federal governance of the country.

In the context of the WG discussion, **participants underlined the role that grants could play in extending the energy transition to low-income households**. Such schemes can be used to offset large upfront costs and involve a larger share of citizens in net-zero energy services as well as to support the set-up of energy communities.

Box 2: Focus on: Grants for services and prosumers only – The EXEED Certified grant case

Grants represent around the 20% of the 10 mapped instruments supporting specifically services and prosumers. The mapping identified them in Ireland and France.

One of two of them is the so-called EXEED Certified grant from the Irish sustainable energy authority (SEAI), providing grant support for projects which are following the EXEED Certified standard for Excellence in Energy Efficient Design[106].

Applications are open to both private businesses and public sector organizations planning an investment for:

- brand new buildings and facilities;
- upgrades or re-purposing of existing buildings and facilities; and
- manufacturing processes.

To be eligible, the project must be in the design phase of planning capital projects and participants must commit to embed efficient design into their projects and achieve the EXEED certification.

The grant amount is calculated as a percentage of the eligible project expenditure up to €3,000,000 per project. There are two stages for grant support under this program.

Stage 1	Stage 2
providing grant support for professional fees in the planning and concept design stage, supporting up to 70% of the additional costs incurred in following the EXEED process.	is for up to 50% of the **incremental capital costs relative to the baseline design with implementation of the EXEED approach**.

Such a grant offer is also paired with a form of technical assistance in the figure of an experienced mentor supporting applicants through the process. **Applications are open throughout the whole year for both stages.**

Additionally, **a specific model contract has been created by SEAI to facilitate EXEED grants for ESCOs-delivered projects**, while ensuring compliance with State Aid obligations and proper management by the Agency.

Loans (132 in total) come mostly from market-oriented public institutions such as national promotional banks (NPBs) or the EIB Group and we found them across all Member States. Some products coming from private banks and funds are also present. Loans

[106] The EXEED Certified standard is an energy management certification scheme developed by the Sustainable Energy Authority of Ireland (SEAI) designed to encourage innovation in design projects to help future-proof the investment by optimising energy performance, reducing operational energy costs and carbon emissions, improving competitiveness, and demonstrating commitment to sustainability.

are prevalent in all geographic areas and no specific differences or trend was identified. Croatia (13), Germany (12), and the Netherlands (11) are the countries with the highest number instruments.

The mapping found 62 equity instruments, across 17 EU countries[107]. Poland is the country with the highest number of equity instruments identified (8). **There are no equity instruments targeting exclusively services and prosumers.**

Quasi-equity, which is a more complex financial instrument, is less present and was found in 12 Member States[108], **for a total of 18 instruments**. On the other hand, **73 instruments can be categorized as blended finance**[109]. None of them, however, is specific for services and prosumers. Such schemes have been mapped in 19 Member States[110] with Poland (17 instruments) being by far the country with the largest availability. **The provision of more sophisticated financial instruments such as (quasi)equity and blended finance require a high degree of cooperation between public and private providers of finance.** Most of the identified instrument are provided by or in cooperation with NPBIs and the EIB Group.

One or more guarantee schemes for services and prosumers are available in 12 EU Member States[111], **for a total of 32.** Czech Republic has 7 instruments, followed by Poland with 4. In the majority of the cases, guarantees are provided by the public sector, especially through facilities financed by the EIB Group or EU funds.

As remarked by WG Members, **most projects in the Services and Prosumers segment are too small to justify individual guarantees**, as individual assessments would turn out to be too costly for the investor. In this sense, a portfolio approach may be more relevant.

Additionally, **WG participants stressed the lack of instruments currently capable of addressing the specific counterparty risk arising in investments that depend on regular payments from end-users** (e.g., households that pay companies for the installation of PV panels or storage systems. For a more in-depth analysis, see Chapter 4.

Finally, **29 instruments also including technical assistance have been mapped across 12 MS**[112]. Poland is the country in which Technical Assistance is provided the most. On 17 occasions this instrument was paired with loans. 15 times it was offered together with a grant. On 8 occasions instruments were offered together with technical assistance. Overall, as showcased above, the volume of money channelled through programmes, mostly loans and grants, that come with a technical assistance part is around €12 billion.

During the WG discussion, **some members underlined two possible solutions** - further analysed in Chapter 4 - **for providing TA in the services and prosumers segment**:

- **TA provided at the level of financial intermediaries**

[107] Belgium, Bulgaria, Croatia, Czech Republic, Estonia, France, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Slovakia, Spain

[108] Belgium, Bulgaria, Estonia, France, Germany, Hungary, Italy, Latvia, Lithuania, Netherlands, Poland, Slovakia

[109] For the purposes of this study, blended finance refers to financing solutions that encompass a mix of different types of financial instruments in a structured and calibrated way, tailored to the investment profile. The funding sources can be either purely public or combination of public and private funding.

[110] Austria, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, France, Germany, Greece, Ireland, Latvia, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania

[111] Bulgaria, Czech Republic, Germany, Greece, Ireland, Latvia, Malta, Netherlands, Poland, Portugal, Slovakia, Spain

[112] Austria, Belgium, France, Greece, Hungary, Ireland, Latvia, Lithuania, Malta, Netherlands, Poland, and Slovakia

- **TA provided directly to the end user**.

Box 3: Focus on: Bonds financing for energy and sustainable activities

Green Bonds are expected to be an increasingly important instrument to finance sustainable activities over the next years. In the last decade in the EU, both public and private sector entities have started tapping the green bond market, following the increasing attention to sustainable finance. Although China has been in 2022 the largest global issuer by number of issuances, the European market remained the largest in terms of issued volumes, with a supply of around $219.03 billion. Historically, European entities have been pioneers in this field, with the EIB being the first issuer of a green bond in the world back in 2007.

1,960 or around 58%, of all GSSSBs of EU issuers between January 2015 and February 2023 were relevant for renewable energy. The following figures will focus on the **use-of-proceeds bonds** (i.e., Green bonds, social Bonds, Sustainability Bonds, **1915 in total**) which had renewable energy as one of the declared uses of proceeds[113, 114]**.**

Services and prosumers is not a use-of-proceeds category that is used in the issuance of green bonds. Therefore, it was not possible to identify and analyse green bonds based only on their relevance for services and prosumers. When services and prosumers is an eligible category, it is included under the broader umbrella of "Renewable energy". For this reason, the following analysis focuses on GSS bonds for renewable energy.

Corporate bonds

Sweden has the highest number of issued corporate U-o-P whose proceeds are entirely or partially earmarked for renewable energy projects among all Member States. This result is largely due to the high number of issuances from real estate companies and housing associations, which account for more than 80% of the total Swedish issuances. **Spain ranks second with 83 bonds in total**, and it leads in terms of the number of issuances from energy sector companies (68). **Germany ranks third overall**, with a total of 70 issuances, including 48 from energy sector companies.

Corporates issued around €216 billion of UoP bonds with proceeds designated for financing renewable energy projects. German and French companies have issued just around €35 billion each, **with an average issuance of around €510 million and €662 million**, respectively. The Netherlands and Spain are next, with €28 billion each, and average issuances of €535 million and €340 million, respectively. On the other hand, Swedish companies issued only around €21 billion, with an average issuance of just €66 million.

Sovereign bonds

[113] Based on data from Environmental Finance retrieved on 29 March 2023.

[114] For EU companies that have operations outside the Union, as well as for DFIs, a non-quantifiable of the raised funds may have been directed towards projects in extra-EU countries

Figure 19: Number of U-o-P bonds relevant for renewable energy issued by companies from 2013 to 2023, per country

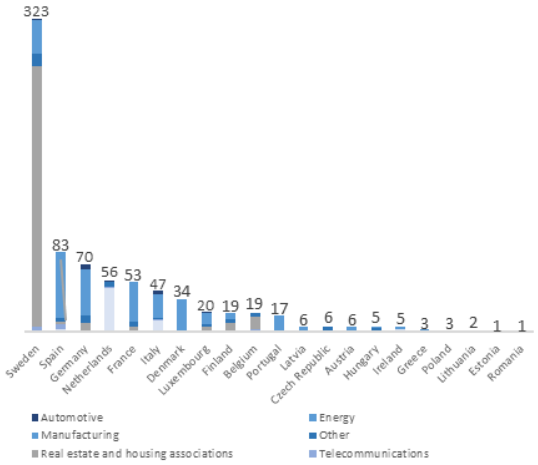
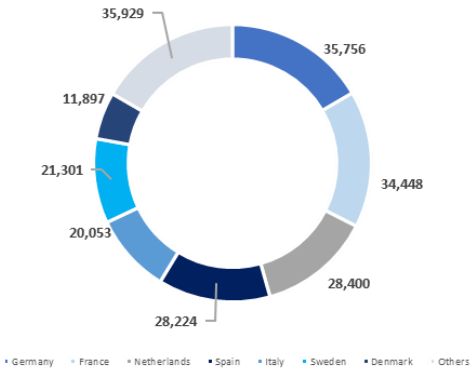


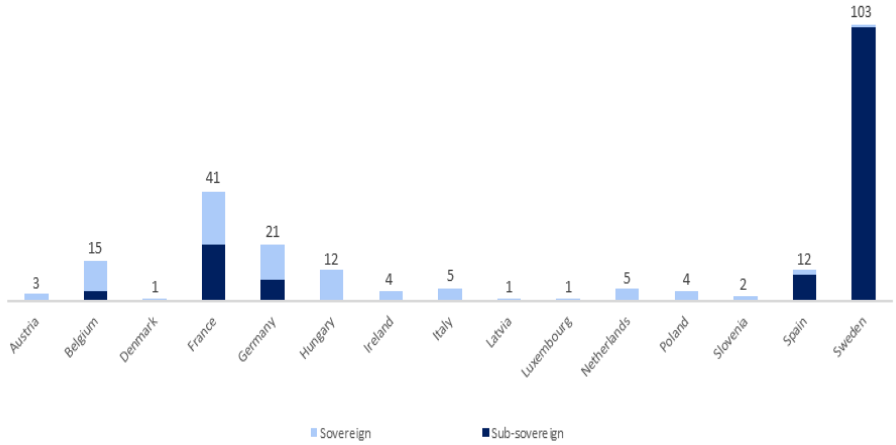
Figure 20: Aggregate volumes of UoP bonds issuances relevant for renewable energy issued by companies from 2013 to 2023 per country (In € M)



Over the analysed time period, a total of 230 UoP bonds whose proceeds are totally or partially earmarked to renewable energy projects were issued by European sovereign and sub-sovereign entities, with sub-sovereigns accounting for 145 issuances and national governments accounting for the remaining 85**.** The Stockholm Regional Council was the sub-sovereign entity with the highest number of bond issuances, while the French State was the leading issuer among sovereign entities.

In terms of volumes, sovereign entities (€182 billion) raised almost seven times the amount of the sub-sovereign ones (€27 billion). This trend could reflect the different

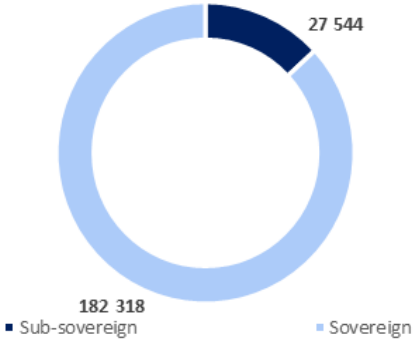
Figure 21: Number of UoP bonds issuances relevant for renewable energy issued by sovereign and sub-sovereign entities from 2013 to 2023



and larger – financial needs that national governments generally have compared to sub-sovereign entities, which are responsible for a narrower range of activities.

On aggregate, **sovereign green bonds accounted for nearly €177 bn.** France is the Member State that issued the most, with €56 bn, followed by Germany, and Italy. This result is not surprising considering that these are also the three largest economies in the EU.

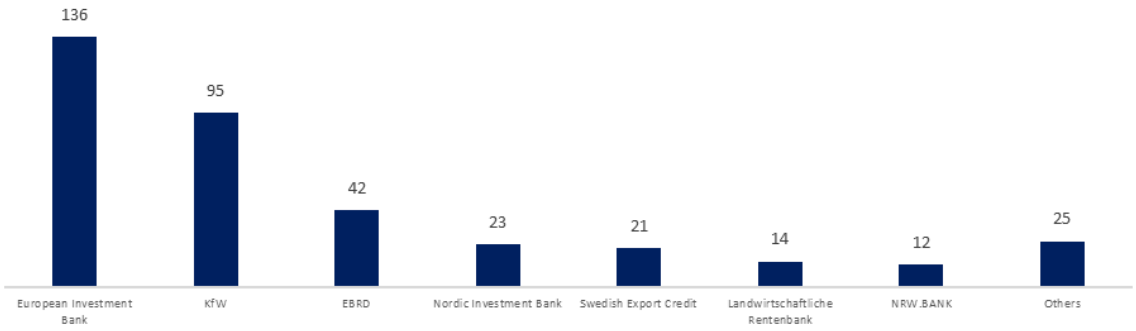
Figure 22: Aggregate volumes of UoP bonds issuances relevant for renewable energy issued by sovereign and sub-sovereign entities from 2013 to 2023 (In € M)



DFIs

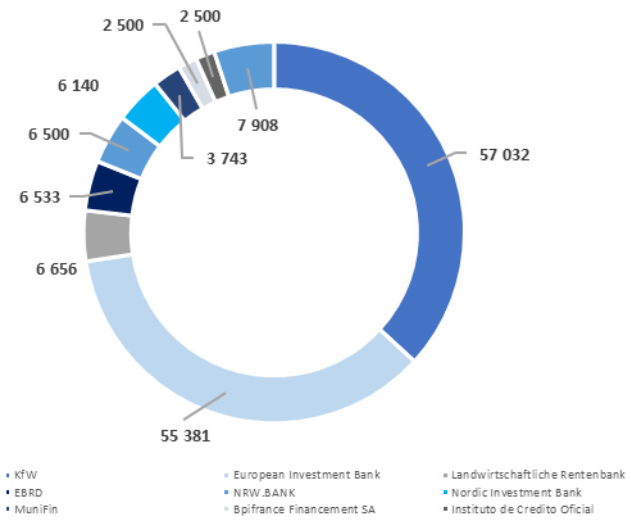
In the analysed dataset, **368 bonds whose proceeds are totally or partially earmarked to renewable energy projects were issued by DFIs, with the EIB (136) accounting for around a third of them**. The EBRD and the Nordic Investment Bank rank third and fourth, after the German NPB, KfW. This category of issuers plays an important role in financing sustainable energy projects. Typically, they issue bonds to raise funds that they can then lend out to support selected projects.

Figure 23: Number of UoP bonds issuances relevant for renewable energy issued by DFIs from 2013 to 2023



In terms of volumes of bond issuances, KfW is the largest issuer with around €57 billion worth of GBs. The bank commenced building its global portfolio in collaboration with the German Ministry for the Environment, Nature Conservation, and Nuclear Safety in 2015. The EIB comes in second place with €55 billion and the combined bond issuances of these two institutions make up over 70% of the total for this category.

Figure 24: Aggregate volumes of UoP bonds issuances relevant for renewable energy issued by DFIs from 2013 to 2023 (IN € M)



Financing instruments by beneficiary

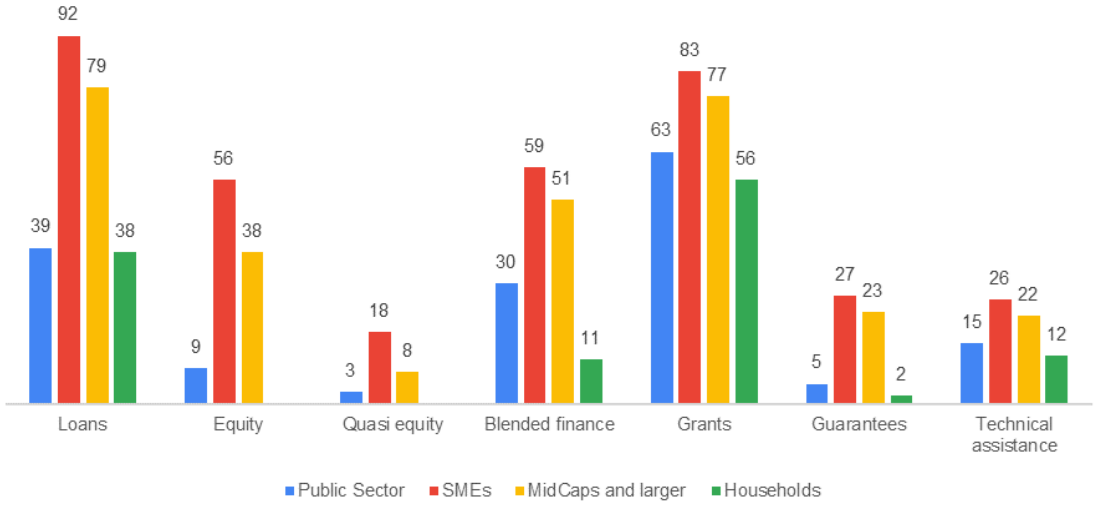
SMEs and larger companies are the most supported recipients by financial instruments in most EU Member States. They are the most supported type of beneficiary due to their higher investment needs in general, which lead to the need for greater support. "Financing costs" was indeed indicated by both SMEs and large companies as a relevant obstacle for their green transition activities in a recent Commission report on EU SMEs[115], showing an existing need for support in the field. Croatia and Poland are the two countries which have the highest number of loan instruments towards the private sector (10 and nine) while Germany and Czech Republic have the highest number of grants (13 and 12).

Most of the equity, quasi-equity and blended finance is directed towards SMEs and larger companies. Indeed, 90% of equity instruments target SMEs and 61% for Midcaps and larger companies. The share that is dedicated to public companies is negligible in all the EU

[115] European Commission (2021). Annual report on European SMEs 2021/2022. SMEs and environmental sustainability.

countries. Similar results are found also for quasi-equity, where all instruments are directed towards SMEs and 44% to Midcaps and large companies.

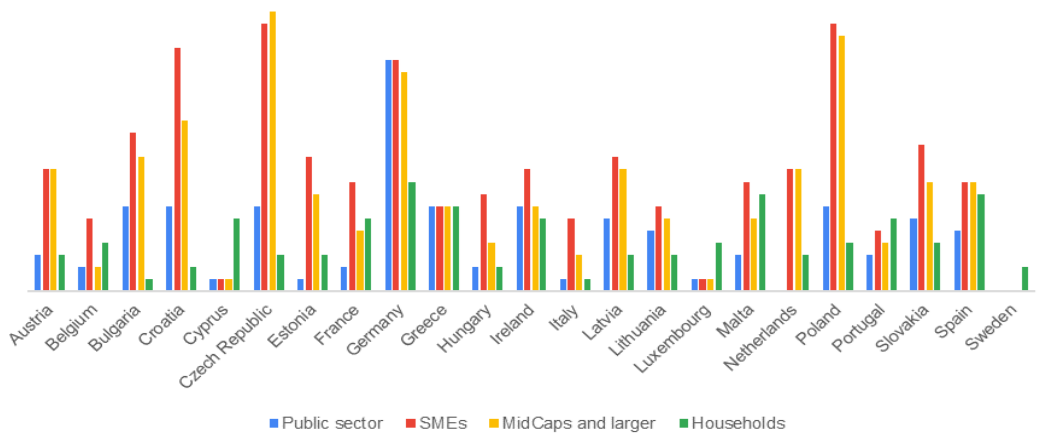
Figure 25: Number of mapped instruments per supported beneficiary by type of instrument



Public-owned companies and public administrations ("public sector") are supported by around a third of the mapped instruments. The lower support for public sector entities could be linked to the extent such entities receive direct budget support from the state budget and their expenditures might not need to be financed through external instruments. Furthermore, some WG members pointed out that some municipal companies are legally not allowed to take out a loan or distribute shares, thus excluding them from many financial support schemes. Only 39 loans were found towards these recipients, mostly in Germany and Slovakia, while grant instruments for public sector are 63, mostly in Germany (15).

In this specific segment, households as well receive a share of instruments of around 30%. Instruments targeting this category of beneficiaries are usually very broad in scope and are aimed at implementing domestic renewable systems which also comprehend the installation of an energy generating technology capable of creating a prosumer situation. Consequently, 87% of all instruments for services and prosumers targeting households also support energy production. Grants are the most used tool to support households, followed by loans (56 and 38 instruments, respectively).

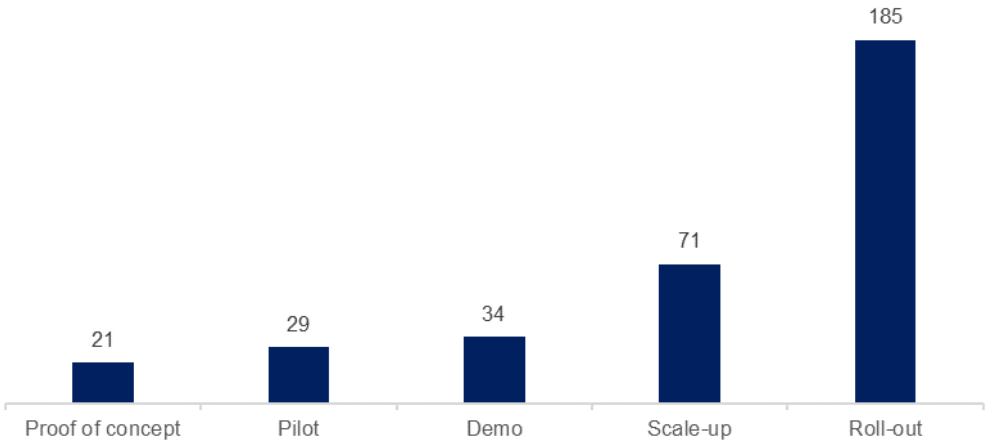
Figure 26: Number of mapped instruments per supported beneficiary by Country



Financing instruments by targeted TRL

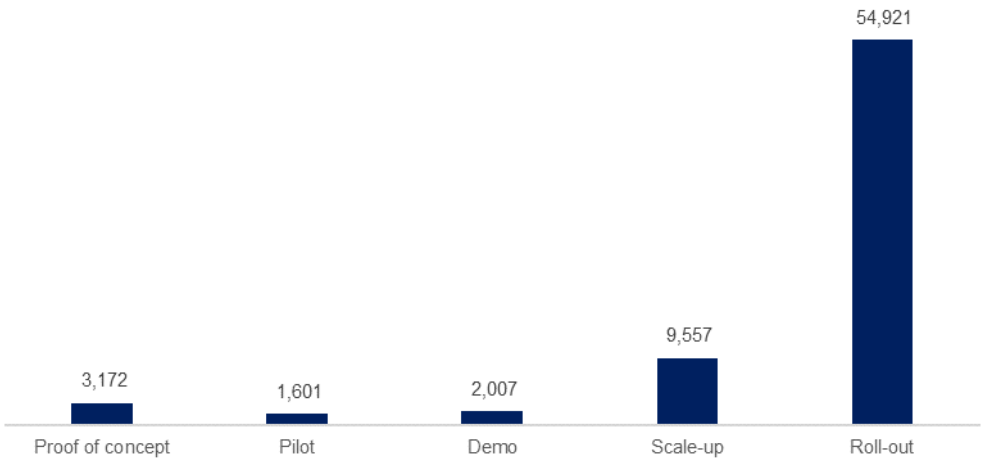
Financial instruments in services and prosumers target mainly projects that are mature and market-ready ("roll-out" stage). Most instruments target mature technologies and roll-out stage projects/activities and the availability of instruments decreases as the maturity stage decreases towards lower TRL and early-stage technologies. Indeed, about 57% of the identified instruments target roll-out stage and 22% are aimed at scale-up stages. This trend stays the same across the different types of instruments mapped. That said, **programmes at EU level like the Innovation Fund or Horizon Europe have been put in place to provide financing for innovative but less mature technologies** that would otherwise struggle to access financing opportunities in the market. Despite not being specific to services and prosumers, these programmes can finance such types of projects too.

Figure 27: Number of instruments per maturity stage



Nevertheless, **based on the available data, about €3 billion is available through financial instruments targeting proof of concept stage and between €1.5 and 2 billion at pilot and demo stage.** The trend in terms of volumes of financing understandably replicates the one of absolute number of instruments. Significantly higher volumes of financing are available for scale-up and – above all – roll-out stage projects/activities. Indeed, the latest stage alone receives a considerably larger amount than all the other stages combined, reflecting the higher amounts of financing needed to deploy a mature technology at scale.

Figure 28: Volume of financing per maturity stage (€ M)



4. Assessing the relevance and effectiveness of instruments

As referred to in Section 2.4, projects by energy services and prosumers continue to face a series of barriers limiting the provision of financing. These barriers stem from incomplete regulatory frameworks, customer inertia, or uncertainties in the performance of the technologies involved, among other risks.

This chapter focuses on the role financial support schemes can play in addressing investment barriers affecting energy services and prosumers, and attempts to assess, based on the mapping of financial support schemes conducted, to what extent existing instruments are effective. Mechanisms for **financing revenues**, such as FiTs, FiPs, net metering or net billing are not analysed under this chapter, which instead focuses on instruments available for the **financing of assets**, such as loans or grants.

Section 4.1 provides more conceptual considerations and evidence from the mapping on the **capacity of different types of instruments to address barriers**. Indeed, not all barriers can be addressed through financial instruments and not all instruments address all barriers. Section 4.2 presents findings on instruments' **effectiveness** in addressing relevant barriers and reaching their objectives, drawing on evidence from the mapping and existing instrument evaluation studies.

4.1. Relevance of instruments in addressing investment barriers: theory and evidence

Theoretical considerations

This section focuses on the main types of instruments identified in the mapping and provides a conceptual analysis of their relevance for addressing different barriers to investment, based on the way they function and their effects on the project's bankability. This framework will then be used in sub-section 4.2 to analyse the findings from the mapping.

Loans

A loan is a debt type of product that can take different forms and function in different ways, depending on the way it is structured. While the mapping exercise did not distinguish among the different types of loans, mainly for a reason of feasibility[116], it is nonetheless useful to understand how different types/features of loans can help addressing investment barriers. This will also be key for the future development of new and improved financial instruments, which would benefit from a more tailored input and insight.

The following paragraphs provide a description of the most relevant features of loans for projects by energy services and prosumers and the type of financing needs they address.

Loans with advantageous terms such as reduced interest rates or collateral requirements are relevant for improving access to finance and financing conditions for price-sensitive prosumers and energy service companies. Access to finance is usually a

[116] Feasibility considerations included a) consistency of available information across loan instruments (most loan descriptions did not provide detailed information on underlying features); and b) consistency of available information across other instruments (most guarantee, equity and grant schemes did not provide detailed information as to their type).

major obstacle for small and medium-sized ESCOs with a limited balance sheet[117]. Similarly, for energy communities traditional bank loans can be expensive and involve high demands in relation to own equity and other collaterals. Loans with preferential conditions (e.g., ethical loans, sustainability-linked loans, or green loans with lower interest rates) can **increase the financing options available** for smaller energy service companies and energy communities, particularly when such entities seek to scale up and their own resources are not enough to ensure their growth.

Loans that facilitate the aggregation of investments are relevant for improving access to finance for small Services and Prosumer projects. Smaller scale projects such as rooftop PVs can face challenges in accessing finance due to their small ticket sizes, which can disincentivise commercial banks from investing. This is due to all the administrative and due diligence processes that must be performed before financing is provided, which in the case of smaller projects might not be worth the effort, as the revenues from the interest rates would be relatively small. There are two main levels at which loans can enable small-project aggregation: (i) at the **individual loan level**, by facilitating the presentation of different investment measures under the same application (e.g. home energy loans for the installation of rooftop PV and other energy-saving systems) and (ii) **at portfolio level**, where loan portfolios of similar small projects can enable larger commercial banks and providers of climate finance like EIB to participate in the financing with larger tickets[118]. Aggregation of small projects into larger portfolios can similarly be exploited by other financial instruments such as guarantees and equity schemes to improve the accessibility of small projects to larger private investors.

Guarantees

Guarantees cover the risk of no payment to the money provider. They are relevant for improving access to finance and financing conditions for projects entailing high real or perceived risks, making them a particularly suited tool for crowding in investments for the Services and Prosumers sector.

Guarantees can be particularly helpful in reducing end-user risks for third party investors and ESCOs. As discussed in WG meetings, ESCO projects frequently involve **counterparty risk** as they depend on end-users regularly paying (e.g., households must be able to pay companies in a timely manner for the installation of PV panels or storage systems). This risk is likely to become more relevant with the ongoing decentralisation of energy production, as more and more users are expected to request installation of small RES systems. As ESCOs rely heavily on debt financing to fund their performance contacts, delayed payment from clients can severely disrupt the servicing of the debts of the ESCO itself and undermine the company's efforts to raise finance at advantageous conditions. Guarantees that undertake some of the risk of the ESCO are therefore relevant in improving **access to finance and financing conditions** for ESCOs seeking third-party funding for their investments[119].

Portfolio guarantees are well suited to catalyse relatively small investments in the Services and Prosumer sectors. As highlighted by WG members, most projects in the

[117] Source: webinar on ESCO project financing solutions, European Commission

[118] See example of recent EIB loan of USD 18M to the Palestine Investment Fund to finance the installation of rooftop PV systems on 500 public schools in the West Bank, and where the electricity generated will be used to power schools and houses.

[119] See example of the ESCO portfolio guarantee offered by Bulgaria's Energy Efficiency and Renewable Sources Fund (EERSF). The EERSF offers a 5% guarantee covering disruptions in the flow of receivables of the ESCO. As delayed payments rather than defaulting clients are considered a more probable risk for an energy service company, a 5% guarantee is deemed sufficient to act as a financial buffer for delayed payments to ESCOs.

Services and Prosumer sector are too small to justify individual guarantees, as individual assessments would turn out to be too costly for the investor**.** A portfolio approach is more relevant in comparison, and it also facilitates the involvement of specialized financiers like EIB who can provide large portfolio guarantee tickets. EIB's Private Finance for Energy Efficiency (PF4EE) instrument[120] is a particularly relevant example of a portfolio guarantee instrument that has improved **access to finance and financing conditions** for various type of Services and Prosumer projects in Europe. By providing a portfolio guarantee to commercial banks, the instrument allows financial institutions to offer **favourable lending conditions** and more **flexible credit granting** for energy efficiency and small RE investments in their markets[121].

In relation to the nature of guarantor entities, **guarantees provided by public sector entities**, such as sovereign or regional governments, can be particularly effective in supporting private borrowers raise sufficient debt for new investments. A public sector guarantee can be a helpful tool to **attract private investors with a risk averse profile** towards new projects, as any losses would be at least partly covered by the public sector. By issuing a guarantee rather than contributing directly to the financing of an investment, the public sector avoids a **crowding-out effect** because of its intervention. In addition, for the public sector budget, a guarantee constitutes an **off-balance sheet instrument** which is not considered public sector debt as long as the revenues of the underlying project make it economically viable. This makes guarantees an **efficient tool** for governments to improve access to finance and financing conditions in services and prosumer markets, without the public authority having to disburse any public resources unless there is a case of default.

Equity

Equity instruments can be a powerful tool for supporting capital-intensive projects by energy communities and for financing young companies offering technological solutions to the services and prosumers sectors. Equity-type instruments expose investors to a higher degree of risk but also to potentially higher returns and can support both mature and less established projects by energy services and prosumers.

Equity financing by members of an energy community is mostly relevant for financing the implementation and operation phases of community projects. Across the EU, the bulk of energy community financing comes from the individual investments of their members[122]. Shares offered to new or existing members can be used as seed capital, as funding for one specific project or as non-specific project funding. There have also been recent examples of energy communities implementing **innovative ways of raising capital from their members** to fund large infrastructure projects or to attract different types of members with different voting rights[123]. Self-financing methods by energy communities are mostly used to cover the financing needs during the project implementation and operation phases but are typically **not sufficient to cover planning and development expenses** of energy

[120] EIB PF4EE product

[121] Section 4.2 provides additional details on this financial instrument and its successful deployment in the case of Belgium.

[122] Source: Energy communities in the EU: Opportunities and barriers to financing (Profundo, 2022)

[123] Energy community GoiEner presented to WG5 members the Voluntary Contribution Window mechanism, through which members of the energy community contribute to the funding of big infrastructure projects, and the Renewable Energy Community Model, built around the idea of mixed communities composed by different types of members/investors with different voting rights.

investments, as citizens are usually not eager to invest during the earlier and riskier phases of a community project.

Cooperative equity funds can be particularly helpful in catalysing the development and construction phases of energy community projects. A cooperative fund is an equity fund managed by a cooperative – an enterprise formed by a group of people to meet their own self-defined goals. Examples of cooperative funds dedicated to energy communities include the revolving fund managed by French cooperative Énergie Partagée or REScoop MECISE, which operates at European level. In the case of Énergie Partagée, 10% of the fund is explicitly allocated to financing the early phases of energy community projects, such as legal and environmental studies. MECISE pools funds from cooperatives, local authorities and private investors from across Europe to provide **temporary equity to energy communities**, helping them finance the development of RE projects before citizens are willing to invest their own money. By **helping to cover the high upfront costs of energy investments**, cooperative funds can therefore facilitate energy communities to finance their projects with **less risk for individual communities**.

Publicly backed venture capital investments are particularly relevant for improving access to finance for young and innovative companies offering technological solutions to energy services and prosumers. In recent years, there has been an increasing number of innovative IT companies developing solutions that enable the energy transition. Such companies require sufficient growth capital and larger tickets to be able to innovate and scale-up. Publicly supported VC investments, such as a recent energy fund launched by VC Belgian Junction Growth and supported by a EUR 30m contribution from the EIF, can therefore be necessary to crowd in private investors and mobilise equity financing for innovative technologies facilitating decentralised energy systems[124].

Grants

Grants can be relevant in addressing a number of investment barriers, depending on the types of investments and beneficiaries targeted and cost components covered.

Investment/capital grants are usually provided to cover development costs, finance viability gaps and reduce the ultimate financing costs to increase projects' competitiveness. They are well suited to address **restrictions in access to finance** affecting emerging technologies in energy services, where private investors may be reluctant to invest due to a high degree of novelty and **technology risks**, uncertain revenues or high investment costs. In addition, private investors may not consider the **positive spill over effects** resulting from research, development, and innovation in new types of energy services, leading to sub-optimal investment outcomes. Aggregated demand response (DR) in particular is a type of business model that has not yet reached full commercial stage, but which requires significant financing for the IT architecture behind Virtual Power Plants – recent Horizon 2020 grants have specifically targeted novel DR tools aiming to increase the number and type of consumers engaged in DR services across Europe[125]. Such type of capital grants can be offered in isolation or combined with other instruments like technical assistance schemes, which can further support companies' path to commercialisation.

[124] In September last year, Junction Growth made an investment in Haulogy, a Belgian company active in the field of software development for energy suppliers and DSOs. The software solutions supported mainly focus on congestion and flexibility management, also in the context of energy communities and virtual power plants management.

[125] See example of the recent Horizon 2020 call on consumer engagement and demand response (open from Sept 2019-Jan 2020).

Grants encouraging citizen engagement in decentralised energy production can help to reduce customer inertia when it comes to participating in the energy service market. Given their non-repayable nature, grants can incentivise households and companies to undertake relatively simple investments that support the energy transition, but which would not be considered a priority by individuals in the absence of sufficiently strong economic incentives. Examples include grants for domestic RE installations or grants supporting the deployment of smart meters. Within the consumer segment, grants can further target **specific types of beneficiaries** with the purpose of encouraging economic investments from specific actors. Of particular relevance are grants to **low-income households** or **underdeveloped communities**[126], for which the installation costs of RE/EE equipment can still present a strong barrier to investment, despite the energy savings that would result from such investments.

Interest rate or guarantee fee subsidies facilitate access of individuals and companies to existing lending or guarantee schemes. By improving the financing conditions of underlying financial products (loans, guarantees), such subsidies strengthen individuals' and companies' incentives for obtaining commercial financing for energy investments. This type of support can be particularly relevant for **smaller companies and individuals** interested in conducting EE/RE renovations in their premises and who may lack the opportunity to negotiate with banks the financing conditions of loans they are interested in contracting.

Indirectly, grants covering **project preparation costs** can also **address insufficient planning and preparation capacity** affecting smaller promoters (e.g., new energy communities) who may lack the human capacities and technical expertise to develop complex energy investments.

Bonds

Bond instruments are relevant in amplifying the sources of medium to long-term capital available to the Services and Prosumer sectors. **Green bonds** in particular are a common type of bond instrument used to raise capital for climate-friendly projects and can be issued by sovereigns, NPBs, commercial banks or corporates directly. By **earmarking their proceeds** towards sustainable projects, green bonds can serve as an important bridge between providers of capital, such as institutional investors, and capital-intensive investments that facilitate the energy transition.

When it comes to the Services and Prosumers sectors which are often characterised by small players (e.g., individual households, small energy service companies), **green bonds do not tend to be a feasible or efficient instrument for such small promoters to raise finance directly** for their investments[127]. Rather, green bonds are primarily a relevant tool for **other larger actors to facilitate the flow of funding** towards energy services and prosumer investments. As discussed in WG meetings, green bonds are one of the instruments that **local authorities** can use to convey resources into energy community projects. Similarly, green bonds issued by **financial institutions** and targeting the financing of RE portfolios can include investment measures by prosumers (e.g., residential PV), thereby **improving access to finance for prosumer projects** under the broader umbrella of RE investments. Lastly, larger RE companies/developers with strong enough balance sheets to issue their own green bonds

[126] See example of Portugal's Vale Eficiencia programme offering vouchers for energy efficiency and renewable energy installations to vulnerable families, or Romania's Action Fund in the field of Sustainable Energy Management, which offers grants for supporting the management of sustainable energy at the level of poor/underdeveloped localities in the country.

[127] As an example of the difficulty faced by smaller players in the energy services market in using green bonds to finance their investments, REScoop recently reported that bonds are hardly accessible to energy communities, as bond issuances generally require higher sums and involve a range of costs and fees.

can also **improve the flow of funding** towards distributed generation projects in the residential or Commercial and Industrial (C&I) segments.[128]

Blended finance

Blended finance instruments are a versatile tool that can support different types of projects by Services and Prosumers with easier access to private finance. Although the mapping did not include a large number of blended finance instruments, such instruments can help **mobilise commercial financing** towards necessary investments in the services and prosumer sectors, whilst **limiting the use of scarce public resources** only to the extent needed to crowd-in enough private finance. Blended finance interventions benefit from the possibility to be tailored to particular sectors and barriers (e.g., equity co-investment facilities providing growth finance to start-ups), making them a **versatile tool** to mobilise private financing towards priority investments in clean energy and types of beneficiaries.

A blended finance instrument is typically developed by a public entity together with one or more private entities, where all entities involved pool their resources; the resources provided by the public entity are usually offered at below-market terms. Contrary to more standard financial instruments in which public resources crowd-in private ones after the launch of the instrument, in blended finance schemes **private and public resources are combined since the creation of the instrument**.

Common types of blended finance include **below-market guarantees** or **concessional debt or equity**. Blended finance is often also combined with technical assistance grants, to provide capacity building and knowledge-sharing to the beneficiary, to strengthen its commercial viability and support in the transaction preparation.

The main investment barriers for private investors addressed by blended finance are (i) high perceived and real risk, and (ii) poor returns for the risk relative to comparable investments. Blended finance aims at creating investable opportunities in developing market sectors, as well as in sectors with under optimal returns to attract sufficient private investments.

Technical Assistance

Technical assistance is relevant for improving the bankability and technical soundness of projects by energy services and prosumers as well as for improving banks' capabilities to finance the sector.

As discussed in WG meetings, **TA related to the Services and Prosumer sectors can be relevant for financial intermediaries and end-users alike**. TA provided to financial intermediaries can be particularly important in connection with guarantees issued by entities such as the EIB, where **intermediaries might lack the specific expertise** in terms of project set-up, development, or preparing the right marketing material to ensure the deployment of funds in their market. TA provided to end-users can support beneficiaries in making the best use of the **right financial instruments** available to the sector and can assist with aspects of project preparation. In relation to the latter, WG members highlighted the potential for TA support to improve end-users' understanding about technical aspects of their projects (e.g., lifetime of components, need for storage systems), the available remuneration framework (e.g., payback periods, how to receive returns) or the possibility/complementarity of further interventions (e.g., coupling insultation with renovation or electrification of the building).

[128] See example of recent green bond issuance by Greenvolt, a Portuguese renewables company with strong presence in the C&I segment, where the proceeds of the bond are aimed at financing RE/EE projects, including in distributed generation and storage (further details in Section 4.2).

Evidence from the mapping

The mapping collected available evidence on the relevance of financial instruments for addressing investment barriers currently affecting projects in the Services and Prosumer sectors[129]. For most instruments mapped, the instrument descriptions and guidelines would typically not refer to the investment barriers targeted. Therefore, for each instrument, its relevance for addressing barriers to investment was established/assessed based on the following sources of information:

- **Instrument type**: The instrument's type (e.g., loan, equity, guarantee) and typical functioning mechanism were taken into account to identify the investment barriers that are most likely to be targeted. To reduce the risk of self-confirmation bias based on the theory of instruments' relevance in addressing barriers, inferences made from the instrument type were contrasted with other sources of information (see following points).
- **General description**: Most instruments in the mapping came with a general description summarising the instrument's main features and eligibilities. Although usually limited in detail, some descriptions were able to provide insight on the investment barriers targeted by the respective schemes. This was mostly in the case of descriptions that explicitly referred to instruments' favourable financing terms, reduced collateral requirements or subordinated position, from which it was possible to infer the instrument's relevance for improving the financing conditions of underlying investments.

- **Instrument-specific characteristics**: In the case of instruments accompanied by more detailed guidelines, their relevance for addressing investment barriers was inferred from instrument-specific features that signalled relevance towards particular barriers. Some examples of such characteristics include:
    - **Targeted beneficiaries**: For instruments explicitly targeting beneficiaries with limited capacity to play a key role in the energy transition e.g., vulnerable households or agricultural holdings, it was generally possible to infer the instrument was promoting greater citizen engagement in local clean energy solutions (e.g., generation and storage).
    - **Targeted technology and innovation level**: For instruments targeting mainly newer technologies and innovative projects it was generally possible to infer instruments' relevance for addressing restrictions in availability of finance, which typically affect less-established technologies and young companies.
    - **Eligible investments and project costs**: For instruments considering project and document preparation costs as eligible expenses covered by the instrument it was generally possible to infer instruments' relevance for supporting promoters' planning and preparation capacities.

However, some methodological caveats should be taken into consideration when reading the results presented below. The information presented in the graphs below should be interpreted as general trends rather than exact matches between instruments and specific barriers. This is because of two main reasons:

(i) **Most instruments do not target only investments in the energy services and prosumer markets**, so the barriers identified as relevant may also be in relation to other segments of the energy value chain and particularly in relation to energy production more broadly (i.e., beyond prosumer investments), as more than 90%

[129] The set of barriers considered are those identified by WG participants as most relevant and presented in Section 2.3

of instruments available to the services and prosumers sectors also finance other types of energy production investments.

(ii) **Most barriers are correlated**, meaning that they are caused by intertwined conditions that might also lead to other barriers. For instance, a new type of business model of energy services might face regulatory barriers such as incomplete definitions of the providers of the associated services, due to such business model not yet being considered in the legislation of certain Member States. At the same time, it might also present high technology risks, such as risks related to the performance of the resource used to facilitate the provision of energy services. Furthermore, the type of investments needed to operate the business model (e.g., high investments in IT software and hardware) might also be subject to worse financing conditions compared to other more mature business models due to inherent performance uncertainties or the perceived regulatory risks. These three barriers all stem from the fact that the business model is based on new types of services and associated technologies but are counted as different as they affect different aspects of the project. This of course poses challenges in the identification of barriers addressed by different instruments, as, from a theoretical perspective, addressing one barrier might also, indirectly and partially, address other barriers.

Financial instruments available for energy services and prosumers target mostly investment barriers related to the availability of finance and financing conditions of investments in the services and prosumer sectors. The results of the mapping confirmed the expected relevance of instruments for these barriers, across all types of instruments considered (see Figure 29 and Table 6 below). **Around 85% of mapped instruments across the main instrument categories (loans, grants, equities, blended finance and guarantees) address restrictions in the availability of finance and more than 50% address restrictions in financing conditions**.

Figure 29: Number of times investment barriers were identified as being "addressed" or "partially addressed" by the mapped financial instruments - by type of barrier

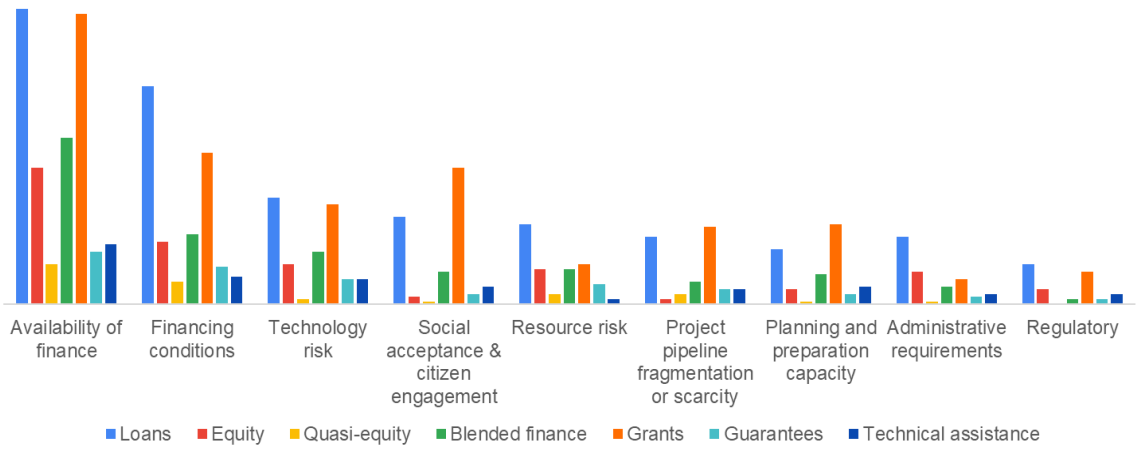


Table 6: Percentage of instruments mapped and identified as "addressing" or "partially addressing" particular barriers

	Availability of finance	Financing conditions	Technology risk	Social acceptance & citizen engagement	Resource risk	Project pipeline fragmentation or scarcity	Planning and preparation capacity	Administrative requirements	Regulatory risk
Loans	90%	67%	33%	27%	24%	20%	17%	20%	12%
Equity	89%	40%	26%	5%	23%	3%	10%	21%	10%
Quasi-equity	89%	50%	11%	6%	22%	22%	6%	6%	0%
Blended finance	92%	38%	29%	18%	19%	12%	16%	10%	3%
Grants	94%	49%	32%	44%	13%	25%	26%	8%	10%
Insurances & Guarantees	66%	47%	31%	13%	25%	19%	13%	9%	6%
Technical assistance	83%	38%	34%	24%	7%	21%	24%	14%	14%

In terms of the other types of barriers, **technology risk is being targeted by several instruments**, with more than 30% of loans, grants, guarantees and TA schemes addressing this barrier. Particularly for TA schemes/tools such as the CliMalta[130] online energy savings and emissions reductions calculation tool, this finding is in line with WG members' observation that TA can be particularly helpful in improving end-users' understanding on the performance of certain technologies. Similarly, the findings support the theoretical predictions that grants can be necessary to support the development of new technologies in energy services – such as in the demand response segment - until these reach sufficient maturity to access private finance.

Limitations in citizen engagement is mainly targeted through grants, but in general financial instruments are not sufficient to address this barrier. The identified examples in the mapping were mainly in relation to schemes with broad eligibilities and encouraging citizen participation in the energy transition, e.g., through RE renovations with the possibility to complement with energy storage installations in residences, commercial or public sector buildings. This finding is in line with theoretical predictions that grants can incentivise investments outside the household/company's usual business needs by improving the economic incentives for such energy investments. However, in parallel to financial incentives, improving the general public's understanding of concrete investments accessible to citizens (e.g., deployment of smart meters, local RE and energy storage solutions) is also important to

[130] The Climalta online tool estimates energy savings and emissions reductions for investments planned or executed by households or enterprises in Malta

ensure end-users are aware of the opportunities to participate in the energy services market – awareness and information campaigns[131] can be a powerful tool in this regard to demystify energy services and new technologies to non-technical audiences.

Resource risk also found some relevance in the mapping, particularly from loans and guarantees targeting this barrier. While loans can provide energy service companies and prosumers with necessary funds to buy resources equipment for the installation of RE systems, financial instruments are an insufficient tool to tackle this barrier effectively. Addressing shortages in key materials like semiconductors or microchips needed to provide energy services to a digitalised grid will require a more holistic policy response at EU level, where better access to finance for strategic supply chain projects is likely to be one of several measures needed to build more resilient supply chains[132].

As expected, financial instruments were not found relevant for addressing regulatory barriers or those related to lengthy administrative requirements. Regulatory barriers such as the need for competitive revenue streams that will properly monetise different energy services cannot effectively or efficiently be addressed through financial schemes, as they require policy and/or legislative changes to the framework governing the sector. Similarly, responding to the risks of long permitting procedures for RE projects which can disincentivize investments by energy communities will require more targeted interventions at key bottlenecks of the legal and permitting process, such as improving human capacities at the responsible public administrations.

The findings indicate there is further need for (i) instruments that at design level facilitate the aggregation of small projects and (ii) instruments combining technical assistance support with financial support. Barriers related to **project pipeline fragmentation**, and to **planning and preparation capacity** were identified as being only modestly addressed by the mapped instruments. Recent studies have also highlighted the need for aggregation of small-scale RE projects[133] and for enhanced technical assistance to end-users such as local authorities, particularly when it comes to understanding and using available resources for decarbonising their building stock[134]. **The small size of projects in the services and prosumer markets is something that could be better targeted through new or revised financial support schemes.** This would be addressed not through the provision of financing per se, but rather through instruments' design and capacity to aggregate small projects under common eligibilities, allowing private investors to co-finance such schemes with meaningful ticket sizes. TA could be targeted to small companies, local authorities, or energy communities interested in providing energy services or producing their own energy and for which practical business and legal support could be particularly beneficial[135].

4.2. Evidence on the effectiveness of financial instruments – Findings from the mapping

Effectiveness of a financial support scheme can be defined as the instrument's capacity to achieve its objectives and targets, intended as addressing barriers and market failures,

[131] See example of EASE's recent social media campaign #EnergyStorageMadeEasy which successfully reached new audiences

[132] Critical_Raw_Materials_Act__securing_the_new_gas_oil_at_the_heart_of_our_economy_I_Blog_of_Commissioner_Thierry_Breton.pdf

[133] Combination of financial instruments and grants, fi-compass Factsheet, May 2021

[134] Technical assistance: Local authorities needs and upcoming policy, BuildUpon, November 2021

[135] See example of the European Energy Efficiency Fund TA facility which supports public beneficiaries to develop bankable EE and small-scale RE projects, or two recent initiatives by the European Commission providing TA to energy communities – the Energy Communities Repository and the Rural Energy Community Advisory Hub

make a project bankable, mobilising additional financing, and contributing to the achievement of energy and climate objectives.

However, this type of assessment can be done only once the scheme has been fully deployed and when the projects that have received financing are completed. Since the mapping exercise covered only ongoing and recently closed financial schemes, only in very few cases was there an available analysis on an instrument's effectiveness so far. Quantitative and qualitative metrics on the deployment and impacts of the schemes are not yet available. Data on resources disbursed, financing crowded-in, GW of new capacity installed, and jobs created will likely be public only once mid-term and ex-post evaluations are conducted. This is not the case for the large majority of instruments mapped.

Given these limitations in data availability, the analysis of effectiveness has been structured around the factors supporting effectiveness, that is the characteristics and features that a financial support scheme can have that are functional to its effectiveness. These factors were defined based on consultations with WG members and other stakeholders from different Member States. **The three main factors identified as key for effectiveness are: broad and flexible scope of application, long-term stability and visibility, and accessibility**, intended as having an easy, periodic, and rapid application process. Based on the findings from the mapping, it was possible to assess to what extent some of these factors are present in existing financial support schemes and provide examples of effectiveness in addressing barriers to investment and in mobilising additional financing.

Enabling factors for instruments' effectiveness

Broad and flexible scope

A technology neutral and sector agnostic instrument profile was pointed as important to support the effectiveness of instruments. WG Members highlighted that a broad and flexible scope, understood as an instrument's capacity to finance different types of technologies, sectors, projects, and projects sizes are important for the instrument's effectiveness. Technological and sector neutrality help simplify a financial instrument and broaden its scope and eligibilities for underlying projects and final recipients. As such, simpler specifications can support instrument roll-out in broad sectors like the energy services and prosumer markets, by facilitating the integrated deployment of multiple technologies accessible to end-users (e.g., PV, batteries, EV) or by enabling combinations of interventions (e.g., RE and EE refurbishments) under the same project.

Long-term stability and visibility

The stability of the instrument over long-term, intended as both the regular provision of financing, and the lack of unforeseen changes occurring during the instrument's lifetime helps creating trust among investors, thus incentivising them to invest. Sudden and unforeseen changes would negatively affect investors' trust and confidence in the instrument, reducing their engagement with it.

Furthermore, the process of formulating, developing and structuring a project is long and complex, and requires **project promoters to have knowledge of call topics years in advance and of the long-term conditions on which the project would be implemented**, so as to adequately plan their business and financial models. Even small changes in application requirements, eligibility criteria, or instrument functioning can derail the project preparation.

Long-term stability and visibility can, however, only be assessed in the long-term, i.e., if a policy or regulation does not change for several years in a row. Since the mapping covered ongoing and new instruments, it was not able to capture this aspect. Nonetheless, this feature should be taken into consideration for the

development of future new financial support schemes, as pointed out in various WG discussions covering different energy segments.

Easy, periodic, and rapid application process (Accessibility)

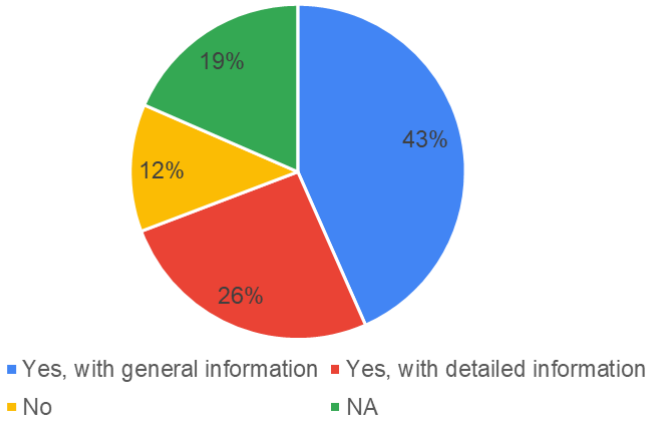
A key element of an instrument's effectiveness is the ability of a potential project promoter to apply for it easily, understood as an **instrument's accessibility**. This was confirmed by multiple discussions with WG Members. Regardless of the scope, financing conditions, and type of financing provided, the instrument will not be able to achieve its objectives and contribute to the decarbonisation of the energy sector if potential project promoters are not interested in applying to it, or do not qualify for financing because they submitted an incomplete or wrong application.

A potential project promoter would apply to get financing from a financial instrument only if the effort required to submit such an application is acceptable in relation to the amount of financing to be received, and the likelihood of success. For each individual project promoter and project there is going to be a "breakeven" point from which the amount and/or type of financing to be received is not worth the effort necessary to comply with the application requirements. Indeed, application processes with too many requirements or instruments with burdensome monitoring and reporting requirements will likely be perceived as less interesting from potential project promoters. This risk is even more relevant for small promoters within the services ad prosumer sectors - e.g., schools, households, hospitals, small industrials - as they often rely on a smaller pool of personnel, often without dedicated expertise in applying for different types of financing, to take care of all the administrative elements of applying and complying with the requirements of a financial instrument. In this context, an instrument's accessibility is assessed against four criteria: the availability of an application manual, the application periodicity, the length of the application in terms of number of pages that needs to be submitted in the application, and the possibility to contact the implementing authority to ask questions and clarifications.

Out of the 326 financial support schemes mapped as available for energy services and prosumers, most of them (225 or 69%) have an application manual for potential applicants. Of these, 84 instruments (26%) have an application manual with detailed information on the application process and requirements, and 141 (43%) have an application manual with more general information on the process, but without going into details on the different steps required. Finally, 40 instruments (12%) are not accompanied by an application manual whereas for 19% of instruments mapped it was not possible to verify whether they have a supporting manual or not.

While the availability of an application manual is not a guarantee of effectiveness, it does nonetheless contribute to reducing errors in applications and helps making the application process clearer and easier to follow. The availability of a supporting manual (even if providing only general information) for the majority of instruments in the mapping targeting energy services and prosumers is therefore a positive aspect improving instruments' likelihood of being effective. Application manuals often also include more details on the instrument's focus and investment strategy, which helps potential beneficiaries understand the instrument's ambition and rationale and establish whether their project is a good fit to the investments targeted. As mentioned above, the manual does not affect the effectiveness of the instrument per se, but it rather reduces the possibilities that smaller promoters (often

Figure 30: Share of instruments with and without an application manual

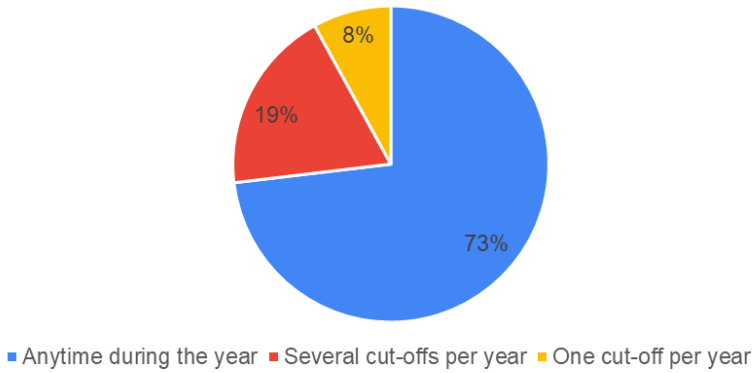


without dedicated staff for these administrative processes) do not receive financing because of administrative or bureaucratic mistakes made during the application process.

The second factor analysed when it comes to accessibility is the **periodicity of the application window**. The assumption made is that instruments for which promoters can apply at any given moment in time (i.e., on a rolling basis) are more accessible to ones with specific cut-off windows or annual deadlines. This is because projects follow timelines that are not always aligned with an application's timeframes. As a result, promoters might no longer be eligible to apply to an instrument by the time their project is ready to seek financing, which would negatively impact the absorption of the instrument concerned and, consequently, its effectiveness.

Among the mapped instruments with information on their application timeframes[136], **the large majority - 73% - accept applications throughout the whole year** (see Figure 31 below).

Figure 31: Instruments targeting energy services and prosumers, by their application windows



This should be interpreted as a **positive fact in terms of accessibility**, as project promoters can prepare their applications without specific concerns and restrictions in terms of timing. For 19% of instruments there are several application windows per year, but it is not possible to apply anytime, whereas for 8% of instruments there is only one application window per year[137].

The third element analysed in terms of accessibility is the **length of applications**, measured in number of pages of documentation, in paper or digital format, that an applicant has to submit to comply with the instrument's requirements. Like for the previous two elements analysed in this section, the length of an application is not a synonym of the effectiveness of an instrument. However, **shorter applications can be generally linked to fewer administrative and**

[136] Data on application timeframes was available for 212 instruments targeting energy services and prosumers.

[137] It should be noted that application windows might differ significantly in terms of duration. This difference is not reflected in the mapping and, consequently, in this analysis.

bureaucratic requirements, as less documents, extracts or certificates need to be sourced by interested applicants. This would thus make the application process easier and faster for promoters, reducing the chances that the applicant gives up on applying due to excessive documentation requirements.

The mapping was able to collect information on the typical length of applications for only 74 instruments available for energy services and prosumers (i.e., less than 25% of instruments concerned). This is not surprising, as applications are usually not made available to the public and is thus difficult to obtain information on their length. Out of the 74 instruments, the large majority (61) usually require applications up to 30 pages-long, whereas the remaining instruments generally require between 30-100 pages of application. Although for most instruments it was not possible to verify the typical length of their applications, it is still **encouraging to see that among instruments with publicly available application forms, shorter/mid-length applications are more common than lengthy forms.**

Finally, the last element considered under the accessibility analysis is the **possibility to contact the implementing entity** to ask questions and clarifications. Ideally, there should be the possibility to interact with the implementing entity deploying the instrument before submitting an application. This is considered important as different promoters might face very different situations and have different questions, which might not all be clearly addressed in the instrument's website or application manual. The ability to confirm financial eligibility questions in particular would be helpful for promoters who are unsure if they can combine the instrument with other forms of financial support and would also be timesaving for implementing entities who would avoid receiving applications incompatible with the instrument's rules. Information on whether it is possible to contact the implementing entity was found only for 58 instruments available for energy services and prosumers. As with the case of the length of application forms, despite the limited information on these aspects of financial instruments, it remains **encouraging to see that most instruments (56 or 97%) offered promoters the option to clarify questions with the implementing entity.**

It was possible to identify two instruments having all the "ideal" characteristics from the accessibility point of view[138], by doing a cross analysis of all the financial support schemes available for energy services and prosumers. These instruments come with an application manual with detailed information, offer the possibility to contact the implementing authority with questions and inquiries, have on average applications below 30 pages, and it is possible to apply to them anytime during the year. Both instruments are loans in Croatia funded by NRRP resources and implemented by the Croatian Bank for Reconstruction and Development. While both instruments are available to the services and prosumer sectors, none of them targets households – one of them targets only public sector entities for energy improvements in public sector buildings, whereas the second instrument targets micro enterprises and SMEs.

All the other instruments mapped are characterised by different combinations of these features (e.g., short applications but only one cut-off per year, etc.). While this does not mean that those instruments are less effective than the two mentioned above, from a beneficiary perspective they represent a bigger effort to apply to. As such and to the extent possible, **they**

[138] This does not mean that these are the only instruments having these characteristics, but rather that these are the only instruments for which it was possible to map these characteristics.

could benefit from further simplifications and/or provision of support to potential applicants as part of their application procedures.

The **visibility of available instruments** was also pointed out by WG Members as a challenge to instruments' accessibility and, therefore, effectiveness. While this point was raised in the context of WG discussions on energy production (WG1), it was considered as a relevant factor for instruments targeting services and prosumers as well, as most instruments for services and prosumers are also available for energy generation activities more broadly. WG Members noted that the number of financial support schemes in some countries make it difficult for project promoters and investors to have complete visibility on the options available to support investments. On this matter, **one-stop-shops** at national level were valued positively as a possible solution to the fragmentation and low visibility that financial support scheme can have.

Examples of effectiveness

Effectiveness in addressing barriers: evidence from the mapping and case studies

The mapping identified a number of financial support schemes with evidence on their effectiveness in addressing barriers, summarized in the table below. As the mapping concentrated on ongoing instruments for which there are no formal evaluations yet, evidence was primarily collected from available news and press releases reporting on instruments' results and impacts achieved so far, as well as feedback from stakeholders consulted in the process of data collection and the views of WG Members shared in the context of the Investors Dialogue on Energy.

Grant schemes found to be effective have attracted a high number of applications and supported many projects. This suggests the schemes are effective in **improving access to finance for target beneficiaries** and in **strengthening the economic incentives** for small-scale RE investments involving self-consumption. Examples include Spain's CE Implementa, a scheme for pilot projects of energy communities that already selected 45 projects for grant financing as of June 2022[139] and Luxembourg's PRIMe House initiative which provided €11 M of subsidies to more than 200 energy renovation and construction projects in a period of nine months. These examples also show the role grants can play in raising awareness and **stimulating greater citizen engagement** for local energy projects.

In relation to **loan instruments**, EIB's recent loan to Italian Energy Service Company Snam is an example of an instrument **improving access to finance and financing conditions** for small-scale energy service investments. The loan supports a pipeline of energy efficiency projects in Italy, mainly in residential buildings and industrial facilities. It has been structured as a framework loan, which can be used in **several tranches over a period of three years**. The additional flexibility foreseen in the loans' disbursement mechanics has been **designed to support a wide pipeline of small to medium sized projects**, while it also facilitates the involvement of EIB in financing EE measures in individual buildings. In addition, each tranche has a maximum tenor of 15 years, **improving the financing conditions of underlying projects** by offering a maturity beyond the tenor usually offered by commercial banks. The loan's effectiveness can be seen through its **high expected additionality and crowd-in effect**, as the Bank's long-term tenor is perceived by the market as a confirmation of the project's soundness and the long-term financial reliability of the borrower[140].

[139] The results achieved by the programme as of June 2022 exceed the implementing entity's initial target of selecting 40 projects.

[140] Expected additionality and crowd-in effect as communicated by EIB

In relation to **equity instruments**, the mapping identified two schemes with evidence of targeting barriers across the services and prosumers sectors:

- Italy's IEFF II equity scheme specializes in **energy efficiency and small-scale RE projects** and has been effective in **amplifying the available sources of capital** for sectors that have traditionally struggled to attract investment. The scheme's effectiveness can be seen through the Fund's raising of around €130 million at first close, above the initial target of €100 million. Supported by the EIB, the Fund has successfully mobilised capital from institutional investors and family offices for investments in the residential, energy community and heating & cooling sectors.
- The Solas Sustainable Energy Fund (SSEF) provides debt financing to ESCOs to carry out energy efficiency and small renewable energy projects, mainly in the EU. SSEF is classified as Article 9 or "Dark Green", the highest classification under the EU's Sustainable Finance Disclosure Regulation. Similar to Italy's IEFF equity programme, SSEF has been effective in **improving access to finance** for types of ESCOs – e.g., smaller providers implementing small-scale EE & RE projects – for whom access to debt remains a barrier to investment. The scheme's effectiveness can be seen through the Fund's raising of EUR 220m at final close, above the target of EUR 200m[141], as well as from the Fund's successful lending in recent months to ESCOs in Ireland and Germany for lightning retrofit and other EE investments[142].

Effective bond instruments identified through desk research include recent green bond issuances by Portugal's Greenvolt and Sweden's Recap Energy, two renewable companies with strong presence in the C&I prosumer markets in Portugal and Spain respectively. In both cases, the bonds were effective in **improving the diversification of available capital** for distributed generation investments – either in a targeted way as in the case of Recap's issuance focused exclusively on C&I projects, or as part of an issuance with broader eligibilities, as in the case of Greenvolt. The instruments' effectiveness can be seen through the **positive response seen from the market** (Greenvolt's issuance was met with demand far exceeding supply as per the company's FY22 Report), as well as from the **innovative nature of the issuance itself** (Recap is one of the first developers in Europe to finance a large C&I portfolio through the bond market).

Instrument name	Instrument type	Instrument description	Country	Barriers addressed	Evidence of Effectiveness
Programa CE-IMPLEMENTA	Grant	Grant scheme to support pilot projects of energy communities.	Spain	Availability of finance for energy communities Limitations in citizen engagement	Number of applications received and projects selected as of June 2022, compared to initial estimates by implementing entity.
PRIMe House Initiative	Grant	Grant scheme for residential energy renovations	Luxembourg	Lack of sufficiently strong incentives for residential RE investments	Volume of financing and number of subsidies granted during the first nine months of the programme
SNAM climate action framework loan	Loan	Framework loan to support a pipeline of small to medium size energy efficiency projects, mainly in residential buildings	Italy	Availability of long-term finance at advantageous conditions for energy services Availability of aggregating mechanisms for	High expected additionality and impact of the financing for the borrower and sub-projects concerned

[141] Besides EIB, SSEF has secured equity commitments from other institutional investors including the Ireland Strategic Investment Fund and MEAG, the asset manager of the Munich Re Group.

[142] Source: Smart energy international

Instrument name	Instrument type	Instrument description	Country	Barriers addressed	Evidence of Effectiveness
				small-scale EE projects	
Solas Sustainable Energy Fund (SSEF)	Equity / Loan	Equity investment by EIB into SSEF, a debt fund focused on financing projects by ESCOs	EU-wide	Availability of dedicated financing solutions for ESCOs	Fund secured commitments 1.1 times above target; Successful execution of inaugural investments
IEEF II – Italian Energy Efficiency Fund II	Equity	Closed-end alternative investment fund focused on energy transition projects.	Italy	Availability of equity financing for small RE projects	Fund achieved first close in Aug 2020 1.3 times above the initial minimum target.
Greenvolt Nov' 2022 green bond issuance	Green bond	5-year green bond whose proceeds are allocated to finance/refinance eligible projects under the company's Green Bond Framework	Portugal	Availability of medium/long-term finance for RE and EE projects, including in the prosumer segment	Size of the demand expressed by the market
Recap Energy Feb' 2023 green bond issuance	Green bond	EUR 9m green bond to refinance the company's solar C&I portfolio in Spain	Spain	Access to debt capital markets for C&I portfolios	Response of market to bond issuance; Pioneering type of issuance in the C&I market segment

Further insight on the role financial instruments can play in addressing investment barriers for projects in the services and prosumer sectors can be gained from two additional case studies identified through desk research and shown below. The first scheme concerns the European Energy Efficiency Fund Technical Assistance facility, which supports public entities in developing energy investment plans. The second scheme concerns the deployment of EIB's PF4EE portfolio guarantee instrument in Belgium.

Box 4: Case study on the European Energy Efficiency Fund Technical Assistance facility

The European Energy Efficiency Fund (eeef) TA facility supports **public beneficiaries[143] in developing bankable sustainable energy investment programmes**. These projects relate to the energy efficiency sector, small-scale renewable energy and/or public urban transport. The eeef TA Facility aims to bridge the gap between sustainable energy plans and real investments through supporting all activities necessary to prepare investments in sustainable energy projects.

Eeef supports TA beneficiaries[144] by way of allocating consultant services to the planned investment programmes, for example for feasibility studies, energy audits and evaluating the

[143] Eligible beneficiaries include Regions, City Councils, Universities, public hospitals and other public entities located in EU Member States.

[144] To benefit from non-reimbursable TA support, beneficiaries must also eventually be financed by the European Energy Efficiency Fund (eeef) following the implementation of the TA. The eeef is a public-private partnership open to investments from institutional and other professional investors; it is backed by the European Commission, EIB and CDP, among other investors.

economic viability of investments. It also covers **direct staff costs** of the TA beneficiaries and **external legal service** costs required.

The first call for proposals for the eeef TA Facility was successfully closed on 1 March 2017. Looking forward, **the eeef's TA Facility remains open, with no deadline,** to receive further TA project proposals on a first come, first served basis, subject to availability of funds and the eeef's interest in the proposed sector/technology.

Applicants are provided with a **brief form** detailing what their proposals need to cover, while the **TA contract template** is also available online, providing applicants with good visibility on the contractual arrangements they can expect if they wish to collaborate with the eeef. In addition, the **evaluation criteria** for awarding TA support are publicly available on the programmes' website, strengthening the **transparency** associated with the programme's selection process. Lastly, the **estimated timelines** of the selection process are also disclosed – candidates are informed they can expect an award/rejection notice within 20 days from project submission and a contractual signature 15 days following the award notice. helping applicants to **factor a potential TA support more concretely into their overall investment plans.**

To date, the eeef has approved **eight public authorities** to develop their sustainable project plans. Among the projects supported with technical and legal advice is the Spanish Municipality of Gijon's ambitious sustainability plan, which involved the **completion of energy audits** on public buildings and street lighting points, the identification of an appropriate set of EE and RE interventions and the **selection of an ESCO company** to carry out the measures.

Source: eeef TA facility website

The example from the eeef TA facility shows how a broad scope and good accessibility features can support a TA scheme in reaching its objectives. The scheme's broad scope is evidenced from the **range of interventions** it offers TA support for (including EE, small-scale RE and urban transport) as well the **range of eligible costs** that can be covered by the TA support, including staff and legal costs. The programme's easy accessibility to beneficiaries is evidenced from the **high degree of information and transparency** offered to potential applicants, which helps beneficiaries **factor the potential TA support more concretely into their investment plans.** The scheme's effectiveness can be seen through the **good number of projects supported to date**, as well as from the **sizeable population** reached through the TA facility activities, estimated at more than 1.5m individuals on an annual basis[145].

The second case study is a good example of how a financial instrument that has **good visibility in the market,** and which is **complemented by technical assistance** can be effective in crowding in commercial financing for ESCO projects. In an interview with EIB, a representative from Belfius Bank in Belgium highlighted the importance of **presenting Belfius' EIB-backed product intensely in the market,** including in events such as 'ESCO-speed-dating', which effectively granted the instrument **good visibility among relevant stakeholders** and supported the bank's pipeline development efforts. Similarly, the example of PF4EE deployment in Belgium shows the role that **TA and one-stop-shop solutions** can play in **supporting the deployment of financial instruments** in complex markets, by helping promoters throughout the process of energy efficiency investment and improving their

[145] Source: eeef Impact Report 2021

readiness to absorb instrument funds[146]. Overall, the evidence suggests the PF4EE portfolio guarantee instrument has been effective in **addressing restrictions in affordable finance** for ESCO projects in Belgium. This can be seen through the **high number of projects supported to date,** including several **flagship initiatives** that served to further develop the EPC market in Belgium[147].

Box 5: Case study on PF4EE - Belfius Energy Efficiency Package

To address the **limited access to adequate and affordable financing for energy efficiency investments**, the European Investment Bank and the European Commission have jointly developed the **Private Finance for Energy Efficiency (PF4EE) instrument**. PF4EE operates through private and public sector partner banks that use the instrument to offer preferential energy efficiency financing in their national markets.

Each PF4EE partner bank benefits from a **portfolio guarantee** (with 80% coverage of losses from individual loans, up to a maximum agreed amount) and an **expert support facility**, which provides consultancy services to improve partner banks' understanding of the energy efficiency market, to support them in the development of loan pipelines, and to ease the appraisal of PF4EE financing requests.

Belfius bank in Belgium joined the PF4EE instrument in 2017 and since then deploys it through the **Belfius Energy Efficiency Package** (BEEP), a new loan product to finance energy efficiency.

BEEP is intended to directly finance **energy efficiency projects of enterprises as well as social profit and education institutions**. Further, **indirect financing**, **channelled through energy service companies** (ESCOs) and third investors, is provided to public energy efficiency projects. The main target sectors of the BEEP product include cogeneration, public lighting, district heating and renewable energy projects related to existing buildings.

Thanks to the PF4EE instrument's portfolio guarantee, **Belfius has successfully developed financing for EPC-projects** (Energy Performance Contracting) in education, social housing and the public sector. Further, several third investor projects relating to photovoltaic installations, co-generation and district heating have been realised. As per June 2022, **more than 80 projects** for total project cost of about EUR 85 million were realised through the PF4EE product BEEP.

To foster energy efficiency loan pipeline development, **Belfius conducted several targeted activities**. For example, Belfius established an **extensive network with stakeholders** from the energy efficiency market and discussed energy efficiency financing in numerous forums across Belgium. Belfius also cooperates with different partners to build **one-stop solutions for customers**, including partners such as ESCOs, engineering companies, EPC facilitators, energy cooperatives, and crowd-lending companies.

[146] As an example of TA support offered by Belfius Bank, the bank partially reimburses energy audits, provided that the investment is financed via Belfius. Belfius also provides tailor-made advice around ESCO financing and EPC contract development. Source: ESCO financing: A Success Story from Belgium (EIB, 2019)

[147] Examples include one of the biggest Energy Performance Contracts in Belgium, where Belfius Bank provided EUR 5m to finance energy efficiency measures related to heating, insulation, and photovoltaics in more than 40 rest homes of a large healthcare group in Flanders.

With the support of the PF4EE instrument, Belfius was able to set up a **permanent green lending office**, integrate green lending in the sustainability strategy, **increase the internal know-how on energy efficiency** and identify and develop integrated solutions for Belfius' customers.

Source: EIB PF4EE website

Effectiveness in mobilising private finance

An important element of an instrument's effectiveness is its multiplier effect, that is the instrument's capacity to attract additional private financing compared to the instrument's initial public budget, and channel funds to the targeted projects. By crowding in and unlocking private financing, financial instruments aim to **increase the overall capital available** to achieve EU policy goals more efficiently[148].

Because an instrument's multiplier is usually only calculated as part of evaluations conducted at the end of the instrument's life, the mapping was able to provide very limited information on the achieved multiplier effects for instruments available to the services and prosumer sectors. Information on the current multiplier effect was available for only one loan instrument launched in 2021 and implemented by the Croatian Bank for Reconstruction and Development (HBOR). This instrument targets investments by micro, small and medium-sized private sector businesses under three broad categories (green transition, digital transition, and competitiveness and resilience) and has achieved a current multiplier effect of 1.18x[149]. This result is somewhat lower than the leverage or multiplier effect achieved by previous loan instruments implemented under ERDF/CF (leverage of 1.3x)[150] or EIB's Covid 19 MBIL programme loan (multiplier of 1.9x)[151].

For what concerns the **target multiplier** of instruments in the sample available for energy services and prosumers, **loan instruments show on average a target multiplier that is slightly higher than the median leverage achieved by ERDF/CF loan instruments** in recent years. Loans in the mapping show an average target multiplier of 1.7x compared to a median leverage of 1.3x achieved by ERDF/CF loans until 2020. This could signal a good potential for current active loan schemes to mobilise private capital for services and prosumers. Alternatively, results could also be influenced by the fact that many instruments in the mapping were developed during or right after the pandemic, which was characterised by increased bank lending to businesses[152] and a successful avoidance of a credit crunch. These observations may have positively influenced the expected crowd-in potential of new loan instruments in the energy sector. In relation to guarantees, **mapped guarantee schemes available to the services and prosumer sectors show lower target multipliers to those achieved by ERDF/CF guarantees in recent years** – 1.75x in case of mapped instruments (average multiplier across 9 schemes) compared to a median leverage of 4.8x based on 87 ERDF/CF guarantee instruments. In addition to differences coming from multiplier and

[148] In addition to the multiplier effect, impact indicators (e.g., tons of CO2 avoided, jobs created) are also important to assess the effectiveness of financial instruments. This section focuses exclusively on the multiplier effect as the mapping did not provide information on the impact generated by ongoing financial schemes.

[149] It was not possible to verify the calculation of the multiplier.

[150] European Commission (2021): *Financial instruments under the European Structural and Investment Funds – Summaries of the data on the progress made in financing and implementing the financial instruments for the programming period 2014-2020.* The median leverage of 1.3x was calculated as at 31 December 2020 and is based on an underlying sample of 451 instruments.

[151] *Rapid assessment of the EIB Group's operational response to the COVID-19 crisis* (2021). It should be noted that the comparison with HBOR's instrument does not focus on the instruments being energy-specific but rather being of the same type (loan instruments). In addition, as calculation methods on the multiplier and leverage vary across the literature, it is not possible to verify that HBOR's instrument and the examples identified above follow the same multiplier or leverage calculation methodology.

[152] At the euro area level, outstanding loans to the non-financial private sector stood at €12.6 trillion before the pandemic crisis, and they increased by approximately 7% by the end of 2021 (European Stability Mechanism, 2022).

leverage calculation methodologies[153], this could signal some remaining constraints in the current use of guarantees to mobilise large volumes of private capital for small-scale energy projects.

Summary of findings on instruments relevance and effectiveness

- **Evidence from the mapping on the relevance of financial instruments for addressing investment barriers** affecting energy services and prosumers projects indicates that**:**
    1. **Financial instruments for services and prosumers investments are primarily relevant for targeting investment barriers related to the availability of finance, financing conditions and market risk**.
    2. **Financial instruments are not relevant for addressing regulatory barriers or those related to administrative requirements**. A similar situation can be said to apply to the barriers related to **resource risks**, which are caused by elements outside the financial market landscape, despite affecting it.
    3. **The mapping seems to suggest that there is further need for schemes combining the provision of finance with technical assistance support.** This should support in further tackling barriers related to the execution of complex energy projects and to limitations in promoters' **planning and preparation capacity.**
- **Examples of mapped instruments found to be effective in addressing barriers include grants and tax rebates, EIB direct loans, equity schemes, and bonds**[154] **in a number of EU Member States.** In general, evidence of the schemes' effectiveness could be seen from their **well-tailored features** for addressing the inherent risks of energy services and prosumers investments and from the direct interest **shown by the target beneficiaries or investors** in the different schemes. More specifically, and considering the different types of instruments mapped:
    1. For grant schemes, evidence of their effectiveness in improving availability of finance and the economic incentives for target recipients was seen mostly through a **high number of applications**[155] **and a high number of projects supported** under such schemes.
    2. In the case of EIB's framework loan to Italy's Snam, the provision of financing in **several tranches over a period of three years** adds an additional flexibility in the loans' disbursement mechanics which seems to be particularly positive to **support a wide pipeline of small to medium sized projects**.
    3. For equity schemes, evidence of their effectiveness in improving the availability of equity financing for energy projects was seen through the schemes' **successful fundraising and inaugural investment activities,** which surpassed the initial fundraising targets, showing strong interest from investors.
    4. In the case of convertible bond issuances, evidence of their effectiveness in amplifying medium/long-term finance and institutional capital for energy

[153] In most cases, the mapping considered the target multiplier as the ratio of target *private* finance attracted based on the amount of public financing. On the other hand, the achieved leverage effect for ERDF/CF instruments considered the *total* amount of finance reaching final recipients divided by the public (ESIF) support. As a result, target multipliers in the mapping are likely to have lower values compared to achieved leverage figures.

[154] As referred in Section 4.2., bond instruments were identified through separate desk research and are not included in the mapping.

[155] While the number of applications alone is not sufficient to define the effectiveness of a grant, it is nonetheless essential to define its uptake, attractiveness and visibility in the market, which are key elements of effectiveness.

projects was seen through **strong and diverse investor demand for the issued bonds.**

- **The mapping provided limited information on the multiplier effect (current or target) of currently active financial instruments.** Loan instruments from the mapping show on average a target multiplier that is slightly higher than comparisons from the literature, which could signal a good potential for current active loan schemes to mobilise private capital for energy projects, although not exclusively for energy services investments. The mapped equity scheme with information on its target multiplier showed slightly lower results than examples from the literature, while guarantee schemes showed the highest deviation (i.e., lower target multiplier results) compared to examples from the literature. In addition to differences coming from multiplier and leverage calculation methodologies, this could signal some constraints in the current use of guarantees to mobilise large volumes of capital for energy projects, or that guarantee schemes for energy are designed for riskier projects which may struggle to attract high levels of investor appetite.

5. Level of maturity of EU clean energy finance markets

This section analyses the level of maturity of clean energy finance market of EU Member States. The aim is to assess to what extent each State has an energy finance market and overall enabling environment that is fit for delivering the ambitious goals of the EU energy transition agenda. The section is organised as follows:

- Section 5.1 provides an overview of the approach adopted to assess clean energy finance maturity
- Section 5.2 shows the analysis that has been performed to assess the maturity of each Member State

5.1. Approach to assessing market maturity

Financial markets and regulatory systems that are able to efficiently allocate capital to clean energy projects and offer appropriate risk-adjusted returns, are a necessary precondition for clean energy finance mobilisation. Financing the energy transition will also require a large-scale mobilization of private capital, and an enhanced role for international and public finance institutions[156]. This means that the public sector and the private financial sector must be able to jointly provide financing that is (i) adequate in terms of volume (ii) with appropriate and relatively cheap[157] terms and (iii) diversified and covering a broad range of market readiness levels, needs and target beneficiaries/clients.

With these considerations in mind, we have developed a framework to assess the maturity of clean energy finance markets, based on three dimensions. The table below summarises the framework, as well as which indicators and metrics we have selected to assess the three dimensions.

Table 7: Characteristics of mature clean energy finance markets, and how our analysis will assess them

Market maturity characteristics	**Description** *Why we have chosen this characteristic*	**Key metric/indicators** *How we will measure it*
Abundant supply of energy finance, primarily from the private sector, with the public sector intervening	• The deployment of energy services technologies and solutions to mitigate carbon emissions typically requires high upfront investment[158,159] • Best (2017)[160] finds that across countries, the availability of financial capital contributes to investments in more capital-intensive energy technologies. For high-income countries, financial capital	To evaluate the supply of finance, we will use the following indicators: • The availability of private finance in each Member State, measured through: o Banking debt of corporates o Stock market capitalisation

[156] IEA (2021), *Financing clean energy transitions in emerging and developing economies*, available on link

[157] Relatively to specific risk-return conditions and the macroeconomic landscape

[158] Steckel JC, Jakob M, Flachsland C et al (2017) From climate finance toward sustainable development finance. Wiley Interdiscip Rev Clim Chang 8:e437. https://doi.org/10.1002/wcc.437

[159] Tietjen O, Pahle M, Fuss S (2016) Investment risks in power generation: a comparison of fossil fuel and renewable energy dominated markets. Energy Econ 58:174–185. https://doi.org/10.1016/j.eneco.2016.07.005

[160] Best R (2017) Switching towards coal or renewable energy? The effects of financial capital on energy transitions. Energy Econ 63:75–83. https://doi.org/10.1016/j.eneco.2017.01.019

Market maturity characteristics	Description *Why we have chosen this characteristic*	Key metric/indicators *How we will measure it*
 **in underserved markets**	supports transitions towards more capital-intensive energy technologies such as wind energy. • In terms for sources of funding, while it is clear that both public and private clean energy financing is needed, both should play very different roles in financing the energy transition. Public sector financing should be directed to underserved markets, emerging technologies, addressing market failures and investing in riskier areas. Private sector finance, on the other hand, should be able to provide the supply of debt and equity finance needed in the market, covering a wide range of levels of technology maturity with a diverse offer of instruments	o Green bond market • The availability of public finance to finance services and prosumers investments in each Member State.
 **Low cost of capital - WACC**	• The weighted average cost of capital (WACC)[161] is one of the most important financial variables for low-carbon infrastructure, given their capital-intensive nature and high upfront costs (Dukan et al., 2019)[162]. • The WACC incorporates the level of interest rates and several country risks, such as regulatory, economic, political and legal. Furthermore, WACC can also reflect technological advancements and increased experience in the energy financing sector, signalling a high level of maturity. • For these reasons, low values of WACC signal mature energy finance markets and a low country risk.	To evaluate the cost of capital, we have calculated the WACC for renewable energy projects in each Member State.
Presence of a diverse set of financial instruments, including the use	• Renewable energy projects are financed mainly with project-level conventional (i.e., non-concessional) debt, which accounted for 32% of the total RE	Comprehensive data on the instruments used for investments in renewable energy is not available. To evaluate the diversity and comprehensiveness of financial

[161] The formula to calculate the WACC is presented below:

$$WACC = \frac{D}{D+E} * Cd * (1-t) + \frac{E}{D+E} * Ce$$

- *D* is the market value of a firm's debt
- *E* is the market value of a firm's equity
- *Cd* is the cost of debt
- *t* is the corporate tax rate
- *Ce* is the cost of equity

[162] Dukan, M., Kitzing, L., Brückmann, R., Jimeno, M., Wigand, F., Kielichowska, I., Klessmann, C., & Breitschopf, B. (2019). *Effect of auctions on financing conditions for renewable energy* (Issue May).

Market maturity characteristics	Description *Why we have chosen this characteristic*	Key metric/indicators *How we will measure it*
 **of 'sophisticated' financial instruments, such as bonds and equity, and a low use of grants for mature technologies**	investment in 2017-2018, on average[163]. • The availability of grants can signal the presence of many early-stage technologies in the market. However, an excessive use of grants signals low maturity of the energy finance market, which is too dependent on free public support. This is the case where grants are deployed for mature technologies that are already capable of accessing private financial markets. • Considering the above, we consider as mature those markets that have a balanced mix of financial instruments, including 'sophisticated' instruments such as bonds and equity. On the other hand, markets that rely solely or mainly on grants and loans can be considered less mature.	instruments available in each country, we will use the following indicators: • Diversity of financing instruments for renewable energy, measured through a repurposed use of the Herfindahl-Hirschman Index (HHI) • Number of categories of 'sophisticated' financial instruments offered in the Member State. • Grants for rollout stage projects as a % of grant instruments To compute the indicators above we have used the data of the mapping of financial instruments presented in Section 3 of this Study.

5.2 Trends on market maturity identified

This section provides an assessment of the maturity of the clean energy finance markets of each Member State, based on the three dimensions presented in the previous section.

Supply of clean energy finance

The availability of private finance indicates a healthy financial system, while public financing should serve specific policy goals and address market failures. Comprehensive data on private and public RE investments broke down for each EU Member State are currently not easily accessible. We can however extrapolate the supply of clean energy finance from a series of data points. In the rest of this section, we analyse the indicators chosen to assess the supply of finance for clean energy investments, as described in Section 5.1.

Availability of private finance: bank financing and capital markets

Below we present the three key metrics that will be used to measure the availability of private finance in each Member State, although none of these metrics is specific to the energy sector. These metrics reflect criteria on private market financing used in the IMF Financial Development index.

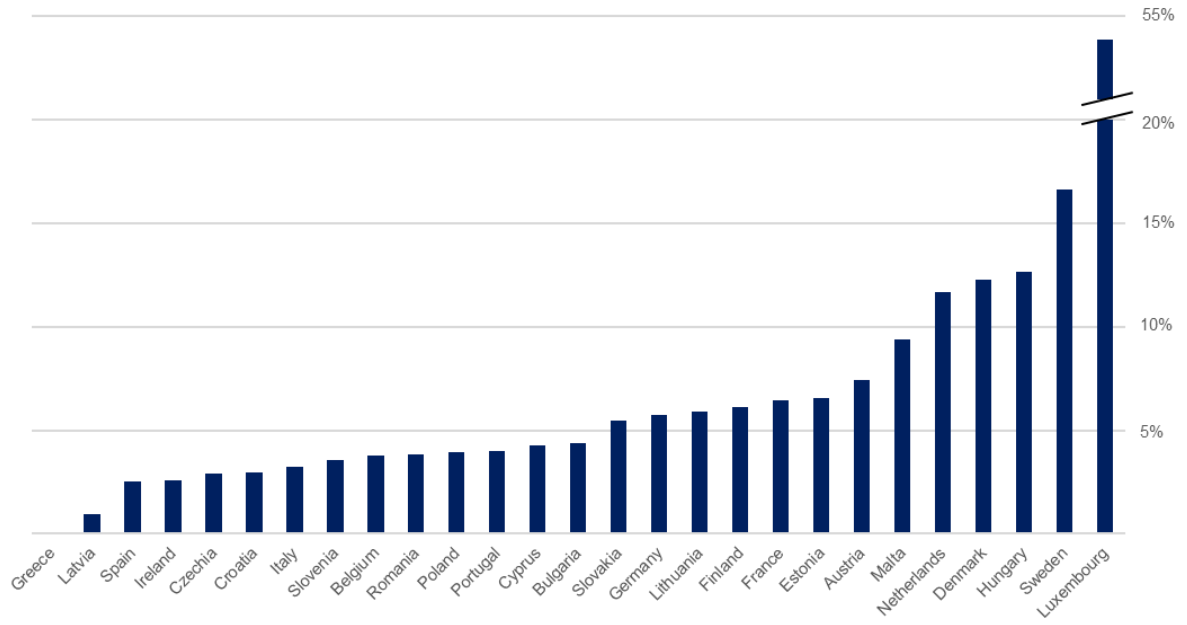
Bank financing

Bank financing is the main source of external finance for firms of all sizes in the European Union. Data from EIBIS 2021 shows that, on average, bank loans represented 59% of external funding for companies in the EU. An adequately high, but sustainable, stock of debt to non-financial corporates can be an indicator of a well-functioning banking system. In countries where the banking system is in distress or constrained by high cost of financing or high ratios

[163] Source: IRENA (2020), *GLOBAL LANDSCAPE OF RENEWABLE ENERGY FINANCE 2020*, available at: Link

of non-performing loans, financial institutions will limit their lending to corporates and households. The banking indicator reported by the European Central Bank, can be used as a proxy of the amount of credit and debt financing that firms can access in each Member State.

Figure 32: Debt securities and loans of the private non-financial sector as a ratio of GDP, 2021



Source: European Central Bank[164]

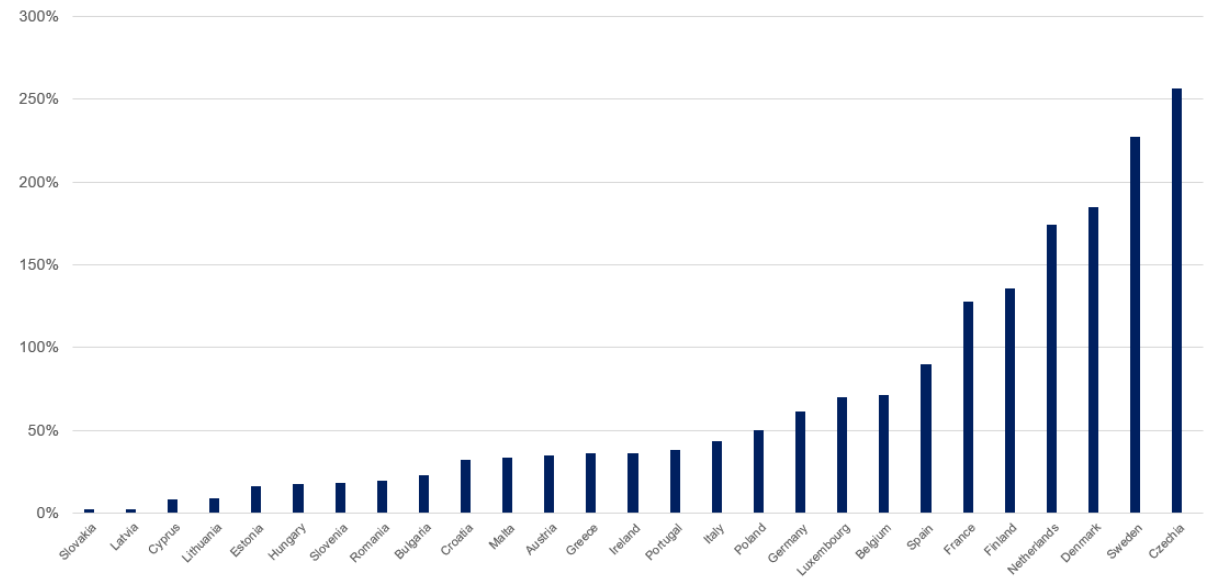
Stock market

The following stock indicator is generally used as a measure of under – or – over-valuation of a country's stock market[165]. For the purposes of our analysis, it is used as an indicator of access to equity capital markets.

[164] Available at: Link

[165] Stock Market Capitalization-to-GDP Ratio: Definition and Formula, available at: Link

Figure 33: Stock market capitalization as % of GDP (2021)



Source: CEIC[166]

Green bonds

The green bonds indicator can help us understand the extent of the level of access to capital markets for financing the energy transition. According to data from the Climate Bonds Initiative[167], energy represents on average 44% of the use of the proceeds of Green Bonds issued in Europe, between 2014 and the first half of 2022, equivalent to over USD 32 billion. This is a proxy of at least part of the RE investments financed via bond issuance, as the energy investments financed by Green Bonds are by definition in clean energy, otherwise the bond could not be labelled as 'Green' according to international standards[168].

The Figure below shows the stock of green bonds (in USD millions) in 23 EU countries[169] issued as of the first half of 2022 as share of their GDP[170]. This analysis allows to compare bond issuance to the relative size of a country's economy. Larger Member States have issued more Green bonds than smaller ones, but such larger issued amounts sometimes represent a smaller share of that country's GDP. For instance, Germany and France are the two countries with the highest issued amounts, but rank 7th and 4th, respectively, in terms of issuances as share of their GDP. Italy has issued in total the 6th highest amount, but ranks only 14th if the issued amount is assessed proportionally to Italy's GDP. Luxembourg is the country with the highest Green bond issuance if assessed in relation to its GDP (15.1%), despite being 11th in terms of absolute amounts.

166 Available at: https://www.ceicdata.com/en/indicator/market-capitalization--nominal-gdp

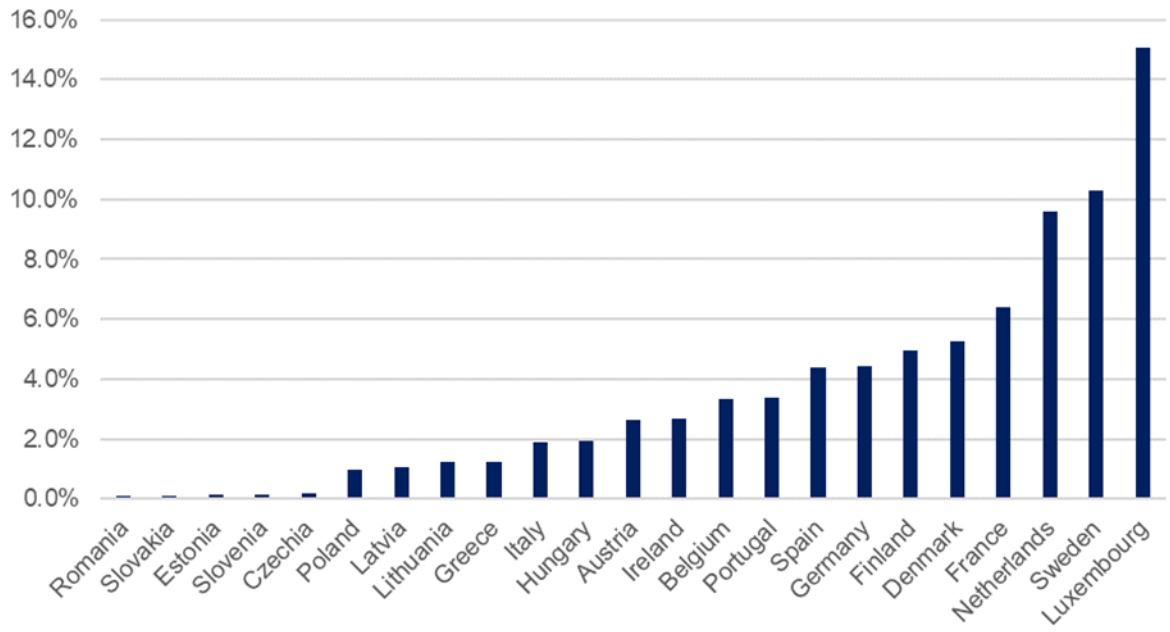
167 Available at: https://www.climatebonds.net/market/data/#use-of-proceeds-charts

168 International Capital Markets Association (ICMA), 2021 Green Bond Principles, available at: Link

169 Green Bonds data have been extracted by the Climate Bonds Initiative database, which did not include all EU-27 countries. Available at: https://www.climatebonds.net/market/data/#use-of-proceeds-charts

170 World Bank data on GDP per capita data (USD current, 2021). Available at: Link

Figure 34: Ratio between Green Bond market size (USD million, as of H12022) and GDP (USD, 2022)



Source: Climate Bonds Initiative[171], The World Bank[172]

Further information on the Green Bond market in EU countries can be found in the box "Focus on: Bonds financing for energy and sustainable activities" in Section 3.

Availability of public finance

When it comes to the energy sector, public finance represented on average 14% of total investments in renewables between 2013-2018[173]. The role of the public sector, and public financial institutions in particular, is to address market failures and intervene in underserved markets, achieving additionality and providing financial resources where they are scarce and/or unaffordable. Public financing resources, although limited, can be crucial to reduce risks, overcome initial barriers, attract private investors and bring new markets to maturity[174].

Data on public investment in RE collected by IRENA[175] provides a relevant indicator of the volumes of financing channelled through the European Investment Bank (EIB). Public RE investments collected by IRENA are largely financed by the EIB (74.2% of the total) via standard loans (98% of the total). Therefore, the analysis of this data should be interpreted with the limitation that it does not capture the full spectrum of RE public financing. Aggregated data for 24 EU Member States[176], between 2000 and 2020, has been adjusted for the size of the economy of each Member State.

[171] Available at: https://www.climatebonds.net/market/data/#use-of-proceeds-charts

[172] Source of GDP per capita data (USD current, 2021): https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?end=2019&locations=EU&start=2019

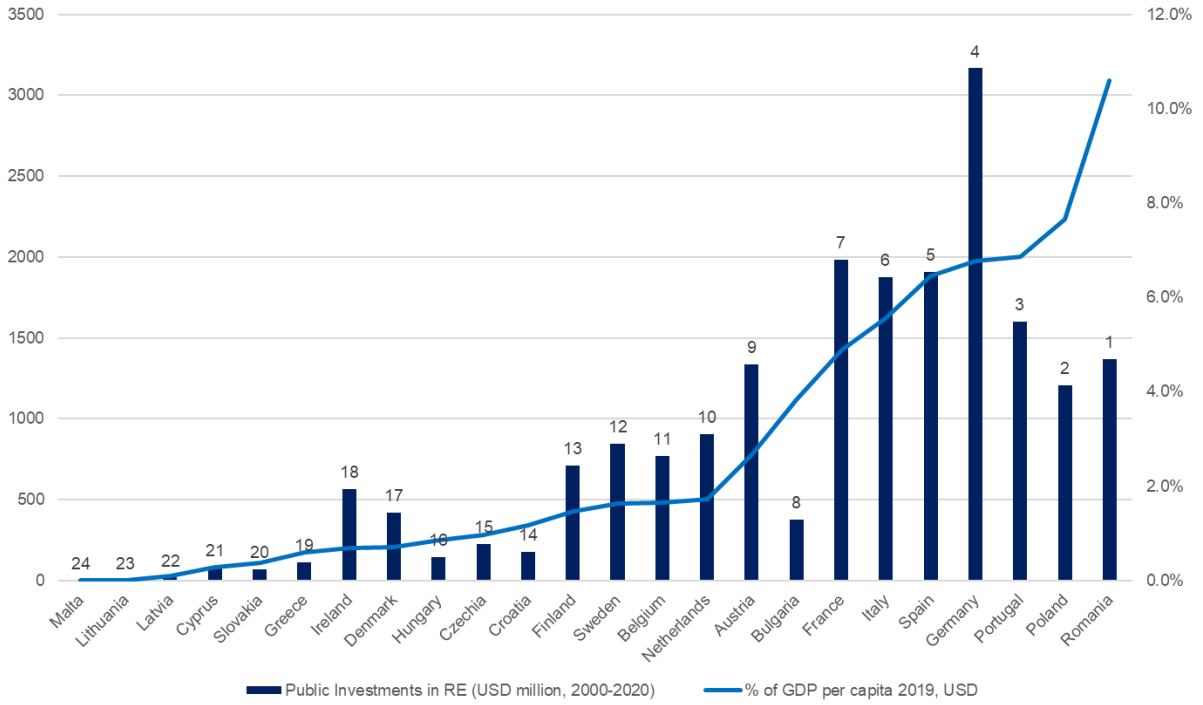
[173] IRENA (2020), *GLOBAL LANDSCAPE OF RENEWABLE ENERGY FINANCE 2020*, available at: https://www.irena.org/publications/2020/Nov/Global-Landscape-of-Renewable-Energy-Finance-2020

[174] Ibid

[175] Available at: https://www.irena.org/Data/View-data-by-topic/Finance-and-Investment/Renewable-Energy-Finance-Flows

[176] Data on Slovenia, Estonia and Luxembourg are not available

Figure 35: Public investments in renewable energy in the EU



Source: IRENA, The World Bank

Cost of financing – Weighted Average Cost of Capital (WACC)

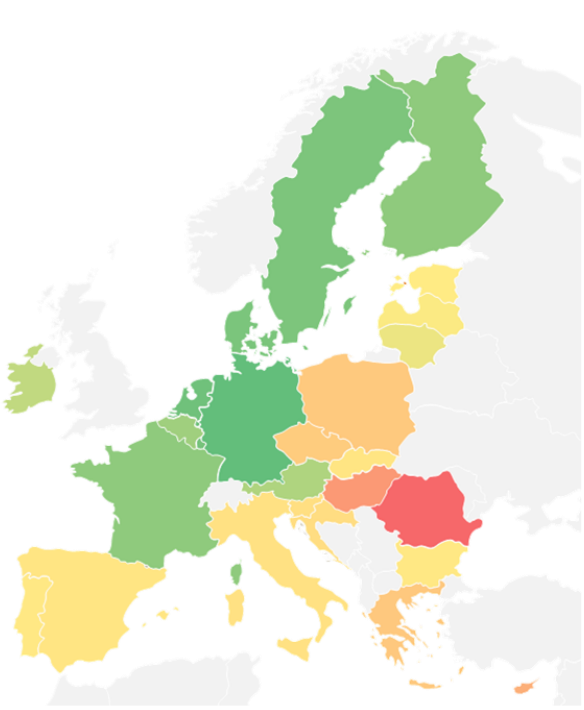
The cost of capital plays a vital role in evaluating investors' risk and return preferences, as well as determining the value of money within the broader economic landscape. It serves as a lever that can influence financial flows and impact prices and choices in the real energy sector. However, decision makers often face challenges due to the lack of reliable financing metrics across various sectors and regions, particularly in emerging and developing economies. Insufficient understanding of the cost of capital can result in misjudging the level of risk, potentially leading to underinvestment or overinvestment in different markets and sectors. This, in turn, has implications for the smooth progression of energy transitions.

The cost of capital expresses the expected financial return, or the stipulated minimum rate, for investing in a company or in a project. This expected remuneration is intricately connected to the level of risk entailed in the cash flows of said company or project.

A low WACC of renewable energy (RE) projects can be considered an indicator of maturity of the clean energy finance market. Indeed, it reflects abundance of capital at relatively low cost and a low country risk, thanks to a regulatory and economic environment that enables RE investments. The Figure below shows that WACC of RE projects in the EU, calculated by PwC for the purposes of this study, based on the latest data available[177]. It should be noted that the WACC values are influenced by national/ European monetary policies and Central Banking. In particular, countries with higher free interest rates correspond to higher WACC values. As a result, the comparison of countries based on their WACC is especially valid among the 20 countries of the Eurozone. Details on the calculation and data sources are available in Annex 3: WACC Calculation.

[177] As of February 2023.

Figure 36: WACC of RE projects across the EU



Country	WACC RE 2022
Romania	12.30%
Hungary	10.26%
Cyprus	9.31%
Greece	8.24%
Poland	8.20%
Czechia	8.09%
Croatia	7.36%
Slovenia	7.25%
Italy	7.17%
Spain	7.01%
Slovakia	7.00%
Portugal	6.90%
Bulgaria	6.87%
Estonia	6.73%
Latvia	6.69%
Lithuania	6.51%
Malta	6.12%
Ireland	5.99%
Austria	5.77%
Belgium	5.59%
Finland	5.50%
France	5.39%
Sweden	5.17%
Denmark	5.15%
Luxembourg	5.10%
Netherlands	5.01%
Germany	4.85%

Source: Statista, Aswath Damodaran (Stern, New York University), IRENA

Comprehensiveness and diversity of financial instruments for services and prosumers

Analysis of the data from the mapping of energy financial instruments conducted as part of the present study sheds further light on the availability and relevance of financial instruments for services and prosumers at Member State level and how they complement the analysis of market maturity.

Diversity of financing instruments for renewable energy and for services and prosumers

A first proxy of the diversity of mapped financing instruments available for each Member State can be obtained through a repurposed use of the Herfindahl-Hirschman Index (HHI)[178]. In the current case, the HHI shows the concentration of identified financing instruments among different types of instruments. In other words, countries with a high HHI (up to 10,000, in the case of one single type of instruments) offer a low variety of financing instrument types, whereas countries with a low HHI (nearing 0) provide a more diverse set of instruments that come with specific answers to different investment barriers.

It should be noted that some of the mapped financing schemes combine different kinds of instruments. In the mapping, those were consistently tagged in several categories of financing instruments. Nevertheless, this does not change the interpretation that can be made for financing instruments.

The obtained HHI values for each Member-State are available in the summary table at the end of this section.

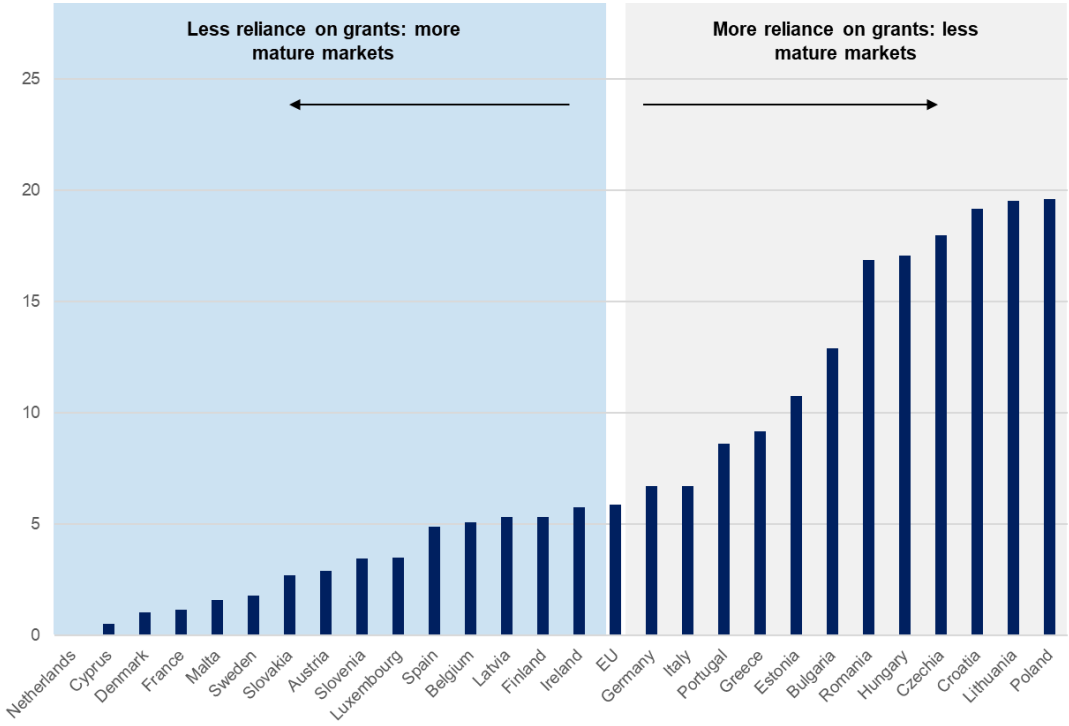
[178] Investopedia 2022, Herfindahl-Hirschman Index (HHI) Definition, Formula, and Example, available on: https://www.investopedia.com/terms/h/hhi.asp

Grant-based instruments and share of grants open for rollout stage projects

In general, markets with a balanced mix of financial instruments, including repayable ones, can be considered more mature. On the other hand, markets that rely solely or mainly on grants can be considered less mature. The percentage of grant-based instruments and the corresponding share of grants that are open to rollout-phase projects are provided for each Member State in the summary table below.

The use of equity, quasi-equity or guarantees is not preferable to that of grants and loans *per se*. Further, it should be taken into account that bank loans represent the main source of external finance for firms in the EU, while equity and bonds are rarely used, as reported by EIBIS[179]. However, the availability of only grants and loans is not likely to address the range of investment needs and barriers faced by the services and prosumers sector at different stages of development.

Figure 37: Share of grants in EU firms' financing mix (all sectors, all sizes)



Source: EIBIS

For the purpose of this study, we have calculated the **percentage of grant instruments for ready to build projects** (rollout-stage technologies such as PV panels) for each Member State. A high value for this indicator can be interpreted as a sign of low market maturity.

The results for the RE sector are broadly consistent with those for the economy as a whole, with a number of countries such as Poland, Croatia, Estonia, Portugal and Czechia ranking high in both.

Summary table on comprehensiveness and diversity of financial instruments

The following table provides a summary of all the indicators introduced in this section:

- HHI as a measure of diversity ranging from 0 (perfect diversity) to 10,000 (one single type of instruments)

[179] European Investment Bank Investment Survey, 2021, available at: https://data.eib.org/eibis/index;jsessionid=58E533D642F2ED07C87B1E9F150ACF75

- Sophisticated instruments score ranging from 0 (no sophisticated instruments) to 5 (high sophistication)
- Percentage of grants for rollout-stage technologies ranging from 0% (relevant use of grants) to 100% (inadequate use of grants)

Table 8: Comprehensiveness and diversity of financial instruments for services and prosumers

Country	HHI	% Grants out of all instruments mapped	Grants for rollout as a % of grant instruments
Austria	1800	20%	50%
Belgium	3611	25%	67%
Bulgaria	4933	40%	50%
Croatia	4649	19%	100%
Cyprus	5469	63%	80%
Czechia	5791	54%	67%
Estonia	4876	18%	100%
France	2936	37%	14%
Germany	6219	66%	26%
Greece	5378	20%	67%
Hungary	3264	0%	0%
Ireland	7422	60%	44%
Italy	6111	17%	0%
Latvia	7200	20%	100%
Lithuania	2249	31%	25%
Luxembourg	7344	63%	60%
Malta	3776	43%	50%
Netherlands	6445	13%	0%
Poland	9734	42%	82%
Portugal	5185	56%	100%
Slovakia	10947	31%	100%
Spain	3964	54%	100%
Sweden	10000	100%	50%

How to read the data – examples of countries:

- **Sweden** shows a limited diversity of financing instruments for services and prosumers, with a high share of grant-based instruments. Half of these grants are directed to mature technologies funding (although not necessarily exclusive to mature technologies).
- On the other hand, the **Netherlands** and **Italy** exhibit a wide variety of financing instruments for services and prosumers, including a moderate share of grants, which could be understood as a sign of more mature markets. None of these grants target explicitly mature technologies.
- **Austria**, the Country with the best HHI value, has a limited offer of grants. Their offer towards mature technologies is balanced as well, targeting equally mature and non-mature technologies.

Summary of findings on market maturity

The following table combines all the indicators presented in the previous sections with information about the RES (investment) gaps for each Member State based on the information presented in Section 2. **Member States have been ranked from 1 to 27 for each indictor**, where 1 is the best and 27 is the worst.

Table 9: Summary of findings on market maturity per country

	Market maturity					Instruments availability	
Member State	**Debt and loans of corporates**	**Stock market capitalisation**	**Green Bonds Market**	**Public investments in RE**	**WACC**	**Concentration Index (HHI)**	**Grants for rollout as a % of grant instruments**
Austria	7	16	12	9	9	1	6
Belgium	19	8	10	11	8	5	8
Bulgaria	14	19	N/A	8	15	10	6
Croatia	22	18	N/A	14	21	8	11
Cyprus	15	25	N/A	21	25	13	9
Czechia	23	1	19	15	22	14	8
Denmark	4	3	5	17	4	N/A	N/A
Estonia	8	23	21	N/A	14	9	11
Finland	10	5	6	13	7	N/A	N/A
France	9	6	4	7	6	3	2
Germany	12	10	7	4	1	16	4
Greece	27	15	15	19	24	12	8
Hungary	3	22	13	16	26	4	1
Ireland	24	14	11	18	10	20	5
Italy	21	12	14	6	19	15	1
Latvia	26	26	17	22	13	18	11
Lithuania	11	24	16	23	12	2	3
Luxembourg	1	9	1	N/A	3	19	7
Malta	6	17	N/A	24	11	6	6

	Market maturity					Instruments availability	
Member State	Debt and loans of corporates	Stock market capitalisation	Green Bonds Market	Public investments in RE	WACC	Concentration Index (HHI)	Grants for rollout as a % of grant instruments
Netherlands	5	4	3	10	2	17	1
Poland	17	11	18	2	23	21	10
Portugal	16	13	9	3	16	11	11
Romania	18	20	23	1	27	N/A	N/A
Slovakia	13	27	22	20	17	23	11
Slovenia	20	21	20	N/A	20	N/A	N/A
Spain	25	7	8	5	18	7	11
Sweden	2	2	2	12	5	22	6

Note: WACC depends on central bank policy which determines risk free rate. It relates to the countries with no EUR. Central bank policy is to decrease inflation so countries with high inflation have higher WACC.

Interpretation of the results at Member State level

The complex picture of indicators presented in Table 9 does not always present a clear-cut conclusion regarding the state of market maturity for the financing of energy services and prosumers, but nevertheless can lay the ground for some general findings at country level.

As can be seen from the following table, it is possible to group the EU Member States based on their relative position to effectively undertake the needed investments for energy systems. Member States were grouped in four categories based on the share of their GDP that the planned investments in energy systems correspond to. The assumption is that the larger the share, the more challenges the country will face in mobilising sufficient resources for such investments, and as such the more a mature market and diversified offering of financial instruments would prove to be key. Investment needs representing up to 3% of the GDP were considered as a low share, and therefore the country is well positioned to undertake them. From 3% to 7% of share, the country was put in the "medium effort" group, whereas for shares above 7% of the GDP it was considered that the country will need significant efforts to mobilise all the necessary financing. Four Member States do not have an estimated investment needs for energy systems. Section 2.2 also lists investment needs in Buildings & industry as part of the investment needs for energy services and prosumers, as they include also investments for households (relevant for prosumers). However, to reduce the overlap with the investment analysis in the parallel Study on financial instruments for Heating & Cooling, only the investment needs in Energy systems were taken into consideration for the grouping of Member States.

It should also be noted that the analysed investment needs come from the NECPs drafted in 2018 and approved in 2019, which therefore pre-date the REPowerEU's targets and ambitions. Member States are currently revising their NECPs, and updated versions are expected to be approved in mid-2024, with likely higher investment needs and targets.

In addition to the effort needed to undertake investments, countries were also classified based on their degree of market maturity, understood as the average of the different rankings displayed in the Table 9 above, and the extent to which the current offering of financial instruments is sufficiently relevant, i.e., the concentration of instruments and the strategic use of grants. The interpretation is provided per group in the following paragraphs.

Table 10: Grouping of countries by market maturity and position to undertake investments

	High market maturity	Medium maturity	Low market maturity
Well positioned to undertake the investments	France, Luxembourg, Germany, Netherlands, Sweden	-	Estonia
Medium effort needed to undertake the investments	Denmark	Italy, Poland	Cyprus, Latvia, Lithuania, Slovakia
High effort needed to undertake the investments	-	Belgium, Bulgaria, Spain, Portugal, Czechia, Austria	Greece, Romania, Slovenia, Croatia
Unassessed needed effort	Finland	Ireland, Hungary, Malta	-

Note: Countries coloured in green are considered to have a relevant offering of financial instruments, whereas those in red have some room for improvement and those in black represents those countries for which no instruments were mapped for Services and Prosumers.

Countries with high market maturity and:

- **Well positioned to undertake investments** – **France**, **Luxembourg**, **Germany**, **the Netherlands** and **Sweden** are all well positioned to face the increased investment needs in energy services and prosumers. They all enjoy a mature energy financing market characterised by low WACC, good levels of public investments and contained use of grants for mature technologies. France and the Netherlands also have a good variety of financial instruments, although the Netherlands is mostly characterised by loans and could benefit from an increased use of guarantees and technical assistance schemes. Sweden was mapped to have only two grant instruments, which placed it in second-to-last place in terms of concentration. However, this could also be explained by the country having a sufficiently mature market that does not require public intervention to direct capital flows to the sector.
- **Medium effort needed –** Although no instruments were mapped for services and prosumers in **Denmark**, the country displays an overall high level of market maturity. Only public investments in renewable energy have been found to be low, but this could also be explained by a smaller national grid and higher degree of private investment.
- **Unassessed effort – Finland** does not have a specific estimated investment need for services and prosumers, not any financial instrument was mapped for energy systems. Nonetheless, the country is positioned rather high in all available indicators, signalling that it should be able to face the needed investments.

Countries with medium market maturity and:

- **Medium effort needed – Italy** and **Poland** are in this category. Italy enjoys high levels of public investments in renewable energy, and none of the mapped grants target mature technologies. Nonetheless, the country has a rather high WACC and the planned investments in energy systems might represent a challenge for the country. Poland ranks rather high in terms of public investments in RE, but high when it comes to concentration of financial instruments and strategic use of grants.
- **High effort needed – Belgium**, **Bulgaria**, **Czechia**, **Austria, Spain**, and **Portugal** belong to this category. These countries present similar levels of market maturity, with some individual features. For instance, Spain and Portugal have a rather high use of grants for mature technologies and solutions, thus representing an area for improvement. Bulgaria ranks low in the stock market capitalisation and is not yet active in the green bond for RE market. Belgium is the country with a relative higher maturity in this category, but could still benefit from a more strategic use of grants. Austria is characterised by an overall low cost of capital and good availability of private financing. It is also the Member State with the best mapped concentration of financial instruments, with a balanced availability of loans, blended schemes, grants, and technical assistance. Czechia ranks high in stock market capitalisation, but could benefit from a wider availability of financial instruments, particularly equity and technical assistance.
- **Unassessed effort – Hungary** and **Malta** have a medium market maturity, characterised, respectively, by a very high WACC and low public investments in renewable energy. Nonetheless, both countries did not set out investment targets for energy systems and is therefore not possible to estimate the magnitude of the effort. **Ireland** is characterised by a medium WACC and good use of grants. However, public

investments in RE are at intermediate levels and there is a rather high concentration of instruments.

Countries with low market maturity and:

- **Well positioned to undertake investments** – **Estonia** has a relatively small estimated investment need for energy systems, placing the country in a rather favourable position to undertake the needed investments. Nonetheless, Estonia could benefit from an increased use of guarantees and technical assistance facilities.
- **Medium effort needed – Cyprus, Latvia, Lithuania,** and **Slovakia.** These countries are all characterised by a medium-to-high WACC, a small green bond market, and a rather concentrated offering of financial instruments, as well as high use of grants towards mature technologies. Latvia and Slovakia, nonetheless, present available instruments of different types, whereas Cyprus could benefit from a more diversified offering, particularly in light of the needed investments in services and prosumers. Lithuania has a good offering of instruments and utilises grants in a strategic way. However, it suffers from low public investments in renewable energy and stock market capitalisation.
- **High effort needed – Greece**, **Romania**, **Slovenia**, and **Croatia** are likely to have to step up their investment efforts in energy in order to tackle the required investments in energy services and prosumers. These countries are all characterised by a rather low market maturity, which represent an additional obstacle to the mobilisation of sufficient public and private resources. Croatia would benefit from a more diversified offering of financial instruments, particularly in terms of guarantee and technical assistance, as loans represent most of the mapped instruments. In Romania and Slovenia no instruments for services and prosumers were found.

6. Findings and recommendations

6.1. Summary of findings

A large step up in financing will be needed for Member States to achieve the Fit for 55 and European Green Deal targets and objectives. To do so, energy services such as demand-side management and new self-consumption configurations are needed to complement the changes in the energy value chain implemented in other segments.

Financial instruments can address some of the barriers to investment for services and prosumers. Different technologies have different financing needs, depending on their maturity and the barriers they face. For emerging technologies, availability and access to finance remain key challenges next to the inherent technology risks. For mature technologies, regulatory and policy risk as well as administrative barriers are key.

A mapping of financial instruments at Member State level resulted in data on 325 instruments available to support services and prosumers in the 27 EU Member States. Among these 325, loans and grants are the most popular instruments across the EU. **A total amount of around €109 billion has been estimated to be available inter alia for services and prosumers projects**. However, while just ten schemes are specific to services and prosumers, most schemes target at least one more energy segment, and 171 schemes target all segments of the energy value chain. Consequently, approximately €21 billion is channelled through services and prosumers-only instruments.

Most of the mapped instruments target mature and market-ready projects, with SMEs and larger companies being the most targeted category of beneficiaries. In the context of services and prosumers, however, households received a comparatively higher support than in other segments of the value chain.

Five primary factors have been identified as crucial for a support scheme to be effective in the services and prosumers sector: being broad and flexible in scope, having long-term stability and visibility, easy and rapid application procedure, effectiveness in mobilising private finance. Across Member States, different levels of market maturity persist. In those countries with limited market maturity and which are characterised by a substantial investment gap to achieve their Renewable Energy Sources 2030 targets, **the presence of a comprehensive range of financial instruments becomes crucial.**

6.2. Recommendations and next steps

Based on the analysis conducted, it was possible to broadly identify the direction in which the next generation of financial support schemes for energy services and prosumers should go:

- Countries with low availability of diverse financial instruments and less mature financial markets would benefit from targeted efforts to develop and expand the offering of schemes for energy service companies, so as to cover a broader range of investment needs and progressively move away from grant-supported investments and more towards repayable instruments. WG Members particularly underlined that guarantees and equity (Venture Capital) schemes and investments are needed.

- Particularly for **energy communities**, a **shortage of availability of equity** financing was identified by WG Members. While energy communities are usually owned by the households and enterprises that are part of them, WG Members noted how a minority stake of the community could be held by investment funds so as to increase the resources available to the community and invest more in the expansion of energy production systems.
- **Bonds** are currently used only by larger ESCOs and not leveraged by energy communities. **Basket bonds** were identified as a possible solution to enable smaller ESCOs and energy communities to issue bonds aimed at financing their renewable energy investments.
- **Technical assistance facilities and funding should also be deployed more broadly**, particularly in countries with low market maturity, to foster capacity building and increase effectiveness and impact of instruments. These facilities should target local authorities and their companies, energy communities, prosumers, and smaller ESCOs, which might sometime lack the human resources and/or knowledge to conduct appropriate financial modelling and prepare applications for financing opportunities.
- **Awareness raising and information campaigns** were also indicated by WG Members as a relevant and important tool to increase citizens' awareness of the benefits of becoming a prosumer or entering an energy community. This would support a larger uptake of current and future schemes and ensure a greater impact.
- In countries with more developed and mature financial markets, the use of guarantees, bonds, and equity should be prioritised to meet the investment needs of the energy sector while limiting the use of public resources.
- While the analysis did not cover regulatory environments in the EU and does not aim to do so, some countries might benefit from a revision of their regulatory frameworks to facilitate investments by prosumers and energy communities. Once approved, the **reform of the Electricity Market Design** might bring significant positive changes in terms of contracts and remuneration mechanisms, which might pave the way for new business models and energy services.
- Particularly for the service and prosumers segment of the energy value chain, new and improved financial support schemes should also **take into consideration the other segments of the value chain**, such as storage, grids, heat pumps and energy generation. While this aspect may be difficult to tackle with individual schemes, it should nonetheless be taken into account by the public sector when designing broader strategies for energy.

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- Annexes

Annex 1: Definitions of instruments used for the mapping

Loan

A loan is an agreement which obliges the lender to make available to the borrower an agreed sum of money for an agreed period of time and under which the borrower is obliged to repay that amount within the agreed time[180]. In case of a loan provided or guaranteed by a public authority, directly or indirectly, it can help addressing a shortage of finance available where commercial banks are unwilling to lend on acceptable terms to the borrower. Nonetheless, commercial banks can also provide loans at better conditions than normal market ones as part of their lending strategy without public support (e.g., as in the case of loans for solar panels installation for which a strong pipeline is foreseen).

A financial instrument in the form of loan can be either provided directly by commercial banks at better conditions than what they would apply in a standard commercial loan (following the market interest rate), or directly by a public (regional, national, or European) body. In the case, for instance, of a guaranteed loan, the bank usually shares the risks it takes with a public authority, which functions as guarantor and financer, and allows the bank to take a greater degree of risk exposure and provide higher amounts of financing than it would be able to do in normal conditions. In the second case, the public authority directly provides the loan and acts as financial institution.

In the case of a public authority, the repayments of the loan allow the so-called revolving effect, that is the situation where the flows of money coming from the repayment of the loan is invested in another loan.

Loans play an important role in the European economy, constituting on average over 50% (56.2%) of the external finance of European companies[181].

Equity

An equity investment is the provision of capital to a company, invested directly or indirectly in return for total or partial ownership of that firm and where the equity investor may assume some management control of the firm and may share the firm's profits. In the case of equity, the financial return depends on the growth and profitability of the company and is earnt through dividends and/or the sale of the shares to another investor[182].

Equity constitutes around 0.5% of EU companies' external finance[183].

[180] European Commission (2015). Guidance for Member States on Financial instruments – Glossary.
[181] EIB Investment Survey 2021.
[182] Fi-compass.
[183] EIB Investment Survey 2021.

Quasi-equity

A type of financing that ranks between equity and debt, having a higher risk than senior debt and a lower risk than common equity. Quasi-equity investments can be structured as debt, typically unsecured and subordinated and in some cases convertible into equity, or as preferred equity.

Grants

Direct financial contributions provided to third-party beneficiaries (i.e. companies and households). This contribution does not need to be paid back, and is usually aimed at covering part of the upfront costs (CAPEX) or of the operating costs (OPEX) of a project. Grants can also be used to cover the costs of technical assistance to companies to conduct energy audits, develop bankable projects, etc.

On average, grants represent 9.16% of EU companies' external financing[184].

Bonds

Bonds are a fixed-income instrument that represents a loan made by an investor to a borrower. In return for the loan, the bond issuer will pay interest to the bondholder at fixed intervals until the bond matures and the money is paid back. Bonds can be issued by companies or by public entities.

According to the EIB Investment Survey 2021, bonds account for around 1% of EU companies' external financing composition[185].

Blended finance

Blended finance is the combination of finance from public and private resources to finance projects. Blended finance can be distinguished from other types of financial instruments by the fact that it requires a combination of public and private resources to implement a certain project jointly by the public and private sector.

Like financial instruments, blended finance is used to achieve public policy objectives that, in the existing market conditions, cannot be achieved through pure market dynamics and/or legislation.

Guarantees

A guarantee is a written commitment to assume the responsibility for all or part of a third party's debt, usually a commercial bank's, if an event such as a loan default occurs[186]. The guarantor, which can be a public institution, disburses resources only if the guaranteed fails to comply with its commitments.

For final beneficiaries (i.e. companies and households), guarantees take the form of a loan, as the guarantee is always provided to a financial intermediary, a bank or a fund, for instance, which then provides financing at better conditions.

[184] EIB Investment Survey 2021.

[185] EIB Investment Survey 2021.

[186] European Commission (2015). Guidance for Member States on Financial instruments – Glossary.

Technical assistance

TA refers to different types of services provided to final beneficiaries and/or financial intermediaries to improve their capacities/skills to, for instance, perform business modelling, financial planning, risk assessment, report, etc.

Technical assistance (TA) is essential for the successful deployment of financial support instruments and for the achievement of their objectives and goals. Know-how transfer and capacity building can provide benefits to all stakeholders involved in an energy generation project. On the one hand, TA can be developed to help project promoters preparing a solid business and financial plan that is ready to be submitted to investors and financial institutions, and thus **improve the investment readiness** of projects and **their ability to access external financing options**. Combining technical assistance with instruments such as loans or grants can therefore facilitate the implementation and uptake of such instruments to support well-defined and more mature project proposals.

TA can also help project promoters comply with the different requirements, for instance, in terms of reporting. This can be particularly helpful for start-ups and SMEs, which might lack dedicated personnel to comply with the requirements or might simply not have the knowledge/expertise to do so. On the other hand, TA can also be useful for investors, banks, and other financial institutions to adequately understand how some sectors and types of project work, how they are structured, and how revenues are generated. This type of TA is sometimes used in market development programmes for new emerging sectors (e.g. blue economy, cybersecurity, etc.). Investors are usually not familiar with emerging sectors and tend to refrain from investing in them due to their lack of awareness of potential revenues, and to the lack of know-how on how to screen opportunities and identify and quantify risks. Finally, TA can also help policymakers, regulatory, and local authorities to better grasp the technicalities and specificities of a given market sector so as to be able to write informed and tailored legislation, regulation, and public procurement.

Annex 2: Overview of EU financing programmes for energy

Energy in the MFF and NGEU	Aim	Specific Funding sectors (if any)	Total Budget
		Main energy-relevant programmes	
Connecting Europe Facility - Energy (CEF Energy)	Supports investments in building new cross-border energy infrastructure in Europe or rehabilitating and upgrading the existing one.	**(1)** Energy Infrastructure projects (PCIs) **(2)** Cross border Renewable Energy projects	€ 5.84 billion
LIFE Programme	The LIFE Programme is the EU's funding instrument for the environment and climate action.	**(1)** Nature and biodiversity **(2)** Circular Economy and Quality of Life **(3)** Climate Change Mitigation and Adaptation **(4)** Clean Energy Transition	€ 5.43 billion
		of which Clean Energy sub-programme	
InvestEU Programme	The InvestEU Programme supports sustainable investment, innovation and job creation in Europe. It aims to trigger more than €372 billion in additional investment over the period 2021-27.	**(1)** Sustainable Infrastructure **(2)** Research, Innovation and Digitalisation **(3)** SMEs **(4)** Social Investment and Skills	€26.2 billion
Horizon Europe	Horizon Europe is the EU's key funding programme for research and innovation which tackles climate change, helps to achieve the UN's Sustainable Development Goals and boosts the EU's competitiveness and growth.	Focus on research and innovation.	€ 95.5 billion
European Regional Development Fund (ERDF)	The European Regional Development Fund (ERDF) aims to strengthen economic, social and territorial cohesion in the European Union by correcting imbalances between its regions.	**(1)** Competitiveness **(2)** Low carbon resilience **(3)** connected: enhancing mobility **(4)** inclusive employment and skills **(5)** locally led development and sustainable urban development	€ 370 billion
Cohesion Fund	The Cohesion Fund provides support to Member States with a gross national income (GNI) per capita below 90% EU-27 average to strengthen the economic, social and territorial cohesion of the EU.	The Cohesion Fund supports investments in the field of environment and trans-European networks in the area if transport infrastructure (TEN-T).	
Just Transition Mechanism (Just Transition Fund and Public Loan Facility)	**The Just Transition Fund** supports the economic diversification and reconversion of the territories concerned. It focuses on: investments in Small and Medium-sized Enterprises, creation of new firms, research and innovation, environmental rehabilitation, clean energy, up- and reskilling of workers, job-search assistance, transformation of existing carbon-intensive installations		**Just Transition Fund:** € 19.32 billion, of which € 10.87 is under NextgenerationEU

Energy in the MFF and NGEU	Aim	Specific Funding sectors (if any)	Total Budget
	The Public Sector Loan Facility (PSLF) is the third pillar of the Just Transition Mechanism. It supports projects addressing the challenges deriving from the transition to the European Union's climate target objectives in the territories most negatively affected by the climate transition as identified in the previously approved Territorial Just Transition Plans.		**PSLF**: €1.525 billion
Recovery and Resilience Facility (RRF)	The aim of the Recovery and Resilience Facility is to mitigate the economic and social impact of the coronavirus pandemic and make European economies and societies more sustainable, resilient and better prepared for the challenges and opportunities of the green and digital transitions.		€ 723.8 billion
Other programmes that might benefit energy			
Neighbourhood, Development and International Cooperation Instrument	The new Global Europe will cover the EU cooperation with all third countries, except for the pre-accession beneficiaries and the overseas countries and territories from the geographic programmes. It will particularly support countries most in need to overcome long-term developmental challenges and will contribute to achieving the international commitments.		€ 79.5 billion
Instrument for pre-accession Assistance (IPA)	The IPA acts on 5 components ● Assistance for transition and institution building; ● Cross-border cooperation (with EU Member States and other countries eligible for IPA); ● Regional development (transport, environment, regional and economic development); ● Human resources (strengthening human capital and combating exclusion); ● Rural development.		€ 14.162 billion
non-MFF/NGEU programmes			
Innovation Fund	The Innovation Fund will contribute to greenhouse gas reduction. It is designed to take into account the lessons learned from its predecessor, the NER300 programme. It focuses on highly innovative technologies and big flagship projects with European value added that can bring significant emission reductions.	Focus on Innovative technologies	€ 25 billion
Modernisation Fund	The Modernisation Fund is a dedicated funding programme to support 10 lower-income EU Member States in their transition to climate neutrality by helping to modernise their energy systems and improve energy efficiency.	**(1)** Generation and use of energy from renewable sources **(2)** Energy efficiency **(3)** Energy storage	€ 48 billion (depending on carbon price)

Energy in the MFF and NGEU	Aim	Specific Funding sectors (if any)	Total Budget
		(4) Modernisation of energy networks, including district heating, pipelines and grids **(5)** Just transition in carbon-dependent regions	

Annex 3: Methodology for WACC Calculation

We have calculated the Weighted Average Cost of Capital (WACC) for Renewable Energy projects in Europe, using the following formula:

$$WACC = \frac{D}{D+E} * CoD * (1-t) + \frac{E}{D+E} * CoE$$

Where:

- *D* is the market value of a firm's debt
- *E* is the market value of a firm's equity
- *t* is the corporate tax rate
- *CoD* is the cost of debt after tax, calculated as follows: $CoD = (risk\ free\ rate + sector\ specific\ spread) * (1-t)$
  We have applied a +2% assumption for lenders' margins to risk free rate and the sector specific spread, based on the literature on energy finance[187]. We have selected the country specific risk-free rate to reflect country risks[188].
- *CoE* is the cost of equity, calculated as follows: $CoE = risk\ free + \beta * ERP$, where ERP is the equity risk premium of every country and β is a measure of the volatility — or systematic risk — of a security or portfolio (or a specific sector/transaction) compared to the market as a whole. ERP is country-specific and β is specific to the renewable energy sector. Both data are extracted from Aswath Damodaran (Stern, New York University)[189].

One note on $\frac{D}{D+E}$ and $\frac{E}{D+E}$. They are specific to the renewable energy sector, reflecting the levels of debt and equity normally used for renewable energy projects. However, in absence of country-specific data, we have assumed that these variables are the same across the whole EU. This is of course an important caveat, as differences in $\frac{D}{D+E}$ and $\frac{E}{D+E}$ across countries might exist and they would significantly affect the WACC.

The table below shows the calculation of the WACC for each country.

[187] Source: IRENA, RENEWABLE POWER GENERATION COSTS IN 2021, available at: https://www.irena.org/publications/2022/Jul/Renewable-Power-Generation-Costs-in-2021#:~:text=The%20global%20weighted%20average%20levelised,%25%20to%20USD%200.075%2FkWh.
[188] Source: Statista, available at: https://www.statista.com/statistics/885915/average-risk-free-rate-europe/
[189] Available at: https://pages.stern.nyu.edu/~adamodar/New_Home_Page/datacurrent.html

Country	ERP - Total Equity Risk Premium	Country Risk Premium	Beta - Green & Renewable Energy	Risk free (Nov-2022)	CoE - Cost of Equity	Tax rate	E/(D+E)	D/(D+E)	CoD - After Tax Cost of Debt	WACC
Austria	6.57%	0.56%	0.87	1.80%	7.51%	25%	67.48%	32.52%	2.85%	5.77%
Belgium	6.85%	0.84%	0.87	1.40%	7.36%	25%	67.48%	32.52%	2.55%	5.59%
Bulgaria	8.24%	2.23%	0.87	1.60%	8.77%	10%	67.48%	32.52%	3.24%	6.87%
Croatia	9.51%	3.50%	0.87	1.50%	9.77%	18%	67.48%	32.52%	2.87%	7.36%
Cyprus	9.51%	3.50%	0.87	3.50%	11.77%	13%	67.48%	32.52%	4.81%	9.31%
Czechia	6.85%	0.84%	0.87	4.10%	10.06%	19%	67.48%	32.52%	4.94%	8.09%
Denmark	6.01%	0.00%	0.87	1.40%	6.63%	22%	67.48%	32.52%	2.65%	5.15%
Estonia	7.00%	0.99%	0.87	2.50%	8.59%	20%	67.48%	32.52%	3.60%	6.73%
Finland	6.57%	0.56%	0.87	1.40%	7.11%	20%	67.48%	32.52%	2.72%	5.51%
France	6.70%	0.69%	0.87	1.30%	7.13%	27%	67.48%	32.52%	2.43%	5.39%
Germany	6.01%	0.00%	0.87	1.20%	6.43%	30%	67.48%	32.52%	2.24%	4.85%
Greece	11.04%	5.03%	0.87	1.60%	11.20%	24%	67.48%	32.52%	2.74%	8.24%
Hungary	8.67%	2.66%	0.87	4.90%	12.44%	9%	67.48%	32.52%	6.28%	10.26%
Ireland	7.00%	0.99%	0.87	1.50%	7.59%	13%	67.48%	32.52%	3.06%	5.99%
Italy	9.08%	3.07%	0.87	1.70%	9.60%	24%	67.48%	32.52%	2.81%	7.17%
Latvia	7.69%	1.68%	0.87	2.00%	8.69%	20%	67.48%	32.52%	3.20%	6.69%
Lithuania	7.19%	1.18%	0.87	2.00%	8.26%	15%	67.48%	32.52%	3.40%	6.51%
Luxembourg	6.01%	0.00%	0.87	1.40%	6.63%	25%	67.48%	32.52%	2.55%	5.10%
Malta	7.19%	1.18%	0.87	2.00%	8.26%	35%	67.48%	32.52%	2.60%	6.12%
Netherlands	6.01%	0.00%	0.87	1.30%	6.53%	25%	67.48%	32.52%	2.48%	5.01%
Poland	7.19%	1.18%	0.87	4.00%	10.26%	19%	67.48%	32.52%	4.86%	8.20%
Portugal	8.67%	2.66%	0.87	1.60%	9.14%	21%	67.48%	32.52%	2.84%	6.90%
Romania	9.08%	3.07%	0.87	7.20%	15.10%	16%	67.48%	32.52%	7.73%	12.30%
Slovakia	7.19%	1.18%	0.87	2.70%	8.96%	21%	67.48%	32.52%	3.71%	7.00%
Slovenia	7.69%	1.68%	0.87	2.60%	9.29%	19%	67.48%	32.52%	3.73%	7.25%
Spain	8.24%	2.23%	0.87	2.10%	9.27%	25%	67.48%	32.52%	3.08%	7.01%
Sweden	6.01%	0.00%	0.87	1.40%	6.63%	21%	67.48%	32.52%	2.70%	5.17%

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