newTRENDs

Diagnosis of energy demand-side policy needs at European level

Deliverable D4.1

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Executive Summary

To achieve the Paris Agreement goals, two central strategies have to be implemented in all countries: i) enhancing energy efficiency (EE) and (ii) decarbonizing remaining energy supply and demand. Scenarios with different focusses and assumptions have been developed to map this development until 2050. While these scenarios present a major step forward beyond previous modelling approaches by integrating societal trends, much more progress is necessary to enhance the empirical basis for such trends and their representation in models. In this context, the project newTRENDs is developing the analytical basis for a "2050 Energy Efficiency Vision" taking into account New Societal Trends in energy demand modelling.

This report provides a diagnosis of energy demand-side policy needs at European level, with a particular focus on effective implementation of the Energy Efficiency First principle. The analysis covers four focus topics of New Societal Trends: (i) digitalisation of the economy and of private lives; (ii) circular economy and low-carbon industry; (iii) shared economy, and (iv) prosumaging (combining production, consumption and storage of energy).

The diagnosis is based on the analysis of EU-level legal acts and preparatory documents, as well as stakeholder engagement through semi-structured interviews and workshops, involving invited experts (including EU policy makers) and newTRENDs team members. The analysis focuses on: (i) providing an overview of diverse policy challenges and responses (policy instruments) in the field of each newTRENDs focus topic at the EU level; (ii) identifying relevant policy makers at the EU level that have an impact on policies development; (iii) identifying needs of policy makers in terms of energy demand models.

The report contributes to developing discourse on possible changes in the EE policies in the frame of New Societal Trends, and to providing knowledge base for strengthening the modeling of relevant policies in demand-side models in the EU.

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1. Introduction

1.1 About the newTRENDs project

The EU 2050 Long-term Strategy develops scenarios for a climate-neutral EU in 2050 that aim at full deployment of low-carbon technologies or assume increased climate awareness of EU citizens translating into lifestyle changes, consumer choices, and a more circular economy. While these scenarios integrate societal trends, further progress is necessary to enhance the empirical basis for such New Societal Trends and their representation in models. New Societal Trends have potentially a large (increasing or decreasing) impact on energy consumption and might lead to cross-sectoral demand shifts that go beyond extrapolation of presently observed trends (continuous trends) and may speed up when they are embraced by larger parts of the society (disruptive trends). Such trends include in particular: digitalisation of the economy and of private lives, circular economy and low-carbon industry, shared economy, and prosumaging, combining production, consumption and storage of energy, which are the main focus topics of the newTRENDs project.

The newTRENDs approach relies on several well-established models (bottom-up energy demand and macro-models), which have all been used extensively in the European context for projections up to 2050 and beyond (EU-28 and individual Member States) and which are run by experienced teams of modellers which have been cooperating frequently in the past. The newTRENDs project strengthens these models while working on New Societal Trends.

The project has the following detailed objectives:

- we aim at **identifying** and **quantifying** how such New Societal Trends affect energy demand (its structure and patterns, including cross-sectoral interdependencies).
- we investigate **how energy demand models are to be improved** to represent such New Societal Trends. We further aim at **representing policies in energy demand models** that can influence such trends, particular in the light of the Energy Efficiency First (EE1) Principle brought forward in the EU policy framework.
- we aim for integrating into energy demand models **recent empirical findings** on the impacts of such New Societal Trends **as well as information from detailed data sources such as smart meter data** available from recent technical advances, in order to improve the empirical basis for such investigations. Special care will be given to **deal with uncertainties** that are inherent when assessing new societal trends.

This report is a part of *WP4 Policy needs and policy analysis for Influencing Energy Demand Arising from New Societal Trends*, which analyses policies that can enhance the demand decreasing trends of New Societal Trends. It aims to strengthen the ability to model relevant EU-level policies in demand-side models.

In particular, WP4 provides:

- an assessment of energy demand-side policies and instruments at European level with major impacts on New Societal Trends (Task 4.1, linked with Deliverable D4.1) as well as of policies and instruments targeting large-scale behavioural changes (Task 4.2, Deliverable D4.2).
- an in-depth assessment of demand-side models in how far they are able to quantify energy demand-side policies impacting on New Societal Trends (Task 4.3, Deliverable D4.3)
- recommendations for better design of energy-demand modelling to appropriately represent such New Societal Trends (Task 4.4, Deliverable D4.4).

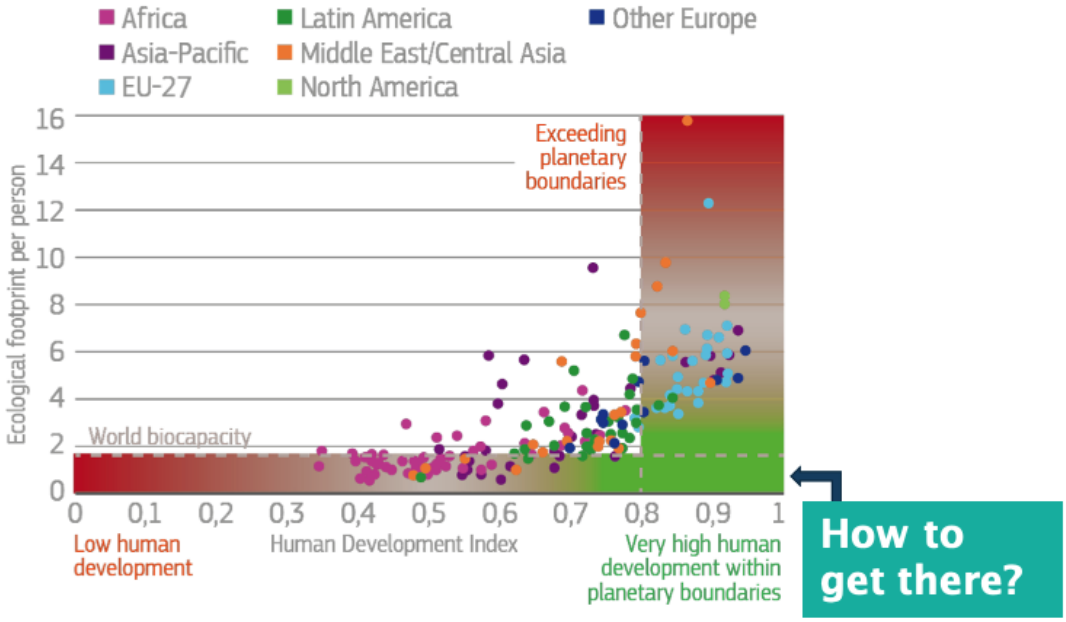
This deliverable summarises the first task of WP4, providing the diagnosis of energy demand-side policy needs at European level.

1.2 EU energy demand-side policies and instruments and new societal trends

According to the UNDP Global Footprint Network, not a single country in the world has achieved a high socio-economic development within planetary boundaries (Figure 1, Bastianioni et al. 2019, Chen et al. 2021). Human activities, which can be measured by the human development index, have resulted in several dramatic consequences, including climate crisis, biodiversity loss, deforestation, ocean acidification, and perturbations in global phosphorus and nitrogen cycles. Significant part of these consequences can be illustrated by ecological footprint per person, measured in 'global hectares' (number of productivity-weighted biologically productive hectares per person), which considers the area required to support the given country's consumption and absorb the related emissions of greenhouse gases (Global Footprint Network 2021).

In this context, all countries of our planet, including Member States of the European Union, look for pathways to high human development within planetary boundaries. To this end, we need policies that consider the intersections between socio-economic and environmental concerns and avoid compromising both. One of the fundamental areas of sustainable development of the continent, and a pillar of the EU Energy Union, is improving the energy efficiency.

Figure 1 Ecological footprint per person and human development index in countries of the United Nations



Source: S. El Khadraoui, The European Green Deal Europe's New Growth Strategy, 2020 (based on EPSC (2019), adapted from UNDP Globbal Footprint Network.

To establish the fundamental, overarching, and cross-sectoral importance of this EU policy area, the European Commission has put forward the Energy Efficiency First (EE1) principle in the recast Energy Efficiency Directive (Directive (EU) 2018/2002), which requires taking utmost account of energy efficiency in any public policies and making relevant investment decisions. The principle necessitates that:

- only the energy really needed is produced,
- investments in stranded assets are avoided,
- demand for energy is reduced and managed in a cost-effective way.

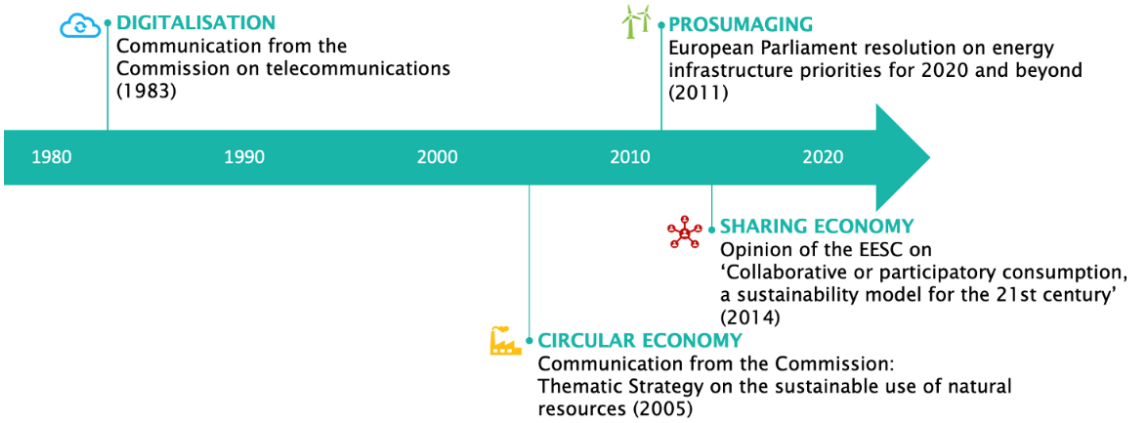
In the 'Fit for 55' package announced in July 2021, the Commission has proposed a legal basis for the application of EE1 across the Union. Implementation of this principle is progressing along with significant changes in lifestyles of Europeans, their consumer choices, as well as transition to a more circular and digital economy. All these changes are in the focus of the newTRENDs project – for further details please see our Deliverable D2.1: *Report describing the selected clusters for New Societal Trends*. We group them in the following four clusters:

- digitalisation of the economy and of private lifes,
- circular economy and low-carbon industry,
- shared economy, and
- prosumaging (combining production, consumption and storage of energy).

Each of these clusters has been addressed in the EU policy making for several years (Figure 2):

- Already in the 80's, the European Commission in its *Communication on Telecommunications – lines of action* (COM/1983/0573 final) expected that the „**Digitalisation** of the network will be the major task during this decade and absorb the bulk of planned investment resources".
- Though the concept of **circular economy** (cyclical economy) was introduced in the 60's in the American economics literature (Boulding 1966), the European Commission used it for the first time in 2005 in its communication on the *Thematic Strategy on the sustainable use of natural resources* (COM 670 (2005)). The Commission noted then China's progress on "developing a concept of <<Circular Economy>>".
- With regard to **prosumaging**, in 2011, in the *Resolution on enegy infrastructure priorities for 2020 and beyond* (2011/2034(INI)), the European Parliament emphasized: „(…) the important role that prosumers and distribution system operators (DSOs) play during the integration into the system of decentralised energy products and demand-side efficiency measures".
- Most lately, in 2014, the European Economic and Social Committee highlighted the importance of **sharing economy**, stating in its opinion on *Collaborative or participatory consumption, a sustainability model for the 21st century* (INT/686-EESC-2013-2788): „Collaborative or participatory consumption is spreading to a growing number of communities and cities around the world, which are using technological networks to do more with less, through activities such as hiring, lending, exchanging, bartering, giving away or sharing products on a previously unimaginable scale."

Figure 2 First references to digitalisation, circular economy, prosumaging and sharing economy in the EU policy making

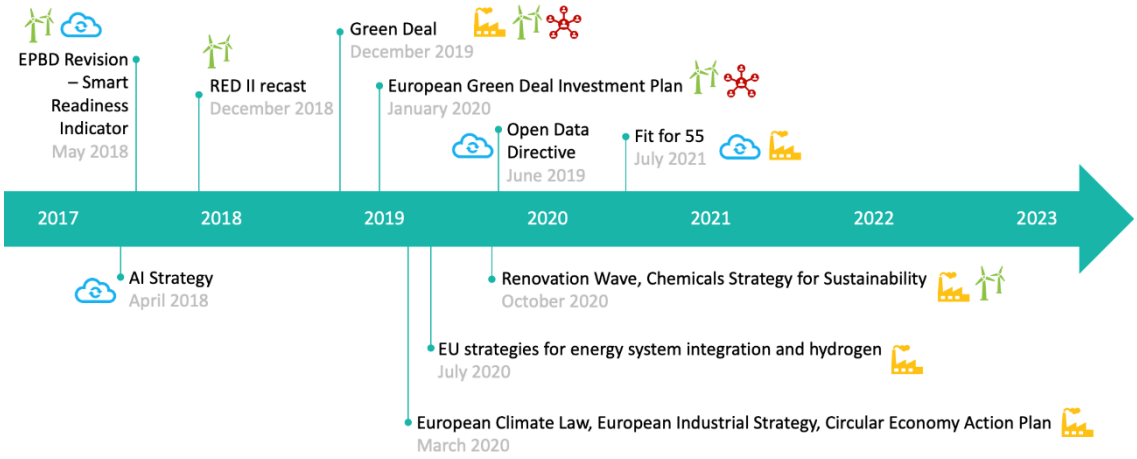


Source: RIC Pro-Akademia (own visualiztation), based on EUR-Lex query

Recently, the links between the EU policy making and new societal trends have further deepened (Figure 3). The Green Deal ambition to make Europe the first climate-neutral continent by 2050 has been followed by several specific regulations, economic and financial instruments, as well as soft measures, which

are on one hand relying on, and on the other hand, are intensifying these trends. To ensure enforcing the EE1 principle in the EU, policies shaping these trends should be properly represented in energy demand models, which are used in the European context for projections up to 2050 and beyond, as well as formulating high-level priorities and strategies. A precondition for this is a better assessment of demand-side policy needs at European level.

Figure 3 Selected recent references to digitalisation, circular economy, prosumaging and sharing economy in the EU policy making between 2017 and 2021



Source: RIC Pro-Akademia (own visualization), based on EUR-Lex query

1.3 Aim and scope of the study

The overall aim of this study is to provide an assessment of demand-side policy needs at European level, with a particular focus on effective implementation of the EE1 principle for the new societal trends. The analysis covers four focus topics of new societal trends, considered in newTRENDs as the most impactful:

- digitalisation of the economy and of private lives,
- circular economy and low-carbon industry,
- shared economy, and
- prosumaging (combining production, consumption and storage of energy).

The analysis focuses on three key elements:

1. Energy demand-side policies and policy instruments in the EU

The objective of this part is to provide an overview of diverse policy challenges and responses (policy instruments) in the field of each newTRENDs focus topic at the EU level.

2. Policy makers

The objective of this part is to identify 'the owners of policy needs', i.e. relevant policy makers at the EU level. who are involved in developing the policy instruments specified in part 1.

3. Policy needs

The objective of this part is to identify the needs of policy makers (indicated in part 2) in terms of energy demand models, and to generate insights on what policies are missing and how existing policies should be changed.

1.4 References

Bastianoni, S., Coscieme, L., Caro, D., Marchettini, N., Pulselli, F.M. The needs of sustainability: The overarching contribution of systems approach (2019) *Ecological Indicators*, 100, pp. 69-73. DOI: 10.1016/j.ecolind.2018.08.024

Boulding, K. The Economics of the Coming Spaceship Earth (1966). In: Jarrett, H., Ed., Environmental Quality in a Growing Economy, Resources for the Future/Johns Hopkins University Press, Baltimore, 3-14.

Chen, X., Li, C., Li, M., Fang, K. Revisiting the application and methodological extensions of the planetary boundaries for sustainability assessment (2021) *Science of the Total Environment*, 788, art. no. 147886. DOI: 10.1016/j.scitotenv.2021.147886

Global Footpring Network. Glossary (2021) . https://www.footprintnetwork.org/resources/glossary/

2. Methodology

2.1 Research approach

We analyse demand-side policy instruments and policy needs related to four distinct new societal trends: prosumaging, digitalisation, circular economy and low-carbon industry, and sharing economy. To provide homogenous and comparative results of policy analysis for each trend, we follow a common framework that includes:

1. Mapping and description of energy demand-side policies and instruments in the EU, and their development and implementation
2. Mapping of policy makers, responsible for development and implementation of EU-wide policies
3. Identification of policy makers' needs from the perspective of both the existing and future (emerging) policy instruments.

In the first step, demand-side policy instruments that potentially could have major impacts in the case of the New Societal Trends at European level are identified. To this end, we analyse:

- the existing EU policy instruments, i.e. instruments that are legally binding as of November 2021,
- the emerging policy instruments, i.e. instruments that are subject to ongoing policy discussions (e.g., they have been put forward in recent academic literature), or they have been formally proposed in official preparatory documents, produced during the various stages of the EU legislative and budgetary processes (including Commission legislative proposals, Council common positions, European Parliament legislative and budgetary resolutions and initiatives).

To ensure a consistent classification of policy instruments, the framework developed within the H2020 INNOPATHS project is updated and used Table 11. Unlike INNOPATHS, we focus on the policy instruments that are related to the new societal trends discussed above. As policy instruments we understand all rules and regulations, both formal (laws, regulations, policy incentives) and informal (bottom-up initiatives, cultural practices), that shape and determine the environment of a given trend. The framework includes three categories: regulation, economic and financial instruments, and soft instruments, which further divide into sub-categories. Regulations include legal acts and other formal documents, such as technical standards, industry and market regulations that should be followed by actors on a given market. Economic and financial instruments mean mechanisms that provide financial incentives (e.g. grants, tax reliefs, subsidies) for given activities and discourage for other through putting additional costs (e.g. tax, charges). Soft instruments cover informal movements,

bottom-up voluntary initiatives and approaches that aim at influencing people's behaviour and consumers' choices.

Table 1 Classification of policy instruments

Policy area	Policy type	Policy instrument
Regulation	Codes/standards/ mandates	Building/grid codes and standards
		Product standards
		Sectoral standards
		Auditing
	Obligation schemes, quotas, and manadatory targets	Obligation schemes
		Carbon Emissions Reduction Target
	Other regulation	Energy market regulations
Economic and financial instruments	Direct investment	Government procurement
		RD&D funding
	Fiscal/financial incentives	Tariffs
		Grants and subsidies
		Loans/soft loans
		Taxes—tax relief/exemption
		User charges
	Market-based instruments	GHG emissions allowances trading scheme
		White certificates
Soft instruments	Performance labels	Endorsement label
		Comparison label
	Information campaigns	
	Voluntary approaches	Negotiated Agreements (Public-private)
		Public Voluntary Schemes
		Unilateral Commitments (Private)

Source: RIC Pro-Akademia, based on Innopaths D2.2

In the second step, institutions and bodies shaping the policies (that were studied in step 1) are identified and shortly characterised. We identify the possibly lowest-level institutions, e.g. departments or task force groups responsible specifically for each policy instrument.

Finally, in the third step, we approach the policy makers identified in the second step, to investigate their policy needs. Here, we focus on the following research questions:

1. How should existing policies be changed?
2. What policies are missing?
3. What are policy maker's needs in terms of modelling?

To narrow down the scope of our analyses and provide sound and useful results, we set the following boundaries:

- We consider only those policies that are in force or under development in 2021. We do not consider policy instruments that have been withdrawn.
- We consider only policy instruments at the EU level. We exclude country-level policies.
- Behavioural change programmes promoting energy conservation within households (which can be regarded as soft policy instruments) are excluded from detailed analyses, since this topic is covered explicitly under Task 4.2 of newTRENDs.
- When analysing the policy makers and their needs, we focus on European Commission's bodies and agencies.

2.2 Methods

Our methods are desk research and policy makers involvement through semi-structured interviews and stakeholder workshops.

- Desk research

We analyse available data sources, especially the EU-level legal acts (including regulations, directives, decisions, recommendations, and opinions) as well as preparatory documents, produced during the various stages of the legislative and budgetary processes (including Commission legislative proposals, Council common positions, European Parliament legislative and budgetary resolutions and initiatives, European Economic and Social Committee opinions, Committee of the Regions opinions). To ensure a proper identification of policy makers, we extend our data sources also to European Commission websites (including organisational chart of relevant DGs), agendas of topic-related events, as well as professional social media (e.g., LinkedIn).

- Semi-structured interviews

Based on the list of relevant policy makers identified through the desk research, we perform semi-structured interviews with 8 policy makers (heads of units or policy officers) from the following 4 units of European Commission's Directorates:

1. DG ENER, Unit B1 Consumers, Local Iniatives, Just Transition (1 interview)
2. DG ENER, Unit C2 Decarbonisation and Sustainability of Energy Sources (1 interview)
3. DG GROW, Unit I3 Green and circular economy (2 interviews)

4. DG CLIMA, Unit C1 Strategy & Economic Assessment (2 interviews)
5. DG MOVE, Unit A3 Economic Analysis and Better Regulation (2 interviews).

Each policy maker was interviewed on one trend studied. Before each interview, the policy makers received a briefing document, containing our findings from desk research (the lists of existing and emerging policies related to the given trend) as well as the following list of questions for the discussion, grouped in three research questions (RQs):

RQ1: How should existing policies be changed / are expected to be changed?

1. Which instruments are most impactful / important for the TREND[1]? Why?
2. Are there any policy instruments that can have a negative impact on the TREND in the EU?
3. What are the main advantages and disadvantages of these instruments?
4. How should existing policies be changed / are expected to be changed?

RQ2: What policies are missing?

1. How do you assess the likelihood that the presented emerging policy instruments will be introduced?
2. How do you assess the potential impact of such instruments on the TREND?
3. What policy instruments should be introduced to support the EU policy regarding the TREND implementation?

RQ3: What are policy makers' needs in terms of modelling?

1. Are energy demand models used for policy design in the field of TREND? If yes, how?
2. In the context of the discussed policy instruments (both existing and emerging), what parameters/ variables resulting from energy demand models do you think would be the most useful for policymaking process?
3. Example of parameter: share of energy consumers in the residential sector that are renewables self-consumers
4. What quantitative aspects would you like to understand more to assist the policy making?

During each interview we asked the participants to express also their general opinions and thoughts, to further explore the studied research questions.

- **Stakeholder workshop**

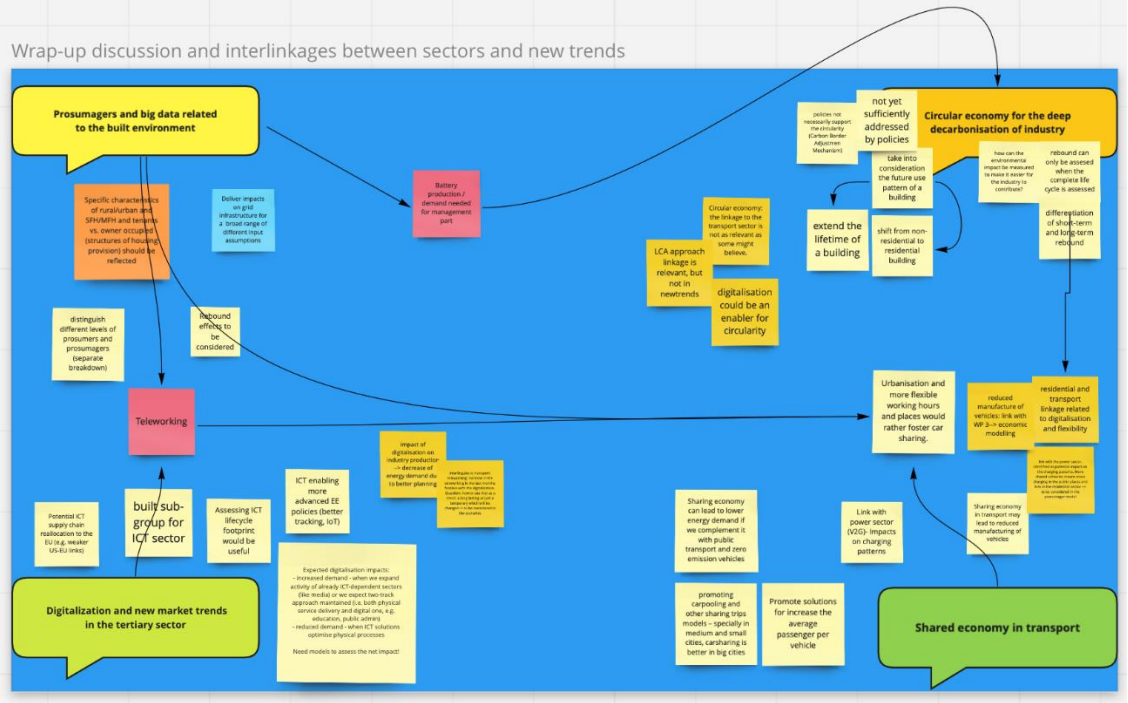
To leverage expert knowledge on the most important needs of policy makers in terms of energy demand modelling in the context of new societal trends, and their assessment of the existing and emerging policies affecting new societal trends, we designed and organised a stakeholder workshop. During this intensive two-hour event, which took place on 22/10/2021, 27 invited experts

1 The word *TREND* was replaced by the name of the relevant new societal trend that was the subject of the given interview (digitalisation, circular economy and low-carbon industry, shared economy, or prosumaging).

(including policy makers and researchers from the European Commission and the Joint Research Centre) and newTRENDs team members worked together to address the three research questions listed above.

Given the ongoing COVID-19 pandemic and the accompanying restrictions on travel and person to person meetings, the workshop took place using two online platforms. Zoom (zoom.com) was used for audio and visual communication, while Miro (miro.com) was used as an online whiteboard application for interactive exchanges (Figure 4).

Figure 4 Summary of the plenary discussion notes from the stakeholder workshop taken using the online interactive whiteboard Miro



Source: RIC Pro-Akademia, based on Miro

Further information on the workshop is provided by newTRENDs Deliverable D8.6 *Report on the first stakeholder meeting*.

3. Prosumaging

3.1 Identification of energy demand-side policies and instruments in the EU

This section analyses and assesses the existing and emerging (potential) energy demand-side policies and instruments (regulations, economic and financial instruments, and soft instruments) addressing prosumaging in the European Union (Table 2).

Table 2 Existing and emerging EU-level energy demand-side policies and instruments in the field of prosumaging

Policy instrument category			Existing EU policy instruments	Emerging EU policy instruments
Regulation	Codes/ standards/ mandates	Building/ grid codes and standards	- Rights of renewables self-consumers (RED II, art. 21) - Energy required by nZEBs should be covered to a very significant extent by RES, including energy produced on-site or nearby (EPBD, art. 2)	-
		Product standards	- Numerous IEC standards, e.g., for PV systems, electric installations, and batteries	-
		Auditing	- Summary & assessment of the enabling framework for renewables self-consumption to be included in the MS' National Energy and Climate Plans and progress reports (RED II, art. 21 (6))	- Benchmarking of prosumaging across the EU (similar to benchmaking of Smart Metering rollouts)
	Obligation schemes/ quotas/ mandatory targets	Mandatory targets	- At least 32% of RES in the EU gross final consumption of energy in 2030 (RED II art. 3 (1)) - Measures promoting the installation of small-scale RES on or in buildings eligible to be considered for the fulfilment of the energy savings obligation (EED, art. 7 & Annex V (1)(e))	- Obligation for MSs to require the use of minimum levels of energy from RES in buildings in their building regulations and codes and, where applicable, in their support schemes (Fit for 55 proposal for RED II recast, art. 15a) - At least 40% of RES in the EU gross final consumption of energy in 2030 (Fit for 55 proposal for RED II recast) - Set targets for MSs on minimum share of prosumers in the population of final energy consumers (Petrick et al. 2019) - Stringent and quantified RES targets for building sector, e.g., 50% of RES

Policy instrument category			Existing EU policy instruments	Emerging EU policy instruments
				share in buildings; ensuring that 40% of heating is provided by heat pumps in 2030 and 70% in 2050 (European Commission 2021a)
		Carbon Emissions Reduction Target	-	- Obligation for MSs to link any support for prosumaging with emissions reduction and/or energy savings (Jahn & Rosenow 2019)
		Energy market regulations	- MSs to put in place an enabling framework to promote and facilitate the development of renewables self-consumption (RED II, art. 21 (6)) - Final customers entitled to act as active customers (ED, art. 15)	-
Economic and financial instruments	Direct investment	Government procurement	- Public procurement on renewables self-consumption under Renovation Wave (renovation of at least 3 % of the total floor area of heated and/or cooled public buildings each year) (EED, art. 5)	- Include PV systems and batteries in Green Public Procurement scheme (Dunlop et al. 2018; European Commission 2020)
		RD&D funding	- Horizon Europe, including Pillar II Global Challenges (…), Cluster 5: Climate, Energy and Mobility	-
		Grants and subsidies	- European Regional Development Fund, Cohesion Fund, Just Transition Fund	- Obligation for MSs to check that any grants/subsidies for prosumaging are offered to stakeholders meeting certain minimum energy efficiency standards (Jahn & Rosenow 2019)
		Loans/soft loans	- InvestEU programme	- Require MSs to establish national loan schemes/guarantees for prosumagers (Scarpellini et al. 2021)

Policy instrument category			Existing EU policy instruments	Emerging EU policy instruments
	Market- based instruments	GHG emissions allowances trading scheme	- MSs to use revenues from auctioning of GHG emission allowances to develop renewable energies (ETS Directive, art. 10(3)(b))	- Require MS to earmark certain part of revenues from GHG auctioning to specific prosumaging-related purposes (Kochanski et al. 2020)
	Fiscal/ financial incentives	Tarifs	-	- Introduce the right of consumers for time-differentiated network tariffs in all MSs (ENEFIRST 2021)
		Taxes – tax reliefs/exemptions	-	- Exemptions from VAT, e.g., for PVs / batteries (Kochanski et al. 2020)
		User charges	- Prohibited and permissible forms of charges and fees for renewables self-consumers (RED II, art. 21)	- Change in conditions for permissible forms of charges and fees for renewables self-consumers (CEER 2021)
Soft instruments	Information campaigns	Contact points in MSs	- MSs to establish contact points for renewables self-consumers and develop programmes to inform citizens on renewables self-consumption (RED II, art. 16 & 18)	- Introduce obligatory quality assessment in information campaigns (e.g., consumers‘ satisfaction) (Rivas et al. 2016)
	Performance labels	Endorsement label	-	- Introduction of Eco-Design measures for PV panels and inverters (Polverini et al. 2021a) - Introduction of Energy Labels for residential PV systems (Polverini et al. 2021b)
		Comparison label	Smart Readiness Indicator (EPBD recast)	-
	Voluntary approaches	Negotiated Agreements (Public-private sector)	-	- Establish an EU-level PPP to directly support prosumaging (e.g., through R&I)
		Public Voluntary Schemes	-	- Introduce an EU-level voluntary scheme on prosumaging for local

Policy instrument category			Existing EU policy instruments	Emerging EU policy instruments
				authorities (e.g., within the Covenant of Mayors)
		Unilateral Commitments (Private sector)	- Renewable Energy Communities (RED II, art. 2 (16)) - Citizen Energy Communities (ED, art. 2 (11))	-

3.1.1 Regulation

Building/grid codes and standards

Grid codes: The primary EU-level legal acts affecting Member States' grid codes are:

- the Renewable Energy Directive (RED II) (European Parliament; Council of the European Union 2018)
- the Electricity Directive (ED) (European Parliament; Council of the European Union 2019a)
- the Electricity Regulation (ER) (European Parliament; Council of the European Union 2019b)

RED II establishes common principles and rules to remove barriers as well as to stimulate investments and cost reductions in renewable energy technologies, also through prosumaging. In particular, it defines 'renewables self-consumer' as:

> 'a final customer operating within its premises located within confined boundaries or, where permitted by a Member State, within other premises, who generates renewable electricity for its own consumption, and who may store or sell self-generated renewable electricity, provided that, for a non-household renewables self-consumer, those activities do not constitute its primary commercial or professional activity' (RED II, art. 2).

On the other hand, ED defines 'active customer' as:

> 'a final customer, or a group of jointly acting final customers, who consumes or stores electricity generated within its premises located within confined boundaries or, where permitted by a Member State, within other premises, or who sells self-generated electricity or participates in flexibility or energy efficiency schemes, provided that those activities do not constitute its primary commercial or professional activity' (ED, art. 2(8)).

Both RED II and ED provide several requirements for the EU Member States with regard to prosumaging, especially on renewables self-consumers' rights (Table 3).

Table 3 Rights of renewables self-consumers and active customers in the EU – requirements for the Member States

Requirements for the Member States	Reference
Ensure that active customers are entitled to sell self-generated electricity, including through power purchase agreements	ED art. 15
Ensure that the renewables self-consumers may use a simple-notification procedure for grid connections to DSOs (for electrical capacity of 10,8 kW or less; Member States may opt for increasing this threshold up to 50 kW)	RED II art. 17 (1) and (2)
Ensure that consumers are entitled to become renewables self-consumers	RED II art. 21 (1)
Ensure that renewables self-consumers are entitled to maintain their rights and obligations as final consumers	RED II art. 21 (2), point (c)
Ensure that renewables self-consumers are entitled to receive remuneration, including, where applicable, through support schemes, for the self-generated renewable electricity that they feed into the grid, which: - *reflects the market value* of that electricity and - which *may* take into account its long-term value to the grid, the environment and society.	RED II art. 21 (2), point (d)
Ensure that renewables self-consumers located in the same building are entitled to: - engage jointly in to generating, storing and selling their excess production of renewable electricity; - arrange sharing of renewable energy that is produced on their site or sites between themselves.	RED II art. 21 (4)
Ensure that the renewables self-consumer's installation may be owned by a third party or managed by a third party, provided that the third party remains subject to the renewables self-consumer's instructions.	RED II art. 21 (5)

Source: RIC Pro-Akademia

In addition to REDII and ED, the ER provides additional specific requirements for rearranging scheduled generation and consumption by renewables self-consumers (redispatching). It requires that renewable self-generated electricity which is not fed into the power grids shall not be subject to non-market-based downward redispatching unless no other solution would resolve network security issues (ER, art. 13(6) c).

Relevance: RED II, ED and ER are the primary EU legal acts that affect Member States' grid codes. RED II and ED introduce the definitions of renewables self-consumers and active customers. Both directives establish several requirements for the EU Member States in the fields related to prosumaging. These grid codes-related regulations can be regarded as regulatory instruments that are effectively used at the EU level for stimulating prosumaging.

Building codes:

There are two main EU-level regulations that affect building codes with regard to prosumaging: REDII and the Energy Performance of Buildings Directive (EPBD) (European Parliament; Council of the European Union 2010).

The EPBD is the primary EU-level legal act affecting Member States' building codes in general. Its Article 2 introduces the definition of nearly-zero energy buildings. It requires that the energy required by such buildings should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby. However, the EPBD does not impose any specific and explicit requirements on Member States with regard to renewables self-consumption. On the other hand, EPBD (article 8) provides such specific and explicit requirements with regard to other features of buildings, e.g.:

- 'Member States shall require new buildings (…) to be equipped with self-regulating devices for the separate regulation of the temperature in each room (…)'
- 'With regard to new residential buildings and residential buildings undergoing major renovation, with more than ten parking spaces, Member States shall ensure the installation of ducting infrastructure, namely conduits for electric cables, for every parking space to enable the installation, at a later stage, of recharging points for electric vehicles (…)'.

The second significant EU-level regulation affecting building codes, i.e. RED II, requires Member States to introduce measures in national building regulations and codes to increase the share of energy from renewable sources in the building sector (RED II art. 15 (4)).

In July 2021, the European Commission put forward a proposal for RED II recast, referred to further as 'Fit for 55 proposal for RED II recast' (European Commission 2021b). In this legislative proposal, the EC proposed an obligation for Member States to require the use of minimum levels of energy from renewable sources in buildings in their building regulations and codes and, where applicable, in their support schemes or by other means with equivalent effect (Fit for 55 proposal for RED II recast, art. 15a).

Relevance: EPBD and RED II are the EU-level regulation that have a significant influence on Member States' building codes. However, the currently binding regulations can be regarded as regulatory instruments that are not effectively used at the EU level for stimulating prosumaging, since they do not provide specific and explicit requirements on this area for the Member States' building codes. The recent EC proposal for REDII recast is expected to improve this situation.

Product standards

Prosumaging products and related standards can be grouped into three main categories: household-level electricity generation (in particular: PV systems and their components), distribution (in particular: electricity installations) and storage (in particular: batteries) (Table 4). The standards for these types of products are provided mainly by the International Electrotechnical Commission (IEC) (Escribano et al. 2016).

Table 4 International standards concerning prosumaging products used in the EU

Prosumaging area (and product type)	Standard number	Standard name
Electricity generation (PV systems and their components)	IEC 50583	Photovoltaics in buildings
	IEC 60068	Environmental testing
	IEC 60891	Photovoltaic devices - Procedures for temperature and irradiance corrections to measured I-V characteristics
	IEC 60904	Photovoltaic devices - Part 1: Measurement of photovoltaic current-voltage characteristics
	IEC 61215	Crystalline silicon terrestrial photovoltaic (PV) Modules
	IEC 61646	Thin-film terrestrial photovoltaic (PV) modules
	IEC 61724	Photovoltaic system performance
	IEC 61727	Photovoltaic (PV) Systems - Characteristics of the Utility Interface
	IEC 61730	Photovoltaic (PV) module safety qualification
	IEC 61853	Photovoltaic (PV) module performance testing and energy rating
	IEC 62093	Balance-of-system components for photovoltaic systems
	IEC 62109	Safety of power converters for use in photovoltaic power systems
	IEC 62116	Utility-interconnected photovoltaic inverters
	IEC 62446	Photovoltaic (PV) systems - Requirements for testing, documentation and maintenance
	IEC 62509	Battery charge controllers for photovoltaic systems
	IEC 62548	Photovoltaic (PV) arrays - Design requirements
	IEC 62738	Ground-mounted photovoltaic power plants
	IEC 63019	Photovoltaic power systems (PVPS)
Electricity distribution (electric installations)	IEC 60050	International Electrotechnical Vocabulary (IEV)
	IEC 60364	Electrical Installations for Buildings
	IEC 60664	Insulation coordination for equipment within low-voltage systems

Prosumaging area (and product type)	Standard number	Standard name
	IEC 61140	Protection against electric shock
	IEC 61557	Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC
	IEC 61643	Low-voltage surge protective devices
	IEC 62305	Protection against lightning
Electricity storage (batteries)	IEC 60622, 61434	Secondary cells and batteries containing alkaline or other non-acid electrolytes
	IEC 60896	Stationary lead-acid batteries
	IEC 61056	General purpose lead-acid batteries (valve-regulated types)
	IEC 61438	Possible safety and health hazards in the use of alkaline secondary cells and batteries
	IEC 62281	Safety of primary and secondary lithium cells and batteries during transport
	IEC 61960	Secondary cells and batteries containing alkaline or other non-acid electrolytes
	IEC 62485	Safety requirements for secondary batteries and battery installations
	IEC 63056	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries for use in electrical energy storage systems

Source: RIC Pro-Akademia, based on (Escribano et al. 2016), (Luthander et al. 2015), (EnergyVille 2021), (Dodd et al. 2020)

Relevance: Product standards for PV systems, electric installations and electricity storage are effectively used at the EU level for stimulating prosumaging. They provide specific and explicit technical requirements on prosumaging-related products.

Sectoral standards

Sectoral standards specify requirements for certain sectors (industry, transport, etc.) for increasing energy efficiency (REN21 2018). While in the EU there are no specific regulations that would directly address energy efficiency improvements in specific sectors through prosumaging, the Energy Efficiency Directive (EED) requires Member States to increase energy efficiency of the demand side, also through renewables (Directive 2012/27/EU)(European Parliament; Council of the European Union 2012). In particular, measures promoting the installation of small-scale renewable energy technologies on or in buildings are eligible to be considered for the fulfilment of the energy savings to be achieved by Member States, according to art. 7 of the EED, provided that they result in verifiable, and measurable or estimable, energy savings (Annex V (2)(e) to the 2012/27/EU Directive).

Relevance: There are no specific EU sectoral standards that would directly address energy efficiency improvements in specific sectors through prosumaging. Still, EED considers prosumaging-related activities (installation of small-scale renewable energy technologies on or in buildings) as eligible measures to be considered for the fulfilment of the energy savings to be achieved by Member States by 2030.

Auditing

Auditing of prosumaging at the EU level is implemented on the basis of RED II, ED and the Governance Regulation (European Parliament; Council of the European Union 2018b).

According to the RED II, Member States shall include a summary of the policies and measures under the *enabling framework to promote and facilitate the development of renewables self-consumption* and an assessment of their implementation respectively in their integrated national energy and climate plans and progress reports pursuant to the Governance Regulation (RED II, art. 21 (6)).

According to the ED, Member States shall ensure that their regulatory authorities monitor the removal of unjustified obstacles to and restrictions on the development of consumption of self- generated electricity (ED, art. 59).

According to the Governance Regulation, Member States shall include in their integrated national energy and climate progress reports information on the implementation of, where applicable:

- national trajectories and objectives, including on renewables self-consumers (Governance Regulation, art. 20 point (a)(5));
- national objectives and measures with regard to ensuring that consumers participate in the energy system and benefits from self-generation (Governance Regulation, art. 23 (1) point (f)).

Relevance: RED II, ED, and the Governance Regulation are the primary legal acts that introduce the requirements for auditing the prosumaging-related progress by the Member States. However, the national reporting on renewables self-consumption and self-generation have to be provided only ‘where applicable’. Still, the obligation of monitoring the removal of unjustified obstacles to and restrictions on the development of consumption of self-generated electricity is unconditional.

Obligation schemes, quotas, and mandatory targets

There are two main binding EU-level mandatory targets that affect prosumaging.

The first one is set in RED II. It requires Member States to collectively ensure that the share of energy from renewable sources in the EU's gross final consumption of energy in 2030 is at least 32 % (RED II art. 3 (1)). The Fit for 55 proposal for

RED II recast assesses that this target is not sufficient in view of stringent climate objectives and needs to be increased to 38-40%.

The second target is provided by the EED. It requires Member States to collectively achieve cumulative end-use energy savings at least equivalent to new savings each year from 1 January 2021 to 31 December 2030 of 0,8 % of annual final energy consumption, averaged over the most recent three-year period prior to 1 January 2019 (EED, art 7 (1)). Measures promoting the installation of small-scale renewable energy technologies on or in buildings may be eligible to be considered for the fulfilment of energy savings targeted by art. 7 of EED, if they result in verifiable, and measurable or estimable, energy savings (EED, Annex V (1)(e)).

Furthermore, the regulations concerning nearly Zero Energy Buildings (nZEB) introduced by EPBD, can be regarded as an important obligation scheme affecting prosumaging in the EU. All new buildings in the Union must be nZEB from 31 December 2020, while all new public buildings needed to be nZEB already since 31 December 2018.

Still, as of 2021, there has been no EU-level obligation scheme *specifically* focusing on prosumaging. However, examples of such policy measures are emerging at regional/state level both in Europe and elsewhere:

- Starting from 2022, German state of Baden-Württemberg requires all new non-residential buildings to have solar panels on them (Shahan 2020);
- Starting from 2020, US state of California requires all residential buildings lower than three stories to have PV with an installed power sufficient to offset the annual average energy demand of the household. The Californian Solar Mandate allows for trading the obligatory 'PV credits' through 'Storage credits' (SolarPower Europe 2020).

The Fit for 55 proposal for REDII recast provides the first step towards introducing similar regulatory solutions at the EU level. It proposes an obligation for Member States to require the use of minimum levels of energy from renewable sources in buildings in their building regulations and codes and, where applicable, in their support schemes or by other means with equivalent effect (Fit for 55 proposal for REDII recast, art. 15a).

Relevance: REDII and EED are the primary sources of the currently binding EU-level mandatory targets that stimulate prosumaging, yet they are not specifically focused on prosumaging. To some extent, also the mandatory implementation of nZEB's across the EU can be regarded as an important regulatory stimulus. Examples of purely 'prosumaging-focused' regulations are being tested at national level, e.g., in Germany and the US. The Fit for 55 proposal for REDII recast provides the first step in this direction – an obligation for Member States to establish minimum levels of energy from renewable sources in buildings.

Carbon Emissions Reduction Target

No EU-level regulation setting Carbon Emissions Reduction Targets for prosumaging has been identified.

Relevance: Carbon Emissions Reduction Targets can be regarded as regulation instruments that are not used to directly support prosumaging at the EU level.

Energy market regulation

The EU-level energy market rules affecting prosumaging are defined in REDII, ER, and ED.

REDII provides several requirements for Member States with regard to planning and governance of renewables self-consumption. In particular, Member States need to:

- Ensure that their relevant authorities include provisions for renewables self-consumption in their planning (RED II, art. 15 (3))
- Encourage local and regional administrative bodies to consult the network operators to reflect the impact of specific provisions on renewables self-consumption on the infrastructure development plans of the operators (REDII, art. 15 (3)).
- Put in place *an enabling framework* to promote and facilitate the development of renewables self-consumption based on an assessment of the existing unjustified barriers to, and of the potential of, renewables self-consumption in their territories and energy networks. That *enabling framework* shall, *inter alia*, address: (1) accessibility of renewables self-consumption to all final customers, including those in low-income or vulnerable households; (2) unjustified barriers to the financing and other unjustified regulatory barriers; (3) incentives to building owners to create opportunities for renewables self-consumption, including for tenants; (4) non-discriminatory access to support schemes as well as to all electricity market segments; (5) contribution of renewables self-consumers to the overall cost sharing of the system when electricity is fed into the grid (REDII, art. 21 (6)).

Additional market regulations directly related to prosumaging are provided by the ER. It requires Member States to consider enabling self-generation, energy storage, demand side measures and energy efficiency by adopting measures to eliminate any identified regulatory distortions (ER, art. 18 (1e)). Furthermore,

new EU-level energy market regulations stimulating renewables self-consumption are expected by some stakeholders[2].

Further significant regulations are provided by ED. It requires Member States to ensure that final customers are entitled to act as active customers without being subject to disproportionate or discriminatory technical requirements, administrative requirements, procedures and charges, and to network charges that are not cost-reflective (art. 15). What is more, several rights of active customers have been specified, including right to sell self-generated electricity. Additionally, specific rights of active customers that own an energy storage facility have been set as well (ED, art. 15(5)).

With regard to collective prosumaging, the ED provides differentiated distribution tariff consideration obligation on Member States (ED, art. 18 (7)).

Furthermore, the ED sets out a framework for procurement of local flexiblity services (ED, art. 32). It requires Member States to allow and provide incentives to distribution system operators to procure flexibility services from providers of distributed generation, demand response or energy storage.

Relevance: EU-level energy market regulations provide several significant requirements for improved planning and governance of renewables self-consumption by the Member States.

3.1.1.1 Economic and financial instruments

Government procurement

Between 2014 and 2020 a total of over 1200 public procurements for prosumaging products (including in particular solar PV and batteries) were awarded at the EU-level (Figure 5). Poland was the primary EU market in terms of the number of awarded PV contracts by public bodies in the field of PV, while French public bodies awarded most contracts in the field of batteries (482 and 99 contracts awarded, respectively).

As of August 2021, no EU-level green public procurement criteria exist for the solar PV products or batteries. At national level such criteria exist at Member State level (e.g., in France), and outside the EU (e.g., in the US) (Dodd et al. 2020).

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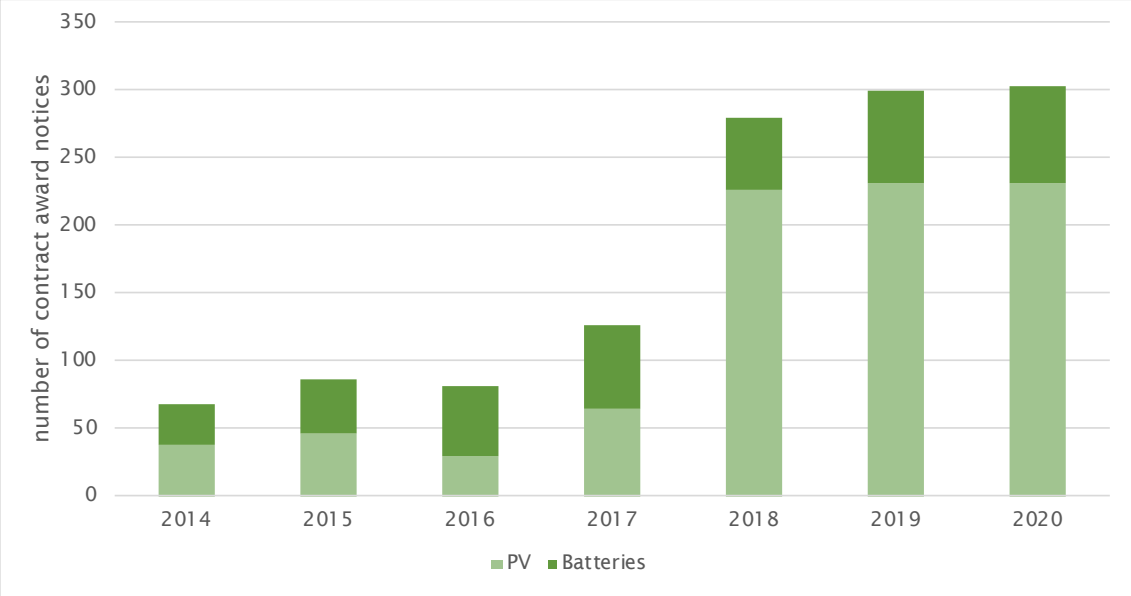
2 In the consultation process of REDII recast, the EC received recommendations from stakeholders to further support the uptake of renewables self-consumption. However, in the announced 2021 proposal for REDII recast, the EC has included such measures in the group of early discarded options for increasing the uptake of renewable electricity. The Commission justified this decision by the fact that the recently introduced legislation changes (RED II recast of 2018) are still being implemented in the Member States.

Figure 5 Public procurements for PV and batteries awarded in the EU between 2014 and 2020– notices published in the Tenders European Daily (TED) – Supplement to the Official Journal of the EU



Source: RIC Pro-Akademia based on EU TED portal (query for 9331200 and 31440000 CPV codes)

Relevance: Public bodies can fulfil an exemplary role as regards prosumaging. Their activities in this area can be implemented together with other building renovation activities implemented within the requirements set by art. 5 of EED (renovation of at least 3 % of the total floor area of heated and/or cooled public buildings each year). By creating demand for prosumaging products, public procurement is a stimulus for the development of renewables self-consumption technologies that are also available outside the public sector. Inclusion of prosumaging-related products in the EU Green Public Procurement could further facilitate this process.

RD&D funding

RD&D funding for prosumaging is available in the EU in the Horizon Europe programme, with the overall budget €95.5 billion for the years 2021-2027. Renewables self-consumption is particularly supported within *Pillar II Global Challenges and European Industrial Competitiveness,* under *Cluster 5: Climate, Energy and Mobility.* According to the Horizon Europe Strategic Plan 2021-2024, the cluster activities are expected to result, *inter alia*, in „more efficient, clean, sustainable, secure and competitive energy supply through new solutions for smart grids and energy systems based on more performant renewable energy solutions". Examples of Horizon Europe calls that directly address prosumaging include HORIZON-CL5-2021-D3-02. The expected impact of projects that will be funded in this call includes, *inter alia,* enhancing consumer satisfaction and

increased system flexibility thanks to facilitating their investment and engagement in the energy transition through self-consumption.

Relevance: Horizon Europe programme supports research and development of novel solutions for facilitating consumers investment and engagement in renewables self-consumption.

Tariffs

Tariffs have multiple functions with regard to prosumaging (Table 5). The primary EU-level regulations affect the tariff schemes related with renewable self-consumption through:

- the ER – it requires that regulatory authorities to consider time-differentiated network tariffs when fixing or approving transmission tariffs and distribution tariffs or their methodologies, where smart metering systems have been implemented (ER, art. 18 (7)). Still, no unconditional requirement for dynamic pricing tariffs has been introduced in the EU regulations.
- the RED II – it designates feed-in tariffs as potential support schemes that can be applied by Member States to promote the use of energy from renewable sources, also by renewable self-consumers (RED II, art. 2 (5) and 21 (2)(d));
- the ED – it provides important regulations facilitating local energy tariffs that incentivise renewable self-consumption. For example, it allows Member States to exempt the operators of local closed operation systems from tariff approval (ED, art. 38 (2)(b)).

Table 5 Tariffs in the EU, their functions with regard to prosumaging and beneficiaries

Tariff type	Function with regard to prosumaging	Beneficiaries
Standard tariffs for electricity consumers	Cost recovery for grid improvements required for distributed generation through prosumaging	DSOs + indirectly: prosumagers
Feed-in tariffs for electricity prosumagers	Promoting renewable energy generation through incentivising investment in prosumaging	Prosumagers
Local energy tariffs	Peak shaving through incentivising renewables consumption when local prosumers are exporting Promoting renewable energy generation and consumption	Prosumagers + their neighbours (regular consumers)

Tariff type	Function with regard to prosumaging	Beneficiaries
	through more competitive pricing	
Time-of-use tariffs	Peak shaving through incentivising investment in energy storage by prosumagers	Regular consumers Prosumagers DSOs

Source: RIC Pro-Akademia

Relevance: EU-level regulations concerning tariffs provide support for engagement of consumers in prosumaging through several types of permissible tariff schemes. Different types of tariffs allowed by the EU law have several different functions with regard to prosumaging.

Grants and subsidies

European Regional Development Fund (ERDF) and Cohesion Fund (CF)

The primary source of EU grants are the European Regional Development Fund (ERDF) and Cohesion Fund (CF), which are regulated under the ERDF & CF Regulation (European Parliament; Council of the European Union). Under the Policy Objective 2, the ERDF supports *inter alia* promoting renewable energy in accordance with REDII (ERDF & CF Regulation, art. 3(1)(b)(ii)). The CF supports *inter alia* investments in renewable energy (ERDF & CF Regulation, art. 6 (1)(a)). However, in the list of expected outputs of the intervention, neither funds provide information explicitly related to the targeted number of prosumagers in the EU (which is the case with regard to other renewable energy policy areas, such as energy communities – RCO 97 *Renewable energy communities supported*).

Relevance: ERDF and CF are financial instruments that are actively used at EU level to support renewable energy use. Still, the top-level regulations on these funding sources do not provide explicit targets with regard to prosumaging.

Just Transition Fund (JTF)

The JTF is a part of the Cohesion Policy 2021-2027 and it is regulated under the JTF Regulation (European Parliament; Council of the European Union). It aims at supporting EU regions that will be the most negatively impacted by the climate neutrality transformation of the EU. The fund supports a wide range of activities, including investments in renewable energy (JTF Regulation, art. 8(2)(e)). However, in the list of expected outputs of the intervention, it does not provide information explicitly related to the targeted number of prosumagers in the supported regions (only to the overall production capacity targets, e.g., RCO 22 *Additional production capacity for renewable energy*). The fund is available only for eligible regions, identified as the most affected by the transition towards climate neutrality.

Relevance: Prosumaging activities in JFT eligible regions can use JFT for faster modernisation of their energy systems towards more sustainable solutions. Still, the EU level regulation on this fund does not provide explicit targets with regard to prosumaging.

Loans/soft loans

InvestEU

The major source of loans for prosumaging at the EU-level is the InvestEU Programme, which is a major element of the European Union's Recovery Plan for Europe. It is regulated under the InvestEU Regulation (European Parliament; Council of the European Union 2021c). Its budget stems partly from Next Generation EU, a temporary recovery instrument that allows the European Commission to raise funds to help repair the damages brought about by COVID-19. The InvestEU Fund will mobilise at least €372 billion through an EU guarantee of €26.2 billion in support of investment by the European Investment Bank (EIB) Group and other financial institutions (European Commission 2021c). Investment in renewable energy is one of the targets of the programme (InvestEU Regulation, art. 8(1)(a)). However, in the list of expected key performance and monitoring indicators of the intervention, it does not provide information explicitly related to the targeted number of prosumagers (only to the overall production capacity targets, e.g., *Additional renewable and other safe and sustainable zero and low-emission energy generation capacity installed*).

Relevance: Loans through InvestEU can be regarded as financial incentives that are expected to be used to support prosumaging. Still, the EU level regulation on this fund does not provide explicit targets with regard to renewable self-consumption.

Taxes — tax relief/exemption

The European Commission obliges Member States to exempt certain goods and services from taxation, especially with regard to the areas of public interest (e.g., medicines, education) (European Commission 2019b). However, prosumaging products are not included on the list of supplies that are exempt from the Value Added Tax (with the right to deduct, without the right to deduct or any other exemption) (Council of the European Union 2006).

Relevance: Tax reliefs or exemptions can be regarded as fiscal incentives that are not used at the EU level to support prosumaging.

User charges

The EU-level regulations on user charges for prosumagers are provided by RED II (Table 6). They differentiate the charges prohibited and permissible levels depending on the subject: whether the electricity is: consumed from or fed into the grid; stored and remaining within the prosumager premises; remaining within the prosumager's premises.

Table 6 Requirements for the Member States from RED II in the field of prohibited and permissible charges, procedures, and fees for renewable self-consumption

Regulatory area	Requirements for the Member States	Reference
Prohibited forms of charges, procedures and fees	1) in relation to the electricity that renewables self-consumers *consume from or feed into the grid:* - discriminatory or disproportionate procedures and charges - network charges that are not cost-reflective	RED II, art. 21(2)(a)(i)
	2) in relation to the *stored renewable electricity* for self-consumption, *remaining within self-consumer' premises*: - any double charges, including network charges	RED II, art. 21(2)(b)
	3) in relation to the self-generated electricity from renewable sources *remaining within self-consumer' premises:* - discriminatory or disproportionate procedures - any charges or fees	RED II, art. 21(2)(a)(ii)
Permissible forms of charges and fees	1) 1) in relation to renewable self-consumers' self-generated renewable electricity remaining within their premises – non-discriminatory and proportionate charges and fees may be applied: - if the self-generated renewable electricity is effectively supported via support schemes, only to the extent that the economic viability of the project and the incentive effect of such support are not undermined; - if the overall share of self-consumption installations exceeds 8 % of the total installed electricity capacity of a Member State, and if an additional condition is met concerning disproportionate burden on electricity system or excessive incentives are provided (from 1 December 2026) - if the self-generated renewable electricity is produced in installations with a total capacity of more than 30 kW.	RED II, art. 21 (3)

Source: RIC Pro-Akademia

Furthermore, the ER requires that any network charges shall not discriminate either positively or negatively against energy storage or aggregation and shall

not create disincentives for self-generation, self-consumption or for participation in demand response (ER, art. 18 (1)).

Relevance: EU-level regulations concerning user charges provide support for engagement of consumers in prosumaging through establishing several prohibited forms of user charges and fees. Still, the existing regulations also provide Member States with a possibility of introducing non-discriminatory and proportionate charges and fees with regard to the renewable self-consumers' self-generated renewable electricity that is remaining within their premises. These rules may be used by Member States to limit the development of prosumaging initiatives, e.g., in case they are judged to be a disproportionate burden on electricity system or excessive incentives are provided.

GHG emissions allowances trading scheme

The EU Emission Trading System (ETS) is regulated by the ETS Directive (European Parliament; Council of the European Union 2003). It requires the EU Member States to dedicate a significant part of their revenues from actioning of GHG emission allowances to develop renewable energies (ETS Directive, art. 10(3)(b)). However, the Directive does not provide information explicitly related to prosumaging as a specific renewable energy measure that should be targeted by the Member States.

Since the ETS is the cornerstone of the EU climate policy, its regulations and coverage are often discussed and analysed. For instance, to further support the EU climate goals, a potential expansion of the ETS coverage to emissions from heating of building sector has been proposed, which would promote the use of heat pumps (Guzs 2019). In turn, in such a case, a further dissemination of prosumaging installations could be expected as well, especially as the carbon price grows.

Relevance: GHG emissions allowances trading scheme can be regarded as financial instrument that is used at the EU level to support renewable energy generation, yet it does not address specifically prosumaging. Still, the experiences of some member states indicate that this financial instrument is used to support prosumaging. For example, in Poland the revenues from GHG emission allowances trading are the funding sources for grants to prosumers through 'Mój Prad' programme.

White certificates

White certificate trading scheme is a market-based financial system that enables companies obliged to reach certain energy savings to trade certificates that are issued for these savings. It can be regarded as a financial instrument that is not applicable for prosumaging.

Relevance: White certificates can be regarded as financial instruments that are not relevant for prosumaging support.

3.1.1.1.1 Soft instruments

Endorsement label

As of July 2021, Ecodesign, Energy Label and Ecolabel schemes did not cover PV products/systems or batteries for prosumagers. Still, PV panels and inverters have been considered to be covered by the EU Eco-Design, Energy Label, Ecolabel and Green Public Procurement since 2016 (European Technology and Innovation Platform for Photovoltaics 2021). Recent studies show that the introduction of a combination of Ecodesign and Energy Label, would improve the life cycle energy yield (Dodd et al. 2020). In 2021, the European Technology and Innovation Platform for Photovoltaics proposed a labelling scheme for PV modules and inverters. It covers several characteristics of such products, including their Global Warming Potential, Gross Energy Requirement, Hazardous Substances, Recycled Content, Recyclability and Repairability and Quality (European Technology and Innovation Platform for Photovoltaics 2021). Similar, yet less comprehensive, labelling schemes have been introduced outside the EU, e.g., in India. The 'Star Rating' (with 5 classes distinguished) are offered for PV modules depending on their efficiency (%) and temperature coefficient for power (Bureau of Energy Efficiency 2019).

The European Commission has recently concluded that Eco-Design measures will be introduced for PV panels and inverters, while residential PV systems will be covered by the Energy Label (European Technology and Innovation Platform for Photovoltaics 2021).

Relevance: Endorsement labels can be regarded as soft instruments that are not widely used at EU level to support prosumaging. However, there are ongoing works on the inclusion of important prosumaging solutions in such schemes.

Information campaigns

The EU regulations require Member States to ensure a wide access to information for renewable self-consumers (Table 7).

Table 7 Requirements for the Member States from the EU Renewable Energy Directive in the field of renewable self-consumption

Regulatory area	Requirements for the Member States	Reference
Access to information	Establish contact points to guide renewables self-consumers projects through and facilitate the entire administrative permit application and granting process	RED II, art. 16 (1)
	Ensure that information on support measures and guidance is made available to all relevant actors	RED II, art. 18 (1) and (5)
	Ensure that information on the net benefits, costs and energy efficiency of equipment and systems for the	RED II, art. 18 (2)

Regulatory area	Requirements for the Member States	Reference
	use of heating, cooling and electricity from renewable sources is made available by the supplier of equipment or by authorities	
	Develop (with the participation of local and regional authorities) information, awareness-raising, guidance or training programmes to inform citizens on benefits and practicalities, including technical and financial aspects of renewables self-consumption	RED II, art. 18 (6)

Source: RIC Pro-Akademia

Relevance: The EU regulations have introduced specific requirements for Member States to ensure that information on prosumaging opportunities is widely and easily available at national level. In this sense, information campaigns can be regarded as soft instruments that are actively used by the EU policy making to support prosumaging.

Negotiated Agreements (Public-private)

The Energy efficient Buildings (EeB) Public Private Partnership (PPP) is a negotiated public-private agreement between the European Commission and the construction industry, represented by the Energy efficient Buildings (E2B) Committee of the European Construction, built environment and energy efficient building Technology Platform (ECTP) (Energy Efficient Buildings 2019). It aims at promoting research to accelerate the reduction of energy consumption in buildings and to increase the European industrial competitiveness. While prosumaging is not directly and explicitly targeted by the EeB, it drives EU-wide initiatives in the related areas of eco-efficient buildings research.

Still, no EU-level PPP has been established to directly support prosumaging, e.g., through research and innovation, which has been the case for other policy areas, e.g., for bioeconomy support (the BBI Joint Undertaking).

Relevance: No public-private negotiated agreements at EU level that would explicitly support prosumaging have been identified. Still, the EeB can be seen as an example of an EU-wide PPP that provides support to the EC in shaping the research funding priorities in the wider area of energy efficient buildings.

Public Voluntary Schemes

No EU-level public voluntary schemes in the field of prosumaging have been identified.

Relevance: No public voluntary schemes in the field of prosumaging at EU level have been identified. Still, introduction of such a scheme could be introduced to encouraging improved energy efficiency, e.g., by setting voluntary commitments for Member States to link the prosumaging incentives (e.g., grants, feed-in-tariffs) with improved energy performance of buildings.

Unilateral Commitments (Private)

The EU legislation concerning unilateral private commitments in the field of prosumaging concerns renewable energy communities and citizen energy communities, which are two similar forms of legal commitments that are regulated under RED II and ED.

RED II defines 'renewable energy community' as 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 the legal entity;

(b) the shareholders or members 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 area where it operates, rather than financial profits (RED II, art. 2 (16)).

ED defines 'citizen energy community' as a legal entity that

(a) is based on a 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 benefits to its members or shareholders or to local areas where it operates rather than 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 energy services to its members or shareholders' (ED, art. 2 (11)).

The EU regulations have left to national legislators and regulators to make decisions on, for instance, the precise proximity requirement that defines a renewable energy community (de Almeida et al. 2021).

Relevance: Private unilateral commitments in the field of prosumaging are soft measures that have been used in the EU policy making to promote collaboration between different stakeholders at local levels. The two existing forms of energy communities are subject to implementation in the legislation of Member States. The EU policy makers have left the national legislators to adjust the requirements for these voluntary commitments to the relevant country-level conditions and contexts.

3.2 Identification of policy makers

DG Energy

The European Commission's Directorate-General for Energy (DG ENER) is responsible for the development and implementation of the EU energy policy. DG ENER:

- develops Commission proposals that are presented to the European Parliament and Council for adoption;
- ensures that the EU legislation is transposed by Member States;
- develops statistical and economic analyses related to energy;
- implements internal energy market;
- ensures nuclear safety;
- represents the EU at international level in high-level meetings in the field of energy policy.

In particular, DG ENER has been responsible for the development of the following policies: Energy performance of buildings directive (EPBD), Energy Labelling Regulation, Internal energy market, Energy Union, Clean energy package, White certificates, Energy Label. In the context of prosumaging, key personnel include staff in the following units:

- A4 Economic Analysis and Foresight, Recovery
- C1 Renewables and Energy System Integration Policy
- B1 Consumers, Local Iniatives, Just Transition
- B2 Energy efficiency

DG Grow

The European Commission's Directorate-General Internal Market, Industry, Entrepreneurship and SMEs is a department that is responsible for the development and implementation of the EU policies concerning the single market. DG Grow's main responsibilities are:

- supporting the development of the EU internal market;
- facilitating the transition towards a smart, sustainable, and inclusive economy;
- supporting SMEs by reducing bureaucracy and providing access to funding and global markets;
- providing policy on the protection and enforcement of industrial property rights.

In particular, the DG Grow has been responsible for the development of the Energy Labelling Regulation, Harmonised European Standards, Public Procurement Strategy, Just Transition Fund. It is composed of nine policy units and employs around 800 staff (DG Grow 2021). In the context of prosumaging,

key personnel include staff engaged in drafting of 'Technical definitions for a Potential Energy Label for PV Modules and Systems' by JRC).

DG RTD

The European Commission's Directorate-General for Research and Innovation is a department that is responsible for the development and implementation of the EU policy on research and innovation. In the context of prosumaging, the DG RTD has been responsible for the development and implementation of Horizon Europe and European Technology and Innovation Platforms (ETIPs).

DG REGIO

The European Commission's Directorate-General for Regional and Urban Policy is a department that is responsible for the development and implementation of the EU policy on regional policy. In the context of prosumaging, the DG Regio has been responsible for the development and implementation of the European Regional Development Fund (ERDF).

DG JUST

The European Commission's Directorate-General for Justice and Consumers is a department that is responsible for the development and implementation of the EU policy on justice, fundamental rights and consumers. In the context of prosumaging, in 2015 DG Just has commissioned the „Study on Residential Prosumers in the European Energy Union", which was completed by GfK Belgium. In the context of prosumaging, key personnel include Unit A4, European Competition Network and Private Enforcement.

3.3 Identification of policy needs

Key findings from policy analysis, insights from stakeholders collected during interviews with policy makers and the stakeholder workshops are presented in Table 8.

Table 8 Policy needs concerning prosumaging identified during interviews with stakeholders and the stakeholder workshop

Policy area	Key findings
Energy	The most impactful and important EU policies for promotion of individual prosumaging are: ○ the right to remuneration for excess production (RED II, art. 21 (2) (d)); ○ non-discriminatory and proportionate user charges and fees that may be applied to renewables self-consumers only in specific circumstances (RED II, art. 21 (3));

Policy area	Key findings
	○ dynamic electricity pricing is expected to become a very important driver of prosumaging. - The most impactful and important EU policy for collective prosumagers is differentiated distribution tariff consideration obligation on MS (ED, art. 18 (7)); framework for procurement of local flexiblity services (ED, art. 32) - Changes in stringency and conditions for permissible and prohibited forms of charges and fees for renewables self-consumers set in RED II may entail significant impacts on the attractiveness of prosumaging activities across the EU - It would be useful if energy demand models informed the policy making on the 'outputs' of prosumaging activity: ○ the amounts of overall energy demand, as well as energy generated by self-consumers, including energy stored by them, energy self-consumed, and energy introduced to the national power grids; ○ the amounts of energy sold under time-of-use tariffs; ○ the amounts of energy generated by individual and collective renewables self-consumers; ○ impacts on grid infrastructure for a broad range of different input assumptions. - It would be useful if energy demand models informed the policy making on the impacts of: ○ changes in conditions for introduction of permissible charges and fees for renewables self-consumers that are set in RED II, art. 21 (3), e.g.: increasing the capacity threshold (30 kW) to incentivise community prosumaging in bigger RES installations ○ changes in business models of prosumaging (e.g., see Dodd et al. 2020, Table 50) ○ introducing an obligation scheme requiring certain share of building energy demand to be covered by RES, including energy produced on-site or nearby ○ various public support forms for prosumagers (e.g., net metering, subsidies) on overall energy demand ○ introducing performance labels & GPP for PV systems on overall energy demand. - Most pressing policy gaps in prosumaging are: ○ legal framework for a wide number of consumer types, e.g., in tenant occupied appartments ○ dynamic electricity pricing; ○ clearer conditions when charges for self-generated electricity remaining within prosumer's premises can be applied by Member States

Policy area	Key findings
	○ linking subsidies for prosumaging with energy efficiency performance standards of buildings; ○ mandatory implementation of smart features for appliances.
Market uptake and consumer empowerment	- It would be useful if energy demand models provided insights on: ○ the uptake of renewables production installations per category of consumer: social (energy poor and vulnerable; middle class; high class; tenants/owners); economic (residential, service and industry sectors); technical (single/multi-family buildings; urban/rural; prosumer/prosumager) ○ the uptake of renewables production installations per category of energy community: geographical (rural/urban) ○ high granularity of consumer profiles based on: cultural, social, economic, environmental and physical characteristics
Cross-disciplinary	- Lowering of energy bills is the primary motivation of starting prosumaging for an average consumer; - Differences in the underlying conditions in urban and rural areas can have a substantial impact on the scale of prosumaging activities: ○ rural areas: higher risk of power outages (voltage issues), leading to a potential domino effect of the "discouraged"; higher share of users and owners of cars (EV transport may play an important role in managing energy). ○ urban areas: less space for RES production and storage facilities; mostly driven by 'district development'; - The existing EU policy framework to stimulate prosumaging appears not fully sufficient, according to the participants of the newTRENDs stakeholder workshop - Rebound effects of prosumaging activity should be further investigated.

3.4 Conclusions

Prosumaging policy instruments particularly important to be modelled according to the policy makers:

- Mandatory targets requiring certain share of building energy demand to be covered by RES, including energy produced on-site or nearby (EPBD, art. 2)
- Use of time-differentiated network tariffs (ER, art. 18 (7))
- Prohibited and permissible forms of charges and fees for renewables self-consumers (RED II, art. 21)

- Community-based prosumaging: Renewable Energy Communities (RED II, art. 2 (16)) and Citizen Energy Communities (ED, art. 2 (11))

Prosumaging indicators of interest from policy making perspective:

- Share of energy consumers in the residential sector that are renewables self-consumers per category of consumer: social (energy poor and vulnerable; middle class; high class; tenants/owners); economic (residential, service and industry sectors); technical (single/multi-family buildings; urban/rural; prosumer/prosumager)
- Share of energy consumers equipped with electricity storage facilities
- Share of household energy consumers/SMEs/local authorities that are a part of an energy community/collective self-consumption schemes
- Share of energy poor and vulnerable consumers in the residential sector that are renewable self-consumers/part of an energy community
- Share of energy consumers in the residential sector equipped with a gas boiler, heat pump and electrolyser
- Share of energy consumers equipped with smart meters
- Share of public authorities that are prosumagers.

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4. Digitalisation

This chapter describes existing and planned EU-level policies which are relevant from the point of view of energy consumption in the **tertiary sector in the context of digitalisation**. In defining the scope of analysis, we focus on the tertiary sector because it already relies on ICT more than other sectors and is expected to undergo further digital transformation as with the development of new digital technologies and innovations that will further transfer existing services to the digital sphere and lead to the emergence of an array of brand-new services relying on such technologies as big data or artificial intelligence. The focus of analysis is aligned with the scope of the modelling work in Work Package 6.

More than the other focus topics, digitalisation is a domain of planned rather than existing policies. The choice of policies included here reflects the Commission's policy-making plans laid down in the Europe Fit for the Digital Age strategy and the Digital Decade agenda. The analysis focuses on policies that may impact the overall volume of digital services as well as the energy efficiency of their underlying digital technologies. Also included are policies that may affect the energy efficiency of non-digital sectors thanks to the use of digital tools (e.g. blockchain in climate action). The analysis is limited to energy consumption by digital applications and does not cover policies regarding energy efficiency of premises where services are provided, such as policies on smart buildings, which are covered under the prosumaging focus topic).

4.1 Identification of energy demand-side policies and instruments in the EU

Policy instrument category			EU policy instruments
Regulation	Codes/ standards/ mandates	Building/ grid codes and standards	NA
		Product standards	- Regulation EU 2019/424 of 15 March 2019 laying down **ecodesign require-ments for servers and data storage products**
		Sectoral standards	- EC Communication **ICT Standardization Priorities for the Digital Single Market** - EC Communication **Digitising European Industry Reaping the full benefits of a Digital Single Market** - **Blockchain technology** – gold standard of blockchain
		Auditing	NA
	Obligation schemes, quotas, and mandatory targets	Obligation schemes	NA
		Europe Digital Targets	- EC Communication **2030 Digital Compass: the European way for the Digital Decade**
	Other regulation		- The '**Europe Fit for Digital Age**' package
Economic and financial instruments	Direct investment	Government procurement	- Green Public Procurement (e.g. computers, monitors, tablets and smartphones, data centres, office buildings, road lightning, transport)
		RD&D funding	- Horizon Europe
		Grants and subsidies	- Digital Europe programme - ERDF and Cohesion Found
		Loans/soft loans	- EIB lending
	Fiscal/ financial incentives	Tariffs	
		Grants and subsidies	Digital Europe programme ERDF and Cohesion Found
		Loans/soft loans	EIB lending
		Taxes—tax relief/exemption	NA
		User charges	
	Market-based instruments	GHG emissions allwances trading scheme	- EU Emissions Trading Scheme
		User charges	NA

Policy instrument category			EU policy instruments
Soft instruments	Performance labels	Endorsement label	NA
	Information campaigns		NA
	Voluntary approaches	Negotiated Agreements (Public-private sector)	- Big Data Value Public-Private Partnership
		Public Voluntary Schemes	- European Innovation Partnership of Smart Cities and Communities - Code of Conduct od ICT - The European Blockchain Partnership - Code of Conduct for Energy Efficiency in Data Centres
		Unilateral Commitments (Private sector)	- Green and Digital Coalition

4.1.1.1.1 Regulation

Product standards

Digitalisation and growing use of cloud services lead to increasing electricity consumption. One of the priorities of the EU is to make data centres more energy efficient and renewable-based to become carbon neutral. EU has adopted **the ecodesign regulation on servers and data storage products** (amended by Regulation 2021/341 of 23 February 2021), which regulates such parameters as: minimum efficiency of the power supply units and minimum server efficiency in active state, maximum energy consumption in idle state and information on the product operating temperature.

Relevance: making servers greener and more energy efficient will reduce the energy demand and may to some extent offset the growth of energy demand expected as a result of the expansion of data centres and cloud computing, while also reducing the related carbon footprint.

Sectoral standards

The Communication from the Commission to the European Parliament, the Council, the European Eco-nomic and Social Committee and the Committee of the Regions on **ICT Standardization Priorities for the Digital Single Market** identifies five priority areas for standard setting in the digital single market 5G communication, cloud computing, Internet of Things, big data and cybersecurity. The aim is to support the standardization of information and communication technologies to improve the interoperability and portability of the cloud, and to support its use at the international level. ICT devices can contribute to improved efficiency and security of the transport sector.

Relevance: ICT standardization in energy sector can promote smart grid and helps consumers to manage energy demand and reduce energy consumption.

In the communication on **Digitising European Industry Reaping the full benefits of a Digital Single Market,** the Commission spells out its ambition to reinforce the EU's competitiveness in digital technologies and to ensure that every industry in Europe, wherever situated, and no matter of what size can fully benefit from digital innovations. The document sets an ambition of reducing the disproportion between SMEs and large enterprises in the implementation of digital solutions. Additionally, it aims at increasing the production of components for devices and software in Europe (clouds, servers, applications). It envisages the development a common IoT architecture and standards to make these solutions safe and widely used. In the social aspect, it points to a need to develop multidisciplinary digital skills (tender data analysis, business, engineers). Further development of the use of automation, robots and intelligent systems in advanced administrative, legal or supervisory processes is planned.

Relevance: IoT solutions bring significant benefits in solutions for smart cities and communities. IoT can contribute to mitigation of many common problems such as traffic, climate change (via improved energy efficiency), healthcare. They can be fused in the case of improving energy efficiency and reducing energy consumption, solutions in smart cities both for buildings and mobility.

The EU wants to be a leader in **blockchain technology**. EC supports the **gold standard of blockchain in Europe**, which includes the following components: environmental sustainability, data protection, e-identity, cyber security and interoperability. Blockchain tools can help to calculate, track and report energy use and emissions in the supply chain, providing incentive toto improve energy efficiency and reduced carbon footprint across the board[3]. With the European Blockchain Partnership, the European Commission will open a sandbox for regulators, companies and experts who will work on health, mobility, environmental energy in terms of data, contracts and digital identity.

Relevance: By improving tracking of energy and emission intensity of goods and services across the supply chain, blockchain technologies may enable novel business models and regulatory tools which promote energy efficient solutions. The proposed European blockchain standard will also make the blockchain technology itself more energy efficient, which is relevant in view of the expected rise of blockchain-based services in other sectors, e.g., the financial sector**.**

3 https://digital-strategy.ec.europa.eu/en/policies/blockchain-climate-action

Europe Digital Targets

The EC Communication **2030 Digital Compass: the European way for the Digital Decade** sets the following goals to be achieved by 2030:

- Digital skills: 80% of all adults should have basic digital skills, 20 million employed ICT specialists
- Digital transformation of Business: 75% of EU companies should use cloud services, artificial intelligence or big data, more than 90% should reach at least basic level of digital intensity, the number of EU unicorns (starts-up with a value more than 1 billion) should double
- Secure and sustainable digital infrastructures: all EU households should have gigabit connectivity and covered by 5G, double EU share in global production of semiconductors, built first quantum computer
- Digitalisation of public services: public services available online, all citizens should have access to medical records, 80% of citizens should use electronic identification (eID) solutions

Relevance: Once translated into specific policies, those strategic targets will stimulate the development of digital services, leading, on the one hand, to higher energy use because of larger overall volume of online traffic, and on the other, to less energy consumption in sectors where conventional service provision will move online.

Other regulations

The 'Europe Fit for Digital Age' package is the EU's strategy to transform society and business and achieve Europe's climate neutral goals by 2050. The strategy assumes action at the level of several activities:

- Artificial Intelligence - the use of artificial intelligence should help to develop safer and greener health services, transport, and production of cheaper and sustainable energy. Commision will propose new rules of AI to make it safe, transparent, ethical and under human control.
- Digital Market Act – the act defines the principles of fair behaviour on the Internet, part of the Eu-ropean Digital Strategy
- Act on digital services - the act describes the principles of consumer protection and their rights, en-ables the provision of services across borders planned directions of policy making as part of package
- European Data Strategy - universal access to data will help businesses, researchers and public authorities grow
- European Industrial Strategy - a document supporting the industry in green and digital trans-formation, should be updated after the COVID pandemic, e.g. accelerating the double trans-formation (ecological and digital), strengthening the resilience of the single market (e.g. better preparation of the single market for the crisis)
- High performance computing - HPC can be use in monitoring and projecting the effects of climate change, producing safer and greener

vehicles, increase cybersecurity and medicine. HPC is one of the key domains in next Multiannual Financial Framework and has investment priority in recovery plans in Europe
- Digital skills and jobs - projects and start-up strategies to improve digital skills in Europe
- Connectivity - it assumes providing the Internet and 5G to all inhabitants of Europe

Relevance: This package of policies will stimulate the development and expansion of digital services and their role in the economy and, depending on the final legislative solutions, may include rules that will affect the energy efficiency of the digital services sector.

4.1.1.1.2 Economic and financial instruments

Government procurement

Green Public Procurement is a voluntary instrument. European public authorities, as one of the largest purchasing consumers, are encouraged to choose environmentally friendly goods, services and works to reduce environmental impact. Some products and services (e.g. computers, monitors, tablets and smartphones, data centres, office buildings, road lightning, transport) have environment criteria to balance between cost, environment performance and market availability. GPP is regulated by directives 2014/2/EU and 2014/25/EU.

Relevance: GPP can influence energy demand by promoting the purchase of more energy efficient devices for online public services.

RD&D funding

Horizon Europe is the EU's largest research and innovation program. It includes the **EIT Digital initiative which supports Europe's strategic innovation agenda**.

Relevance: Activities supported under Horizon Europe may lead to the development of technologies and innovations that, on the one hand, improve the efficiency of energy generation and use, and on the other stimulate the development of novel digital services, expansion of existing ones, and enable moving more conventional services online.

Grants and subsidies

The **Digital Europe programme** with a budget of €7.5 billion is set to accelerate recovery and digital transformation in Europe. It will support the development of supercomputing, AI, cybersecurity, advanced digital skills and wide use of digital technologies across the economy and society.

Relevance: Activities supported under the Digital Europe programme may lead to the development of technologies and innovations that, on the one hand,

improve the efficiency of energy generation and use, and on the other stimulate the development of novel digital services, expansion of existing ones, and enable moving more conventional services online.

EU founding **ERDF and Cohesion Found** will promote e.g. innovative and smart economic transportation and regional ICT activity. The ERDF and the Cohesion Fund shall contribute with 30% and 37% respectively of the Union contribution to expenditure supported for the achievement of the climate objectives set for the EU budget.

Loans/soft loans

Funding available from the European Investment Bank can support the development of digitalization like high-speed internet, mobile networks, data centres, ICT apps and cloud computing.

Relevance: by targeting digital infrastructures and businesses in the digital sector, EIB lending can stimulate the development of digital services.

GHG emissions allowances trading scheme

Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union (ETS Directive) is one of Europe's main instruments promoting reductions of greenhouse gas emissions from the power sector.

Relevance: As a market-based instrument imposing a price on CO2 emissions from power generation, the EU-ETS not only promotes the phaseout of carbon-intensive power sources and development of clean energy, but may also incentivise energy savings and incorporation of energy-efficiency considerations into the development of digital services by influencing electricity prices which, in turn, may encourage further optimisation of energy consumption by the digital infrastructure and the establishment of its energy-intensive elements in locations where sufficiently large volumes of cheap, zero-emissions energy are available.

4.1.1.1.3 Softs instruments

Negotiated Agreements (Public-private sector)

As part of **the Big Data Value Public-Private Partnership**, the EC works with the European industry sector and researchers in a Public Private partnership to cooperate in data-related research and innovation, enhance community building around data and to set the grounds for a thriving data-driven economy in Europe.

Relevance: By supporting large-scale demonstration projects, offering an experimentation space, enabling technologies and partnerships, the initiative may stimulate the development of novel digital services that rely on big data.

Public Voluntary Schemes

The European Innovation Partnership of Smart Cities and Communities is focused on improving energy efficiency in networks and services. One important aspect of smart cities is to use information and communication technologies for a better understanding of the workings of the energy sector, and especially smart energy management.

Relevance: With focus on transport, water supply, waste disposal facilities, street lights and heats buildings, the initiative may impact the energy efficiency of public services by using smart solutions for energy use optimisation.

The Code of Conduct for ICT was launched in 2000 as a voluntary instrument. It is a mechanism to initiate new policies to improve, inter alia, energy efficiency in the areas of: external power supply units (EPS), data centres, broadband, digital TV services and uninterruptible power supplies (UPS).

Relevance: The Code of Conduct for ICT supports an increase in energy efficiency and electricity demand reduction in the areas which it covers

The European Blockchain Partnership is an initiative whose task is to provide the best knowledge and information for policy-makers in the field of blockchain. Technical support will allow for the creation of a law that is better suited to the realities.

Relevance: The Partnership will contribute to the development of blockchain policies and as such may impact the energy efficiency of block-chain technologies, as well as the dynamics of growth of digital services that rely on blockchain.

The Code of Conduct for Energy Efficiency in Data Centres has been created in response to the increasing energy consumption in data centres and the need to reduce the related environmental, economic and energy supply security impacts. The aim is to inform and stimulate data centre operators and owners to reduce energy consumption in a cost-effective manner without hampering the mission critical function of data centres.

Relevance: The Code encourages data centre owners and their customers to reduce energy consumption.

Unilateral Commitments (Private sector)

The Green and Digital Coalition is a declaration signed by 26 CEOs taking action to promote sustainable digitalisation and invest in green digital technologies and services, measure the impact of those technolo-gies on environment, prepare recommendation and guidelines for other sectors.

Relevance: the Coalition offers a forum to raise awareness of energy efficiency in digital services among business leaders.

4.2 Identification of policy makers

DG Climate Action

The European Commission's Directorate-General Climate Action is a department that is responsible for fostering the EU transition towards a low-carbon and climate resilient economy. For more detailed overview, see section 4.3.

In the context of digitalisation, key units at DG CLIMA include:

- C.1 – Strategy and Economic Assessment
- C.2 – Governance & Effort Sharing

DG Energy

The European Commission's Directorate-General for Energy is a department that is responsible for the development and implementation of the EU energy policy. For more detailed overview, see section 4.3.

In the context of digitalisation, key units at DG Energy include:

- B.2 – Energy Efficiency
- B.3 – Buildings and Products
- B.5 – Innovation, Research, Digitalisation, Competitiveness

Joint Research Centre

The Joint Research Centre is a science and knowledge service of European Commission wchich help design EU policies by providing evidences, bring policies together to make sense of societal challenges, possible approaches and solutions.

In the context of digitalisation the JRC key units include:

- C – Energy, Transport and Climate

DG CONNECT

The European Commission's Directorate-General for Communications Networks, Content and Technology supports digital transformation of the Union's economy and society, fosters the internal market and makes Europe fit for the digital age.

In the context of digitalisation the DG CONNECT key units include:

- ADV06 – Digital Aspects of green Transformation

4.3 Identification of policy needs

Identification of policy needs has been performed during interviews with stakeholders, which have been conducted in August and October 2021. Invitations have been sent to eight European Commission's representatives. The invitation contained the policies in the field of digitization of the service sector, selected in the previous chapter. Further stakeholder feedback was gathered during the stakeholder workshop organized in October 2021. In total, inputs from five stakeholders were recieved.

As part of the interviews, the following questions were asked:

Topic 1: Policy makers' needs in terms of modelling

- What parameters / variables resulting from energy demand models do you think would be the most useful for policy making process? Examples of parameter: electricity use by ICT equipment across the sectors (incl. by type of equipment), ICT sectoral energy use
- What quantitative aspects would you like to understand more to assist the policy making?
- Do you have any other comments or suggestions on how energy demand models could assist policy making?

Topic 2: Existing and emerging policies in energy aspects of digitalisation

- Do you think the presented list is complete?
- Which instruments are most impactful / important for digitalisation? Why?
- How do you assess the potential impact of such instruments in energy aspects of digitalisation?

The main findings of the respective DGs' responses during the interviews are presented in the Table 5.

The COVID 19 pandemic has changed the perception of digitalisation in the tertiary sector - the impact of cloud computing and data centres, which have been heavily burdened with remote work, learning and purchasing, is now becoming significant in energy demand.

A significant challenge seems to be modeling of the ICT devices impact on the power system operation and the influence of Demand Side Response (DSR) on the system balancing. Increasing the demand in the longer term will force investing in an intelligent power grid, which will be necessary to reduce network congestion, increase its capacity and flexibility.

Table 9 Results of interviews with key stakeholders

Policy area	Key findings
Energy	- There is already a lot of information about the impact of data centres on energy demand - more data is needed in a field of new digitalisation devices (storage, 5G). - There is a need to determine how cloud computing will increase energy demand, how it will change energy costs and data transfer costs. - There is a need to determine how digitalisation may enable DSR and what impact it will have on energy producers and consumers as well as on electrified transport. - There is a need to better understand the impact of digitalisation and the change in energy demand for investment purposes for the modernization of transmission and distribution networks. - There is need for more in-depth modelling of the relationship between digitalisation, network congestion, flexibility and electrification.
Climate	- The modelling of digitalisation itself is not a problem - the challenge is to find the right input data. The modelling today may account for an increase in demand by cloud computing and data servers, but there is no information on the increase in demand by ICT devices. - There is a need to better understand the impact of ICT devices on the optimisation of energy use and how their use affects on energy costs. - It would be useful to define additional indicators that will allow to determine the greater accuracy and completeness of the models and forecasts.

4.4 Conclusions

Digitalisation policy instruments particularly important to be modelled:

- Digitalisation targets and investment in new digital services.
- Policies enabling energy demand reporting by ICT devices within smart grids.

Digitalisation indicators of interest from policy making perspective:

- Energy use by ICT equipment across the sectors (incl. by type of equipment).
- Energy use and emissions related to ICT equipment production
- Impact of teleworking on transport and households energy demand: by sector and net total.

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5. Circular economy & low-carbon industry

5.1 Identification of energy demand-side policies and instruments in the EU

This section analyses and assesses the existing and emerging energy demand-side policies and instruments (regulations, economic and financial instruments, and soft instruments) addressing circular economy and low carbon industry in the European Union (Table 8).

Table 10 Existing and emerging EU-level energy demand-side policies and instruments in the field of circular economy and low-carbon industry

Policy instrument category			Existing EU policy instruments	Emerging EU policy instruments
Regulation	Codes/ standards/ mandates	Building/ grid codes and standards	- Energy performance of building directive	- EPBD: Long-term renovation strategies - Strategy for a Sustainable Built Environment
		Product standards	- Eco-design Directive, Energy Labelling Regulation, Harmonised European Standards - General product safety directive - Construction Products Regulation (CPR)	- Introduction of new product standards based on a Life Cycle Assessment (or similar) - Industry-led industrial symbiosis reporting and certification system - Circular Electronics Initiative, common charger solution, and reward systems to return old devices - New regulations on batteries - New regulations of waste oils
		Sectoral standards	- Waste Framework Directive -	- Review of the Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment - New regulations on end-of-life vehicles

Policy instrument category			Existing EU policy instruments	Emerging EU policy instruments
				- Review of regulations on packaging (reduction of overpackaging) - Restriction of intentionally added microplasticsc and measures on unintentional release of microplastics - Policy framework for bio-based plastics and biodegradable or compostable plastics - EU Strategy for Textiles - EU-wide harmonised model for separate collection of waste and labelling to facilitate separate collection - Scoping the development of further EU-wide end-of-waste and by-product criteria - Revision of the rules on waste shipments - Regulatory framework for the certification of carbon removals - Leading efforts towards reaching a global agreement on plastics - Proposing a Global Circular Economy Alliance and initiating discussions on an

Policy instrument category		Existing EU policy instruments	Emerging EU policy instruments
			international agreement on the management of natural resources - Mainstreaming circular economy objectives in free trade agreements, in other bilateral, regional and multilateral processes and agreements, and in EU external policy funding instruments
	Auditing	- The monitoring framework for the circular economy [COM(2018)29]	- Obligation for large companies to perform energy / sustainability audits on regular basis - Methodologies to track and minimise the presence of substances of concerning recycled materials and articles made thereof - Updating the Circular Economy Monitoring Framework to reflect new policy priorities and develop further indicators on resource use, including consumption and material footprints
Obligation schemes/ quotas	Obligation schemes	- Waste Framework Directive (quotas for recycling rates for MS) - Directive on packaging and packaging waste (quotas for recycling rates of packaging materials for MS)	- Introduction of mandatory shares of recycled plastic content in certain products - Waste reduction quotas for specific streams - REDII proposal sets obligation for industry to increase its energy consumption from

Policy instrument category			Existing EU policy instruments	Emerging EU policy instruments
			- The Directive on the landfill of waste - Directive 2018/849	renewable energy sources by 1.1 percentage points per year, and a target of 50% for renewable fuels of non-biological origin used as feedstock or as an energy carrier.
		Carbon Emissions Reduction Target	- EU ETS	-
	Other regulation		- The EU action plan for the Circular Economy - The Raw Material Initiative - The Strategy for plastics - A hydrogen strategy for a climate-neutral Europe	- Roadmap to a Resource Efficient Europe sets milestones towards transforming the EU's economy into sustainable one by 2050. - Sustainable product policy initiative - Measures establishing a new "right to repair"
		Energy market regulations	- The Internal energy market - The Energy Union - The Clean energy package	-
Economic and financial instruments	Direct investment	Government procurement	- Green public procurement	- Green public procurement become obligatory -
		RD&D funding	- Horizon Europe, in particular Pillar II Global Challenges and European	-

Policy instrument category			Existing EU policy instruments	Emerging EU policy instruments
			Industrial Competitiveness, under Cluster 4: Digital, Industry and Space and Cluster 5: Climate, Energy and Mobility.	
		Grants and subsidies	- European Regional Development Fund (ERDF) and Just Transition Fund (JTF)	- Reflecting circular economy objectives in the revision of the guidelines on state aid in the field of environment and energy
		Loans/soft loans	- European Investment Bank	-
	Market-based instruments	GHG emissions allowances trading scheme	- The EU Emissions Trading System	- Review of the Industrial Emissions Directive, including the integration of circular economy practices in upcoming Best Available Techniques reference documents
		White certificates	- White certificates scheme	-
	Fiscal/ financial incentives	Tarifs	-	- Carbon Border Adjustment Mechanism
		Taxes – tax reliefs/exemptions	-	- Energy Taxation Directive - Green claims
Soft instru-mentnts	Performance labels	Endorsement label	- Energy Label, CE marking, WEEE label	- LCA Certificate being obligatory for products - Harmonised information systems for the presence of substances of concern

Policy instrument category			Existing EU policy instruments	Emerging EU policy instruments
	Voluntary approaches	Negotiated Agreements (Public-private sector)	- Bio-based Industries Joint Undertaking - Fuel Cells and Hydrogen Joint Undertaking - Sustainable Process Industry through Resource and Energy Efficiency (SPIRE) - European Technology and Innovation Platforms (ETIPs)	-
		Public Voluntary Schemes	- Green public procurement	-
		Unilateral Commitments (Private sector)	- The Ecolabel - The Circular Plastic Alliance	-

5.1.1.1.1 Regulation

Building/grid codes and standards

Energy performance of buildings directive (EPBD)

The Energy performance of buildings directive (EPBD) is the main EU's measure that promotes energy efficiency in buildings. It sets minimum energy performance requirements for new buildings, for the major renovation of buildings and for the replacement or retrofit of building elements. It also requires all new buildings to be nearly zero-energy buildings (nZEB) from the end of 2020, while all new public buildings from 2018.

The EU countries had to draw up and submit nZEB national plans, describing how they intended to increase the number of nZEBs in their respective Country to comply with the EPBD. Furthermore, each Member State shall establish a long-term renovation strategy (residential & non-residential buildings, public & private) facilitating the cost-effective transformation of existing buildings into nearly zero-energy buildings by 2050.

Relevance: EPDB promotes building energy efficiency and nearly zero energy buildings. When applied in industry, on one hand it decreases energy consumption in buildings operated by the industry, and on the other - stimulates the development of sustainable products and technologies for the construction sector.

Product standards

Eco-design Directive, Energy Labelling Regulation, Harmonised European Standards

The Eco-design directive (2009/125/EC) provides a legal framework for requirements for energy-related products. Its aim is to improve environmental performance of energy-related products, in particular, in terms of their energy efficiency and environmental impact. It covers a wide range of products from two main categories: products that use, generate, transfer or measure energy, and products that have impact on energy consumption, such as materials and products used in the construction industry or water-using products.

The Energy labelling regulation (EU 2017/1369) supports the Eco-design directive and puts a requirement for energy-related products producers to inform customers about how energy efficient their products are. This enables customers to compare products and save energy during the product lifetime. It also triggers manufacturers to constantly improve energy efficiency of their products of foster innovation. The regulation obliges suppliers to put a label in paper form on each unit of the product, and the label should follow a standardised form, specific for each type of a product. The label should include a graphical information on the product class, from dark green (meaning the most efficient), to dark red (meaning the least efficient product). If appropriate, it

should be also accompanied by information about the absolute energy consumption and other relevant information, such as noise level or water consumption.

Both the Eco-design directive and the Energy labelling regulation are implemented through product-specific regulations (Table 11).

The implementation of the Eco-design and energy labelling regulations is complemented by selected **harmonised European standards** (European Commission 2021h). They are developed by standard organisations, namely CEN, CENELEC, or ETSI, and are published in the Official Journal of the European Union. Their application by manufacturers is voluntary, since they can choose other way of demonstration that their product meets obligatory requirements.

Figure 6: Template of an energy label for household washing machines and washer-dryers (European Commission 2021j)

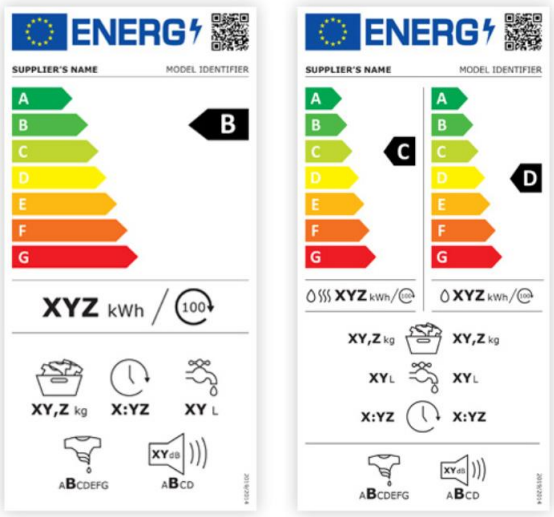

Table 11 Energy efficient products covered by Ecodesign and Energy Labelling regulations as of April 2021 (European Commission 2021c)

Group	Products	Ecodesign	Energy Labelling
Circulators	Circulators and glandless circulators integrated in products	(EC) No 641/2009 (EU) No 622/2012	
Computers	Computers and computer servers	(EU) No 617/2013	
Dishwashers	Household dishwashers	(EU) No 1016/2010	(EU) No 1059/2010

Group	Products	Ecodesign	Energy Labelling
Domestic ovens, hobs and range hoods	Domestic ovens, hobs and range hoods	(EU) No 66/2014	(EU) No 65/2014
Electric motors	Electric motors	(EC) No 640/2009 (EU) No 4/2014	
Fans	Industrial fans driven by motors	(EU) No 327/2011	
Heating and cooling appliances	Air conditioners and comfort fans	(EU) No 206/2012	(EU) No 626/2011
	Hot-water boilers	92/42/EEC	
	Water heaters and hot water storage tanks	(EU) No 814/2013	(EU) No 812/2013
	Space heaters	(EU) No 813/2013	(EU) No 811/2013
	Local space heaters, Solid fuel local space heaters	(EU) 2015/1188 (EU) 2015/1185	(EU) 2015/1186
	Solid fuel boilers	(EU) 2015/1189	(EU) 2015/1187
	Air heating products, cooling products, high temperature process chillers and fan coil units	(EU) No 2016/2281	
Lamps (directional and LED)	Directional lamps, light emitting diode lamps and related equipment	(EU) No 1194/2012 (EU) 2015/1428	(EU) No 874/2012
Lamps (non directional)	Non-directional household lamps (including amendment on ultraviolet radiation)	(EC) No 244/2009 (EC) No 859/2009 (EU) 2015/1428	(EU) No 874/2012
Lamps (fluorescent and professional)	Fluorescent lamps without integrated ballast, for high intensity discharge lamps and for ballasts and luminaries able to operate such lamps (including amendment)	(EC) No 245/2009 (EU) No 347/2010 (EU) 2015/1428	(EU) No 874/2012
Power supplies	External power supplies	(EC) No 278/2009	
Refrigerated storage cabinets	Professional refrigerated storage cabinets, blast cabinets, condensing units and process chillers	(EU) 2015/1095	(EU) 2015/1094

Group	Products	Ecodesign	Energy Labelling
Refrigerating appliances	Household refrigerating appliances	(EC) No 643/2009	(EC) No 1060/2010
Set-top boxes	Simple set-top boxes	(EC) No 107/2009	
Standby and off mode	Electric power consumption standby and off mode of electrical and electronic household and office equipment	(EC) No 1275/2008 (EC) No 801/2013	
Television	Television	(EC) No 642/2009 (EC) No 801/2013	(EU) No 1062/2010
Transformers	Small, medium and large power transformers	(EU) No 548/2014	
Tumble driers	Household tumble driers	(EU) No 932/2012	(EU) No 392/2012
Vacuum cleaners	Vacuum cleaners	(EU) No 666/2013	(EU) No 665/2013
Ventilation	Ventilation units	(EU) No 1253/2014	(EU) No 1254/2014
Washer-driers (combined)	Household combined washer-driers	-	96/60/EC
Washing machines	Household washing machines	(EU) No 1015/2010	(EU) No 1061/2010
Water pumps	Water pumps	(EU) No 547/2012	

Relevance: Eco-design Directive, Energy Labelling Regulation, Harmonised European Standards allow customers to compare products in terms of their energy and environmental performance.

General product safety directive

The General product safety directive (2001/95/EC) sets a broad framework for ensuring safety of products introduced on the EU market. The rules must be complied by producers and distributors, so that use of products is safe and pose no risk for the consumers. The directive covers a broad range of products, except of pharmaceuticals, medical devices and food that have their specific regulations. According to the directive, a product is considered to be safe if it meets requirements set by the European legislation. In its absence, the product must comply with relevant national standards. If both are missing, the product safety is determined using voluntary national standards transposing European standards, the European Commission's guidelines on product safety assessment, sectoral safety regulations, the state of the art and consumer expectations concerning safety (European Parliament; Council of the European Union 2002). Consumers must be informed about potential risks related to the

product use. Body that places a product on the market is obliged to monitor its safety and recall it when it is unsafety.

Relevance: Despite the directive concerns more the health safety related to usig products, it also idirectly supports the circular economy paradigm by ensuring longer liveability of products and preventing from market low quality products that would need replacement in relatively short time and increased the waste streams volume.

Construction Products Regulation (CPR) (Regulation (EU) No 305/2011)

The construction products regulation harmonises assessment of the construction material properties and the way of communicating them to consumers. Any construction material placed on the EU market is required to be CE marked. This ensures that construction products are tested only once and may be sold in all EU countries. Thanks to the common information structure, consumers can easily compare materials and products from different countries.

Relevance: high performance construction materials, e.g. low-carbon, can be easier introduced on EU national markets and purchased by clients.

Sectoral standards

Waste Framework Directive

The Waste Framework Directive (2008/98/EC) sets rules for waste management in the EU. Its core principle is a waste hierarchy, which first requires prevention of the waste generation. If the waste production is unavoidable, the waste streams should be reused, recycled or recovered. Waste disposal is the least preferred option. The directive introduces the extended producer responsibility rule that puts financial responsibility to the producer for the management of the waste stage of a product's life cycle. The directive also establishes rules for changing a status of a waste – from waste to product or secondary raw material.

Figure 7 Waste management hierarchy (European Commission 2021k)

Relevance: the directive sets basic rules for circular economy in the EU. It establishes rules for waste management and sets quotas that pushes member states to increase recycling and reuse rates of primary materials.

Auditing

The European Commission is responsible for a monitoring of the circular economy development in the EU. In its Communication on a monitoring framework for the circular economy COM(2018)29 (European Commission 2018b) the Commission provides information about performance indicators related to the circular economy development in the EU. The framework for the progress monitoring includes a set of indicators used for monitoring of the circular economy development in the EU.

Table 12 Monitoring indicators of the circular economy used by the EC (European Commission 2018b)

Area	Indicators	Relevance
Production and consumption	1 EU self-sufficiency for raw materials	Mitigation of risks related to raw materials shortage
	2 Green public procurement	Public institutions consume significant amount of goods and therefore can play a leading role in the circular economy development
	3a-c Waste generation	Waste generation should be minimalised
	4 Food waste	Food waste should be minimalised due to negative environmental, climate and economic impact

Area	Indicators	Relevance
Waste management	5a-b Overall recycling rates	Waste recycling is a significant part of the circular economy
	6a-f Recycling rates for specific waste streams	
Secondary raw materials	7a-b contribution of recycled materials to raw materials demand	Secondary raw materials are an important source of raw materials in circular economy
	8 Trade in recyclable raw materials	It reflects importance of recyclable raw materials
Competitiveness and innovation	9a-c Private investments, jobs and gross value added	It reflects the contribution of the circular economy to the economic growth
	10 Patents	Innovative solutions pushes the green economy development

Relevance: Collecting information on the monitoring indictors allows the EC to efficiently manage the circular economy development the EU, initiate corrective actions in case of too low pace of the deployment, and plan future measures.

Obligation schemes

Waste Framework Directive

The Waste Framework Directive (2008/98/EC) sets quotas for the member states regarding the recycling rates of specific waste streams, i.e.:

- by 2020, the preparing for re-use and the recycling of waste materials, such as paper, metal, plastic and glass from households shall be increased to a minimum of overall 50 % by weight
- by 2020, the preparing for re-use, recycling and other material recovery, including backfilling operations using waste to substitute other materials, of non-hazardous construction and demolition waste shall be increased to a minimum of 70 % by weight
- by 2025, the preparing for re-use and the recycling of municipal waste shall be increased to a minimum of 55 %, and to 60% and 65% by weight by 2030 and 2035 respectively (European Commission 2008).

Relevance: the directive sets quotas that push member states to increase recycling and reuse rates of primary materials.

Directive on packaging and packaging waste

Directive (EU) 2018/852 amending Directive 94/62/EC on packaging and packaging waste sets rules for manufacturers and retailers related to product

packaging. Packaging must meet a set of rules, aimed at minimisation of the packaging materials consumption and reusability of packaging.

The directive sets also quotas for packaging recycling for the EU Member States:

- a minimum of 65 % by weight of all packaging waste will be recycled by the end of 2025, and 70% by the end of 2030;
- minimum quotas regarding recycling of specific materials contained in packaging waste (Table 13).

Table 13 Minimum quotas of materials recycling for the EU Member States

Material	Quota for 31.12.2025 (by weight)	Quota for 31.12.2030 (by weight)
Plastic	50%	55%
Wood	25%	30%
Ferrous metals	70%	80%
Aluminium	50%	60%
Glass	70%	75%
Paper and cardboard	75%	85%

Relevance: the directive actively supports the circular economy by requiring from manufacturers imolementation of measures aimed at miminimising the amount of packaging waste. It also setts on MSs quotas for recycling of packaging materials.

Directive on the landfill of waste

Directive 2018/850 amending Directive 1999/31/EC on the landfill of waste regulates the waste disposal at landfills, and lays down rules for protecting the environment and human health from risks related to waste management. The directive requires that the landfills do not cause risk or reduce it as far as possible in terms of impact on surface water, groundwater, soil, air, global environment and human health, during its whole life-cycle (European Commission 2018c). The directive also ensures a progressive reduction of the amount of waste being landfilled by increasing the recovery and recycling rates, and to decrease environmental impact of waste landfills. The directive also sets a targets that by 2030 waste that could be recycled or recovered will not be put on landfills, and by 2035 the amount of landfilled waste will me at maximum of 10% of the total amount of municipal waste generated (by weight).

The directive promotes effective use of materials and preventing waste generation by using the waste management hierarchy, the same as in the Waste Framework Directive ().

Relevance: the directive promotes circular use of materials and requires responsible approach to the waste management by promoting the waste hierarchy and preventing waste landfilling.

Directive 2018/849

The directive 2018/849 of May 30, 2018, amending Directives 2000/53/EC on end-of-life vehicles, 2006/66/EC on batteries and accumulators and waste batteries and accumulators, and 2012/19/EU on waste electrical and electronic equipment regulates the treatment of waste coming from vehicles, batteries, accumulators end electronics. It requires that member states introduce incentives for the application of the waste hierarchy in regards to the treatment of end-of-life products. Member States are also obligated to monitoring levels of recycling levels achieved each year.

Relevance: the directive actively supports the circular economy by promoting the waste hierarchy and monitoring of the recycling levels of waste streams from vehicles, batteries, accumulators end electronics.

Renewable Energy Directive II (REDII)

The proposal for amending the renewable energy directive (COM(2021) 557 final), being a part of a "Fit for 55" package, sets new targets for industries regarding renewable energy consumption. It intorduces an obligation for industry to increase its energy consumption from renewable energy sources by 1.1 percentage points per year, and a quota of 50% for renewable fuels of non-biological origin used as feedstock or as an energy carrier (European Commission 2021b).

Relevance: the proposal supports the transition towards the low-carbon industry by decreasing carbon footprint of energy and promoting more sustainable energy sources.

Carbon Emissions Reduction Target

As of November 2021, the current EU target for decreasing greenhouse gas emissions is set for 55% by 2030, compared to 1990 levels. It was raised from 40% in the "Fit for 55 package" in July 2021 by the European Commission, as a step towards achieving the climate neutrality by 2050. The carbon emission reduction is implemented by three complementary means: the EU Emissions Trading System (ETS), the Effort Sharing Regulation, and the Land use, land use change and forestry Regulation.

ETS – see section 5.1.1.1.2

The Effort Sharing Regulation sets targets for EU Members States to decrease GHG emissions in sectors that are not covered by EU ETS, such as buildings, transport, agriculture and waste. It covers the following gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), and nitrogen trifluoride (NF_3). Depending on the wealthy of EU countries, each EU country has an individual quota. In total, the EU quota is set for 40%, compared to 2005.

Regulation on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry (LULUCF) requires from EU Member States

that GHG emissions coming from LULUCF are lower than CO2 removed from the atmosphere in 2021-2030 by activities performed in this sector.

Relevance: sectors covered by the EU ETS are motivated to decrease their emission levels and invest in less carbon-intensive technologies. Other industry sectors are triggered by national measures and legislation, under the Effort Sharing Regulation and LULUCF.

Other regulation

EU action plan for the Circular Economy

The first EU circular economy action plan has been adopted in 2015 and included 54 measures moving the EU towards sustainable economic development. Actions that have been planned covered the whole life cycle of products and materials – production, consumption, waste management, and secondary raw material market. In 2019, the European Commission has performed a review of the action plan implementation. The conclusion was that all activities have been delivered, and some of them will be continuously implemented in the future. In 2020 a new plan has been adopted, being a part of the European Green Deal. The new action plan sets a schedule for the 35 measures implementation in each of the field crucial for the circular economy deployment: production, consumption, waste management, market for secondary raw materials, innovation and investments, and sectorial actions for plastics, food waste, critical raw materials, construction and demolition, and biomass and bio-based materials. The overall objective of the plan is to decrease pressure on environment and natural resources by preventing the waste generation and keeping resources in the loop as long as possible (European Commission 2020a).

Relevance: it is the main EU policy document on circular economy. It sets direction and concrete measures that are implemented in the EU.

Public Procurement Strategy

The aim of the Public Procurement Strategy is to improve processes of carrying out public procurements, so that they could be used more effectively for implementation of EU policies. The strategy focuses on six major areas:

1) Ensuring wider uptake of strategic public procurement;
2) Professionalising public buyers;
3) Improving access to procurement markets;
4) Increasing transparency, integrity and better data;
5) Boosting the digital transformation of procurement ;
6) Cooperating to procure together (European Commission 2017).

Relevance: public procurement might be an instrument that public authorities use to support implementation of certain policies, including circular economy.

Raw Materials Initiative

The Raw Material Initiative from 2008 answers the challenge of providing access to strategic raw materials in the EU. It recognises that access to raw material stock is crucial for maintaining competitiveness of the European industry. It includes an integrated raw materials strategy, which focuses on the following areas:

1) provide access to raw materials from global markets;
2) provide sustainable supply of raw materials from EU sources;
3) improve resource efficiency and increase use of secondary raw materials coming from recycling (Commission of the European Communities 2008b).

The strategy covers all materials, except of fuels and materials coming from agriculture. The list of critical raw materials in the EU are regularly published by the European Commission.

Relevance: The Raw Material Initiative promotes recycling and use of secondary raw materials.

Roadmap to a Resource Efficient Europe

The roadmap sets milestones towards transforming the EU's economy into sustainable one by 2050, using resources in efficient way, with minimised impact on environment. It also shows how policies interrelate and build on each other. The roadmap covers economy transformation, ecosystem services and key sectors responsible for environmental impact. In terms of economy, it sets milestones in the following issues:

- Sustainable consumption and production
  - Improving products and changing consumption patterns
  - Boosting efficient production
- Turning waste into a resource
- Supporting research and innovation
- Environmentally harmful subsidies and getting the prices right
  - Phasing out inefficient subsidies
  - Getting the prices right and reorienting the burden of taxation (European Commission 2011).

Relevance: the Roadmap sets direction for the EU policies. To meet proposed milestones, operational documents are needed, such as action plans or legal acts.

Strategy for Plastics

The EU's strategy for plastic, adopted in 2018, is a part of the Circular economy action plan. The aim of the strategy is to reduce plastic waste by supporting more sustainable production and consumption. The strategy proposes a set of measures in the following areas:

1) Improving profitability of plastic recycling;
2) Preventing plastic waste generation and littering to environment;

1) Supporting innovation and investment in the field of recyclable plastic materials and plastic recycling;
2) International cooperation in terms of standards for plastics (European Commission 2018a)

Relevance: The Strategy for plastics promotes plastic recycling and prevents plastic littering in the environment.

A hydrogen strategy for a climate-neutral Europe

A hydrogen strategy for a climate-neutral Europe (COM(2020) 301 final) considers hydrogen as an energy source that would allow for smooth decarbonisation of the EU's energy consumption by 2050. The strategy sets a path that would allow for wide use of hydrogen in the economy. It is divided into three phases, with different strategic objectives for each stage:

- Phase 1 (2020-2024): decarbonise existing hydrogen production by commissioning at least 6 GW of renewable hydrogen electrolysers, and produce 1 million tonnes of renewable hydrogen.
- Phase 2 (2025-2030): increase importance of hydrogen in the energy system by commissioning at least 40 GW of renewable hydrogen electrolysers, and produce 10 million tonnes of renewable hydrogen.
- Phase 3 (2030-2050): renewable hydrogen technologies become mature and are widely installed in hard-to decarbonise sectors (European Commission 2020b).

Energy market regulations

Internal energy market

Internal energy market is a basis of the EU energy policy. It has been adopted since 1996, and its objective it to provide affordable and competitively priced energy, environmental sustainability, and energy security. It connects and harmonises national markets and ensures security of energy supply, including electricity, gas and oil. Furthermore, it protects customers by setting responsibilities of energy market participants and ensuring that customer rights are obeyed (European Parliament 2021).

Relevance: by supporting sustainable energy, the internal energy market indirectly supports low-carbon industry deployment by decreasing the carbon footprint of products. In particular, it supports decreasing the carbon footprint of the industry it these EU MSs, that still have their enegy mix strongly dependent on fossil fuels.

Energy Union

The energy union strategy has been adopted in 2015 and sets a framework for providing in the EU secure, sustainable, competitive and affordable energy. The strategy has five interrelated dimensions:

- Energy security, solidarity and trust – by diversification of energy sources and collaboration of Member States;
- A fully integrated European energy market – infrastructure ensuring free flow of energy;
- Energy efficiency contributing to moderation of demand;
- Decarbonising the economy;
- Research, Innovation and Competitiveness – supporting research in the field of low-carbon and clean energy technologies (European Commission 2015).

Relevance: the Energy Union pushes the energy market towards sustainable solutions and low-carbon energy, which supports low-carbon industry deployment by decreasing the carbon footprint of products.

Clean energy package

The clean energy package, adopted in 2019, is the next step of the implementation of the Energy Union. It is a framework for the energy system transition and meeting the GHG emissions reduction targets. It is composed of the following parts:

1) Energy efficiency first rule;
2) Showing global leadership in the take-up of renewables;
3) A new energy rulebook;
4) More rights for consumers;
5) Increased security of supply thanks to a smarter and more efficient electricity market (European Commission 2019a).

Relevance: the Clean energy package pushes the energy market towards sustainable solutions and low-carbon energy, which supports low-carbon industry deployment by decreasing the carbon footprint of products.

5.1.1.1.2 Economic and financial instruments

Green public procurement

Green Public Procurement (GPP) is a process of obtaining by public bodies goods, services and works whose environmental impact during their life cycle is lower compared to goods, services and works with identical intended use which would otherwise be ordered (Commission of the European Communities 2008a). In practice, green public procurement (GPP) means the application of minimum technical requirements which must be met by contractors. Application of GPP is voluntary. The European Commission initially selected 10 sectors for which the application of GPP has the greatest potential. The list is constantly being developed - in June 2021 it covered the following 20 areas (European Commission 2021f):

1) Cleaning products and services
2) Computers, monitors, tablets and smartphones
3) Copying and graphic paper
4) Data centres, server rooms and cloud services
5) Electrical and Electronic Equipment used in the Health Care Sector
6) Electricity
7) Food Catering services and vending machines
8) Furniture
9) Imaging Equipment, consumables, and print services
10) Office Building Design, Construction and Management
11) Paints, varnishes and road markings
12) Public Space Maintenance
13) Road Design, Construction and Maintenance
14) Road lighting and traffic signals
15) Road Transport
16) Sanitary Tapware
17) Textile
18) Toilets and Urinals
19) Waste Water Infrastructure
20) Water-based Heaters

Relevance: By selecting suppliers with lower environmental impact, the public sector can make a significant contribution to conserving natural resources. By creating demand for green products and services, public procurement is a stimulus for the development of environmentally friendly technologies that are also available outside the public sector.

RD&D funding

RD&D funding is available in the EU in the Horizon Europe programme, with the overall budget €95.5 billion. Circular economy and low-carbon industry is particularly supported within *Pillar II Global Challenges and European Industrial Competitiveness,* under *Cluster 4: Digital, Industry and Space* and *Cluster 5: Climate, Energy and Mobility.*

Relevance: Horizon Europe programme supports development of innovative low-carbon technologies and circular industries.

Tariffs

Carbon Border Adjustment Mechanism (CBAM)

A carbon tariff for imported goods is a measure that prevent carbon leakage, i.e. buying products manufactured in countries with lower environmental standards than in the EU, in particular in terms of GHG emissions. The carbon border tax has been discussed in the EU for several years, and is intended to be fully introduced in 2026, proceeded with a transitional phase between 2023 and 2025. When importing specific goods to the EU, importers will have to buy carbon certificates that would cover the difference between the carbon prices in the EU and ta place of origin of the given good. Initially, the CBAM will be applied to sectors which are at the highest risk of a carbon leakage: cement, iron and steel, aluminium, fertilisers, and electricity (European Commission 2021a, 2021l).

Relevance: CBAM will prevent carbon leakage and support carbon-intensive industries in further reducing their environmental impact by decreasing pressure on being cost-competitive, compared to manufacturers from outside the EU.

Grants and subsidies

European Regional Development Fund (ERDF)

The European Regional Development Fund supports investments implemented by national and regional authorities and aims to strengthen economic, social and territorial cohesion in the EU. In the financial perspective 2021-2027, it has the following funding priorities:

- PO 1: More competitive and smarter Europe by promoting innovative and smart economic transformation and regional ICT connectivity;
- PO 2: Greener, low-carbon transitioning towards a net zero carbon economy and resilient Europe;
- PO 3: More connected Europe;
- PO 4: More social and inclusive Europe;
- PO 5: Europe closer to citizens (European Parliament; Council of the European Union 2021b).

Relevance: PO1 supports projects aimed at the development of new sustainable technologies, and PO 2 – projects aimed to transition toward the circular economy.

Just Transition Fund (JTF)

The Just Transition Fund is a part of the Cohesion Policy 2021-2027 and aims at supporting EU regions that will be the most negatively impacted by the climate neutrality transformation of the EU. The fund supports a wide range of activities, from social ones such as up- and reskilling of workers, through post-industrial lands rehabilitation, to the technology switch from carbon-intensive to more

environmental-friendly. The fund is available only for eligible regions, identified as the most affected by the transition towards climate neutrality.

Relevance: Carbon-intensive industries based in JFT eligible regions can use JFT for sooner modernisation of their installations towards low-carbon solutions.

Loans/soft loans

European Investment Bank

The European Investment Bank supports the EU's climate policy and climate neutrality vision by financing projects in the field of energy efficiency, low-carbon supply, innovation and enabling infrastructure. It focuses more on energy generation than low-carbon technologies themselves.

Relevance: EIB stimulates shift towards clean energy, which decreases carbon intensity of the whole economy.

Taxes—tax relief/exemption

The Energy Taxation Directive (2003/96/EC) has been adopted in 2003 and sets minimum tax rates for heating fuel and electricity that should be respected by Member States when deciding on national energy and fuel taxes. Tax rates are however outdated and do not support the EU's transition towards climate and energy objectives. In the "Fit for 55" communication, the European Commission announces the adjustment of the energy tax rates, so that they answer the climate and environmental challenges (European Commission 2021a).

Relevance: New minimum tax rates for energy and fuels might support transition towards low-carbon technologies and energy systems, e.g. special electricity tariffs incentivising low carbon heat electrification.

User charges

Not applicable – user charges has not been identified as a measure supporting circular economy and low-carbon industry.

GHG emissions allowances trading scheme

EU Emissions Trading System (ETS)

The EU ETS covers 40% of the EU's greenhouse gas emission, and regulates emissions allowances of around 10,000 installations from power and manufacturing sector (Table 14). It is based on "cap and trade" system, which allows installations to emit given annual allowances. In case of emission decrease, it is possible to save allowances for a next year, or sell them to these units that exceeded their limits.

Table 14 Gases and sectors covered by the EU ETS (European Commission 2021e)

Gas	Industry sector
CO_2	electricity and heat generation oil refineries, steel works, and production of iron, aluminium, metals, cement, lime, glass, ceramics, pulp, paper, cardboard, acids and bulk organic chemicals commercial aviation within the European Economic Area
N_2O	production of nitric, adipic and glyoxylic acids and glyoxal
perfluorocarbons (PFCs)	production of aluminium

White certificates

White certificates is an energy saving obligations scheme that grants a certificate for companies and institutions that reached given energy savings through implementation of energy efficiency measures. The largest companies, e.g. electricity distributers with more than 50,000 customers, have certain annual quotas to achieve. The system is also open for volunteers. Certificates are tradable, i.e. obliged bodies that did not meet their obligations can buy certificates in an open market (Bertoldi and Rezessy 2006). White certificate schemes are implemented at national level and are currently adopted in Austria, Bulgaria, Croatia, Denmark, Greece, Ireland, Italy, Luxembourg, Poland, Slovenia, Spain, and United Kingdom (Signoret 2017).

Relevance: The white certificates scheme is implemented at national level and is voluntary option for the EU Member States. The scheme supports low-carbon industry by incentivising energy efficiency measures adoption. It can be very effective system (example of Italy, where in the first 12 years after the implementation it was responsible for 62% of all savings generated in industry (Di Santo and de Chicchis 2019)), but often has also limited impact (example of Poland, where the system was over complicated and poorly managed (Rosenow et al. 2020)).

5.1.1.1.3 Soft instruments

Endorsement label

Endorsement labels provide customers with understandable and comparable information about the product key parameters. The EU adopted both voluntary and mandatory labels. Following the International Organization for Standardization (ISO) guidelines, there are three types of voluntary environmental labels:

- Type I (ISO 14024) – the label is awarded by an independent organisation and indicates overall environmental performance (e.g. Ecolabel);
- Type II (ISO 14021) – a self-declared label, after meeting a pre-defined criteria (e.g. 100% recycled paper);
- Type III (ISO 14025) – the label is awarded by an independent organisation and indicates quantified environmental performance (e.g. Ecoprofile).

Mandatory labels include the following:

- Energy Label – it provides information about the energy performance of a product; See Section 5.1.1.1.1.
- CE marking – it certifies that the product meets safety, health and environmental requirements of the EU; see section 5.1.1.1.1.
- WEEE label (crossed out wheeled dustbin symbol) – a symbol placed on any electronic and electrical equipment meaning that at the end of life, it should not be disposed to municipal waste and must be taken to a separate collection facility for recovery and recycling.

Relevance: environmental labels provide information about the environmental impact of a product and thus can encourage customers to choose more sustainable products. The WEEE label supports the circular economy by indicating products that should be passed for recovery and recycling.

Information campaigns

No EU-level information campaigns have been identified.

Negotiated Agreements (Public-private)

Bio-based Industries Joint Undertaking

The Bio-based Industries Joint Undertaking (BBI JU) is a public-private partnership signed by the EU and the Bio-based Industries Consortium (BIC) with a total budget of EUR 3.7 billion, implemented in 2014-2020. The main objective of the BBI JU is to foster the transition of the EU towards green economy by supporting the development of new technologies that use renewable biological feedstock instead of fossil resources. BBI JU provides support to projects in the bio-based sectors, in the three focus areas:

1) Feedstock – sustainable biomass production;
2) Biorefineries – large-scale demonstrations;
3) Markets, products and policies – development of markets for bio-based products (Bio-based Industries Joint Undertaking 2021).

Relevance: BBI JU supports resource-efficiency and low-carbon bio technologies that can replace in the future traditional, carbon-intensive ones.

Fuel Cells and Hydrogen Joint Undertaking

The Fuel Cells and Hydrogen Joint Undertaking (FCH JU) is a public-private partnership between the European Commission, industry represented by Hydrogen Europe and the academia represented by Hydrogen Europe Research.

The total budget of FCH JU in the financial period 2014-2020 amounts EUR 1.33 billion. The man objective of FCH JU is to accelerate the EU market for fuel cells and hydrogen technologies by supporting research and innovation projects in this field. The FCH JU focuses on the following areas:

- Green hydrogen production,
- Minimal use of critical raw materials,
- Heat and electricity production,
- Hydrogen storage and grid balancing,
- Clean transport (Fuel Cells and Hydrogen Joint Undertaking 2021).

Relevance: FCH JU finances clean energy generation in fuel cells which supports low-carbon industry development.

Sustainable Process Industry through Resource and Energy Efficiency (SPIRE)

Sustainable Process Industry through Resource and Energy Efficiency (SPIRE) is a contractual public-private partnerships (cPPPs) which supports the EU climate policy by fostering the development of resource and energy efficient technologies in the most energy-intensive industries:

- Cement,
- Ceramics,
- Chemicals,
- Engineering,
- Non-ferrous metals,
- Minerals,
- Pulp & paper,
- Refining,
- Steel,
- Water (Sustainable Process Industry through Resources an Energy Efficiency 2021).

Relevance: SPIRE supports initiatives that improve energy and resource efficiency in industry.

European Technology and Innovation Platforms (ETIPs)

European Technology and Innovation Platforms (ETIPs) are industry groups that develop and implement European Strategic Energy Technology Plans (SET Plan). The objective of SET Plans is to coordinate the development of low-carbon technologies at trans-national level to foster the transition into climate-neutral EU vision. SET Plans cover not only research, but also product introduction to the market, financing, legal and regulatory issues. As of July 2021, the following ETIPs have been established:

- ETIP Batteries Europe – battery industry;
- ETIP Bioenergy – bioenergy and biofuels;
- ETIP Wind – wind energy;
- ETIP Deep Geothermal - geothermal energy;

- ETIP Ocean Energy;
- ETIP Photovoltaic;
- ETIP Renewable Heating and Cooling;
- ETIP Smart Networks for Energy Transition;
- ETIP Sustainable Nuclear Energy;
- ETIP Zero Emission Fossil Fuel Power (ZEP) (European Commission 2021g).

Relevance: ETIPs bring together industry, sectoral associations, policymakers and research institutions for the development of enabling clean energy technologies.

Public Voluntary Schemes

See Green public procurement in section 5.1.1.1.2

Unilateral Commitments (Private)

Ecolabel

Ecolabel has been established in 1992 and certifies that a producer of a certain good meets highest environmental standards related to a product life-cycle. Criteria has been set in a manner that 10-20% of products on the EU market can meet them. Currently over 72,000 products and services is awarded with the Ecolabel (European Commission 2021d).

Relevance: the Ecolabel promotes sustainable and durable products with minimised environmental impact. In particular this relates to production processes with limited GHG emissions and waste generation.

Circular Plastics Alliance

The Circular Plastic Alliance has been established by the European Commission in 2018. Its aim is to boost the plastic recycling in the EU to meet a quota of 10 million tonnes by 2025. As of July 2021, 282 signatories representing industry, academia and public sector joined the Alliance. The Alliance published a report summarising the current state-of-play on plastic waste in the EU, developed a workplan with measures allowing for achieving the quota, and settled an R&D agenda for circular plastics (Circular Plastic Alliance 2020a, 2020b, 2020c).

Relevance: the Circular Plastic Alliance supports plastic recycling and closing the loop of plastic in the industry.

5.2 Identification of policy makers

DG Environment

The European Commission's Directorate-General Environment is a department that is responsible for the development and implementation of the EU environmental policy. DG Environment works at different levels:

- develops Commission proposals that are presented to the European Parliament and Council for adoption;
- ensures that the EU legislation is transposed by Member States;
- evaluates the legislation and policies;
- represents the EU at international level in high-level meetings in the field of environmental policy;
- manages the LIFE programme (in collaboration with DG Climate Action).

In particular, the DG Environment has been responsible for the development of the following policies:

- Eco-design Directive
- Waste Framework Directive
- COM(2018)29 - a monitoring framework for the circular economy
- Directive on the landfill of waste
- Directive on packaging and packaging waste
- Directive 2018/849[1]
- EU action plan for the Circular Economy
- Roadmap to a Resource Efficient Europe
- Strategy for Plastics
- Green public procurement
- WEEE label

DG Environment is composed of six directorates (policy units) and employs over 470 staff (DG Environment 2021). Directorate B Circular Economy & Green Growth is responsible for issues related to circular economy and low-carbon industry.

In the context of circular economy and low-carbon industry, key personnel includes:

- Director of the Directorate B Circular Economy & Green Growth
- Head of Unit of ENV.B.1 Sustainable Production, Products and Consumption
- Head of Unit of ENV.B.3 Waste Management and Secondary Materials

DG Climate Action

The European Commission's Directorate-General Climate Action is a department that is responsible for fostering the EU transition towards a low-carbon and climate resilient economy. DG Climate Action works at different levels:

- develops Commission proposals that are presented to the European Parliament and Council for adoption;
- ensures that the EU legislation is transposed by Member States;
- hosts and manages the EU ETS;
- represents the EU at international level in high-level meetings in the field of climate change and ozone-depleting substances;

- implements the 20% climate mainstreaming target (in collaboration with other DGs);
- manages the LIFE programme (in collaboration with DG Environment).

In particular, the DG Climate Action has been responsible for the development of the following policies:

- EU ETS
- Effort Sharing Regulation
- LULUCF

DG Climate Action employs around 250 staff and is composed of three directorates (policy units) (DG Climate Action 2021):

- A International, Mainstreaming & Policy Coordination;
- B European & International Carbon Markets;
- C Climate strategy, Governance and Emissions from Non-trading Sectors.

In the context of circular economy and low-carbon industry, key personnel includes:

- Director of the Directorate B European & International Carbon Markets
- Head of Unit of CLIMA.B.1 ETS Policy Development and Auctioning
- Head of Unit of CLIMA.B.3 International Carbon Market, Aviation and Maritime
- Head of Unit of CLIMA.B.3 International Carbon Market, Aviation and Maritime

DG Energy

The European Commission's Directorate-General for Energy is a department that is responsible for the development and implementation of the EU energy policy. DG Energy works at different levels:

- develops Commission proposals that are presented to the European Parliament and Council for adoption;
- ensures that the EU legislation is transposed by Member States;
- develops statistical and economic analyses related to energy;
- implements internal energy market;
- ensures nuclear safety;
- represents the EU at international level in high-level meetings in the field of energy policy;

In particular, the DG Energy has been responsible for the development of the following policies:

- Energy performance of buildings directive (EPBD)
- Energy Labelling Regulation
- Internal energy market
- Energy Union

- Clean energy package
- White certificates
- Energy Label

DG Energy is composed of five directorates (policy units) and employs around 600 staff (DG Energy 2021). In the context of circular economy and low-carbon industry, key personnel includes:

- Director of the Directorate A Energy Policy: Strategy and Coordination
- Head of Unit of A4 Economic Analysis and Foresight, Recovery
- Director of the Directorate C Green Transition and Energy System
- Head of Unit of C2 Decarbonisation and Sustainability of Energy Sources

DG Grow

The European Commission's Directorate-General Internal Market, Industry, Entrepreneurship and SMEs is a department that is responsible for the development and implementation of the EU energy policy. DG Grow's main responsibilities are:

- supporting the development of the EU internal market;
- facilitating the transition towards a smart, sustainable, and inclusive economy;
- supporting SMEs by reducing bureaucracy and providing access to funding and global markets;
- providing policy on the protection and enforcement of industrial property rights.

In particular, the DG Grow has been responsible for the development of the following policies:

- Energy Labelling Regulation
- Harmonised European Standards
- Construction Products Regulation
- Public Procurement Strategy
- Raw Materials Initiative
- Just Transition Fund
- CE marking
- Circular Plastics Alliance

DG Grow is composed of nine directorates (policy units) and employs around 800 staff (DG Grow 2021). In the context of circular economy and low-carbon industry, key personnel includes:

- Director of the Directorate A. Strategy & economic analysis
- Head of Unit of A4. Strategy and regulation: single market and industrial policy
- Director of the Directorate I. Ecosystems IV: Mobility & energy intensive industries
- Head of Unit of I1. Energy intensive industries –raw materials

- Head of Unit of I3. Green and circular economy

Other

DG RTD

The European Commission's Directorate-General for Research and Innovation is a department that is responsible for the development and implementation of the EU policy on research and innovation.

In the context of circular economy and low-carbon industry, the DG RTD has been responsible for the development and implementation of the following policies:

- Horizon Europe
- Bio-based Industries Joint Undertaking
- Fuel Cells and Hydrogen Joint Undertaking
- European Technology and Innovation Platforms (ETIPs)

DG REGIO

The European Commission's Directorate-General for Regional and Urban Policy is a department that is responsible for the development and implementation of the EU policy on regional policy.

In the context of circular economy and low-carbon industry, the DG Regio has been responsible for the development and implementation of the European Regional Development Fund (ERDF).

DG JUST

The European Commission's Directorate-General for Justice and Consumers is a department that is responsible for the development and implementation of the EU policy on justice, fundamental rights and consumers.

In the context of circular economy and low-carbon industry, the DG Just has been responsible for the development of the General product safety directive.

DG TAXUD

The European Commission's Directorate-General for Taxation and Customs Union is a department that is responsible for the development and implementation of the EU policy on custom and taxation.

In the context of circular economy and low-carbon industry, the DG TAXAUD has been responsible for the development of the Carbon Border Adjustment Mechanism and Energy Taxation Directive (2003/96/EC).

5.3 Identification of policy needs

Key findings from policy analysis, insights from stakeholders collected during interviews with policy makers and the stakeholder workshops are presented in in Table 15.

All policymakers stated that energy demand modelling is an important source of information when creating policy instruments – both ex-ante, to simulate the impact of a given intervention, and ex-post, for evaluation of their results. Some modelling is done internally in the EC, however, most of the work is outsourced to external partners specialised in energy modelling.

An important aspect of using energy demand models is their usefulness for designing new policy instruments. They should allow for analysis of cross-sectoral measures and instruments involving new energy sources (e.g., hydrogen). New policies should take into consideration the whole lifecycle of products and possible change of their purpose in the future, which should be also reflected in the models. Since there are policies that aim at transition towards low-carbon industry, but does not necessarily support the circularity (e.g., Carbon Border Adjustment Mechanism), the wider perspective is needed for their assessment. This requires improving energy demand models in terms of their interlinkages between sectors and players.

Another aspect is the level of detail provided by energy demand models. Stakeholders often use energy demand models for simulating scenarios for a specific industry sector (e.g., steel production), and detailed results at this level should be available.

Financial aspects were also often addressed by stakeholders. Energy demand models should allow answering in particular questions on costs (both OPEX and CAPEX) of policy instruments implementation and optimal financial mix (private/ public sources) for delivering given goals.

Finally, to better understand results provided by energy demand modelling, models should be better described. In particular, this concerns their limitations, assumptions done and uncertainty levels. Also, a comparison of models developed by different teams should be available, as well as their interoperability and transposing datasets between models.

Table 15 Policy needs concerning circular economy and low-carbon industry identified during interviews with stakeholders and the stakeholder workshop

Policy area	Key findings
Energy	- Energy demand modelling is an important source of information for policymaking. Some modelling is done internally by the EC, and some analyses are subcontracted to external partners.

Policy area	Key findings
	- Depending on the timescale of an analysis and its objectives, different level of detail is required from models. Short-term analyses require more detailed outputs, e.g. unit energy consumption in a given sector. For long-term forecasting, more general outputs are needed, e.g. utilisation rates, number of vehicles on the market. - From the energy policy point of view, the transition towards the circular economy is not considered as an objective itself but is a mean (a group of means) bringing the EU towards the energy policy goals. - Energy demand models are used in different ways, including scenario analyses, sensitivity analysis, checking how a change of various parameters would affect the energy system, etc. Energy demand models should be able to address different needs. - New policy instruments, in particular those related to the "Fit for 55" package, will be introduced in the close future. Energy demand models should support their development and implementation.
Industrial growth	- Energy demand modelling is an important source of information for policymaking. Some modelling is done internally by the EC, but most analyses are subcontracted to external partners. - From the industrial growth point of view, the energy demand modelling is used for analysis of impacts of given policy instruments implementation. Energy demand modelling is used to run different scenarios and verify how the industry (as a whole) and/or given sectors would react on specific measures. An important component is financial analysis, which shows cost distribution between stakeholders and allows for its optimization. - The major limitation of energy demand models is a low level of disaggregation of their results. There is a need of obtaining detailed results per sector, while current models provide more general data. Also, value chains and supply chains should be better addressed. - Financial components of energy demand models are of major importance. In particular, energy demand models should assist in answering questions on the required amount of investment needed for achieving defined goals, distinguishing private and public sources. - Energy demand models should assist in designing future energy mix and simulating various scenarios. In particular, the role of natural gas and hydrogen (both blue and green) should be included in models.

Policy area	Key findings
	- Uncertainty of models should be better addressed by their authors. - Energy demand models should improve their understanding of the industry ecosystem. Interactions between different sectors and players should be better addressed.

Climate	- Energy demand models should allow for variant analysis and answer questions on how assumptions and outputs relate to each other.
	- Energy demand models should allow for answering a question of what policies could deliver given effect.
	- Documentations of models should be extended and easier available, to ease understanding of results of analyses, their uncertainty, and limitations. Also, comparison of different energy models should be available, to better choose proper tools for different analyses.
	- The interoperability of different models should be improved, to allow transferring data between models.
	- Energy demand models should allow answering the following questions:
	  o How to improve the impact of existing industrial processes?
	  o To what extent given process can be substituted by another one?
	- Energy demand models should allow for obtaining data on the stock overview, e.g. fuel sources and raw materials consumed, imported, and exported in the EU.
	- Carbon flows should be better addressed by energy demand models.
	- Cross-sectoral issues are of major importance and should be better addressed by models. How do changes in a given sector impact others, including supply chains? For example, how the increase in wood use in the construction sector will impact land use?
	- Financial aspects should be better addressed, e.g. cost of implementation of specific policy instruments should be taken into account.

Cross-disciplinary	- Since buildings are long-lasting goods, future patterns of building use should be taken into consideration during the design phase, to extend the lifetime of buildings. The shift from non-residential to residential buildings, or change in the functional division of a building should be available to prevent the pre-mature demolition of a building. This should be covered in future legislation changes.

Policy area	Key findings
	- It would be useful to analyze what drives circularity in the current policy instruments. - The whole lifecycle of products should be taken into consideration when creating any policy instrument. - Linkages between directives addressing different life cycle stages are relevant.

5.4 Conclusions

Circular economy and low-carbon industry policy instruments important to be modelled:

- The "Fit for 55" package will bring many new or revised policy instruments. Since they will set the main direction of the EU climate and energy policy, it is important to know their impact. In particular, the carbon border adjustment mechanism, the revised renewable energy directive and the recast of the energy efficiency directive are of the biggest interest of stakeholders.
- Stakeholders also mentioned multiple times that knowing interactions between policy instruments, in a cross-sectoral dimension, is important to them.
- Policy instrumentd directly influencing the fuel demand structure: the Hydrogen strategy for a climate-neutral Europe, the Clean energy package and the Energy Union.

Circular economy and low-carbon industry indicators of interest from policy making perspective:

- Financial indicators related to the policy instruments implementation – CAPEX, OPEX, optimal financial mix.
- Energy mix resulting from the implementation of policy instruments, in particular for gas, and blue and green hydrogen.
- More detailed results for industry sectors.
- Parameters describing the quality of the analysis performed with the use of an energy demand model: limitations, assumptions done, uncertainity levels.

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6. Sharing Economy

This chapter describes existing and planned EU-level policies that are relevant from the point of view of energy consumption in the **transport sector in the context of the rise of sharing economy**. In defining the scope of sharing economy, we follow the approach adopted by the Commission in the communication "A European agenda for the collaborative economy". Sharing economy is thus understood as "business models where activities are facilitated by collaborative platforms that create an open marketplace for the temporary usage of goods or services often provided by private individuals".

We limit the scope of analysis to the transport sector firstly, to keep it focused and aligned with the scope of the modelling work package in the project, and secondly, because the transport sector seems to be the one in which the rise of sharing economy models can have the most significant impact on the volume and patterns of energy consumption (compared to short-term accommodation rentals, exchange of care services and other models where there is no evident strong link between sharing and energy use). The analysis therefore encompasses car-sharing, ride-sharing, car-pooling, sharing schemes of city bikes, e-scooters and similar devices, and any other collaborative economy models that create alternatives to individual car ownership and use on the one hand, and public transport on the other.

As a relatively new phenomenon, sharing economy is not the object of dedicated policies (although the Commission follows its development closely and policies may follow). However, there are a number of policies in the areas of transport, energy, service provision, urban mobility, urban development and finance which may influence the direction and pace of its development, and its (positive or negative) impact on energy demand. When choosing the relevant regulations, were sought to identify rules in the field of transport and energy that directly impact energy use in transport, as well as rules in other fields such as taxation, service provision, working conditions, urban planning, air pollution etc., which may indirectly influence the growth dynamics of sharing economy models in the field of transport.

6.1 Identification of energy demand-side policies and instruments in the EU

Policy instrument category			EU policy instruments
Regulation	Codes/ standards/ mandates	Building/ grid codes and standards	Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure
		Product standards	Commission Regulation (EU) 2019/1781 of 1 October 2019 laying down ecodesign requirements for electric motors and variable speed drives Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 setting CO2 emission performance standards for new passenger cars and for new light commercial vehicles Directive 1999/94/EC of the European Parliament and of the Council of 13 December 1999 relating to the availability of consumer information on fuel economy and CO2 emissions in respect of the marketing of new passenger cars
		Sectoral standards	Regulation (EC) No 1071/2009 of the European Parliament and of the Council of 21 October 2009 establishing common rules concerning the conditions to be complied with to pursue the occupation of road transport operator
		Auditing	NA
	Obligation schemes, quotas, and mandatory targets	Obligation schemes	Directive (EU) 2019/1161 of the European Parliament and of the Council of 20 June 2019 amending Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles
		Carbon Emissions Reduction Target	Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement
	Other regulation	Labour market regulations	Directive 2002/15/EC of the European Parliament and of the Council of 11 March 2002 on the organisation of the working time

Policy instrument category			EU policy instruments
			of persons performing mobile road transport activities Regulation (EC) No 561/2006 of the European Parliament and of the Council of 15 March 2006 on the harmonisation of certain social legislation relating to road transport
		Market access regulations	Directive 2006/123/EC of the European Parliament and of the Council of 12 December 2006 on services in the internal market Directive 2000/31/EC of the European Parliament and of the Council of 8 June 2000 on certain legal aspects of information society services, in particular electronic commerce
		Energy market regulations	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
Economic and financial instruments	Direct investment	Government procurement	Regulation (EU) 2020/852 (Taxonomy) on the establishment of a framework to facilitate sustainable investment and the Commission Delegated Act establishing technical screening criteria
		RD&D funding	Horizon2020/Horizon Europe, including the EIT Urban Mobility initiative
	Fiscal/ financial incentives	Tariffs	NA
		Grants and subsidies	EU structural and regional funds (ERDF, Cohesion Fund) LIFE programme Proposed Digital Europe Programme
		Loans/soft loans	EIB lending
		Taxes—tax relief/exemption	(Planned revision of) Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity
		User charges	NA
	Market-based instruments	GHG emissions allwances trading scheme	Potential inclusion of the transport sector into the EU Emissions Trading Scheme.
		White certifcates	NA
Soft inst	Performance labels	Endorsement label	NA

Policy instrument category			EU policy instruments
	Information campaigns		NA
	Voluntary approaches	Negotiated Agreements (Public-private sector)	European Clean Bus deployment Initiative
		Public Voluntary Schemes	Green Public Procurement toolkit including general GPP guidelines and specific guidance on GPP in transport and in public space maintenance EU guidance on the development of cycling infrastructure CLARS Platform providing information on LEZ, congestion charging schemes and urban traffic restrictions in EU
		Unilateral Commitments (Private sector)	Providing insurance by platform operators

6.1.1.1.1 Regulation

Building/grid codes and stand*ards*

Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure lays down the minimum requirements for the building-up of alternative fuels infrastructure, including recharging points for electric vehicles and refuelling points for natural gas (LNG and CNG) and hydrogen, to be implemented by means of Member States' national policy frameworks, as well as common technical specifications for such recharging and refuelling points, and user information requirements.

Relevance: the Directive increases availability of infrastructure needed for some sharing economy models such as electric car rentals.

Product standards

Commission Regulation (EU) 2019/1781 of 1 October 2019 laying down **ecodesign requirements for electric motors and variable speed drives** establishes ecodesign requirements for the placing on the market or the putting into service of electric motors and variable speed drives, including where they are inte-grated in other products.

Relevance: the Regulation may influence the durability and repairability of vehicles employed in car sharing schemes, electric scooter rentals, etc.

Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 setting **CO2 emission performance standards for new passenger cars and for new light commercial vehicles** establishes CO2 emissions performance requirements for new passenger cars and for new light commercial

vehicles in order to contribute to achieving the Union's target of reducing its greenhouse gas emissions.

Relevance: the Regulation impacts the CO2-intensity and fuel economy of new fleets, hence influences energy consumption by car-sharing services that still rely on internal combustion vehicles.

Directive 1999/94/EC of the European Parliament and of the Council of 13 December 1999 relating to the availability of consumer information on fuel economy and CO2 emissions in respect of the marketing of new passenger cars lays down requirements concerning the provision of information on a car's fuel economy and CO2 emissions to customers.

Relevance: The Directive reinforces the impact of Regulation 2019/631 on CO2 performance standards of cars.

Sectoral standards

Directive 2006/123/EC of the European Parliament and of the Council of 12 December 2006 **on services in the internal market** establishes general provisions facilitating the exercise of the freedom of establishment for service providers and the free movement of services.

Relevance: this directive determines the status of service providers in sharing economy models and, hence, the application of other EU rules to service provision in sharing economy (cf. the ECJ ruling in case C-434/15 on the status of Uber).

Directive 2000/31/EC of the European Parliament and of the Council of 8 June 2000 on **certain legal aspects of information society services, in particular electronic commerce** lays down common rules on the freedom to provide online services in the internal market.

Relevance: impacts the ability of digital platforms supporting sharing economy models to operate across borders and build up at scale.

Directive 2006/123/EC of the European Parliament and of the Council of 12 December 2006 on services in the internal market establishes general provisions facilitating the exercise of the freedom of establishment for service providers and the free movement of services.

Relevance: this directive determines the status of service providers in sharing economy models and, hence, the application of other EU rules to service provision in sharing economy (cf. the ECJ ruling in case C-434/15 on the status of Uber).

Directive 2000/31/EC of the European Parliament and of the Council of 8 June 2000 on **certain legal aspects of information society services, in particular electronic commerce** lays down common rules on the freedom to provide online services in the internal market.

Relevance: impacts the ability of digital platforms supporting sharing economy models to operate across borders and build up at scale.

Obligation schemes, quotas, and mandatory targets

Directive (EU) 2019/1161 of the European Parliament and of the Council of 20 June 2019 amending Directive 2009/33/EC **on the promotion of clean and energy-efficient road transport** vehicles defines "clean vehicles" and sets national targets for their public procurement. It applies to different means of public procurement, including purchase, lease, rent and relevant services contracts.

Relevance: in addition to providing a definition of clean vehicle for all purposes, it impacts the share of clean vehicles in municipal and public vehicle-sharing schemes.

Carbon Emissions Reduction Target

Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 **on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030** contributing to climate action to meet commitments under the Paris Agreement lays down binding emissions reduction targets in the non-ETS sectors including transport for the period 2021 to 2030.

Relevance: by setting the emissions reduction target, the Effort Sharing Regulation obligates member states to achieve national emission reduction targets in sectors not covered by the EU ETS. This requires setting domestic policy frameworks covering these sectors, which incentivise shifts towards cleaner, more efficient solutions. In case of transport, this includes i.a. shifting to sustainable transport modes and promoting electrification.

Energy market regulations

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 establishes**, inter alia, requirements for grid operators to enable integration of electric vehicle charging points.

Relevance: it impacts the availability of EV charging infrastructure needed for some sharing economy models such as car sharing services that use EVs.

Environmental regulations

Directive (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on **the reduction of national emissions of certain atmospheric pollutants** establishes the emission reduction commitments for the Member States' anthropogenic atmospheric emissions of air pollution including pollu-tants coming from the transport sector such as nitrogen oxides (NOx) and fine particulate matter (PM2.5) and obligations to adopt and implement national pollution control programmes.

Relevance: The Directive has major implications for the design of national and local urban mobility policies and infrastructures, which may be conducive to the development and expansion of certain sharing economy models such as car-pooling or bike-sharing.

Labour market regulations

Directive 2002/15/EC of the European Parliament and of the Council of 11 March 2002 on **the organisation of the working time of persons performing mobile road transport activities** establishes minimum requirements in relation to the organisation of working time in order to improve the health and safety protection of persons performing mobile road transport activities and to improve road safety and align conditions of competition.

Relevance: Under the ECJ ruling in case C-434/15 given on 20 December 2017, ride-sharing platforms such Uber do not provide information society services but are part of services in the field of transport and therefore ride sharing services have to comply with EU and national regulations applicable to 'conventional' taxi service providers, which may influence the expansion of this kind of ride-sharing models.

Regulation (EC) No 561/2006 of the European Parliament and of the Council of 15 March 2006 on **the harmonisation of certain social legislation relating to road transport** lays down rules on driving times, breaks and rest periods for drivers engaged in the carriage of goods and passengers by road in order to harmonise the conditions of competition between modes of inland transport, especially with regard to the road sector, and to improve working conditions and road safety.

Relevance: by regulating the working conditions of drivers offering ride-sharing services the regulation, on the one hand, may improve the quality of such services, while also influencing the rate of market expansion of this kind of ride-sharing.

6.1.1.1.2 Economic and financial instruments

Government procurement

Regulation (EU) 2020/852 (Taxonomy) on the **establishment of a framework to facilitate sustainable investment** and the Commission Delegated Act lay down criteria for sustainable investment in, inter alia, urban and suburban transport, road passenger transport, operation of personal mobility devices, cycle logistics, and transport by motorbikes, passenger cars and light commercial vehicles.

Relevance: the Taxonomy may influence the sustainability (recyclability, emissions performance, etc.) of vehicles purchased for the purposes of providing car, bike or e-scooter sharing schemes and ride sharing services. RD&D funding.

RD&D funding

Eu funding under the Horizon Europe programme and the proposed Digital Europe programme will support research and innovation for the digital transition.

Relevance: This may include technologies and applications needed for the development and deployment of sharing economy models in the transport sector, as well as their energy efficiency.

Grants and subsidies

EU funding under the **structural and regional funds** (European Regional Development Fund, Cohesion Fund) can support the development of infrastructure for sharing economy models (charging points, cycling infrastructure, broadband coverage), development of digital applications and services by SMEs, or manufacture of energy-efficient vehicles.

Relevance: increased funding for the projects related to the development of the shared economy, enabling further development of the sector and increase in the availability and diversity of the services

Loans/soft loans

EU funding available from the EIB can support the development of infrastructure for sharing economy models (charging points, cycling infrastructure, broadband coverage), development of digital applications and services by companies, or manufacture of energy-efficient vehicles.

Relevance: increased funding for the projects related to the development of the shared economy, enabling further development of the sector and increase in the availability and diversity of the services

Taxes—tax relief/exemption

Council Directive 2003/96/EC of 27 October 2003 **restructuring the Community framework for the taxation of energy products and electricity** lays down rules on the taxation of, inter alia, motor fuels and electricity. It is currently under review to adjust it to Europe's new climate objectives.

Relevance: new tax rules on motor fuels may lead to faster phase-in of electric vehicles but also increase the demand for mobility options that are more cost-efficient than owning a car, including sharing economy services.

GHG emissions allowances trading scheme

Proposed inclusion of the transport sector into the EU Emissions Trading Scheme.

Relevance: will depend on the final shape of the provisions to be adopted. However, the inclusion of transport into the ETS may increase the demand for

mobility options that are more cost-efficient than owning a car, including sharing economy services.

6.1.1.1.3 Soft instruments

Public Voluntary Schemes

The Green Public Procurement toolkit offers guidance on the public procurement of vehicle fleets, fleet services and public transport services, which may be relevant for municipal car-sharing or bike-sharing schemes. EU **guidance on the development of cycling infrastructure**, on the other hand, helps cities build safe and effective infrastructure for cycling, which is crucial for the development and uptake of certain sharing economy models such as bike-sharing or e-scooter schemes.

EU platforms for the co-operation and information exchange among municipal authorities, such as UR-BACT or the CLARS platform, can influence local urban mobility policies and mobility infrastructure spend-ing in ways that are relevant for the development of sharing economy models (urban traffic restrictions, low-emissions zones, development of infrastructure such as cycling lanes or charging points, municipal charges and fees on sharing schemes, etc.)

6.2 Identification of policy makers

DG Climate Action

The European Commission's Directorate-General Climate Action is a department that is responsible for fostering the EU transition towards a low-carbon and climate resilient economy. For more detailed overview, see section 6.3.

In the context of sharing economy, key units at DG CLIMA include:

- C.1 – Strategy and Economic Assessment
- C.2 – Governance & Effort Sharing

DG Energy

The European Commission's Directorate-General for Energy is a department that is responsible for the development and implementation of the EU energy policy. For more detailed overview, see section 6.3.

In the context of sharing economy, key units at DG Energy include:

- B.2 – Energy Efficiency
- B.3 – Buildings and Products
- B.5 – Innovation, Research, Digitalisation, Competitiveness

DG Move

The European Commission's Directorate-General for Mobility and transport is a department that is responsible for the development and implementation of the EU policies concerning the transport. DG Move's main responsibilities are:

- supporting sustainable development of transport, including reduction of its impact on the environment, provision of sustainable mobility alternatives, and increasing uptake of alternative transport fuels,
- ensuring that European transport sector is smart and innovative, making the most of digitalisation and automation,
- developing integrated and connected Trans-European Transport network,
- ensuring that internal market for transport is efficient and accessible,
- improving connectivity links with the key partners of the EU,
- ensuring high level of transport safety.

In the context of sharing economy the DG Move key units include:

- B.4 Sustainable and Intelligent Transport

DG Grow

The European Commission's Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs is a department that is responsible for the development and implementation of the EU policies concerning the single market.

In the context of sharing economy the DG GROW key units include:

- I.2 Mobility

6.3 Identification of policy needs

Identification of policy needs has been performed during interviews with stakeholders, which have been conducted in August and October 2021. Invitations have been sent to eight European Commission's representatives. The invitation contained the policies in the field of sharing economy, selected in the previous chapter. Further stakeholder feedback was gathered during the stakeholder workshop organized in October 2021. In total, inputs from eight stakeholders were received.

As part of the interview, the following questions were asked:

Topic 1: Policy makers' needs in terms of modelling

- What parameters / variables resulting from energy demand models do you think would be the most useful for policy making process? Examples of parameter: shared mobility energy use and its structure by type of energy source, share of vehicles covered by the sharing economy in the total fleet

- What quantitative aspects would you like to understand more to assist the policy making?
- Do you have any other comments or suggestions on how energy demand models could assist policy making?

Topic 2: Existing and emerging policies in field of energy aspects of sharing economy in transport

- Do you think the presented list is complete?
- Which instruments are most impactful / important for sharing economy in transport? Why?
- How do you assess the potential impact of such instruments in field of energy aspects of sharing economy in transport?

The main findings are presented in the Table 16. Shared mobility services, combined with the electrification of cars, can significantly affect the demand for electricity. This requires the development of policies based on the results of modeling changes in energy demand, the strength of power grids, and investing in flexibility and reliability.

Table 16 Results of interviews with key stakeholders

Policy area	Key findings
Energy	- There is a need to better understand what will happen to the energy networks as a result of mass electrification of cars, including those used within shared economy. - There is a need to assess the impact of the shared economy and the change in energy demand on the investment need in the modernization of transmission and distribution networks
Climate	- Changes in public awareness could affect the sharing mobility market and demand for energy after COVID-19 pandemic (reduced trust in public transport, increased use of private cars). - Need to understand structural changes in long-distance vs short- and medium-distance road transport competitiveness given the need to decarbonise the sector and its impact on the costs.

6.4 Conclusions

Sharing economy policy instruments important to be modelled:

- Carsharing and carpooling policies and their impact on urban mobility, in particular the individual car ownership levels and net impacts on the energy demand
- Carsharing and carpooling policies and their impact on energy demand and use, in particular whether they support faster electrification and to what extent other energy and climate policies may support electrification of this segment of market
- Policy conditions for sharing economy and public transportation development as a complementary and non-competing services

Sharing economy indicators of interest from policy making perspective:

- Shared mobility energy use and its structure by type of energy source
- Share of vehicles covered by the sharing economy in the total fleet
- Share of transport activity covered by the sharing economy

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