Impacts of PVP concepts on grid system

EU Policy Workshop "For the Sake of Decarbonising Europe: Bringing PV Prosumers and Distribution System Operators together“

10 March 2020, Brussels

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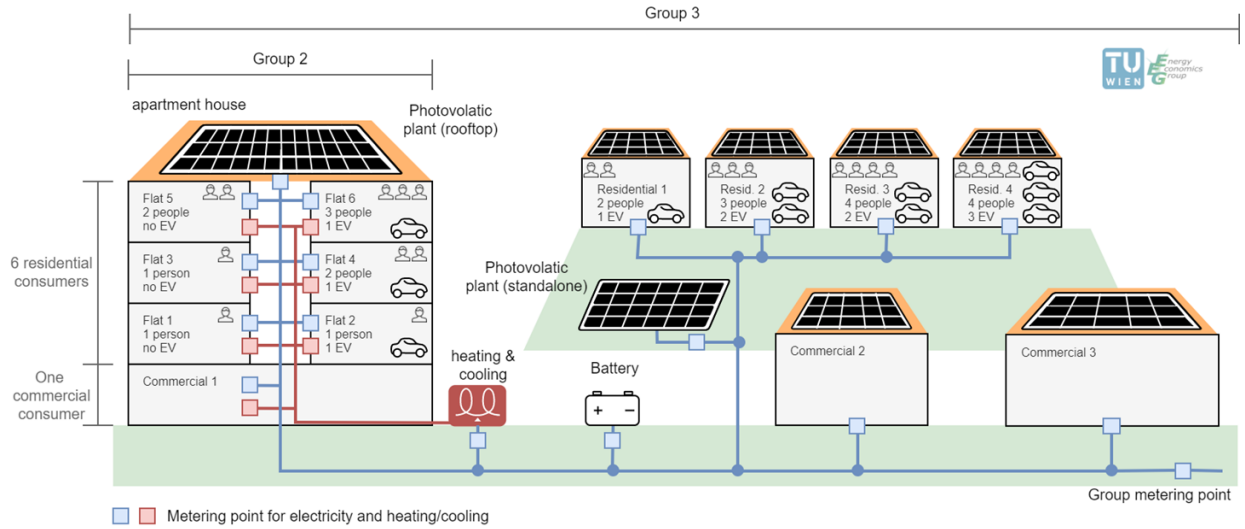
(I) Objective of the work carried-out

(I) Objective of the work carried-out: PVP4Grid project

- The PVP4Grid project explores **photovoltaic (PV) energy prosumer concepts**, particularly in terms of energy communities, by carrying out qualitative analysis and quantitative simulations and testing of PV prosumer concepts in eight different EU countries.

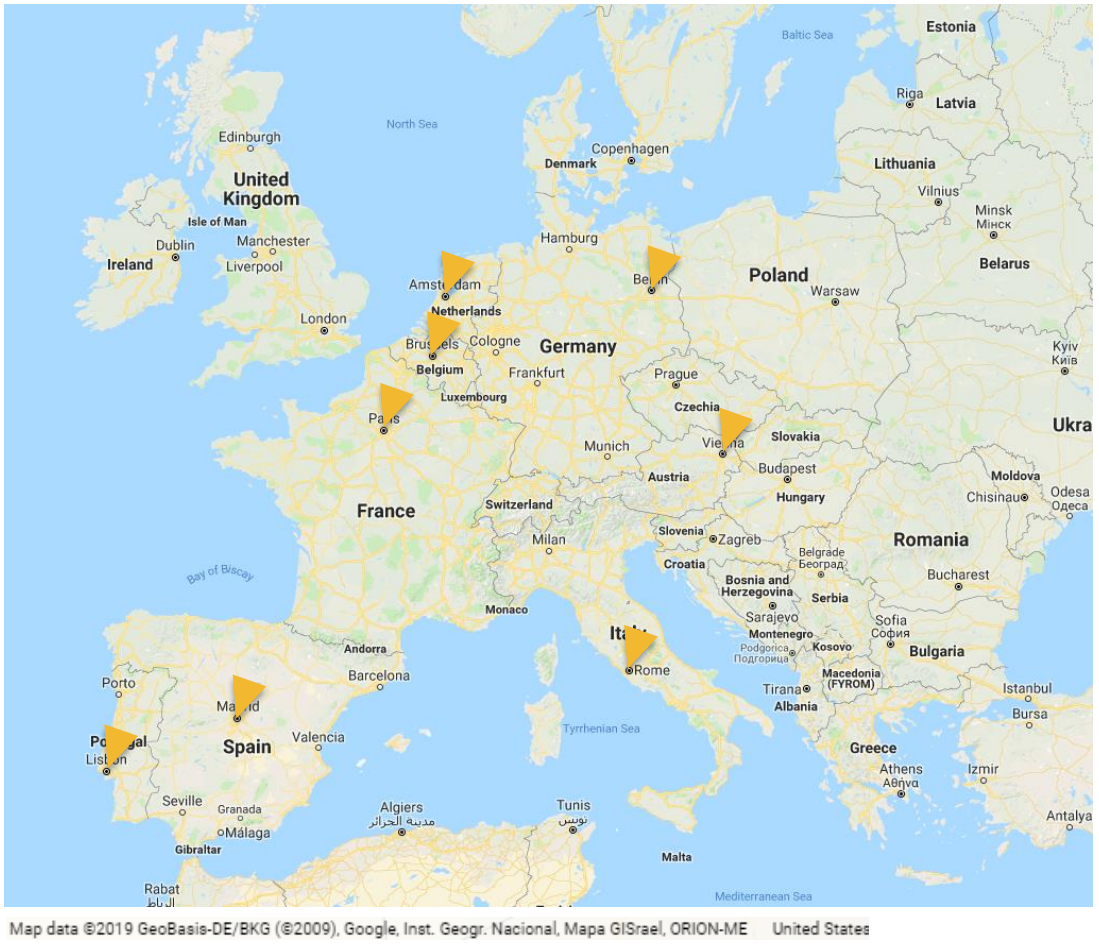
- The overall objective is to gain better understanding of those factors that can potentially **enable** or **hinder** the process of consumers becoming PV prosumers in economically viable and system-friendly manner.



(I) Objective of the work carried-out: Target countries

8 target countries:

- Austria,
- Belgium,
- France,
- Germany,
- Italy,
- the Netherlands,
- Portugal and
- Spain



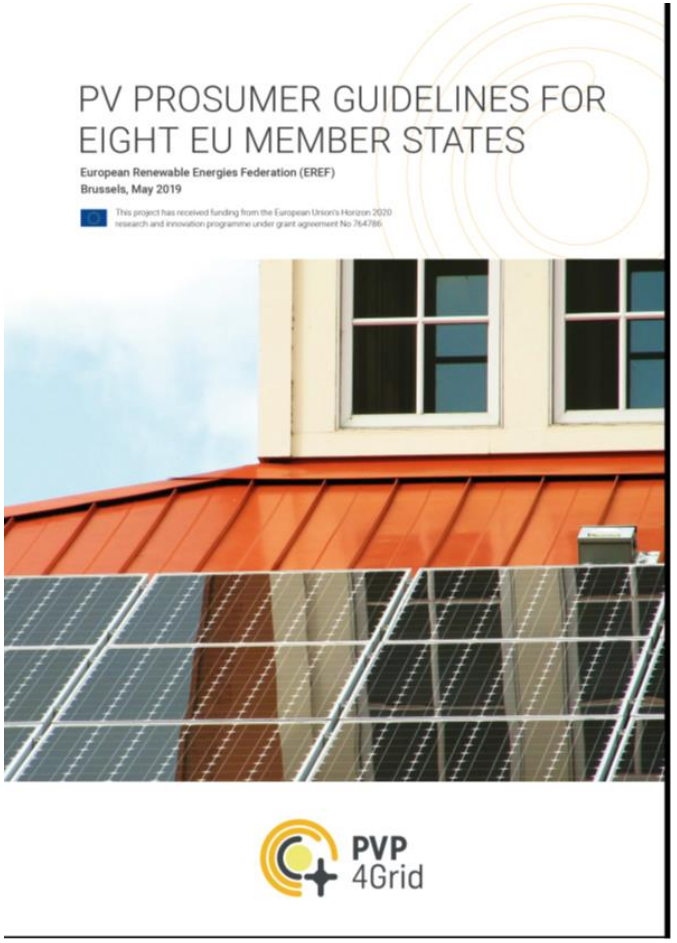
(I) Objective of the work carried-out: WP4

- Work Package 4 (WP4) of the PVP4Grid project aims to bring the results of the qualitative and quantitative analysis of the prosumer concepts to attention of wider audience.

- Consist of three streams of work:
  a) Prosumer Guidelines (*finalised*)

  b) Impact of PVP concept on grid system

  c) Policy recommendations (*on-going*)



(I) Objective of the work carried-out: Task 4.2 Impact of PVP concept on grid system

- To complement the Prosumer Guidelines by looking at the side of grid system and providing an **overview of the impact the increasing PV energy self-consumption on the grid system**

➢ **Eight country reports** (*finalised*) in national languages:
  - Followed a predefined common template and guidelines…
  - …but at the same time allowed the report to be tailored for country-specific context and needs.
  - Available: https://www.pvp4grid.eu/guidelines-policy-papers/

➢ **A summary report** *(work in progress)* aimed to bring the country-specific findings together including:
  - Overview of the context of the grid system in the EU,
  - Changes the new EU regulation framework suggests,
  - General challenges and drivers influencing the energy self-consumption and its implications to the distribution network,
  - A summary of the quantitative analysis (simulation results) of the improved prosumer concepts and their implications from the perspective of the grid,
  - To conclude, the study presents the key findings of stakeholder workshops held in different PVP4Grid target countries.

(II) Background context: Grid system in the EU countries

(II) Background context: Grid system in the EU countries

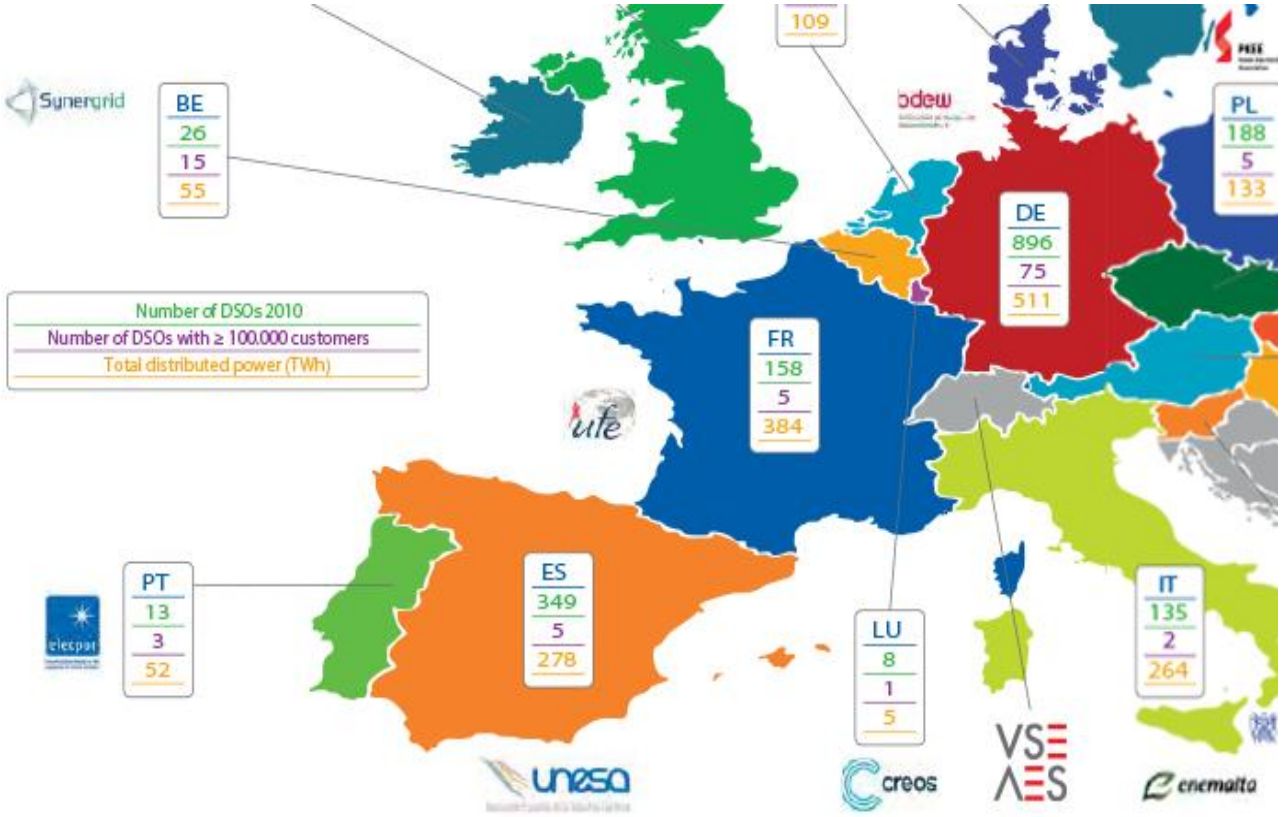
- Transmission and distribution are key activities of an electricity system **linking the electricity production with electricity users**
- Conventionally, the European electricity sector was characterised by vertically integrated state or privately-owned monopolies
- Over the last decades, the sector has seen important changes including a gradual process of **opening the European electricity markets to competition** to achieve more competitive prices and establishment a unified **European energy market**
- As a result of unbundling, in many European countries, the vertically integrated utilities have been divided into **competitive generation and supply of electricity** and **non-competitive transmission and distribution networks**
- As a result of different degrees and pace of implementing the unbundling requirements in different Member States, **big differences exist how the system operators are organised** in different European countries.

Source; Prettico, G., Flammini, M. G., Andreadou, N., Vitiello, S., Fulli, G., Masera, M., Distribution System Operators observatory 2018 - Overview of the electricity distribution system in Europe, EUR 29615 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-79-98738-0, doi:10.2760/104777, JRC113926.

(II) Background context: Grid system in the EU countries

DSOs in Europe – 2,400 companies, 190 with > 100,000 users

- Austria: 138 (13)
- Belgium: 24 (15)
- France: 158 (5)
- Germany: 880 (75)
- Italy: 144 (3)
- Netherlands: 11 (8)
- Portugal: 13 (3)
- Spain: 349 (5)



Source: Power Distribution in Europe Facts & Figures- Eurelectric, 2013

(II) Background context: Grid system in the EU countries

Level of concentration

High concentration: one DSO (99-100% of distributed power)

Medium concentration: One dominant DSO (≥ 80% of distributed power) and several smaller local DSOs

Medium concentration: A mix of DSOs, with the three largest accounting for more than 60% of distributed power

Low concentration: Mainly small, local DSOs. The three largest DSOs usually deliver less than 50% of distributed power

Ownership

Largely private ownership

Largely public - national level ownership

Largely public – municipalities ownership

Largely shared control

Data not available

Source: Power Distribution in Europe Facts & Figures- Eurelectric, 2013

(II) Background context: Current state of play - EU DSOs and prosumers

- Currently, prosumers are not really managed by DSOs, but generally treated as normal connection points
  - Only 28% of the DSOs replied positively in respect to prosumers, and even less (11%) said that they managed active consumers

- Depends on country-specific context
  - Stage of development of regulatory framework
  - Lack of regulatory framework defining how to manage prosumers

- Some of the DSOs however handle prosumers in pilot projects and foresee these activities as more important in future

Figure 28. DSOs handling prosumers

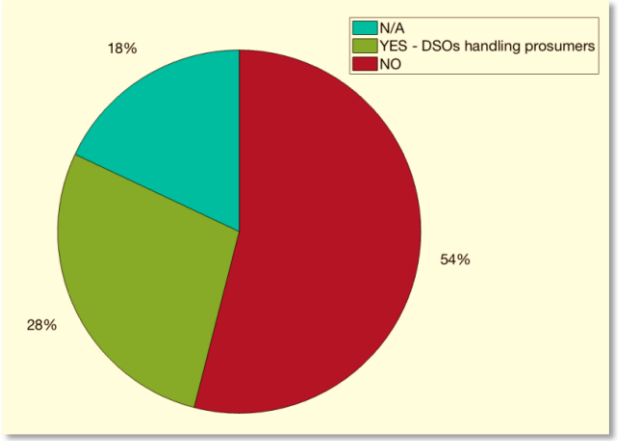
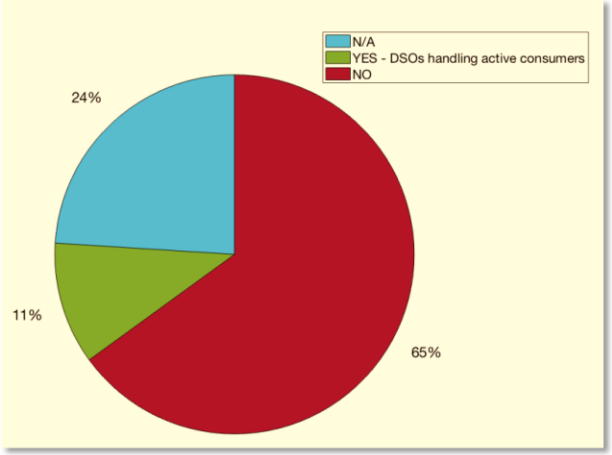


Figure 29. DSOs handling active consumers

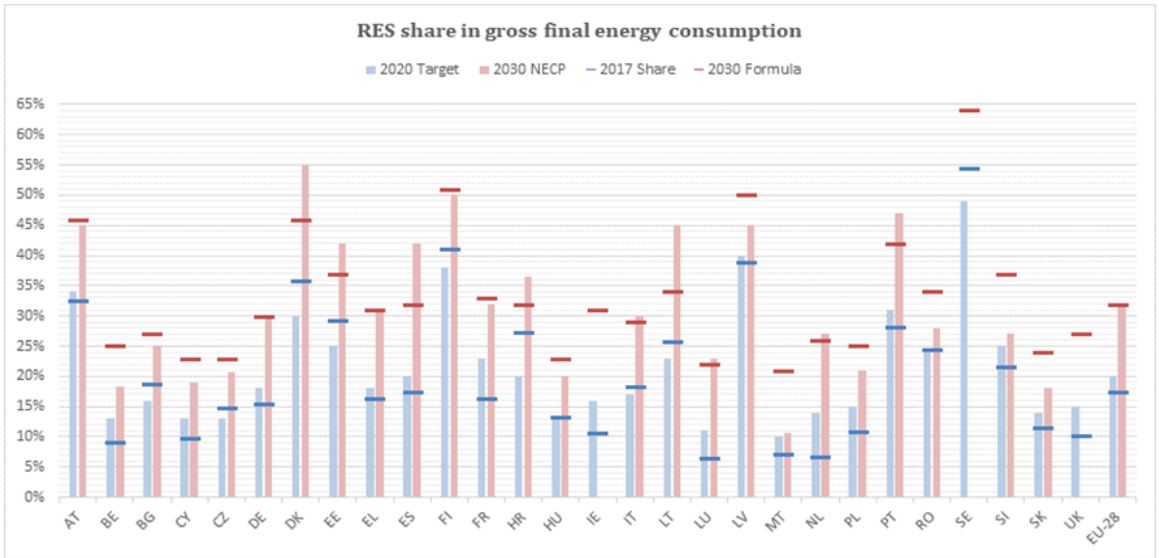


Source; Prettico, G., Flammini, M. G., Andreadou, N., Vitiello, S., Fulli, G., Masera, M., Distribution System Operators observatory 2018 - Overview of the electricity distribution system in Europe, EUR 29615 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-79-98738-0, doi:10.2760/104777, JRC113926.

(III) Overview of challenges and drivers

(III) Overview of challenges and drivers: Great variety in RES targets and potential

- Clean energy for all Europeans package set a RES target to achieve at least **32% by 2030**
- The RES target-setting in National energy and climate plans (NECPs) and progress depends on the **historic energy-mix** and **country specific RES potential**
- In the PVP4Grid countries, the target setting for 2030 varies from **25% in Belgium and the Netherlands** to **45% in Austria**

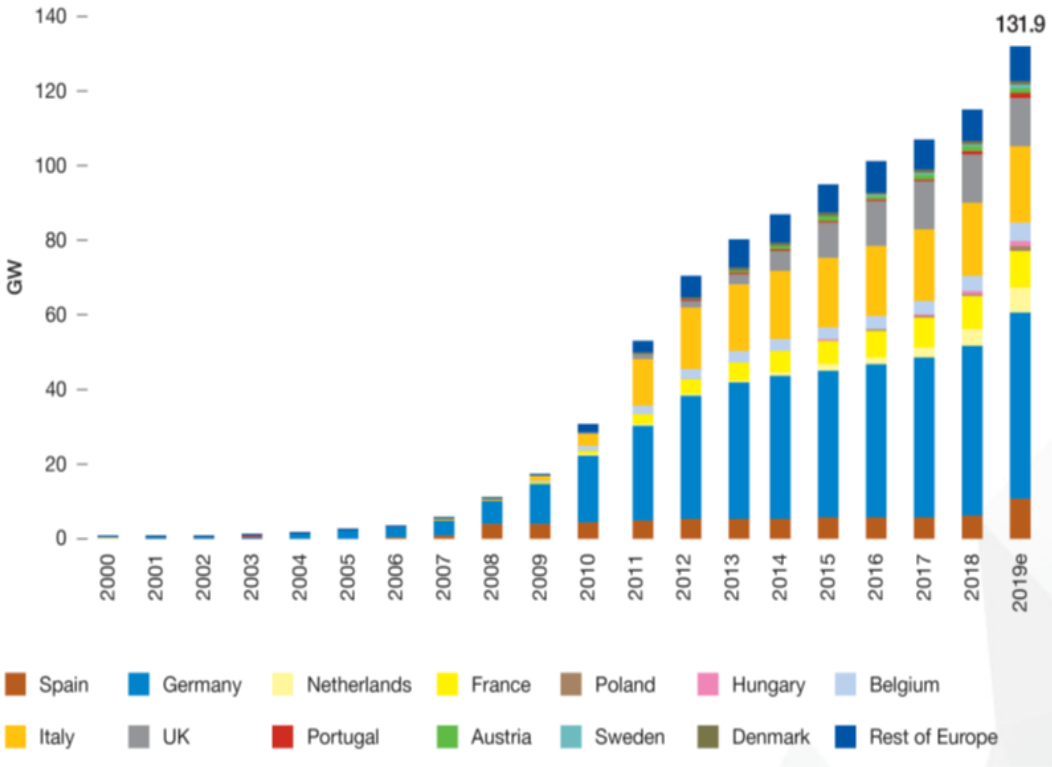


National renewables contributions based on draft NECPs

Source: European Commission (2019) United in delivering the Energy Union and Climate Action - Setting the foundations for a successful clean energy transition. COM(2019) 285 final.

(III) Overview of challenges and drivers: Significant differences in total installed PV capacity

- The EU reached a total installed PV capacity of 132 GW at the end of 2019
- The installed capacity however varies significantly among PVP4Grid countries
  - Germany: 49.9 GW
  - Italy: 20.5 GW
  - Spain: 10.6 GW
  - France: 9.97 GW
  - Netherlands: 6.7 GW
  - Belgium: 4.7 GW
  - Austria and Portugal: 1-2 GW.



EU28 total solar PV installed capacity (GW) 2000 – 201

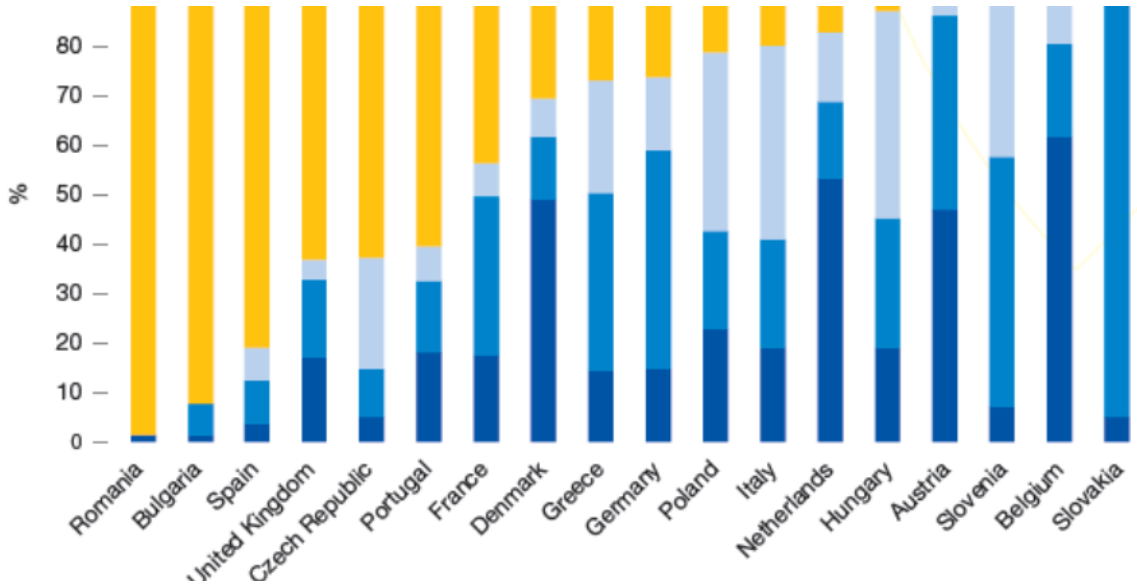
Source: SolarPower Europe (2020) EU Market Outlook for Solar Power / 2019 – 2023

(III) Overview of challenges and drivers: The distributed PV generation is increasing

- The deployment of rooftop solar PV systems has increased significantly over the last year
- It has been estimated to increase to 320 GW by 2024 presenting close 50% of the total PV growth globally.

- In Europe by the end of 2018, cumulative PV system capacity distribution was:
  - 19% of the n residential rooftops
  - 30% on commercial roofs,
  - 17% industrial segment,
  - 34% utility-scale.

- From the PVP4Grid countries, Belgium, Austria and the Netherlands have the highest non-utility scale PV capacities respectively.

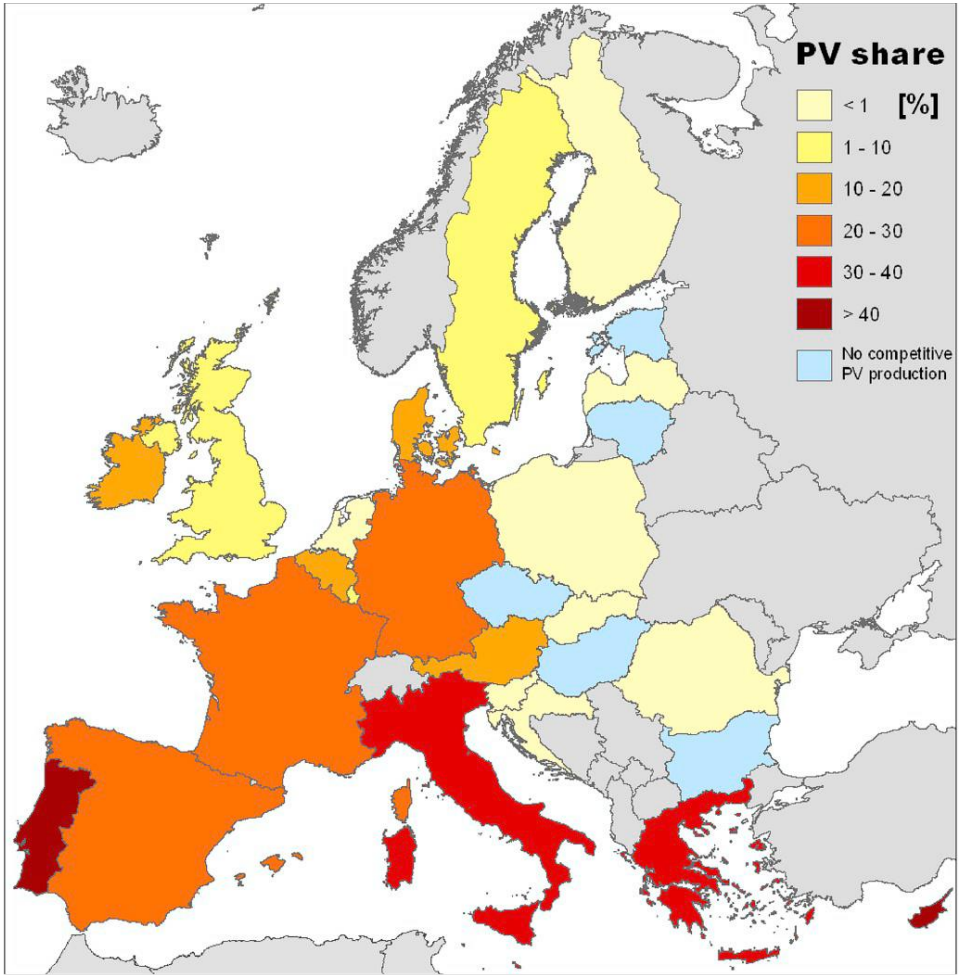


EU solar PV total capacity segments (%) 2018 for selected countries

Source: SolarPower Europe (2020) EU Market Outlook for Solar Power / 2019 – 2023

(III) Overview of challenges and drivers: PV self-consumption potential is huge but also varies among countries

- A recent study assessed the untapped rooftop PV potential in the EU based on satellite imagenary
- The results show that the EU rooftops could potentially produce 680 TWh of solar electricity annually, representing 24.4% of current electricity consumption
  - Cyprus, Portugal, Malta, Greece and Italy have the highest potential,
  - Followed by France, Spain and Germany.
  - Countries in eastern Europe lag behind because of barriers to installing PV on rooftops.



Modelled rooftop solar PV share in the final electricity consumption

Source: Bódis et al. (2019) A high-resolution geospatial assessment of the rooftop solar photovoltaic potential in the European Union. Renewable and Sustainable Energy Reviews, Vol. 117, October 2019, 109309.

(III) Overview of challenges and drivers: Increasing distributed generation may challenge the grid capacity

- Distributed generation has become a challenge for grid planning and operation in some countries.

- For instance, in Germany the vast increase of PV connected to the low voltage network caused problems for grid stability.
  - Despite that the regulatory framework ensured priority access for RES to the grid ahead of conventional power, the DSOs were authorised **to curtail certain PV systems** in critical situations, to prevent their network from blackouts or their infrastructure from damage.
  - At the same time, the regulation also encouraged the DSOs to **enhance their networks** to allow more renewable capacity to be injected to the grid.

- In general a careful consideration of the local conditions, different connection patterns, including aspects such as unit sizes, technologies and location within the network are critical to minimize adverse impacts on the network.

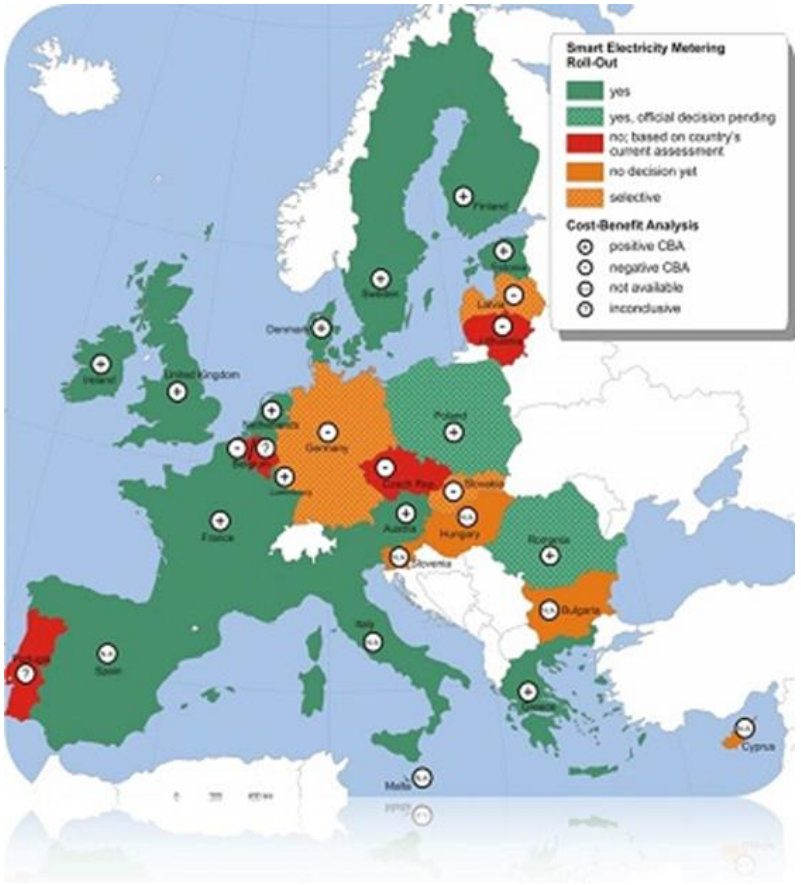
Source:Rakhau, E. and Collins, C. (2019) The rapid growth of solar integration into grids: learn from Germany. Available: https://energypost.eu/the-rapid-growth-of-solar-integration-into-grids-learn-from-germany/ and Prettico, G., Flammini, M. G., Andreadou, N., Vitiello, S., Fulli, G., and Masera, M. (2019) Distribution System Operators Observatory – Overview of the electricity distribution system in Europe. EUR 29615 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-79-98738-0, doi:10.2760/104777, JRC113926.

(III) Overview of challenges and drivers: Power grid modernisation has taken different paces among the EU Member States

- Smart metering infrastructure and other technologies driving the power grid modernisation are essentially enabling technologies for energy self-consumption
  - Permit a two-way flow of electricity and data and availability of new operational data, control systems and digital communications tools
  - DSOs will have better and new planning options, including demand response, electrical energy storage, vehicle to grid communication etc.

- The first step of power grid modernisation includes the roll-out of smart metering systems. The EU aims to replace at least 80% of electricity meters with smart meters by 2020

- The development so far has been uneven among the EU Member States

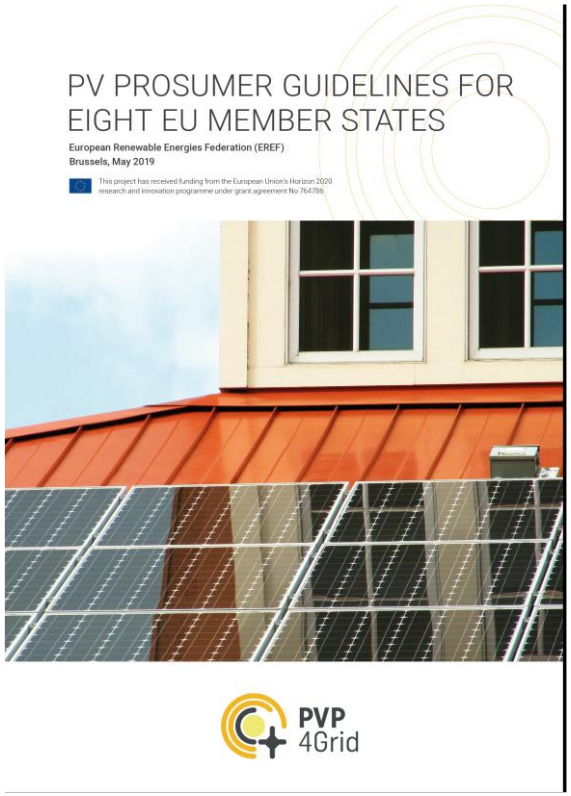


Smart electricity metering roll-out

Source: JRC (2014) Smart Metering deployment in the European Union. Available: https://ses.jrc.ec.europa.eu/smart-metering-deployment-european-union

(III) Overview of challenges and drivers: The barriers for PV self-consumption are mainly not technical by nature, but regulatory

- In large majority of the EU countries, the PV self-consumption has been limited to single-family homes or small PV systems in apartment buildings.
- The rooftops of multi-apartment buildings or office buildings with multiple ownership represent a large share of the total available rooftop and until recently was untapped potential.
- The existing differences in administrative provisions, technical regulations end electricity codes make the implementation highly complicated.
- The PVP4Grid Prosumer Guidelines are a tool for consumers
  - 8 Guidelines applied to national context (in national languages)
  - EU Guideline (in English)
  - Available: https://www.pvp4grid.eu/guidelines-policy-papers/



(III) Overview of challenges and drivers: The barriers for PV self-consumption are mainly not technical by nature, but regulatory

Change of ownership of power generation capacity

- The new regulatory framework stipulates that the DSOs can own flexible distributed energy resources only under specific circumstances
  - ➢ This means that the primary role of future DSOs is to act as “neutral market facilitators”
  - ➢ Also prone to change the renewable energy investment patterns

New incentives schemes for regulating the DSOs

- Despite the changing role of the DSOs, their activities will **maintain to be guided by regulation**
- Although the regulation varies depending on the country context, the general drivers are common across the EU and are typically based **on performance of the grid,**
- Distributed generation can have a **negative impact on the performance**
- Within the current incentive schemes, the distributed generation could thus lead to **decreased income for DSOs**
- The considerations for **new regulatory principles are on-goi**ng and include aspects encouraging to enhanced innovation delivering most efficient long-term outcomes for consumers

(III) Overview of challenges and drivers: The barriers for PV self-consumption are mainly not technical by nature, but regulatory

Need to redesign the grid tariffs

- From the perspective of the DSOs, the energy self-consumption may lead to lower power usage and consequently lower revenues to DSOs
  - DSOs call for redesigning the grid tariffs in such a manner that the costs induced by the energy self-consumption are correctly reflected in the electricity bills
  - Others argue that the grid costs need to be shared in an equitable and non-discriminatory way among grid users not favouring PV-owners over those consumers over non-PV owners.

- The grid tariff design is thus a complex issue that need proper attention to avoid cross-subsidising, unfair treatment of consumers or providing wrong incentives

(III) Overview of challenges and drivers: The barriers for PV self-consumption are mainly not technical by nature, but regulatory

Coordination among the actors, policies and regulations.

- The design of policies for incentivising PV prosumption needs to be **well coordinated** with the regulation guiding the grid system in order **to avoid misaligned or even conflicting effects**
  - For example, even though high-powered net-metering may have positive effect on PV deployment, the overall impact on the system may not be only positive by leading to favouring PV-owners over non-PV owners, challenges of the operational limits of the network, curtailment, etc.
  - Similarly, when designing incentive schemes for DSOs, a holistic approach, considering the implications to the whole power system is needed.
  - It is very important to define the roles and responsibilities of DSOs and TSOs, but also consumers to allow optimal functioning of the system and fair distribution of the costs and benefits.

Thank you!

More information:

Hanna Kuittinen
hanna.Kuittinen@tecnalia.com
Eduardo Roman
eduardo.roman@recnalia.com

Twitter: twitter.com/PVP4Grid
Website: www.pvp4grid.eu
Contact: info@pvp4grid.eu

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