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Smart Grids and Beyond: An EU research and innovation perspective

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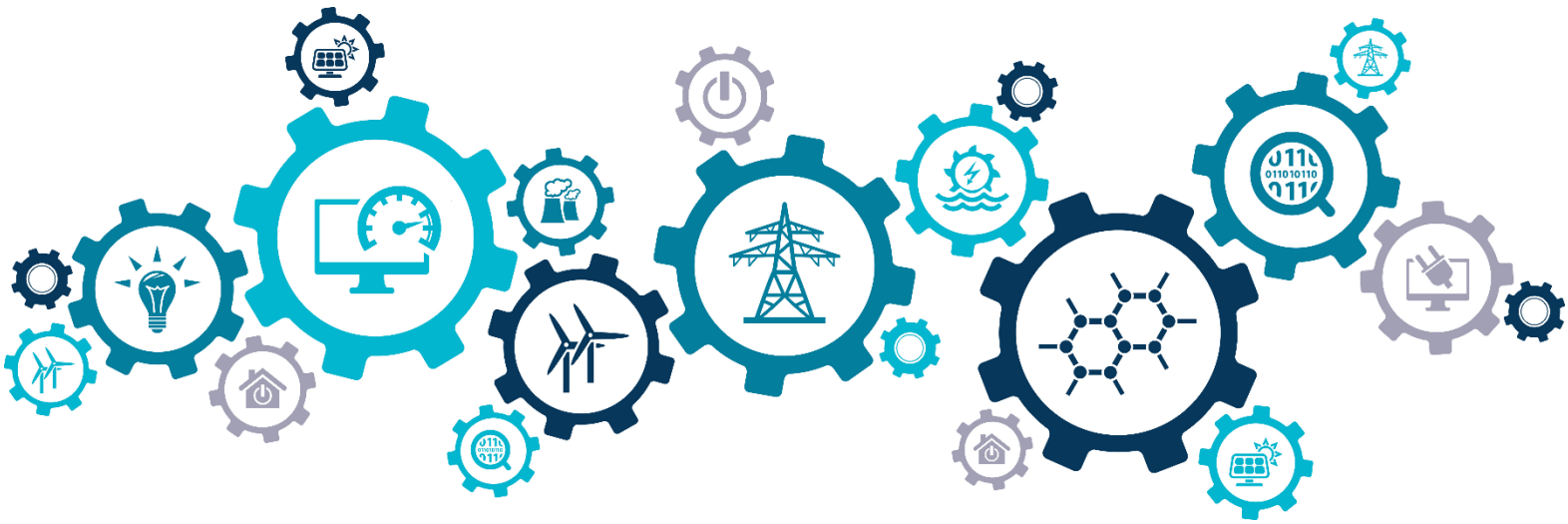

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Contents

Abstract

This report presents an overview of EU research and innovation (R&I) projects in the field of smart grids funded by the last two framework programmes for R&I (the seventh EU framework programme for research, technological development and demonstration activities and Horizon 2020) and by the competitiveness and innovation framework programme. R&I projects can play a pivotal role in addressing and investigating the technological, regulatory, economic and social challenges of the energy transition, and analysing them can help to understand the direction Europe is taking and inform current and future policy developments. The report looks into projects addressing the need to modernise the electricity grid and to better integrate the behaviours and actions of all connected users. In this sense, it goes 'beyond smart grids' strictly speaking, and looks at the energy transition beyond purely technological solutions. The analysis of the projects surveyed provides an overview of the main trends; of the main areas in which projects intervene; and of the organisations that participate in the projects as well as synergies and collaborative links between the organisations.

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Executive summary

Policy context

A shift towards a low-carbon economy calls for increasing digitalisation and electrification of the energy system. The energy sector has been an early adopter of digital technologies, using them to facilitate grid management and operation. Digital technologies are viewed as enablers of a more connected, intelligent, efficient, reliable and sustainable energy system. The political guidelines of the European Commission 2019–2024 call for Europe to tackle the challenges of being the first climate-neutral continent and to address the transformations brought about by digital technologies. In this context, the Commission has put forward a series of policy documents that should lead Europe to be a climate-neutral continent by 2050 raising the 2030 emission reduction target to at least 50 % ('A European green deal'[1]) while ensuring that Europe grasps the potential of digital technologies to provide solutions to societal challenges ('A Europe fit for the digital age'[2]). The twin challenge of a green and digital transformation has to happen together in order for Europe to lead the transition to a healthy planet and a new digital world (European Commission 2020a). The twin digital and energy transition is thus positioned at the core of a low-carbon economy. In the last 10 years, several EU energy policy documents have placed smart grid technologies at the centre of the energy transition. At the same time, there has been an increasing awareness that digital technology deployment entails active participation of consumers and should be accompanied by an assessment of the associated societal implications; this is needed to guarantee early identification of the challenges and opportunities that the use of digital technologies and other innovative solutions can present for EU consumers' living conditions.

Key conclusions

General trend. There was an increase in research and innovation (R&I) activities in the smart grid arena in 2007–2020. More specifically, in 2014–2020 (covered by Horizon 2020 (H2020)) there was a 25 % increase in the number of projects, a 59 % increase in total investment and a 117 % increase in EU funding compared with 2007–2013 (covered by the seventh EU framework programme for research, technological development and demonstration activities (FP7), the competitiveness and innovation framework programme – information and communication technology policy support programme (CIP-ICT-PSP) and the competitiveness and innovation framework programme – intelligent energy Europe programme (CIP-IEE)). Most projects received an EU contribution of less than EUR 5 million. On average they received 73 % of their funding from the EU, but half of all projects received more than 78 % of their funding from it. On average, EU funding shares increased from 62 % in 2007–2013 to 82 % in 2014–2020. In addition, the number of demonstration projects in comparison with research and development projects rose substantially in 2007-2020, thanks to the increasing maturity reached by many technologies and solutions and the growing focus on demonstrating the enabling role of smart grids in accelerating the twin digital and energy transition. There are significant differences between countries, with Spain, Germany and Italy showing the largest numbers of participations (one participation being defined as the participation of one organisation in one project) and the highest shares of collaboration links with other countries. The situation is rather different when focusing on the regional dimension; the top five EU regions, in terms of number of participations are in France, Spain, Greece and Belgium and the top five regions in terms of EU funding are in France, Germany and Spain.

Project domains. Most of the projects focus on demand-side management (DSM), mainly in the residential sector. There is a balanced distribution of EU funding across all project domains with DSM bearing the highest share of EU funding, followed by smart city, smart network management and integration of distributed generation and storage. The project domain 'other' also received a substantial share of EU funding, which

[1] https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age_en
[2] https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age_en

indicates increased R&I attention to cross-cutting issues, such as cybersecurity, standardisation, development of big energy data platforms, and socioeconomic, cultural, political and gender aspects of the energy transition.

Participating organisations. R&I stakeholders represent 42 % of participations in all projects, technology and service providers 22 %, regulated operators 9 %, energy market players and public institutions 8 % each, and the organisations grouped under the macro-category 'other' 11 %. Among the organisations that participated in over 10 projects, those in the top 15 positions in terms of number of participations are mainly research centres and universities. More than half of the organisations participating in H2020 projects were newcomers, i.e. first-time applicants that did not apply to any of the other reviewed programmes (FP7, CIP-ICT-PSP, CIP-IEE). The share of newcomers is above average for organisation categories that are newer in the smart grid arena, such as transport solution providers, market operators and energy brokers / traders, energy cooperatives and local governments, while it is below average for more traditional actors, such as transmission system operators (TSOs), research centres and universities. This indicates that H2020 was successful in allowing new organisations to join and receive funding, particularly new actors in the smart grid sector that are able to push innovative technologies and business models to markets.

Participating organisations by project domain. Organisation categories show a varied pattern of participation in the different domains, in line with the business sector in which they operate and their role in smart grid deployment. For example, local governments are active in the smart city and e-mobility domains, where they play a pivotal role for the transformation of city infrastructures and services. Housing associations / real estate developers are also particularly active in the smart city domain, indicating a growing interest among the residential sector, especially the social housing sector. Distribution system operators (DSOs) and transmission system operators (TSOs), traditionally active in the smart network management domain, show a high level of participation in the domain 'other', indicating their growing interest in the cross-cutting issues addressed by these projects, such as cybersecurity, the potential of big data for the modernisation of the European electricity grid and the creation of new smart grid services. DSOs and TSOs increasingly collaborate with ICT and software providers, in particular in the smart network management and DSM domains, which points to the strong commitment of system operators to digitalising their businesses but also to the key role of collaboration on the road to the digital transformation of the energy sector.

Main findings

Related and future JRC work

JRC will continue collecting and analysing R&I projects at national and EU levels with the aim of supporting early identification of the challenges and opportunities that the use of digital technologies and other innovative solutions can pose to EU consumers' living conditions.

Quick guide

Chapter 1 presents the policy context and the scope of the work. Chapter 2 elaborates the ad hoc methodology developed for identifying and selecting projects and for the organisation of data. Chapter 3 provides first an overview of the main general trends, and then a focused analysis of project domains and participating organisations. Finally, Chapter 4 presents a summary of the main findings.

1. Introduction

1.1. Policy context

The political guidelines of the European Commission 2019-2024 (von der Leyen 2019) emphasise the urgency of leading the transition to a healthy and new digital world, addressing the challenges of Europe being the first climate-neutral continent (Commission priority 'A European Green Deal'[3]) and the transformations brought about by digital technologies (Commission priority 'A Europe fit for the digital age'[4]).

While 'A European Green Deal' intends to transform the EU into a climate-neutral continent by 2050 and to raise the 2030 emission reduction target to at least 50 %, 'A Europe fit for the digital age' aims to ensure that Europe grasps the potential of the digital age and of digital technologies to provide solutions to societal challenges. In the communication 'Shaping Europe's digital future' (European Commission 2020a) the European Commission emphasises that the twin challenge of a green and digital transformation has to happen together in order for Europe to lead the transition to a healthy planet and a new digital world. The twin digital and energy transition is placed at the core of a low-carbon economy.

A shift towards a low-carbon economy calls for increasing digitalisation and electrification of the energy system. Combining widespread electrification and digital technologies with renewable power can in fact become a central pillar for the development of smart grids and smart cities, fostering energy efficiency improvement in urban areas, sustainable mobility systems, and innovative sustainability-related consumer-centred services. A growing electrification of the economy is already occurring worldwide, as 'electricity is increasingly the "fuel" of choice in economies that are relying more on lighter industrial sectors, services and digital technologies' (IEA 2018, p. 24).

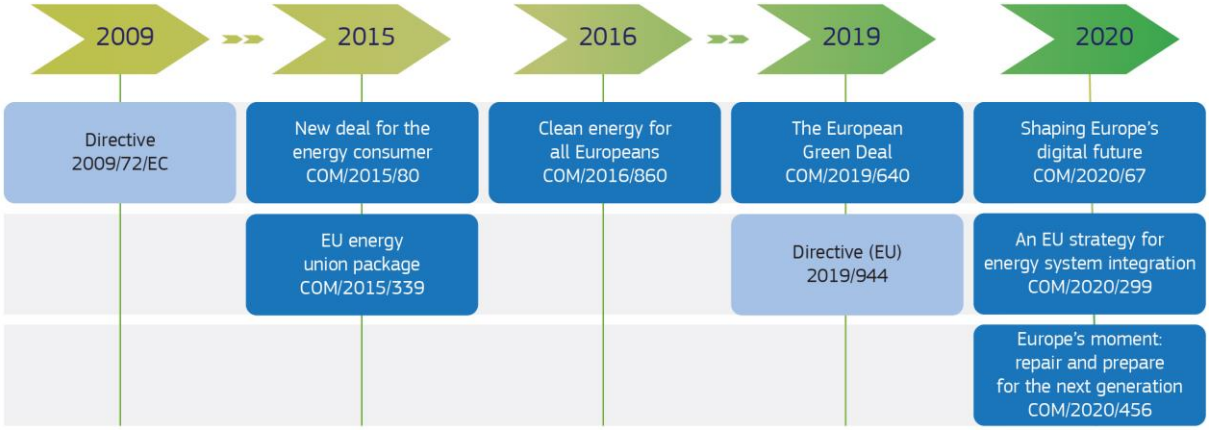
The energy sector has been an early adopter of digital technologies, using them to facilitate grid management and operation. It is argued that in the coming decades digital technologies will enable more connected, intelligent, efficient, reliable and sustainable energy systems (IEA 2017). To this end, digitalisation of the energy sector should be adopted along the whole value chain, from production to distribution, consumption and management of energy.

In the net zero emission report (IEA 2021), the IEA maintains that the rapid electrification of all sectors will make electricity even more central to energy security than it is today. The report projects that electricity systems' flexibility will quadruple by 2050 as reductions in fossil fuel capacity reduce conventional sources of flexibility. This transition calls for major increases in all sources of flexibility: batteries, demand response and low-carbon flexible power plants, supported by smart meters and more digital electricity networks (IEA 2021, p. 23).

With the 2009 Third Energy Package[5] the EU energy policy put forward smart meters – a building block for the digitalisation of the electricity grid – as enabling technologies for more efficient and sustainable use of energy. In this context, the EU Smart Grids Task Force was set up to advise the European Commission on issues related to the development and deployment of smart grids. In the last 10 years, many EU policy documents have followed, in which smart grid technologies' central role in the energy transition has been further established (Figure 1). At the same time, there has been increasing awareness that digital technology deployment entails active participation of consumers (European Commission 2015a) (European Commission 2015b) and should be accompanied by an assessment of the associated societal implications; this is needed to guarantee early identification of the challenges and opportunities that the use of digital technologies and other innovative solutions can present for EU consumers' living conditions (European Commission 2016) (European Commission 2019) (European Commission 2020a) (European Commission 2020b) (European Commission 2020c).

[3] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
[4] https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age_en
[5] https://ec.europa.eu/energy/topics/markets-and-consumers/market-legislation/third-energy-package_en

Figure 1. Digitalisation of the electricity sector in EU energy policy documents



Source: JRC, 2021.

1.2. Scope of the report

The Joint Research Centre (JRC) has since 2011 monitored developments in the smart grid arena, collecting quantitative and qualitative data about smart grid projects in Europe. The first smart grid project outlook was released in 2011 and updated three times, in 2013, 2014 and 2017 (Giordano, Gangale, et al. 2011) (Giordano, Meletiou, et al. 2013) (Covrig, et al. 2014) (Gangale, Vasiljevska, et al. 2017). Further analyses on data subsets have focused on issues of energy poverty, collective action in the energy sector and consumer engagement (Gangale and Mengolini 2019) (Gangale, Mengolini and Marinopoulos , et al. 2020) (Gangale, Mengolini and Onyeji 2013). In 2020, we started a new data collection exercise, with the launch of a revised online questionnaire. The increasing number of smart grid projects at national and international levels and the associated difficulty of exhaustively retrieving data do not allow for a thorough, comprehensive and fair analysis. Therefore, for the 2021 edition, we have decided to limit the scope of our research and analysis to EU co-funded research and innovation (R&I) projects. Our aim is to offer insights based on more complete and accurate information using official sources of the European Commission as well as to provide a closer look into the R&I trends in Europe driven by European R&I needs.

The report presents an overview of EU-funded efforts in the field of smart grids carried out in Europe under the last two framework programmes for R&I: the seventh EU framework programme for research, technological development and demonstration activities (FP7) and the eighth EU framework programme for research and innovation, better known as Horizon 2020 (H2020). For the sake of exhaustiveness, we also included in the analysis the projects funded by the competitiveness and innovation framework programme – information and communication technology policy support programme (CIP-ICT-PSP) and the competitiveness and innovation framework programme – intelligent energy Europe programme (CIP-IEE). R&I projects can play a pivotal role in addressing and investigating the technological, regulatory, economic and social challenges of the energy transition, and analysing them can help to understand the direction Europe is taking and inform current and future policy development (Gangale, Mengolini and Marinopoulos , et al. 2020) (Gangale and Mengolini 2019) (Mengolini, Gangale and Vasiljevska 2016). We build our research and analyses on the definition of smart grid as an 'electricity network that can integrate in a cost efficient manner the behaviour and actions of all users connected to it, including generators, consumers and those that both generate and consume, in order to ensure an economically efficient and sustainable power system with low losses and high levels of quality, security of supply and safety' (European Parliament and Council 2013, article 12). In this perspective, we look into projects dealing with grid modernisation as well as integration of connected users' behaviours. In both cases, a key role is played by new business models and practices, new regulations and market designs, as well as by more intangible elements such as consumers' behavioural change and social acceptance. With this in mind, we broaden our scope beyond smart grids in the strict sense, in order to look at the energy transition beyond purely

technological solutions. Ultimately, transformation of technology goes hand in hand with changes in culture, behaviour and practice, and thus there is a compelling need for social sciences and humanities input in research and policy approaches dealing with energy transition. To develop our methodology for project selection and categorisation we have closely looked into similar European initiatives such as Bridge[6] and ETIP SNET[7] and aligned our approach accordingly.

Unlike previous editions in which the focus was mainly on the technological side, the 2021 *Smart Grids and Beyond* outlook offers a sociotechnical perspective. The report has been thought of as a compendium of key facts and figures that can be used to inform and support further analysis. In the field of smart grids, knowledge sharing is indeed of fundamental importance to stimulate regulators to design tailored incentive schemes, to inspire public authorities to replicate initiatives successfully tested elsewhere and to inform companies' investment strategies. It can also provide a glimpse of the market opportunities for emerging market players in the smart grid domain.

[6] https://www.h2020-bridge.eu/
[7] https://www.etip-snet.eu/

2. Methodology

This chapter presents the project identification and selection criteria, the sources used for data collection and the categories for the classification of project domains and participants.

2.1. Identification and selection criteria

The identification and selection of projects were guided by the following criteria:

- The project is a **research and development** (R&D) or **demonstration** project. By R&D projects we mean projects that carry out 'creative and systematic work undertaken in order to increase the stock of knowledge – including knowledge of humankind, culture and society – and to devise new applications of available knowledge' (OECD 2015, p. 44). By demonstration projects we mean projects that carry out real-world testing of technological solutions, market designs, policy schemes and business models in different operational environments.

- The project has received **EU funding** under one of the following programmes: CIP-ICT-PSP, CIP-IEE, FP7 and H2020 (see Box 1).

- The project **start date** is between January 2007 and December 2020.

- The project addresses at least one of the following **aspects**:

    - integration of new technologies, capabilities and resources into the grid (e.g. new ICT and energy technologies that increase network operational efficiency and enable integration of increased shares of distributed energy resources; capabilities that enable real-time or close to real-time monitoring and control of network operation by grid operators and of energy usage by the end user);

    - market design and regulatory frameworks that facilitate grid integration of renewable energy sources (RESs), energy storage and new type of loads, such as electric vehicles;

    - cross-cutting issues relevant to smart grid development, such as cybersecurity, standardisation and interoperability;

    - the promotion and integration of the behaviours and actions of all connected users, including those who are energy poor, using different means (e.g. ICT-enabling technologies, collective approaches, awareness raising and behavioural change strategies).

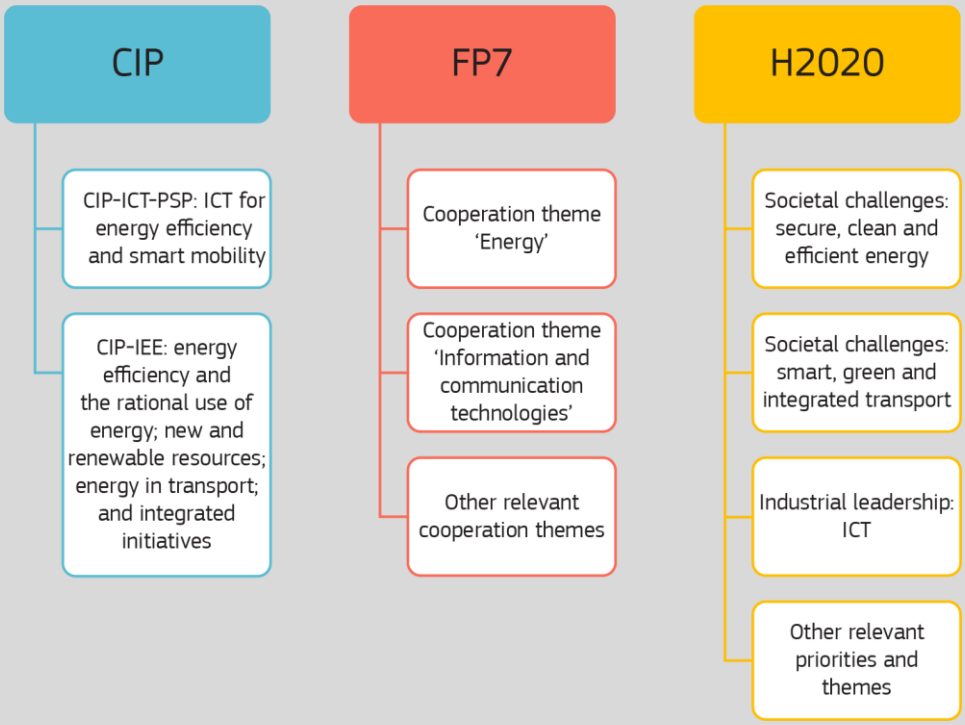
Box 1. Funding sources

CIP-ICT-PSP and CIP-IEE[8] are two funding programmes under the competitiveness and innovation framework programme (CIP), which ran from 2007 to 2013 with an overall budget of EUR 3 621 million. **CIP-ICT-PSP** aims at wider uptake and best use of ICT and digital content by citizens, governments and businesses, in particular small and medium-sized enterprises (SMEs). The focus is placed on driving this uptake in areas of public interest while addressing EU challenges such as moving towards a low-carbon economy or coping with an ageing society. We looked into projects funded in the area of ICT for energy efficiency and smart mobility. The programme contributes to a better environment for developing ICT-based services, and helps overcome hurdles such as the lack of interoperability and market fragmentation. **CIP-IEE** promotes efficiency and rational use of energy resources by encouraging the use of renewable sources and offering incentives for the adoption of the latter in various sectors, such as transport. To achieve this objective, it aids pilot projects, projects in their first commercial application, and projects promoting and publicising the development of capacities, the dissemination of know-how, the exchange of experiences, public awareness raising, and education and training. We looked into projects funded under all four CIP-IEE funding areas: SAVE – energy efficiency and the rational use of energy; ALTENER – new and renewable resources, STEER – energy in transport; and integrated initiatives.

FP7 ran between 2007 and 2013 with a total budget of EUR 50.6 billion. It was organised in four programmes: cooperation, ideas, people and capacities. We looked into the specific cooperation programme, specifically at the themes 'Energy' and 'Information and communication technologies'. We also reviewed the other themes to identify relevant projects for our analysis, such as the themes 'Transport' and 'Nanosciences, nanotechnologies, materials and new production technologies', both building on the smart grid concept to integrate the growing penetration of electric vehicles and RESs using, for example, integrated concepts of interconnectivity between buildings, distributed energy resources, grids and other networks at district level.

H2020 ran from 2014 to 2020, with a budget of nearly EUR 80 billion. It brought together three separate programmes/initiatives: the multiannual research framework programmes, innovation aspects of CIP and the EU contribution to the European Institute of Innovation and Technology. We focused our search and analysis on projects under the priorities 'Societal challenges' (secure, clean and efficient energy and smart, green and integrated transport) and 'Industrial leadership' (ICT). Other themes with direct links to the scope and aim of our study were also subject to investigation (e.g. secure societies, nanotechnologies).

Selection of EU framework programmes with direct link to smart grids



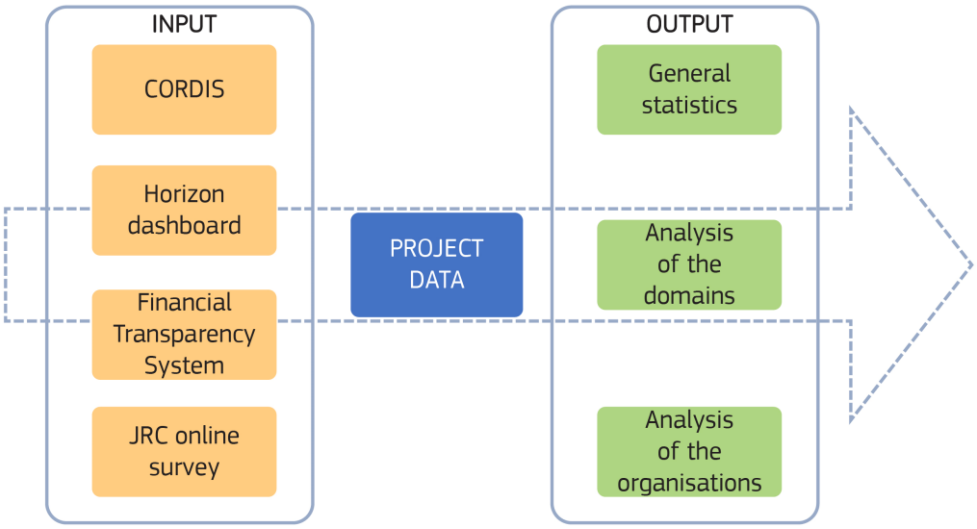
Source: JRC, 2021.

[8] We refer to the IEE follow-on programme, which was included in CIP in order to contribute to achieving the objectives of EU energy policy and to implementing the Lisbon Agenda.

2.2. Data sources

This report builds on a large number of data collected through desk research, at both funding programme level and project level. In April 2020 we also launched an online survey to collect data directly from project participants. Figure 2 gives an overview of the main sources of information used for data collection: the EU CORDIS web page[9], the Horizon dashboard[10], the Financial Transparency System of the European Commission[11] and the JRC online survey.

Figure 2. Data input and output



Source: JRC, 2021.

The resulting database includes the following project information:

- project name,
- start and end date,
- total budget and EU contribution,
- funding programme and call for proposal,
- participating organisations, their role in the project, country, EU contribution,
- if relevant, the SME status of the organisations.

Through the analysis of project documentation (project documentation and deliverables, related articles, project websites), we also derived and included the following information:

- project stage of development (R&D or demonstration),
- project domain, that is the area of intervention where the solutions investigated and tested in the project aim to produce their impact (see Section 2.3),

[9] https://cordis.europa.eu/projects/en
[10] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/horizon-dashboard
[11] https://ec.europa.eu/budget/fts/index_en.htm

- number and location of the implementation sites, that is the place where projects' solutions are trialled, demonstrated and validated,
- the organisation category of each project participant, according to the classification adopted for this study (see Section 2.4),
- for demand-side management (DSM) projects, the consumption sector involved (i.e. residential, mixed, non-residential).

2.3. Project domains

Based on the aim and the scope of the selected projects, as well as the type of technologies and solutions developed and trialled in these projects, we have identified seven main project domains as summarised in Table 1.

Table 1. Classification of project main domains

Application	Definition
Smart network management	Smart network management projects focus on increasing the operational flexibility of the electricity grid through enhanced grid monitoring and control capabilities. Typically, this involves installation of network monitoring and control equipment, and fast and real-time data communications.
Demand-side management	Demand-side management projects include both projects that aim to shift consumption to another point in time (demand response) and projects that aim to reduce the level of energy consumption and increase the efficiency of energy usage, including projects focusing on energy awareness.
Integration of distributed generation and storage	Integration of distributed generation and storage projects focus on advanced control schemes and new ICT solutions for integrating distributed generation and energy storage into the distribution network while ensuring system reliability and security of supply.
Integration of large-scale RESs and storage	Integration of large-scale RESs and storage projects mainly aim to integrate RESs at transmission or high-voltage distribution network level.
Smart city	Smart city projects focus on optimising energy systems in smart cities by, for example, development of new energy data ecosystems to accommodate cross-domain data, or development of ICT tools to facilitate sharing of renewable energy within a neighbourhood and in this way enable energy-neutral or energy-positive neighbourhoods.
E-mobility	Electric mobility projects focus on the integration of electric vehicles and plug-in hybrid vehicles into the electricity network (development of charging infrastructure, smart charging strategies, sector integration, etc.).
Other	This group includes projects that cannot be categorised under any of the categories above. Examples of such projects include projects focusing on big data and artificial intelligence technologies for leveraging the potential of smart grids; projects dealing with regulatory, institutional and social conditions for development and operation of new clean energy communities; projects focusing on cybersecurity and smart grid standardisation; etc.

Source: JRC, 2021.

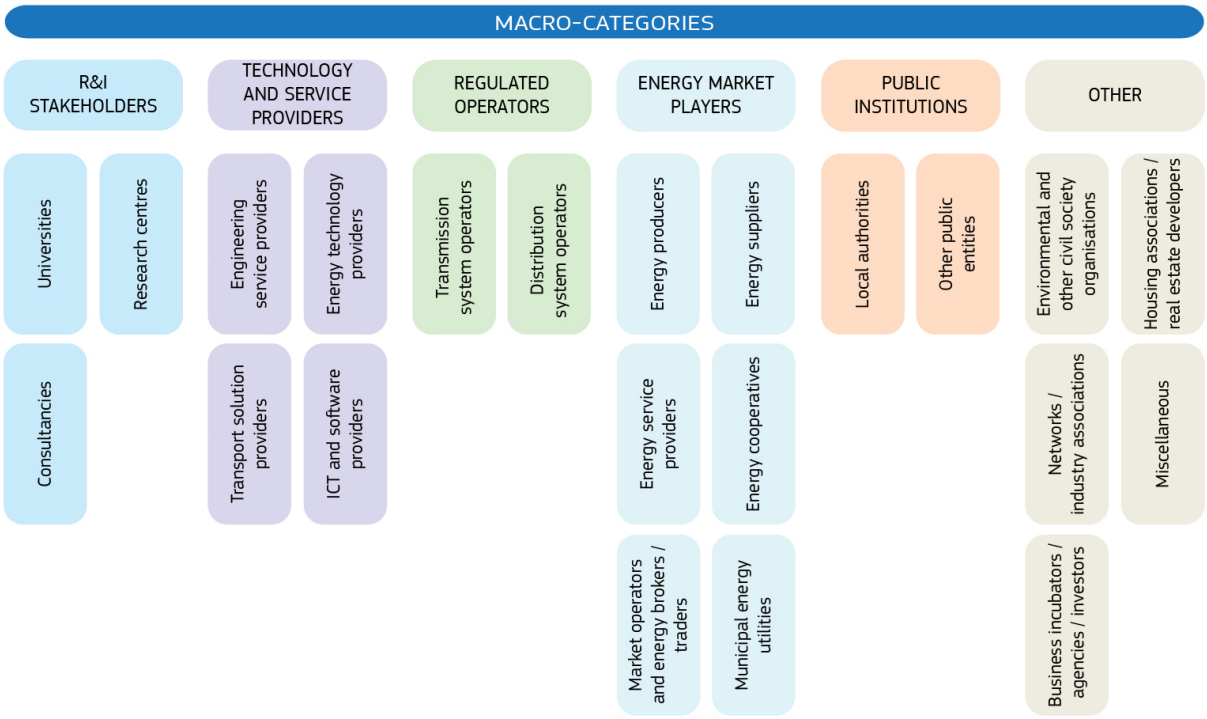
We strove to identify a single domain for each project. In some cases, however, projects investigate and trial several solutions without any one of them prevailing, as they focus instead on the systemic integration of different smart grid solutions. For example, a project can focus on the integration of RESs and demand response along with the necessary smart grid infrastructure to support them and in this case the project has been assigned to three main project domains.

2.4. Project participants

Project participants have been classified under 22 categories, grouped in 6 macro-categories, as detailed in Figure 3 and Table 2.

A 'participation' is defined as the participation of one organisation in one project. As many organisations appear in more than one project, we look at both the number of participations and the number of organisations (i.e. the number of participations is higher than the number of organisations).

Figure 3. Organisation categories



Source: JRC, 2021.

This categorisation introduces changes from the classification adopted by previous smart grid outlook editions. Modifications reflect changes in definitions provided in policy documents and take into account the definitions used in recent reports (Bridge 2019) (ETIP SNET 2018). In some cases, assigning the organisation category required extra investigation. Many energy companies, for example, are active as both producers and suppliers, and the project information is not always sufficient to determine which branch of the integrated organisation is involved in the project. Difficulties were also registered with many organisations using digital solutions as part of their core business. Whether to classify them as ICT and software providers or energy service providers was particularly challenging at times and required deeper investigation of the company's business model and of its specific role in the project. This points to a growing presence of organisations with integrated activities as part of their core business, largely enabled by the digitalisation of the energy sector.

Table 2. Organisation categories: definitions

Macro-category	Category	Definition
Energy market players	Energy producers	Natural or legal persons who generate energy[12]
	Energy suppliers	Natural or legal persons active in the sale, including the resale, of energy to customers[13]
	Energy cooperatives	Associations in which citizens jointly own and participate in decentralised energy or energy efficiency initiatives, independently of their legal statute
	Municipal energy utilities	Organisations owned or dominated (> 50 % shares) by local public authorities that operate in different businesses along the energy supply value chain
	Market operators and energy brokers / traders	Organisations that manage and/or operate the business of an energy exchange; organisations involved as buyers or sellers of energy and related products for their own account or on behalf of a third party
	Energy service providers	Specialised energy service companies offering energy audits, energy efficiency services and energy performance contracting (e.g. energy service companies (ESCOs)) and companies aggregating multiple customer loads or generated electricity for sale, purchase or auction in any electricity market (aggregators[14])
Research and Innovation stakeholders	Universities	Public or private higher education institutions
	Research centres	Public or private organisations dedicated to scientific research
	Consultancies	Organisations providing professional expert advice to other public and private organisations
Technology and service providers	Energy technology providers	Manufacturers and/or suppliers of a wide range of technological products and solutions for the energy and automotive industries[15]
	ICT and software providers	Organisations active as software developers (including software as a service), system designers, system integrators and telecom companies
	Engineering service providers	Organisations involved in a broad spectrum of consulting, engineering and analytical services that work collaboratively with partners across the energy, utilities, infrastructure and associated sectors[16]

[12] Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (European Parliament and Council 2019).
[13] Directive (EU) 2019/944.
[14] Directive (EU) 2019/944.
[15] By way of example, organisations under this category include those providing power quality, distribution and control solutions; solutions for energy conversion technologies, their components and other related energy services; storage technologies; and electric vehicle charging infrastructure.
[16] By way of example, the category includes companies that carry out maintenance services and activities for electricity, gas, water and communication infrastructure; construction, installation and maintenance of high-voltage electrical networks and telecommunications systems; engineering, procurement, construction and commissioning of renewable and conventional energy projects; installation and management of smart metering infrastructure; and construction of low-energy buildings and other civil infrastructures.

	Transport solution providers	Organisations operating in the conventional and electro-mobility sectors[17]
Regulated operators	Transmission system operators	Natural or legal person who is responsible for operating, ensuring the maintenance of and, if necessary, developing the transmission system in a given area and, when applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the transmission of electricity[18]
	Distribution system operators	Natural or legal person who is responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given are and, where applicable, its interconnections with other systems, and for ensuring the long-term ability to meet reasonable demands for the distribution of electricity[19]
Public institutions	Local governments	Government units having a local sphere of competence including a variety of public entities, mainly counties, municipalities, cities and towns
	Other public entities	Public organisations active in different energy-related fields[20]
Other	Business incubators / funding agencies and early-stage investors	Organisations that actively support the process of creation and development of new companies by providing guidance, mentorship and other services / organisations that provide funding to support research or entrepreneurial activities
	Environmental and other civil society organisations	Organisations dedicated to furthering environmental and other public interest causes[21]
	Housing associations / real estate developers	Organisations that provide affordable housing for rent or accession to ownership to specific target groups, typically defined in terms of socioeconomic status or the presence of vulnerabilities / organisations involved in a variety of activities, ranging from the renovation and re-leasing of existing buildings to the purchase of greenfield sites and the sale of developed land or parcels to others
	Networks / industry associations	Federations providing a collective voice for their members at national and/or international level
	Miscellaneous	Organisations active in various sectors that cannot be placed in any of the abovementioned categories

Source: JRC, 2021.

[17] By way of example, this category includes charging point operators; mobility service providers; shared mobility operators; public transport operators; traffic information, planning and optimisation companies; private transport companies; and companies providing software solutions for the optimisation of sustainable and multimodal mobility.
[18] Directive (EU) 2019/944.
[19] Directive (EU) 2019/944.
[20] By way of example, this category includes environmental and energy agencies; regional and local development agencies; urban regeneration agencies; and community development agencies.
[21] By way of example, this category includes organisations dedicated to environmental protection; sustainable development; the relief of fuel poverty; the promotion of civic participation; and the protection of citizens' and consumers' rights.

3. Projects overview - statistical analysis

3.1. General statistics

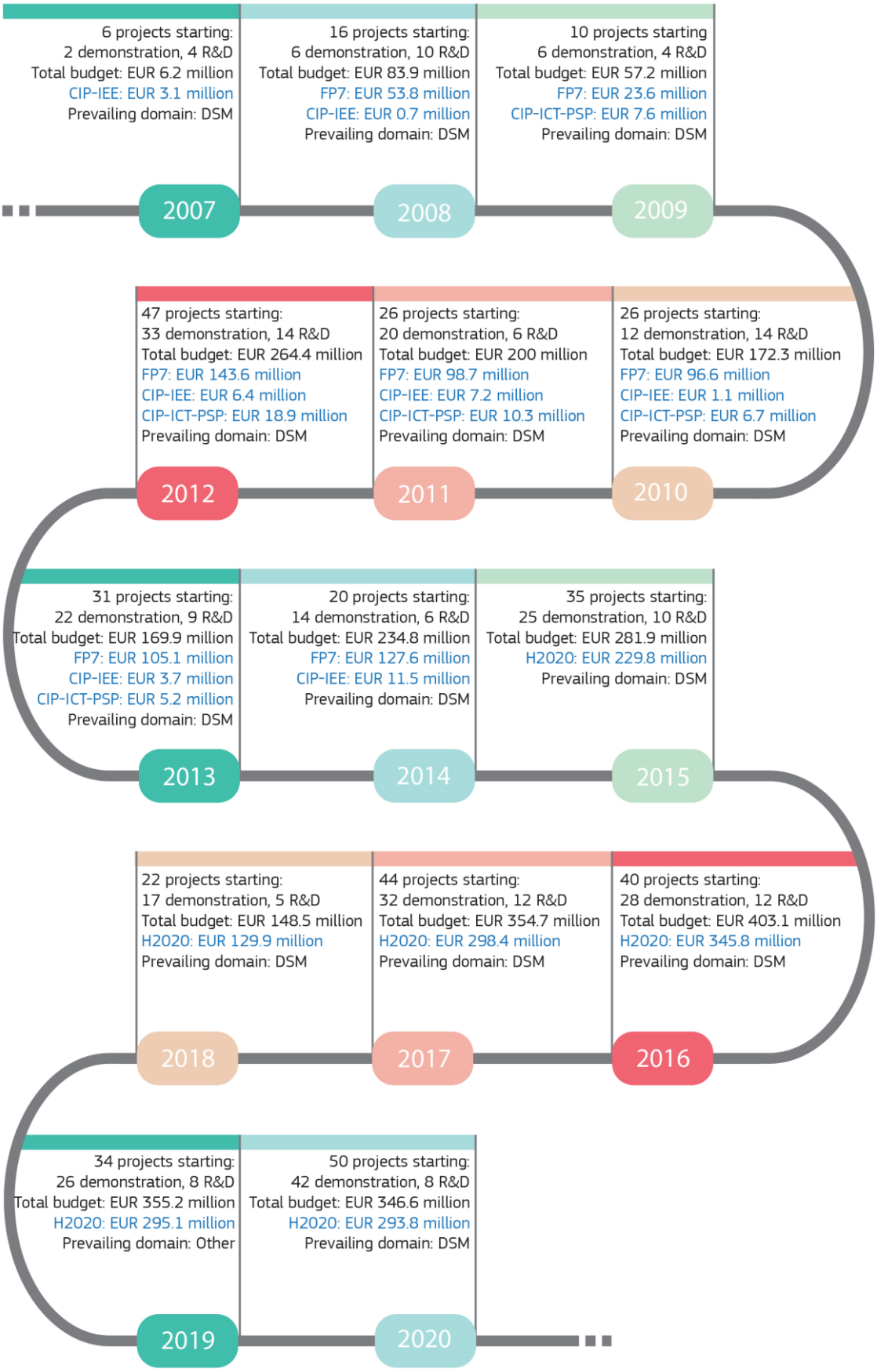
Overall, we collected and analysed 407 projects, totalling around EUR 3 billion of investment and EUR 2.3 billion of EU contribution from three EU funding programmes. The projects bring together 3 130 organisations from 45 countries, with an average of 15 (median of 12) organisations per project. There are 285 demonstration projects, carrying out real-world testing of technological solutions, market designs, policy schemes and business models in 1 243 implementation sites. These findings are summarised in Figure 4.

Figure 4. Summary of main findings

Source: JRC, 2021.

Figure 5 presents the projects' timeline, in terms of number of projects starting each year during 2007–2020, number of R&D versus demonstration projects, total budget, EU contribution per funding programme, and the prevailing project domain (in terms of number of projects per domain). We see that most of the projects starting each year focus on DSM with the exception of 2019, for which the prevailing domain is 'other'.

Figure 5. Projects' timeline



Source: JRC, 2021.

Figure 6 summarises the main project data, indicating an increase in activities in the smart grid area over 2007–2020. A strong increase in the number of projects can be observed between FP7 and H2020 (79 %), indicating the growing importance of this field in relation to the transition towards a more secure, sustainable and inclusive energy system. The total investments increased by over 80 %, and EU funding by 145 %. Even considering CIP-ICT-PSP and CIP-IEE together with FP7, H2020 still shows a significant increase in the number of projects (25 %), in total investments (59 %) and in EU funding (117 %).

Figure 6. Number of projects, total investment and EU funding for all programmes

	CIP-ICT-PSP	CIP-IEE	FP7	H2020
Demonstration projects: 285	22	13	80	170
Total demonstration investment: EUR 2.62 billion	EUR 94.71 million	EUR 17.91 million	EUR 798.25 million	EUR 1.71 billion
Demonstration EU contribution: EUR 1.96 billion	EUR 47.09 million	EUR 12.87 million	EUR 483.16 million	EUR 1.42 billion
R&D projects: 122	3	17	47	55
Total R&D investment: EUR 460.41 million	EUR 2.41 million	EUR 29.84 million	EUR 245.7 million	EUR 182.46 million
R&D EU contribution: EUR 365.96 million	EUR 1.68 million	EUR 20.77 million	EUR 166.05 million	EUR 177.46 million

Source: JRC, 2021.

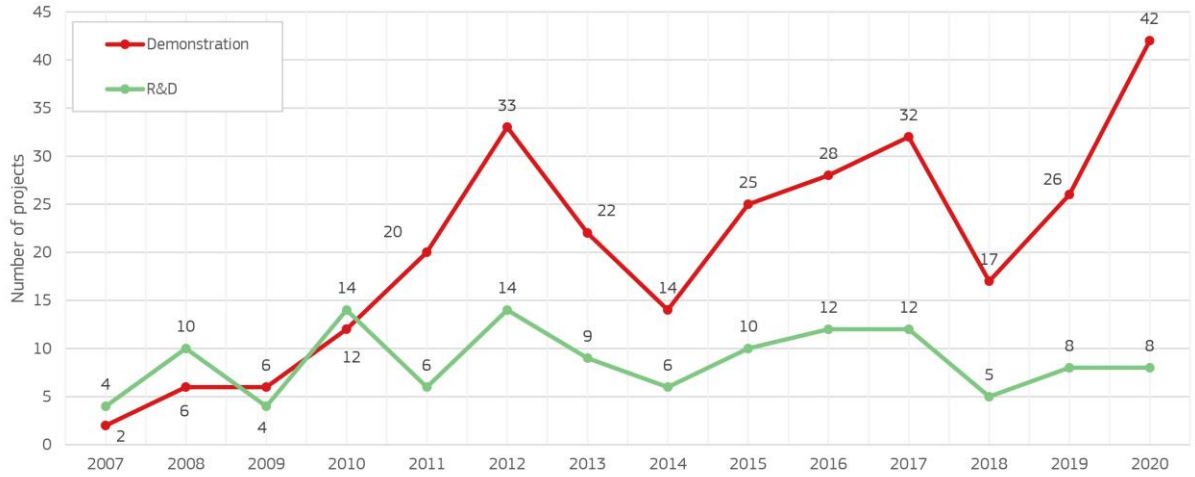
Project data also reveal the different characters of the funding programmes. CIP-ICT-PSP funded mainly demonstration projects (22 out of 25) aimed at validating and replicating innovative and interoperable ICT-based services for energy efficiency and smart mobility in real settings. CIP-IEE focused more on the non-technical barriers to market uptake and to the promotion and dissemination of energy technologies, and funded a more balanced mix of R&D and demonstration projects (17 and 13 respectively). Between FP7 and H2020, the number of demonstration projects rose substantially, thanks to the increasing maturity reached by many technologies and solutions and the growing focus on demonstrating the enabling role of smart grids in accelerating the twin digital and energy transition.

3.1.1. Research and development versus demonstration projects

Overall, the number of demonstration projects increased from 115 in 2007–2013 to 170 in 2014–2020, while R&D projects decreased from 67 to 55. The associated EU contribution to demonstration projects increased from EUR 543.11 million to EUR 1 410 million for demonstration projects, while for R&D projects the EU contributions decreased from EUR 188.5 million to EUR 177.46 million. In relative terms, the demonstration share of the EU contribution increased from 59.6 % to 82.5 % between 2007–2013 and 2014–2020, while the R&D share increased from 67.8 % to 97.3 % (Figure 7 and Figure 8). It needs to be noted that in the figures

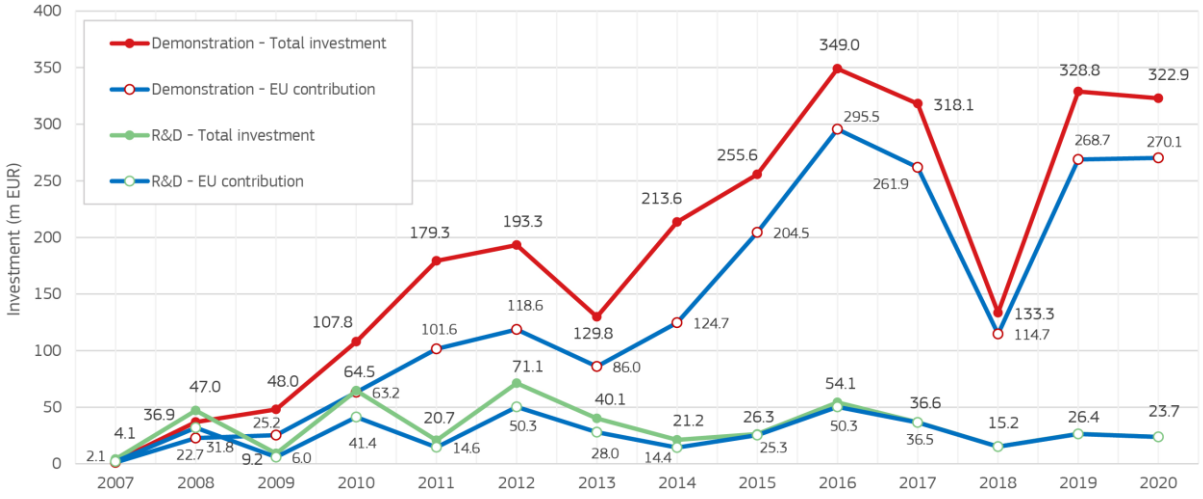
throughout the report, projects have been assigned to the start and not to the funding year; this implies that some projects funded under FP7 and CIP, which started in 2014, appear under the funding period 2014–2020.

Figure 7. Time distribution of R&D and demonstration projects



Source: JRC, 2021.

Figure 8. Time distribution of R&D and demonstration investment and EU contribution

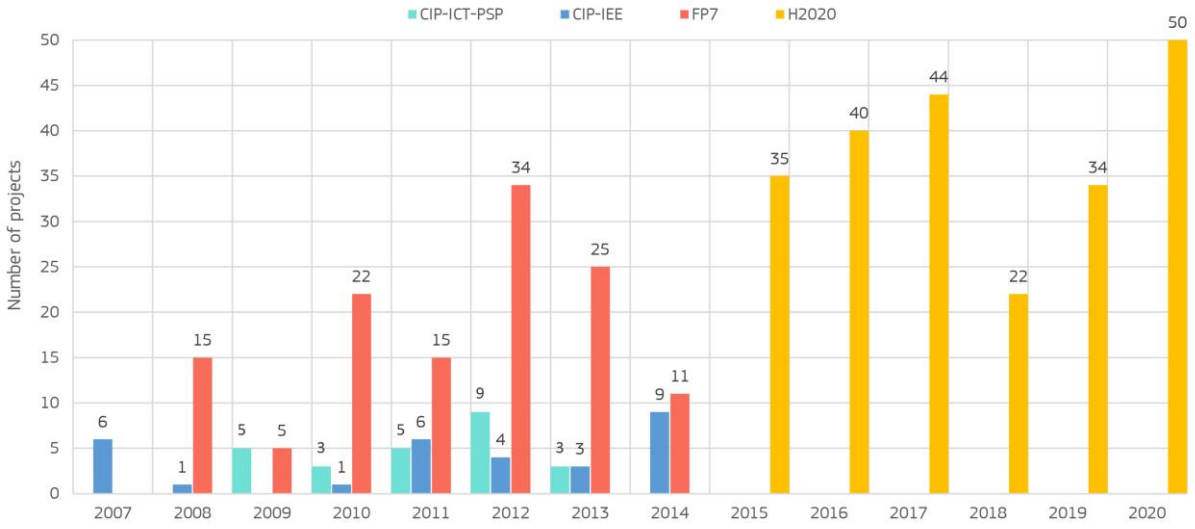


Source: JRC, 2021.

3.1.2. Time distribution and EU funding

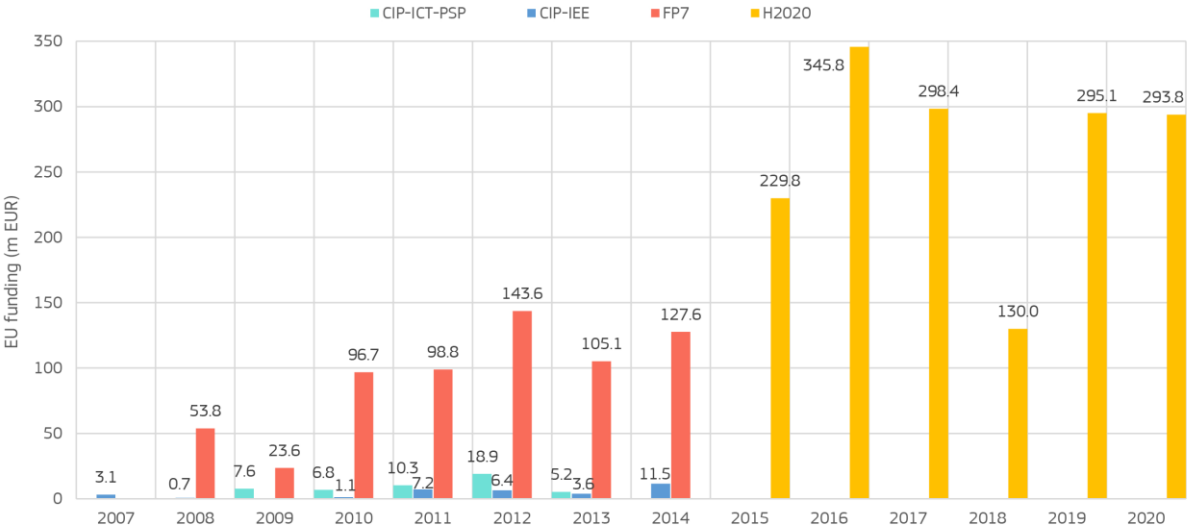
Figure 9 and Figure 10 show the time distribution of projects and EU funding across funding programmes, confirming the overall upward trend but also revealing a slowdown in certain years. Yearly variations could be due to a variety of factors, including the amount of funding available each year and the evolving priorities of the yearly work programmes.

Figure 9. Time distribution of projects for all programmes



Source: JRC, 2021.

Figure 10. Time distribution of EU funding for all programmes

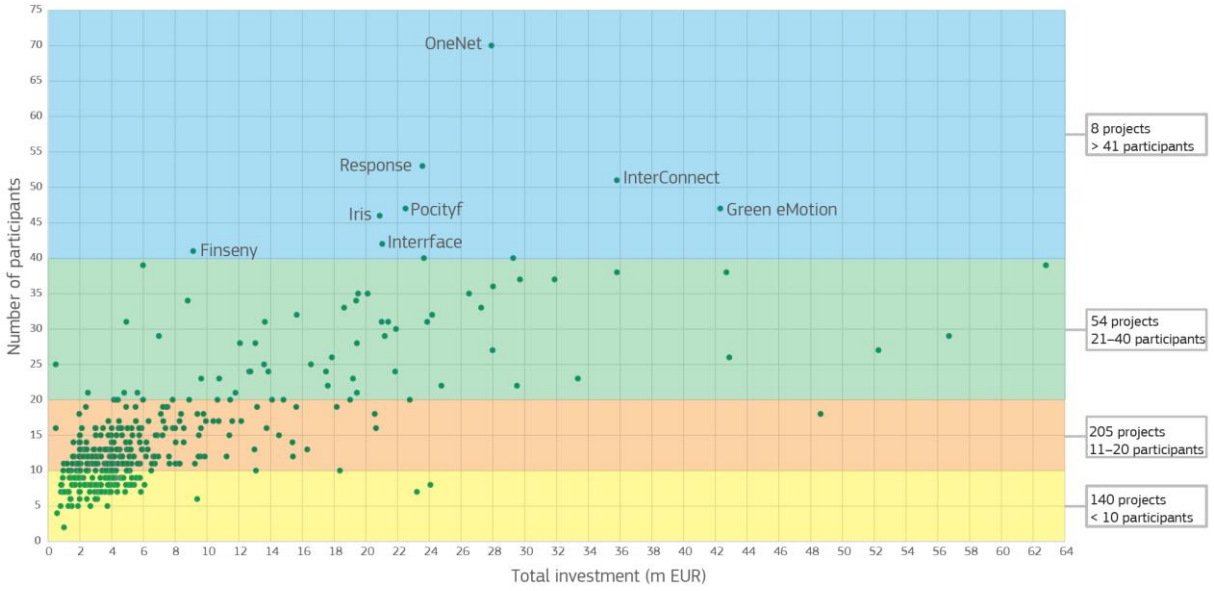


Source: JRC, 2021.

3.1.3. Participations and EU funding

Project consortia range from 70 partners (OneNet project) to 2 partners (Energise project), with an average of 15 (median of 12) (Figure 11).

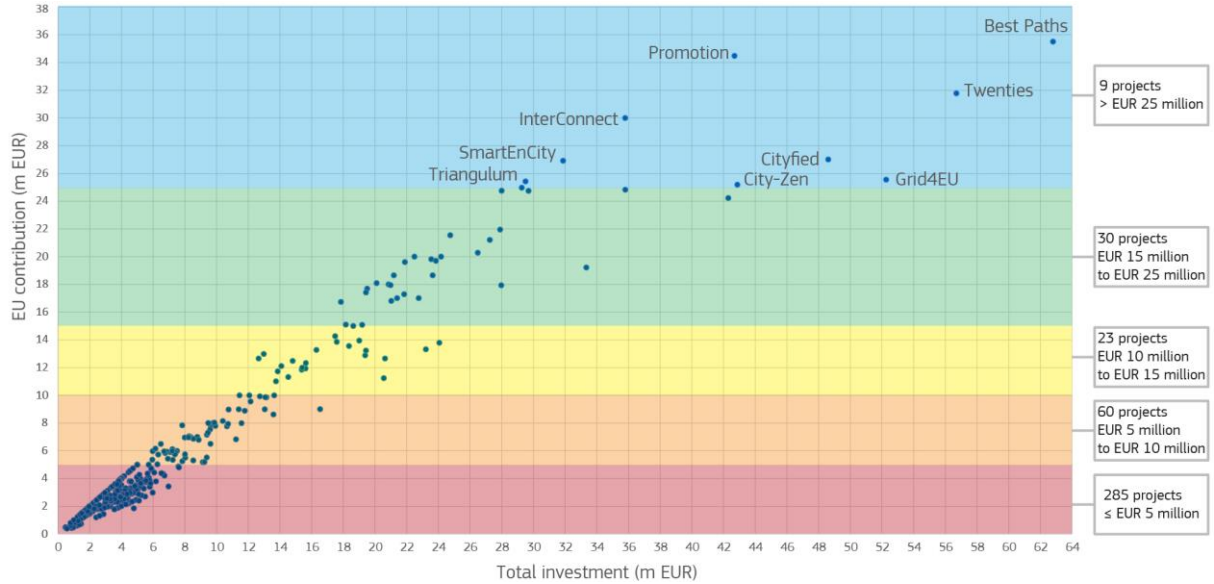
Figure 11. Number of participants by project for all programmes



Source: JRC, 2021.

The majority of projects received an EU contribution of less than EUR 5 million. On average, they received 73 % of their funding from the EU, but half of all projects received more than 78 % from it. On average, funding shares increased from 62 % in 2007–2013 to 82 % in 2014–2020, calculated as total EU contribution divided by total budget (Figure 12).

Figure 12. EU funding by project for all programmes



Source: JRC, 2021.

3.2. Project domains

This section focuses on the project domains with the aim of closely looking into the direction EU efforts take when it comes to deployment of smart grid solutions and technologies. More specifically, we investigate the magnitude of investment across time and place and across EU funding programmes.

3.2.1. Investment per project domain

Figure 13 provides an overview of the total investment and EU contribution as well as number of projects in each project domain. It also differentiates between types of project (R&D and demonstration). We see that demonstration projects prevail in most of the domains, except in the domain integration of large-scale RESs and storage and the domain 'other'. Projects categorised in the domain 'other' largely focus on R&D on specific topics, such as investigation of regulatory, institutional and social conditions to support the emergence of energy communities or on energy transition at large, market design and business models for flexibility provisions. They also build on synergies between electricity, heating/cooling and gas networks. On the other hand, projects in the smart city domain are all demonstration projects whose activities may include prototyping, testing, demonstrating, piloting, large-scale product validation and market replication.

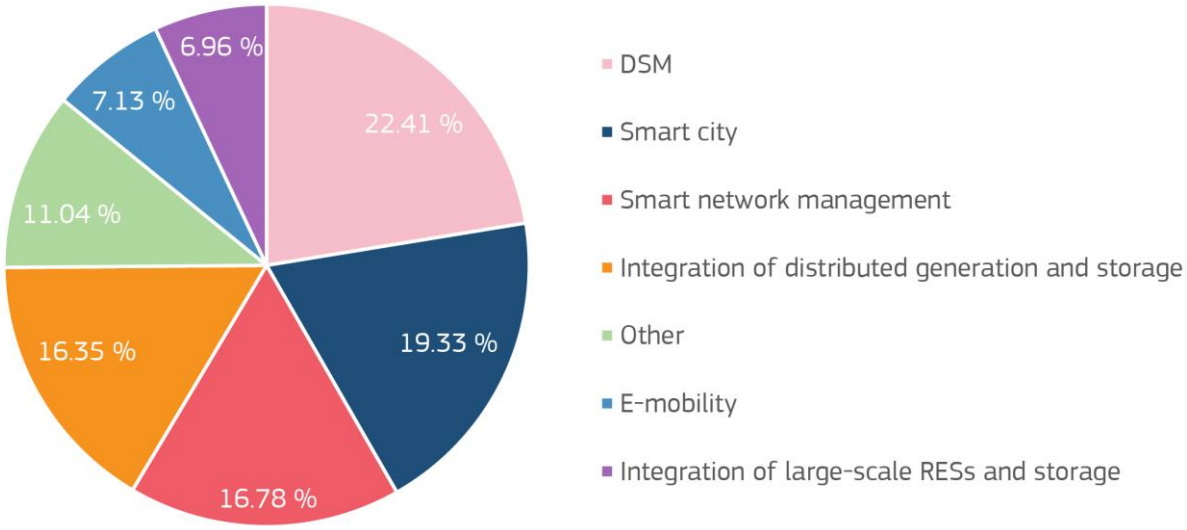
Figure 13. Investment and number of projects in each project domain

	Smart network management	DSM	Integration of distributed generation and storage	Integration of large-scale RESs and storage	Smart city	E-mobility	Other
Demonstration projects: 285	42	135	44	7	23	19	15
Total demonstration investment: EUR 2.62 billion	EUR 413.51 million	EUR 633.43 million	EUR 410.90 million	EUR 196.33 million	EUR 571.60 million	EUR 190.97 million	EUR 201.92 million
Demonstration EU contribution: EUR 1.96 billion	EUR 297.31 million	EUR 461.80 million	EUR 313.73 million	EUR 133.11 million	EUR 449.43 million	EUR 140.36 million	EUR 162.89 million
R&D projects: 122	23	27	27	13	0	8	24
Total R&D investment: EUR 460.41 million	EUR 127.67 million	EUR 78.27 million	EUR 75.21 million	EUR 36.75 million	0	EUR 37.76 million	EUR 104.75 million
R&D EU contribution: EUR 365.96 million	EUR 92.80 million	EUR 59.12 million	EUR 66.32 million	EUR 28.64 million	0	EUR 25.30 million	EUR 93.78 million

Source: JRC, 2021.

Figure 14 illustrates the percentage of EU funding by main project domain. We can observe a quite balanced distribution of EU budget across all project domains with DSM bearing the highest share of the EU budget (22.41 %), followed by smart city (19.33 %), smart network management (16.78 %) and integration of distributed generation and storage (16.35 %). The project domain 'other' also holds a substantial share of the EU budget, higher than in the domains e-mobility and integration of large-scale RESs and storage, which indicates increased R&I focus on cross-cutting issues, such as cybersecurity, standardisation and development of big energy data platforms, as well as more general but equally relevant socioeconomic, cultural, political and gender aspects of the energy transition.

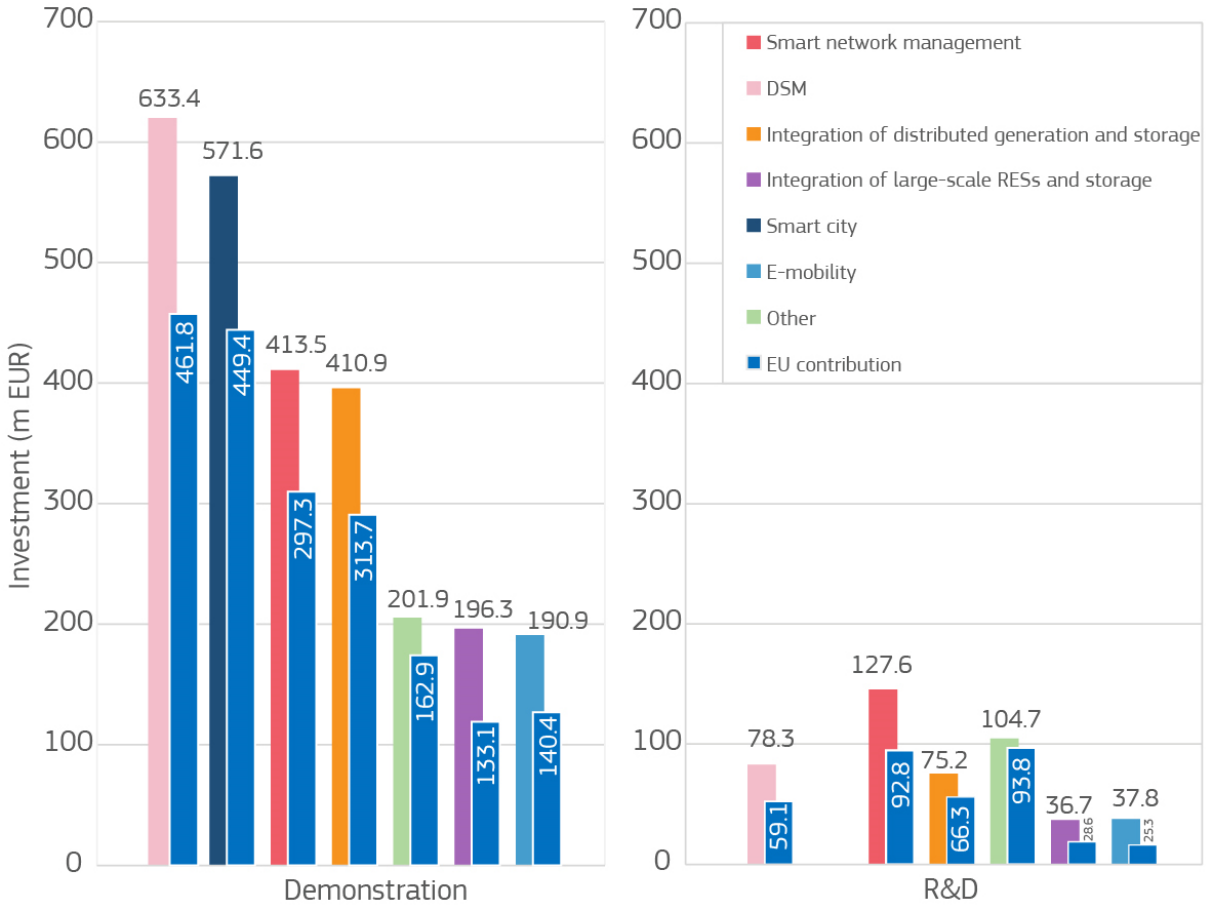
Figure 14. Percentage of EU funding by main project domain



Source: JRC, 2021.

Figure 15 illustrates the share of total and EU demonstration and R&D investment per main project domain. EU funding for demonstration projects accounts for more than 70 % in all domains and nearly 70 % in the case of integration of large-scale RESs and storage (67.8 %). In addition, demonstration projects bear a higher share of the total project investment in all project domains, despite the higher number of R&D projects in the domains DSM, integration of large-scale RESs and storage and 'other' (Figure 13). The largest proportion of the R&D projects in the domain 'other' focus on the important role of social sciences and humanities aspects in supporting the clean energy transition. Additional aspects include development of advanced tools and technologies for grid modelling, operation, and planning. R&D projects focusing on integration of large-scale RESs and storage investigate aspects such as use and implementation options for auctions for RESs support, financing alternatives for RESs, tools for the design and modelling of new markets and negotiation mechanisms facilitating 100 % renewable European power systems.

Figure 15. Share of total and EU R&D and demonstration investment by main project domain

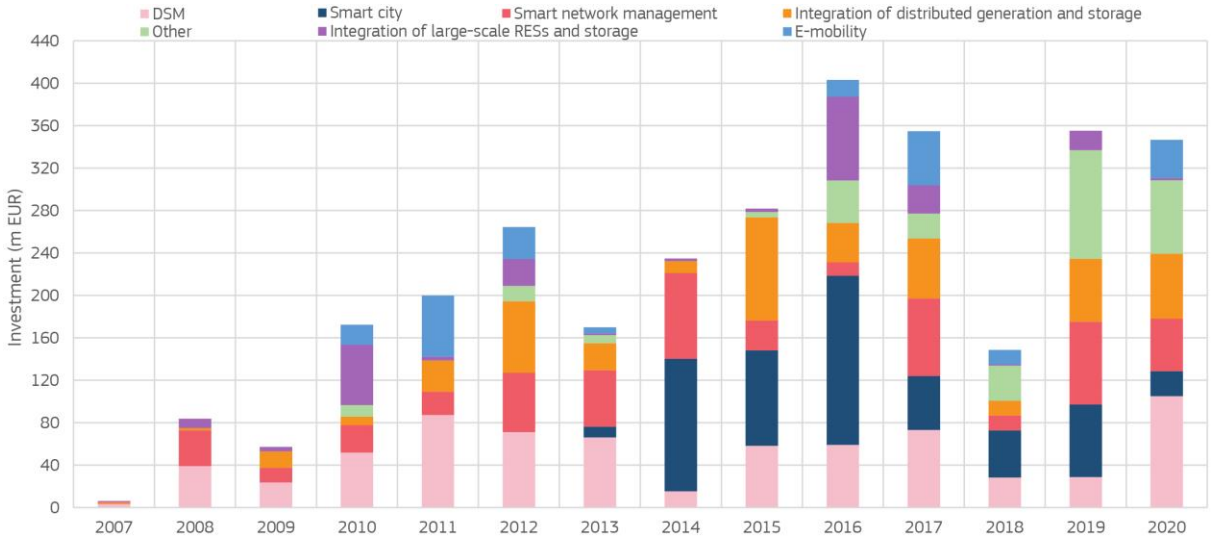


Source: JRC, 2021.

3.2.2. Time distribution of investment per project domain

Figure 16 illustrates the time distribution of total investment in each project domain. We can see that all project domains remain present across the years, although with different shares relative to the other domains. The domain 'other' shows increasing shares in recent years, which could indicate the need to investigate other aspects of smart grids, equally relevant for their successful deployment. Some of these aspects include cybersecurity, building on the potential of big data in reinforcing European efforts to modernise the European electricity grid and creation of new smart grid services. Other aspects investigate how social innovation can bring about more sustainable energy systems in Europe. Additional aspects focus on the socioeconomic, gender, sociocultural, and sociopolitical factors and their interrelations with technological, regulatory, and investment-related aspects in the field of smart grids and its role in the energy transition, in general.

Figure 16. Time distribution of total investment in each main project domain



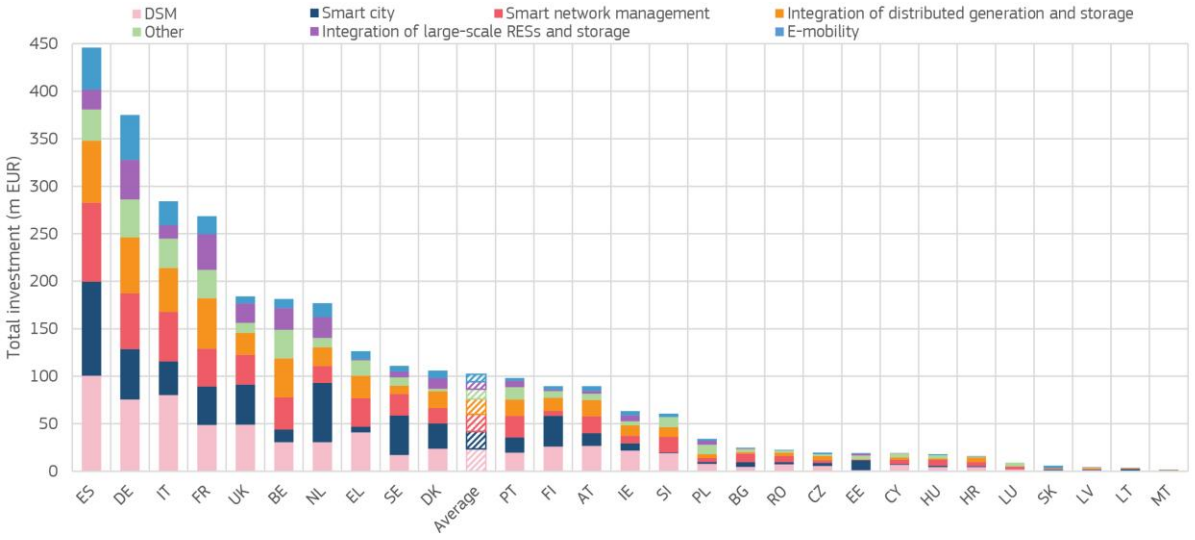
Source: JRC, 2021.

3.2.3. Geographical distribution of investment per project domain

Figure 17 shows the geographical distribution of the total investment in each project domain. Spain displays the largest share of total project investment in the domains of smart network management and DSM, followed by Denmark and Italy. Spain also appears to have the highest share of total investment in the domain of smart city, followed by the Netherlands. Nevertheless, different characteristics of the Member States and national circumstances – e.g. size, population and electricity landscape – need to be taken into account in these observations. To this end, Figure 18 and Figure 19 illustrate the geographical distribution of total investment per project domain normalised by gross domestic product (GDP)[22] and by population[23]. In both cases, Slovenia – which appears at the low end of the investment level spectrum (Figure 17) – shows the largest share of investment after normalisation in all project domains except e-mobility and smart city. This can basically be attributed to the size and small population of the country, as well as its location in Europe. As a regional crossroads, Slovenia needs to increasingly invest in smart grids to be able to respond to large transit power flows from neighbouring countries. Estonia shows the highest share of total investment in the smart city domain after normalisation, moving from the low end of the investment range (Figure 17). Countries such as Germany, France and the United Kingdom – which appear to have the largest investment in most of the project domains – move to the low end of the investment spectrum after normalisation.

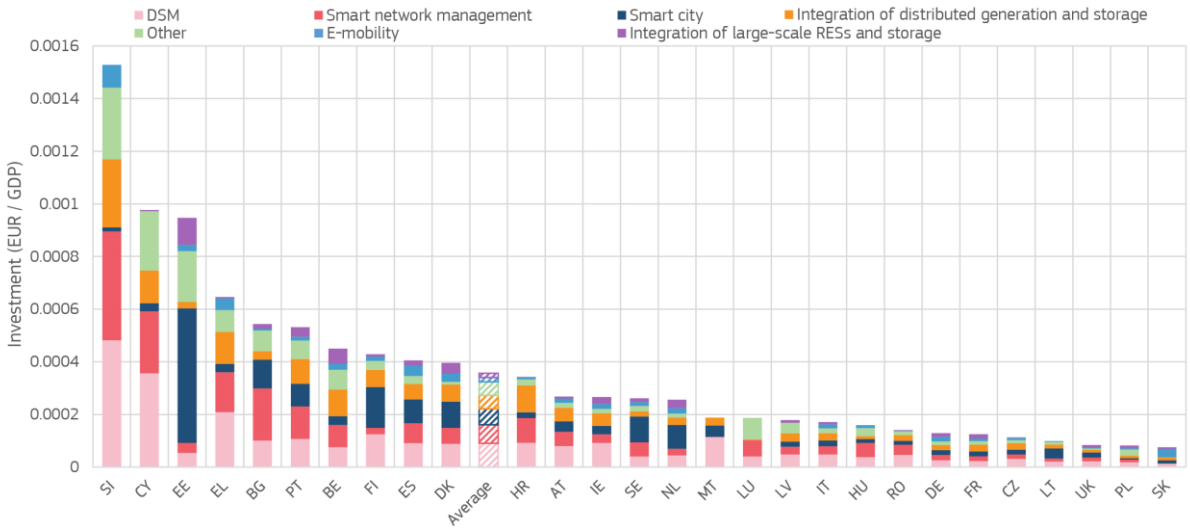
[22] https://ec.europa.eu/eurostat/databrowser/view/tec00001/default/table?lang=en
[23] https://ec.europa.eu/eurostat/databrowser/view/tps00001/default/table

Figure 17. Geographical distribution of total investment in each main project domain



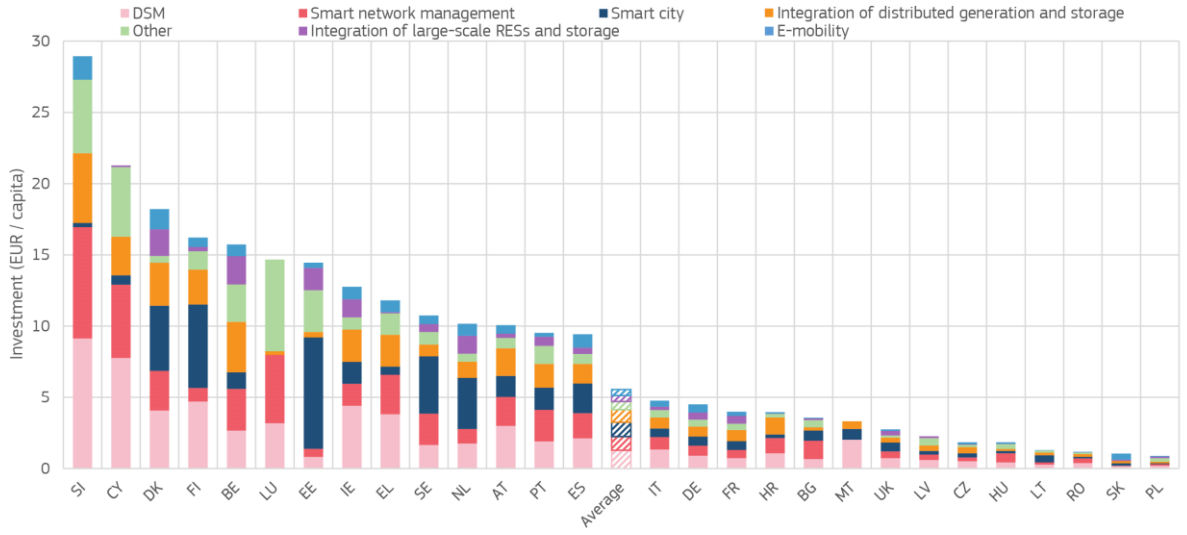
Source: JRC, 2021.

Figure 18. Geographical distribution of total investment in each main project domain normalised by GDP



Source: JRC, 2021.

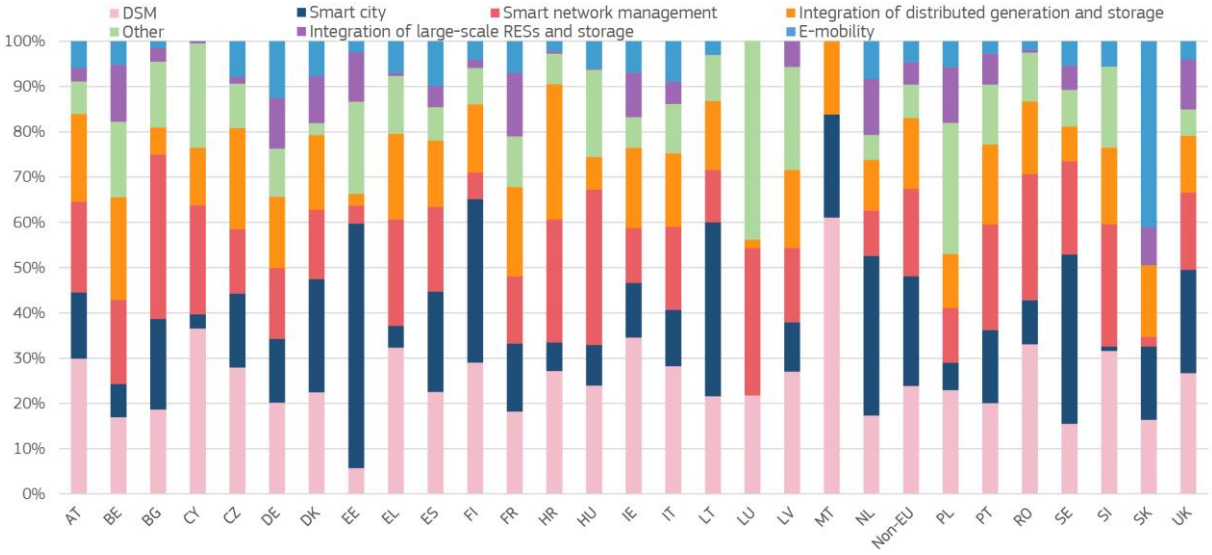
Figure 19. Geographical distribution of total investment in each main project domain normalised by population



Source: JRC, 2021.

Figure 20 illustrates the percentage of total investment distribution in each project domain. By looking at the percentage distribution of total investment, we can observe the presence of all project domains, in most of the countries. What emerges is the large share of investment in smart city projects in some Member States, such as Estonia, the Netherlands, Lithuania, Sweden and Finland. It also emerges from the figure that cross-cutting issues – included in the domain 'other' – are largely present in all the Member States.

Figure 20. Percentage distribution of total investment by smart grid domain and country

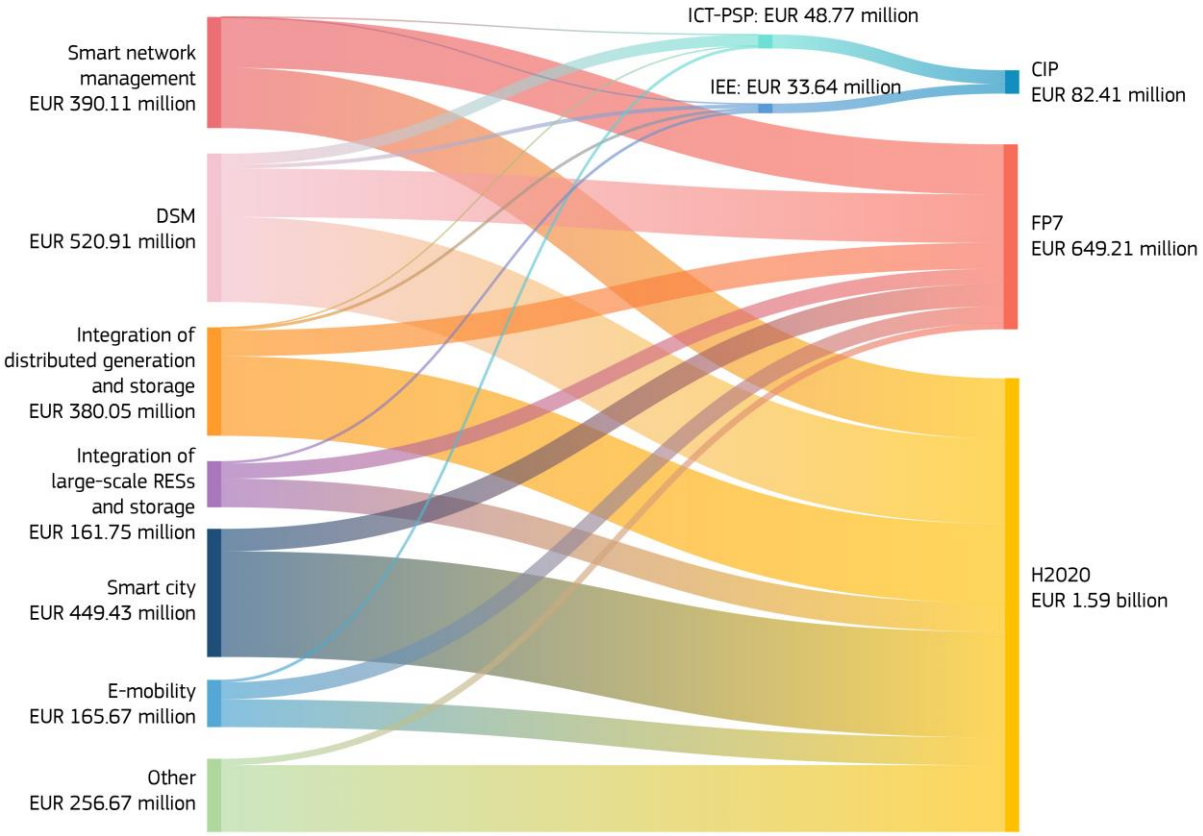


Source: JRC, 2021.

3.2.4. Share of EU budget across project domains and funding programmes

Figure 21 illustrates the share of EU budget across project domains and funding programmes. While the FP7 and H2020 budgets for the projects included in our analysis are largely balanced across all the domains, CIP-IEE mainly focuses on integration of large-scale RESs and storage, integration of distributed generation (DG) and storage, and DSM, whereas CIP-ICT-PSP mainly targets DSM projects.

Figure 21. Share of EU budget across project domains and funding programmes



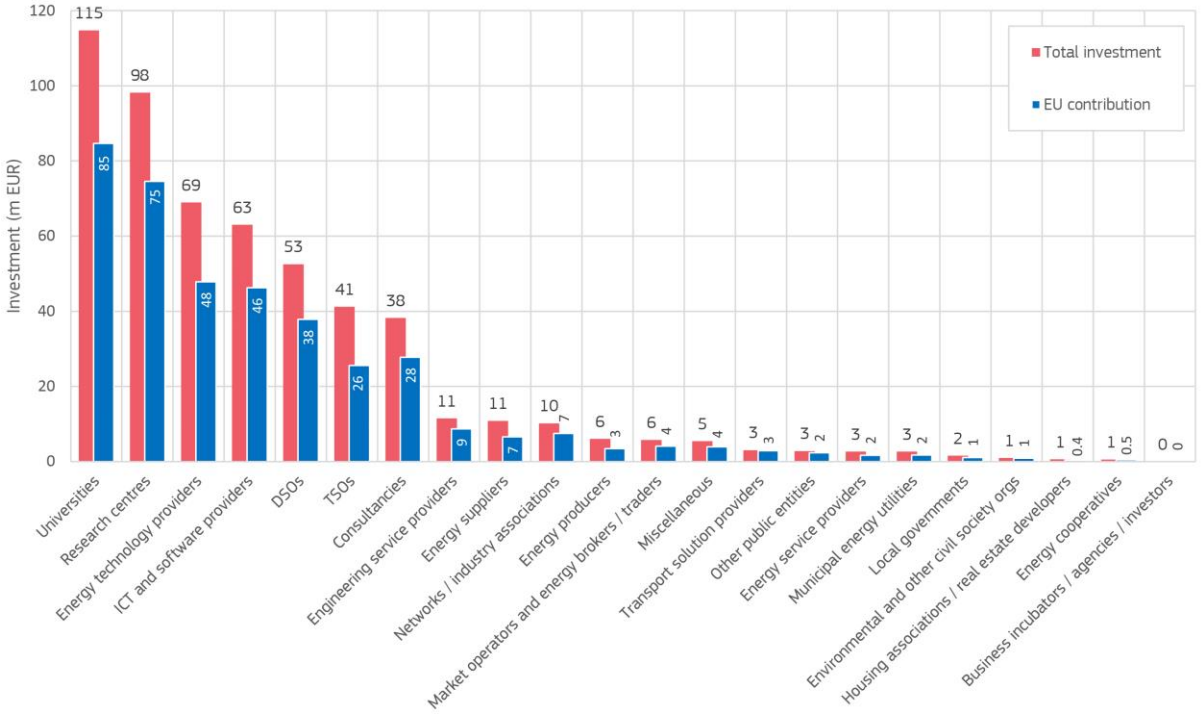
Source: JRC, 2021.

3.2.5. Analysis by project domain

3.2.5.1. Smart network management

Figure 22 illustrates the shares of total and EU investment in the smart network management domain by organisation type. We can see that after universities and research centres – the organisations with the highest shares of total budget across all project domains – energy technology providers, ICT and software providers, DSOs and TSOs have the largest shares of total and EU budgets in this project domain.

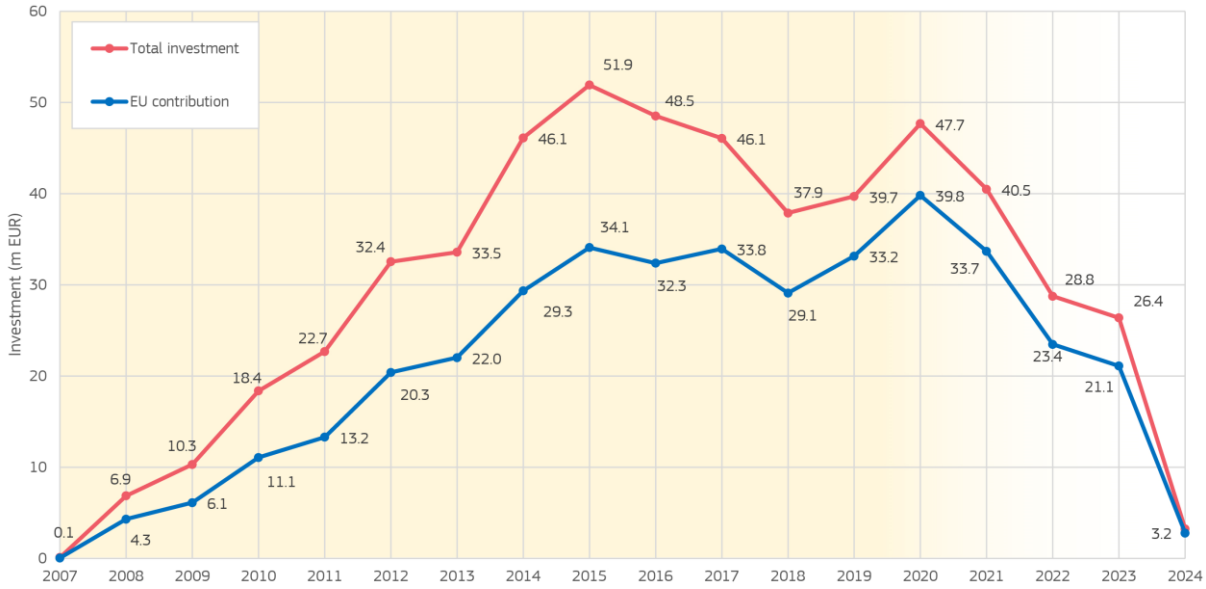
Figure 22. Share of smart network management investment by organisation type



Source: JRC, 2021.

Figure 23 illustrates the distribution of total and EU investment in the smart network management domain over the project lifespan. We can observe an increase in total investment through the years, with a drop taking place in 2018, accompanied by the same trend in the EU budget. Nevertheless, in 2020 the EU budget exceeded the budget peak of 2015 and it is expected to continue growing in the coming years. The reduction after 2020 is attributed to the fact that our database includes only projects with a starting date before the end of 2020.

Figure 23. Distribution of smart network management investment over the project lifespan

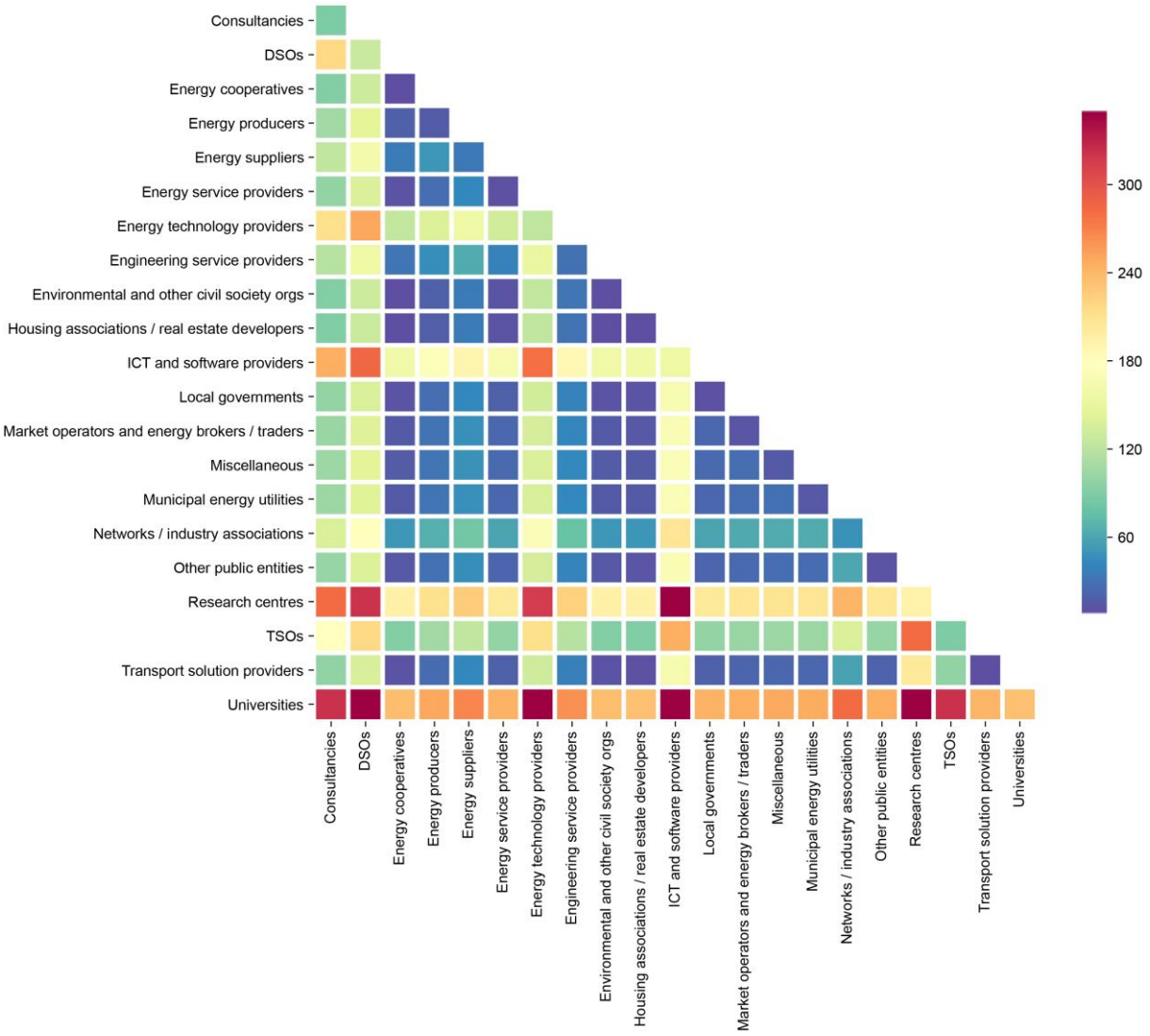


Source: JRC, 2021.

Figure 24 illustrates the collaboration links between different types of organisations to help understand who collaborates with whom in the smart network management domain. The links represent the number of

collaborations between each pair of organisations participating in projects in this domain. Universities and research centres are the entities that collaborate most with the rest of the organisations. We can also see that DSOs, ICT and software providers, energy technology providers and TSOs, are also active actors in this domain. More specifically, we can see that DSOs collaborate strongly with ICT and software providers, energy technology providers and TSOs, as well as with universities and research centres.

Figure 24. Collaboration links between different organisations active in smart network management

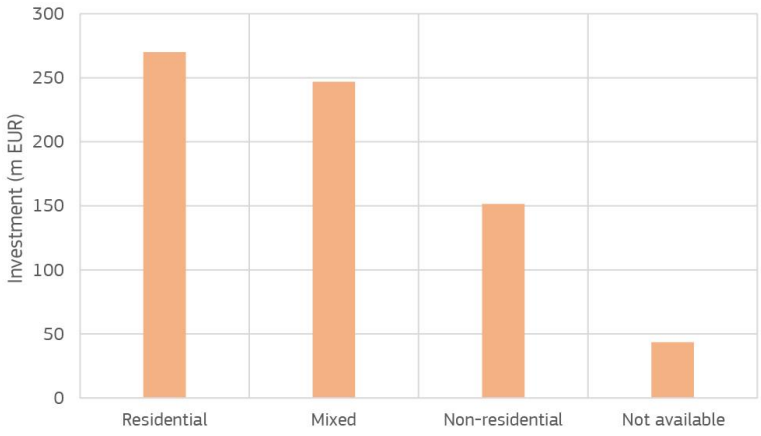


Source: JRC, 2021.

3.2.5.2. Demand-side management

Figure 25 illustrates the share of DSM investment in each energy consumption sector. The residential sector has the largest share of total investment in this domain, followed by mixed (commercial and/or industrial and/or public, in addition to residential) and non-residential (commercial and/or industrial and/or public). Some projects – mainly R&D – do not specify the energy consumption sector in which the project's solutions are to be trialled/deployed.

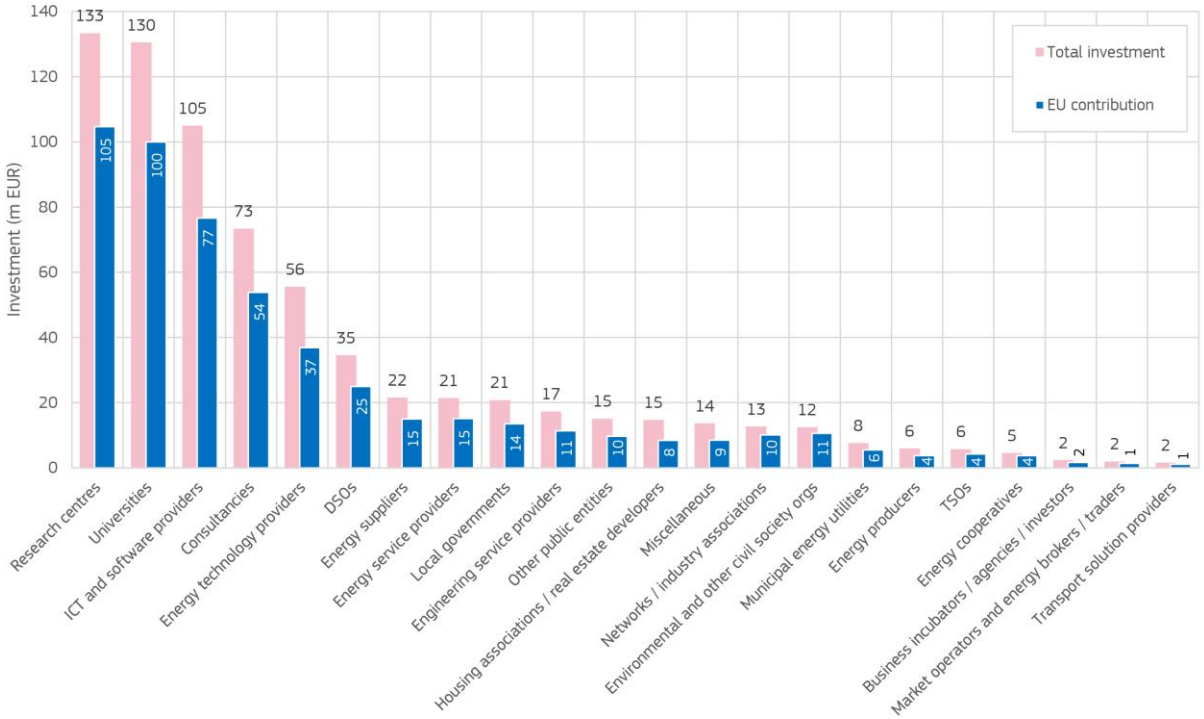
Figure 25. Share of DSM investment in each energy consumption sector



Source: JRC, 2021.

Figure 26 illustrates the share of total and EU investment in the DSM domain by organisation type. We can see that after universities and research centres – the organisations with the highest shares of total budgets across all project domains – ICT and software providers, consultancies, energy technology providers and DSOs have the largest shares of total and EU budgets in this project domain.

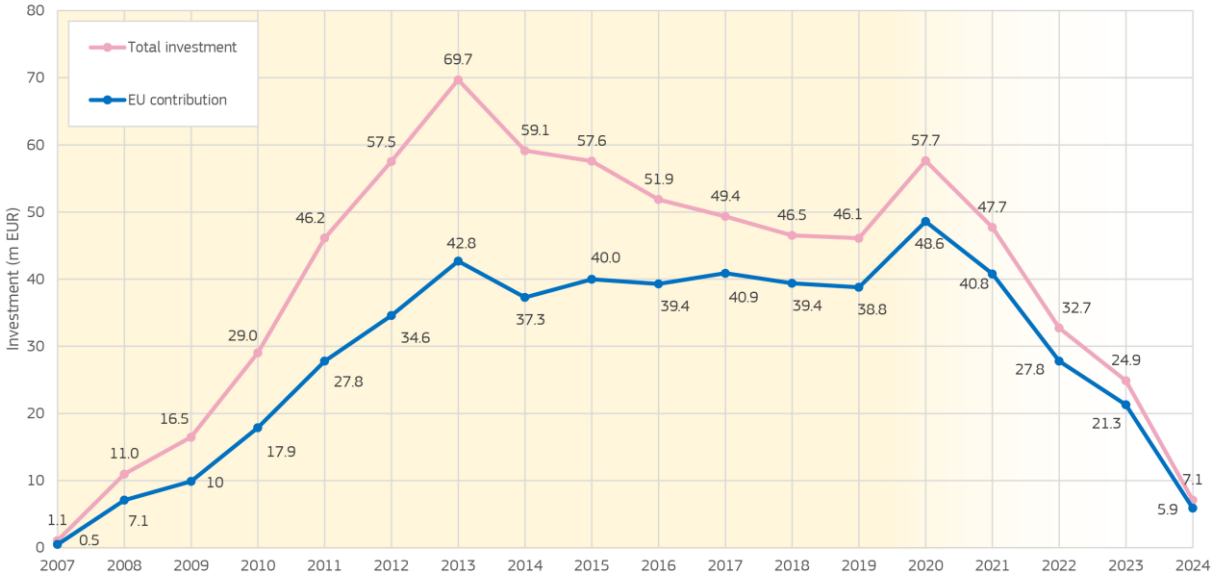
Figure 26. Share of DSM investment by organisation type



Source: JRC, 2021.

Figure 27 illustrates the distribution of total and EU investment in the DSM domain over the project lifespan. We can observe an upward trend in total and EU investment through the years until 2013, with a sudden drop in 2014, followed by one peak in 2020. The drop in 2014 could be partially attributed to the end of FP7 in 2013, but also to the end of CIP as projects under CIP–IEE, largely focusing on DSM, were part of it. As in the other domains, the reduction after 2020 is attributed to the fact that our database includes only projects with a starting date before the end of 2020.

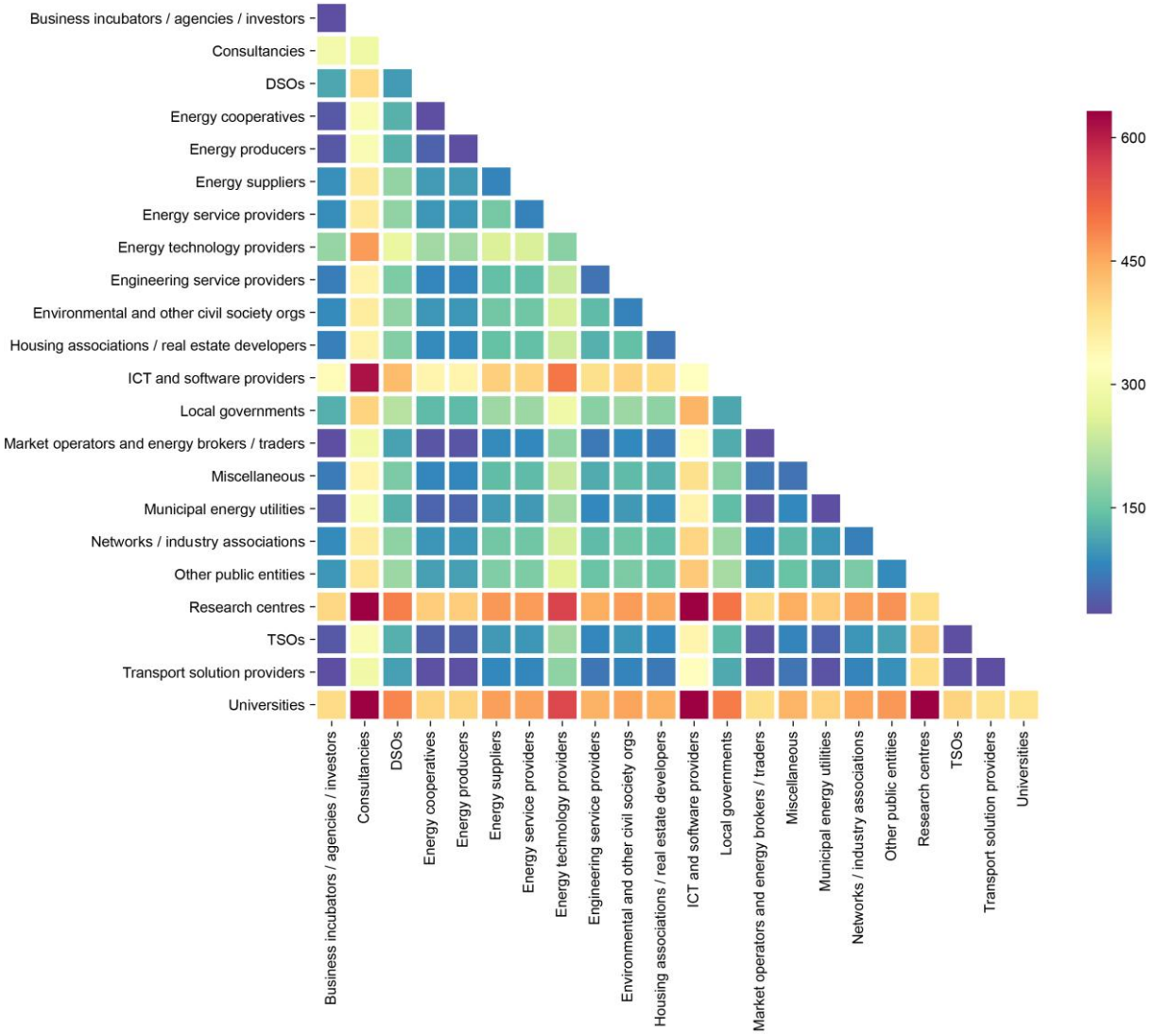
Figure 27. Distribution of DSM investment over the project lifespan



Source: JRC, 2021.

Figure 28 illustrates the collaboration links between different types of organisations to help understand who collaborates with whom in the DSM domain. The links represent the number of collaborations between each pair of organisations participating in projects in this domain. Universities, research centres and consultancies are the entities that collaborate most with the rest of the organisations. We can also see that ICT and software providers, consultancies, energy technology providers and local governments are also active in this domain. DSOs are also highly active in this domain and besides universities and research centres, they also collaborate with ICT and software providers, energy technology providers, and other entities such as energy suppliers, energy service providers and local governments.

Figure 28. Collaboration links between different types of organisations active in DSM

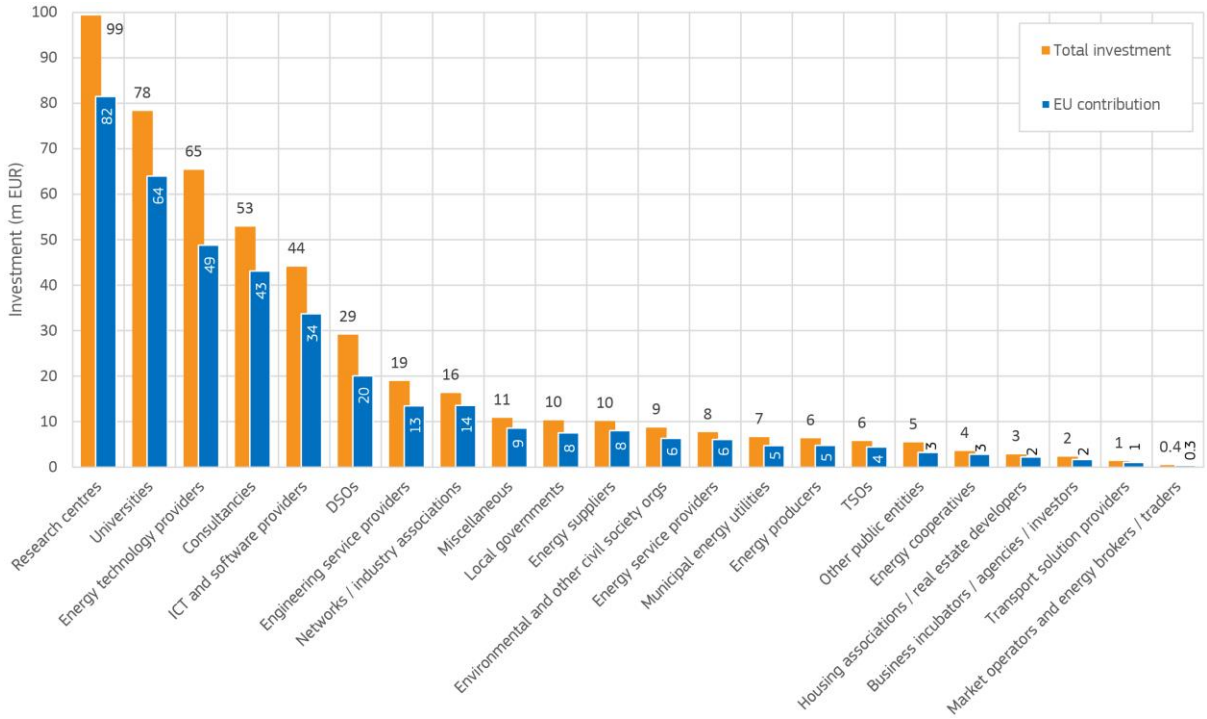


Source: JRC, 2021.

3.2.5.3. Integration of distributed generation and storage

Figure 29 illustrate the share of total and EU investment in the integration of DG and storage domain by organisation type. We can see that after universities and research centres – the organisations with the highest shares of total budgets across all project domains – energy technology providers and ICT and software providers together with consultancies have the largest shares of total investment in this domain.

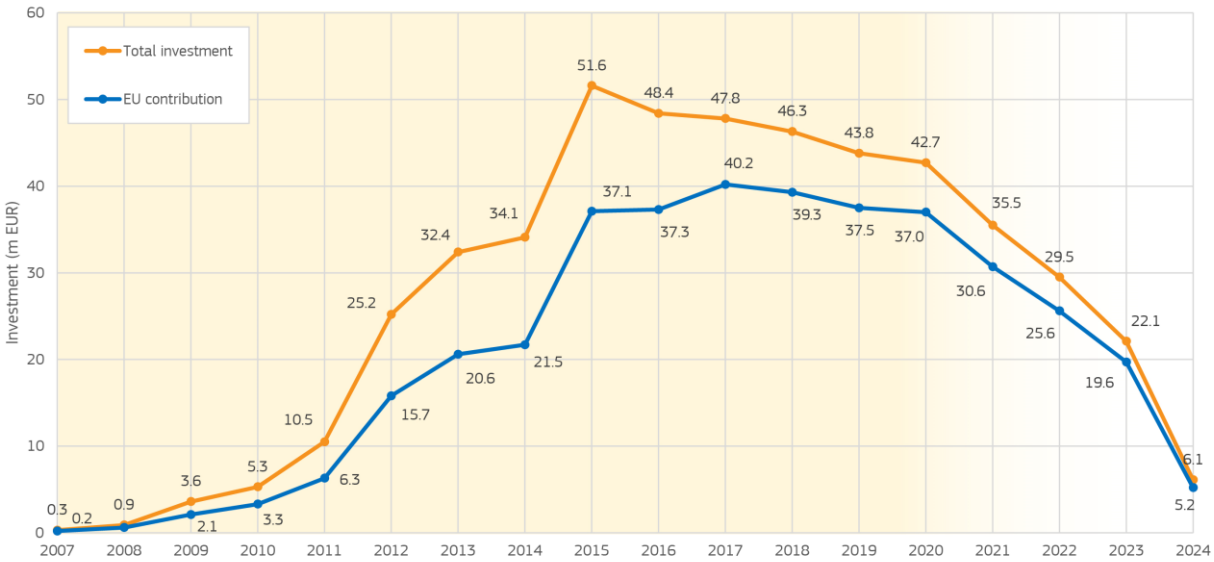
Figure 29. Share of integration of DG and storage investment by organisation type



Source: JRC, 2021.

Figure 30 illustrates the distribution of total and EU investment in the integration of DG and storage domain over the project lifespan. We can observe an upward trend in total and EU investment through the years with a peak in 2015. As in the other domains, the reduction after 2020 is attributed to the fact that our database includes only projects with a starting date before the end of 2020.

Figure 30. Distribution of integration of DG and storage investment over the project lifespan

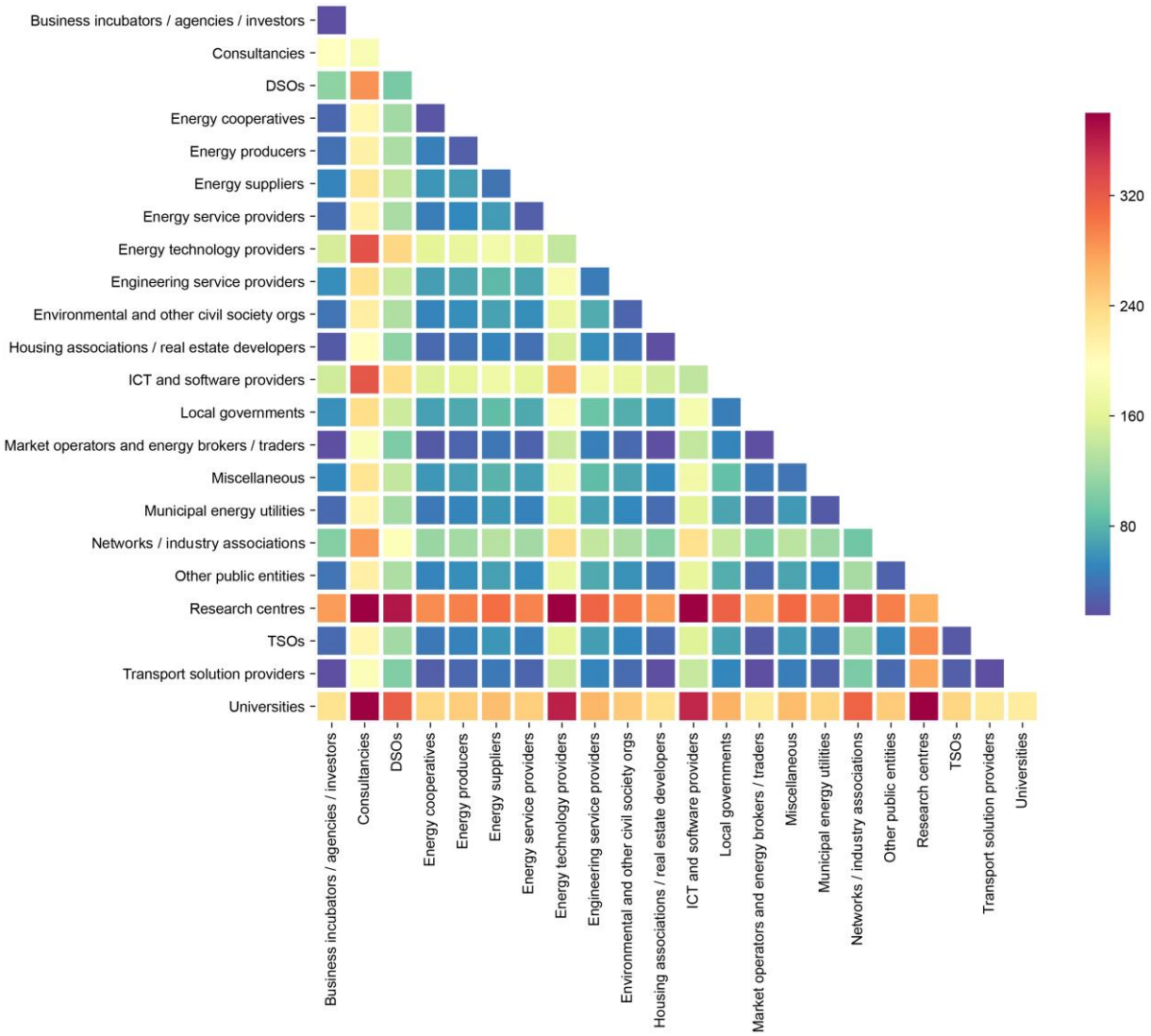


Source: JRC, 2021.

Figure 31 illustrates the collaboration links between different types of organisations to help understand who collaborates with whom in the integration of DG and storage domain. The links represent the number of collaborations between each pair of organisations participating in projects in this domain. As with the other

domains above, universities, research centres and consultancies are the entities that collaborate most with the rest of the organisations. We can see that ICT and software providers, energy technology providers, DSOs and networks / industry associations are also active in this domain.

Figure 31. Collaboration links between types of organisations active in integration of DG and storage

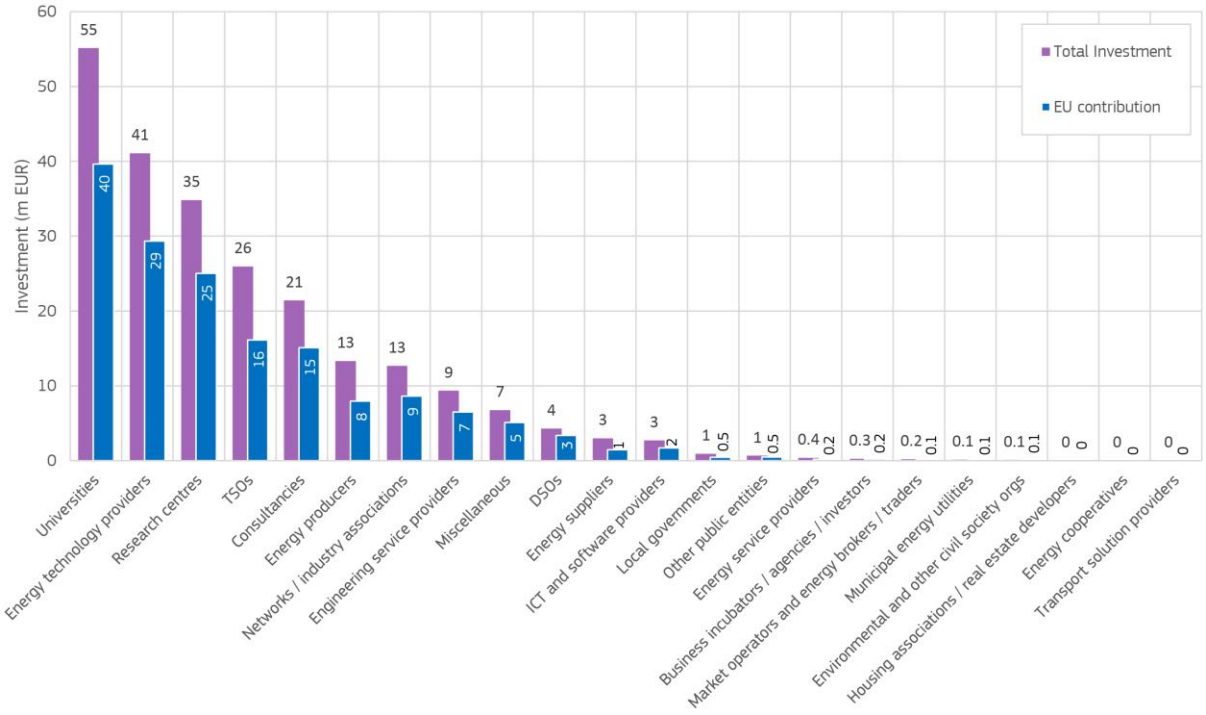


Source: JRC, 2021.

3.2.5.4. Large-scale integration of renewable energy sources and storage

Figure 32 illustrates the share of total and EU investment in the integration of large-scale RESs and storage domain per organisation type. We can see that after universities – one of the organisations with the highest share of total budget across all project domains – energy technology providers, research centres and TSOs have the highest budgets in this project domain.

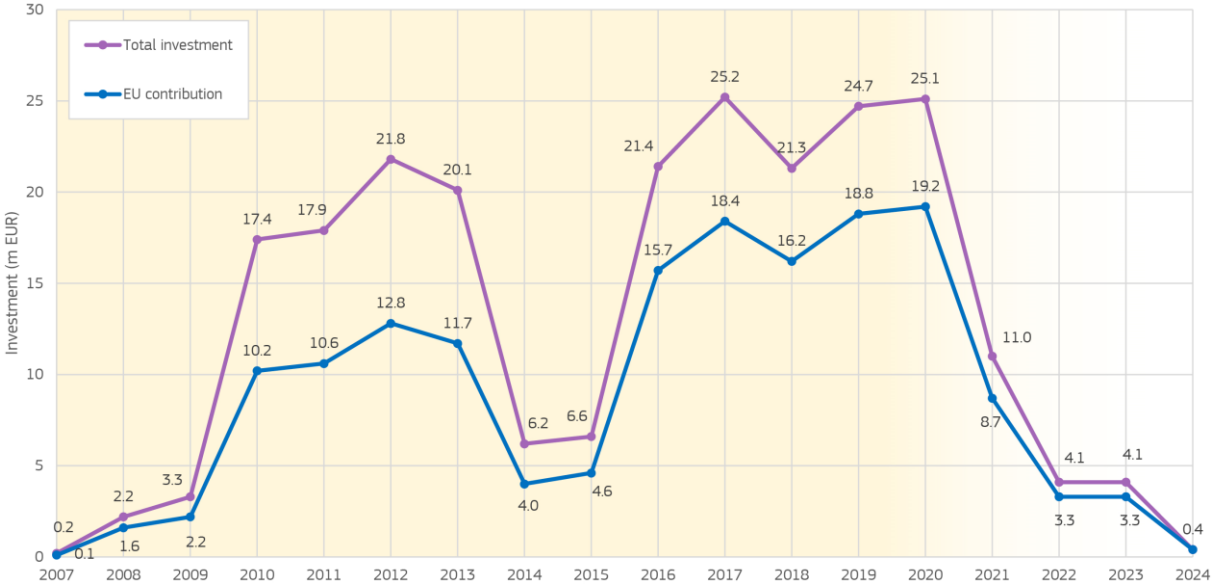
Figure 32. Share of integration of large-scale RESs and storage investment by organisation type



Source: JRC, 2021.

Figure 33 illustrates the distribution of total and EU investment in the integration of large-scale RESs and storage domain over the project lifespan. We can observe an increase in total and EU investment through the years with a peak in 2012, followed by higher peaks in 2017, 2019 and 2020. There is also a sudden drop in 2014 that could be partially attributed to the end of the FP7 and CIP in 2013. As in the other domains, the reduction after 2020 is attributed to the fact that our database includes only projects with a starting date before the end of 2020.

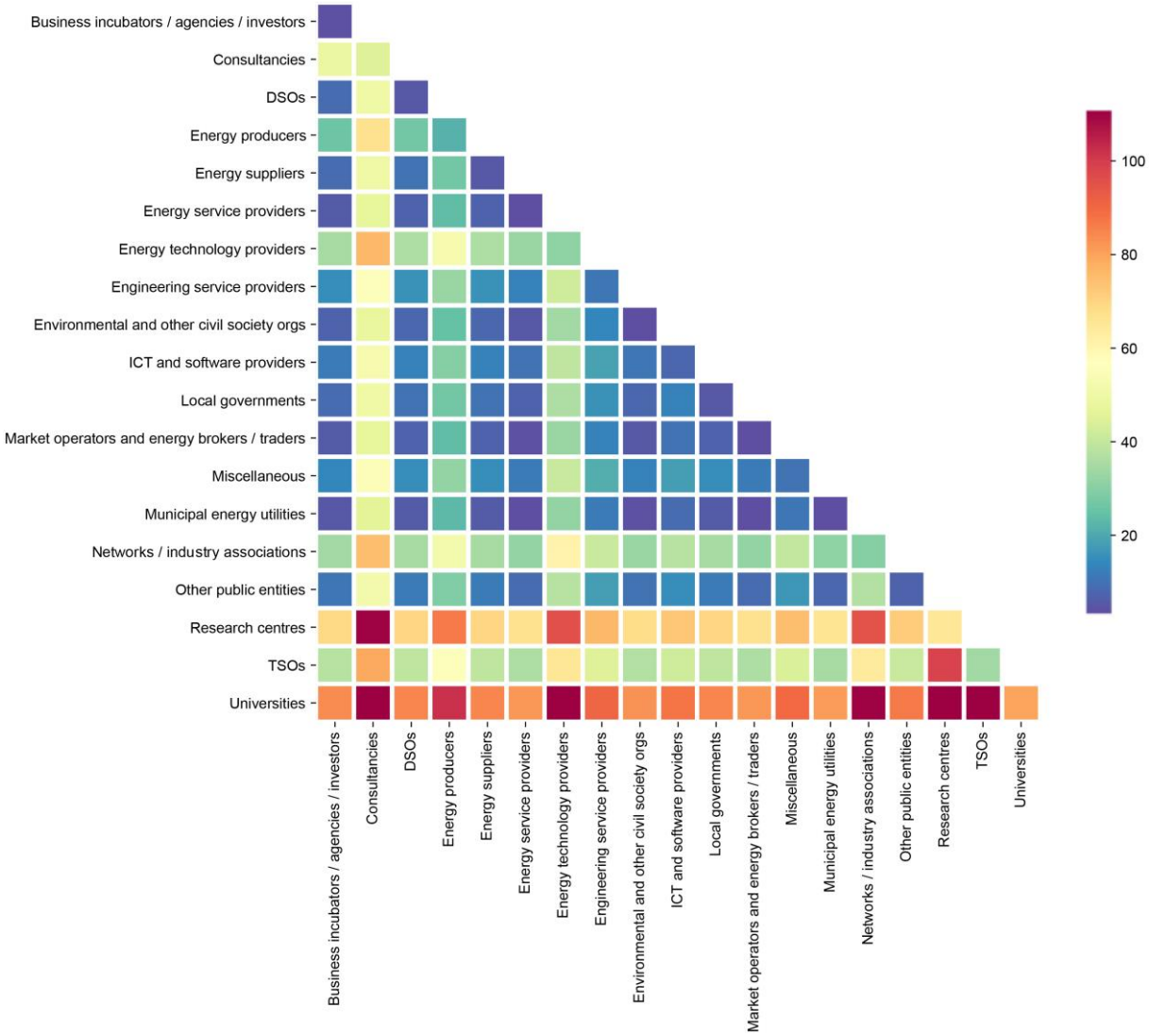
Figure 33. Distribution of integration of large-scale RESs and storage investment over the project lifespan



Source: JRC, 2021.

Figure 34 illustrates the collaboration links between different types of organisations to help understand who collaborates with whom in the integration of large-scale RESs and storage domain. The links represent the number of collaborations between each pair of organisations participating in projects in this domain. Universities and energy technology providers are the entities that collaborate most with the rest of the organisations. We can also see that, besides universities and research centres, energy technology providers, TSOs and networks / industry associations are also active in this domain.

Figure 34. Collaboration links between different types of organisations active in integration of large-scale RESs and storage

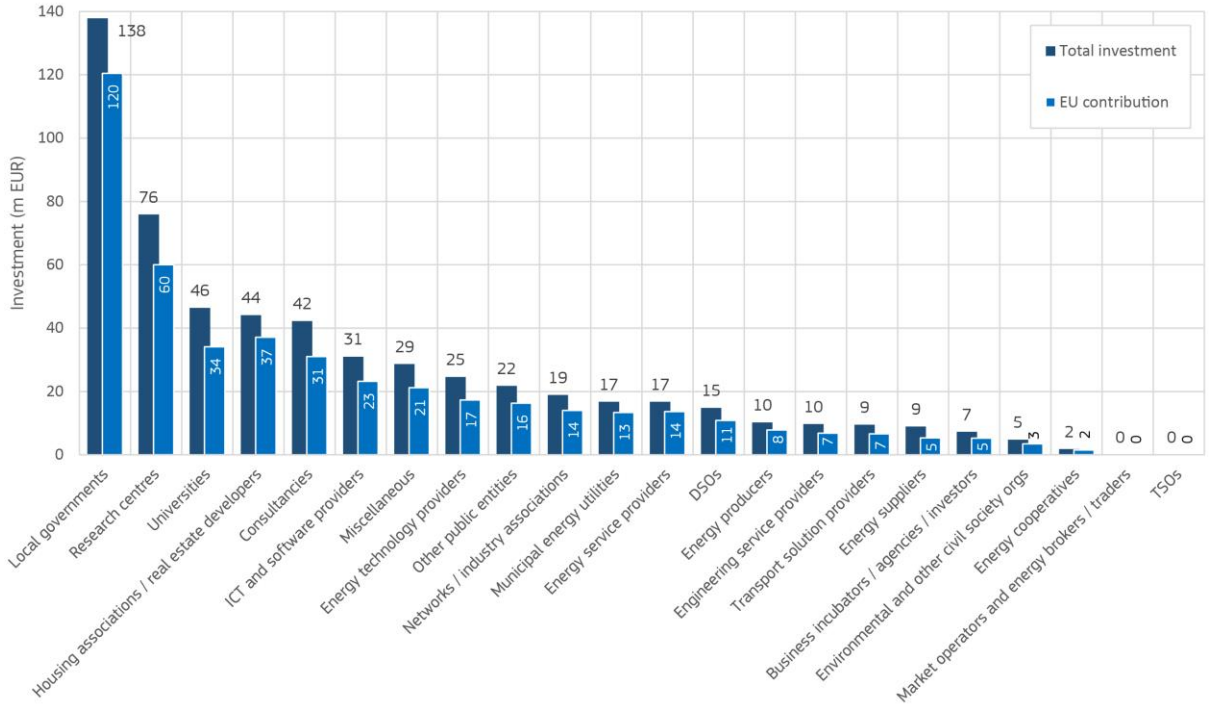


Source: JRC, 2021.

3.2.5.5. Smart city

Figure 35 illustrates the share of total and EU investment in the smart city domain by organisation type. We can see that local governments, together with research centres, universities and housing associations / real estate developers, have the highest shares of budgets related to projects in this domain, thus demonstrating the increasing interest of local actors in the development of smart city projects.

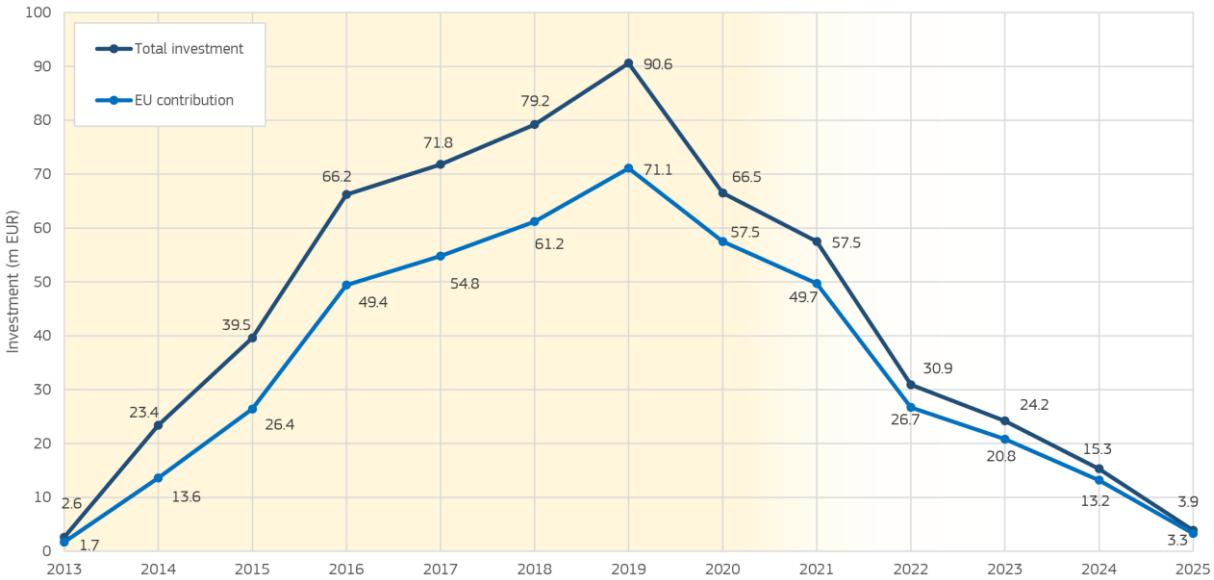
Figure 35. Share of smart city investment by organisation type



Source: JRC, 2021.

Figure 36 illustrates the distribution of total and EU investment in the smart city domain over the project lifespan. We can observe an increase in total and EU investment through the years with a peak in 2019. As in the other domains, the reduction after 2020 is attributed to the fact that our database includes only projects with a starting date before the end of 2020.

Figure 36. Distribution of smart city investment over the project lifespan

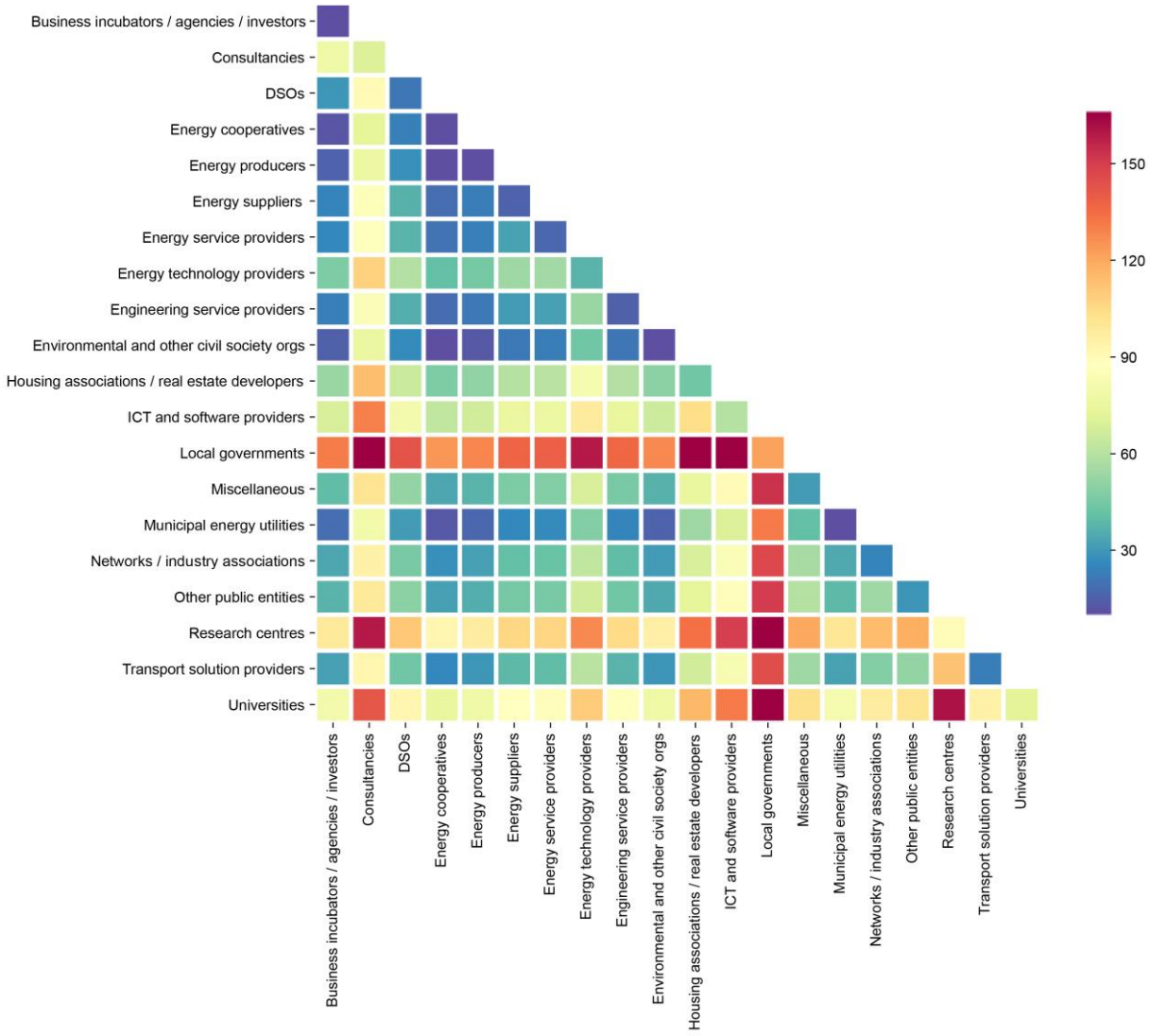


Source: JRC, 2021.

Figure 37 illustrates the collaboration links between different types of organisations to help understand who collaborates with whom in the smart city domain. The links represent the number of collaborations between each pair of organisations participating in projects in this domain. Local governments are the entities that

collaborate most with the rest of the organisations – mainly with research centres and universities, but also with the category 'miscellaneous' (e.g. water and waste treatment companies, automotive equipment manufacturers), municipal utilities, other public entities, and networks / industry associations. In addition, besides universities, research centres and consultancies, also ICT and software providers, housing associations / real estate developers, transport solution providers and energy technology providers show great interest in participating in this domain.

Figure 37. Collaboration links between different types of organisations active in the smart city domain

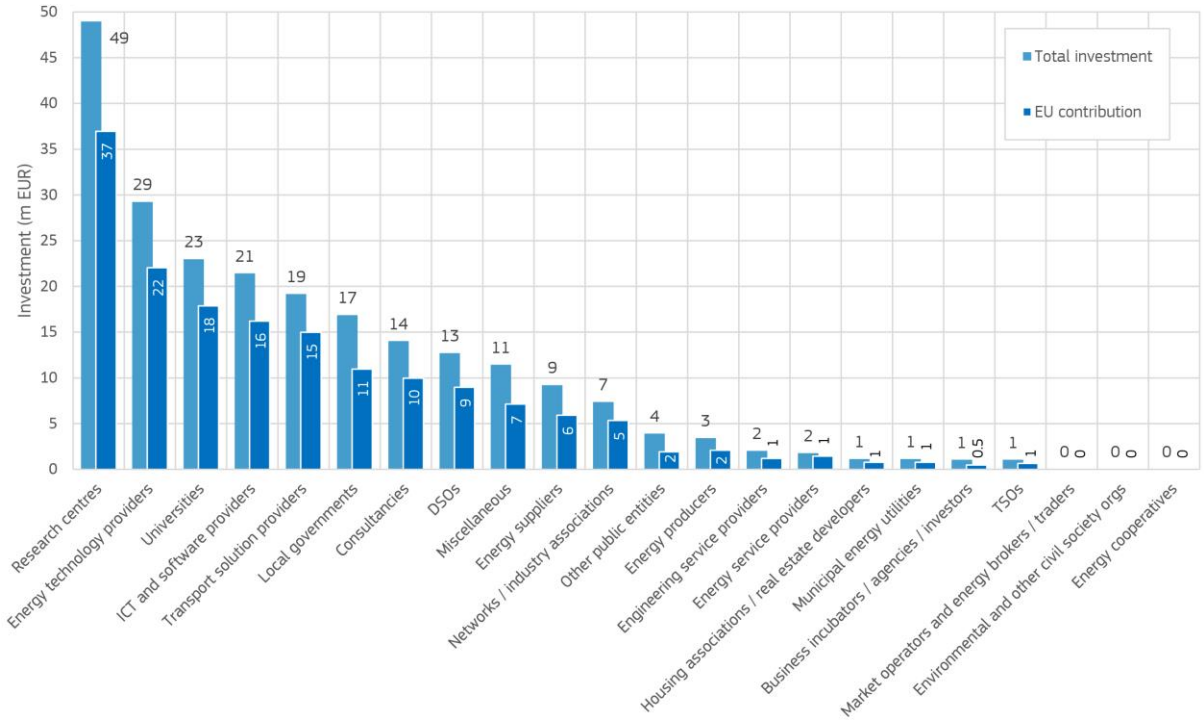


Source: JRC, 2021.

3.2.5.6. E-mobility

Figure 38 illustrates the share of total and EU investment in the e-mobility domain by organisation type. We can see that after research centres – one of the organisations with the highest share of total budget across all project domains – energy technology providers, universities, and ICT and software providers have the highest budgets.

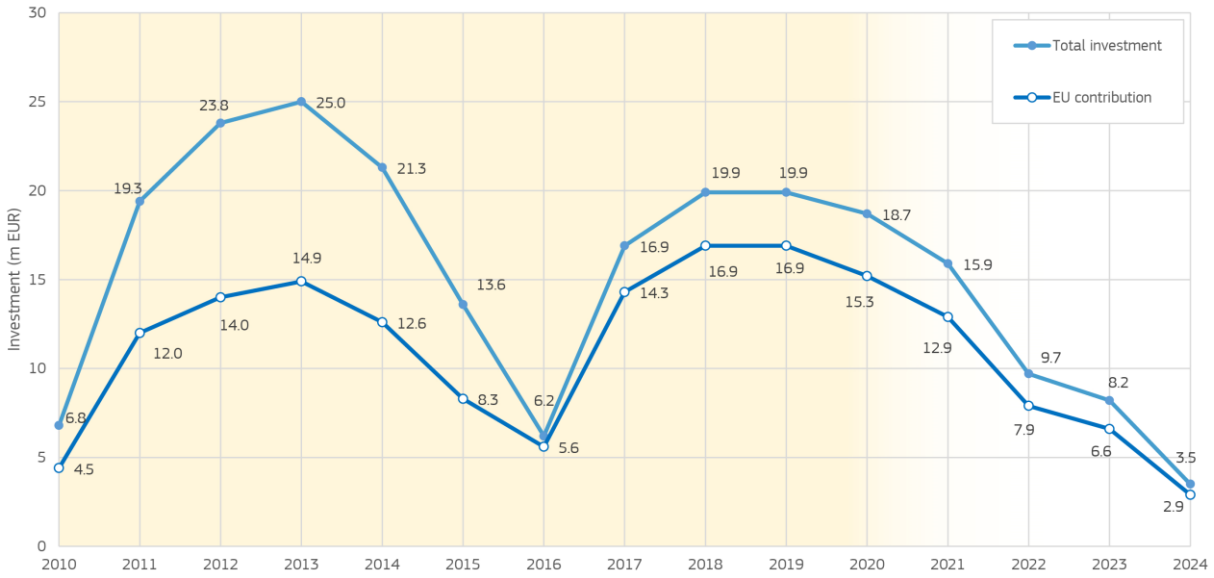
Figure 38. Share of e-mobility investment per organisation type



Source: JRC, 2021.

Figure 39 illustrates the distribution of total and EU investment in the e-mobility domain over the project lifespan. We can observe an increase in total and EU investment through the years with a peak in 2013, followed by another peak in 2018 and 2019. We can also see a sudden drop in 2016, followed by a sharp increase in 2017. As in the other domains, the reduction after 2020 is attributed to the fact that our database includes only projects with a starting date before the end of 2020.

Figure 39. Distribution of e-mobility investment over the project lifespan

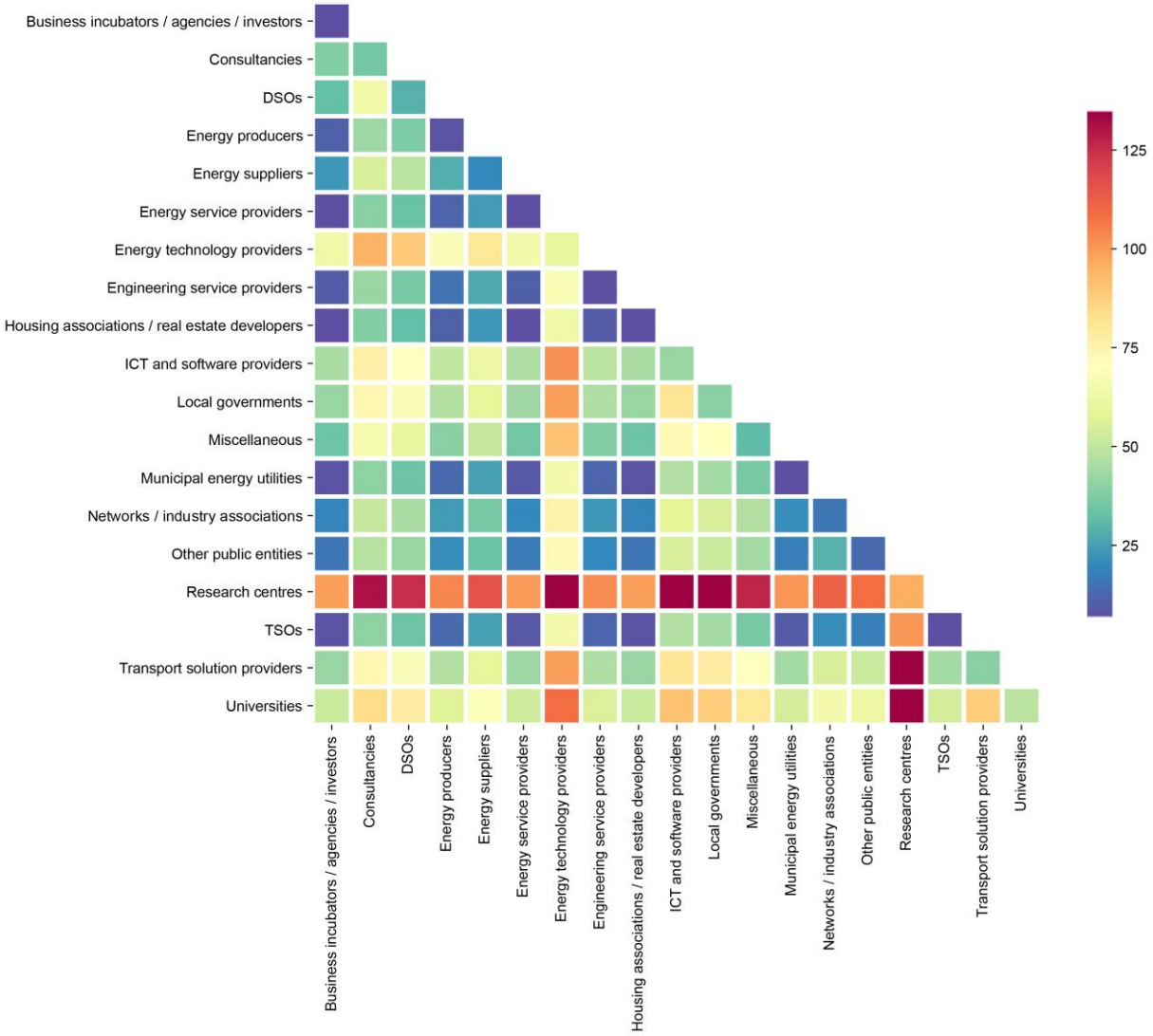


Source: JRC, 2021.

Figure 40 illustrates the collaboration links between different types of organisations to help understand who collaborates with whom in the e-mobility domain. The links represent the number of collaborations between

each pair of organisations participating in projects in this domain. Research centres are the entities that collaborate most with the rest of the organisations. We can also see that energy technology providers, ICT and software providers, transport solution providers, universities, local governments and 'miscellaneous' (mainly automotive equipment manufacturers) also actively collaborate in this domain.

Figure 40. Collaboration links between different types of organisations active in e-mobility

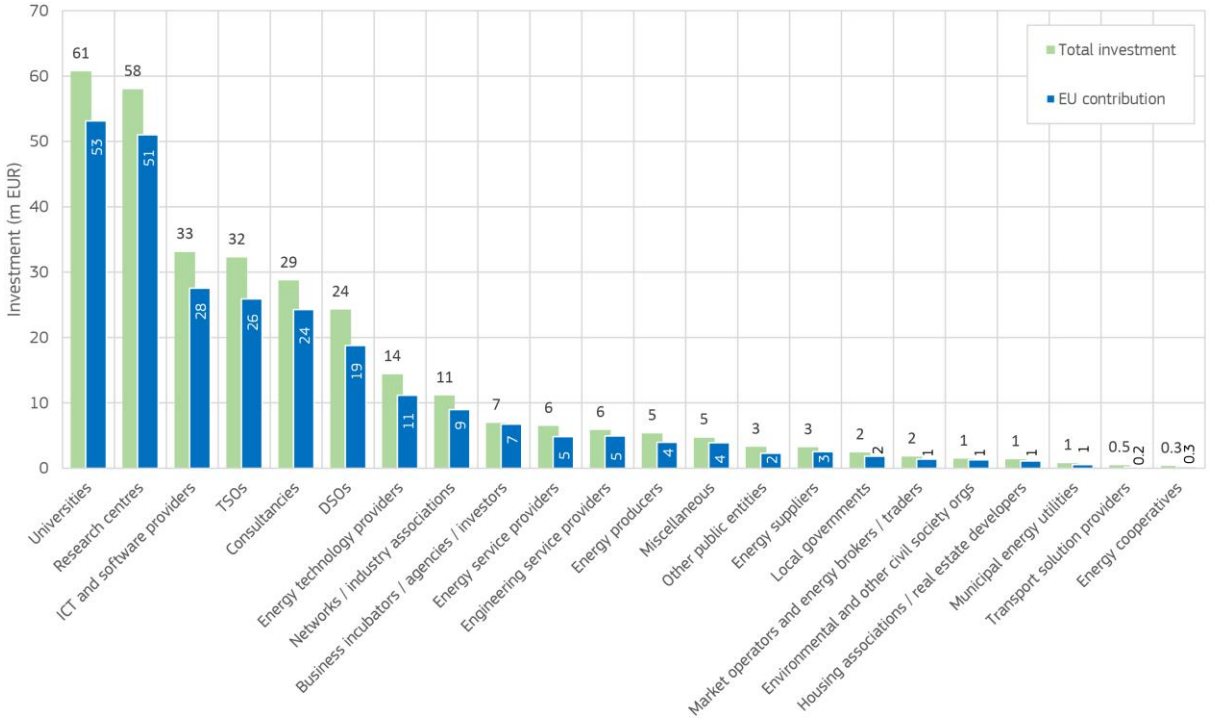


Source: JRC, 2021.

3.2.5.7. Other

Figure 41 illustrates the share of total investment in the domain 'other' by organisation type. We can see that after universities and research centres – the organisations with the highest shares of total budgets across all project domains – ICT software providers and TSOs have the highest budgets in this domain.

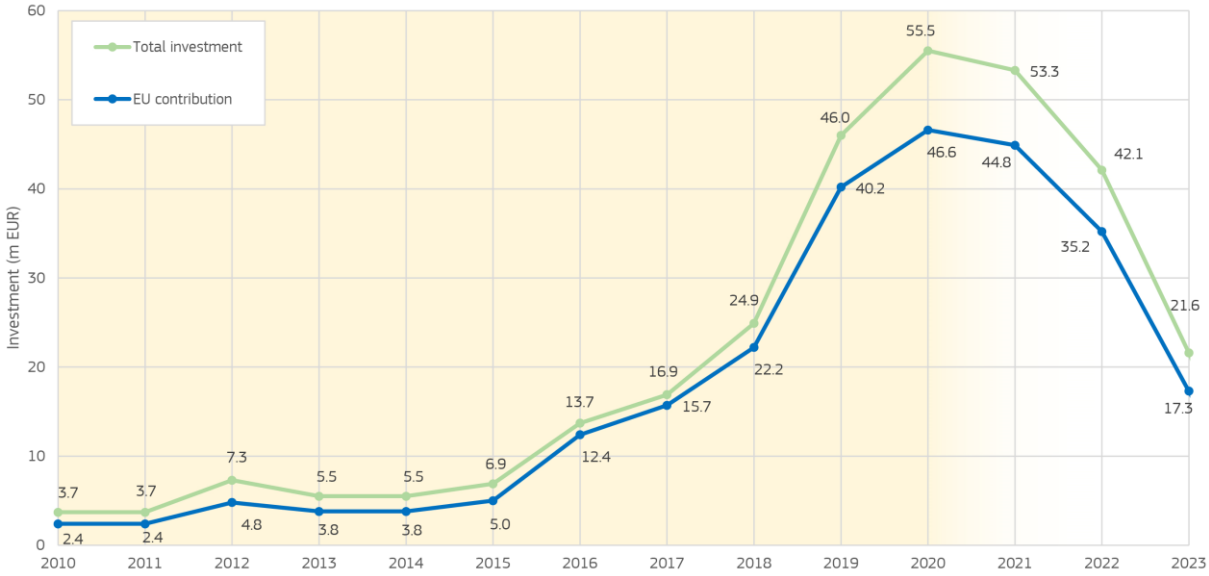
Figure 41. Share of investment by organisation type in domain 'other '



Source: JRC, 2021.

Figure 42 illustrates the distribution of total and EU investment in the domain 'other' over the project lifespan. We can observe an upward trend of total and EU investment along the years with a peak in 2020. As in the case of the other domains, the reduction after 2020 is attributed to the fact that our database includes only projects with a starting date before the end of 2020.

Figure 42. Distribution of investment in domain 'other' over the project lifespan

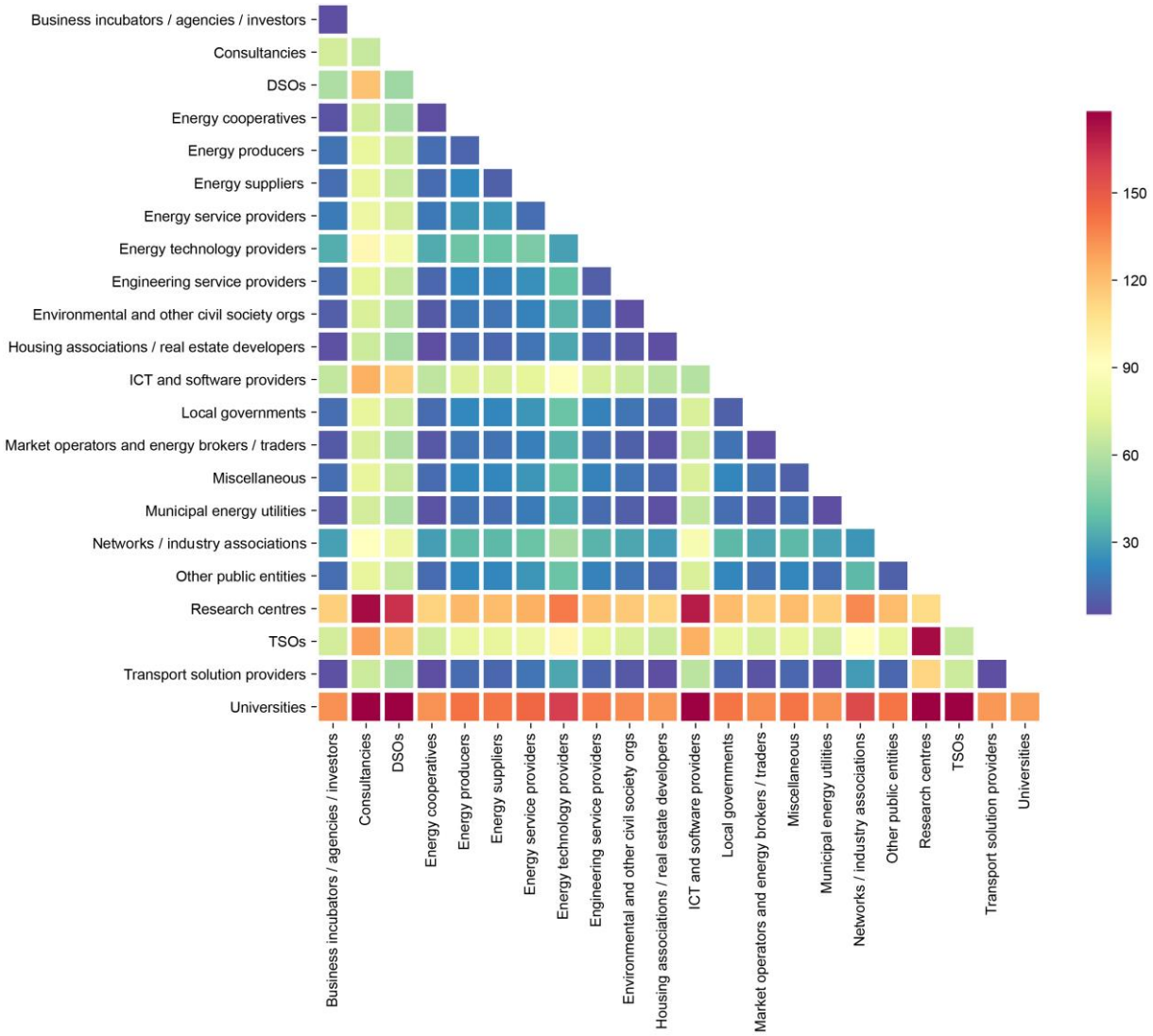


Source: JRC, 2021.

Figure 43 illustrates the collaboration links between different types of organisations to help understand who collaborates with whom in the domain 'other'. The links illustrate the number of collaborations between each pair of organisations participating in projects in this domain. Universities and research centres are the entities

that collaborate most with the rest of the organisations. We can also see that DSOs and TSOs are active in this domain – mostly collaborating with research centres and universities but also with consultancies, ICT and software providers and with each other (TSO–DSO).

Figure 43. Collaboration links between different types of organisations active in the domain 'other'



Source: JRC, 2021.

3.3. Participating organisations

3.3.1. Overall picture

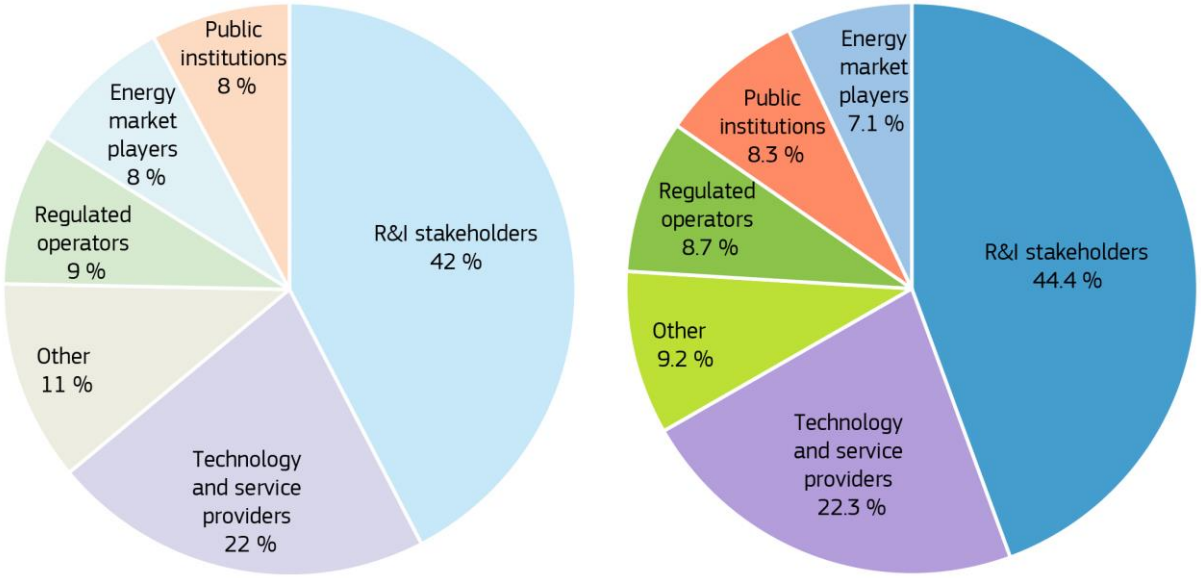
3.3.1.1. Number of participants and EU funding

The project catalogue reports 5 986 participations and 3 130 organisations. Project participants have been classified under 22 categories, grouped in 6 macro-categories, as detailed in Table 2. The presence of a varied range of actors is in line with the evolution of the energy system towards a complex sociotechnical system, which combines the integration of new technological advances in energy systems and ICT with human behavioural and social aspects. Such complexity requires collaboration between different actors: older players

in the smart grid arena, such as regulated operators, energy producers and suppliers, and more recent players, such as local governments and civil society organisations.

Overall, R&I stakeholders represent 42 % of participations, technology and service providers 22 %, regulated operators 9 %, energy market players and public institutions 8 % and the organisations grouped under the macro-category 'other' 11 %. The distribution of EU funding across the macro-categories follows roughly the same pattern (Figure 44).

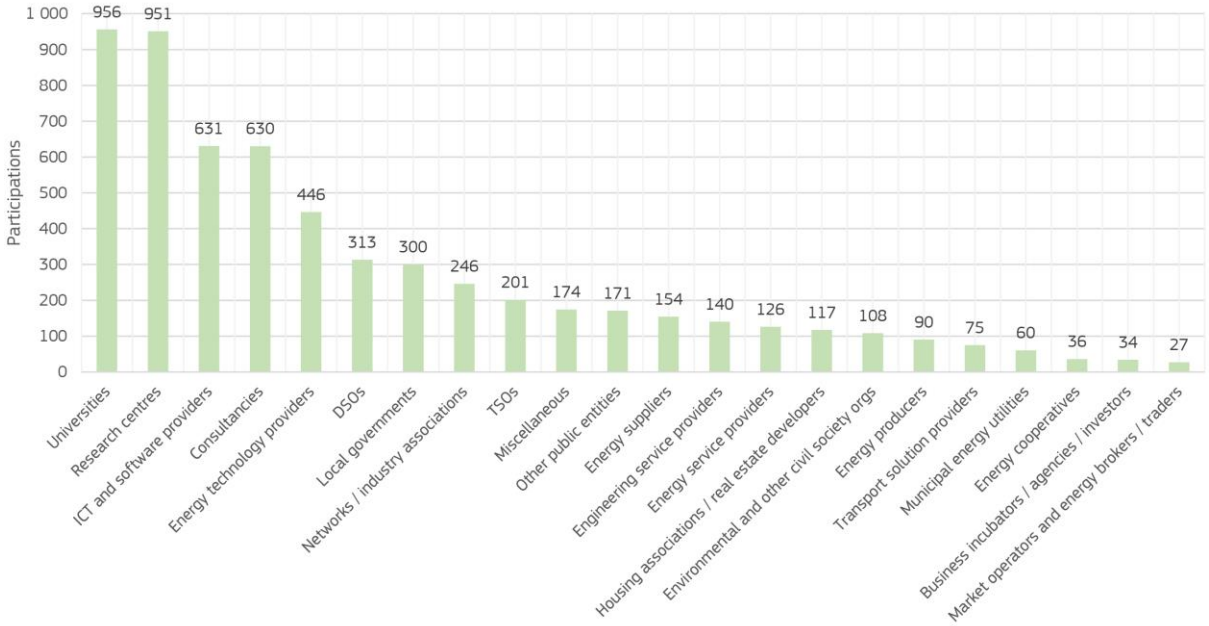
Figure 44. Distribution of participations (left) and EU funding (right) by macro-category



Source: JRC, 2021.

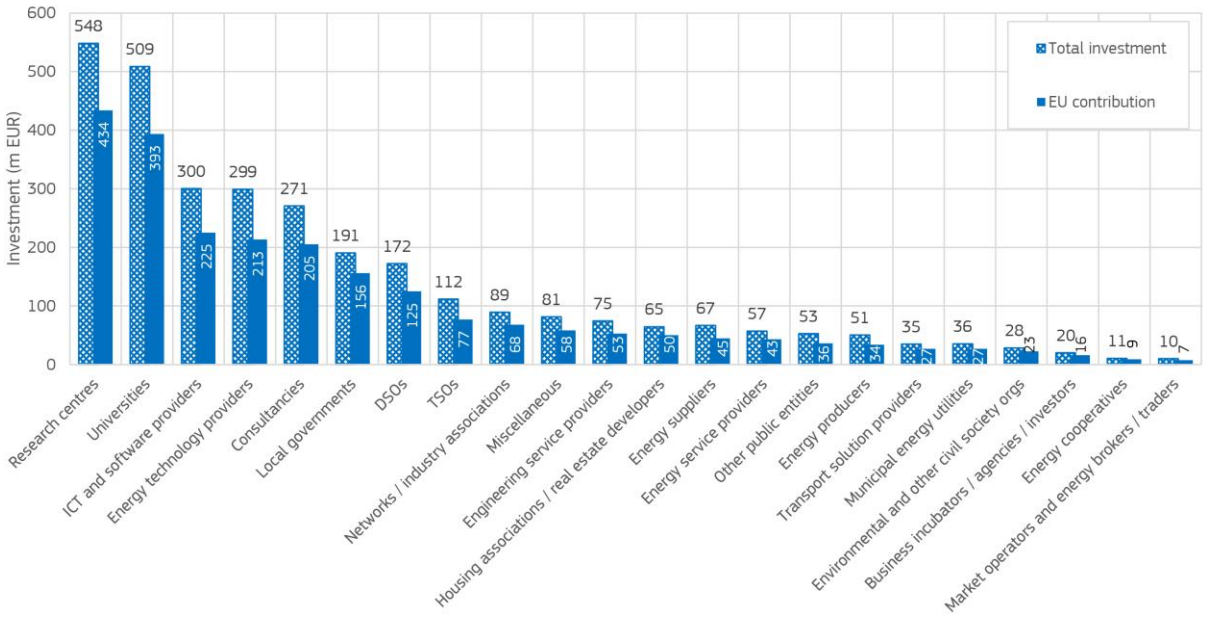
Within the macro-categories, individual categories show different numbers of participations along the distribution spectrum (Figure 45). Moreover, the amount of EU contribution received by each category (Figure 46) does not always reflect the distribution of participations, as the amount received for each participation is dependent on many factors, including the size of the project, the different roles in the project and differing local costs associated with participating.

Figure 45. Distribution of participations across participant categories



Source: JRC, 2021.

Figure 46. Distribution of total budget and EU contribution across participation categories



Source: JRC, 2021.

3.3.1.2. Participations across funding programmes

Out of the total 5 986 participations, 316 were recorded in CIP-IEE, 411 in CIP-ICT-PSP, 1 644 in FP7 and 3 615 in H2020. The average number of participants per project shows differences between funding programmes. It increased from FP7 to H2020 (from 13 to 16), showing a tendency towards more complex projects, involving a wider range of participants. In the same period, the average project total budget also increased from EUR 8.22 million (FP7) to EUR 8.4 million (H2020), confirming a tendency towards larger projects. CIP-ICT-PSP projects

show the same average number of participants as H2020 projects (16), while CIP-IEE projects have the lowest average number of participants (10).

Figure 47 presents the distribution of participations and EU funding by macro-category and funding programme, highlighting that the participation of some actors, such as public institutions, energy market players (particularly energy cooperatives) and some of the organisations grouped under 'other' (mainly networks / industry associations and environmental and other civil society organisations) was supported, ahead of H2020, by CIP-ICT-PSP and CIP-IEE.

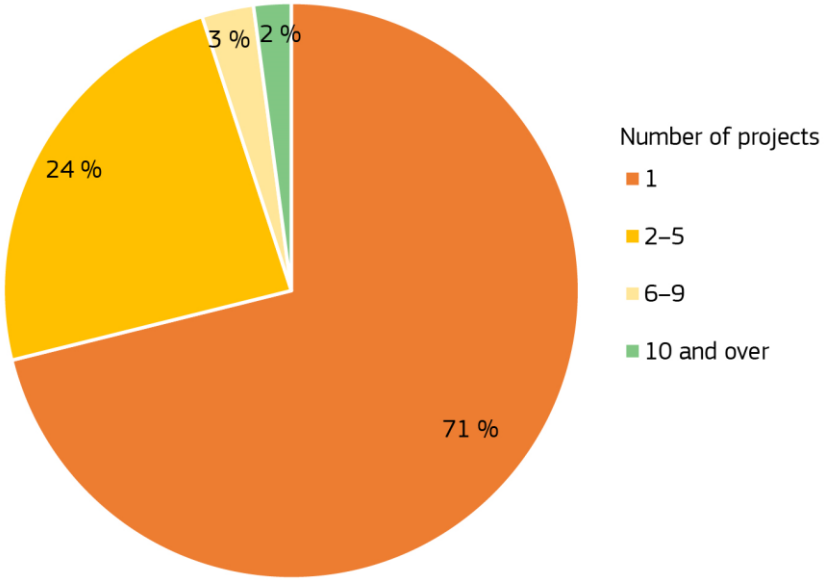
Figure 47. Distribution of participations (top) and EU funding (bottom) by macro-category and funding programme

Source: JRC, 2021.

3.3.1.3. Participation ranges and first-time participants

On average, each organisation participated in eight projects. Across all funding programmes, 71 % of the organisations only participated in 1 project, while only 2 % participated in over 10 projects (see Figure 48).

Figure 48. Project participation ranges



Source: JRC, 2021.

Among the organisations that participated in over 10 projects, those in the top 15 positions in terms of number of participations are mainly research centres and universities (Figure 49). The participation of these organisations in a large number of projects implies that they were assigned large cumulative EU contributions that helped to support the creation of big knowledge centres.

In H2020, 54 % of the organisations were newcomers, i.e. successful first-time applicants to H2020 that did not apply to any of the other reviewed programmes (FP7, CIP-ICT-PSP, CIP-IEE). This finding indicates that H2020 was successful in allowing new organisations to join and receive funding, particularly new players in the smart grid sector that are able to push innovative technologies and business models to markets. Figure 50 shows the distribution of newcomers across organisation categories.

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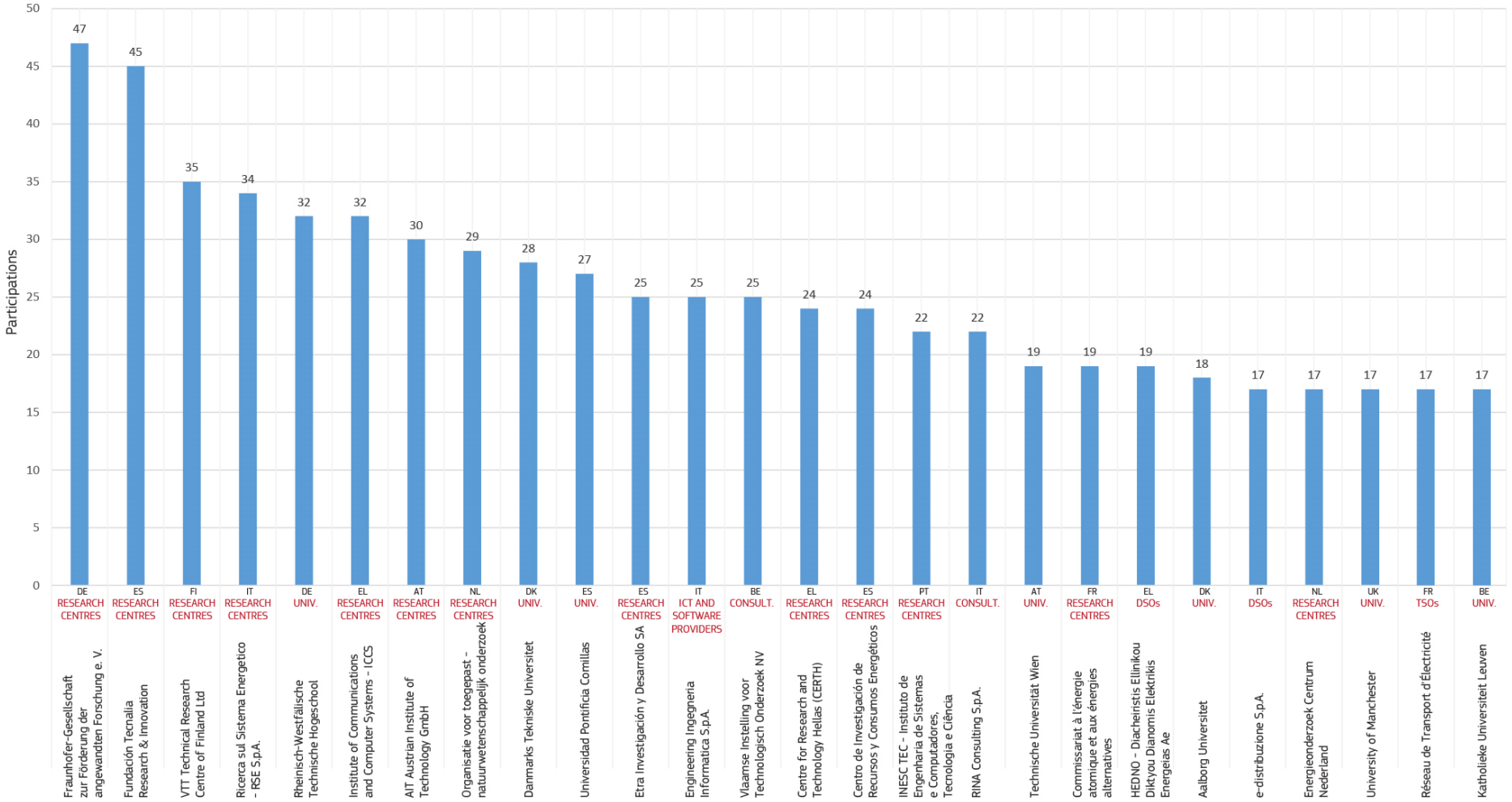
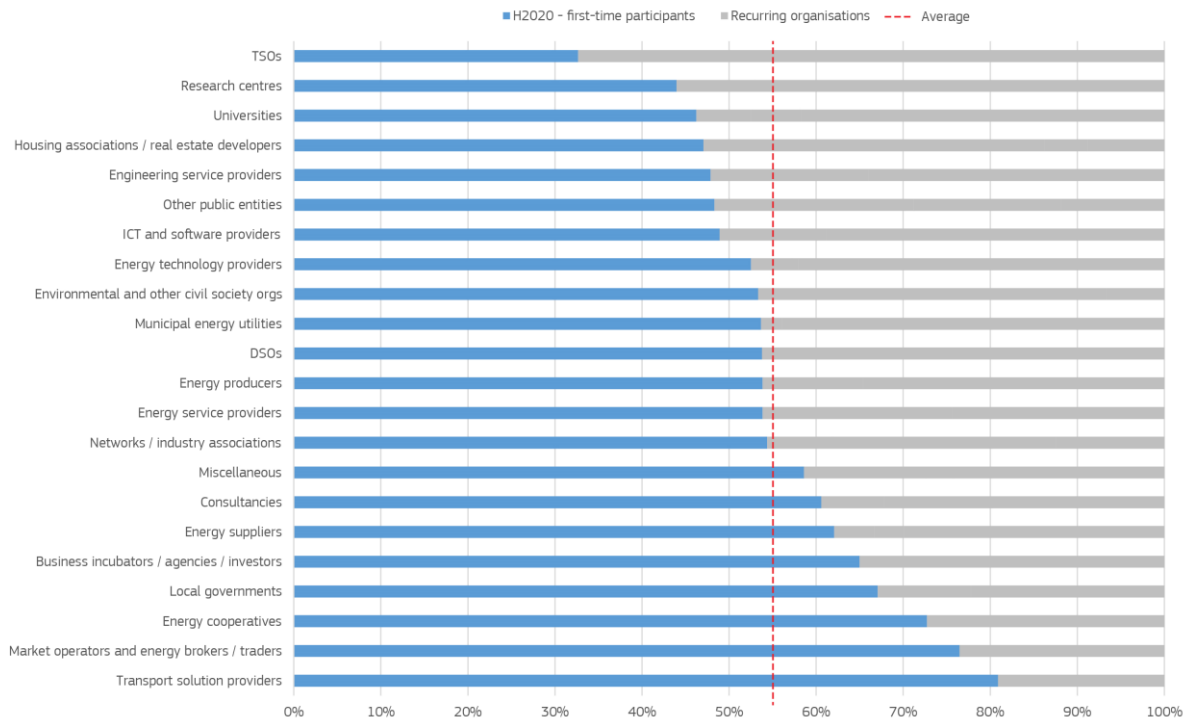
Figure 49. Organisations in the top 15 positions in terms of number of participations, 2007–2020



Source: JRC, 2021.

Figure 50. Percentages of H2020 newcomers by category



Source: JRC, 2021.

The share of newcomers varies discernibly by organisation category. It is above average for categories that are newer in the smart grid arena, such as transport solution providers (81 %), market operators and energy brokers / traders (76 %), energy cooperatives (73 %) and local governments (67 %), while it is below average for more traditional players, such as TSOs (33 %), research centres (44 %) and universities (46 %).

The large-scale participation of new transport solution providers can be explained by H2020 funding of smart city projects – alongside e-mobility projects – in which innovative solutions are tested involving different organisations operating in the conventional and electro-mobility sectors. Germany is the country with the highest number of newcomer transport solution providers in 2014–2020.

Projects in the smart city domain – alongside a pretty steady number of new DSM projects per year – also contribute to explaining the large number of new entrants in the local government category. The participation of local governments, as the public stakeholders closest to the public, provides an opportunity for citizens to take advantage of the opportunities offered by innovative technologies and new business models and to benefit from the ongoing energy transition. Italy and Spain are the countries with the highest numbers of newcomers among local governments (18 and 16 respectively).

The participation of new market operators and energy brokers / traders in H2020 is mainly found in smart network management and DSM projects that aim to define and test new approaches to the wholesale market, facilitating the participation of variable RESs, adequately remunerating new flexibility services to the grid and reducing the cost of network operations. These projects promote collaboration among different organisations, and facilitate the networking of cross-border players and the establishment of a balancing market. Among the participants, we find several nominated electricity market operator (NEMOs)[24], such as IBEX, HUPX, HEnEx and OMIE.

[24] A NEMO is an entity designated by the competent authority to run the day-ahead and intraday integrated electricity markets in the EU.

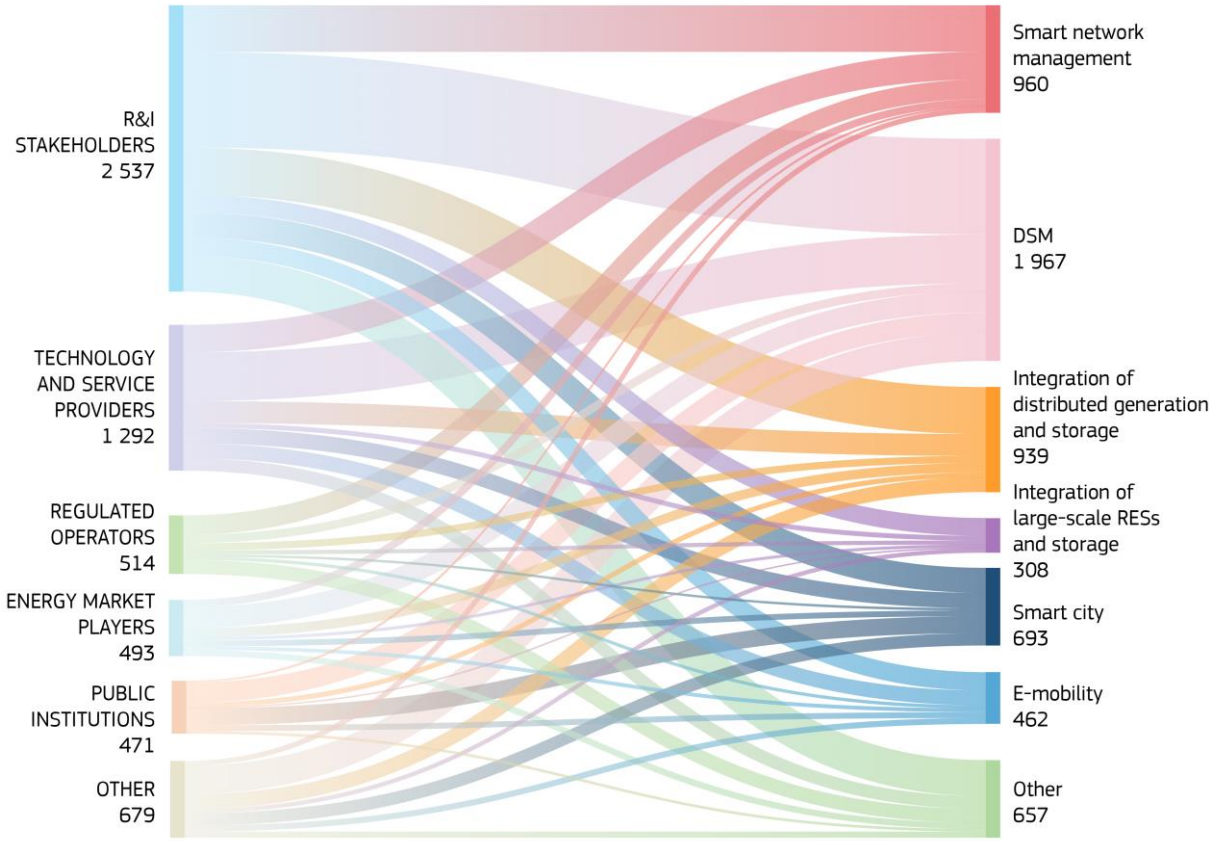
Finally, H2020 shows the participation of energy cooperatives, a category that previously only appeared in CIP-IEE projects. Energy cooperatives are community-led energy initiatives, usually trusted as community partners and political advocates. They appear mainly in DSM and integration of DG and storage projects, aimed at boosting local energy sources and activating local demand response. In these projects, they often act as facilitators to enhance the involvement of local energy consumers and producers, and as knowledge centres to develop and test methodologies based on best practices. Their participation is favoured by several calls for proposals, as they are considered to be facilitators that trigger investments and promote public support for sustainable energy technologies at the community level. Newcomers come from 11 countries: Germany, Ireland, Spain, the Netherlands and Portugal have two newcomers each.

As for the other funding programmes, only about 9 % of the organisations that participated in FP7 also participated in CIP-ICT-PSP, and 6 % in CIP-IEE, suggesting weak linkages between these programmes in the smart grid sector.

3.3.1.4. Participations across domains

Organisations are active across all domains, with notable differences among macro-categories. All macro-categories, however, show the highest number of participations in the DSM domain, with the sole exception of regulated operators, which show the highest number of participations in the smart network management domain (Figure 51).

Figure 51. Number of participations in each macro-category across domains

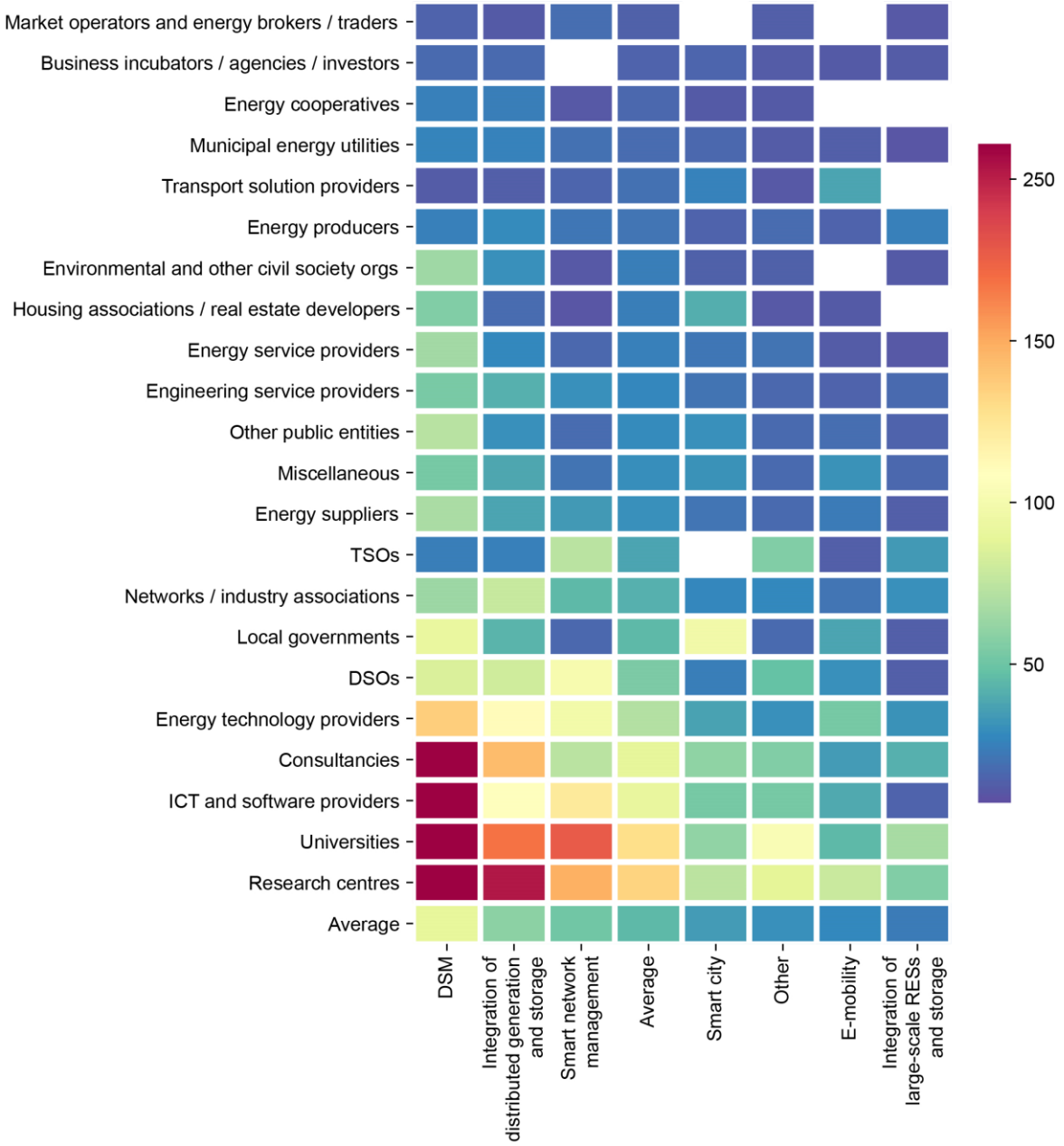


Source: JRC, 2021.

Within the macro-categories, each category shows distinctive levels of participation in the different domains (Figure 52). Apart from research centres, universities and consultancies, which show a high level of participation in all domains, the other organisation categories show a more varied pattern, in line with the business sector in

which they operate and their role in smart grid deployment. Local governments for example, are particularly active in the smart city and e-mobility domains, where they play a pivotal role in the transformation of city infrastructures and services. In the smart city domain, in particular, local governments work together with other partners to develop and demonstrate innovative energy solutions, often through cooperative processes, to improve local energy efficiency and increase local production of renewable energy. Housing associations / real estate developers are also particularly active in this domain, indicating a growing interest among the residential sector, especially the social housing sector, in a just energy transition that addresses energy poverty by increasing residential energy efficiency and self-consumption of renewable energy. Finally, DSOs and TSOs, traditionally active in the smart network management domain, show a high level of participation in the domain 'other', indicating their growing interest in the cross-cutting issues addressed by these projects, such as cybersecurity, the potential of big data for the modernisation of the European electricity grid and the creation of new services enabled by smart grid deployment.

Figure 52. Organisation categories participation shares by domain

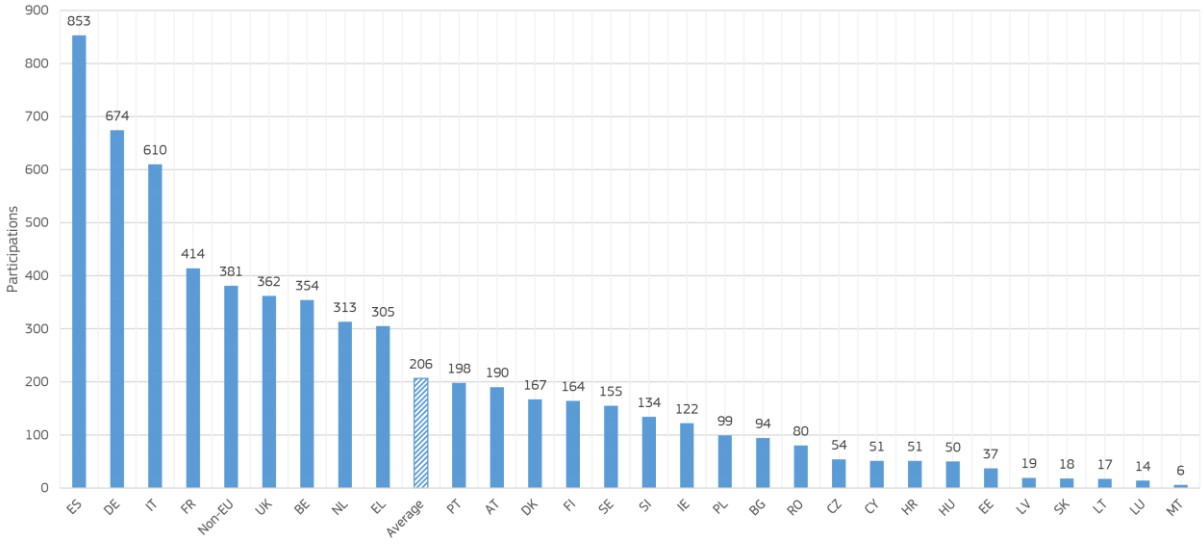


Source: JRC, 2021.

3.3.1.5. Geographical distribution of participations

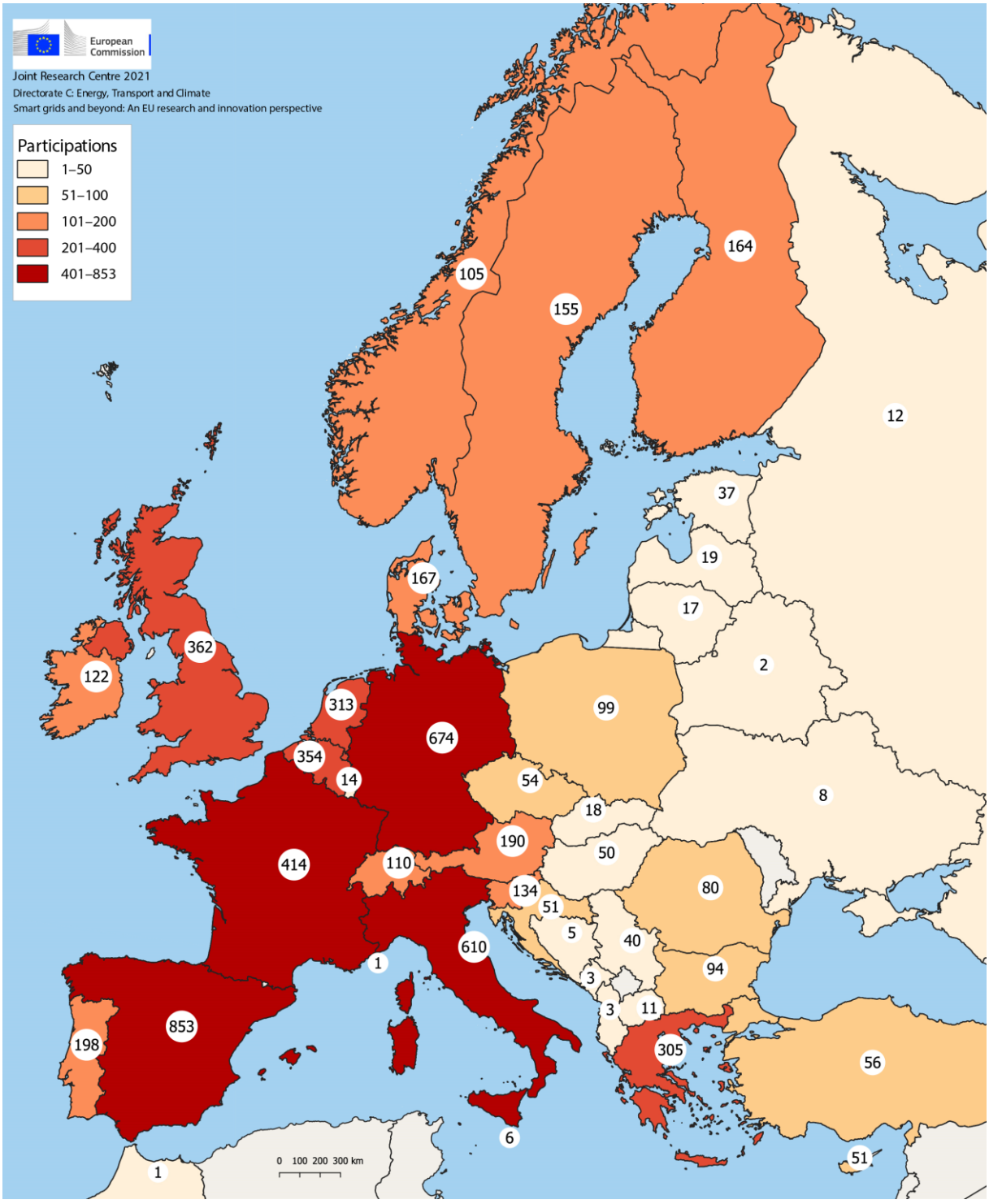
The geographical distribution of participations highlights relevant differences between countries, with Spain, Germany and Italy showing the largest numbers of participations (Figure 53 and Figure 54) and the highest shares of EU contribution (Figure 55).

Figure 53. Geographical distribution of participations (graph)



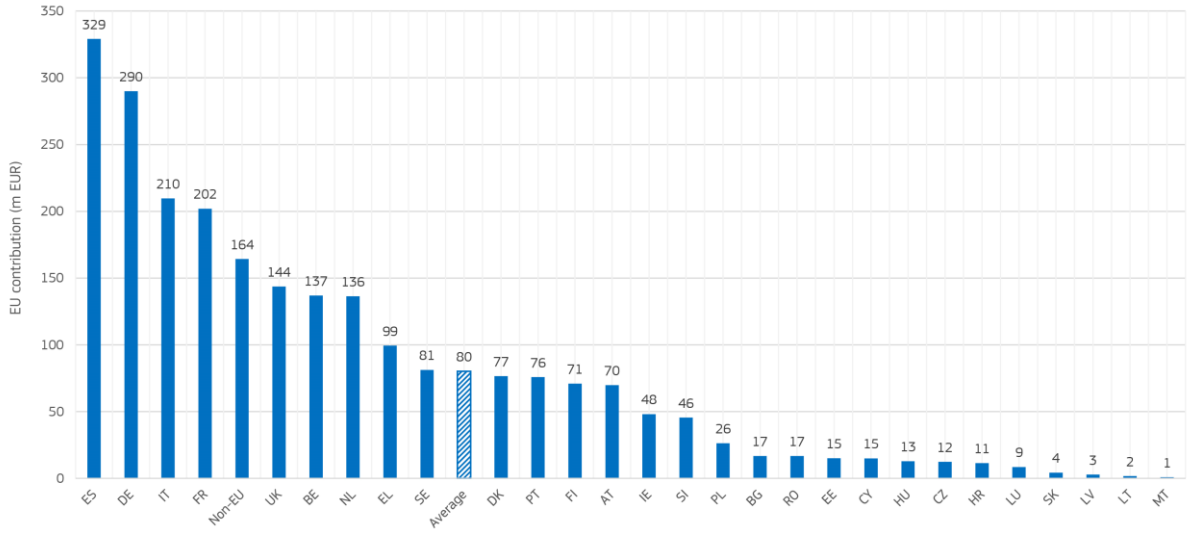
Source: JRC, 2021.

Figure 54. Geographical distribution of participations (map)



Source: JRC, 2021.

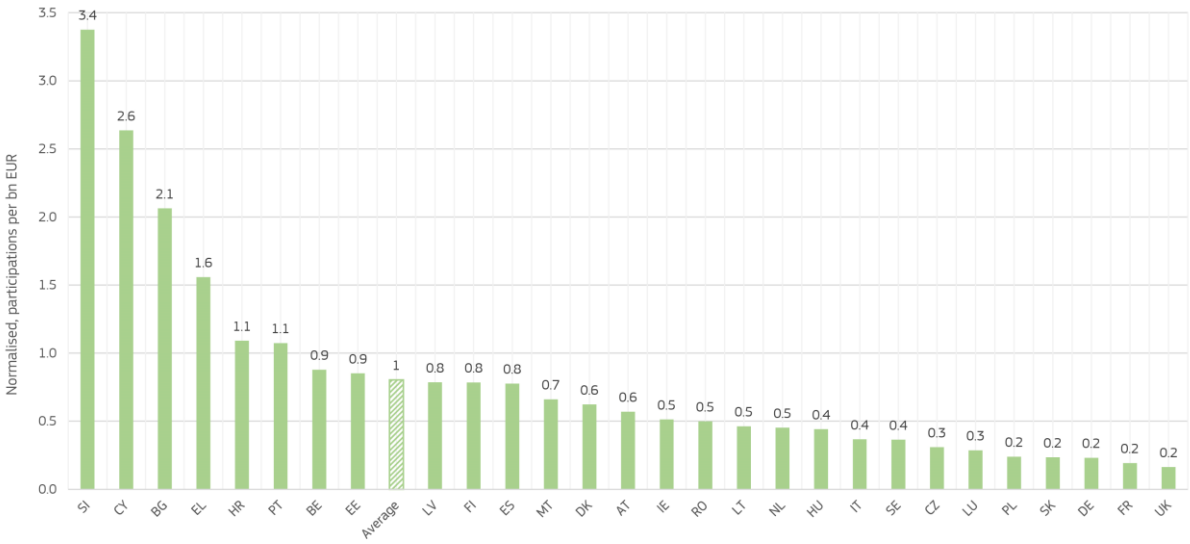
Figure 55. Geographical distribution of EU contribution



Source: JRC, 2021.

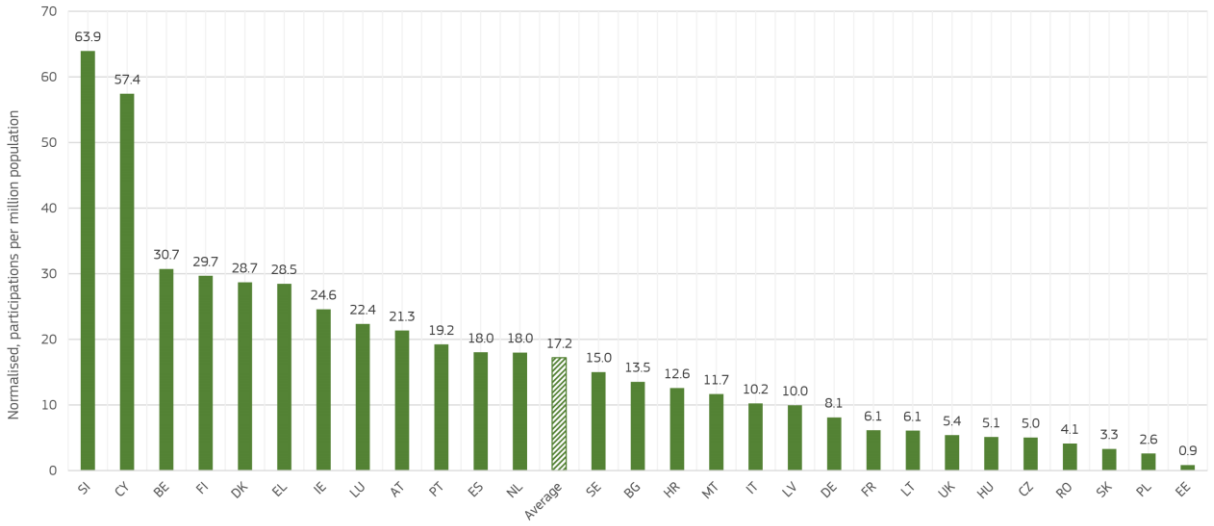
Different levels of participation can be explained by a wide range of country-specific circumstances, such as the state of the electricity grid, the overall climate for innovation, the existence of a favourable national or regulatory environment, and differences in GDP and population. Figure 56 and Figure 57 present the geographical distribution of participation after normalisation by GDP and population, showing large differences in the positioning of many countries.

Figure 56. Number of participations normalised by GDP



Source: JRC, 2021.

Figure 57. Number of participations normalised by population (million)

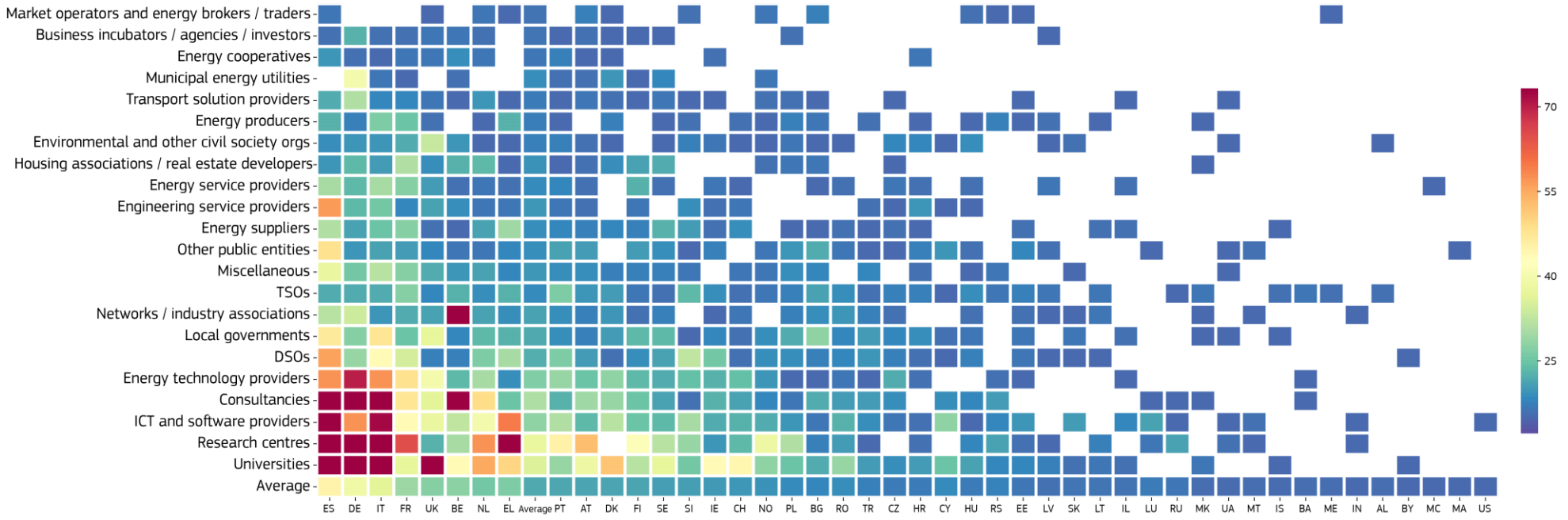


Source: JRC, 2021.

Several countries at the low end of the participation level spectrum, move to the top positions after normalisation. Slovenia is the most evident case, jumping from well below the EU average to the first position in the ranking in both normalisations. As already reported in previous editions of the SG outlook (Gangale, Vasiljevska, et al. 2017), Slovenia is indeed a small country with a small population, which, given the peculiarities of its power networks, has invested in a timely manner and extensively in the modernisation of the grids, at both transmission and distribution levels. At transmission level, Slovenia is a regional crossroads, exposed to large transit power flows from neighbouring countries, with the consequent need to improve the observability and predictability of the power systems. At distribution level, attention has focused on the need to enable the active participation of users and new market players through the adoption of innovative solutions and business models. Participation data for Slovenia confirm this situation, with a high level of participation by DSOs (18 % of participations, against 5 % overall), TSOs (9 %, against 3 % overall) and energy suppliers (6 % against 3 % overall) (Figure 59).

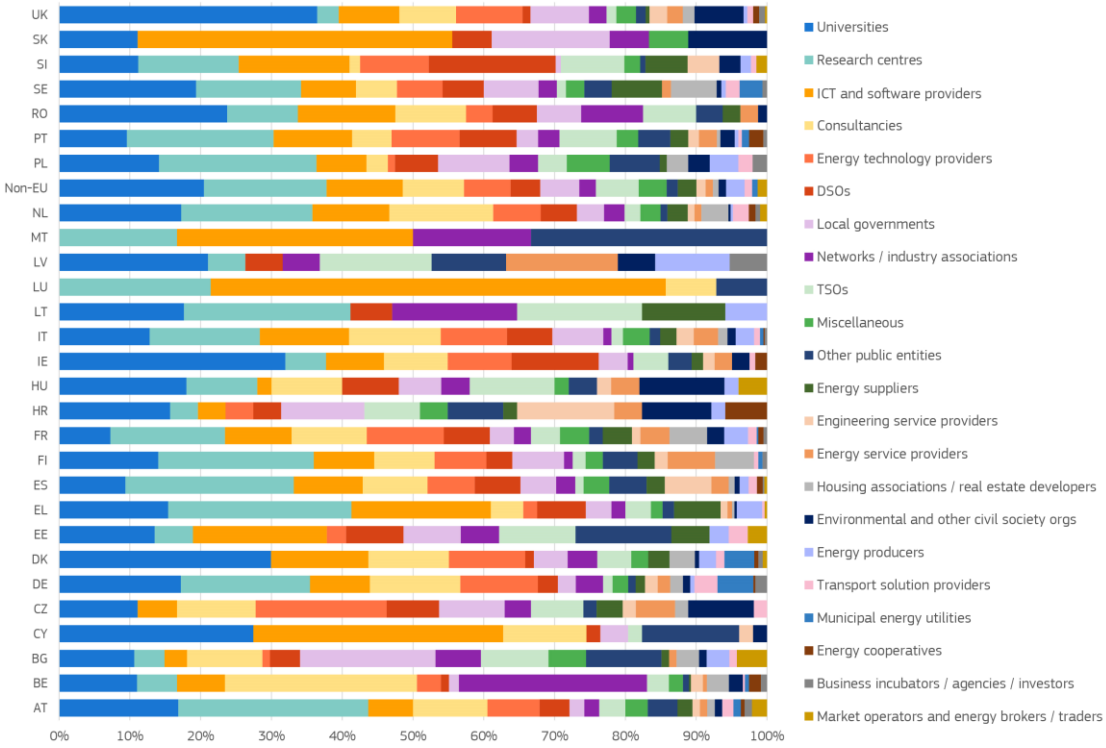
Figure 58 and Figure 59 show the number and the share of participations by organisation category and by country.

Figure 58. Number of participations by organisation category and by country



Source: JRC, 2021.

Figure 59. Share of participations by organisation category and by country



Source: JRC, 2021.

An interesting case is that of municipal energy utilities, which only appear in 10 Member States, with Germany towering above all others (34 participations out of 60 and 19 organisations out of 41). Municipal energy utilities (*Stadtwerke*) are characteristic of Germany's energy landscape, and their peculiarity lies not only in their organisational structure, but also in their being active in different businesses along the energy supply value chain. Their participation in EU-funded projects reflects their inclination to embrace innovation and collaboration with other actors in the energy arena.

Energy cooperatives, active in the generation and retail of renewable energy, also come from a limited number of countries. Interestingly, most organisations in the database do not come from countries with a long and strong tradition of cooperativism in the energy sector, such as Denmark and Germany, but rather come from countries that more recently started on this path, such as Spain, Belgium and Portugal (8, 6 and 5 participations respectively).

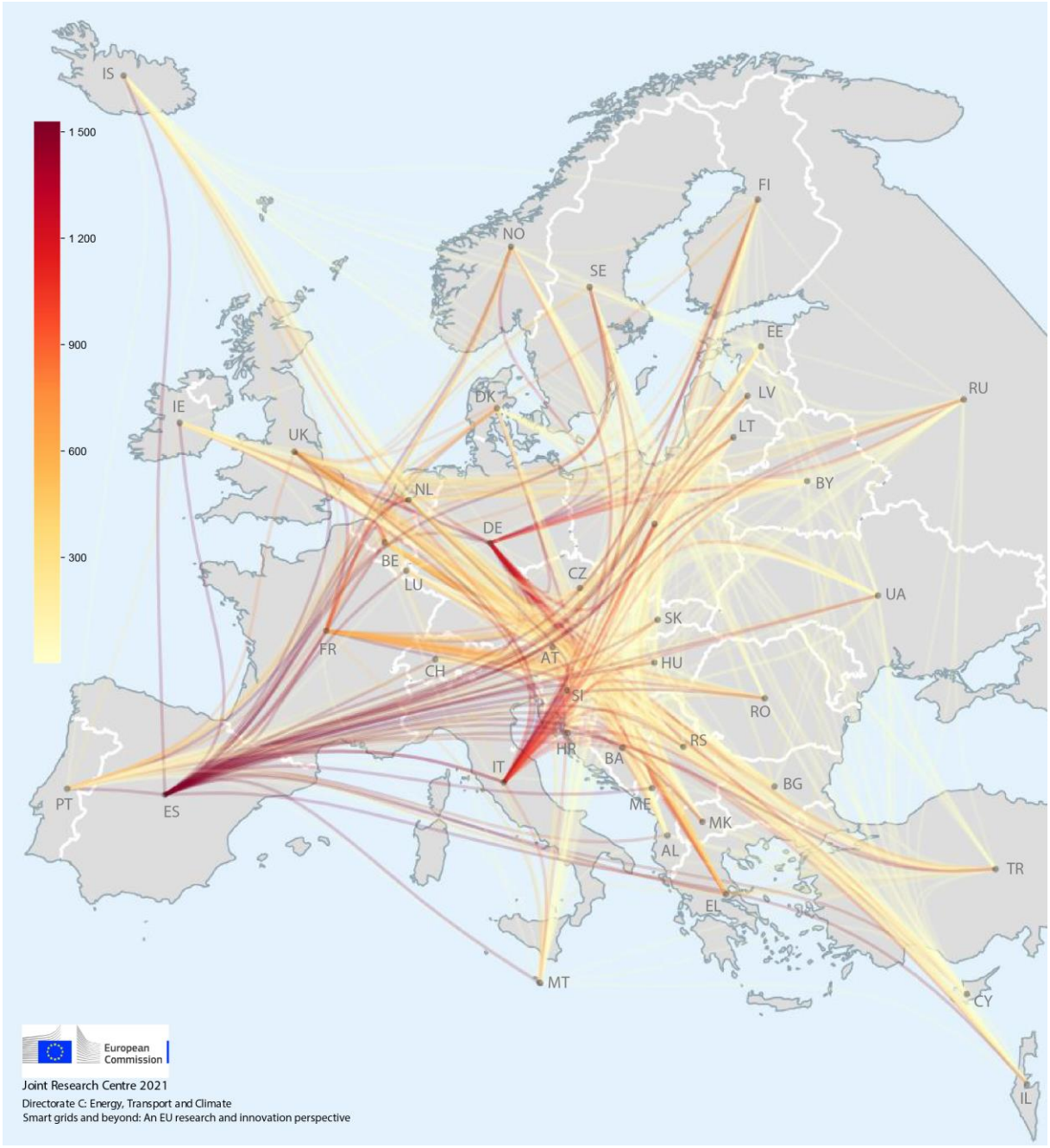
Annex 1 provides an overview of the geographical distribution of participations and of the most active organisations for all organisation categories.

3.3.1.6. Collaboration links between countries

EU–funded projects offer a valuable opportunity for organisations from different countries to establish collaborative links and share experiences and ideas, as well as to network and explore new market possibilities. Figure 60 shows the collaboration links between countries for all funding programmes and for all organisation categories. Each line represents the number of collaborations, established through the participation in the same project, between the organisations of two countries. The colour coding exemplifies the number of collaborations: darker red lines correspond to a higher number of collaborations. Figure 61 shows an alternative visualisation of the same data.

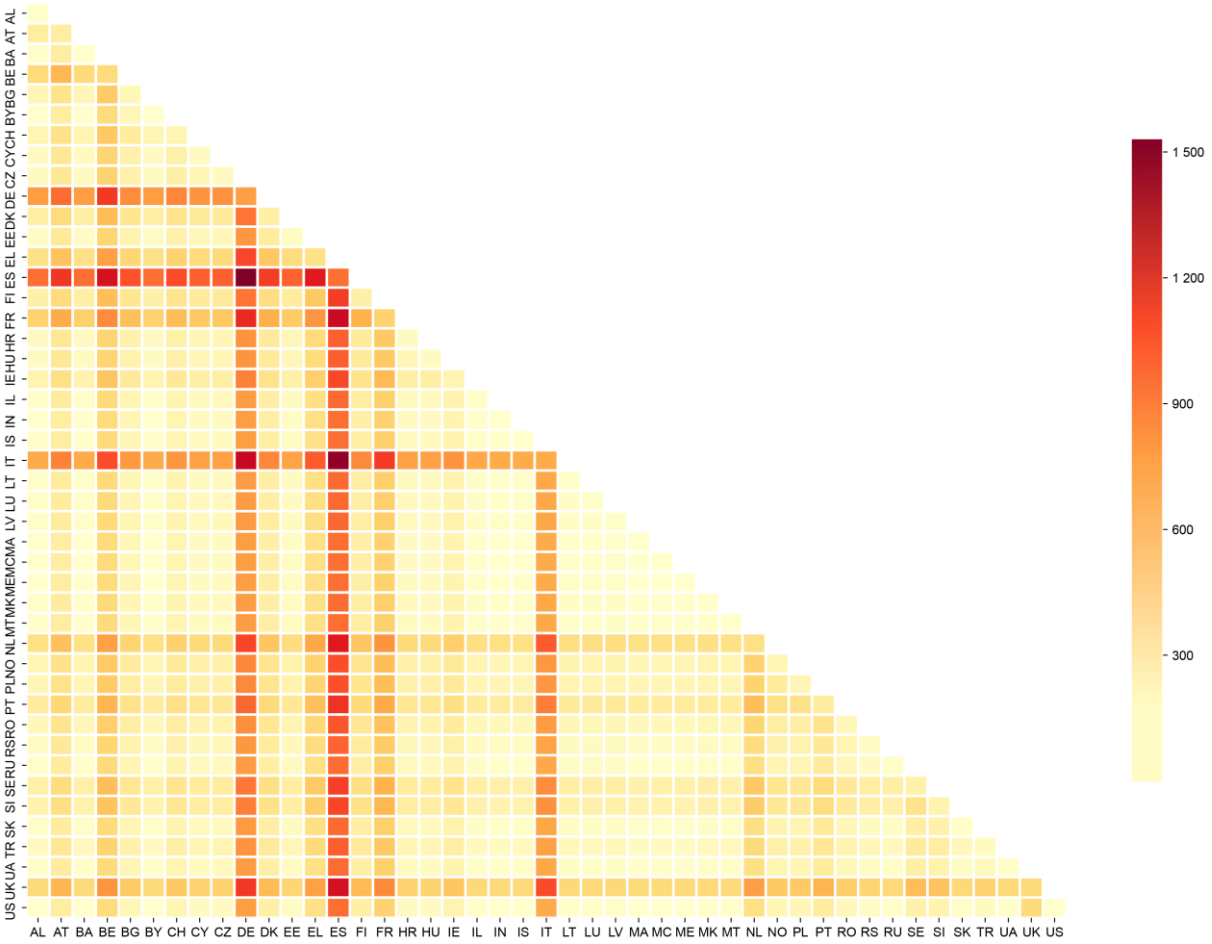
Spain, Germany and Italy are the countries with the highest shares of collaborations. Spain accounts for around 9 % of the collaborations established by all countries, Germany 7 % and Italy 6 %. Spain shows strong collaboration links (over 900 collaborations) with a high number of countries (19), and very strong collaboration links (over 1 200 collaborations) with 5 countries (i.e. Germany, Italy, France, the United Kingdom and Belgium, in descending order). Germany and Italy show strong collaboration links (over 900 collaborations) with 5 countries (Belgium, France, Greece, the Netherlands and the United Kingdom), and very strong collaboration links (over 1 200 collaborations) with only 2 countries (Spain and Italy for Germany and Spain and Germany for Italy). This representation is based on the total number of collaborations and does not take into account the country's size, in terms of GDP or population.

Figure 60. Collaborative links between countries for all programmes (map)



Source: JRC, 2021.

Figure 61. Collaborative links between countries for all programmes



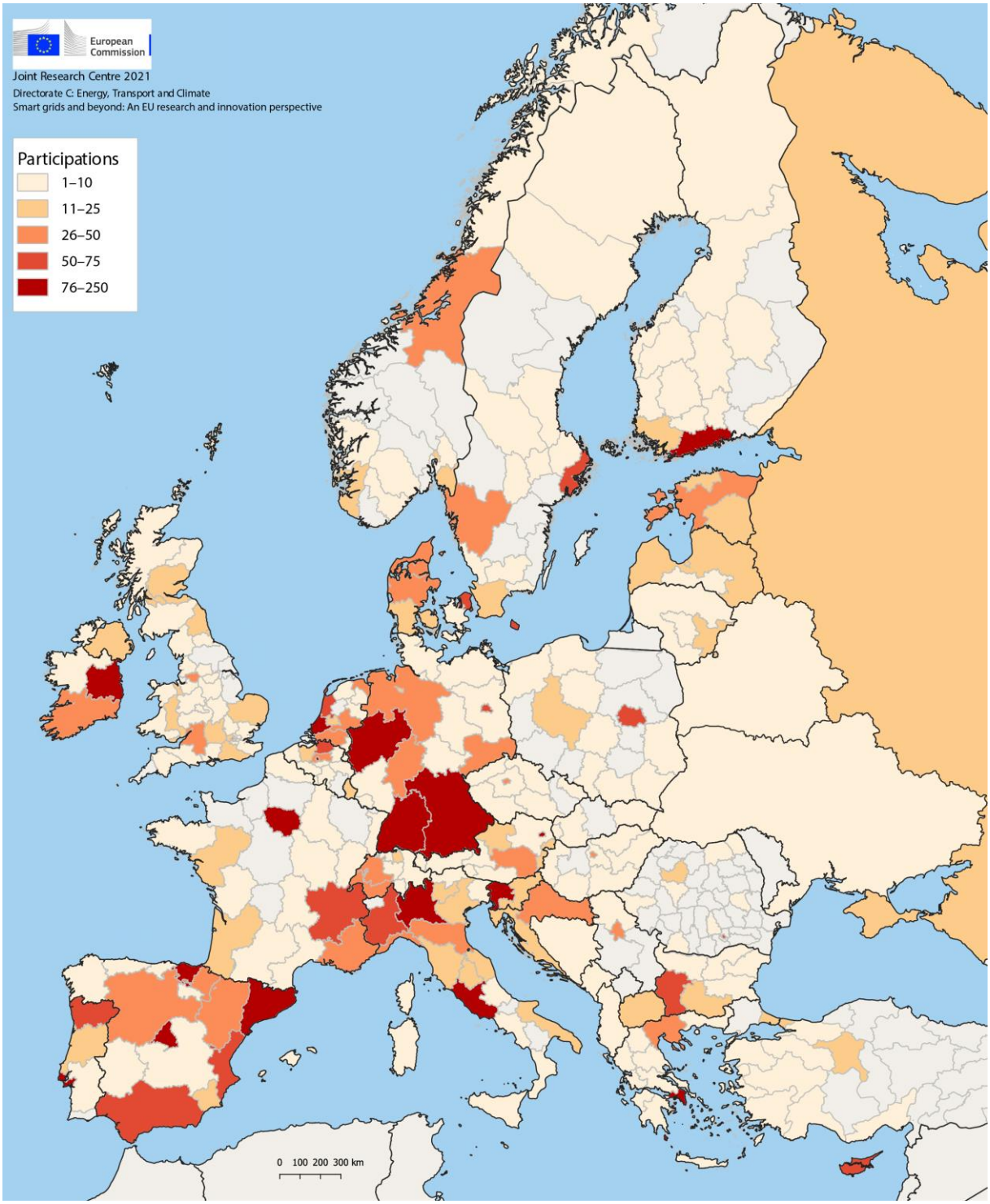
Source: JRC, 2021.

3.3.1.7. The regional dimension

Large differences in participation also emerge within countries, with some regions towering over the others (Figure 62). The concentration around some areas, often the capital cities, is partly due to the location of the participating organisations' headquarters, which does not necessarily coincide with the areas where the solutions investigated in the projects are demonstrated. This geographical distribution does not take into account the region's economic strength or its population. Figure 62 presents the regional distribution of participations according to the EU NUTS[25] classification. We used the NUTS 2 level for EU countries, the United Kingdom, Norway and Turkey. For all other countries we used the NUTS 1 level.

[25] The Nomenclature of Territorial Units for Statistics (NUTS) classification is a hierarchical system for dividing up the economic territory of the EU and the United Kingdom for the purposes of the collection, development and harmonisation of European regional statistics; socioeconomic analyses of the regions; framing of EU regional policies. The NUTS 2021 classification (https://ec.europa.eu/eurostat/documents/345175/629341/NUTS2021.xlsx), valid for data transmissions to Eurostat from 1 January 2021, lists 104 regions at NUTS 1 level, 283 regions at NUTS 2 level and 1 345 regions at NUTS 3 level.

Figure 62. Distribution of participations at NUTS level



Source: JRC, 2021.

Table 3 reports the top five regions by number of participations. Interestingly, this ranking does not include regions from three of the top five countries in terms of number of participations, namely Germany, Italy and the United Kingdom.

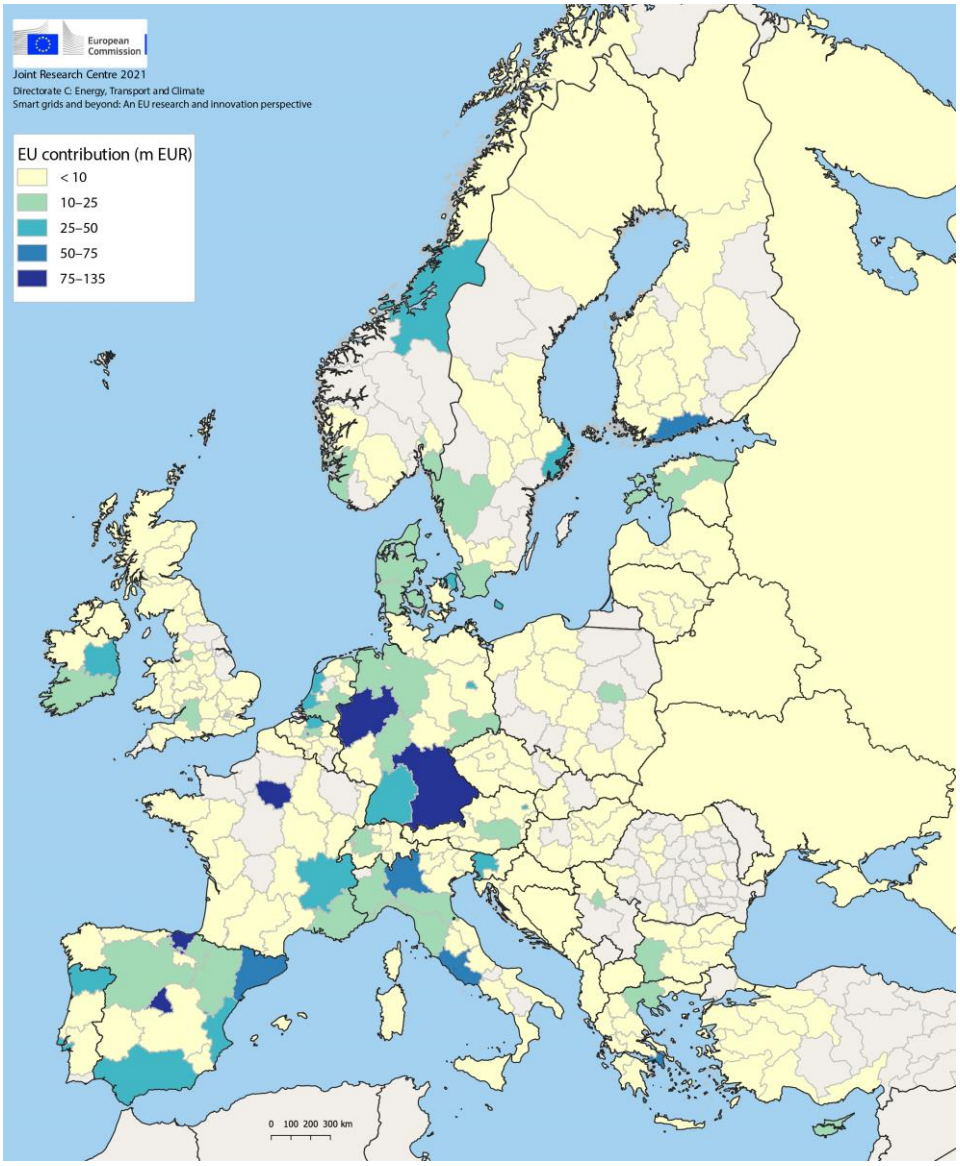
Table 3. Top five regions in terms of number of participations

Region name	Country	Number of participations	Prevailing domain
Île-de-France	France	250	DSM
Community of Madrid	Spain	234	DSM
Attica	Greece	227	DSM
Brussels Region	Belgium	201	DSM
Catalonia	Spain	164	DSM

Source: JRC, 2021

The distribution of EU funding at regional level (Figure 63) is roughly in line with the distribution of participations (Figure 62), but, as we can see from a comparison between Table 3 and Table 4, the top five regions in terms of participation do not fully coincide with the top five regions in terms of EU contribution.

Figure 63. Geographical distribution of EU financial contribution, regional level



Source: JRC, 2021.

Table 4. Top five regions in terms of EU funding

Region name	Country	EU contribution, (million EUR)	Prevailing domain
Île-de-France	France	135	Integration of DG and storage
North Rhine-Westphalia	Germany	79.3	Smart network management
Community of Madrid	Spain	79.1	DSM
Basque Country	Spain	78.1	Smart city
Bavaria	Germany	76	DSM

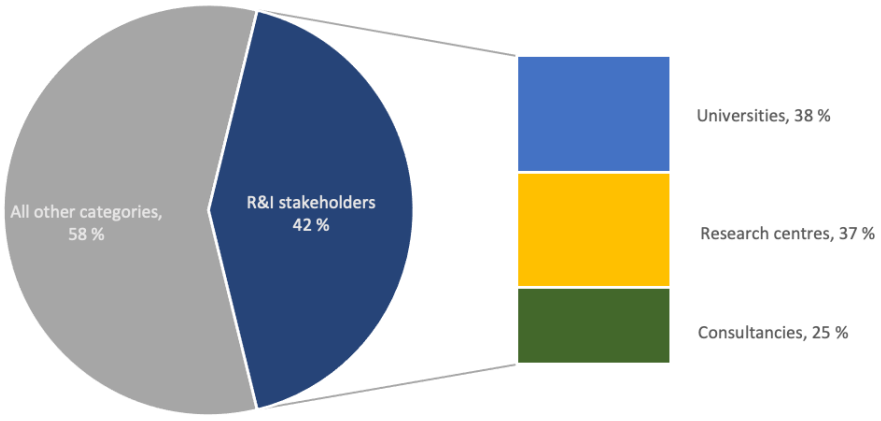
Source: JRC, 2021

3.3.2. Macro-categories focus

3.3.2.1. Research and innovation stakeholders

R&I stakeholders form the largest macro-category with over 40 % of total participations (Figure 64). Within this macro-category, universities and research centres show roughly the same share of participations (38 % and 37 %, respectively), while consultancies make up 25 %. Together, they account for 44 % of the total EU contribution allocated to projects in our database. R&I stakeholders represents the vast majority of organisations in the top 15 positions in terms of participation (Figure 49), confirming the support provided by EU funding to the emergence of research leaders in the smart grid sector.

Figure 64. R&I stakeholders: within-group shares of participations



Source: JRC, 2021.

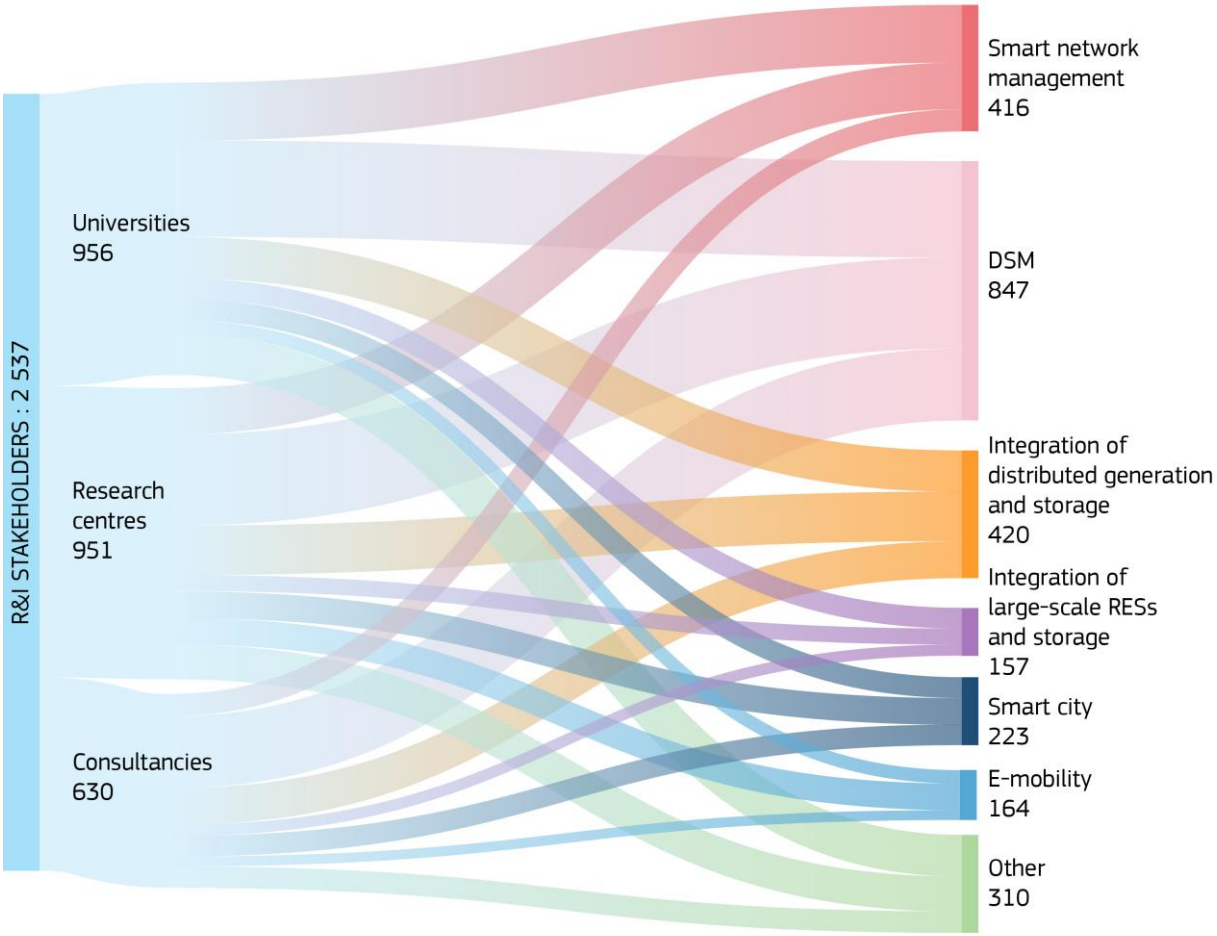
Role in the projects. Overall, R&I stakeholders took the lead in 62 % of the projects, with research centres leading 28 % of the projects (115 projects), universities 19 % (76 projects) and consultancies 15 % (61 projects).

R&D versus demonstration projects. As for the share of R&I stakeholders participation in R&D projects, the share of universities and research centres is higher than average (33 % and 28 % respectively, against 24 % for all macro-categories), confirming a tendency of higher education and research organisations to participate

preferentially in research projects, as already highlighted in previous studies (van der Veen, et al. 2014). Consultancies' share of participation is in line with the average (24 %). The participation of R&I stakeholders in demonstration projects presents a mirror image: it is below average (76 %) for universities (67 %) and research centres (72 %) and in line with the average for consultancies (76 %).

Participations across domains. Within this macro-category, all organisation categories show the highest number of participations in the DSM domain (Figure 65).

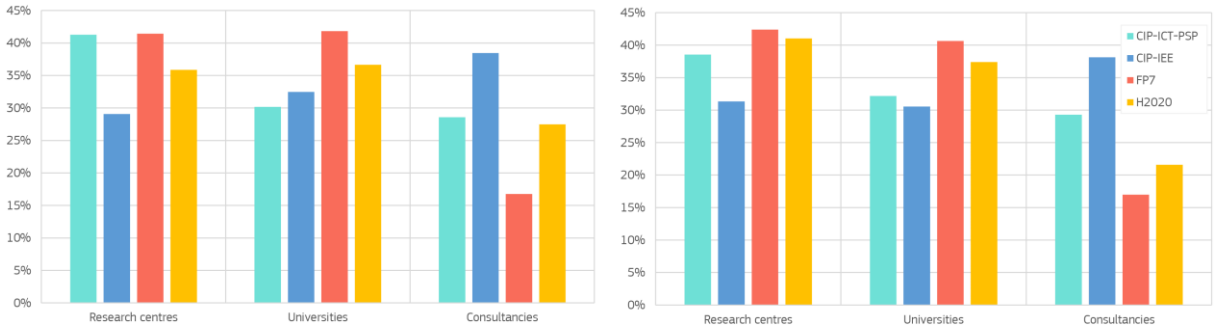
Figure 65. R&I stakeholders: participations across domains



Source: JRC, 2021.

Participation across funding programmes. R&I stakeholders participated in projects funded under all programmes. FP7, H2020 and CIP-IEE show similar participation rates by universities and research centres, while CIP-ICT-PSP shows a predominance of research centres. Consultancies, on the other hand, show the highest participation rate in CIP-IEE projects and the lowest in FP7 (Figure 66 left). The share of EU financial contribution follows roughly the same pattern (Figure 66, right).

Figure 66. Share of participations (left) and EU financial contribution (right) across funding programmes, R&I stakeholders

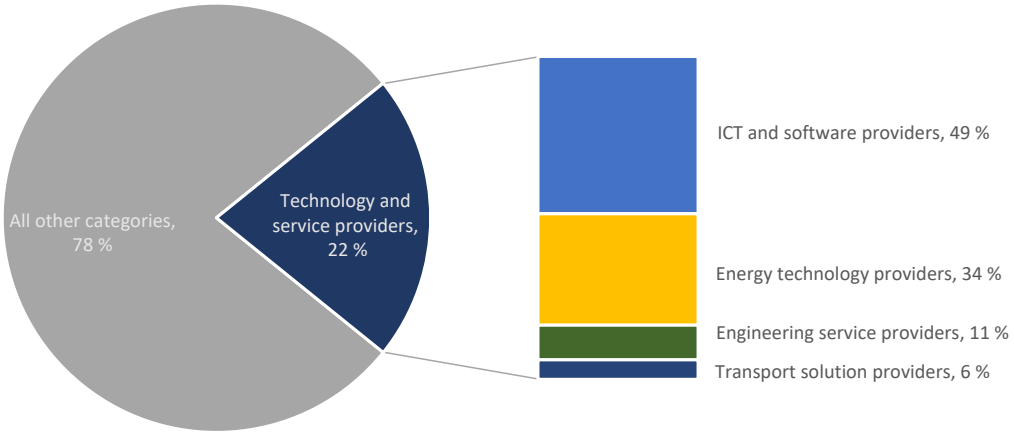


Source: JRC, 2021.

3.3.2.2. Technology and service providers

The macro-category technology and service providers represent 22 % of participations and 22 % of the total EU contribution allocated to projects in our database. Within this macro-category, ICT and software providers get the lion's share of participations (49 %) (Figure 67). Only 1 organisation, namely the ICT and software provider Engineering SpA, figures in the top 15 positions in terms of participation (Figure 49).

Figure 67. Technology and service providers: within-group shares of participations



Source: JRC, 2021.

Large companies are predominant in all categories except ICT and software providers. The share of SMEs[26] is about 52 % for ICT and software providers, 43 % for engineering service providers, 32 % for energy technology providers, and 30 % for transport solution providers. The higher prevalence of SMEs in the ICT and software providers category can be explained by the vast opportunities offered by the evolving energy system to new business and consumer services that are enabled by ICT solutions. Innovation in this field can be pursued by companies of all sizes. SMEs' collaboration in international projects can support faster research and testing of technological innovations and business models, and help them to find new partners and expand their business in other countries.

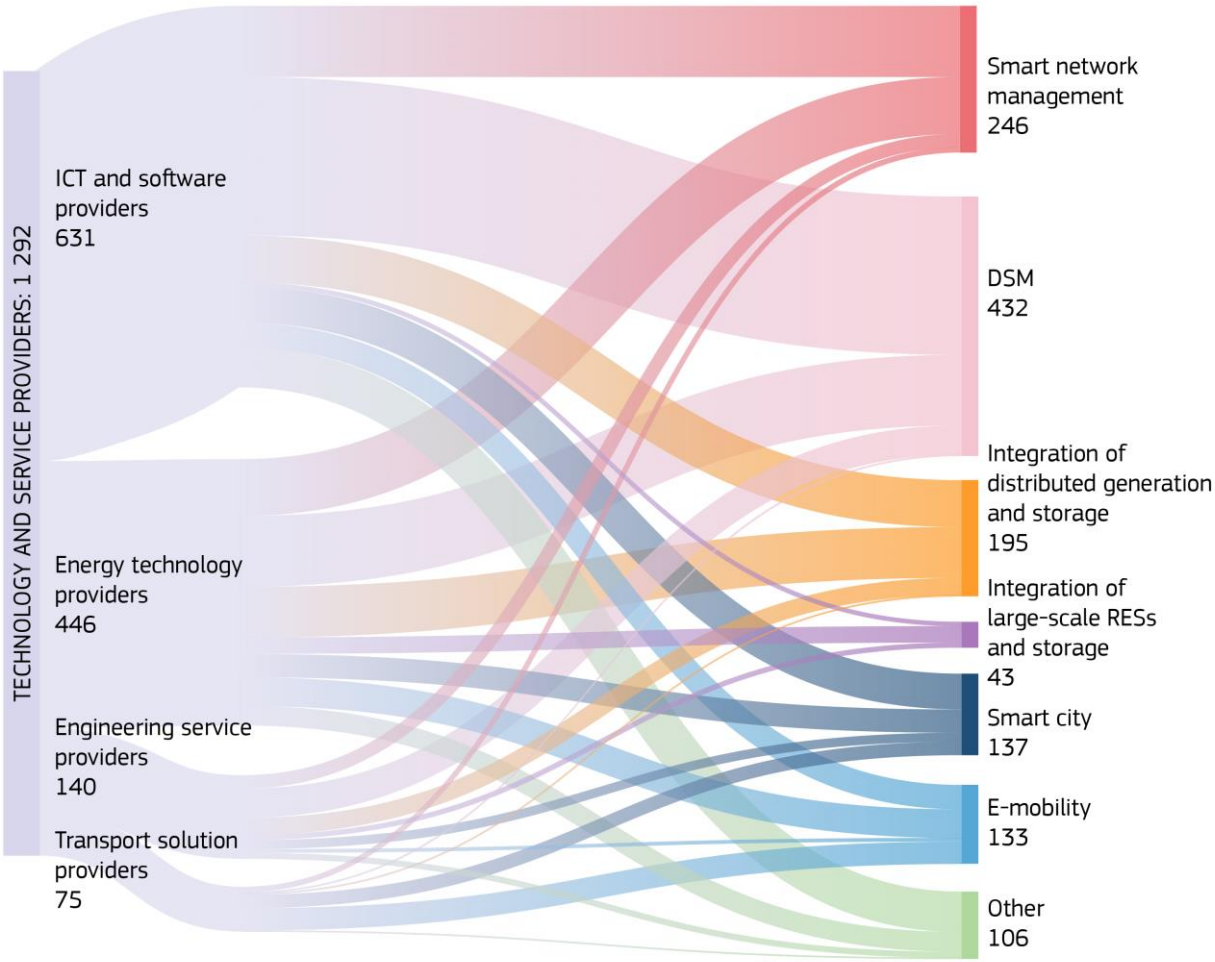
[26] As defined in the Commission recommendation concerning the definition of micro, small and medium-sized enterprises (European Commission 2003). Information on SME status was retrieved from the organisation profile of the FP7 and H2020 dashboard: https://webgate.ec.europa.eu/dashboard/sense/app/a22d6695-65d1-4f7a-a06f-b5bf3f3cc59c/sheet/3bcd6df0-d32a-4593-b4fa-0f9529c8ffb0/state/0).

Role in the project. Overall, technology and service providers took the lead in 17 % of the projects, with ICT and software providers leading 11 % of the projects (44 projects), energy technology and engineering service providers 3 % each (11 and 14 projects respectively) and transport solution providers never taking a leading role.

R&D versus demonstration projects. Technology and service providers' participation in R&D projects is lower than the average (24 %) for all categories in the group (18 % for ICT and software providers, 13 % for transport solution providers, 20 % for energy technology providers and 16 % for engineering service providers). This finding could be explained by their role as providers of technologies and solutions that are typically trialled in demonstration projects. Conversely, the participation of technology and service providers in demonstration projects is higher than the average (76 %) for all categories in the group (ICT and software providers 82 %, energy technology providers 80 %, engineering service providers 84 % and transport solution providers 87 %).

Participation across domains. Within the macro-category, all organisation categories show the highest number of participations in the DSM domain, with the sole exception of transport solution providers which show the highest number of participations in the e-mobility domain (Figure 68).

Figure 68. Technology and service providers: participations across domains

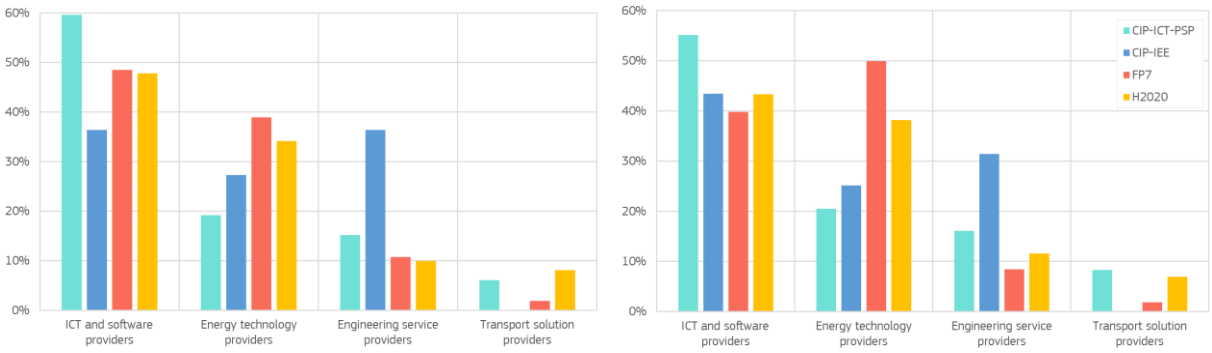


Source: JRC, 2021.

Participation across funding programmes. Technology and service providers participated in projects funded under all programmes, with the sole exception of transport solution providers which did not take part in CIP-

ICT-PSP projects. Figure 69 shows the within-group share of participations (left) and the within-group share of EU financial contribution (right).

Figure 69. Share of participations (left) and EU financial contribution (right) across funding programmes, technology and service providers

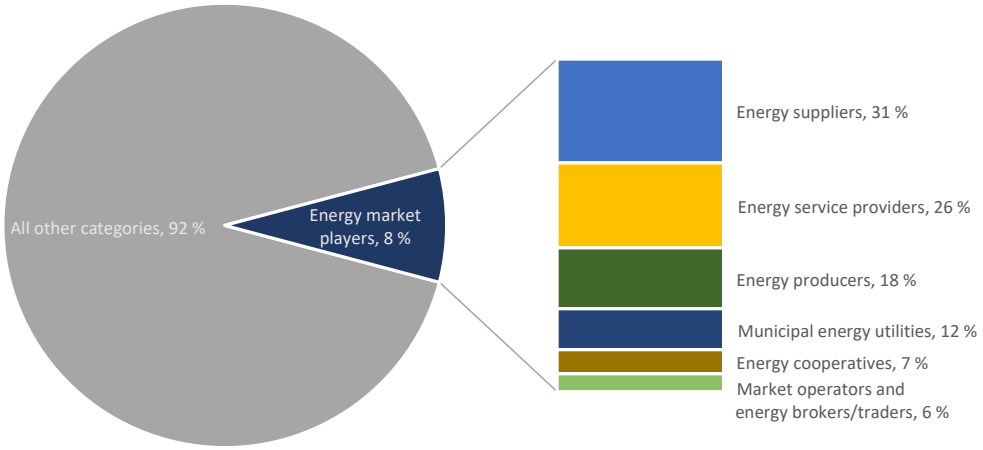


Source: JRC, 2021.

3.3.2.3. Energy market players

The macro-category energy market players represents 8 % of participations and 7 % of the total EU contribution allocated to projects in our database. Within this macro-category, energy suppliers account for over a third of participations (31 %) (Figure 70).

Figure 70. Energy market players: within-group shares of participations



Source: JRC, 2021.

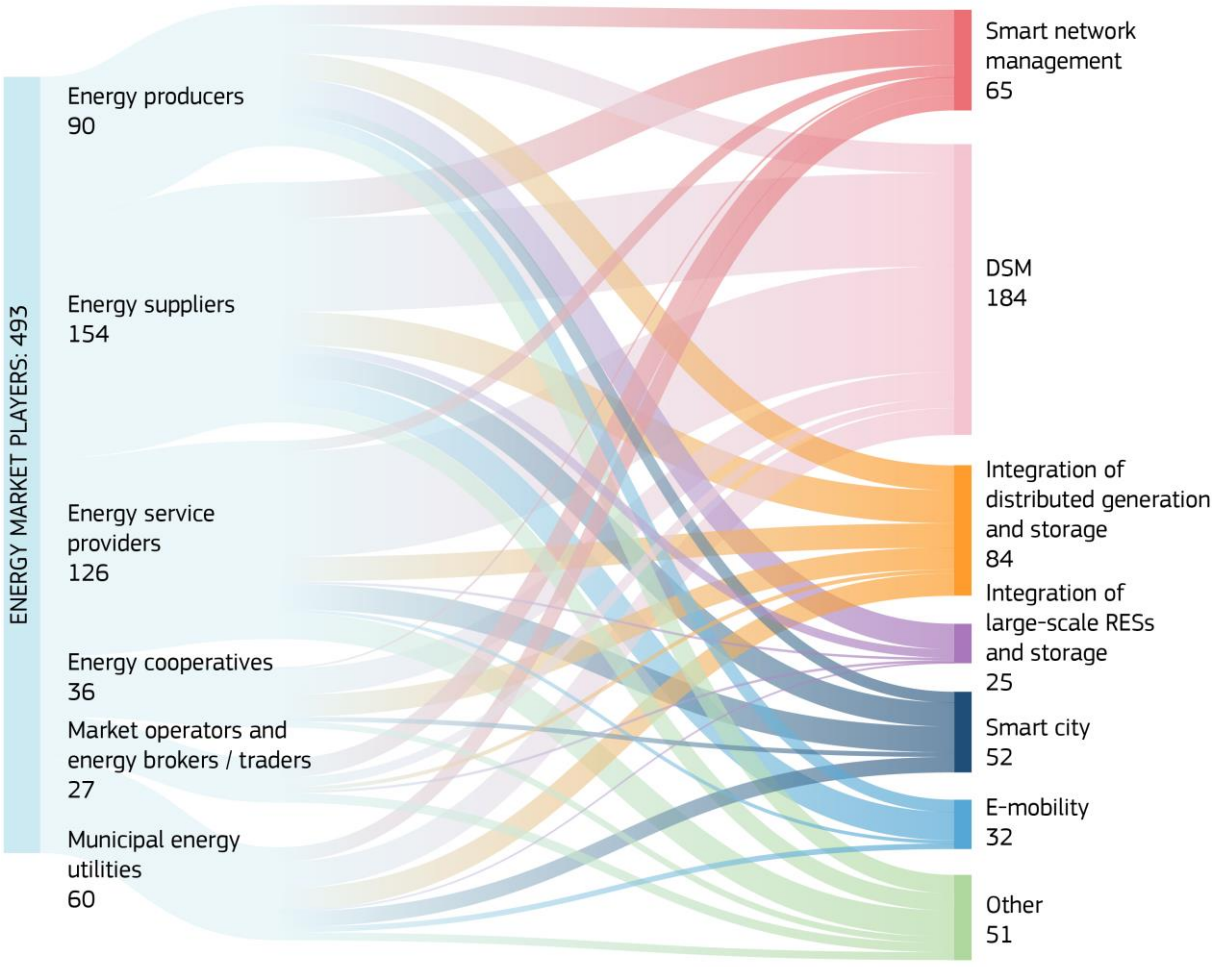
Role in the project. Overall, energy market players took the lead in only 3 % of the projects, with energy service providers leading five projects, energy suppliers leading three projects, energy producers leading two projects and municipal energy utilities and energy cooperatives leading one project each. Market operators and energy brokers / traders never took a leading role.

R&D versus demonstration projects. Energy market players' participation in R&D projects varies considerably between categories in the group. It is below average (24 %) for energy service providers (9 %), municipal energy utilities (17 %) and energy suppliers (23 %), while it is above average for energy cooperatives

(25 %), energy producers (29 %) and market operators and energy brokers / traders (37 %). The particularly high level of participation of market operators and energy brokers / traders in R&D projects is in line with what we highlighted before. They mainly participated in R&D smart network management and DSM projects that aim to define and test new approaches to the wholesale market, facilitating the participation of variable RESs, adequately remunerating new flexibility services to the grid and reducing the cost of operations. The participation of energy market players in demonstration projects presents a mirror image: it is above average (76 %) for energy service providers (91 %), municipal energy utilities (83 %) and energy suppliers (77 %), while it is below average for energy cooperatives (75 %), energy producers (71 %) and market operators and energy brokers / traders (63 %).

Participations across domains. Within the macro-category, all organisation categories show the highest number of participations in the DSM domain, with the sole exception of market operators and energy brokers / traders which show the highest number of participations in the smart network management domain (Figure 71).

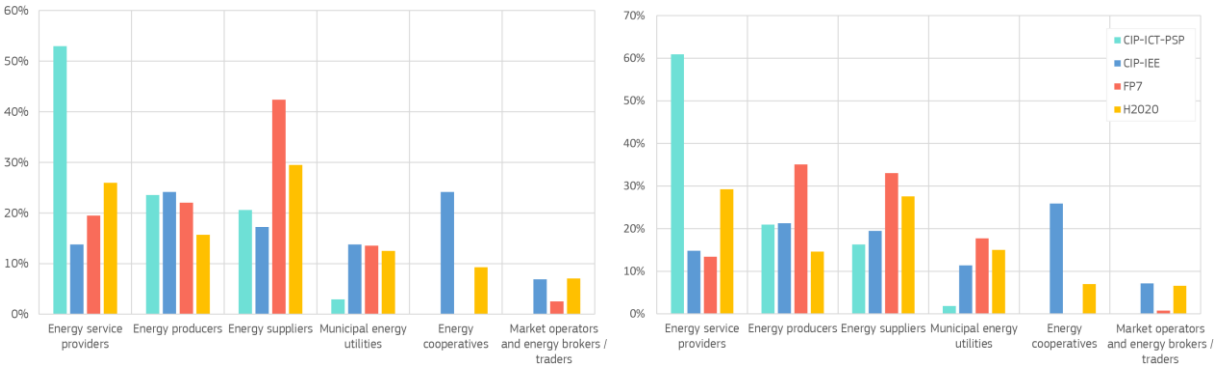
Figure 71. Energy market players: participations across domains



Source: JRC, 2021.

Participation across funding programmes. Energy market players participated in projects funded under all programmes, with the exception of energy cooperatives, which participated only in CIP-IEE and H2020 projects, and market operators and energy brokers / traders, which did not participate in CIP-ICT-PSP projects. Figure 72 shows the within-group share of participations (left) and the within-group share of EU financial contribution (right).

Figure 72. Share of participations (left) and EU financial contribution (right) across funding programmes, energy market players

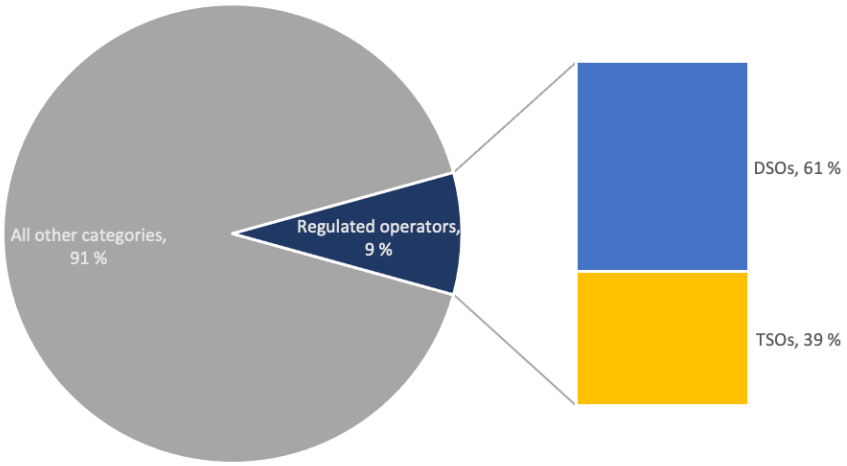


Source: JRC, 2021.

3.3.2.4. Regulated operators

The macro-category regulated operators represents about 9 % of participations and 9 % of the total EU contribution allocated to projects in our database. Within this macro-category, DSOs represent 61 % of participations and TSOs 39 % (Figure 73). Only 3 organisations, namely the Greek DSO Hedno, the Italian DSO E-distribuzione SpA and the French TSO RTE, figure in the top 15 positions in terms of participation (Figure 49).

Figure 73. Regulated operators: within-group shares of participations



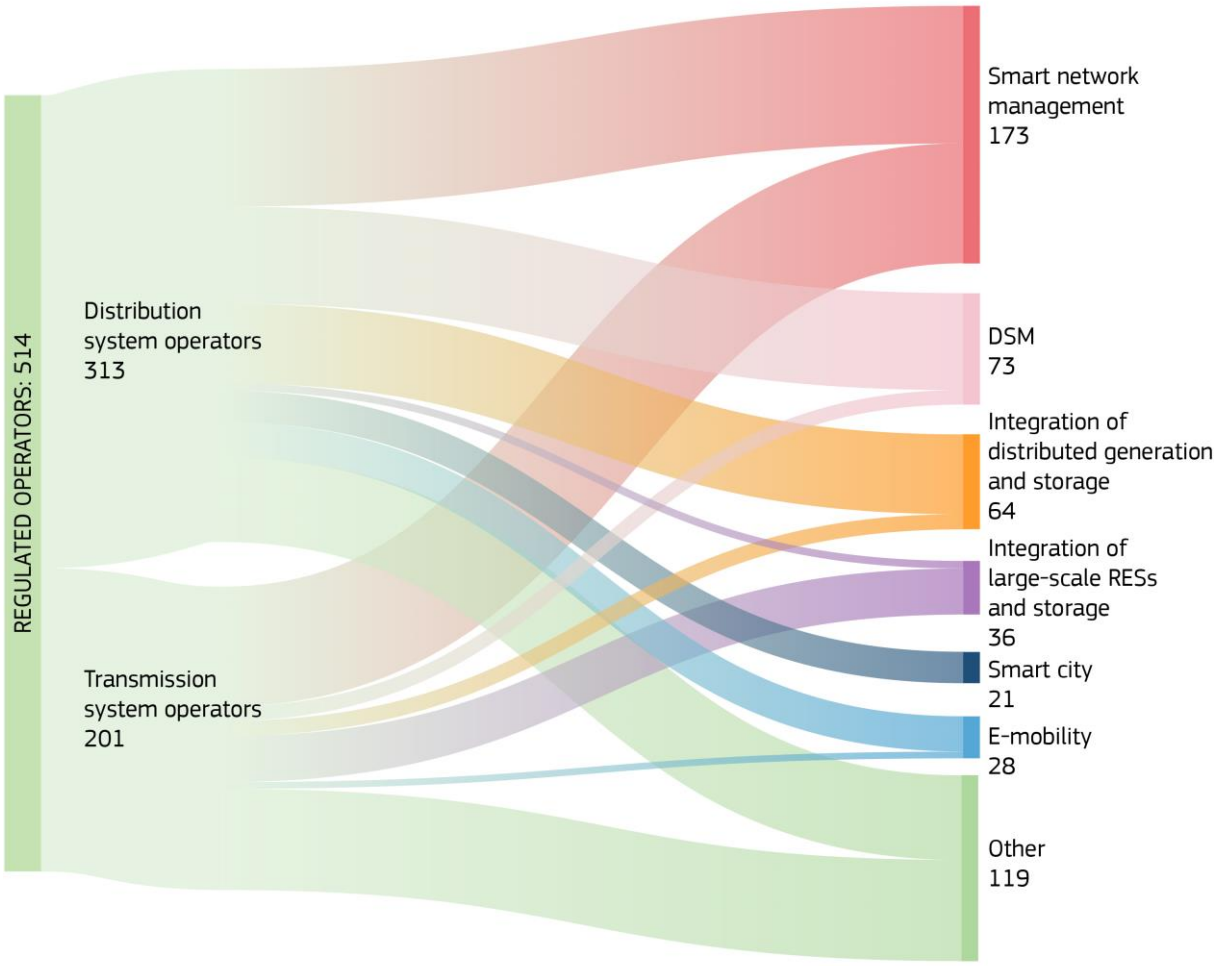
Source: JRC, 2021.

Role in the project. Overall, regulated operators took the lead in 7 % of the projects, with *DSOs* leading 5 % and *TSOs* leading 2 % of the projects (19 and 10 projects respectively).

R&D versus demonstration projects. Participation in R&D projects is below average (24 %) for DSOs (19 %) and above average for TSOs (46 %). TSOs participated in several R&D projects, mainly funded under FP7, that aimed at investigating new tools, methods and solutions to support the integration of massive intermittent energy sources and of electric vehicles, while ensuring secure grid operation; enhancing TSO-DSO interoperability; and further harmonising and integrating the European power network. The participation of regulated operators in demonstration projects presents a mirror image: it is above average (76 %) for DSOs (81 %) and below average for TSOs (54 %).

Participations across domains. Both DSOs and TSOs show the highest number of participations in the smart network management domain (Figure 74).

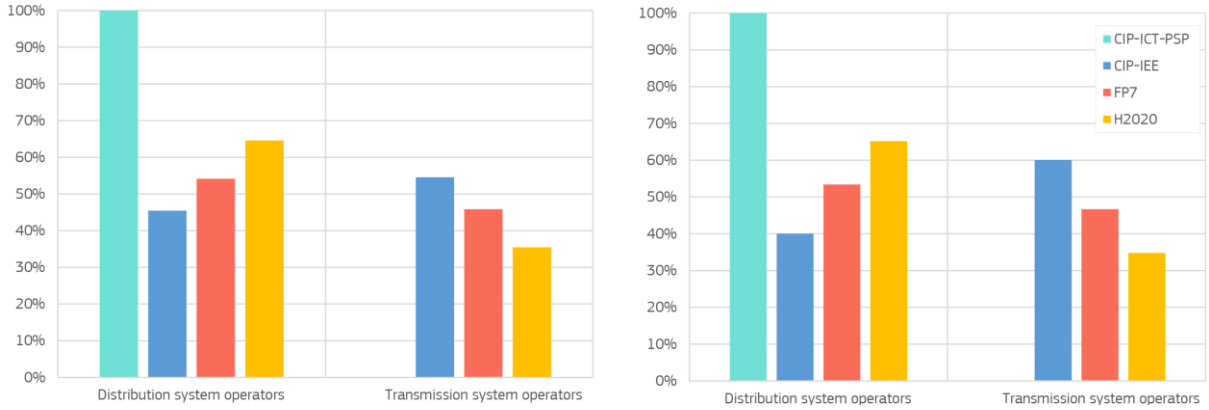
Figure 74. Regulated operators: participations across domains



Source: JRC, 2021.

Participation across funding programmes. DSOs participated in projects funded under all programmes, while TSOs did not participate in any CIP-ICT-PSP project. Figure 75 shows the within-group share of participations (left) and the within-group share of EU financial contribution (right).

Figure 75. Share of participations (left) and EU financial contribution (right) across funding programmes, regulated operators

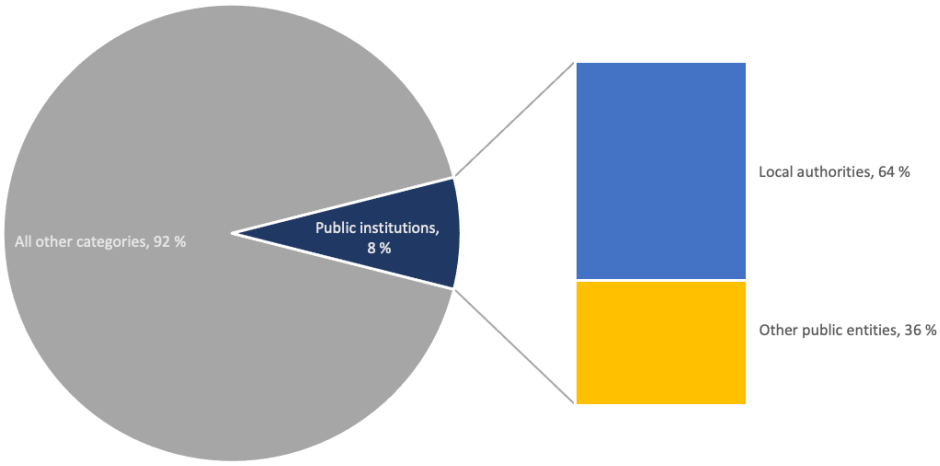


Source: JRC, 2021.

3.3.3. Public institutions

The macro-category public institutions represents 8 % of participations and 8 % of the total EU contribution allocated to projects in our database. Within this macro-category, local authorities represent 64 % and other public authorities 36 % (Figure 76).

Figure 76. Public institutions: within-group shares of participations



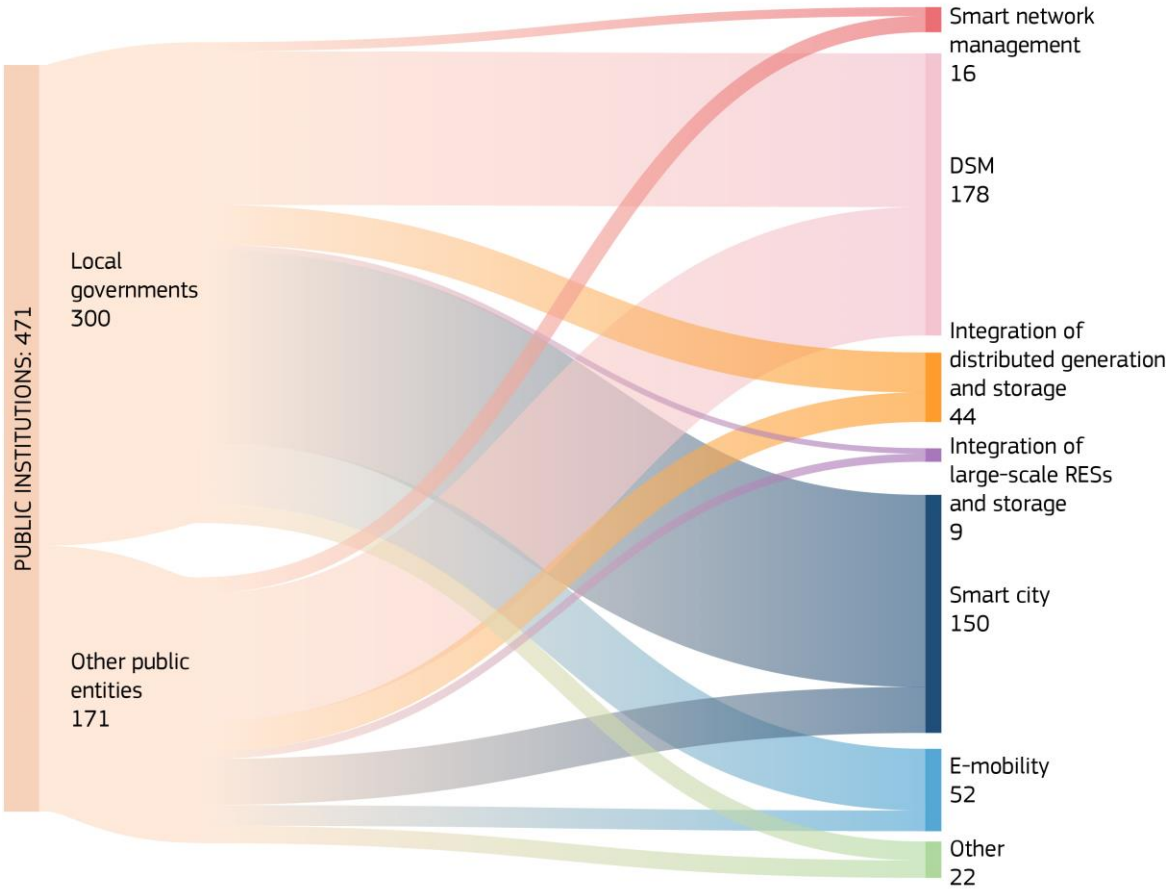
Source: JRC, 2021

Role in the project. Overall, public institutions took the lead in 4 % of the projects, with local governments leading eight projects and other public entities leading nine projects.

R&D versus demonstration projects. Participation in R&D projects is below average (24 %) for both categories (local governments, 6 %; other public entities, 20 %). This finding is in line with the high number of participations by both categories in the smart city domain, where we only find demonstration projects. The participation of public institutions in demonstration projects presents a mirror image, being above average (76 %) for both categories (local governments, 94 %; other public entities, 80 %).

Participations across domains. Local governments show the highest number of participations in the smart city domain, while other public entities show the highest number of participations in the DSM domain (Figure 77).

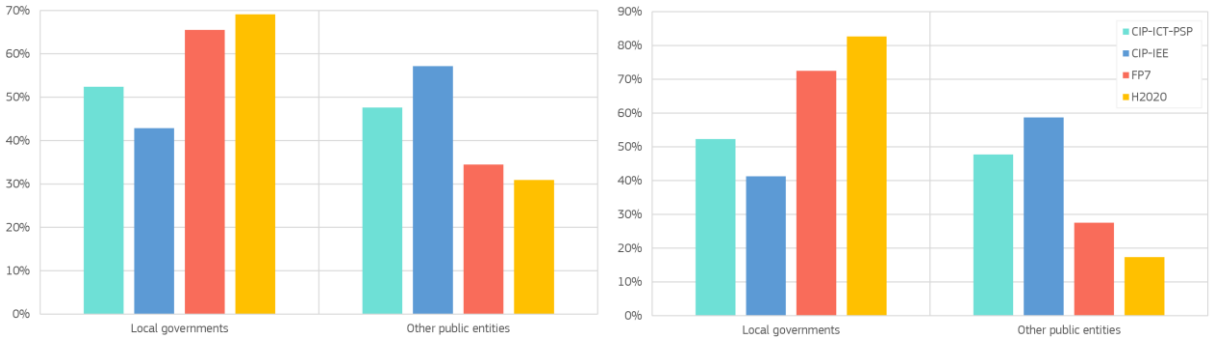
Figure 77. Public institutions: participations across domains



Source: JRC, 2021.

Participation across funding programmes. Public institutions participated in projects funded under all programmes. Figure 78 shows the within-group share of participations (left) and the within-group share of EU financial contribution (right).

Figure 78. Share of participations (left) and EU financial contribution (right) across funding programmes, public institutions

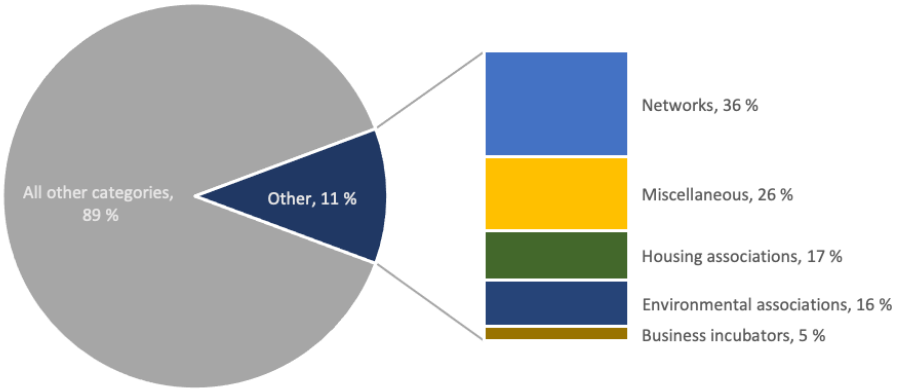


Source: JRC, 2021.

3.3.3.1. Other

The macro-category 'other' represents 11 % of participations and 9 % of the total EU contribution allocated to projects in our database (Figure 79). Within this macro-category, networks have the highest share of participations (36 %), followed by 'miscellaneous' (26 %).

Figure 79. Other: within-group shares of participations



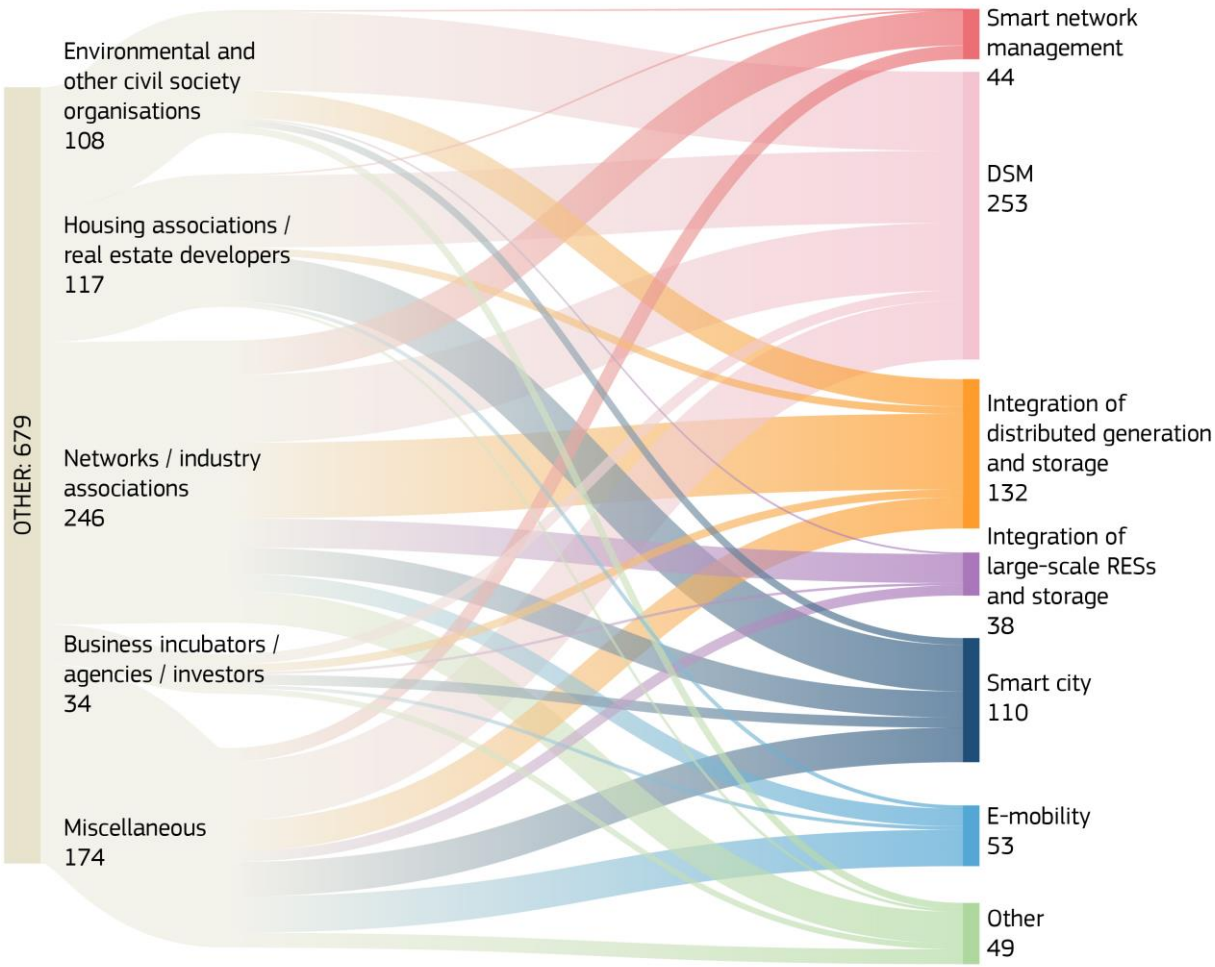
Source: JRC, 2021.

Role in the project. Overall, the organisations under the macro-category 'other' took the lead in 7 % of the projects, with networks / industry associations leading 16 projects, environmental and other civil society organisations leading 7 projects, 'miscellaneous' leading 3 projects, housing associations / real estate developers leading 2 projects and business incubators / funding agencies / early-stage investors not leading any project.

R&D versus demonstration projects. Participation in R&D projects is below average (24 %) for all within-group categories (housing associations / real estate developers, 1 %; networks / industry associations, 21 %; business incubators / funding agencies / early-stage investors, 21 %; miscellaneous, 16 %), with the sole exception of environmental and other civil society organisations (33 %). Their participation in demonstration projects offers a mirror image, with all within-group categories being above average (76 %) with the sole exception of environmental and other civil society organisations.

Participation across domains. Within the macro-category, environmental and other civil society organisations, housing associations / real estate developers and 'miscellaneous' show the highest number of participations in the DSM domain; networks / industry associations in the integration of DG and storage domain and business incubators / funding agencies / early-stage investors equally in the DSM and smart city domains (Figure 80).

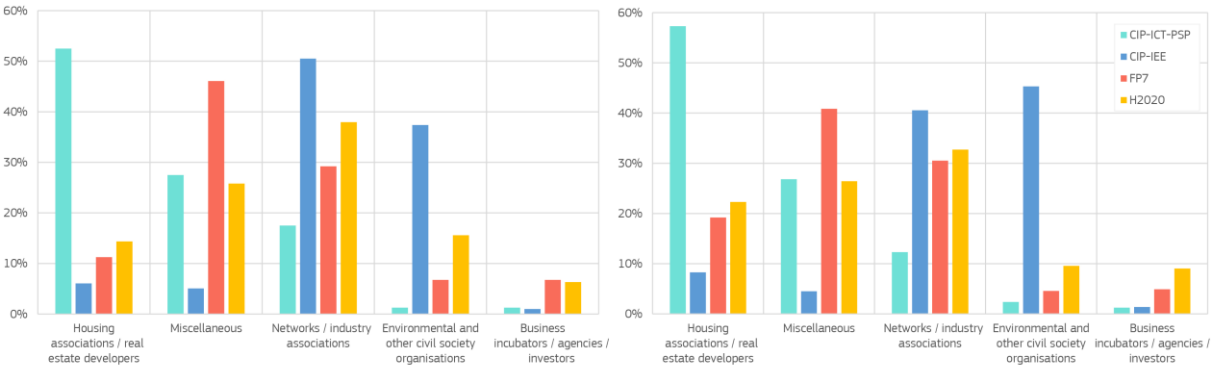
Figure 80. Other: participations across domains



Source: JRC, 2021.

Participation across funding programmes. Organisations grouped under the category 'other' participated in projects funded under all programmes, with housing associations / real estate developers showing a high level of participation in CIP-ICT-PSP projects and networks / industry associations and environmental and other civil society associations in CIP-IEE projects. Figure 81 shows the within-group share of participations (left) and the within-group share of EU financial contribution (right).

Figure 81. Share of participations (left) and EU financial contribution (right) across funding programmes, 'other'



Source: JRC, 2021.

4. Conclusions

This report presents an overview of EU-funded R&I efforts in the field of smart grids. It analyses 407 projects, funded under the last two framework programmes for R&I, FP7 and H2020, and under CIP, more specifically CIP-ICT-PSP and CIP-IEE. These projects – identified using an ad hoc methodology developed for collecting and categorising projects – represent a total investment of around EUR 3 billion, of which EUR 2.3 billion comes from EU funding. They bring together 3 130 organisations from 45 countries, with an average of 15 (median of 12) organisations per project and a total of 5 986 participations. There are 285 demonstration projects, carrying out real-world testing of technological solutions, market designs, policy schemes and business models in 1 243 implementation sites.

For the **general trend**, the study reveals an increase in R&I activities in the smart grid area in 2007–2020. More specifically, in 2014–2020 (covered by H2020) there was a 25 % increase in the number of projects, a 59 % increase in total investment and a 117 % increase in EU funding compared with 2007-2013 (covered by FP7, CIP-ICT-PSP and CIP-IEE). Most projects received an EU contribution of less than EUR 5 million. The average EU funding share is 73 %, but half of all projects have a funding share of above 78 %. On average, EU funding shares increased from 62 % in 2007–2013 to 82 % in 2014–2020. The number of demonstration projects in comparison with R&D projects rose substantially in 2007–2020, thanks to the increasing maturity reached by many technologies and solutions and the growing focus on the demonstration of the enabling role of smart grids. The geographical distribution of participations reveals significant differences across countries, with Spain, Germany and Italy showing the largest numbers of participations and the highest shares of collaboration links with other countries. The picture is rather different when focusing on the regional dimension: the top five EU regions, in terms of number of participations, are from France, Spain, Greece and Belgium, and the top five regions in terms of EU funding are in France, Germany and Spain.

The study also investigates the **project domains** – areas of intervention where the solutions investigated and tested in the projects aim to produce their impacts. Most of the projects focus on DSM, mainly in the residential sector. We observe a balanced distribution of EU funding across all project domains with DSM having the highest share of EU funding, followed by smart city, smart network management and integration of distributed generation and storage. The project domain 'other' also received a substantial share of EU funding, which indicates increased R&I attention to cross-cutting issues, such as cybersecurity, standardisation, development of big energy data platforms, and socioeconomic, cultural, political and gender aspects of the energy transition. In addition to the time distribution, we look into the geographical distribution of total investment in each project domain. Most EU countries participate in projects across all smart grid domains, with some countries showing a particularly strong focus on a specific domain. Estonia, the Netherlands, Lithuania, Sweden and Finland, for example, show the largest shares of investment in the smart city domain.

Furthermore, the study investigates **participating organisations**. R&I stakeholders represent 42 % of participations in all projects, technology and service providers 22 %, regulated operators 9 %, energy market players and public institutions 8 % each and the organisations grouped under the macro-category 'other' 11 %. Among the organisations that participated in over 10 projects, those in the top 15 positions in terms of number of participations are mainly research centres and universities. The attribution of large cumulative EU contributions to these types of organisation helped to support the creation of big knowledge centres. More than half of the organisations participating in H2020 projects were newcomers, i.e. first-time applicants that did not apply to any of the other reviewed programmes (FP7, CIP-ICT-PSP, CIP-IEE). The share of newcomers is above average for organisation categories that are newer in the smart grid arena, such as transport solution providers, market operators and energy brokers / traders, energy cooperatives and local governments, while it is below average for more traditional actors, such as TSOs, research centres and universities. This indicates that H2020 was successful in allowing new organisations to join and receive funding, particularly new actors in the smart grid sector that are able to push innovative technologies and business models to markets.

The analysis of **participating organisations by project domain** highlights the important role of some categories of organisations in specific domains. Local governments for example, are particularly active in the smart city and e-mobility domains, where they play a pivotal role in the transformation of city infrastructures and services. Housing associations / real estate developers are also particularly active in the smart city domain, indicating a growing interest among the residential sector, especially the social housing sector, in a fair energy transition that addresses energy poverty by increasing residential energy efficiency and self-consumption of renewable energy. Finally, DSOs and TSOs, traditionally active in the smart network management domain, show a high level of participation in the domain 'other', indicating their growing interest in the cross-cutting issues addressed by these projects, such as cybersecurity, the potential of big data for the modernisation of the European electricity grid and the creation of new smart grid services. DSOs and TSOs increasingly collaborate with ICT and software providers, in particular in the smart network management and DSM domains, which points to the strong commitment of system operators to digitalising their businesses but also to the key role of collaboration on the road to digital transformation of the energy sector.

References

Bridge. 2019. *The Bridge initiative and project fact sheets.* BRIDGE H2020.

Covrig, Catalin Felix, Mircea Ardelean, Julija Vasiljevska, Anna Mengolini, Gianluca Fulli, and Eleftherios Amoiralis. 2014. *Smart Grid Projects Outlook 2014, EUR 26651.* Luxembourg: Publications Office of the European Union.

ETIP SNET. 2018. *Presentation of recent and ongoing R&I projects in the scope of the ETIP SNET.* ETIP SNET.

European Commission. 2016. "Commission communication — Clean Energy for All Europeans (COM/2016/860)." Brussels.

European Commission. 2015b. "Commission communication — Delivering a New Deal for Energy Consumers (COM/2015/339)." Brussels.

European Commission. 2015a. "Commission communication — Enery Union Package: A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy (COM/2015/80)." Brussels.

European Commission. 2020c. "Commission communication — Europe's moment: Repair and Prepare for the Next Generation (COM/2020/456)." Brussels.

European Commission. 2020b. "Commission communication — Powering a climate-neutral economy: An EU Strategy for Energy System Integration (COM/2020/299)." Brussels.

European Commission. 2020a. "Commission communication — Shaping Europe's digital future (COM/2020/67)." Brussels.

European Commission. 2019. "Commission communication — The European Green Deal (COM/2019/640)." Brussels.

European Commission. 2003. "Commission recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises (2003/316/EC)." Brussels.

European Parliament and Council. 2019. *Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU.* OJ L 158, 14.6.2019, p. 125–199, Brussels: European Union.

European Parliament and Council. 2013. *Regulation (EU) No 347/2013 of the European Parliament and of the Council of 17 April 2013 on guidelines for trans-European energy infrastructure and repealing Decision No 1364/2006/EC and amending Regulations (EC) No 713/2009, (EC) No 714/2009 and (EC) N.* OJ L 115, 25.4.2013, p. 39–75, Strasbourg: European Union.

Gangale, Flavia, and Anna Mengolini. 2019. *Energy poverty through the lens of EU research and innovation projects, EUR 29785.* Luxembourg: Publications Office of the European Union.

Gangale, Flavia, Anna Mengolini, and Ijeoma Onyeji. 2013. "Consumer engagement: An insight from smart grid projects in Europe." *Energy Policy* Vol. 60, pp. 621-628.

Gangale, Flavia, Anna Mengolini, Antonios Marinopoulos , and Julija Vasiljevska. 2020. *Collective actions in the energy sector: insights from EU reseach and innovation projects, EUR 30339.* Luxembourg: Publications Office of the European Union.

Gangale, Flavia, Julija Vasiljevska, Catalin Felix Covrig, Anna Mengolini, and Gianluca Fulli . 2017. *Smart grid projects outlook 2017: Facts, figures and trends in Europe, EUR 28614.* Luxembourg: Publications Office of the European Union.

Giordano, Vincenzo, Alexis Meletiou, Catalin Felix Covrig, Anna Mengolini, Mircea Ardelean, and Gianluca Fulli . 2013. *Smart Grid projects in Europe: Lessons learned and current developments - 2012 update, EUR 25815.* Luxembourg: Publication office of the European Union.

Giordano, Vincenzo, Flavia Gangale, Catalin Felix Covrig, and Manuel Sanchez Jimenez. 2011. *Smart Grid Projects in Europe: lessons learned and current developments, EUR 24856.* Luxembourg: Publications Office of the European Union.

IEA. 2017. *Digitalization & Energy .* International Energy Agency.

IEA. 2021. *Net Zero by 2050. A Roadmap for the Global Energy Sector.* Intenational Energy Agency.

IEA. 2018. *World Energy Outlook 2018.* International Enegy Agency.

Mengolini, Anna, Flavia Gangale, and Julija Vasiljevska. 2016. "Exploring Community-Oriented Approaches in Demand Side Management Projects in Europe." *Sustainability* 8(12), 1266.

OECD. 2015. *Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific, Technological and Innovation Activities.* OECD Publishing: Paris.

van der Veen, Geert, Matthias Altmann, Patrick Eparvier , Matthias Ploeg, and Paola Trucco . 2014. *Evaluation of the impact of projects funded under the 6th and 7th EU Framework Programme for RD&D in the area of non-nuclear energy. Final Report.* Technopolis Group.

von der Leyen, Ursula. 2019. *Political guidelines for the next European Commission 2019-2014. A Europe that strives for more. My agenda for Europe.* European Commission.

Abbreviations

CIP	competitiveness and innovation framework programme
DSM	demand-side management
DSO	distribution system operator
FP7	seventh EU framework programme for research, technological development and demonstration activities
GDP	gross domestic product
H2020	Horizon 2020
ICT	information and communication technology
IEE	intelligent energy Europe
PSP	policy support programme
R&D	research and development
R&I	research and innovation
RES	renewable energy source
SMEs	small and medium-sized enterprises
TSO	transmission system operator

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Annexes

Annex 1. Geographical distribution and highest ranking organisations per category

Universities

There are 333 participating universities, representing 26 Member States (all except Luxembourg and Malta), plus 8 non-EU countries. The highest numbers of participations are from the United Kingdom (132 participations, 48 participating universities), Germany (116 participations, 40 participating universities), Spain (80 participations, 24 participating universities) and Italy (78 participations, 29 participating universities). The EU contribution to universities amounts to EUR 393.4 million, EUR 290.6 million of it for demonstration projects and EUR 102.8 million for R&D projects. Table 4 reports the highest ranking universities in terms of number of participations.

Table 4. Highest ranking universities in terms of number of participations

Top 15 rank	Within-group rank	University	Country	CIP-IEE	CIP-ICT-PSP	FP7	H2020	Total	Lead role	Demonstration (%)
5	1	RWTH Aachen University	DE	0	1	12	19	32	3	75
8	2	Danmarks Tekniske Universitet	DK	2	1	10	15	28	1	46
9	3	Universidad Pontificia Comillas	ES	5	0	11	11	27	1	56

Research centres

There are 298 participating research centres, representing 24 Member States (all except Czechia, Denmark, Cyprus and Slovakia), plus 7 non-EU countries. The highest numbers of participations are from Spain (203 participations, 55 participating research centres), Germany (123 participations, 44 participating research centres), Italy (95 participations, 29 participating research centres) and Greece (79 participations, 14 participating research centres). The EU contribution to research centres amounts to EUR 433.7 million, EUR 348.6 million of it for demonstration projects and EUR 85.1 million for R&D projects. Table 5 reports the highest ranking research centres in terms of number of participations.

Table 5. Highest ranking research centres in terms of number of participations

Top 15 rank	Within-group rank	Research center	Country	CIP-IEE	CIP-ICT-PSP	FP7	H2020	Total	Lead role	Demonstration (%)
1	1	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V	DE	3	1	16	27	47	8	64
2	2	Fundación Tecnalia Research & Innovation	ES	0	4	20	21	45	5	69
3	3	VTT Technical Research Centre of Finland	FI	1	2	11	21	35	8	80

Consultancies

There are 345 participating consultancies, representing 22 Member States (all except Croatia, Estonia, Latvia, Lithuania, Malta and Slovakia), plus 7 non-EU countries. The highest numbers of participations are from Belgium (96 participations, 34 participating consultancies), Germany (86 participations, 50 participating consultancies), Italy (79 participations, 40 participating consultancies) and Spain (78 participations, 43 participating consultancies). The EU contribution to consultancies amounts to EUR 205.1 million, EUR 165.2 million of it for demonstration projects and EUR 39.9 million for R&D projects. Table 6 reports the highest ranking consultancies in terms of number of participations.

Table 6. Highest ranking consultancies in terms of number of participations

Top 15 rank	Within-group rank	Consultancy	Country	CIP-IEE	CIP-ICT-PSP	FP7	H2020	Total	Lead role	Demonstration (%)
10	1	Vlaamse Instelling voor Technologisch Onderzoek N.V. (VITO)	BE	0	1	8	16	25	3	52
12	2	Rina Consulting SPA	IT	0	2	7	13	22	7	100
–	3	VaasaETT Ltd Ab Oy	FI	0	0	3	9	12	0	75

Information and communication technology and software providers

There are 368 participating ICT and software providers, representing 26 Member States (all except Latvia and Lithuania), plus 9 non-EU countries. The highest numbers of participations are from Spain (83 participations, 49

participating ICT and software providers), Italy (77 participations, 38 participating ICT and software providers), Greece (60 participations, 21 participating ICT and software providers) and Germany (57 participations, 33 participating ICT and software providers). The EU contribution to ICT and software providers amounts to EUR 225.2 million, EUR 195 million of it for demonstration projects and EUR 30.2 million for R&D projects. Table 7 reports the highest ranking ICT and software providers in terms of number of participations.

Table 7. Highest ranking ICT and software providers in terms of number of participations

Top 15 rank	Within-group rank	ICT and software provider	Country	CIP-IEE	CIP-ICT-PSP	FP7	H2020	Total	Lead role	Demonstration (%)
10	1	Engineering - Ingegneria Informatica Spa	IT	0	1	6	18	25	6	92
–	2	Atos Spain SA	ES	0	0	4	11	15	3	80
–	3	Sap SE	SE	0	2	8	3	13	2	62

Energy technology providers

There are 297 participating energy technology providers, representing 21 Member States (all except Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta and Slovakia), plus 6 non-EU countries. The highest numbers of participations are from Germany (74 participations, 51 participating energy technology providers), Spain (57 participations, 40 participating energy technology providers), Italy (57 participations, 35 participating energy technology providers) and France (45 participations, 25 participating energy technology providers). The EU contribution to energy technology providers amounts to EUR 213.4 million, EUR 194.4 million of it for demonstration projects and EUR 19 million for R&D projects. Table 8 reports the highest ranking energy technology providers in terms of number of participations.

Table 8. Highest ranking energy technology providers in terms of number of participations

Top 15 rank	Within-group rank	Energy technology provider	Country	CIP-IEE	CIP-ICT-PSP	FP7	H2020	Total	Lead role	Demonstration (%)
–	1	Schneider Electric Industries SAS	FR	0	0	2	7	9	1	67
–	2	Renault SAS	FR	0	1	4	3	8	1	75
–	3	Siemens AG	DE	0	0	1	6	7	1	57
–	3	Efacec Energia, Máquinas e Equipamentos Eléctricos SA	PT	0	0	3	4	7	0	71
–	3	Etrel Svetovanje in druge storitve DOO	SI	0	1	3	3	7	0	71
–	3	Siemens AG	DE	0	0	6	1	7	1	43

Engineering service providers

There are 94 participating engineering service providers, representing 17 Member States (all except Bulgaria, Denmark, Estonia, Latvia, Lithuania, Luxembourg, Malta, Poland, Romania, Slovakia and Sweden), plus 2 non-EU countries. The highest numbers of participations are from Spain (56 participations, 30 participating engineering service providers), Italy (15 participations, 10 participating engineering service providers) and Germany (12 participations, 10 participating engineering service providers). The EU contribution to engineering service providers amounts to EUR 53 million, EUR 47 million of it for demonstration projects and EUR 6 million for R&D. Table 9 reports the highest ranking engineering service providers in terms of number of participations.

Table 9. Highest ranking engineering service providers in terms of number of participations

Top 15 rank	Within-group rank	Engineering service provider	Country	CIP-IEE	CIP-ICT-PSP	FP7	H2020	Total	Lead role	Demonstration (%)
–	1	Acciona Construccion SA	ES	0	2	7	4	13	0	85
–	2	Končar Inženjering za energetiku i transport DD	HR	0	0	1	6	7	0	86
–	3	Cobra Instalaciones y Servicios SA	ES	0	0	1	5	6	1	83

Transport solution providers

There are 68 participating transport solution providers, representing 19 Member States (all except Cyprus, Croatia, Hungary, Latvia, Lithuania, Luxembourg, Malta, Romania and Slovakia), plus 3 non-EU countries. The highest numbers of participations are from Germany (22 participations, 17 participating transport solution providers), Spain (10 participations, 9 participating transport solution providers), the Netherlands (7 participations, 6 participating transport solution providers), Italy and France (both with 5 participations and 5 participating transport solution providers). The EU contribution to transport solution providers amounts to EUR

26.9 million, EUR 22,8 million of it for demonstration projects and EUR 4.1 million for R&D projects. The highest ranking organisations are not reported, as all 68 would appear at the top in terms of number of participations.

Energy suppliers

There are 87 participating energy suppliers, representing 22 Member States (all except Cyprus, Latvia, Luxembourg, Hungary, Malta and Slovakia), plus 4 non-EU countries. The highest numbers of participations are from Spain (22 participations, 13 participating energy suppliers), Greece (20 participations, 4 participating energy suppliers) and France (16 participations, 1 participating energy suppliers). The EU contribution to energy suppliers amounts to EUR 44.8 million, EUR 39.3 million of it for demonstration projects and EUR 5.5 million for R&D projects. Table 10 reports the highest ranking energy suppliers in terms of number of participations.

Table 10. Highest ranking energy suppliers in terms of number of participations

Top 15 rank	Within-group rank	Energy supplier	Country	CIP-IEE	CIP-ICT-PSP	FP7	H2020	Total	Lead role	Demonstration (%)
–	1	EDF - Électricité de France SA	FR	0	1	10	5	16	0	69
–	2	PUBLIC POWER CORPORATION S.A.	EL	0	1	8	4	13	1	38
–	3	Vattenfall AB	SE	0	0	1	3	4	0	100
–	3	E.ON Sverige AB	SE	0	0	2	2	4	0	75
–	3	EnBW Energie Baden	DE	2	0	2	0	4	0	0

Energy service providers

There are 78 participating energy service providers, representing 19 Member States (all except Denmark, Estonia, Cyprus, Lithuania, Luxembourg, Malta, Poland, Slovenia and Slovakia), plus 3 non-EU countries. The highest numbers of participations are from Italy and Spain (21 participations each, 12 and 10 participating energy service providers respectively) and France (17 participations, 13 participating energy service providers). The EU contribution to energy service providers amounts to EUR 43 million, EUR 41.5 million of it for demonstration projects and EUR 1.5 million for R&D projects. Table 11 reports the highest ranking energy service providers in terms of number of participations.

Table 11. Highest ranking energy service providers in terms of number of participations

Top 15 rank	Within-group rank	Energy service provider	Country	CIP-IEE	CIP-ICT-PSP	FP7	H2020	Total	Lead role	Demonstration (%)
–	1	Kiwi Power Ltd	UK	0	0	0	5	5	0	100
–	1	Giroa SA	ES	0	1	0	4	5	0	100
–	1	CiviESCo Srl	IT	0	0	0	5	5	0	100
–	2	Caverion Suomi Oy	FI	0	0	1	3	4	0	100
–	2	Engie SA	FR	0	1	0	3	4	0	100
–	2	Enel.si srl	IT	0	0	3	1	4	0	50
–	3	Regenera Levante SL	ES	0	0	0	3	3	0	67
–	3	Enerim Oy	FI	0	0	0	3	3	0	100
–	3	Ekodoma Ltd	LV	1	0	1	1	3	0	67
–	3	SEnerCon GmbH	DE	0	1	1	1	3	0	67
–	3	Ennovatis GmbH	DE	0	1	2	0	3	0	67

Energy producers

There are 52 participating energy producers, representing 18 Member States (all except Belgium, Czechia, Ireland, Cyprus, Luxembourg, Malta, Austria, Romania, Slovakia and Finland), plus 5 non-EU countries. The highest numbers of participations are from Italy (16 participations, 9 participating energy producers), France (14 participations, 5 participating energy producers) and Spain (11 participations, 3 participating energy producers). The EU contribution to energy producers amounts to EUR 33.8 million, EUR 29.8 million for demonstration projects and EUR 4 million for R&D projects. Table 12 reports the highest ranking energy producers in terms of number participations.

Table 12. Highest ranking energy producers in terms of number of participations

Top 15 rank	Within-group rank	Energy producer	Country	CIP-IEE	CIP-ICT-PSP	FP7	H2020	Total	Lead role	Demonstration (%)
–	1	EDF - Électricité de France SA	FR	0	0	5	3	8	1	50
–	2	Iren Spa	IT	0	0	1	5	6	0	100
–	2	Mytilinaios Anonimi Etaireia	EL	0	0	0	6	6	0	83
–	3	Iberdrola Renovables Energía SA	ES	2	0	2	1	5	0	60

Municipal energy utilities

There are 41 participating municipal energy utilities, representing 9 Member States (i.e. Belgium, Denmark, Germany, France, Italy, Austria, Portugal, Finland and Sweden), plus 1 non-EU country. The highest numbers of participations are from Germany (34 participations, 19 participating municipal energy utilities), Denmark (7 participations, 6 participating municipal energy utilities) and Sweden (5 participations, 4 participating municipal energy utilities). The EU contribution to municipal energy utilities amounts to EUR 26.7 million, EUR 25.7 million of it for demonstration projects and EUR 1 million for R&D projects. Table 13 reports the highest ranking municipal energy utilities in terms of number of participations.

Table 13. Highest ranking municipal energy utilities in terms of number of participations

Top 15 rank	Within-group rank	Municipal energy utility	Country	CIP-IEE	CIP-ICT-PSP	FP7	H2020	Total	Lead role	Demonstration (%)
–	1	MVV Energie AG	DE	1	0	2	2	5	0	60
–	2	Badenova AG & Co. KG	DE	1	0	0	3	4	0	50
–	2	Stadtwerk Haßfurt GmbH	DE	0	0	0	4	4	0	75
–	3	SWW Wunsiedel GmbH	DE	0	0	0	3	3	0	100

Energy cooperatives

There are 22 participating energy cooperatives, representing 11 Member States (i.e. Belgium, Denmark, Germany, Spain, France, Croatia, Ireland, Italy, the Netherlands, Austria, Portugal and the United Kingdom). The highest numbers of participations are from Spain (7 participations, 3 participating energy cooperatives), Belgium (6 participations, 2 participating energy cooperatives), Portugal (4 participations, 2 participating energy cooperatives) and the Netherlands (3 participations, 3 participating energy cooperatives). The EU contribution to energy cooperatives amounts to EUR 8.8 million, EUR 7.9 million of it for demonstration projects and EUR 0.9 million for R&D projects. Table 14 reports the highest ranking energy cooperatives in terms of number of participations.

Table 14. Highest ranking energy cooperatives in terms of number of participations

Top 15 rank	Within-group rank	Energy cooperative	Country	CIP-IEE	CIP-ICT-PSP	FP7	H2020	Total	Lead role	Demonstration (%)
–	1	Ecopower cvba	BE	2	0	0	3	5	1	60
–	2	Zelena energetska zadruga za usluge	HR	0	0	0	3	3	0	100
–	2	Som Energia SCCL	ES	1	0	0	2	3	0	67
–	2	EnergÊtica S. Coop	ES	0	0	0	3	3	0	67
–	3	Coopérnico - Cooperativa de Desenvolvimento Sustentável Crl	PT	0	0	0	2	2	0	100
–	3	Enercoop	FR	1	0	0	1	2	0	50
–	3	Enercoutim - Associação Empresarial de Energia Solar de Alcoutim	PT	0	0	0	2	2	0	100

Market operators and energy brokers / traders

There are 17 participating market operators and energy brokers / traders, representing 10 Member States (Bulgaria, Denmark, Estonia, Greece, Spain, Hungary, Netherlands, Austria, Slovenia and the United Kingdom), plus 3 non-EU countries. The highest numbers of participations are from Austria (4 participations, 3 participating organisations) and Bulgaria (4 participations, 2 participating organisations). The EU contribution to market operators and energy brokers / traders amounts to EUR 7.4 million, EUR 4.4 million of it for demonstration projects and EUR 3 million for R&D projects. The highest ranking organisations are not reported, as all 17 would appear at the top in terms of number of participations.

Distribution system operators

There are 106 participating DSOs, representing 26 Member States (all except Luxembourg and Malta), plus 4 non-EU countries. The highest numbers of participations are from Spain (55 participations, 15 participating DSOs), Italy (39 participations, 9 participating DSOs) and France (27 participations, 7 participating DSOs). The EU contribution to DSOs amounts to EUR 124.9 million, EUR 113.6 million of it for demonstration projects and EUR 11.3 million for R&D projects. Table 15 reports the highest ranking DSOs in terms of number of participations.

Table 15. Highest ranking DSOs in terms of number of participations

Top 15 rank	Within-group rank	DSO	Country	CIP-IEE	CIP-ICT-PSP	FP7	H2020	Total	Lead role	Demonstration (%)
13	1	Hedno - Diacheiristis Ellinikou Diktyou Dianomis Elektrikis Energeias Ae	EL	0	0	4	15	19	0	79
15	2	E-Distribuzione Spa	IT	1	1	12	3	17	4	71
–	3	EDP Distribuição Energia SA	PT	0	0	6	10	16	3	75

Transmission system operators

There are 49 participating TSOs, representing 25 Member States (all except Luxembourg, Malta and Slovakia), plus 10 non-EU countries. The highest numbers of participations are from France (17 participations, 1 participating TSO), Portugal (16 participations, 2 participating TSOs) and Slovenia (12 participations, 1 participating TSO). The EU contribution to TSOs amounts to EUR 77 million, EUR 51 million of it for demonstration projects and EUR 26 million for R&D projects. Table 16 reports the highest ranking TSOs in terms of number of participations.

Table 16. Highest ranking TSOs in terms of number of participations

Top 15 rank	Within-group rank	TSO	Country	CIP-IEE	CIP-ICT-PSP	FP7	H2020	Total	Lead role	Demonstration (%)
–	1	RTE - Réseau de transport d'électricité	FR	1	0	10	6	17	3	35
–	2	ELES, d.o.o., sistemski operater prenosnega elektroenergetskega omrežja	SI	0	0	3	9	12	1	67
–	2	Terna - Rete Elettrica Nazionale Spa	IT	1	0	5	4	10	0	40
–	3	Elia System Operator SA	BE	0	0	9	1	10	0	50

Local governments

There are 243 participating local governments, representing 24 Member States (all except Latvia, Lithuania, Luxembourg and Malta), plus 7 non-EU countries. The highest numbers of participations are from Italy (44 participations, 35 participating local governments) Spain (43 participations, 31 participating local governments) and the United Kingdom (30 participations, 15 participating local governments). The EU contribution to local governments amounts to EUR 155.9 million, EUR 153.7 million of it for demonstration projects and EUR 2.2 million for R&D projects. Table 17 reports the highest ranking local governments in terms of number of participations.

Table 17. Highest ranking local governments in terms of number of participations

Top 15 rank	Within-group rank	Local government	Country	CIP-IEE	CIP-ICT-PSP	FP7	H2020	Total	Lead role	Demonstration (%)
–	1	Bristol City Council	UK	0	3	1	3	7	0	86
–	2	Ayuntamiento de Málaga	ES	0	0	1	3	4	0	100
–	2	Manchester City Council	UK	0	1	2	1	4	1	100
–	3	Municipality of Warsaw	PL	0	1	0	2	3	0	100
–	3	Grad Rijeka	HR	1	0	1	1	3	0	100
–	3	Obshtina Burgas	BG	1	0	0	2	3	0	100
–	3	Ayuntamiento de Zaragoza	ES	1	0	0	2	3	0	100
–	3	Blaenau Gwent County Borough Council	UK	0	0	1	2	3	0	67
–	3	Comhaire nan Eilean Siar	UK	1	0	1	1	3	0	33
–	3	Comune di Genova	IT	0	2	0	1	3	0	100

Other public entities

There are 118 participating other public entities, representing 25 Member States (all except Denmark, Lithuania and Slovakia), plus 4 non-EU countries. The highest numbers of participations are from Spain (45 participations,

34 participating other public entities), Bulgaria (10 participations, 2 participating other public entities) and Italy and Portugal (9 participations each, 8 and 6 participating other public entities respectively). The EU contribution to other public entities amounts to EUR 36.3 million, EUR 31 million of it for demonstration projects and EUR 5.3 million for R&D projects. Table 18 reports the highest ranking other public entities in terms of number of participations.

Table 18. Highest ranking other public entities in terms of number of participations

Top 15 rank	Within-group rank	Other public agency	Country	CIP-IEE	CIP-ICT-PSP	FP7	H2020	Total	Lead role	Demonstration (%)
–	1	Energy Agency of Plovdiv	BG	4	1	2	1	8	0	100
–	2	Electricity Authority of Cyprus	CY	0	0	0	5	5	0	100
–	2	Krajowa Agencja Poszanowania Energii SA	PL	1	0	0	4	5	0	20
–	2	Mittetulundusuhing Tartu Regiooni Energiaagentuur	EE	0	0	0	5	5	0	60
–	3	Lisboa E-Nova - Agência de Energia e Ambiente de Lisboa	PT	0	1	1	2	4	0	100

Miscellaneous

There are 157 participating organisations in the category miscellaneous, representing 19 Member States (all except Czechia, Estonia, Ireland, Cyprus, Latvia, Lithuania, Luxembourg, Malta, Romania), plus 5 non-EU countries. The highest numbers of participations are from Spain (31 participations, 27 participating organisations), Italy (23 participations, 22 participating organisations) and France (17 participations, 15 participating organisations). The EU contribution to the organisations grouped under the category miscellaneous amounts to EUR 58.3 million, EUR 50.4 million of it for demonstration projects and EUR 7.9 million for R&D projects. The highest ranking organisations are not reported, as all 157 would appear at the top in terms of number of participations.

Networks / industry associations

There are 160 participating networks/industry associations, representing 24 Member States (all except Croatia, Cyprus, Luxembourg and Slovenia), plus 4 non-EU countries. The highest numbers of participations are from Belgium (94 participations, 46 participating networks / industry associations), Germany (26 participations, 13 participating networks / industry associations) and Spain (23 participations, 18 participating networks/industry associations). The EU contribution to networks/industry associations amounts to EUR 68.1 million, EUR 50.8 million of it for demonstration projects and EUR 17.4 million for R&D projects. Table 19 reports the highest ranking networks / industry associations in terms of number of participations.

Table 19. Highest ranking networks / industry associations in terms of number of participations

Top 15 rank	Within-group rank	Network / industry association	Country	CIP-IEE	CIP-ICT-PSP	FP7	H2020	Total	Lead role	Demonstration (%)
–	1	ICLEI European Secretariat GmbH	DE	1	0	0	8	9	0	56
–	1	European Distribution System Operators for Smart Grids (EDSO)	BE	1	0	2	6	9	1	67
–	2	REScoop EU Asbl	BE	0	0	0	7	7	0	71
–	2	CRE - Romanian Energy centre	RO	0	0	0	7	7	0	86
–	3	Stichting New Energy Coalition	NL	0	0	0	5	5	0	100
–	3	WindEurope - European Wind Energy Association	BE	3	0	2	0	5	2	20
–	3	EUREC - European Renewable Energy Council	BE	3	1	0	1	5	0	0

Housing associations / real estate developers

There are 102 participating housing associations / real estate developers, representing 16 Member States (all except Estonia, Ireland, Croatia, Cyprus, Lithuania, Luxembourg, Latvia, Hungary, Malta, Romania, Slovenia and Slovakia), plus 2 non-EU countries. The highest numbers of participations are from France (22 participations, 19 participating housing associations / real estate developers), and the Netherlands and Germany (12 participations each, 12 and 11 participating housing associations / real estate developers, respectively). The EU contribution to housing associations / real estate developers amounts to EUR 50.1 million, EUR 50 million of it for demonstration projects and EUR 0.1 million for R&D projects. Table 20 reports the highest ranking housing associations / real estate developers in terms of number of participations.

Table 20. Highest ranking housing associations / real estate developers in terms of number of participations

Top 15 rank	Within-group rank	Housing association / real estate developer	Country	CIP-IEE	CIP-ICT-PSP	FP7	H2020	Total	Lead role	Demonstration (%)
–	1	Cecodhas - Comite Europeen de Coordination de l'habitat Social Aisbl	BE	0	1	0	3	4	0	75
–	2	Akademiska Hus AB	SE	0	0	0	3	3	0	100
–	3	Vilogia SA	FR	1	0	0	1	2	0	100
–	3	Sociedad Municipal Zaragoza Vivienda	ES	0	1	0	1	2	0	100
–	3	Habitats et Territoires Conseil	FR	0	2	0	0	2	0	100
–	3	Kreis Lippe Der Landrat	DE	0	0	0	2	2	0	100
–	3	Mostostal Warszawa SA	PL	0	1	1	0	2	0	100
–	3	Cordium Cuba	BE	0	0	1	1	2	0	100
–	3	SPM Promocions Municipals de Sant Cugat del Vallès SA	ES	0	1	0	1	2	0	100
–	3	CV Zonnige Kempen	BE	1	1	0	0	2	0	100
–	3	Granlund Oy	FI	0	1	0	1	2	0	100
–	3	Moulins Habitat	FR	0	2	0	0	2	0	100

Environmental and other civil society organisations

There are 75 participating environmental and other civil society organisations, representing 23 Member States (all except Estonia, Lithuania, Luxembourg, Malta and Finland), plus 4 non-EU countries. The highest numbers of participations are from the United Kingdom (25 participations, 17 participating organisations), France (10 participations, 5 participating organisations) and Germany, Belgium and Italy (7 participations each, 7, 5 and 5 participating organisations respectively). The EU contribution to environmental and other civil society organisations amounts to EUR 22.5 million, EUR 15.4 million of it for demonstration projects and EUR 7.1 million for R&D projects. Table 21 reports the highest ranking environmental and other civil society organisations in terms of number of participations.

Table 21. Highest ranking environmental and other civil society organisations in in terms of number of participations

Top 15 rank	Within-group rank	Environmental and civil society organisation	Country	CIP-IEE	CIP-ICT-PSP	FP7	H2020	Total	Lead role	Demonstration (%)
–	1	Severn Wye Energy Agency Limited	UK	3	0	o	2	5	0	80
–	2	Prioriterre	FR	3	0	0	1	4	0	100
–	2	GreenDependent Sustainable Solutions Association	HU	1	0	1	2	4	0	50
–	2	DECO - Associação Portuguesa para a Defesa do Consumidor	PT	1	0	0	3	4	0	25
–	2	Društvo za oblikovanje održivog razvoja	HR	1	0	0	3	4	0	75
–	3	Hespul	FR	1	0	1	1	3	0	100
–	3	Knowle West Media Centre	UK	0	1	0	2	3	0	100
–	3	Federacja Konsumentów Stowarzyszenie	PL	0	0	0	3	3	0	67

Business incubators / funding agencies / early-stage investors

There are 20 participating business incubators, representing 14 Member States (i.e. Belgium, Denmark, Germany, Spain, France, Italy, Latvia, the Netherlands, Austria, Poland, Portugal, Finland, Sweden and the United Kingdom). The highest number of participations is from Germany (11 participations, 1 participating business incubator). The EU contribution to business incubators amounts to EUR 16 million, EUR 15.20 million of it for demonstration projects and EUR 0.8 million for R&D projects. The highest ranking organisations are not reported, as all 20 would appear at the top in terms of number of participations.

Annex 2. List of projects

Project acronym	Website	Funding program
3e-Houses	https://cordis.europa.eu/project/id/250491	CIP-ICT-PSP
Achieve	https://ec.europa.eu/energy/intelligent/projects/en/projects/achieve	CIP-IEE
Address	https://cordis.europa.eu/project/id/207643	FP7
Advanced	https://cordis.europa.eu/project/id/308923	FP7
AIM	https://cordis.europa.eu/project/id/224621	FP7
AMBASSADOR	https://cordis.europa.eu/project/id/314175	FP7
Aml-MoSES	https://cordis.europa.eu/project/id/224250	FP7
AnyPLACE	https://cordis.europa.eu/project/id/646580	H2020
Assist	https://cordis.europa.eu/project/id/754051	H2020
Assured	https://cordis.europa.eu/project/id/769850	H2020
Atelier	https://cordis.europa.eu/project/id/864374	H2020
Attest	https://cordis.europa.eu/project/id/864298	H2020
AURES	https://cordis.europa.eu/project/id/646172	H2020
AURES II	https://cordis.europa.eu/project/id/817619	H2020
Barenergy	https://cordis.europa.eu/project/id/213558	FP7
BD4OPEM	https://cordis.europa.eu/project/id/872525	H2020
BEAMS	https://cordis.europa.eu/project/id/285194	FP7
Be Aware	https://cordis.europa.eu/project/id/224557	FP7
BECA	https://cordis.europa.eu/project/id/270981	CIP-ICT-PSP
Beneffice	https://cordis.europa.eu/project/id/768774	H2020
BESOS	https://cordis.europa.eu/project/id/608723	FP7
BEST Energy	https://cordis.europa.eu/project/id/238889	CIP-ICT-PSP
Best Paths	https://cordis.europa.eu/project/id/612748	FP7
Beyond2020	https://ec.europa.eu/energy/intelligent/projects/en/projects/beyond2020	CIP-IEE
BeyWatch	https://cordis.europa.eu/project/id/223888	FP7
BodenTypeDC	https://cordis.europa.eu/project/id/768875	H2020
Bright	https://cordis.europa.eu/project/id/957816	H2020
Campus21	https://cordis.europa.eu/project/id/285729	FP7
Cassandra	https://cordis.europa.eu/project/id/288429	FP7
Catalyst	https://cordis.europa.eu/project/id/768739	H2020
C-DAX	https://cordis.europa.eu/project/id/318708	FP7
Changing Behaviour	https://cordis.europa.eu/project/id/213217	FP7
ChArGED	https://cordis.europa.eu/project/id/696170	H2020
Cheetah	https://cordis.europa.eu/project/id/723716	H2020
Citizenergy	https://ec.europa.eu/energy/intelligent/projects/en/projects/citizenergy	CIP-IEE
Cityfied	http://cordis.europa.eu/project/rcn/197827	FP7
CityOpt	https://cordis.europa.eu/project/id/608830	FP7
CityxChange	https://cordis.europa.eu/project/id/824260	H2020
City-zen	https://cordis.europa.eu/project/id/608702	FP7
CIVIS	https://cordis.europa.eu/project/id/608774	FP7
CLEAR	https://ec.europa.eu/energy/intelligent/projects/en/projects/clear	CIP-IEE
CLEAR 2.0	https://cordis.europa.eu/project/id/749402	H2020
ComAct	https://cordis.europa.eu/project/id/892054	H2020
COME RES	https://cordis.europa.eu/project/id/953040	H2020
Comets	https://cordis.europa.eu/project/id/837722	H2020
Compile	https://cordis.europa.eu/project/id/824424	H2020
Conseed	https://cordis.europa.eu/project/id/723741	H2020
COOPERaTE	https://cordis.europa.eu/project/id/600063	FP7
CoordiNet	https://cordis.europa.eu/project/id/824414	H2020
CO-POWER	https://ec.europa.eu/energy/intelligent/projects/en/projects/co-power	CIP-IEE
CoSSMic	https://cordis.europa.eu/project/id/608806	FP7
Cotevos	http://cordis.europa.eu/project/rcn/110924	FP7
Creators	https://cordis.europa.eu/project/id/957815	H2020
Crossbow	https://cordis.europa.eu/project/id/773430	H2020
CrowdFundRES	https://cordis.europa.eu/project/id/646435	H2020
CryoHub	https://cordis.europa.eu/project/id/691761	H2020
CUBER	https://cordis.europa.eu/project/id/875605	H2020
Dareed	https://cordis.europa.eu/project/id/609082	FP7
DC4Cities	https://cordis.europa.eu/project/id/609304	FP7

Decide	https://cordis.europa.eu/project/id/894255	H2020
Defender	https://cordis.europa.eu/project/id/740898	H2020
Dehems	https://cordis.europa.eu/project/id/224609	FP7
DELTA	https://cordis.europa.eu/project/id/773960	H2020
Dimmer	https://cordis.europa.eu/project/id/609084	FP7
Discern	https://cordis.europa.eu/project/id/308913	FP7
DLC+VIT4IP	https://cordis.europa.eu/project/id/247750	FP7
Dolfin	https://cordis.europa.eu/project/id/609140	FP7
Dominoes	https://cordis.europa.eu/project/id/771066	H2020
domOS	https://cordis.europa.eu/project/id/894240	H2020
DR-BOB	https://cordis.europa.eu/project/id/696114	H2020
DREAM	https://cordis.europa.eu/project/id/609359	FP7
DRES2Market	https://cordis.europa.eu/project/id/952851	H2020
Drimpac	https://cordis.europa.eu/project/id/768559	H2020
DRIVE	https://cordis.europa.eu/project/id/774431	H2020
E+	https://cordis.europa.eu/project/id/600065	FP7
E3SoHo	https://cordis.europa.eu/project/id/250497	CIP-ICT-PSP
EASY-RES	https://cordis.europa.eu/project/id/764090	H2020
eBADGE	https://cordis.europa.eu/project/id/318050	FP7
E-Balance	http://cordis.europa.eu/projects/rcn/109894	FP7
ebalance-plus	https://cordis.europa.eu/project/id/864283	H2020
Echoes	https://cordis.europa.eu/project/id/727470	H2020
EC-LINC	https://ec.europa.eu/energy/intelligent/projects/en/projects/ec-linc	CIP-IEE
ECO2	https://cordis.europa.eu/project/id/784988	H2020
Eco-Bot	https://cordis.europa.eu/project/id/767625	H2020
EcoGem	https://cordis.europa.eu/project/id/260097	FP7
EcoGrid EU	https://cordis.europa.eu/project/id/268199	FP7
ECO-Qube	https://cordis.europa.eu/project/id/956059	H2020
eCREW	https://cordis.europa.eu/project/id/890362	H2020
e-DASH	https://cordis.europa.eu/project/id/285586	FP7
EdgeFLEX	https://cordis.europa.eu/project/id/883710	H2020
Edison	https://cordis.europa.eu/project/id/297386	CIP-ICT-PSP
eDREAM	https://cordis.europa.eu/project/id/774478	H2020
EEPOS	https://cordis.europa.eu/project/id/600050	FP7
e-Highway2050	https://cordis.europa.eu/project/id/308908	FP7
E-HUB	https://cordis.europa.eu/project/id/260165	FP7
E-LAND	https://cordis.europa.eu/project/id/824388	H2020
Electrific	https://cordis.europa.eu/project/id/713864	H2020
EL-EFF Region	https://ec.europa.eu/energy/intelligent/projects/en/projects/el-eff-region	CIP-IEE
E-Lobster	https://cordis.europa.eu/project/id/774392	H2020
ELSA	https://cordis.europa.eu/project/id/646125	H2020
Elvire	https://cordis.europa.eu/project/id/249105	FP7
Elviten	https://cordis.europa.eu/project/id/769926	H2020
Emerald	https://cordis.europa.eu/project/id/314151	FP7
Empower	https://cordis.europa.eu/project/id/646476	H2020
Empowering	https://ec.europa.eu/energy/intelligent/projects/en/projects/empowering	CIP-IEE
EmpowerMed	https://cordis.europa.eu/project/id/847052	H2020
EN-2	https://ec.europa.eu/energy/intelligent/projects/en/projects/en2	CIP-IEE
Enable.EU	https://cordis.europa.eu/project/id/727524	H2020
Enchant	https://cordis.europa.eu/project/id/957115	H2020
enCOMPASS	https://cordis.europa.eu/project/id/723059	H2020
EnerGAware	https://cordis.europa.eu/project/id/649673	H2020
Energise	http://cordis.europa.eu/project/rcn/194455	H2020
Energise II	https://cordis.europa.eu/project/id/727642	H2020
Energy Neighbourhood	https://ec.europa.eu/energy/intelligent/projects/en/projects/energy-neighbourhood	CIP-IEE
EnergyKeeper	https://cordis.europa.eu/project/id/731239	H2020
EnergyMEASURES	https://cordis.europa.eu/project/id/894759	H2020
EnergyTIC	https://cordis.europa.eu/project/id/270947	CIP-ICT-PSP
ENERsip	https://cordis.europa.eu/project/id/247624	FP7
eNeuron	https://cordis.europa.eu/project/id/957779	H2020
Enpor	https://cordis.europa.eu/project/id/889385	H2020
Entropy	https://cordis.europa.eu/project/id/649849	H2020
EPIC-HUB	https://cordis.europa.eu/project/id/600067	FP7
Eplace	https://cordis.europa.eu/project/id/325182	CIP-ICT-PSP
E-price	https://cordis.europa.eu/project/id/249096	FP7

eSESH	https://cordis.europa.eu/project/rcn/191721	CIP-ICT-PSP
eStorage	https://cordis.europa.eu/project/id/295367	FP7
eTEACHER	https://cordis.europa.eu/project/id/768738	H2020
EU heroes	https://cordis.europa.eu/project/id/764805	H2020
EUniversal	https://cordis.europa.eu/project/id/864334	H2020
EU-SysFlex	https://cordis.europa.eu/project/id/773505	H2020
Evident	https://cordis.europa.eu/project/id/957117	H2020
Evolvdso	https://cordis.europa.eu/project/id/608732	FP7
Farcross	https://cordis.europa.eu/project/id/864274	H2020
FEEdBACk	https://cordis.europa.eu/project/id/768935	H2020
FEVER	https://cordis.europa.eu/project/id/864537	H2020
FHP	https://cordis.europa.eu/project/id/731231	H2020
Fiemser	https://cordis.europa.eu/project/id/248605	FP7
Fiesta	https://ec.europa.eu/energy/intelligent/projects/en/projects/fiesta	CIP-IEE
Finesce	https://cordis.europa.eu/project/id/604677	FP7
Finseny	https://cordis.europa.eu/project/id/285135	FP7
Flex4Grid	http://cordis.europa.eu/project/rcn/194427	H2020
Flexcoop	https://cordis.europa.eu/project/id/773909	H2020
Flexgrid	https://cordis.europa.eu/project/id/863876	H2020
Flexiciency	http://cordis.europa.eu/project/rcn/194447	H2020
Flexigrid ES	https://cordis.europa.eu/project/id/864579	H2020
Flexigrid SE	https://cordis.europa.eu/project/id/864048	H2020
Flexitranstore	https://cordis.europa.eu/project/id/774407	H2020
Flexmeter	http://cordis.europa.eu/project/rcn/194457	H2020
FlexPlan	https://cordis.europa.eu/project/id/863819	H2020
FutureFlow	https://cordis.europa.eu/project/id/691777	H2020
G4V	https://cordis.europa.eu/project/id/241295	FP7
GAIA	https://cordis.europa.eu/project/id/696029	H2020
Garpur	https://cordis.europa.eu/project/id/608540	FP7
GENiC	https://cordis.europa.eu/project/id/608826	FP7
Geyser	https://cordis.europa.eu/project/id/609211	FP7
GIFT	https://cordis.europa.eu/project/id/824410	H2020
GOFLEX	https://cordis.europa.eu/project/id/731232	H2020
Green Emotion	https://cordis.europa.eu/project/id/265499	FP7
GREEN@Hospital	https://cordis.europa.eu/project/id/297290	CIP-ICT-PSP
GreenCharge	https://cordis.europa.eu/project/id/769016	H2020
GreenCom	https://cordis.europa.eu/project/id/318213	FP7
GreenDataNet	https://cordis.europa.eu/project/id/609000	FP7
GreenPlay	https://cordis.europa.eu/project/id/649621	H2020
GreenSoul	https://cordis.europa.eu/project/id/696129	H2020
Grid4EU	https://cordis.europa.eu/project/id/268206	FP7
Gridsol	https://cordis.europa.eu/project/id/727362	H2020
GridTECH	https://ec.europa.eu/energy/intelligent/projects/en/projects/gridtech	CIP-IEE
GrowSmarter	https://cordis.europa.eu/project/id/646456	H2020
Hestia	https://cordis.europa.eu/project/id/957823	H2020
HIFLEX	https://cordis.europa.eu/project/id/857768	H2020
HiPerDNO	https://cordis.europa.eu/project/id/248135	FP7
Holisder	https://cordis.europa.eu/project/id/768614	H2020
HosPilot	https://cordis.europa.eu/project/id/238933	CIP-ICT-PSP
Hyperride	https://cordis.europa.eu/project/id/957788	H2020
I3RES	http://cordis.europa.eu/project/rcn/106338	FP7
IANOS	https://cordis.europa.eu/project/id/957810	H2020
ICE-WISH	https://cordis.europa.eu/project/id/270898	CIP-ICT-PSP
Icoeur	https://cordis.europa.eu/project/id/227122	FP7
ICT 4 EVEU	https://cordis.europa.eu/project/id/297224	CIP-ICT-PSP
ICT4FEV	https://cordis.europa.eu/project/id/260116	FP7
ICT4SmartDG	http://cordis.europa.eu/project/rcn/191801	CIP-ICT-PSP
IDE4L	http://cordis.europa.eu/projects/rcn/109372	FP7
Ideas	https://cordis.europa.eu/project/id/600071	FP7
iDistributedPV	https://cordis.europa.eu/project/id/764452	H2020
IElectrix	https://cordis.europa.eu/project/id/824392	H2020
iFLEX	https://cordis.europa.eu/project/id/957670	H2020
IGREENGrid	https://cordis.europa.eu/project/id/308864	FP7
Improgres	https://ec.europa.eu/energy/intelligent/projects/en/projects/improgres	CIP-IEE
In2stempo	https://cordis.europa.eu/project/id/777515	H2020

InBetween	https://cordis.europa.eu/project/id/768776	H2020
INCIT-EV	https://cordis.europa.eu/project/id/875683	H2020
Increase	http://cordis.europa.eu/projects/rcn/109974	FP7
IndustRE	https://cordis.europa.eu/project/id/646191	H2020
Inertia	https://cordis.europa.eu/project/id/318216	FP7
Ingrid	https://cordis.europa.eu/project/id/296012	FP7
INSULAE	https://cordis.europa.eu/project/id/824433	H2020
InteGrid	https://cordis.europa.eu/project/id/731218	H2020
inteGRIDy	https://cordis.europa.eu/project/id/731268	H2020
INTEGRIS	https://cordis.europa.eu/project/id/247938	FP7
InterConnect	https://cordis.europa.eu/project/id/857237	H2020
InterFlex	https://cordis.europa.eu/project/id/731289	H2020
Interplan	https://cordis.europa.eu/project/id/773708	H2020
Interpreter	https://cordis.europa.eu/project/id/864360	H2020
Interrface	https://cordis.europa.eu/project/id/824330	H2020
INTrEPID	https://cordis.europa.eu/project/id/317983	FP7
IntUBE	https://cordis.europa.eu/project/id/224286	FP7
Invade	https://cordis.europa.eu/project/id/731148	H2020
IRENE-40	http://cordis.europa.eu/project/rcn/90317	FP7
IRIS	https://cordis.europa.eu/project/id/774199	H2020
Islander	https://cordis.europa.eu/project/id/957669	H2020
iTESLA	https://cordis.europa.eu/project/id/283012	FP7
iUrban	http://cordis.europa.eu/project/rcn/110156	FP7
KnoholEM	https://cordis.europa.eu/project/id/285229	FP7
Lightness	https://cordis.europa.eu/project/id/953020	H2020
Maesha	https://cordis.europa.eu/project/id/957843	H2020
Magnitude	https://cordis.europa.eu/project/id/774309	H2020
Making-City	https://cordis.europa.eu/project/id/824418	H2020
Market4RES	https://ec.europa.eu/energy/intelligent/projects/en/projects/market4res	CIP-IEE
Mas2tering	http://cordis.europa.eu/project/rcn/192066	FP7
Massig	https://ec.europa.eu/energy/intelligent/projects/en/projects/massig	CIP-IEE
MAtchUP	https://cordis.europa.eu/project/id/774477	H2020
Meister	https://cordis.europa.eu/project/id/769052	H2020
MERGE	https://cordis.europa.eu/project/id/241399	FP7
Merlon	https://cordis.europa.eu/project/id/824386	H2020
MetaPV	https://cordis.europa.eu/project/id/239511	FP7
Meter-ON	https://cordis.europa.eu/project/id/308794	FP7
Migrate	https://cordis.europa.eu/project/id/691800	H2020
Mirabel	https://cordis.europa.eu/project/id/248195	FP7
MOBI.Europe	https://cordis.europa.eu/project/id/297271	CIP-ICT-PSP
Mobility 2.0	https://cordis.europa.eu/project/id/314129	FP7
Mobincity	https://cordis.europa.eu/project/id/314328	FP7
Mobistyle	https://cordis.europa.eu/project/id/723032	H2020
Molecules	https://cordis.europa.eu/project/id/297244	CIP-ICT-PSP
MUSE GRIDS	https://cordis.europa.eu/project/id/824441	H2020
mySMARTLife	https://cordis.europa.eu/project/id/731297	H2020
Naiades	http://cordis.europa.eu/project/rcn/194439	H2020
Natconsumers	http://cordis.europa.eu/project/rcn/195485	H2020
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PV CROPS	https://cordis.europa.eu/project/id/308468	FP7
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