Comparison of national polycentric settings in the partner countries

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7 ANNEX I – NEWCOMERS Deliverable template

New Clean Energy Communities in a Changing European Energy System (NEWCOMERS)

Deliverable 3.2

Comparison of national polycentric settings in the partner countries

Version: 1.0

WP 3: National polycentric settings: mapping and comparison

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

Summary of NEWCOMERS

In its most recent Energy Union package, the European Union puts citizens at the core of the clean energy transitions. Beyond policy, disruptive innovations in energy sectors are challenging the traditional business model of large energy utilities. One such disruptive, social innovation is the emergence of new clean energy communities ("NEWCOMERS").

The possible benefits of these "NEWCOMERS" for their members and for society at large are still emerging and their potential to support the goals of the Energy Union is unclear. Using a highly innovative holistic approach – drawing on cutting edge theories and methods from a broad range of social sciences coupled with strong technical knowledge and industry insight – the NEWCOMERS consortium will analyse European energy communities from various angles. By taking an interdisciplinary approach and through employing co-creation strategies, in which research participants are actively involved in the design and implementation of the research, the NEWCOMERS project will deliver practical recommendations about how the European Union as well as national and local governments can support new clean energy communities to help them flourish and unfold their potential benefits for citizens and the Energy Union.

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Summary of NEWCOMERS's Objectives

As subsidiary objectives, the NEWCOMERS project aims to

- provide **a novel theoretical framework based on polycentric governance theory**, combined with elements from social practice theory, innovation theory and value theory, in which the emergence and diffusion of new clean energy communities can be analysed and opportunities for learning in different national and local polycentric settings can be explored;

- develop a **typology of new clean energy community business models** which allows to assess the different types of value creation of "newcomers" as well as their economic viability and potential to be scaled up under various conditions;

- identify the **types of clean energy communities that perform best along a variety of dimensions**, such as citizen engagement, value creation, and learning, and their potential to address energy poverty, while being based on sustainable business models;

- investigate the **regulatory, institutional and social conditions**, at the national and local level which are favourable for the emergence, operation and further diffusion of new clean energy communities and enable them to unfold their benefits in the best possible way;

- explore **how new clean energy communities are co-designed with their members' (i.e. citizens' and consumers') needs**, in particular whether new clean energy communities have the potential to increase the affordability of energy, their members' energy literacy and efficiency in the use of energy, as well as their members' and society's participation in clean energy transition in Europe;

- deliver **practical recommendations based on stakeholder dialogue** how the EU as well as national and local governments can support new clean energy communities to make them flourish and unfold their benefits in the best possible way;

- offer citizens and members of new clean energy communities a **new online platform 'Our-energy.eu'** on which new clean energy communities can connect and share best practices and interested citizens can learn about the concept of energy communities and find opportunities to join an energy community in their vicinity.

Find out more about NEWCOMERS at: https://www.newcomersh2020.eu/

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NEWCOMERS Consortium Partners

Logo	Organisation	Type	Country
	Institute for Environmental Studies (IVM), Vrije Universiteit Amsterdam (VUA)	University	The Netherlands
	International Institute for Industrial Environmental Economics (IIIEE) at Lund University (LU)	University	Sweden
	Environmental Change Institute (ECI), University of Oxford (UOXF)	University	United Kingdom
	Institute of Social Sciences, University of Ljubljana (UL)	University	Slovenia
	Institute for Advanced Energy Technologies "Nicola Giordano" (ITAE), National Research Council (CNR)	Research organisation	Italy
	Leibniz Institute for Economic Research (RWI)	Research organisation	Germany
	Consensus Communications (CONS)	Private for Profit (SME)	Slovenia
	GEN-I	Private for Profit (Large company)	Slovenia

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Document information

Delivery Type	Report
Deliverable Number	3.2
Deliverable Title	Comparison of national polycentric settings in the partner countries
Due Date	30 Nov 2020
Submission Date	30 Nov 2020
WP/Task related	3.2
Work package leader	Jenny Palm
Author(s)	Jenny Palm and Klara Eitrem Holmgren
Name (Partner organisation)	Lund University
Reviewer(s)	Daniela Lazaroska; Maša Mlinarič
Keywords	Polycentric setting; energy system, electricity system, emissions, country comparison
Dissemination level	
Project coordinator	Julia Blasch (VUA)
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Cite as	Palm, J. and Eitrem Holmgren, K. (2020). Comparison of national polycentric settings in the partner countries, Deliverable D3.2 developed as part of the NEWCOMERS project, funded under EU H2020 grant agreement 837752, November 2020.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

Revisions

Version	Date	Author	Status
1.0	30 Nov 2020	Jenny Palm; Klara Eitrem Holmgren	First draft

Reviews

Version	Date	Reviewer	Review Title
1.0	3 Nov 2020	Daniela Lazoroska	Reviewer 1
1.0	16 Nov 2020	Maša Mlinarič	Reviewer 2

Statement of originality:

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

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Figures and Tables

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Abbreviations

Abbreviation	Explanation and translation
AU	Acquirente Unico, a subsidiary of Gestore dei Servizi Elettrici (Italy)
CEC	Citizen energy communities, defined in the revised Electricity Directive (IEMD, 2019/944/EU) in the European Commission's 'Clean Energy for all Europeans' package.
CHP	Combined Heat and Power
CO2	Carbon dioxide
DE	Germany
DH	District heating
DNOs	Distribution Network Operators
DSO	Distribution System Operators
E.ON	German electric utility company
EC	Energy community
EEG	The Renewable Energy Sources Act (Germany)
Energy intensity	Energy intensity is a measure of a country's energy (in-) efficiency. It is measured with primary energy and GDP, namely the amount of energy used per unit of gross domestic product (GDP).
ENTSO-E	European Network of Transmission System Operators
ESO	Electricity System Operator
EU	European Union
EUR	Euro €
FiTs	Feed-in tariffs
GB	Great Britain
GDP	Gross domestic product
GDP per capita ($)	Gross domestic product by its total population
GDP PPP	Gross domestic product based on purchasing power parity
GHG(s)	Greenhouse gas(es)
GW	Gigawatt
IEA	International Energy Agency
IEMD	The revised Electricity Directive (2019/944/EU) in the European Commission's 'Clean Energy for all Europeans' package.
IT	Italy
JRC	Joint Research Centre, the European Commission's science and knowledge service
kW	Kilowatt
kWh	Kilowatt-hour
Mt	Million tonnes
Mtoe	Million tonnes of oil-equivalent
MW	Megawatt

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NECP	National Energy and Climate Plan, part of the EU-package 'Clean energy for all Europeans'
NEWCOMERS	New Clean Energy Communities in a Changing European Energy System
NGESO	National Grid Electricity System Operator (United Kingdom)
NI	Northern Ireland
NL	The Netherlands
PPP	Purchasing power parity
PV	Photovoltaics
REC	Renewable energy communities, defined in the revised Renewable energy directive (RED II, 2018/2001/EU) in the European Commission's 'Clean Energy for all Europeans' package.
RED II	The revised Renewable energy directive (2018/2001/EU) in the European Commission's 'Clean Energy for all Europeans' package.
RES	Renewable Energy Source(s)
RESC	Renewable Energy Source Community (Slovenia)
SDE +	The Sustainable Energy Transition Scheme (the Netherlands)
SE	Sweden
SI	Slovenia
tCO2	Tonnes of carbon dioxide
TFC	Total Final Consumption
Toe	Tonne of oil equivalent, defined as 107 kilocalories (41.868 gigajoules)
TPES	Total primary energy supply
TSO	Transmission System Operator
TWh	Terawatt-hour
UK	United Kingdom
USD	US Dollar

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1 EXECUTIVE SUMMARY

This deliverable compares the national polycentric settings of the six partner countries of the NEWCOMERS project, i.e. Germany, Italy, the Netherlands, Slovenia, Sweden and the United Kingdom. The comparison is based on figures from Deliverable 3.1 (D3.1) that described the countries' characteristics related to polycentric governance, with specific focus on the countries' socio-technical systems and actors. The country comparisons in this deliverable focus on socio-economic conditions, technical systems including energy and electricity production and consumption, institutional settings of renewable energy support and actors. The deliverable is the basis for D3.3, which will further discuss factors that hinder or enable the development of energy communities in the six NEWCOMERS countries.

The figures in D3.1 have been updated when possible and are compared to figures of IEA or EU-28 averages to enable a broader comparison of the countries' national characteristics. The figures are based on existing literature, national reports and statistical information, with sources containing information about all six partner countries being prioritized.

The following key takeaway messages from D3.2 can be outlined. The countries' developments of ECs can be divided into three categories according to their current number of ECs: high (UK, DE); medium (NL, SE); and low (IT, SI). In relation to their population size, UK and NL have the highest relative numbers of ECs, followed by DE and SE and finally SI and IT. The comparisons of the six countries' socio-economic conditions, technical systems and institutional settings suggest that there is a complex combination of national characteristics that enable polycentric governance and the establishment of ECs. When single characteristics were compared, there were seldom strong correlations between the countries' relative rankings to one another and their current figures of ECs. These findings of D3.2 provide an interesting basis for D3.3 in discussions of the combination of settings that enable polycentric governance of ECs whilst linking to previous literature on EC development.

2 INTRODUCTION

Part of the NEWCOMERS project aims is to explore under which polycentric settings new clean energy communities (ECs) emerge and under which conditions ECs are supressed. Research is carried out in six European Union Member States (DE, IT, NL, SI, SE, UK). The countries' settings in which polycentric governance structures can evolve and operate were described in D3.1, with a focus on the countries' characterization in relation to e.g. energy generation, organisation of the electricity market, regulations and diversity of actors. This deliverable aims to compare these findings of D3.1.

The NEWCOMERS project uses polycentric governance theory[1], where the concept of polycentric governance implies that "governance in a specific issue-area is simultaneously taking place at several locations (or loci) with their own semi-autonomous decision-making centres".[2] This deliverable's comparison of countries' settings is based on the data collection of D3.1 and therefore also based in the same analytical framework, the Institutional Analysis and Development (IAD) framework. The framework is defined in WP 2, D2.1[3], and adapted to the analysis of these deliverables in D3.1 (see Figure 2.1). The analytical focus of variables in the IAD framework in D3.1 and D3.2 are illustrated in Figure 2.1 and include context (socio-economic conditions, technical systems and institutional arrangements) and action arena (actors). More information on the project's polycentric governance theory can be found in WP 2, D2.1.

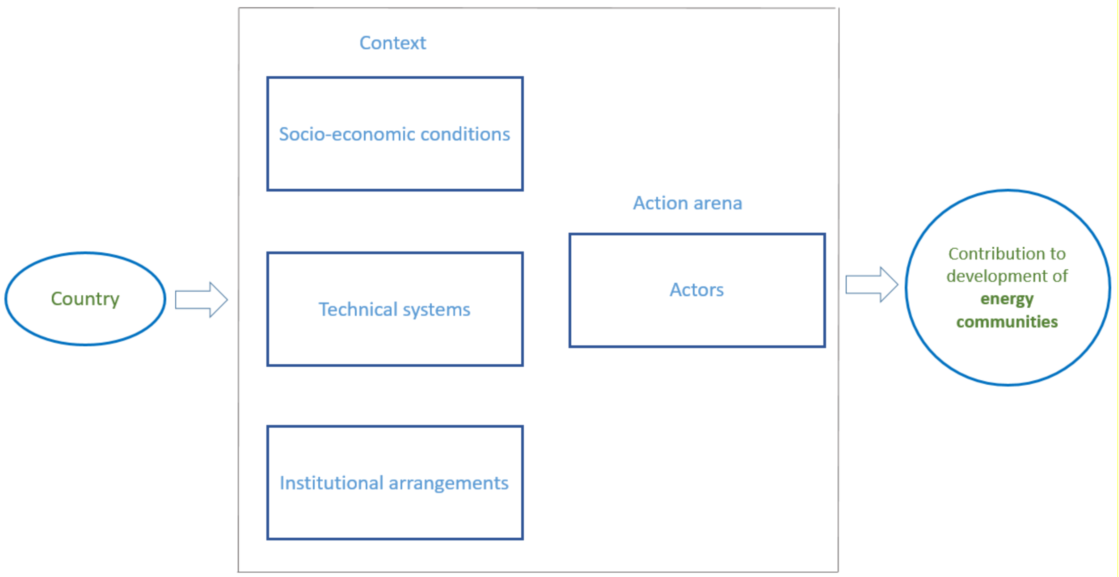

Figure 2.1 The variables of the IAD framework in focus of this report

The NEWCOMERS project strives to complement previous literature on the development of European ECs. Other projects have explored the two EU Directives, as part of the European

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[1] e.g. Ostrom, E. (2010). Polycentric systems for coping with collective action and global environmental change. *Global Environmental Change*, 20, 550-557. Jordan, A., Huitema, D., Schoenefeld, J., van Asselt, H., & Forster, J. (2018). Governing Climate Change Polycentrically. In: A. Jordan, D. Huitema, H. van Asselt, & J. Forster (Eds.), *Governing Climate Change: Polycentricity in Action?* (pp. 3-26). Cambridge: Cambridge University Press.
[2] van der Grijp, N.M. et al. (2019). Theoretical framework focusing on learning in polycentric settings. Deliverable D2.1 developed as part of the NEWCOMERS project, funded under EU H2020 grant agreement 837752, December 2019, p.24.
[3] van der Grijp, N.M. et al. (2019). Theoretical framework focusing on learning in polycentric settings. Deliverable D2.1 developed as part of the NEWCOMERS project, funded under EU H2020 grant agreement 837752, December 2019.

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Commission's 'Clean Energy Package', that formally recognize certain categories of community energy initiatives as ECs. See for instance the REScoop report for an analysis of Member States' draft National Energy and Climate Plans (NECP).[4] With its theoretical and empirical focus on regulatory, institutional and social conditions, the NEWCOMERS project contributes to the field with an analysis of the settings in which ECs may arise as well as potential barriers to their development.

2.1 Role of this deliverable in the project

This deliverable aims to compare the socio-economic conditions, technical systems, institutional arrangements and actors in the six partner countries and when relevant compare the national characterisations with an IEA or EU-28 average. The comparison is a first step to analyse how different settings linked to polycentric governance influence the emergence and functioning of new forms of energy communities. This deliverable is the basis for the next step to analyse factors that hinder or enable new ECs to emerge, what forms of ECs work best in different settings, and what can be learned from the six NEWCOMERS countries (D3.3).

2.2 Approach

The comparison is based on the country descriptions in D3.1. The figures derived from D3.1. have been updated when possible and we have also added figures on IEA or EU-28 averages to enable a comparison of the six countries on a broader range. We used relevant figures of an IEA average when available. When IEA lacked a good IEA average comparison, we chose to compare with an EU-28 average.

The data collection in D3.1 was done in a consistent way that allowed for a comparison between the countries. Sources that contain information about all six countries were therefore prioritized, such as data from the European Commission. The IEA reports on country reviews were another important common source, as the IEA has made reviews for all countries except Slovenia. When IEA's review reports were outdated or lacked relevant information, we complemented with information from websites, national reports and statistics. For more information about the data used, see D3.1.

As this deliverable is based primarily on the figures from D3.1, it shares many of the same delimitations in terms of which aspects of the countries' national characteristics that are compared. The deliverable does therefore not compare characteristics of for instance institutional settings or actors that are not covered by D3.1. Only a few additional socio-economic characteristics were compared. The two deliverables, D3.1 and D3.2, will be the basis for the coming analysis (D3.3) of how different settings correlated to polycentric governance influence whether and what types of ECs are developed, and what enables or hinders the emergence of new ECs in the different countries. D3.3 will allow a deeper analysis of the findings of D3.2, linking greater to further literature on ECs.

2.3 Structure of the document

This deliverable is structured in the following way: The six countries' characteristics are compared in Chapter 3, beginning with an overview of their energy communities in section 3.1. The countries' socio-economic conditions are contrasted in section 3.2, followed by a comparison of their technical systems including energy production and consumption and the electricity

[4] Roberts, J & Gauthier, C. (2019) "Energy communities in the draft National Energy and Climate Plans: encouraging but room for improvements", REScoop.eu, European University Viadrina, Friends of the Earth Europe.

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system (section 3.3). Section 3.4 presents the countries' institutional settings, with focus on energy policy, renewable energy support and subsidies. Section 3.5 compares the actors involved in the partner countries. Chapter 4 summarises and discusses the findings in sections according to the themes discussed in chapter 3. The findings are related to the next deliverable, D3.3. The final chapter 5 draws conclusions.

3 COMPARISON OF THE COUNTRIES

In D3.1, socio-economic, technical, and institutional characteristics of the six partner countries (NL, SE, UK, DE, IT, SI) were described. In this chapter we will do a comparison of the six countries' characteristics and add a comparison to an IEA average or an EU-28 average. We start by giving an overview of existing ECs in the NEWCOMERS' countries.

3.1 Overview of energy communities in the partner countries

In D3.1. a short overview of the existing ECs in the countries was given. **Fel! Hittar inte referenskälla.Fel! Hittar inte referenskälla.** displays an overview of the countries' ECs with key figures.

Table 3.1 Overview of characterisations of the countries' energy communities

	UK[5]	DE[6]	NL[7]	SE[8]	IT[9]	SI[10]
Number of ECs	**>1500 ECs**		**>100 ECs**		**<50 ECs**	
Definition of EC	EC is defined in the EC strategy	Lack a single definition. EC for wind-based electricity production is defined in Renewable Energy Act	EC in renewable electricity production defined in legal framework	Lack a single definition	Lack a single definition	Lack a single definition. RES community is defined in by-law

[5] https://www.gov.uk/guidance/community-energy; Government of the United Kingdom (2014) Community Energy Strategy: Full Report
[6] Bridge horizon 2020 (2019) Energy Communities in the EU. Task force Energy Communities; https://www.unendlich-viel-energie.de/media/file/3591.89_Renews_Spezial_Community_energy_LECo.pdf; https://www.buendnis-buergerenergie.de/fileadmin/user_upload/wpbl27_BEG-Stand_Entwicklungen.pdf
[7] Bridge horizon 2020 (2019) Energy Communities in the EU. Task force Energy Communities; Kooij, H-J., Oteman, M., Veenman, S., Sperling, K., Magnusson, D., Palm, J. & Hvelplund, F. (2018). Between grassroots and treetops: Community power and institutional dependence in the renewable energy sector in Denmark, Sweden and the Netherlands, Energy Research & Social Science, 37, 52-64; https://www.hieropgewekt.nl/uploads/inline/Lokale%20Energiemonitor%202019_DEF_feb2020_2.pdf; https://www.hieropgewekt.nl/local-energy-monitor
[8] Magnusson, D. & Palm, J. (2019). Come together-the development of Swedish energy communities, Sustainability, 11(4), 1056.
[9] Candelise, C. & Ruggieri, G. (2017). Community energy in Italy: Heterogeneous institutional characteristics and citizens engagement, IEFE, Center for Research on Energy and Environmental Economics and Policy, Università Bocconi, Milano, Italy.; Magnani, N. & Osti, G. (2016). Does civil society matter? Challenges and strategies of grassroots initiatives in Italy's energy transition, Energy Research and Social Science, 13, 148-157; R.J. Hewitt et al. (2019). Social innovation in community energy in Europe; a review of the evidence, Frontiers in Energy Research, 7(31)
[10] https://www.compile-project.eu/news/installation-and-connection-of-pv-in-luce-slovenia/; http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED7867; https://oe.finance.si/8856504/Mala-hidroelektrarna-Krajcarca-primer-kaj-zmore-zadruga

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First EC	In the 1990s	Has existed for at least 2 decades	1980s	1970	1962	1992
Technology	Wind, solar, hydro-electricity, heat pump, biomass energy efficiency	Solar, wind, biogas, DH, own grid	Solar, wind, heat, but also car sharing	Wind, heat, eco-villages, solar, "rural communities"	Hydro-electricity, solar, wind	PV, hydro-electricity, (wood biomass for) DH

Table 3.1 shows that ECs have developed in the studied countries during the last twenty to sixty years. The number of registered ECs in the partner countries differ greatly. The United Kingdom and Germany are in the lead with 5000 and 1747 registered ECs respectively, followed by the Netherlands (585) and Sweden (140). Italy and Slovenia have substantially fewer ECs developed compared to the other countries, with 34 and 5 registered respectively.

These numbers of ECs presented in Table 3.1 and Figure 3.1 are collected based on the NEWCOMERS project's definition of clean energy communities in D2.1, the deliverable that provides the project's theoretical framework. A clean energy community is defined as an "association of actors engaged in energy system transformation for reduced environmental impact, through collective, participatory, and engaging processes and seeking collective outcomes".[11] The NEWCOMERS definition may be broader than the definitions of ECs established by public actors in the six studied countries. Community initiatives defined by the NEWCOMERS project as ECs may likewise be described by a different terminology by the countries.

The countries were examined in order to find current national definitions of ECs in place similar in type to the two official definitions of ECs established at an EU level. Two of the eight legislative steps of the European Commission's 'Clean Energy for all Europeans' package define ECs, namely the revised Electricity Directive (IEMD, 2019/944/EU) and the revised Renewable energy directive (RED II, 2018/2001/EU). The two definitions of ECs are citizen energy communities (CEC) in IEMD and renewable energy communities (REC) in RED II. Both definitions see ECs as voluntary, member-controlled initiatives to organize collective cooperation of energy-related activities in a way that emphasizes a range of community benefits over strictly focusing on financial profits. RECs can be considered as a subgroup of CECs as they have stricter requirements, such as only allowing renewable energy production and including proximity conditions of members.[12] The directives are under transposition in all Member States. The full definitions of CEC and REC and a further discussion on their similarities and differences can be found in D2.1.

As Table 3.1 shows, several of the countries were found to lack a single government-defined national definition of ECs (DE, SE, IT, SI). This lack of national definitions influences the countries' data on registered ECs. Germany, the Netherlands, Slovenia and the United Kingdom have legal

[11] van der Grijp, N.M. et al. (2019). Theoretical framework focusing on learning in polycentric settings. Deliverable D2.1 developed as part of the NEWCOMERS project, funded under EU H2020 grant agreement 837752, December 2019, p.23.
[12] Caramizaru, E. & Uihlein, A. (2020) Energy communities: an overview of energy and social innovation

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frameworks in place for some type of ECs. The legal frameworks in DE, NL and UK were established without the RED II and IEMD definitions in mind but share certain similarities.[13]

The German Renewable Energy Act (EEG) that entered into force in 2017 defines the concept of "Bürgerenergiegesellschaft", or 'Citizens' Energy Company'. Citizens Energy Companies cover solely electricity production from wind and have requirements in place concerning a minimum number of involved members (ten) and voting rights, where 51 percent of voting rights are reserved to citizens.[14] The EEG was established without the EU Clean Energy package in mind, but nevertheless gives effect to for instance the right in RED II on a support scheme that accounts for the specificities of renewable ECs. Overall, Germany does not have a single definition for all types of ECs. The term often used is "citizen energy" (Bürgerenergie) which can cover both groups and individuals.[15]

In the Netherlands, a regulatory sandbank was established in 2015 that focuses primarily on sustainable energy generation and energy efficient grid use. The framework includes energy associations or cooperatives who can only operate on the electricity sector and need to be based in renewable energy sources. Currently, members need to be connected to the same medium or low voltage network and 80 percent of participants need to be private end-consumers. The experimental regime is based on an article of the Dutch Electricity Act 1998 and the Crown decree of 28 February 2015 on experiments on decentralized sustainable electricity generation, commonly known as the Experiments Electricity Law-regime. The exemptions to the regime are also further coupled to regulations or restrictions by the Minister of Economic Affairs and Climate. A revised experiment scheme seems to be underway to broaden to any type of entity within either electricity or gas without a proximity requirement as well as to allow new possible partnerships. The regulatory framework was not established with the EU Clean Energy package in mind, but certain features can be seen as an implementation of some rights under both RED II and IEMD, such as the right to fair, proportionate, transparent and non-discriminatory procedures.

In 2019, Slovenia adopted a new by-law for Self-supply of Electricity from Renewable Energy Sources that introduces the concept of Renewable Energy Source Community (RESC). The new by-law allows RESC to operate on the electricity market to the extent that it is fully based on renewable energy. The by-law is viewed as an important step towards a later transposition of the related EU-directives. The RESC differ in several ways from the CEC and REC of the Clean Energy package. For instance, the Slovenian framework has a considerably narrower scope as it is primarily focused on RESC as a form of collective self-consumption with more limited rights, privileges, and responsibilities. The participation criteria are broader than CEC and REC as any entity can participate, but the proximity requirements are stricter than a REC as all members must be located behind the same transformer station.[16]

The United Kingdom defines 'community energy' in its national Community Energy strategy from 2014.[17] The term includes community projects or initiatives focused on the four strands of reducing energy use, managing energy better, generating energy (electricity or heat) or purchasing energy. Both communities of place and of interest are included, and there is an emphasis on community benefits and community ownership and leadership. In addition, shared ownership or joint ventures where benefits are shared by the community are included, such as

[13] Bridge horizon 2020 (2019) Energy Communities in the EU. Task force Energy Communities
[14] Bridge horizon 2020 (2019) Energy Communities in the EU. Task force Energy Communities
[15] https://www.unendlich-viel-energie.de/media/file/3591.89_Renews_Spezial_Community_energy_LECo.pdf
[16] Bridge horizon 2020 (2019) Energy Communities in the EU. Task force Energy Communities; http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED7867
[17] Government of the United Kingdom (2014) Community Energy Strategy: Full Report

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co-operatives, social enterprises and development trusts, as well as projects without formal structures. The UK's definition of community energy was established prior to EU's Clean energy package and the 2014 strategy does not discuss the eligibility requirements of ECs as closely as the EU directives. The reported number of countries' ECs differ in studies due to the above described differing terminology and definitions of ECs. In particular, the number of the United Kingdom's ECs differ significantly between studies, where These categories of high, medium and low numbers of ECs with corresponding colours are used throughout D3.2 in order to analyse the comparisons of the countries' national settings of polycentrism in relation to their development of ECs. These linkages between the three categories and the countries' national characteristics will also be furthered explored in D3.3. The three categories are based on the countries' most current reported numbers of ECs, which lends itself for a comparison of the countries' current state of ECs. The single figure of ECs presently in place in the countries does however not reflect trajectories of EC development over time.

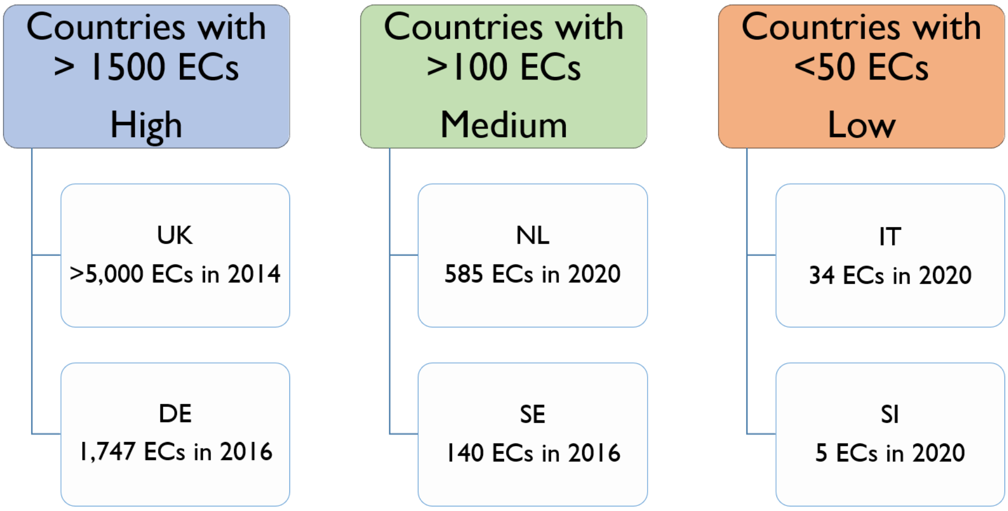

Figure 3.1 The countries divided into three segments according to their number of energy communities

is based on UK government figures that account for more than 5,000 ECs[18] while a JRC report presents 431 energy communities in the UK.[19] The UK figure of over 5,000 ECs was chosen by the NEWCOMERS project as government numbers and other public sources were prioritized in the data collection. Furthermore, the type of initiatives included by the UK government aligns well with the type of initiatives included by public sources in other studied countries, such as in the Swedish case. Nevertheless, it is important to keep the potential difference in terminology between studies in mind and that is also why the number of ECs differ between sources.

Fel! Hittar inte referenskälla.Fel! Hittar inte referenskälla. exhibits that ECs across the six countries share certain common traits concerning the type of energy produced. All the countries have ECs that focus on solar power and nearly all include wind power projects as well, apart from Slovenia which has so far only a focus on PV and hydroelectricity. United Kingdom and Italy also have ECs with registered hydroelectric initiatives. Other types include biogas, district heating (DH) and other heat production, ownership of a local grid, eco-villages as well as other sharing initiatives. These findings are mirrored in a JRC report of twenty-four case studies of ECs in nine countries (Belgium, Denmark, Germany, France, Poland, Spain, Sweden, Netherlands, and the

[18] https://www.gov.uk/guidance/community-energy
[19] Caramizaru, E. & Uihlein, A. (2020) Energy communities: an overview of energy and social innovation

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United Kingdom) that found solar power to be the dominant generated energy source, followed by wind and biomass.[20] The findings of D3.1 also showed that one of the most common organizational structures of ECs among the countries are cooperatives. A more in-depth analysis of the institutional settings surrounding energy communities can be found in section 3.4. More information on the countries' ECs can likewise be found in D3.1.

In These categories of high, medium and low numbers of ECs with corresponding colours are used throughout D3.2 in order to analyse the comparisons of the countries' national settings of polycentrism in relation to their development of ECs. These linkages between the three categories and the countries' national characteristics will also be furthered explored in D3.3. The three categories are based on the countries' most current reported numbers of ECs, which lends itself for a comparison of the countries' current state of ECs. The single figure of ECs presently in place in the countries does however not reflect trajectories of EC development over time.

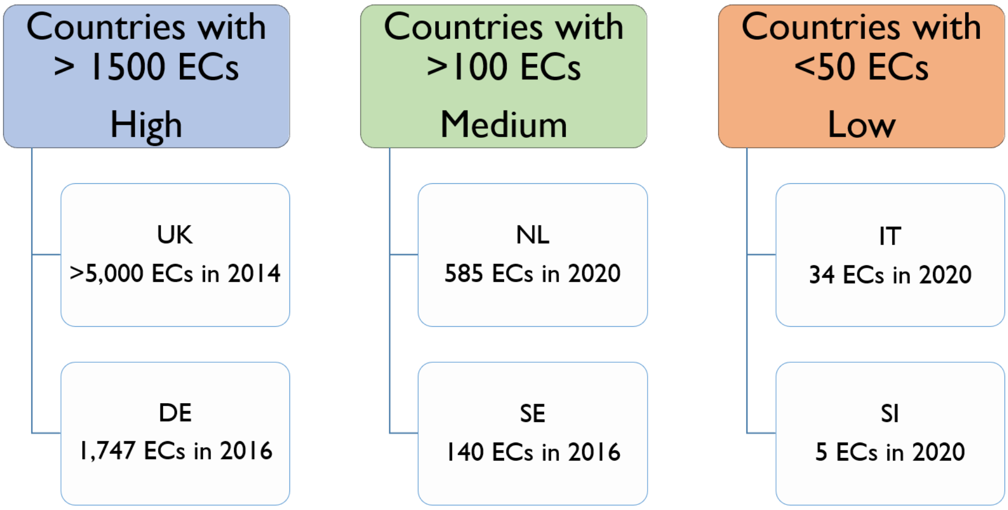

Figure 3.1 The countries divided into three segments according to their number of energy communities

, NEWCOMERS' six partner countries have been divided into three segments based on the number of ECs established in each country. These categories of high, medium and low numbers of ECs with corresponding colours are used throughout D3.2 in order to analyse the comparisons of the countries' national settings of polycentrism in relation to their development of ECs. These linkages between the three categories and the countries' national characteristics will also be furthered explored in D3.3. The three categories are based on the countries' most current reported numbers of ECs, which lends itself for a comparison of the countries' current state of ECs. The single figure of ECs presently in place in the countries does however not reflect trajectories of EC development over time.

[20] Caramizaru, E. & Uihlein, A. (2020) Energy communities: an overview of energy and social innovation

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

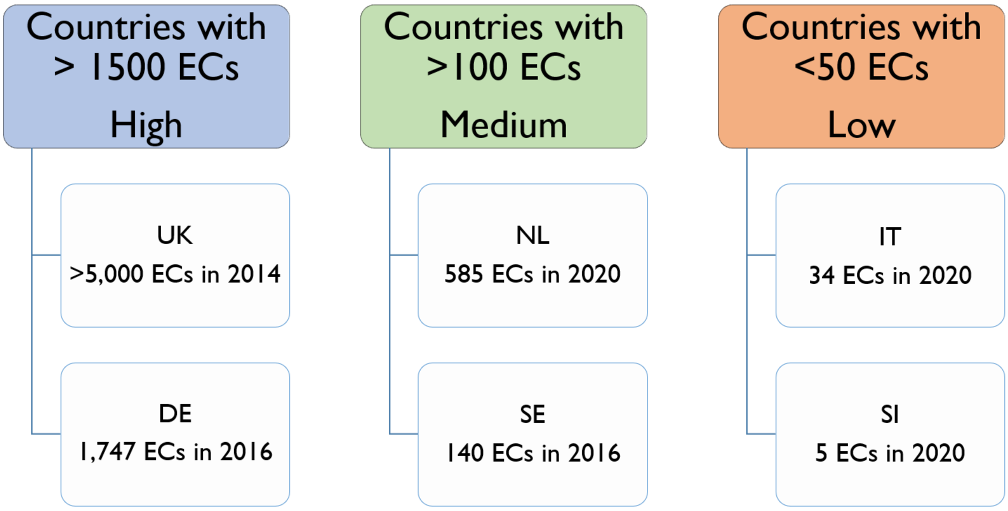

Figure 3.1 The countries divided into three segments according to their number of energy communities

3.2 Context: Socio-economic conditions

In this section, the countries' key socio-economic figures are compared, including GDP per capita, population and urban population.

Fel! Hittar inte referenskälla. ranks the countries' GDP per capita with their corresponding European and world rankings.

Table 3.2 GDP per capita[21]

Country	GDP per capita (USD) (2019)	GDP per capita (USD) Rank Europe (2019)	GDP per capita (USD) Rank world (2019)
Netherlands	52,367.9	7	12
Sweden	51,241.9	8	13
Germany	46,564.0	12	18
United Kingdom	41,030.2	15	23
Italy	32,946.5	16	28
Slovenia	26,170.3	20	36

Fel! Hittar inte referenskälla. shows that the GDP per capita of the Netherlands is double the size of Slovenia's GDP per capita. The significant difference between the countries' GDP means that they represent a wide range in the European ranking of countries in terms of economic output per capita, from place 7 (NL) to 20 (SI). In comparison to the world ranking, all six countries nevertheless represent the top 40 countries with highest GDP per capita. There are no clear differences between the countries with high and medium numbers of EC. IT and SI with both low numbers of ECs are here placed in the bottom of the six countries but are nevertheless still high in the world ranking.

Table 3.3 shows the countries' number of ECs in relation to their population size, ranking the countries according to their number of ECs per million inhabitants. Table 3.4Table 3.4 displays the countries' total population and urban population. The countries are listed according to the size of their urban population, from the highest to the lowest share.

[21] http://statisticstimes.com/economy/european-countries-by-gdp-per-capita.php

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Table 3.3 Countries' energy communities in relation to population size

Country	ECs per million inhabitants	Number of ECs	Population (2020)[22]
United Kingdom	>73.7	>5000 ECs in 2014	67,886,011
Netherlands	34.1	585 ECs in 2020	17,134,872
Germany	20.9	1,747 ECs in 2016	83,783,942
Sweden	13.9	140 ECs in 2016	10,099,265
Slovenia	2,5	5 ECs in 2020	2,078,938
Italy	0.6	34 ECs in 2020	60,461,826

Table 3.4 Population and urban population

Country	Urban population (%) (2020)[23]	Population (2020)[24]	Urban population (%) EU Average (2019)[25]
Netherlands	92 %	17,134,872	75 %
Sweden	88 %	10,099,265	
United Kingdom	83 %	67,886,011	
Germany	76 %	83,783,942	
Italy	69 %	60,461,826	
Slovenia	55 %	2,078,938	

Table 3.3 shows that when the countries' number of ECs are ranked according to their relative size, the countries share quite similar placements to the three categories of high, medium and low numbers of ECs in Figure 3.1. UK is still the leading country with its 73.7 ECs per million inhabitants and IT and SI have the lowest relative sizes of ECs with 2.5 and 0.6 ECs per million inhabitants respectively. However, there are also a few noticeable differences between the countries' absolute and relative figures of ECs. While DE has the second highest number of ECs in total, NL has more ECs per million inhabitants than DE. Table 3.3 likewise shows that IT has an even lower relative number of ECs than SI, despite IT's longer history of EC development.

As seen in Table 3.4, the countries represent a range of urban population sizes. The majority of the Dutch population live in urban areas (92 percent) whereas it is only close to half of the population in Slovenia (55 percent). In comparison to the EU average of a 75 percent urban population, four of the countries (NL, SE, UK and DE) have slightly or considerably higher percentages and those are also the one with medium or high numbers of ECs. IT and SI, with the lowest number of ECs, are both below average.

Table 3.5 ranks the countries according to their share of their population with tertiary education.

[22] https://www.worldometers.info/population/countries-in-europe-by-population/
[23] https://www.worldometers.info/population/countries-in-europe-by-population/
[24] https://www.worldometers.info/population/countries-in-europe-by-population/
[25] https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=EU

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Table 3.5 Tertiary education

Country	Population (15-64 years) with tertiary education (%) (2017)[26]
United Kingdom	38.7
Sweden	36
Netherlands	32.1
Slovenia	28.7
EU-28	27.9
Germany	24.8
Italy	16.5

As Table 3.5 shows, the majority of countries (UK, SE, NL, SI) had a higher share of their population with a tertiary education than the average in EU countries in 2017. The table suggests that there is no strong correlation between the six countries' shares of populations with higher education and their number of ECs. While the three countries with the highest shares (UK, SE, NL) also represent higher numbers of ECs, SI has a higher share of inhabitants with higher education than the EU average despite its few ECs. DE has the opposite relation, with a lower ranking of higher education than the EU average despite its large number of ECs.

Table 3.6 displays the countries according to their inhabitants' levels of trust in other people using data from World Values Survey (2017-2020)[27]. The figures are ranked according to the category "Most people can be trusted".

Table 3.6 Trust in other people

Country	Most people can be trusted (%)	Need to be very careful (%)	Don't know (%)	No answer (%)
Sweden	62.8	35.7	1.2	0.4
Netherlands	58.5	39.8	1.5	0.2
Germany	43.4	52.5	3.2	0.8
United Kingdom	40.2	59.3	0.5	0.0
Italy	26.6	71.3	1.6	0.6
Slovenia	25.3	73.2	1.0	0.5

The countries are in Table 3.7 ranked after the level of trust in the political system. The figures are from Eurostat (2013)[28] and the unit of measure is the average of all individuals' ratings on a scale from 0 ("not satisfied at all") to 10 ("fully satisfied").

Table 3.7 Trust in political and legal system

Country	Trust in political system (2013)	Trust in legal system (2013)
Sweden	5.5	6.7
Netherlands	5.5	6.2
Germany	4.9	5.3
United Kingdom	3.8	5.5
EU-28	3.5	4.6
Italy	2.1	3.6
Slovenia	1.8	2.7

[26] https://ec.europa.eu/eurostat/web/products-datasets/-/edat_lfs_9903
[27] http://www.worldvaluessurvey.org/WVSOnline.jsp
[28] https://ec.europa.eu/eurostat/web/products-datasets/-/ilc_pw03

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Table 3.6 and 3.7 display similar results where inhabitants in SE and NL express the largest relative trust in both other inhabitants as well as the political and legal system, followed by DE and UK. IT and SI have the lowest trust in all three categories. While around sixty percent in SE and NL believe that most people can be trusted, approximately seventy percent in IT and SI believe that one needs to be very careful.

In Table 3.7, the countries with high and medium numbers of ECs (SE, NL, DE, UK) have higher trust in both political and legal systems than the EU average. The countries with low numbers of ECs (IT, SI) have lower trust in both categories than the EU average. Particularly the trust in the countries' political systems are low in both IT and SI, with 2.1 and 1.8 respectively. All countries displayed a higher trust in the legal system than in the political system.

3.3 Context: Technical system

In the following section the countries' energy systems are described, including energy production and consumption, the electricity system, and energy-related emissions.

3.3.1 Energy production

Table 3.8 displays the countries' energy production (Total Primary Energy Supply, TPES) alongside EU and IEA averages. The countries are listed according to their TPES per capita.

Table 3.8 Energy production

Country	TPES (toe)/capita (2018)	TPES (Mtoe) (2018)	TPES (toe)/ capita EU average (2018)[29]	TPES (toe)/ capita IEA average (2018)[30]
Sweden[31]	4.9 toe	47.9 Mtoe	3.1 toe	4.2 toe
Netherlands[32]	4.2 toe	71.7 Mtoe		
Germany[33]	3.6 toe	298.3 Mtoe		
Slovenia[34]	3.4 toe	6.9 Mtoe		
United Kingdom[35]	2.6 toe	176.8 Mtoe		
Italy[36]	2.5 toe	150.6 Mtoe		

As can be seen in Table 3.8, the countries' energy productions differ substantially. Sweden's highest TPES per capita (4.9 toe) is almost the double of Italy's figure (2.5 toe). In relation to the EU and IEA averages, United Kingdom and Italy are below both average values, Germany and Slovenia are situated in between the two averages and the Netherlands and Sweden have the same or larger energy supplies than both average values. The difference between the IEA and EU averages of TPES per capita also suggests that the non-EU members of the IEA have high values of

[29] https://www.iea.org/data-and-statistics?country=WEOEUR&fuel=Key%20indicators&indicator=TPESbyPop
[30] IEA (2020). Energy Policies of IEA Countries. The Netherlands 2020 Review
[31] https://www.iea.org/data-and-statistics/data-tables?country=SWEDEN&energy=Balances&year=2018; https://www.iea.org/countries/sweden
[32] https://www.iea.org/data-and-statistics/data-tables?country=NETHLAND&energy=Balances&year=2018; https://www.iea.org/countries/the-netherlands
[33] https://www.iea.org/countries/germany
[34] https://www.iea.org/countries/Slovenia
[35] https://www.iea.org/data-and-statistics/data-tables?country=UK&energy=Balances&year=2018; IEA (2019). Energy policies of IEA countries. United Kingdom 2019 Review
[36] https://www.iea.org/data-and-statistics/data-tables?country=ITALY&energy=Balances&year=2016; https://www.iea.org/countries/italy

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TPES per capita. There was no obvious trend seen here in relation to how many ECs that exist in the countries.

3.3.2 TPES by source

In Table 3.9, the countries' TPES by source are displayed. The countries are listed according to the column 'Total Fossil Fuels' which is the countries' share of fossil fuels in their TPES, i.e. the sum of the shares in percentage of oil, natural gas and coal.

Table 3.9 TPES by source

Country	Total Fossil fuels (%)	Energy sources in TPES (%)									
		Oil	Natural gas	Coal	Nuc-lear	Wind	Solar	Bio/ waste	Hydro	Geothe -rmal	Electr -icity trade
Netherlands (2017)[37]	91.8	37.8	40.3	13.7	1.4	0.9	0.2	5	-	0.1	0.6
Italy (2016)[38]	79.9	34.1	38.5	7.3	-	1	1.4	8.7	2.4	3.7	2.1
Germany (2018)[39]	79.3	32.8	24.0	22.5	6.6	3.2	1.6	10.1	0.5	0.1	-1.4
United Kingdom (2017)[40]	78.5	34.5	38.6	5.4	10.4	2.4	0.6	7.1	0.3	-	0.7
Slovenia (2017)[41]	61	33	11	17	24	0.3	0.3	10	5	0.3	N.A.
Sweden (2017)[42][43]	27	21.2	1.9	3.9	34.9	3.1	0.4	26.3	11.4	-	-3.3

Although the countries' TPES profiles differ, Table 3.9 displays that there remains a strong dependence on fossil fuels overall. Oil, natural gas and coal have the three largest shares in the energy production of several countries (NL, IT, DE, UK). The Netherlands has the largest fossil fuel dependency with 92 percent of its supply consisting of oil, natural gas or coal. Italy, Germany, and the United Kingdom have similar shares of fossil fuels of close to 80 percent of their total energy production, which is similar to the 2018 IEA median. The countries have nevertheless a larger share of fossil fuels than the EU-28 average of 71 percent in 2018.[44] Slovenia's 61 percent of fossil fuels is thus lower than both IEA and EU averages. The most apparent difference among the countries' fossil fuel profiles is Sweden's low figure (27 percent) as Sweden has by far the lowest share of fossil fuels among the IEA countries.[45] The large shares of fossil fuels in the majority of the countries could provide an incentive for the development of ECs. However, no obvious trends can be identified concerning the countries' shares of fossil fuels and the three categories of ECs.

[37] https://www.ieabioenergy.com/wp-content/uploads/2018/10/CountryReport2018_Netherlands_final.pdf
[38] https://www.ieabioenergy.com/wp-content/uploads/2018/10/CountryReport2018_Italy_final.pdf
[39] IEA (2020). Germany 2020 Energy Policy Review
[40] IEA (2019). Energy policies of IEA countries. United Kingdom 2019 Review
[41] OECD (2019). Fossil Fuel Support Country Note. Slovenia; http://stats.oecd.org/wbos/fileview2.aspx?IDFile=bd2dc92f-1480-46d3-bd55-850d267aeb8d
[42] IEA (2019). Energy Policies of IEA Countries. Sweden 2019 review
[43] Sweden's TPES also includes: Peat 0.3 %.
[44] https://www.iea.org/data-and-statistics?country=EU28&fuel=Energy%20supply&indicator=TPESbySource. This data excludes electricity and heat trade.
[45] IEA (2019). Energy Policies of IEA Countries. Sweden 2019 review

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In the countries' profiles of fossil fuels, the large percentages of natural gas of Netherlands, Italy and the United Kingdom are noteworthy, as these countries have the three largest shares of natural gas in their TPES among IEA members.[46] Sweden's share of nuclear power represents one of the largest shares of nuclear power in a country's TPES in the IEA.[47] Similarly, Table 3.9 shows that nearly one fourth of Slovenia's energy mix consists of nuclear power.

Although many countries show a more diversified energy mix than previously with a reduced reliance on fossil fuels, the countries' shares of renewable energy sources remain small. If excluding the category of bio/waste, as its eligibility as a renewable energy source remains debated, most countries experience low shares of renewables between one percent (NL) to six percent (SI). Sweden's energy supply of renewable sources (15 percent) is the largest share among the countries. All countries have between five to ten percent of bio/waste apart from Sweden with the largest share of 26 percent.

3.3.3 Energy consumption

In Table 3.10 the countries' energy consumption alongside IEA averages are shown. The countries are listed according to their total final consumption (TFC) per capita, from highest to lowest.

Table 3.10 Energy consumption

Country	TFC/ capita (toe)	TFC (Mtoe)	Energy intensity (TFC/GDP PPP)
Netherlands[48]	4.2 toe (2018	64.5 Mtoe (2017)	90.2 toe/USD million PPP (2015)
Sweden[49]	3.3 toe (2017)	33.5 Mtoe (2017)	73.7 toe/USD million PPP (2017)
IEA[50]	2.9 toe (2017)	N.A.	73.9 toe/USD million PPP (2017)
Germany[51]	2.7 toe (2017)	227.0 Mtoe (2017)	62.3 toe/USD million PPP (2017)
Slovenia[52]	2.4 toe (2018)	5.1 Mtoe (2018)	N.A.
Italy[53]	1.9 toe (2014)	116.6 Mtoe (2014)	59.9 toe/USD million PPP (2016)
United Kingdom[54]	1.9 toe (2017)	127.3 Mtoe (2017)	49.0 toe/USD million PPP (2017)

Comparing the values in Table 3.10, the largest energy consumption by the Netherlands (4.2 toe per capita) is more than double of the 1.9 toe per capita of Italy and the United Kingdom. The Netherlands' high TFC per capita is explained by its large refining and petrochemical industries.[55] While the final energy consumption of these three countries (NL, IT, UK) differ noticeably from the IEA average of 2.9 toe per capita, the other three countries (DE, SI, SE) display values that correspond more closely to the IEA average.

The ranking of countries according to TFC per capita to a large extent mirrors their order of energy intensity (TFC/GDP PPP). Similar to the comparison of TFC per capita, Italy and United Kingdom have considerably lower energy intensity values than the IEA average. However, all countries but Netherlands have lower energy intensity than the IEA average. The findings in Table 3.10 suggest

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[46] IEA (2019). Energy policies of IEA countries. United Kingdom 2019 Review
[47] IEA (2019). Energy Policies of IEA Countries. Sweden 2019 review
[48] https://ec.europa.eu/eurostat/documents/2995521/9549144/8-07022019-AP-EN.pdf/4a5fe0b1-c20f-46f0-8184-e82b694ad492; https://estore.enerdata.net/netherlands-energy.html; https://tradingeconomics.com/netherlands/total-final-energy-consumption-tfec-wb-data.html
[49] IEA (2019). Energy Policies of IEA Countries. Sweden 2019 review
[50] IEA (2020). Energy Policies of IEA Countries. The Netherlands 2020 Review
[51] IEA (2020). Germany 2020 Energy Policy Review
[52] https://pxweb.stat.si/SiStatDb/pxweb/en/30_Okolje/30_Okolje__18_energetika__01_18179_bilanca_kazalniki/1817902S.px/
[53] IEA (2016). Energy Policies of IEA countries. Italy 2016 review
[54] IEA (2019). Energy policies of IEA countries. United Kingdom 2019 Review
[55] https://estore.enerdata.net/netherlands-energy.html

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that there is no clear relation between a country's number of ECs and its TFC per capita or energy intensity.

3.3.4 Electricity system

The following section compares key figures in the countries' electricity systems. In 2018, around 500 million citizens were provided by electricity in the EU through an electricity system with 467 000 gigawatt-hours (GWh) of trade.[56]

3.3.4.1 Electricity production

Table 3.11 presents key figures of the countries' electricity productions. The countries are listed by their electricity generation, with the highest value first.

Table 3.11 Electricity production

Country	Electricity generation (TWh)	Net export/import (TWh) (2018)	Installed capacity (GW)
Germany[57]	644 TWh (2018 prov.)	48.7 TWh (net export)	215.5 GW (2017)
United Kingdom[58]	335.5 TWh (2017)	19 TWh (net import)	103.5 GW (2017)
Italy[59]	280.7 TWh (2015)	43.9 TWh (net import)	117.7 GW (2014)
Sweden[60]	159.3 TWh (2018)	17.2 TWh (net export)	39.8 GW (2017)
Netherlands[61]	121 TWh (2019)	8 TWh (net import)	35 GW (2018)
Slovenia[62]	16.3 TWh (2018)	0.5 TWh (net import)	3.6 GW (2017)

Table 3.11 shows that the countries differ in their electricity production, where Germany's electricity generation is fortytimes the size of Slovenia's. The countries' size of electricity generation corresponds quite closely with their relative size of installed electricity capacity. The only countries that change place in their rankings are Italy and the United Kingdom, where IT has a larger installed capacity, and the UK has a greater electricity generation. The countries likewise have different profiles concerning their production in relation to the national demand, where Sweden and Germany are the two sole exporters. As the figures solely represent the outcome of a single year, the countries' total electricity import or export may differ over time depending on a range of factors. In 2018, Slovenia had only a small net import of electricity, but the country's dependency of electricity imports has fluctuated greatly between 2009-2017.[63]

[56] IEA (2020) European Union 2020 Energy Policy Review
[57] IEA (2020). Germany 2020 Energy Policy Review
[58] IEA (2019). Energy policies of IEA countries. United Kingdom 2019 Review; https://www.iea.org/data-and-statistics/data-tables?country=UK&energy=Electricity&year=2018
[59] IEA (2016). Energy Policies of IEA countries. Italy 2016 review; https://www.iea.org/data-and-statistics/data-tables?country=ITALY&energy=Electricity&year=2018
[60] https://www.iea.org/data-and-statistics/data-tables?country=SWEDEN&energy=Electricity&year=2018; IEA (2019). Energy Policies of IEA Countries. Sweden 2019 review
[61] https://www.cbs.nl/en-gb/figures/detail/80030eng; IEA (2020). Energy Policies of IEA Countries. The Netherlands 2020 Review
[62] Agencija za energijo (2019). Report on the Energy Sector in Slovenia 2019; https://www.iea.org/data-and-statistics?country=SLOVENIA&fuel=Energy%20supply&indicator=Electricity%20generation%20by%20source; https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Electricity_production_and_supply_statistics&oldid=59327#Production_of_electricity, data from the excel file
[63] Agencija za energijo (2017). Report on the energy sector in Slovenia 2017

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3.3.4.2 Electricity generation mix

Table 3.12 presents the countries' electricity generation according to their energy source. The table ranks the countries according to the column 'Total Fossil fuels' which is the countries' share of fossil fuels in their electricity generation mix, i.e. the sum of the shares in percentage of oil, natural gas and coal.

Table 3.12 Electricity generation mix

Country	Total Fossil fuels (%)	Total Fossil fuels IEA avg. (%)	Energy sources in electricity generation mix (%)								
			Oil	Natural gas	Coal	Nuclear	Wind	Solar	Bio/ waste	Hydro	Other
Netherlands (2019)[64]	73.2	47	0.1	58.7	14.4	3.2	9.5	4.3	4.6	0.1	5.2
Italy (2015)[65][66]	59.7		4.8	38.3	16.6	-	5.2	9.3	7.8	15.6	2.2
Germany (2018 prov.)[67]	51.5		0.8	13.2	37.5	11.8	17.3	7.4	9.1	2.8	-
United Kingdom (2017)[68]	48.2		0.5	40.8	6.9	21.0	14.9	3.4	10.7	1.8	-
Slovenia (2018)[69]	31.4		0.1	2.9	28.4	35.4	-	1.6	1.7	30	4.6
Sweden (2017)[70]	0		-	-	-	39	11	0.1	9	40	0.9

The countries' shares of fossil fuels based on the generation mix presented in Table 3.12 can be compared to the IEA average of 47 percent fossil fuels. Some countries, such as the United Kingdom with 48 percent fossil fuels and Germany with 52 percent, are quite close to the IEA average. Concerning the countries with a low number of ECs, Slovenia displays less fossil fuels in its generation mix (31 percent) whilst Italy has a higher share (60 percent). The fossil fuel dependency of the Netherlands and Sweden differ the greatest from the IEA average. The Netherlands has one of the most carbon-intensive electricity generation mixes in Europe with a share of 73 percent fossil fuels, whereas Sweden has one of the lowest fossil fuel shares in its mix among the IEA countries. Overall, the six countries display a substantially lower fossil fuel dependency in their electricity generation mix than in their TPES (see Table 3.9).

Correspondingly, the countries' shares of renewable energy sources in the generation mix differ. If the category of bio/waste is treated separately, the majority of the countries (IT, SI, DE, UK) are situated between 20 to 32 percent of renewable energy: 20 (UK), 28 (DE), and 32 (IT, SI). The

[64] https://www.cbs.nl/en-gb/figures/detail/80030eng; https://www.cbs.nl/en-gb/figures/detail/82610ENG
[65] IEA (2016). Energy Policies of IEA countries. Italy 2016 review
[66] Italy's category of 'Other' energy sources represents 2.2 percent geothermal energy
[67] IEA (2020). Germany 2020 Energy Policy Review
[68] IEA (2019). Energy policies of IEA countries. United Kingdom 2019 Review
[69] https://www.iea.org/data-and-statistics?country=SLOVENIA&fuel=Energy%20supply&indicator=Electricity%20generation%20by%20source
[70] Swedish Energy Agency (2019). Energy in Sweden. Facts and Figures 2019. Eskilstuna: Swedish Energy Agency

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Netherlands and Sweden display more outlying numbers of renewable energy in their mixes, with 14 and 51 percent respectively. The studied countries have different profiles of renewable energy sources, where for instance Germany and United Kingdom have the largest shares in wind power among the studied countries whilst Italy has the largest share of solar power among all IEA countries.[71] In total for the six countries, the combined share of hydro power is the largest share of renewable energy sources as a result of Slovenia's and Sweden's high percentages (30 and 40 percent respectively of their total electricity generation). Wind power has the second largest share of renewable energy sources in total.

If bio/waste is included to make the figures comparable to the IEA average of renewable energy in electricity generation, all countries apart from the Netherlands place higher than the IEA 2017 average of 24.7 percent renewable energy.[72]

The countries' dependency on nuclear energy differ greatly as well, where Sweden and Slovenia display high shares (39 respectively 35 percent) and Italy and Netherlands have very low or no nuclear energy included in their electricity mixes.

3.3.4.3 Electricity consumption

In Table 3.13 electricity consumption by country is presented. The countries are listed according to the electricity consumption per capita, from the highest value to the lowest.

Table 3.13 Electricity consumption

Country	Consumption/capita (2019)	Consumption/ capita EU Average (2018)[73]	Electricity consumption (2019)
Sweden[74]	12.8 MWh	6.0 MWh	131.8 TWh
Slovenia[75]	7.1 MWh		14.9 TWh
Germany[76]	6.7 MWh		558.9 TWh
Netherlands[77]	6.7 MWh		116.9 TWh
Italy[78]	5.2 MWh		311.9 TWh
United Kingdom[79]	4.8 MWh		318.3 TWh

In 2018, the majority of the countries (SE, SI, DE, NL) had higher electricity consumption per capita than the EU average of 6.0 MWh. Sweden's electricity use per capita particularly stands out in Table 3.13 as it is close to double of Slovenia's second highest consumption. Sweden's electricity consumption is one of the highest in the world, due to large electricity-intensive industries and traditionally low electricity prices that have also resulted in widespread use of direct electric heating in detached houses.[80]

[71] IEA (2016). Energy Policies of IEA countries. Italy 2016 review
[72] IEA (2019). Energy Policies of IEA Countries. Sweden 2019 review
[73] https://www.iea.org/data-and-statistics?country=EU28&fuel=Electricity%20and%20heat&indicator=ElecConsPerCapita
[74] https://www.iea.org/data-and-statistics?country=SWEDEN&fuel=Electricity%20and%20heat&indicator=ElecConsPerCapita
[75] https://www.iea.org/data-and-statistics?country=SLOVENIA&fuel=Electricity%20and%20heat&indicator=ElecConsPerCapita
[76] https://www.iea.org/data-and-statistics?country=GERMANY&fuel=Electricity%20and%20heat&indicator=ElecConsPerCapita
[77] https://www.iea.org/data-and-statistics?country=NETHLAND&fuel=Electricity%20and%20heat&indicator=ElecConsPerCapita
[78] https://www.iea.org/data-and-statistics?country=ITALY&fuel=Electricity%20and%20heat&indicator=ElecConsPerCapita
[79] https://www.iea.org/data-and-statistics?country=UK&fuel=Electricity%20and%20heat&indicator=ElecConsPerCapita
[80] IEA (2019). Energy Policies of IEA Countries. Sweden 2019 review

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

3.3.4.4 Electricity consumption by sector

Table 3.14 displays the countries' electricity consumption by sector. The countries are listed alphabetically and therefore no colours are used to highlight the countries' different positions. The category 'commercial' includes commercial and public services as well as agriculture and forestry.

Table 3.14 Electricity consumption by sector

Country	Industry (%)	Commercial (%)	Residential (%)	Transport (%)	Other (%)
Germany (2017)[81]	43	28	24	2	2
Italy (2018)[82]	40	34	22	4	N.A.
Netherlands (2018)[83]	33	43	21	2	N.A.
Slovenia (2018)[84]	50	23	25	2	N.A.
Sweden (2017)[85]	39	22	35	2	2
United Kingdom (2017)[86]	30	32	34	2	2

While Table 3.14 shows that the industrial, commercial, and residential sectors account for the largest shares of the final consumption for all countries, the countries' profiles nevertheless differ. Industry has the largest share for the majority of countries (DE, IT, SI, SE,). Especially Slovenia's and Germany's electricity consumption are dominated by the industrial sector (50 and 43 percent respectively). The commercial sector is most pronounced in the Netherlands, which can be partially explained by the country's relatively large consumption by its agriculture and forestry sector (9 percent of total consumption). For the United Kingdom, the industrial, commercial, and residential sectors each account for around one-third of the final consumption. The United Kingdom and Sweden have the largest shares of residential electricity consumption among the countries. For all countries, the transport sector's consumption is very small.

3.3.4.5 Electricity price

Table 3.15 and Table 3.16 display the countries' electricity prices. In Table 3.15, the countries are listed according to their share of taxes and levies in the average price, from the highest share to the lowest.

Table 3.15 Electricity prices[87]

Country	Share of taxes and levies in average price (%) (2017)	Households' average electricity price per 100 kWh (EUR) (2017)
Germany	54 %	28.7 EUR
Italy	38%	21.4 EUR
EU-28	37 %	20.4 EUR
Sweden	35 %	19.4 EUR
Slovenia	31 %	16.1 EUR

81 IEA (2020). Germany 2020 Energy Policy Review
82 https://www.iea.org/data-and-statistics?country=ITALY&fuel=Electricity%20and%20heat&indicator=ElecConsBySector
83 https://www.iea.org/countries/the-netherlands
84 https://www.iea.org/data-and-statistics?country=SLOVENIA&fuel=Electricity%20and%20heat&indicator=ElecConsBySector
85 IEA (2019). Energy Policies of IEA Countries. Sweden 2019 review
86 IEA (2019). Energy policies of IEA countries. United Kingdom 2019 Review
87 https://ec.europa.eu/eurostat/documents/2995521/8489679/8-29112017-AP-EN.pdf/600c794f-c0d8-4b33-b6d9-69e0489409b7

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Netherlands	27%	15.6 EUR
United Kingdom	24%	17.7 EUR

In Table 3.15, Germany particularly stands out as the country with the highest share of taxes and levies, as the share represents more than half of its electricity price. Germany pays the third highest electricity price among all IEA countries, as a result of a high surcharge on electricity consumers to finance renewable energy among other things.[88] All countries have larger shares of taxes and levies than the median tax rate of IEA member countries (22 percent).[89] However, compared to the EU average of 37 percent of taxes and levies in the average household electricity price[90], the majority of countries have lower shares (SE, SI, NL, UK). For all countries but the United Kingdom, their share of taxes and levies mirror their situation in the ranking of electricity price. Despite having the lowest share of taxes and levies, the United Kingdom has higher electricity prices than Slovenia and the Netherlands. In total, all countries but Germany and Italy have lower electricity prices than the EU average of 20.4 Euro per kWh.

In Table 3.16, the countries' average yearly household electricity costs are related to households' average income. The countries are listed according to the households' electricity costs as average share of total household income.

Table 3.16 Electricity prices as share of household income

Country	Households' electricity costs as avg. share of income (%) (2017)	Households' avg. price per 100 kWh (EUR) (2017)[91]	Households' avg. electricity usage (kWh) (2017)[92]	Households' avg. electricity cost/year (EUR) (2017)	Households' mean net income/year (EUR) (2017)[93]
Sweden	6.7 %	19.4 EUR	9601 kWh	1862.6 EUR	27,916 EUR
Slovenia	5.1 %	16.1 EUR	4280 kWh	689.1 EUR	13,585 EUR
Germany	3.9 %	28.7 EUR	3334 kWh	956.9 EUR	24,757 EUR
EU-28	3.9 %	20.4 EUR	3713 kWh	757.5 EUR	19,384 EUR
Italy	3 %	21.4 EUR	2651 kWh	567.3 EUR	18,714 EUR
United Kingdom	2.6 %	17.7 EUR	3666 kWh	648.9 EUR	25,244 EUR
Netherlands	1.8 %	15.6 EUR	3051 kWh	476 EUR	26,355 EUR

Table 3.16 shows that Swedish households had the highest average electricity usage in 2017 (9601 kWh/year), substantially higher than Slovenian households' 4280 kWh per year and the EU average of 3713 kWh per year. The other four countries all have average electricity consumptions between 2600-3700 kWh. Sweden and Slovenia also had the highest electricity consumption per capita, as seen in Table 3.13.

The yearly electricity costs are also the highest shares of household expenses in Sweden and Slovenia, 6.7 and 5.1 percent respectively. As mentioned previously, Sweden's high household electricity consumption can be linked to a traditionally higher usage of electric heating. In 2016,

[88] IEA (2020). Germany 2020 Energy Policy Review
[89] IEA (2020). Energy Policies of IEA Countries. The Netherlands 2020 Review
[90] https://ec.europa.eu/eurostat/documents/2995521/8489679/8-29112017-AP-EN.pdf/600c794f-c0d8-4b33-b6d9-69e0489409b7
[91] https://ec.europa.eu/eurostat/documents/2995521/8489679/8-29112017-AP-EN.pdf/600c794f-c0d8-4b33-b6d9-69e0489409b7
[92] https://www.odyssee-mure.eu/publications/efficiency-by-sector/households/electricity-consumption-dwelling.html
[93] https://ec.europa.eu/eurostat/databrowser/view/ilc_di04/default/table?lang=en

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energy consumption for space heat and hot water in buildings comprised of 26 percent electricity in Sweden.[94] The other countries had considerably lower shares of electricity in heating, such as Germany's 3 percent[95] or UK's 8 percent in total for storage and non-storage.[96] Despite having the second lowest electricity costs per 100 kWh among the countries, Slovenian households pay the second highest relative share of electricity costs as a result of having the lowest average yearly income among the countries. While Table 3.15 showed that Germany had both the highest share of taxes and levies in its electricity price and a substantially higher average electricity price per 100 kWh than the other countries, the share of electricity costs of German households' incomes is the same as the EU average.

Table 3.16 does not show a clear relation between the countries' numbers of ECs and their relative share of electricity costs in household expenses. All three categories of high, medium, and low number of ECs are represented both above and below the EU average of 3.9 percent.

3.3.4.6 The electricity grid

In Table 3.17 the countries' electricity grids and smart grids are contrasted. The countries' transmission system operators (TSO) and distribution system operators (DSO) are explored. The countries are listed alphabetically and therefore no colours are used to highlight the countries' different positions.

Table 3.17 Electricity grids (TSOs, DSOs and smart meters)

Country	TSO	DSO	Smart meters
Germany[97]	4	880 (2013)	Smart meter roll-out slowly occurring. First stage of 2016 Act only targets larger consumers and generation facilities (consumers with an energy consumption exceeding 6 000 kWh per year).
Italy[98]	1	144 (2013)	Almost 32 million installed in homes and businesses in 2015.
Netherlands[99]	1	8 (2017)	In 2018, around 5.2 million (54%) households had a smart meter. Obligation for the DSOs to implement a second round of residential smart meter deployment from 2021 to 2023.
Slovenia[100]	1	5 (2018)	57% of consumers on the distribution system were equipped with smart meters in 2017.

[94] IEA (2019). Energy Policies of IEA Countries. Sweden 2019 review
[95] IEA (2020). Germany 2020 Energy Policy Review
[96] https://www.statista.com/statistics/426988/united-kingdom-uk-heating-methods/
[97] IEA (2020). Germany 2020 Energy Policy Review; https://publications.jrc.ec.europa.eu/repository/bitstream/JRC113926/jrc113926_kjna29615enn_newer.pdf
[98] IEA (2016). Energy Policies of IEA countries. Italy 2016 review; https://publications.jrc.ec.europa.eu/repository/bitstream/JRC113926/jrc113926_kjna29615enn_newer.pdf
[99] IEA (2020). Energy Policies of IEA Countries. The Netherlands 2020 Review; https://energiecijfers.info/hoofdstuk-1/
[100] Agencija za energijo (2017). Report on the energy sector in Slovenia 2017; https://publications.jrc.ec.europa.eu/repository/bitstream/JRC113926/jrc113926_kjna29615enn_newer.pdf; https://www.agen-rs.si/izvajalci/elektrika/distribucijsko-omre

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Sweden[101]	1	173 (2013)	In the process of rolling out second generation of smart meters by the end of 2024. All DSOs will install smart meters.
United Kingdom[102]	Great Britain (GB) is operated by a single Electricity system operator (ESO): National Grid Electricity System Operator (NGESO). EirGrid is the TSO for Northern Ireland (NI).	15 Distribution Network Operators (DNOs) in total: 14 DNOs owned by 6 different groups in GB; and one (Northern Ireland Electricity Networks) in Northern Ireland. A process is underway to develop DNOs into DSOs.	Since 2016, a full-scale rollout of smart meters for both electricity and gas in homes and small businesses on a voluntary basis in GB. Planned end-date of 2024. Semi-smart prepayment meters were introduced to NI in 2002 and by 2014 they were used in approx. 40 percent of households. However, fully smart meters are uncommon as of yet.

Table 3.17 shows that the number of TSOs and DSOs differ between the countries. The majority of the countries have a single TSO (IT, NL, SI, SE), while Germany has four and the UK has an overarching ESO for Great Britain and a regional TSO present in Northern Ireland. The countries' systems of DSOs differ likewise, where some countries only have less than ten (SI, NL), and others have over a hundred (IT, SE) or even closer to a thousand (DE). The United Kingdom has instead fifteen DNOs that are underway to develop into DSOs.

Table 3.17 also displays that all six countries are currently rolling out smart meters, with some countries particularly advancing quickly. Slovenia is for instance one of the leading countries in Europe regarding introducing advanced metering.[103] Similarly, the Netherlands had 54 % of households equipped with a smart meter in 2018.

3.3.5 Energy related emissions

Table 3.18 presents the countries' energy-related emissions. The countries are ranked according to CO_2/population, from the highest to the lowest.

Table 3.18 Energy-related emissions[104]

Country	CO_2/Pop (tCO_2/capita) (2017)	CO_2 emissions (Mt of CO_2) (2017)	CO_2/TPES (tCO_2/toe) (2017)	CO_2/GDP (kg CO_2/2010 USD) (2017)
Netherlands	9.08	155.6	2.10	0.17
Germany	8.70	718.8	2.31	0.19
Slovenia	6.49	13.4	1.94	0.25
United Kingdom	5.43	371.1	2.04	0.13
Italy	5.31	321.5	2.10	0.15
Sweden	3.74	37.6	0.77	0.07

[101] IEA (2019). Energy Policies of IEA Countries. Sweden 2019 review; https://publications.jrc.ec.europa.eu/repository/bitstream/JRC113926/jrc113926_kjna29615enn_newer.pdf

[102] https://www.ofgem.gov.uk/system/files/docs/2019/06/dso_-_ofgem_regulatory_principles_and_priorities_workshop_notes.pdf; https://www.ofgem.gov.uk/electricity/transmission-networks/gb-electricity-transmission-network; https://eu-sysflex.com/partners/eirgrid-eirgrid-plc/; Darby, S.J. & Liddell, C. (2016). Communicating 'smartness': smart meter installers in UK homes, European Council for an Energy-Efficient Economy (eceee).

[103] Agencija za energijo (2019). Report on the Energy Sector in Slovenia 2019

[104] IEA (2019). Key World Energy Statistics

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As Table 3.18 reveals, the carbon-dioxide emissions per capita differ greatly between the countries. The Netherlands' CO_2 emissions per capita is the highest among the countries (9.08 tCO_2 per capita). Sweden has distinctly the lowest energy-related emissions per capita among the countries (3.74 tCO_2), as well as the second-lowest figure in the IEA.[105] The EU-28 average in 2017 of 6.3 tCO_2/capita[106] sits in the middle of the countries; half of the countries have higher carbon-dioxide emissions per capita than the EU average (NL, DE and SI) and the other half have lower (UK, IT, SE).

Examining the column of CO_2/GDP in Table 3.18, all countries place close to a CO_2 intensity of 0.1-0.2 CO_2 where Sweden has the lowest value (0.07). All countries but Slovenia have lower CO_2 intensity than the IEA average of 0.24 in 2016.[107] One difference between the measures is that while Slovenia has the highest CO_2 intensity in relation to its GDP, its CO_2 emissions per capita (CO_2/Pop) and its carbon intensity of the energy mix (CO_2/TPES) are noticeably lower than other countries.

3.4 Context: Institutional settings

In this section, the countries' main subsidy schemes and support for renewables and ECs are presented. More in-depth descriptions of European countries' legal and regulatory frameworks for energy sectors have been presented elsewhere.[108]

3.4.1 Subsidies and support

In Table 3.19, the countries' main subsidies for renewable energy and feed-in-tariff schemes are described. The countries are presented in alphabetic order and no colours are used to highlight the order.

Table 3.19 Renewable energy subsidies and programmes

Country	Main subsidies for renewables	Feed-in Tariffs (FiT)
Germany[109]	Previous tax incentives on biofuels have expired and since 2015, biofuels are subsidised solely through EU biofuel targets.	FiTs and feed-in premiums have supported all RES since the 2000s. Set by government initially and eventually moved to market-based through auctions. The Renewable Energy Sources Act (2000) enabled financial support, guaranteed grid connectivity for renewables and preferential dispatch for 20 years.
Italy[110]	Waste, biomass and other renewable energy are exempt from taxes if used for heat or electricity. Tax credits for instalment costs of solar PV system. Net metering scheme for renewable energy producers.	Had a FiT scheme in place between 2005-2013, especially beneficial for photovoltaic installations.

[105] IEA (2019). Energy Policies of IEA Countries. Sweden 2019 review
[106] https://www.iea.org/data-and-statistics?country=EU28&fuel=CO2%20emissions&indicator=CO2PerCap
[107] IEA (2019). Energy Policies of IEA Countries. Sweden 2019 review
[108] Herbart Smith Freehills (2019) European Energy Handbook 2019-2020. A survey of the legal framework and current issues in the European Energy sector
[109] IEA (2020). Germany 2020 Energy Policy Review
[110] IEA (2016). Energy Policies of IEA countries. Italy 2016 review; Di Dio, V., Favuzza, S., La Cascia, D., Massaro, F. & Zizzo, G. (2015). Critical assessment of support for the evolution of photovoltaics and feed-in tariff(s) in Italy, *Sustainable Energy Technologies and Assessments*, 9, 95-104.

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	Between 1999-2012, a green certificate scheme was in place requiring a yearly minimum quota of renewable electricity inserted into the power system.	
Netherlands[111]	Subsidies for renewable energy through the Sustainable Energy Transition Incentive scheme (SDE+, expanded to SDE++ in 2020) which supports renewables and a wide range of technologies that reduce GHG emissions. A net metering scheme allows energy tax incentives for communities that communally produce electricity from renewable sources (the so-called postal code area scheme). There is also a net metering scheme that supports small-scale PV deployment and subsidies e.g. for energy efficiency measures.	A tender-based premium feed-in scheme (SDE+) since 2011. Replaced by SDE++ scheme in 2020, where sustainable energy techniques will compete on the avoidance of CO2 emissions cost-effectively instead of on produced sustainable energy.
Slovenia[112]	A net metering scheme from 2016 for all renewable energy installations of households and small enterprises, from 2019 for collective self-consumption in multi-apartment buildings and RES communities. Eligiblity for incentives for self-sufficiency in electricity is expanding from individual to small business consumption and community self-sufficiency. A RES and Combined Heat and Power (CHP) support scheme has been in place since 2009. The scheme grants producers state aid for electricity produced using RES and CHP in the form of guaranteed prices or operational support. In the support scheme hydro energy, wind, solar energy, geothermal energy, biomass, biogas, energy from landfill gas, sewage treatment plants and energy from biodegradable waste are included.	A FiT and premium tariff since 2002, granted via tender procedures. Electricity producers can select either a guaranteed FiT or a bonus (premium) on top of the free market price for electricity.
Sweden[113]	Subsidy programme supporting local and regional infrastructure investments since 2015 with around 1900 projects funded. Investment aid	No FiT scheme in place.

[111] IEA (2020). Energy Policies of IEA Countries. The Netherlands 2020 Review; Government of the Netherlands (2016). Energy report. Transition to sustainable society

[112] Agencija za energijo (2019). Report on the Energy Sector in Slovenia 2019; http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED7867#; https://www.energetika-portal.si/nc/novica/n/prenovljene-spodbude-eko-sklada-za-naprave-za-samooskrbo-z-elektricno-energijo-za-izvedbo-4224/

[113] Palm, J. (2018). Household installation of solar panels - motives and barriers in a 10-year perspective, *Energy Policy*, 113, 1-8; IEA (2019). Energy Policies of IEA Countries. Sweden 2019 review

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	of 20% for installation of PVs since 2019. Prosumers who are net buyers from the grid are exempted from network charges for the electricity they feed into the network Households may receive subsidies for investing in storage. Biogas production from manure is supported by a subsidy of a maximum of SEK 0.4/kWh of biogas produced.	
United Kingdom[114]	Major support schemes for electricity generation based on RES include Renewable Obligations (since 2002 but closed for new applications in 2017) with obligations of UK electricity suppliers to source an increasing proportion of the electricity from renewable sources and Contracts for Difference (since 2013) between current and contracted prices paid to suppliers in order to support new large-scale low-carbon generation projects.	FiT scheme between 2010-2019 that supported solar PV, onshore wind, hydropower and anaerobic digestion up to 5 MW and micro co-generation with a capacity up to 2 kW. Generators received payment for every kWh generated and extra for energy exported to the local network. The scheme supported over 800 000 installations, mostly solar, with a total capacity of 6 GW.

Table 3.19 displays the range of renewable subsidies present in the countries. Common strategies are tax incentives on biofuels and other renewable energy sources, renewable obligations and net metering schemes. Several countries (DE, NL, SI) have FiT schemes in place to encourage renewable energy production. Some countries (IT, UK) have previously had FiT schemes in place but have ended the schemes. Sweden is the only country that does not currently have or has previously had a FiT scheme. While Table 3.19 examined the main subsidies for solely renewables, many countries may likewise have subsidies or relief in taxes for fossil fuels for certain sectors as well as energy taxations.

The deliverable D3.1 also revealed that the countries have few or no programmes or subsidies in place that approach specifically ECs. While the subsidies for renewable energy and FiTs presented in Table 3.19 can in most cases be used to support ECs, they do not specifically target these types of communities. Few EU-countries have policies and measures in place to support ECs or national quantitative EC targets.[115] As one of the few programmes in the six countries, the Netherlands has an ambition to realise fifty percent local ownership in wind and solar projects by 2030 through the development of thirty regional energy strategies.[116] NL has furthermore a policy instrument that aims to stimulate local ownership of renewable energy projects through its postal code area scheme. Energy consumers receive a tax deduction for the amount of energy that local community-owned renewable energy projects produce.[117] Within the UK, Wales and Scotland have targets for levels of community energy.[118] The UK government support for ECs has overall

[114] IEA (2019). Energy policies of IEA countries. United Kingdom 2019 Review; https://www.ofgem.gov.uk/system/files/docs/2018/12/essential_guide_to_closure_0.pdf
[115] Roberts, J & Gauthier, C. (2019) Energy communities in the draft National Energy and Climate Plans: encouraging but room for improvements
[116] https://www.iea.org/policies/7986-climate-agreement
[117] Kooij, H-J., Oteman, M., Veenman, S., Sperling, K., Magnusson, D., Palm, J. & Hvelplund, F. (2018). Between grassroots and treetops: Community power and institutional dependence in the renewable energy sector in Denmark, Sweden and the Netherlands, Energy Research & Social Science, 37, 52-64
[118] Roberts, J & Gauthier, C. (2019) Energy communities in the draft National Energy and Climate Plans: encouraging but room for improvements

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decreased since 2010, but a few programmes such as the research and development programme 'Prospering from the Energy Revolution' have some links with ECs.[119] These findings of the countries' overall few programmes and measures targeting specifically ECs mirror the results of the REScoop policy report of all EU Member States' draft NECPs, that found that very few Member States put forward any objective or target for supporting ECs. The report furthermore underlines the importance of separating between self-consumption of renewables as an activity and renewable ECs, which is not just an activity but also a way of organisation.[120]

3.5 Action arena: Actors

In this section, government and other actors engaged with ECs as well as market actors involved in electricity generation and the retail market are described and compared. An overview of the countries' TSOs and DSOs can be found in Table 3.17.

3.5.1 Government, authorities and other actors

In D3.1, the countries' main government actors and institutions responsible for energy policy and regulation were presented. As these actors were found to be very similar across the countries, this deliverable will not discuss these actors in closer detail. In all six countries, ministries and implementing agencies are responsible for formulating and implementing national climate and energy policy. Regional and local governments or federal states likewise have responsibilities in for instance policy implementation or other aspects of energy deliverance. Independent regulatory authorities exist in some countries, overseeing electricity and energy markets. Competition and market authorities to safeguard competition are also common in the countries. For a more detailed outlook on public actors, see D3.1, page 87 and onwards.

The existence of intermediaries and umbrella organisations to support ECs can play an important role in creating visibility and put ECs on the political agenda. A number of the countries (UK, NL and DE) have different forms of umbrella organisations in place. The umbrella organisation Community Energy England enables non-financial support to new initiatives in England. Wales and Scotland have similar organisations.[121] There are also some local government bodies and NGOs that develop and support local energy initiatives in the UK. NL has an umbrella organisation for ECs, Energie Samen, as well as a knowledge platform for local sustainable energy initiatives.[122] Furthermore, the bottom-up Participation Coalition (Participatiecoalitie) has offered to support municipalities and regions with the implementation of the Regional Energy Strategies under the National Climate Agreement.[123] In DE, there is support for ECs from both the German Cooperative and Raiffesen Confederation (DGRV) and the Citizens Energy Alliance (BBEn).[124]

The ten NEWCOMERS case study communities examined in D4.2 also displayed that ECs are often engaged with a range of actors, particularly energy suppliers, technical delivery partners and installers, software developers and grid operators.

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[119] https://www.gov.uk/government/news/prospering-from-the-energy-revolution-full-programme-details
[120] Roberts, J & Gauthier, C. (2019) Energy communities in the draft National Energy and Climate Plans: encouraging but room for improvements
[121] https://communityenergyengland.org/pages/who-we-are
[122] https://energiesamen.nu/
[123] https://departicipatiecoalitie.nl/
[124] https://www.unendlich-viel-energie.de/media/file/3591.89_Renews_Spezial_Community_energy_LECo.pdf

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3.5.2 Market actors

Table 3.20 displays the main market actors in the electricity grid, with focus on the energy producers and retail suppliers. The countries are listed alphabetically and therefore no colours are used to highlight the order.

Table 3.20 Actors in electricity market

Country	Production	Trade	Switching rate of households
Germany[125]	There are several hundred electricity providers. Over 50 % of conventional electricity comes from the four largest utilities (E.ON, RWE, Vattenfall and EnBW), 25% comes from public utilities that operate at the regional or city level. For renewable power, there is a much larger, more eclectic group of producers.	The market share for the four largest companies on the retail level is large, but still less than 40%. End-users had 143 providers in their network to choose from in 2017, and households could choose from 124 providers.	In 2017, the switching rate for households was 7.2%. 41.2% had contracts with the default supplier.
Italy[126]	In 2013, Enel Servizio Elettrico was the largest power producer (25 % of total generation). Next five largest companies cover 24 % of the market: Eni (8.5%), Edison (6%) and A2A Energia, ERG and Iren Mercato (3.1% each)	Three retail markets: -Enhanced market: In total 236 suppliers, but Enel serve 85 % of customers. Significant share of purchases from the single buyer, AU. Italy is the only country in Europe to retain the single buyer model. -Open market: the largest number of retail providers (336 in 2016). Enel largest provider with 35 %. -Safeguarded: two companies.	Within the three markets, more and more customers are actively moving from the safeguarded or enhanced protection market to the open market. Switching between retail providers is however more problematic, requiring time and resources.
Netherlands[127]	The main companies in terms of power generating capacity are Essent, Vattenfall, Eneco and Engie.	In 2019, there were 57 active electricity suppliers on the retail market. The three largest energy suppliers – Essent (RWE), Vattenfall (Nuon) and Eneco –accounted for over 70% of retail electricity sales in 2018.	In 2019, 20 % of retail customers switched suppliers, an increase from around 12.6 % in 2012.

[125] IEA (2020). Germany 2020 Energy Policy Review
[126] IEA (2016). Energy Policies of IEA countries. Italy 2016 review; Stagnaro, C., Amenta, C., Di Croce, G., & Lavecchia, L. (2020). Managing the liberalization of Italy's retail electricity market: A policy proposal, *Energy Policy*, 137.
[127] IEA (2020). Energy Policies of IEA Countries. The Netherlands 2020 Review; Mulder, M., & Willems, B. (2019). The Dutch retail electricity market, *Energy Policy*, 127, 228-239; https://www.energievergelijk.nl/onderwerpen/welke-energieleveranciers-zijn-er; https://www.energievergelijk.nl/wp-content/uploads/2018/06/Energieleveranciers_April2019.jpg

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Slovenia[128]	In 2019, nine companies were operating large facilities with an installed capacity of over 10 MW. Most of the major actors in electricity production are owned by the two parent companies, HSE and GEN Energija.	In 2019 there were 22 electricity suppliers active in the retail market, of which 16 supplied electricity to household consumers. The market share of the three largest suppliers (GEN-I, ECE and E3) were 56.7 % of household customers.	In 2019, 4.9 % of households switched suppliers. The number of switches has decreased the last three years and was close to 7 % in 2016.
Sweden[129]	Electricity generation is dominated by a few large generators. The three biggest generators (Vattenfall, Fortum and Uniper) generate 73% of the total electricity, whereof Vattenfall generates 40% of the total.	There are more than 120 suppliers. At the end of 2017, the largest suppliers were Vattenfall (about 18 % of customers), E.ON (12,5 %) and Fortum (11,5 %), in total about 42 % of customers. Some suppliers operate only locally or regionally.	In 2017, 9.5% of the end-users switched supplier.
United Kingdom[130]	In 2018, there were 170 licensed electricity generators active. Eight generators provide 71% of the volumes in 2017. In particular dominated by six companies who owned approx. 50 % of the total installed capacity in 2017.	Wholesale market has been dominated by six vertically integrated companies active in generation and retail during the last twenty years In 2018 there were 73 suppliers active in Great Britain's electricity market. There have been many new entrants to the market over the past 10 years. No small player has reached a 5% market share.	In 2018, around 18.4% of consumers switched suppliers. More than 60% have only switched once or never. 54% have been on default tariffs for more than three years.

Table 3.20 reveals that all six countries are dominated by a few main generators, between two to eight, that provide the largest share of the electricity volume. Several countries however have a large number of electricity generators in total, which is the case for instance for Germany and the United Kingdom. The countries' retail markets are similarly moderately concentrated, as a few electricity suppliers had large market shares of the customers. The number of active suppliers ranges from 22 (SI), 57 (NL), 73 (UK), more than 120 (SE), 143 (DE) to 336 (IT). Italy thus has the highest number of retail providers among the six countries, both in its open market and enhanced protection market.

These numbers of retail providers must however be contrasted with the column representing the rate of households switching energy suppliers. A country's switching rate can reveal the retail market's competitiveness, but also the activity and agency of consumers in their energy choices. Table 3.20 reveals that while there is an increased number of people making active supplier choices by moving between markets in Italy, it remains time- and work-consuming to change supplier.[131] The Netherlands' switching rate of 20 percent of total retail customers is among the

[128] Agencija za energijo (2019). Report on the Energy Sector in Slovenia 2019; OECD (2019). Fossil Fuel Support Country Note. Slovenia
[129] IEA (2019). Energy Policies of IEA Countries. Sweden 2019 review
[130] IEA (2019). Energy policies of IEA countries. United Kingdom 2019 Review
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countries with the highest retail switching rates in Europe.[132] The United Kingdom's rate of 18.4 percent closely follows. However, the rest of the countries exhibit a lower switching rate of between five to ten percent (DE, SI, SE).

132 IEA (2020) Energy Policies of IEA Countries. The Netherlands 2020 review

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4 DISCUSSION

The following chapter discusses and summarizes the findings of chapter 3, linking the findings to the analysis of the upcoming D3.3.

4.1 Energy communities

The number of ECs differ, where the United Kingdom and Germany have the largest number of established ECs in absolute terms, followed by the Netherlands and Sweden. Italy and Slovenia have substantially fewer ECs. The development of ECs is a process that has been going on for many years (20-60 years) in all partner countries. During these years the countries have most likely developed local versions of ECs and that is also why it can be difficult to come up with a single definition for ECs that fits them all. All countries, except the UK, lack a single government-defined definition of EC, which opens for localized versions to develop within the countries. Several of the countries (UK, DE, NL, SI) have legal frameworks in place to support one type of ECs, such as ECs based solely on electricity production from wind in the case of DE, but these legal frameworks do not necessarily signify that the countries have a single encompassing definition of ECs beyond the support from the legal framework. None of the countries have yet transposed the EU Directives defining ECs in the form of CECs and RECs.

The lack of single definitions of ECs in the countries indicates the development of both national and local versions of what an EC is within the EU, including how an EC should be interpreted and what to include and exclude. The terminology may also differ between countries, such as defining projects as ECs or community energy initiatives. While plural definitions can allow local versions of community energy initiatives that match the local context to arise, it becomes more difficult to target ECs for support in policies. A national definition can be easier to communicate and be used to attract new ECs. The countries' legal definitions of ECs may be aligned following that all Member States are to transpose the EU Directives. The lack of definition is most likely both a benefit and a disadvantage for future development of ECs, which is an important aspect that will be further discussed in D3.3.

At the same time, it seems like the EC developments within the selected countries are quite similar in that many ECs are cooperatives and have a focus on solar and/or wind power. This will be further discussed in D3.3 too, also in relation to WP2 and D2.2 on the project's typology of new clean energy communities.

4.2 Socio-economic conditions

When the GDP per capita was compared, it was found that Italy and Slovenia are placed in the bottom of the six countries with the lowest GDP per capita (even if all countries are ranked high in a global perspective). As Italy and Slovenia are the countries with the fewest ECs in our case study, this result is interesting to discuss in D3.3 in relation to earlier research on whether ECs are for all citizens or only for the wealthiest. Italy and Slovenia are also the countries with the smallest urban population. As ECs are often seen as beneficial for rural areas, this result is likewise of interest to discuss further in D3.3.

When comparing the relative number of ECs in relation to the countries' populations, there are a few differences concerning their placement in the three categories of high, medium and low numbers of ECs. While DE has the second highest number of ECs in total, NL has more ECs per million inhabitants than DE. Likewise, IT has an even lower relative number of ECs than SI, despite IT's longer history of EC development. The different positions of countries in relation to their number of ECs and their population size are of interest to discuss further in D3.3.

When comparing levels of higher education, many of the countries with high or medium numbers of ECs (UK, SE, NL) correspondingly had a higher share of their population with a tertiary

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education than the EU average. There is nevertheless no clear relation between a country's number of ECs and its share of inhabitants with higher education, as both the relative placements of DE and SI did not follow this trend. DE had a high number of ECs but a lower share of its population with a higher education than the EU average and SI displayed the opposite values with a low number of ECs but a higher ranking of higher education than the EU average.

The comparisons of trust in other people and in political and legal systems showed that SE and NL had the highest relative trust in all three categories, followed by DE and UK, and finally IT and SI. The countries with high and medium numbers of ECs (SE, NL, DE, UK) had higher trust in both political and legal systems than the EU average. The countries with low numbers of ECs, IT and SI, had substantially lower trust in all three categories. As previous literature has suggested that a culture of trust and other informal institutions are of significance for the development of ECs, the countries' levels of trust will be of interest to explore further in D3.3.

4.3 Technical systems

When it comes to the countries' profiles of TPES, no clear trend could be seen concerning the countries' share of energy sources and their number of ECs. There remains a strong dependence on fossil fuels, where the Netherlands, Germany, Italy and the United Kingdom all have around 80 percent of fossil fuels out of their TPES. Following this result, the countries had very low shares of renewable energy sources in their TPES. Sweden has by far the lowest share of fossil fuels among the studied countries as well as among IEA countries. Instead, Sweden has a high share of nuclear power compared to the other partner countries. Slovenia shared a relatively high share of nuclear power compared to the other case countries. A high share of nuclear power can be a barrier for the development of new ECs and a high share of renewables can be an enabler. This is an issue that will be further elaborated upon in D3.3.

The most interesting results concerning the countries' final energy consumption was that the largest consumption by the Netherlands (4.2 toe per capita) is more than double of that of Italy and the United Kingdom with 1.9 toe per capita. A related interesting result is that the Netherlands, Italy and the United Kingdom differ noticeably from the IEA average of 2.9 toe per capita, where the Netherlands was above average and the other two under. The other countries (DE, SI, SE) display values that correspond more closely to the IEA average. Based on these results, the energy consumption figures do not seem to have any influence on the number of ECs, as for instance Italy and the United Kingdom have the same low TFC per capita but differ greatly in their number of ECs, from Italy's 34 and the United Kingdom's over 5000s ECs respectively.

The countries' size of electricity production correlates quite well with the countries' number of inhabitants. The only exception is that Sweden and the Netherlands have changed places as Sweden has a larger generation. The countries share the same relative rankings in fossil fuel shares in their electricity generation as their fossil fuel shares in their TPES. The fossil fuel dependency in the countries' electricity generation mix differs most from the IEA average for the Netherlands and Sweden, where the Netherlands has one of the most carbon-intensive electricity generations in Europe and Sweden has one of the lowest. This is reflected also in the figures for renewable energy, where Sweden has a high share of renewables and the Netherlands a low share. Germany and the United Kingdom have the largest shares in wind power among the studied countries whilst Italy has the largest share of solar power among the IEA countries. Sweden and Slovenia have high shares of nuclear power. High fossil fuel dependency could be an enabler for new ECs to emerge, which will be explored further in D3.3.

The shares of fossil fuel, renewables and nuclear power of the Netherlands and Sweden are also mirrored in their CO^2 emissions per capita, where NL has the highest and SE the lowest. Three countries have higher carbon-dioxide emissions per capita than the EU average, namely the

Netherlands, Germany and Slovenia, and the other three countries, the United Kingdom, Italy and Sweden, have lower. Following this ranking of countries, there is no clear trend between the countries' energy-related emissions and their number of ECs.

The majority of the countries (SE, SI, DE, NL) have a higher electricity consumption per capita than the EU average. SE's electricity use per capita stands out as it is close to double of SI with the second highest consumption. The industrial, commercial, and residential sectors account for the largest shares of the final consumption for all countries. Industry has the largest share for all countries but the Netherlands. The electricity consumption in transportation is still low for all countries.

Germany stands out as the country with the highest electricity price, as it has the third highest electricity price among all IEA countries. Nevertheless, the share of electricity costs of German households' incomes is the same as the EU average. All countries but Germany and Italy have lower electricity prices than the EU average. All countries have larger shares of taxes and levies than the median tax rate of IEA member countries. Germany has the highest share of taxes and levies of all six countries. For all countries but the UK, their share of taxes and levies mirror their ranking of electricity price. Despite having the lowest share of taxes and levies, the United Kingdom has higher electricity prices than both Slovenia and the Netherlands.

In relation to average incomes, the electricity costs in Sweden and Slovenia reflect substantially larger shares of the average household income than in the rest of the countries. Sweden has the largest average electricity usage among the countries as well, which is more than double the size of Slovenia's second largest household electricity consumption. Despite having one of the lowest electricity costs, Slovenian households pay the second highest relative share of electricity costs as they have the lowest average yearly income among the countries. No clear relation was identified between the countries' numbers of ECs and their relative share of electricity costs in household expenses. All three categories of high, medium, and low number of ECs were represented both above and below the EU average of 3.9 percent. The impact of high electricity prices as a potential enabler of new ECs to develop will be further examined in D3.3.

4.4 Institutional settings

The countries had a range of renewable subsidies, such as tax incentives on biofuels and other renewable energy sources, renewable obligations and net metering schemes. DE, NL and SI have FiT-schemes in place, while Italy and the United Kingdom have ended theirs. Sweden is the only country that does not currently have or has previously had a FiT scheme. The countries have few programmes or subsidies in place that target energy communities specifically. Examples of quantitative targets to advance ECs and other support programmes could be found in NL, Scotland and Wales. D3.3 will further investigate and discuss the potential effect of generous subsidies for renewables and ECs on the development of new ECs. All six countries are also currently rolling out smart meters, with some countries (SI, NL) particularly advancing quickly.

4.5 Actors

The countries were found to have similar main government actors and institutions responsible for energy policy and regulation. The case studies of D4.2 exhibited that ECs are often engaged with a range of actors, particularly energy suppliers, technical delivery partners and installers alongside other actors such as software developers and grid operators. A few countries have one or several umbrella organisations in place that support ECs (UK, NL and DE). Support in the form of umbrella organisations or intermediaries can be an important factor in order to create supportive national environments for ECs to develop in. The linkages between these types of supportive functions and the development of ECs are further discussed in D3.3. The number of TSOs and DSOs differ between the countries. The majority of countries have a single TSO, apart

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from Germany that instead has four and the United Kingdom that has an ESO for Great Britain and a TSO for Northern Ireland. Slovenia and the Netherlands have up to ten DSOs, Italy and Sweden have over a hundred and Germany has closer to a thousand. The United Kingdom has instead 15 DNOs that are underway to develop into DSOs. In the electricity market all countries are dominated by a few main generators, between two and eight. The countries' retail markets are similarly moderately concentrated. The number of active retailers ranges from 22 (SI) to 336 (IT). The rate of households switching energy suppliers differ where the Netherland's switching rate of 20% is among the highest in Europe, but also the United Kingdom has a high switching rate. Germany, Sweden and Slovenia have a lower switching rate. A diversity of actors on the market together with active customers can both be assumed to enable new ECs to emerge, which is something that will be further elaborated in D3.3.

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5 CONCLUSION

The aim of this deliverable was to compare national characteristics in the six studied countries, Germany, Italy, the Netherlands, Slovenia, Sweden and the United Kingdom in order to explore the settings in which polycentric governance structures and ECs can evolve. The deliverable is based on D3.1 where the national contexts for each country were presented in more detail. In this report, the countries' current developments of ECs were contrasted and the countries were divided into three categories according to their current number of ECs: high (UK, DE); medium (NL, SE); low (IT, SI). These categories served as a basis to analyse the countries' polycentric settings in relation to their development of ECs. Each country's socio-economic conditions, technical system (energy and electricity), institutional arrangements and relevant actors were compared, when suitable with IEA or EU averages.

This deliverable is a first step to analyse how different national contexts linking to polycentric governance forms influence the emergence of new forms of ECs. It also serves as a basis for delivery D3.3 which aims to evaluate what forms of ECs work best in different polycentric settings and what potential there is for learning between different polycentric settings. The findings summarized in the discussion in chapter 4 will be discussed more extensively in relation to earlier research in D3.3.

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

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