establishing Community Renewable Energy Webs - Rolling out a business model and operational tool creating webs of households that jointly manage energy to improve efficiency and renewables uptake

Deliverable 5.1:
Draft report on the legal and administrative framework regarding the adaptability of the eCREW approach

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Executive Summary

This deliverable reports the current situation concerning the legal and administrative framework regarding the adaptation of the eCREW approach in selected countries. The countries are chosen as those hosting Lighthouse Communities (Germany, Spain, and Turkey) and the countries with Follower Communities that demonstrate high potentials for the implementation of the eCREW approach (Austria, Greece, and Italy).

The analysis mainly evaluates the current situation in these countries regarding the adaptation of the Revised Renewable Energy Directive (RRED) 2018/2001/EU and the Revised Energy Market Directive (REMD) 2019/944 of the European Union. These two directives are significant in terms of introducing the REC (renewable energy communities) and the CEC (citizen energy communities) concepts into the EU legislation. In addition to the legislative structure, the administrative frameworks, as well as the interaction between the legal and administrative structures, particularly in the context of the implementation of RECs and CECs, are also assessed.

The deliverable also addresses the energy profiles and energy market structures of the selected countries, since these factors may provide significant pointers to the adaptability of the eCREW approach.

Given the framework defined by the legal and administrative structures, the energy markets and energy profiles of the selected countries, the implementation of the RECs and CECs, hence the eCREW approach is also determined by how individuals and communities perceive these concepts and to what extent they volunteer for participating in these endeavours. In order to address these aspects, the deliverable utilizes information on demographics of the selected countries as well as the results of the ECHOES international survey. The survey was conducted in 31 countries (EU 28 including the United Kingdom, plus Norway, Switzerland and Turkey) with more than 18,000 participants within the context of the H2020 project ECHOES and aimed to identify the perspectives and choices of individuals relevant to energy-related issues and energy transition.

The analysis of the legislative and administrative structures reveals that the adaptation of the directives RRED and REMD are yet to be completed in all selected countries, although some countries (e.g., Greece, Spain, Germany) have demonstrated more progress.

One of the main factors for the adaptability of the eCREW approach is the situation regarding the electricity generation of community initiatives. In all selected countries, there are conditions under which individuals are allowed to generate electricity for their own consumption. However, there are differences in terms of community-based collective electricity generation. Austria and Germany, for instance, have more flexible implementations in this respect, whereas in Turkey there are a high number of and restrictive requirements to be fulfilled, such as being in the same tariff group and being connected to the same connection point, or using a single common meter. As restrictions are imposed in terms of electricity generation, the adaptability of the eCREW approach becomes more difficult.

Energy cooperatives, acting as RECs and CECs are closely related to the eCREW approach, since the CREWs can utilize the framework provided for energy cooperatives in terms of legal and administrative requirements. The situation in selected countries regarding energy cooperatives is not uniform, either. The legislation in Germany, for instance, allows energy cooperatives to be active players of the energy market, Spain legislation imposes limitations in terms of activities that energy cooperatives can perform, and the legislations in Austria and Italy do not allow energy cooperatives to be players in the energy markets.

The analysis of demographic variables point out to negative factors such as ageing populations in general, higher levels of unemployment in some countries, and positive factors such as, increasing levels of education and life expectancies in general, that may affect the adaptability of the eCREW approach.

Based on the results of the ECHOES international survey, the perceptions of individuals that may impact the implementation of RECs and CECs are mainly characterized by high levels of awareness regarding climate change and environmental issues, rather lower tendency to get into action, individually, or with the community. It is important to note that the individuals admit the importance of community action in terms of energy and environment-related issues. However, their trust in the communities for undertaking such joint endeavours needs to be strengthened.

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1 Introduction

This deliverable analyses the legal and administrative framework regarding the aspects related to the eCREW approach in selected countries, namely, Austria, Germany, Greece, Italy, Spain, and Turkey. countries), current legal uncertainty can be an obstacle for its wider uptake and further development. In selecting these countries, the countries with Lighthouse Communities (Germany, Spain, and Turkey) and the countries with Follower Communities showing strong interest towards the implementation of the eCREW approach (Austria, Greece, and Italy) were prioritized.

Since the eCREW approach is conceptualized with the Energy Communities phenomenon in the center, the analysis mainly focuses on the legal and administrative constructs, uncertainties, barriers, as well as motivators and potentials for the development of energy communities, hence the eCREW approach. The key concepts concerning energy communities are introduced to the European Union (EU) legislation by the Revised Renewable Energy Directive (RRED) 2018/2001/EU and the Revised Energy Market Directive (REMD) 2019/944. The former legislation, RRED, introduces and defines the concept of "renewable energy communities" (RECs), and the latter, REMD, introduces and defines the "citizen energy communities" (CECs). Clearly, an assessment of the uptake and implementability of the eCREW approach calls for an analysis of how well the concepts of renewable energy communities and citizen energy communities defined by these directives can be actually practiced in the respective countries. One key issue at this point is to identify the state of progress and current developments in terms of transposing the Revised Renewable Energy Directive and the Revised Energy Market Directive into national legislation in each country. To this end, this deliverable seeks to identify the current situation regarding the adoption of RRED and REMD in developments per country in focus.

Although suitability of the legislative framework is a major determinant, adaptability of the eCREW approach depends on yet another set of relevant factors pertaining to the specific conditions in the selected countries. The analysis of these factors is also included in this deliverable.

To begin with, the administrative framework, including the level of bureaucracy, ease of establishing energy communities, availability of financial skill-wise and knowledge-wise capacity of the administrative units, significantly affect how efficiently and effectively the RECs and/or CECs can be implemented in real life. In this respect, this deliverable analyses the administrative framework in selected countries, and also discusses the interaction between legal and administrative frameworks, with reference to the eCrew approach.

Another important determining factor that connects to both the legislative and the administrative frameworks is the energy market construct and infrastructure. Structure and maturity of the energy markets, level of decentralization, number of players, pricing and tariff schemes, implementability of the split-incentives approach of eCREW, demand management processes, smart meter deployment, and more importantly the existing and potential pathways for the involvement of renewable energy communities and citizen energy communities in the energy market are all essential pointers regarding the eCREW approach. Moreover, the Lighthouse Communities have the electricity providers as CAEs (Community Administering Entities) of the CREWs, which makes the legislative, administrative, and energy market structures even more important for the implementation of eCREW approach. Hence, with these considerations, the energy market structures of the selected countries are also analysed in this deliverable.

The legislative and administrative frameworks as well as the market structure are of crucial importance in terms of paving the way for the implementation of RECs and CECs. Within the framework defined by these factors, the tendency of individuals and communities to participate in RECs and CECs are also affected by the current situations of the selected countries in terms of their energy profiles and progress in communities regarding energy-related initiatives. To provide pointers to these factors, this deliverable also provides an analysis of how the energy profiles of the selected countries have evolved and the current situation in terms of community initiatives, particularly energy-related community initiatives.

Another layer of key factors regarding the adaptability of the eCREW approach pertains to the demographic and socio-economic characteristics, awareness and attitudes of individuals and communities towards the RECs and CECs. Hence, the information regarding the demographic structures of the selected countries is also presented. In order to reflect the perspectives of individuals and communities, results of the ECHOES international survey conducted as part of the H2020 project ECHOES was utilized. The survey included 114 questions aimed at identifying the perspectives and choices of individuals relevant to energy-related issues and in particular, energy transition. The survey was conducted in 31 countries (EU 28 including the United Kingdom, plus Norway, Switzerland and Turkey), with more than 18,000 participants.

1.1 Background and Scope – Key elements and objectives of the eCREW approach

The eCREW approach aims at a shift of focus from the individual-centered energy initiatives to community-centered energy initiatives. In doing so, it foresees the utilization of digital tools (e.g., mobile app) as a significant mediator for fostering the and operationalizing the initiatives that target the energy efficiency and the adoption of renewable energy systems.

The main conceptual element of the eCREW approach is the Community Renewable Energy Webs (CREWs). The CREW consists of households (may also include farms or commercial entities) that jointly utilize their electricity production and storage capacities, as well as their consumption. Hence, a typical CREW involves prosumers and consumers, that balance their energy production and consumption within the CREW community. In this way, the prosumers are able to meet their own energy demand and use their surplus for meeting the demands of consumers within the CREW in return for monetary and non-monetary benefits. The consumers within the CREW are able to participate in an ecosystem based on renewable energy generation and meet their demands from renewable energy systems. In this way, the participants of a CREW can be involved in energy-related cooperation by joining forces towards undergoing the economic burden of establishing a legal entity or making the initial investments. Since all members of the CREW are not necessarily bound to a specific geographic area, the CREW concept can be implemented as a new business model for energy communities, even for energy retailers, providing flexibility and attracting new participants or customers.

Although the CREWs share common goals, such as energy savings and energy efficiency, with household-centered initiatives, the CREW framework calls for the establishment of a more comprehensive operational and decision-making framework as compared to individual-centered incentive systems and initiatives. At this point, the use of digital tools (e.g., smart metering, mobile phone app) is a key element of the eCREW approach in terms of achieving the targets of individuals and CREWs and providing a means for the interaction and cooperation of CREW participants.

Along with the digital tools, members of a CREW are associated with the Community Administering Entity (CAE), with which each member has an electricity supply contract. The CAE is the legal entity authorized to make electricity supply contracts with households and other types of customers.

The CREW members are expected to download a smartphone app (available in the Android and IOS platforms). The smart meters of the members are also connected (i.e., can send information to) the smartphone app. In terms of interaction and cooperation, the smartphone app facilitates the members of the CREW to communicate for determining the common CREW objectives and relevant strategies. On the operational side, the information shared through the smartphone app allows members to make their energy-related decisions as informed decisions based on data and follow best practices and utilize monetary and non-monetary incentives as motivations for adapting energy-savings behaviour.

1.2 The role of empowering community energy initiatives in transforming the European Energy System

With the energy transition progressing, the community energy initiatives are expected to have more significant roles in the energy system. Community energy initiatives act as convenient and correct models for organizing the energy-related actions of the citizens and communities, allowing the citizens to actively participate in these initiatives that support the energy transition.

Along with the empowerment of citizens and communities, community energy initiatives also promote the wider acceptance of renewable energy initiatives, by the individuals and the society. This, in turn, is a motivating factor for private companies or communities that are considering renewable energy investments. There are also direct benefits provided through community energy initiatives, to the citizens. By involvement in these initiatives, citizens can improve their energy efficiency, reducing their energy consumption, and hence energy costs. This, coupled with incentives and supply tariffs also helps in reducing poverty.

On the energy system side, community energy initiatives foster the implementation of community-wide energy storage solutions and demand response techniques. These implementations provide flexibility to the energy systems, reducing the need for installing and maintaining redundant auxiliary supply capacity.

The concepts of energy communities are included in the EU legislation the two directives, RRED and REMD, in the context of the Clean Energy for All Europeans package. These directives enable the participation of individuals and communities in the energy markets. Accordingly, individuals and energy communities are entitled to generate, consume, share, or sell electricity, or provide flexibility services through demand-response and storage. Hence, the directives position the empowerment and active participation of individuals, as well as the uptake of energy communities as central components for the reorganisation and transition of the energy system.

The more formal structure of the energy communities as legal entities enhances the citizens to be able to have a say in the energy market, which would be very difficult to achieve as individuals. The legal identity of the energy communities also provides opportunities for making use of business opportunities and cooperation with other members of the energy market.

The community energy initiatives are also inline with the goals of the directives in terms of the deployment of renewable energy systems along with self-consumption.

2 Conceptualizing eCREW - Community Renewable Energy Web – Approach: Energy Community Initiatives and Legal and Administrative Frameworks

This chapter focuses on the presentation of the eCREW approach related to the market and governance models, as well as existing Energy Community initiatives. The following section provides an overview of the legal and administrative provisions to be observed.

2.1 eCREW approach and its relevance to the existing Energy Community Initiatives

Existing Energy Community Initiatives are heterogeneous in terms of both organisational and legal forms. Examples are peer to peer energy marketplaces, community tariffs, energy clouds with community features or local energy communities. The eCREW approach constitutes another Community Initiative that separates itself from existing schemes.

In eCREW, most members of a CREW are prosumers that produce excess electricity, households capable of storing electricity, or households that consume but not produce electricity. A “CREW contract” is developed together with regional energy retailing companies that hold the right to establish supply contracts with consumers. This contract includes electricity supply and generation surplus trade tariffs with the ability to improve benefits to both producers and consumers of PV electricity. The initiation of promoting energy sharing among CREW members is thus referred to as the split-incentives approach (SIA), as described in Deliverable 2.2: Definition of the split-incentives approach in LCs. This chapter sums up the main points of D2.2, outlining the main eCREW approach and further describes three specific examples of existing Energy Community Initiatives, identified in the competitive landscape analysis as part of Deliverable 2.4 and already been successfully implemented.

2.1.1 Business and Governance Models

The concept of eCREW's business and governance model evolves around this notion of a SIA. The specific layout and implementation of the SIA depends on the prevailing market conditions: the SIA in an open market system versus a subsidised integration of renewable electricity surpluses. In the following, both concepts are briefly discussed.

In the open market system, excess electricity is sold at market costs and every citizen is allowed to sell surpluses to an energy provider at tariff models offered by the provider. Excess electricity is thus generally sold to a retailer/grid for a fixed low feed-in tariff (e.g. 3c€/kWh), while the energy costs of each kWh purchased are higher (e.g. 6c€/kWh). The SIA would offer the following benefits for CREW participants.

Regarding consumers, CREW members can buy excess electricity from other members at a lower price than that offered by the energy provider (e.g. 5c€/kWh). These price differences (e.g. 1c€/kWh) are refunded as bonus payments by the Community Administering Entity (CAE). Grid electricity is only necessary when total CREW demand exceeds total CREW supply. Regarding producers, CREW members can sell their excess electricity to other members at higher prices than if they were to sell it to the grid (e.g. 4c€/kWh). The differences are again paid as bonus payments by the CAE. Selling surpluses for the common feed-in tariff is only necessary when total CREW supply exceeds total CREW demand. Regarding CAEs, the difference between the price the producer receives and consumer pays is the revenue of the CAE (in this example 1 c€/kWh).

Many national regulations offer a subsidised integration of renewable electricity surpluses with fixed feed-in tariffs. Thus, the pure energy price when purchasing electricity from the energy provider is often lower than feed-in tariffs. While the incentives were found in-between provider-defined supply and feed-in tariffs in the open market system, subsidised integration calls for a different SIA concept. One possibility is bonus payments for energy exchanged within the CREW. Since both consumers and producers would benefit monetarily from such payments at the expense of the CAE, such a bonus system is a solution only for the transitional period from subsidised feed-in tariffs to the open market system. The SIA would offer the following benefits for CREW participants.

Regarding consumers, the consumption of excess CREW electricity is incentivised as a bonus (e.g. 1 c€/kWh) credited against the standard energy supply tariff. These incentives are refunded as bonus payments by the CAE. Regarding producers, excess electricity is sold to the provider at standard feed-in tariffs. Surpluses that could be utilized within the CREW are remunerated by the CAE as bonus payments (e.g. 1 c€/kWh) to the producer. Regarding CAEs, their revenue and costs are dependent on national regulations and involve allocations of subsidies. As of now, the CAE has to cover the bonus payments for the CREW members. The benefits for CAEs within this concept are thus mainly based on attracting new clients, until the feasibility of profitable business models under appropriate adaptations of regulations and the implementation of a proper SIA.

The term Community Energy Initiatives is broad and existing Community Initiatives thus vary considerably by organisational and legal framework, scale, goal, etc. Specific examples range from shared energy storage systems in local neighbourhoods set up by the municipality to simple but nationwide electricity tariffs expanded by community features. The following paragraphs present three existing Community Initiatives that differ to a varying degree to the eCREW approach: The Brunnthal Energy Community, the Lition Energy marketplace and the eFriends Energy Community.

The Brunnthal Energy Community was established by shine, a brand of GreenCom Networks, a German-French company based in Munich, Germany. All residents of Brunnthal in the district of Munich, Germany, can join the local community. Public buildings with PV support the community with electricity production. Members can share their excess electricity with the community and receive electricity when they do not produce enough. The business model is based on a monthly fee of 10€ for members, additional 5€ per month cover the smart metering costs. The fixed electricity tariff is 28c€/kWh. Monetary incentives to join the community are a consumption discount of 3c€/kWh when the community is producing enough renewable electricity, and a production premium of 1c€/kWh for electricity consumed in the community, in addition to the existing EEG-remuneration. This incentive scheme resembles the SIA in a market with subsidised integration of renewable electricity surpluses, the energy provider bears the costs of the monetary benefits for the consumers and producers. As of now, only residents of Brunnthal can join the community.

Lition Energy is an energy trading platform established by Lition Energie GmbH, a Berlin-based green energy supplier. Several larger green energy producers are under contract and operate in the marketplace. Others, e.g. private households with PV, can also become sellers on the marketplace if they purchase or own a PV from Lition with a certain minimum capacity. In addition, a so-called solar community is also part of the marketplace. Excess electricity which cannot be consumed or sold on the marketplace, can be sold to the solar community for 1c€/kWh in addition to the existing feed-in-remuneration (in accordance with Renewable Energy Act 2021). Consumers can either select a specific producer or the solar community, to which a larger number of producers contribute, to buy electricity from. In this model, producers set their own desired prices in addition to the EEG-remuneration. This additional price is paid by the consumers. Thus, producers have direct monetary incentives to join the marketplace that are covered by the consumers. The consumers do not have direct monetary incentives within this model.

eFriends is a Community Energy Initiative established by eFriends Energy GmbH, a smaller energy supplier based in Nappersdorf, Austria. Consumers can select a maximum of 6 connections from whom they can purchase their personal electricity mix. The number of connections can be increased for an extra monthly fee. Producers can set their own prices for each connection individually. The maximum net price is 8,3ct/kwh. Thus, energy can also be "sold" for free to friends, family, etc, or two producers can also trade with each other. The amount of energy you trade with another producer within a month can then be consumed at 0ct/kWh. Excess energy that cannot be sold to the community is bought by eFriends Energy at a net price of 4.5ct/kwh. The monthly fee within eFriends is 4.99€. The required eFriends smart-meter costs 349€ plus individual installation costs. eFriends takes 10% of the producers' marketplace revenue. There are no direct monetary incentives for consumers or producers within this model.

2.2 Conceptualization of eCREW approach under Legal and Administrative Frameworks

The eCREW approach positions itself as a third pillar alongside RECs and CECs, with eCREW adding a new business model to the existing system of electricity supply contracts. The following discussion highlights which legal steps are necessary for the implementation of the eCREW approach.

As mentioned above, the eCREW approach is being developed with regional energy retailing companies that have the right to establish supply contracts with consumers. For the implementation of the eCREW approach, a contract is required that regulates provisions with regard to the electricity exchange in CREWs, such as the price for the sale and purchase of surplus electricity within the CREWs as well as the regular electricity purchase from the public grid.

Since the electricity exchange is carried out via the public grids, the respective national grid charges, levies and taxes must be observed.

The setting of prices for electricity from renewable sources results either from the open market or from the subsidized integration of electricity surpluses from renewable sources. The respective national regulations must be observed for this. The eCREW approach is to be adapted accordingly.

In addition to the contractual agreement on electricity price and the administrative support provided by the CEA, it is necessary to observe data protection regulations and access to electricity consumption and production data of the individual CREW members. For the data required for the use of the mobile app or web application, the respective national regulations must also be followed.

The further legal and administrative framework may differ slightly in the individual member states or states outside the EU. The concrete introduction of the eCREW approach has to be examined on the basis of the individual national regulations. This may result in modifications of the eCREW approach when it is introduced as a business model in the respective state.

3 Examining the Relevant EU Directives concerning the adoption of the eCREW Approach

3.1 Overview of Renewable Energy Directive (RED II) 2018/2001/EU

Treaty on the Functioning of the European Union (TFEU) set the goal to generate and use the energy from renewables (Art. 194). To clarify this mission, the EU has regulated several Directives so far.

One of these was Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market This was important because it set national targets for the generation of electricity from renewable sources. The Directive defined the term “renewable energy sources" as “renewable non-fossil energy sources (wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases)”. The personal participation of the citizens in the energy generation was no concern of the Directive and the Union at that time. The Directive was repealed by the Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources. The Directive 2009/28/EC, apart from setting new national targets, brought the obligation to member states to issue a national renewable energy action plan for 2021 – 2030. This is to outline the pathway to reach the targets set forth. One important aspect of the Directive was its requirement from member states to adopt “simplified and less burdensome authorisation procedures” for smaller projects, and for decentralised devices generating energy. Decentralised devices, especially, have been seen as a mean for citizens’ contribution in generating energy from renewable sources. There was no emphasis on collective production, however.

With a new decade in view, the EU decided to renew its target set previously by the said Directives. Directive 2018/2001/EU (RED II) of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources is accepted for this reason.

RED II is a part of the Clean Energy Package, aiming to facilitate the transition to a clean energy economy. Additionally, it was intended to establish a common framework for the promotion of energy from renewable sources and setting binding union targets for the overall share of renewable energy.

The RED II sets a binding Union target for the overall share of energy produced from renewable sources in the Union's gross final energy consumption in 2030. Moreover, through this Directive, the European Union intends? to facilitate the procedures for investors, by reducing the administrative burdens and associated costs. There are also plans to strengthen the production of renewable energy through a cost-effective and market-based support scheme. Finally, a regulatory framework for the right to self-consumption is also planned.

The RED II includes a binding target of 32% for renewable energies within the European Union by 2030, with an upward revision clause by 2023. Unlike previous Directives on the subject, national targets are not specified in the directive.

The rules also serve to create an enabling environment for accelerating public and private investments in innovation and modernization, in all key sectors. It aims to provide guiding principles on financial support schemes RES, self-consumption of renewable energy, energy communities and district heating. It aims to strengthen cross-border cooperation mechanisms, simplify administrative processes, strengthen criteria for sustainability and reduction of greenhouse gas emissions for biofuels, and to integrate the use of renewable energy sources in the transport, heating and cooling sectors.

Like Directive 2009/28 which preceded it, RED II allows the establishment of support schemes which may exist in several forms (Article 2). On the other hand, it establishes more detailed requirements than the current directive; it specifies in particular that these support schemes must "provide incentives for the integration of electricity from renewable sources in the electricity market in a market-based and market-responsive way" (Article 4/2). It also specifies that "support for electricity from renewable sources is granted in an open, transparent, competitive, non-discriminatory and cost-effective manner." (Article 4/4). The support schemes should be designed according to characteristics of renewable energy communities.

Article 15 urges the member states to set proportionate and necessary national rules in competence with the energy efficiency principle. The same article also asks for predictable timeframes for any kind of authorization, certification and/or licensing procedures.

The Directive establishes rules concerning:

- financial aid schemes for electricity produced from renewable sources;
- the self-consumption of this electricity;
- the use of energy from renewable sources in heating and cooling and in transport;
- regional cooperation between Member States and between Member States and third countries;
- guarantees of origin;
- administrative procedures;
- information and training, in particular the establishment of certification or equivalent qualification systems for installers of biomass boilers and stoves, solar photovoltaic or thermal systems, surface geothermal systems and heat pumps of small size.

Finally, it defines criteria for sustainability and reduction of greenhouse gas emissions for biofuels, bioliquids and fuels derived from biomass, proportionate according to the date of commissioning of the installations.

Member States must transpose and apply these provisions by 30 June 2021 at the latest.

The most important aspect of the RED II in terms of the e-CREW approach is the introduction of the legal institution of "renewable energy communities".

Article 2/16 of the Directive defines the renewable energy communities (REC) as a legal entity:

- which, in accordance with the applicable national law, is based on open and voluntary participation, is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity;
- the shareholders or members of which are natural persons, SMEs or local authorities, including municipalities;
- the primary purpose of which is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where it operates, rather than financial profits.

As seen, the RED II attempted to define the REC according to organisation, members, and activities.

The RECs have been set up in particular to facilitate the local acceptability of renewable energy projects financed by citizens on private capital. Therefore, it is regulated that (RE) and their members of a REC should be located close to renewable energy projects developed by the community. It should also be noted that a renewable energy community may operate in all renewable energy markets. It can "produce, consume, store and sell renewable energy, including through renewables power purchase agreements" (Art. 22/1-a). However, the activities the RECs can carry out are not limited to those mentioned above. Supplying energy or providing aggregation or other commercial energy services are also possible (Art. 22/4).

Member States are under the obligation to eliminate unjustified regulatory barriers for such communities. They should allow the distribution system operator to work with energy communities. As stated in the definition, the participation to the membership of the communities should be accessible. The terms regarding the elimination of the barriers and administrative procedures of the Directive also apply to RECs.

It should be said that the regulation of REC is seen as a way to expand the share of renewable energy at national level.

Apart from defining REC, RED II allows renewable self-consumers (defined as an actor who holds the right to generate renewable electricity for its own consumption, and who may store or sell self-generated renewable electricity) to act jointly when located in the same building or multi-apartment block. This is not accepted as a community, but as a type of self-consumer by the Directive.

RED II does not include any provision on smart metering and data sharing. This shortcoming is compensated by the Directive 2019/944/EU.

3.2 Overview of Internal Electricity Market Directive (ED 2019) 2019/944

The aim of the internal electricity market regulations is to organise competitive electricity markets, to deliver choices for final customers, to provide new business opportunities, competitive prices, efficient investment signals and higher standards of service, and to contribute to security of supply and sustainability.

The Directive 96/92/EC was the pioneer on this subject. The first regulations, however, fell short of providing full access to the network, creating competitive tariffs and competitive markets. The Directive 2003/55/EC was considered to fulfil these shortcomings. It stayed in force nearly six years, and towards the end of this period, the policy makers examined the obstacles to the sale of electricity on equal terms and without discrimination in the Community. In addition to this, there were new subjects for policy makers to deal with within the Community. One was climate change, considered as a threat to the security of the supply of energy. Moreover, the incentives to join the generating activities were found insufficient. A new directive was drafted and finally accepted by 2009. The Directive 2009/72/EC attempted to solve these issues. This directive stayed in force for a decade, but the market changed during this time. Decarbonisation became a major priority. The Commission's Communications put the citizens at the core of all visionary planning. The old directive expired and a new one was needed. After much work, EU came up with the Directive 2019/944 of 5 June 2019 on common rules for the internal market for electricity.

The Directive outlines rules for the generation, transmission, distribution, supply and storage of electricity, together with consumer protection aspects, aiming to create integrated competitive, consumer-centred, flexible, fair and transparent electricity markets in the EU. Cooperation among member states was found necessary to achieve the goals set forth.

The Directive gives special importance on customer rights, billing, aggregation, citizen involvement in energy generation activities, access to data, electromobility clean energy, new responsibilities for distribution and transmission system operators, as well as national energy regulators. Like RRED, facilitating administrative procedures and burdensome bureaucracy are also among the subjects that attract attention.

From the e-CREW approach, the Directives include, apart from other provisions, two very important factors. The first one is the regulation about the concept of “citizen energy community” (CEC). The second is the regulation on smart meters and data sharing. Apart from these, the definition related to individual and collective self-consumption needs to be examined.

The Directive considered the importance of the citizen’s involvement with the energy market. Consuming self-generated electricity was already on the rise but self-generation was not easy in terms of administrative and legal procedures and financial cost of doing so. Collective action, on the other hand, has the potential for all citizens (that are also consumers) to participate in generating, consuming or sharing energy.

The Directive allows not only a single customer to be counted as “active customer” (Art. 2/6)., but also a group of jointly acting final customers, who consume or store electricity generated within their premises or (if allowed by the State) within other premises, or sell self-generated electricity or participates in flexibility or energy efficiency schemes, provided that these activities do not constitute their primary commercial or professional activity. As seen, the Directive created a legal foundation for one or more final customers to generate and consume – or even sell – the electricity.

CEC, another way of to be counted as collective generation, is defined by the Directive as a legal entity that:

- “is based on voluntary and open participation and is effectively controlled by members or shareholders that are natural persons, local authorities, including municipalities, or small enterprises;
- has for its primary purpose to provide environmental, economic or social community benefits to its members or shareholders or to the local areas where it operates rather than to generate financial profits; and
- may engage in generation, including from renewable sources, distribution, supply, consumption, aggregation, energy storage, energy efficiency services or charging services for electric vehicles or provide other energy services to its members or shareholders”.

The definition is based on organization, purpose and activities.

The Directive constitutes an obligation for member states to enable CEC to access all electricity markets, directly or through aggregation, in a non-discriminatory manner. This means that the CEC may become a distribution system operator (DSO as well). This is important, since the Directive has separated a whole chapter on the regulation of distribution system operators. It gives to DSOs new responsibilities to improve smart and digitalised electricity distribution networks.

The definition of the CEC resembles that of REC, but the two types of community have differences as well. As stated above, a REC should be located close to renewable energy projects, a condition that does not apply to a CEC. A specific emphasis on renewable sources in a REC does not exist for CEC. An energy community can only be called REC if its activity is based on renewable energy sources. A CEC, on the other hand, may choose to use renewable sources or conventional sources. A limitation on CEC, that does not exist for REC, is the dedication of its scope of activity to the electricity market. A REC's area of activity, however, may be all energy markets including the electricity.

The distinction between two energy communities can best be seen on Table.

Table 1: Differences between Citizen Energy Communities and Renewable Energy Communities

	Citizen Energy Community	Renewable Energy Community
Membership	Natural persons, local authorities, including municipalities, or small enterprises and microenterprises	Natural persons, local authorities, including municipalities, or small enterprises and microenterprises, provided that for private undertakings their participation does not constitute their primary commercial or professional activity
Geographic limitation	No geographic limitation, MS can choose to allow cross-border Citizen Energy Communities	The shareholders of members must be located in the proximity of the renewable energy projects that are owned and developed by the Renewable Energy Community
Allowed activities	Limited to activities in the electricity sector. Electricity generation, distribution and supply, consumption, aggregation, storage or energy efficiency services, generation of renewable electricity, charging services for electric vehicles or provide other energy services to its shareholders or members	Can be active in all energy sectors. Production, consumption and selling of renewable energy
Technologies	Technology neutral	Limited to renewable energy technologies

Source: Council of European Energy Regulators, Report on Regulatory Aspects of Self Consumption and Energy Communities, 2019

The Directive gives special attention to metering (including smart metering) and data sharing activities. Energy efficiency and empowerment of final customers are the basic goals of this regulation. The installation of smart metering systems (that is defined as "an electronic system that is capable of measuring electricity fed into the grid or electricity consumed from the grid, providing more information than a conventional meter, and that is capable of transmitting and receiving data for information, monitoring and control purposes, using a form of electronic communication") is specified? as the duty of the member states. The development of smart grids is given importance as well. The Directive regulates the functionalities of smart metering systems in detail (Article 20). The measurement of actual electricity consumption, provision of information on actual time of use to final customers, the privacy of final customers, and the protection of data is accepted among major functionalities. The general principles on data management is also set forth. Data managers are under the obligation to allow the necessary persons / institutions access to data from smart metering systems while ensuring the protection of personal data.

3.3 Overview of Energy Efficiency Directive (EED 2018) 2018/2002/EU

As a part of the clean energy packet that aims to deliver the EU 2030 energy and climate goal, the Directive 2018/2002/EU (EED 2018) on energy efficiency is accepted on 11 December 2018. The EED 2018 actually amends the Directive 2012/27/EU on energy efficiency. The EU is an energy importing union and not self-sufficient in energy. As the dependence on import increases over the years, energy efficiency became a major policy during the first decade of the 21st century. This led to the acceptance of the Directive 2012/27/EU that set some measures for the EU to reach a 20% energy efficiency target by 2020. Some of the measures were:

- annual reduction of 1.5% in national energy sales
- at least 3% energy efficient renovations per year
- a system for buildings on energy efficiency
- preparation of national action plans every three years
- minimum energy efficiency standards and labelling for a variety of products
- energy audits for large companies
- free access to data on energy consumption

It was clear that by the end of 2010's, an update on the Directive was needed. This was done with EED2018. EED 2018 brought a new numerical target for 2030: 32.5% energy efficiency (Art. 1). To reach the target, new measures were announced:

- annual reduction of 0.8% in national energy consumption (Art. 7) (0.24% for Cyprus and Malta).
- annual reduction of 0.8% in national energy consumption for 10 years after 2030 unless the goal is changed by Commission's revision of 2027.
- preparation of a 10 year national energy and climate plan outlining the way to reach the targets (Art. 3)
- right to access to data for households on energy consumption to better understand and control energy consumption
- clear and transparent information on the cost of heating, cooling and hot water consumption.
- a general review of the EED 2018 by 2024 and every 5 years thereafter.

The targets set forth for metering and data sharing carries special importance for the e-CREW approach. EED 2018 urges member states to set up a metering system that will accurately calculate and inform the customer on their actual energy consumption and actual time of use. Special attention is given here for customers who are part of the centralised and district heating and cooling system. All the meters and allocators installed after October 2020 are required to be remotely readable devices.

The information on the energy billing and historical consumption or heat cost allocator readings of final users is required to be available upon request to the final user and/or to an energy service provider. The information that shall be given to final customers with the bill is set with an annex to the EED 2018. As the billing is expected to be made electronically, the privacy and data protection of final users is also important. The member states are required to promote cyber security against any malicious acts. The Directive leaves the member States the right to specify? the responsible organization for information and data sharing duties.

Both billing and access to data shall be free of charge.

If the numerical energy efficiency targets examined, it can be concluded that the targets are threefold:

- EU energy efficiency target set by Art. 1
- Indicative national energy efficiency targets set by Art. 3 that is expected to be announced by National Energy and Climate Plan for the decade,
- Binding national end-use energy savings target set by Art. 7

The following table summarized the difference among the three articles:

Table 2: Differences of numerical energy efficiency targets of EED 2018

	Art. 1	Art. 3	Art. 7
Target	Energy efficiency headline target (32.5%)	Consumption target (max. Annual primary or final energy consumption consumed)	Savings target (primary or final energy saved)
Level	EU: To be achieved collectively	Member States: Contribution per MS towards the overall consumption target	Member States: Assessment of energy savings from energy savings obligation scheme or alternative measures
Legal nature	Indicative	Indicative	Binding
Approach	Political	Top-down, scenario-based, planning	Bottom-up, based on energy savings calculations per measure

Source: https://help.leonardo-energy.org/hc/en-us/articles/360009360159-How-are-the-targets-of-the-EED-defined-and-related-

3.4 Identification of concepts and definitions of the Energy Communities according to RED II and ED 2019

In light of the Paris Agreement on Climate Change, which includes the Union's binding target to reduce emission by at least 40% below 1990 levels by 2030, the European Parliament and the Council have developed a small number of Directives containing the general principles on which Member States' action should be based on to reduce emissions.

In particular, as broadly underlined within Directive 2018/2001 (RED II) and Directive 2019/944 (ED), one of the fundamental elements that has to be implemented in order to achieve the aforementioned targets is the increase of the use of renewable energy.

3.4.1 Renewable Energy Community (RED II)

Within this context, the 131 recitals that precede the text of the Directive RED II, enunciate the remarks, the researches, and the values that have guided the European Parliament and the Council in the adoption of the Directive itself.

In particular, the recital 50 introduces the problem of the length of administrative procedures, one of the major barrier to the development of energy communities; for this reason, each Member State, according to the peculiarities of its system, should provide an appropriate level of governance enabling more coordination between different authorization bodies, as well as a more efficient and transparent administrative process.

Moreover, the recital 63 stressed out the importance of the development of the renewable energies market that creates "positive impact on regional and local development opportunities, export prospects, social cohesion and employment opportunities". The move towards decentralised energy production would also reduce energy transmission loss and foster local community development through the creation of job opportunities and income sources.

In addition, the recital 67 emphasises the role that energy communities could have in the fight against energy poverty, and it also suggests that Member States should provide a discipline enabling all householders – even disadvantaged families and vulnerable consumers – to take part in energy communities.

Article 2. 16 of Directive 2018/2001 (RED II) defines an "Energy Community" as a legal entity of which the main features are:

- the open and voluntary participation to the Community;
- the effective and direct control of the Energy Community exercised by shareholders or members;
- the kind of shareholders who could be natural persons, SMEs or local authorities, including municipalities;
- the purpose of providing to the whole community environmental, economic or social benefits, rather than financial profits.

The following article 22, indexed "Renewable energy communities", contains the principles on which Energy Communities should be based on.

In particular, the first paragraph establishes that participants should be able to maintain "their rights or obligations as final customers" and "that for private undertakings, their participation does not constitute their primary commercial or professional activity".

The second paragraph, states that European Union Member States while transposing the Directive, should guarantee that Energy Communities have the right:

- to use power purchasing agreement to produce, consume, store and sell renewable energy;
- to share between members, the energy produced by the production units owned by the Community itself;
- to access to all energy markets without being discriminated against.

Moreover, the fourth paragraph emphasises the importance of a complete legal and administrative framework able to promote, spread and facilitate the development of renewable energy communities. Within this purpose, the framework should remove all unnecessary legal and administrative obstacles for the birth and the development of Energy Communities as well as to provide "fair, proportionate and transparent procedures, including registration and licensing procedures, and cost-reflective network charges, […] in line with a transparent cost-benefit analysis of distributed energy sources”. The normative framework, according to the regulation of final consumer protection, should also assure a non-discriminatory treatment with regard to the activities, rights and obligations of those who are actively involved in the Community with the role, for example, of producers, suppliers or final customers.

Finally, the seventh paragraph provides that Member States elaborate specific support systems shaped on the peculiarity of Energy Communities in order to allow them to compete with other market participants for economic support.

3.4.2 Citizen Energy Community (ED 2019)

Citizen Energy Communities are governed by the EU Directive 2019/944 of 5 June 2019.

The attention of the European legislator on this issue derives from the development of the distributed energy technologies and from the consumer empowerment that have made community energy an effective and cost-efficient way to meet citizens' needs and expectations regarding energy sources, services and local participation.

The article 2.11 contains a definition of this concept which differs from that of renewable energy communities. The definition is made up of three elements: the first of an organizational type, the second of a finalistic type, and the third, optional.

With specific reference to the organizational requirement, the voluntary and open participation of the members is required, as well as the exercise of effective control by them. Members can be individuals, local authorities or small enterprises.

The second requirement concerns the primary purpose to provide environmental, economic or social community benefits to its members or to the local areas where it operates rather than to generate financial profits.

It is also envisaged that the community can carry out energy activities, including generation, distribution and storage.

The following article 16 is entirely dedicated to the Citizen Energy Communities.

The first paragraph establishes the right of members to leave the community and to retain their rights and obligations as household customers or active customers. It is also envisaged that relevant distribution system operators cooperate with Citizen Energy Communities to facilitate electricity transfers within citizen energy communities. In this regard, the regulatory authority must establish a fair compensation which will be paid by Citizen Energy Communities.

The same provision then focuses on the authorization regime that must be adopted by the member states. In fact, it is envisaged that the Citizen Energy Communities are subject to procedures and obligations that respect the principle of proportionality and transparency, also regarding the overall distribution of the costs of the system.

The second paragraph gives member states the power to ensure that Citizen Energy Communities are open to cross-border participation, are subject to the exemptions provided for closed distribution systems, and have the availability and autonomous management of distribution networks in the area.

One of the main novelties of the directive is in fact the empowerment of Member States to allow citizen energy communities to become distribution system operators either under the general regime or as closed distribution system operators. In these cases, the fourth paragraph states that Member States must ensure that Citizen Energy Communities have the right to conclude an agreement for the operation of the community network with the relevant system operator, they are subject to adequate network charges at the connection points between their network and the distribution network outside the citizen energy community and that such network charges account separately for the electricity fed into the distribution network and the electricity consumed from the distribution network outside the citizen energy community.

The third paragraph regulates the role of energy communities of citizens on the market. It is expected that they can access all energy markets and that they will be treated in a non-discriminatory and proportionate way according to the role played. The financial responsibility of citizens' energy communities is also sanctioned with reference to the imbalances they bring to the electricity grid. It is also specified that energy communities must be treated as active customers regarding the consumption of self-produced electricity. Finally, the right to organize the sharing of electricity produced by the production units owned by the community is recognized, as long as the members of the community retain their rights and obligations as final consumers.

3.5 Positioning eCREW approach concerning the existing community concepts in the EU directives

This chapter deals with the question of how the eCREW approach fits into the European framework. First, it should be noted that the eCREW approach is to be established as a third pillar alongside Citizen Energy Community (CEC) and Renewable Energy Community (REC). On the one hand, it should be said at the beginning that eCREW and the European Energy Communities have the same or similar aspects and objectives. On the other hand, the Energy Communities are different from the eCREW approach in some essential points. These similarities and differences will be discussed in the following and the position of the eCREW approach in relation to the existing Energy Community concept of the EU will be presented.

3.5.1 Similarities between Energy Communities and the eCREW approach

Commonalities exist in the efforts to promote joint electricity generation and electricity use by citizens. The focus of Energy Communities is on electricity, among other things. At eCREW, the focus is on using electricity from renewable energy sources to support the potential of citizens at the household level who have capacities for shared power generation and storage. Another common characteristic is that eCREW aims to promote energy efficiency, while the Energy Communities also have the objective of increasing energy efficiency at the household level.

The REC at European level includes the activity of energy production, consumption, storage and trading. The provisions of the ED 2019 specify for CEC that this community may engage in generation, including from renewable sources, distribution, supply, consumption, aggregation, energy storage, energy efficiency services or charging services for electric vehicles or provide other energy services to its members or shareholders. eCREW enables members in their community to generate electricity and sell their surplus electricity among each other using the public grid. REC and CEC are also to be enabled to exchange energy through the distribution system.

Thus, there are unities about the type of energy (electricity), use of the public grid, and support for households to actively participate in the generation of renewable energy and also to use it efficiently. The differences between the Energy Communities and the eCREW approach are presented below, because eCREW actively supports the participants by providing an app or web application, among other things.

3.5.2 Differences between eCREW approach and Energy Communities

The most significant differences between the eCREW approach and the Energy Communities relate to their establishment. The legal definitions of RED II and ED 2019 already specify that these communities must be established as legal entities. This circumstance is an essential point in which the eCREW approach differs. This is an aspect of eCREW that is intended to provide citizens with simplified access to energy cooperation, because citizens do not have to care about establishing a legal entity.

Participation in eCREW is based on a contract with a local energy retailing company (the Community Administering Entity – CAE) offering the eCREW approach. Administrative activities for CREW members are handled by the CAE, such as preparing the invoice for members and providing the mobile app/web application. The contract (here eCREW-contract) is an electricity supply contract with standard electricity tariffs for consumption and generation. The eCREW contract also specifies that whenever there is surplus electricity for some CREW members, this electricity is automatically purchased from members who, for example, do not have their own generation facility. Only after the surplus electricity has been consumed, the members are supplied with the required residual electricity from the public grid. This makes it possible for households to participate in a community without administrative effort, because only a contract with a CAE is necessary.

Another key difference is in the potential members of eCREW and Energy Communities. RED II and ED 2019 impose a limit on participation. For RECs, only natural persons, local authorities including municipalities, or small and medium enterprises are possible members/shareholders. This excludes larger companies. The situation is similar for CEC. Here, while participation is open for all categories of entities, control of CEC remains with those members/shareholders who are natural persons, local authorities including municipalities, or small businesses. No limitation of participants or their control powers are necessary in the eCREW approach. Main application of eCREW will be by household customers, but industrial companies with their own PV system can also participate. With eCREW, it is not necessary to limit the control powers of its members in the individual CREW. Each eCREW operates under the principle of selling surplus energy and purchase of this energy by other members. The intermediary in this is the energy retailing company (CAE).

Energy Communities have in common under RED II and ED 2019 that the objective of a REC and CEC is not primarily financial profit, but to provide environmental, economic, or social community benefits for its members/shareholders or the local areas where Energy Communities operate. In comparison, the eCREW approach provides for no rejection in regard to potential profits. By establishing eCREW as a business model, the margin between the price of buying and selling electricity in a CREW is the revenue generated by CEAs. Whether individual CREW members also benefit financially is not ruled out by the eCREW approach.

RED II provides for RECs to be located in the proximity of renewable energy projects. This represents a proximity requirement that can be further defined by individual member states when implementing it into national law. For CEC, no proximity requirement is specified in ED 2019. Again, there are no set rules for the eCREW approach as to how far CREW's radius of action extends. It is rather a decision of the CAE how far it rolls out the eCREW business model.

In contrast to energy communities as defined by RED II and ED 2019, the eCREW approach is by default provided through an energy retailing company (specifically CAE). The CAE organizes the CREWs and takes over their administrative responsibilities, which is a significant simplification in this respect.

For Energy Communities, the Directives stipulate that member states must provide e.g. cost-reflective network charges in their implementation of the CEC. The same is also provided for REC. These cost-reflective network charges do not apply to eCREW, which does not interfere with network charges, but applies standard rates.

From the similarities and differences listed above, it is clear that eCREW can be used flexibly. The establishment of a REC or CEC as a legal entity brings benefits in the form of rights and facilitations (which must first be implemented into national law), but all relevant regulations must be complied with in order to enjoy the benefits. eCREW forms an alternative to Energy Communities in this respect. In addition to the provisions of the directives, their specific implementation in the member states must also be taken into account, which makes further consideration with the eCREW approach necessary.

4 National Adoption of eCREW Approach under Legal and Administrative Frameworks in Selected Countries

4.1 Austria

4.1.1 Country Profile

4.1.1.1 Demographics

Austria is located in the southern part of Central Europe and is composed of nine federal states (in German: Bundesländer) including its capital and largest city, Vienna. With an area of around 83.883km², Austria is the 20th largest country in Europe and the 13th largest in the European Union (EU). In 2020, its population was approximately 8.9 million, resulting in a population density of 106 inhabitants per km².

Dividing the population by age groups reveals that roughly 23% are between 45 and 59 years old, and 20%, between 30 and 44. Up to 14-year-olds and 15- to 29-year-olds make up 14% and 17% of the population, respectively. While the dependency ratio in 2019 (age-population ratio of those typically not and typically (aged 15-64) in the labor force) is 50%, meaning the share of economically active is around twice the share of economically inactive, the given age structure might increase the future dependency ratio and thus impose serious implications on Austria's pension system. Also, the share of females (0.51) is slightly higher than the share of males (0.49).

Table 3 shows above statistics for Austria and its 9 federal states. Upper Austria, Salzburg, Tyrol and Vorarlberg belong to Western Austria, Carinthia and Styria to Southern Austria and Burgenland, Vienna and Lower Austria to Eastern Austria.

Table 3: Descriptive Statistics By State, 2020. Data Sources: Area And Population: Statistik Austria (2021a). Age And Gender: Statistik Austria (2020a). Own Calculations.

2020	Austria	Burgenland	Carinthia	Lower Austria	Upper Austria	Salzburg	Styria	Tyrol	Vorarlberg	Vienna
Area (km²)	83882,86	3965,20	9536,47	19179,76	11982,64	7154,52	16399,40	12648,38	2601,66	414,83
Area (%)	100,00	4,73	11,37	22,86	14,28	8,53	19,55	15,08	3,10	0,49
Population	8 901 064	294 436	561 293	1 684 287	1 490 279	558 410	1 246 395	757 634	397 139	1 911 191
Population (%)	100,00	3,31	6,31	18,92	16,74	6,27	14,00	8,51	4,46	21,47
Population Density	106,11	74,26	58,86	87,82	124,37	78,05	76,00	59,90	152,65	4607,17
Dependency ratio	50,24	54,74	54,75	53,23	51,01	50,58	51,30	48,72	50,46	45,08
Female (%)	50,81	50,98	51,24	50,77	50,36	51,08	50,61	50,69	50,36	51,22
Male (%)	49,19	49,02	48,76	49,23	49,64	48,92	49,39	49,31	49,64	48,78
0-14 (%)	14,41	13,13	13,31	14,44	15,13	14,63	13,41	14,55	15,98	14,57
15-29 (%)	17,49	14,40	15,41	16,02	17,47	17,60	16,96	18,21	17,76	19,87
30-44 (%)	20,02	18,34	18,18	18,64	19,51	20,01	19,44	20,19	20,26	22,72

45-59 (%)	22,69	24,20	23,62	23,97	22,72	22,49	22,89	22,76	22,51	20,96
60-74 (%)	15,81	19,17	18,40	16,54	15,83	15,97	16,77	15,19	14,87	13,66
75+ (%)	9,57	10,75	11,08	10,39	9,33	9,31	10,53	9,11	8,61	8,23

Lower Austria is the largest state by area, making up 23% of Austria, followed by Styria (20%) and Upper Austria (14%). While Vienna, the capital, makes up only 0.5% of the total area, it has the largest population, with more than 1.9 million inhabitants, resulting in a population density of 4600 inhabitants per km². Burgenland has the lowest density, with 74. The dependency ratio varies by state, with Vienna reporting the lowest (45%) and Carinthia the highest (55%). This is due to the fact that, in general, states with more urban areas have a smaller older population and a larger prime working age population. Figure 1 shows Austria's population density for each of the 2095 municipalities. While the most densely populated area is Vienna and its surroundings, it is clear that the Austrian Alps, running in a west-east direction, play a major role in Austria's population distribution.

The Alps cover the west, south and the central area of Austria, 62,8% of the total area. In the north, the Alpine- and Carpathian foreland and parts of the Bohemian Forest, a granite mountain range, make up 21.5% of Austria. In the East, the Vienna- and parts of the Pannonian Basin cover 15.7% of Austria. Further, roughly 32% of Austria's area is used agriculturally (Statistik Austria, 2016) and 47.6% is forest area (BFW, 2012). 58.5% of Austria's population is urban, while 41.5% is rural (World Bank, 2019). In 2016, 6.7% of the total area consisted of residential and commercial areas, as well as infrastructures (Getzner and Kadi, 2019).

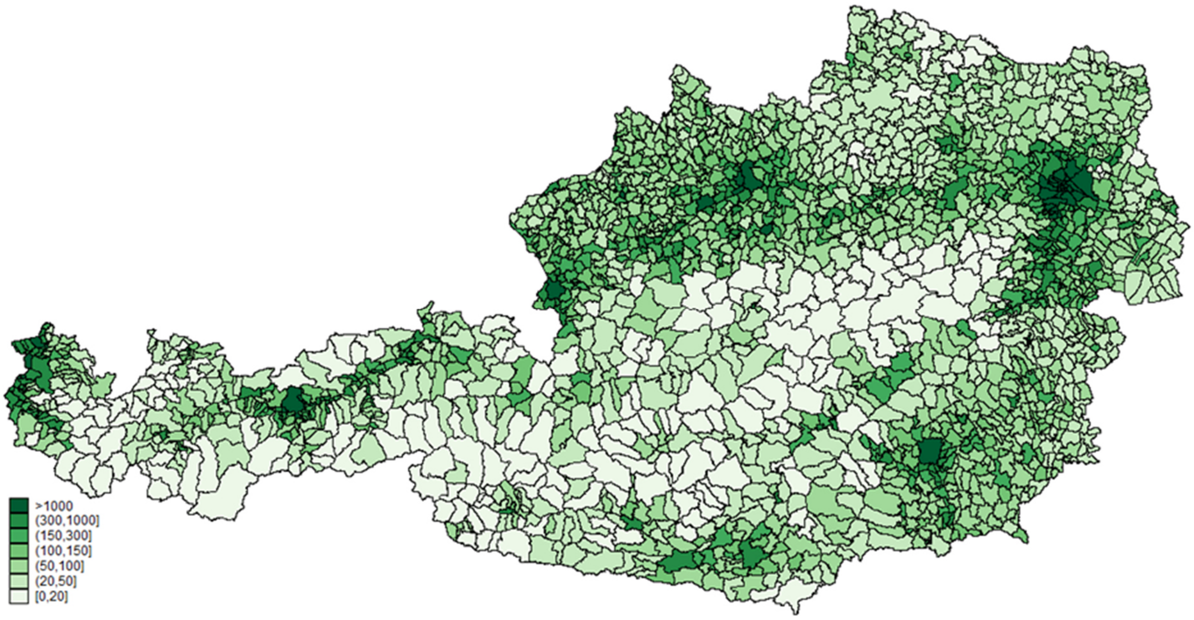

Figure 1: Population Density By Municipality, 2019. Data Sources: Statistik Austria (2020b) and own calculations.

This landscape diversity does not necessarily translate to regional income diversity. In 2019, the average gross income employed per year was around 29.500€, as table 4 shows. This measure includes part-time employees, individuals who are not employed over the full year, and excludes apprentices. Females earned only 64% of male income. This is largely because a larger share of females is part-time employed. Regional heterogeneity exists on a smaller scale, with a difference of the lowest earning state Vienna (27.600€) to the highest, Burgenland (32.300), of less than 5.000€ per year. Vienna also reports the highest ratio of female to male income (81.2%).

Looking at only full-time, full-year employed, the average gross income in Austria was 43.700€. It is apparent that not only regional heterogeneity decreases, but also the difference between female and male income. The gap between the most equal state Vienna (95.2%) and the most unequal state Vorarlberg is still substantial.

Table 4: Income And Education By State. Data Sources: Income: Statistik Austria (2019). Education: Statistik Austria (2018). Own Calculations.

Gross income of employed per year in € (2019)	Austria	Burgenland	Carinthia	Lower Austria	Upper Austria	Salzburg	Styria	Tyrol	Vorarlberg	Vienna
Total	29 458	32 325	30 063	32 621	32 072	28 601	30 491	28 078	31 091	27 615
Female	22 808	24 571	22 611	25 023	22 916	22 169	22 602	20 870	21 719	24 714
Male	35 841	38 969	36 865	39 150	39 955	35 892	37 565	36 152	41 367	30 435
Female income in % of male	63,6	63,1	61,3	63,9	57,4	61,8	60,2	57,7	52,5	81,2
Gross income of full-time, full-year employed per year in € (2019)										
Total	43 719	43 926	43 335	45 159	44 310	43 177	43 265	42 896	46 790	43 902
Female	39 320	39 349	38 574	40 707	37 875	37 885	37 979	37 173	38 812	42 662
Male	45 900	46 429	45 508	47 346	47 030	45 728	45 872	45 652	50 610	44 828
Female income in % of male	85,7	84,8	84,8	86,0	80,5	82,8	82,8	81,4	76,7	95,2
% of 25- to 64-year-olds with college/university degree (2018)										
Total	18,10	13,6	15,5	15,4	14,6	17,3	16,6	16,6	14,5	27,1
Female	19,9	15,3	17,7	17,3	15,9	18,9	18,1	17,8	15	29,4
Male	16,3	11,7	13,2	13,4	13,1	15,7	15,1	15,3	14	24,7

In 2018, the percentage of 25 to 64-year-olds with college/university degrees was 18.1. While regional heterogeneity is rather low, Vienna marks an exception. While 13.6% of this age group attained tertiary education in Burgenland, this share is almost double in Vienna (27.1%). Also, without exception, the share of tertiary education is higher for females in all states. According to the OECD (2021), the percentage of 25-to 64-year-olds with tertiary education attainment (ISCED classification) in Austria in 2019 was 33.9%, while the OECD average was 38%.

While regional income heterogeneity is limited, the unemployment rates vary substantially by state. Table 5 depicts unemployment rates following a national definition for 2020. The national unemployment rate is defined as the ratio of unemployed registered at the Austrian Public Employment Service (in German: Arbeitsmarktservice, AMS) and the labour force potential (AMS registered plus employed).

The average unemployment rate in Austria was 9.9%. Upper Austria reported the lowest rate with 6.5%, and Vienna the highest rate with 15.1%, followed by Carinthia with 11.3%.

Table 5: Unemployment Rate (National Definition) By State, 2020. Data Source: Ams (2020)

National definition	Austria	Burgenland	Carinthia	Lower Austria	Upper Austria	Salzburg	Styria	Tyrol	Vorarlberg	Vienna
Unemployment rate (%)	9,9	9,4	11,3	9,4	6,5	7,3	8,4	8,1	7,7	15,1

Next, Table 6 depicts unemployment rates following the international ILO definition for different age groups in 2020. While the average unemployment rate for all ages (15 to 74) was 5.4%, youth unemployment was significantly higher (10.5%) compared to older age groups. Male and female unemployment rates are similar.

Table 6: Unemployment Rate (Ilo Definition), 2020. Data Source: Statistik Austria (2021b)

ILO definition	15-74	15-24	25-44	45-54	55-64	Male	Female
Unemployment rate (%)	5.4	105	5,6	3,8	4,0	5,5	5,2

As can be seen in Table 7 in 2020, 28.8% of all employees in Austria were employed in the crafts sector, followed by industry, commerce, information and consulting and tourism.

Table 7: Employees By Sector In %, 2020. Data Source: Wko (2021)

	Crafts	Industry	Commerce	Banking and insurance	Transport and traffic	Tourism	Information and consulting
Employees (%)	28.8	18,9	21,3	4,1	8,3	9,2	9,4

4.1.1.2 Energy profile (production, supply, consumption etc.)

Table 8 provides Austria's energy balance in 2019, measured in Terajoule (TJ). National energy production consists largely of renewable energy, namely 83% of total energy production stems from renewable sources. Gas, oil and coal and combustible waste make up only approximately 5% each. However, Austria relies heavily on gas and oil imports. These account for approximately 78% of total gross available energy. Gross final energy consumption has increased by around 1% since 2018 to about 1139 Petajoule (PJ), a similar level to 2017. In the Renewable Energy Directive (2009/28/EC) Austria's goal is to achieve a 34% share of renewable energy in its gross final energy consumption in 2020. In 2019, this goal was almost reached with a share of 33,6% (Statistik Austria, 2020c).

Austria's final energy consumption comprises the transport sector, accounting for 36% of the total, followed by industry with a share of 27%, private households with a share of 25%, public and private services with 10%, and agriculture with a 2% share. Since 2018, energy consumption of the transport sector and private households both increased by 2%, and consumption of public and private services by 3%. The industrial sector however decreased energy use by 2%. Regarding the composition of the total national energy consumption, there were no significant changes of the share of renewables or electricity, and coal-based energy sources, natural gas and district heating however increased by 1% each. In addition, the use of petroleum products increased by +2% (Statistik Austria, 2020c).

Table 8: Energy Balance In Tj, 2019. Data Source: Statistik Austria (2020c)

	Solid (coal and combustible waste)	Gas	Oil	Renewables	Electricity	Total (incl. district heating)
1. Production	28 363	32 237	27 643	430 087		518 330
2. Import	115 234	492 484	637 502	37 578	93 769	1 376 566
3. Stocks	-3 669	105 675	4 103	794		106 903
4. Export	2	97 642	119 950	34 019	82 506	334 118
5. Gross available energy (1+2-3-4)	147 264	321 403	541 092	432 852	11 263	1 453 875
6. Conversion loss	130 487	98 202	418 525	270 531	33	917 776
7. Conversion output	77 796		405 829	10 085	255 083	833 675
8. Consumption of energy sector	63 672	10 460	15 661	0	25 771	115 564
9. Transport loss	611	111			11 896	25 264
10.Non-energy consumption	1 544	14 866	73 603	174		90 188
11. Gross final energy consumption (5+7-(6+8+9+10))	28 747	197 765	439 132	172 233	228 644	1 138 758
Agriculture	17	1 080	9 274	6 873	4 393	22 095
Private households	805	59 050	39 575	82 728	66 175	280 644
Industry	27 921	112 013	12 236	47 985	100 855	311 577
Transport	4	10 510	370 125	20 231	11 804	412 675
Public and private services	0	15 111	7 921	14 415	45 418	111 767

In 2018, road transport accounts for 86% of the transport sector's total consumption and demand has steadily and substantially increased in the past years. Since 1990, energy demand has almost doubled, and since 2015, increased by 8%. The doubling of the demand for road transport and the near tripling of demand for air transport since 1990 are the main drivers of these developments (Statistik Austria, 2020c). On the other hand, the final energy demand of the residential sector has increased at a significantly lower rate until 2018 and was approximately 15% above the value of 1990, and only 1% above the 2015 value (Statistik Austria, 2020c). In 2019, the energy mix in the residential sector shows that renewable energy sources are in the lead with 29.5%, followed by natural gas (21%), electricity (24%), oil (14%), district heating (12%), and coal (<1%). Both the transport and the residential sector play an important role in Austria's current climate and energy strategy.

Figure 2 depicts Austria's energy mix from 2010 to 2019 in TJ. Gross final energy consumption has been relatively stable in the last decade and increased by around 22000 TJ since 2010. Moreover, no significant changes in the composition of the energy mix can be observed.

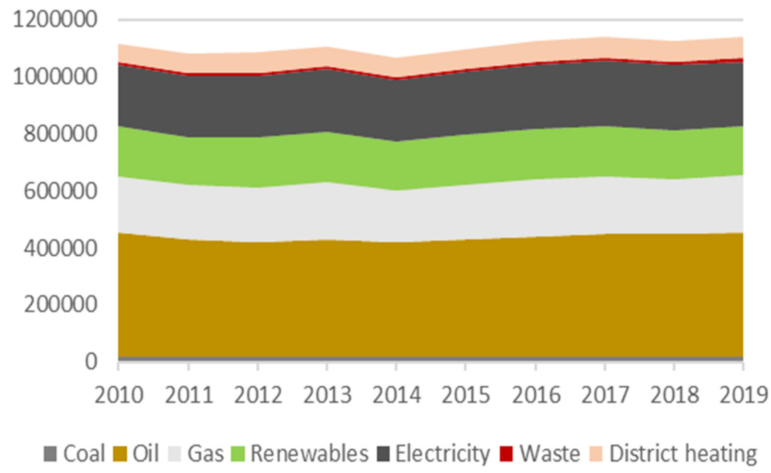

Figure 2: Energy Mix In Tj, 2010-2019. Data Source: Statistik Austria (2020c)

Figure 3 shows Austria's energy mix in 2019. 39% of consumed energy is oil based, 20% is electric energy and 17% is gas based. Austria relies heavily on imports of oil and gas, and thus imports play also a significant role in overall energy consumption.

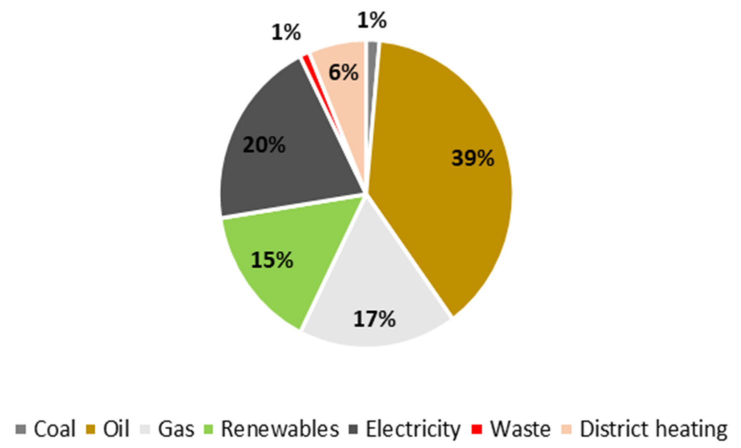

Figure 3: Energy Mix In %, 2019. Data Source: Statistik Austria (2020c) And Own Calculations

Austria's gross domestic electricity production equalled 255083 TJ in 2019, a similar level to 2010. As shown in Figure 4 over the course of the decade, electricity production has fluctuated to some degree, reaching its decade low in 2014 with 221805 TJ. The composition of sources has experienced several changes. Wind and solar energy, hydro and biogenic have all become increasingly important, while the share of coal, gas and oil has decreased since 2010.

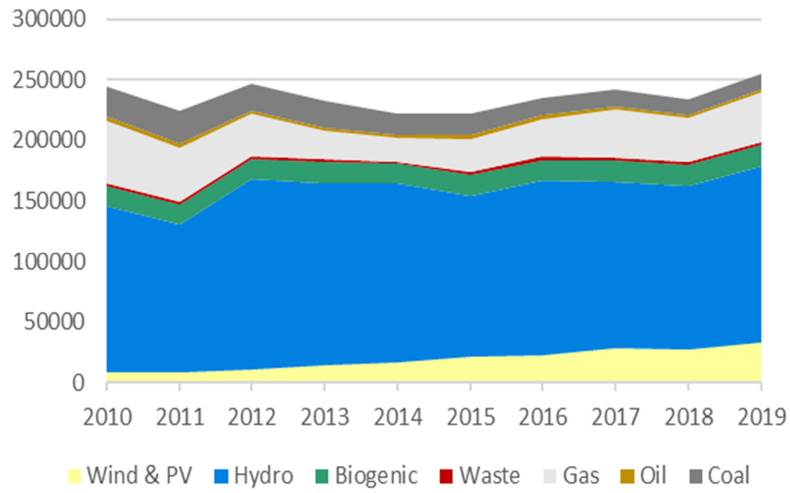

Figure 4: Gross Domestic Electricity Production By Source In Tj, 2010-2019. Data Source: Statistik Austria (2020c)

In 2019, 57% of domestic electricity production originated from hydropower sources, 13% from wind and solar energy, and 7% from biogenic sources. Summing up, Austria produced 77% from renewable sources (see figure 5).

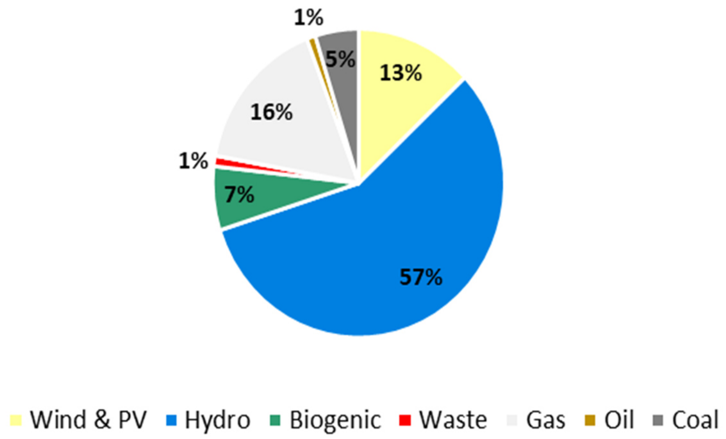

Figure 5: Gross Domestic Electricitiy Production By Source In %, 2019. Data Source: Statistik Austria (2020c) And Own Calculations

Looking at electricity consumption by sector, industry consumes 44% of gross final electricity consumption, followed by private households with 29% and public and private services with 20% (see figure 6).

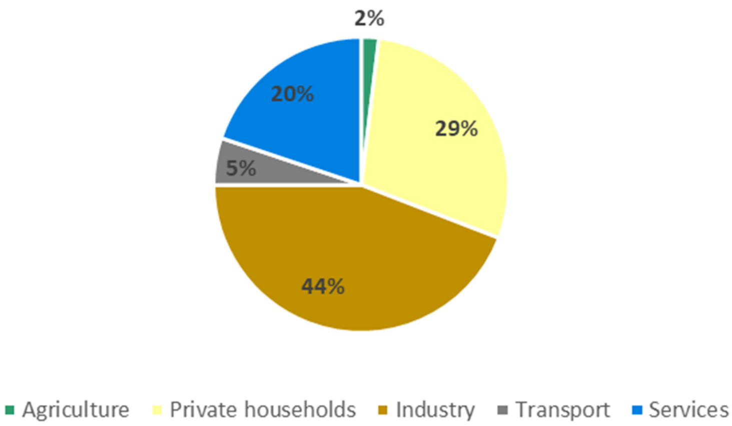

Figure 6: Final Electricity Consumption By Sector In %, 2019. Data Source: Statistik Austria (2020c) And Own Calculations

The national climate and energy strategy of Austria targets the main energy policy goals of the EU as agreed in the Paris Agreement, and more recently, the Clean Energy for all European legislation. It guides the long-term transformation of the national energy system by providing the necessary political and regulatory framework. Austria aims to achieve, amongst others, the following three goals by 2030. Firstly, it targets a reduction of greenhouse gas (GHG) emissions not covered by the EU Emissions Trading System (non-ETS) of 36% compared to 2005. Secondly, it aims to increase the ratio of renewable energy to gross final energy consumption to 46-50%. As stated above, in 2019, the share was 33.6%. Additionally, it aims to generate 100% of total electricity consumption from domestic renewable energy sources, taking into account an anticipated increase in electricity consumption, as imported fossil fuels will be replaced by electricity from renewable sources in the mobility, building and production sectors. However, electricity trading will still play an important role. Austria's objective is to balance electricity imports and exports and to meet demand with domestic renewable energy. Finally, regarding energy efficiency, primary energy intensity should fall by 25-30% compared to 2015 (BMNT, 2019).

Since the transport sector consumes the largest share of total final energy consumption it plays a key role in Austria's national climate and energy strategy. The following three main projects are prioritized: increasing the efficiency of goods transport logistics, strengthening of public rail transport and imposing a comprehensive e-mobility plan.

These projects require a variety of measures, such as increasing the share of renewables in the fuel sector and incentivizing vehicles with low CO2-emissions by means of a reform of the tax regime. Also, an expansion of the public rail transport, with a focus on the connection of the capitals of Austria's nine federal states is planned, as well as the trans-European goods transports is to be facilitated by finalizing several tunnel projects to allow better transport links. Additional measures focus on local public transport systems and promoting e-mobility by means of tax benefits, subsidies and a nationwide charging infrastructure (BMNT, 2019).

Further, three projects target private households: thermal renovation of buildings, renewable heating systems and a large-scale rooftops solar panel program. Firstly, around 50% of all buildings in Austria were constructed before 1970 and renovation comes thus with significant energy saving in many cases (Statistik Austria, 2020d). Secondly, funding for the replacement of old, fossil-fuel based heating systems as well as subsidies in newly built buildings support renewable heating solutions. Finally, the solar panel program aims to install one million photovoltaic power plants on residential rooftops as Austria aims to generate 100% of total electricity consumption from domestic renewable energy sources (BMNT, 2019).

4.1.1.3 Energy market and infrastructure

The Austrian energy market was liberalized on October 1, 2001, and since then all electricity customers have been free to choose their electricity supplier. The same has been done for gas customers since October 2002[1]. The full liberalization of the energy market took place with the Energy Liberalization Act of 2002[2], which amended the laws governing energy and created new ones[3]. In Austria, E-Control is responsible for regulating the electricity and gas markets[4]. In Austria, electric power is primarily traded between producers and consumers (APG, n.d.).

On the Austrian market, there are several system charges, duties, taxes and support programs for green electricity. In addition to the pure energy price, customers have other cost components to pay. For a typical household with a yearly electricity consumption of 3500kWh, E-Control estimates the following electricity price composition. The energy price accounts for around 36% of the consumer electricity price, system charges, for 25% and the rest (duties, taxes, etc.), for 39%. The energy price is composed of a monthly base price and the price per kilowatt hour consumed (E-Control, n.d.-b).

System charges[5] are regulated in §§ 52 to 58 Electricity Act 2010[6], which form the basis for Ordinance. The Austrian regulatory authority sets the amounts and maximum limits for the following charges, namely in the System Charges Ordinance[7].

Customers have to pay the following three periodic system charges. The system utilization charge (in German: Netznutzungsentgelt) covers costs incurred by system operators for the construction, expansion and operation of their networks. The charge for system losses (in German: Netzverlustentgelt) covers costs induced by losses during the distribution of electricity from the generating facilities to the consumers. The metering charge (in German: Entgelt für Messleistungen) covers the costs of installation, maintenance and reading of metering points. The system charges are linked to the take-off and feed-in of electricity into the public grid. In total, there are seven components from which the system charges are determined, which must be paid either by the withdrawing party[8] and/or the injecting party[9].[10] There are two exemptions from the system charges for injecting parties. Injecting parties with a connected capacity of up to and including 5 megawatts (MW) are exempt from the charge for system losses, and are also exempt from the charge for system services, provided that they have a connected capacity of less than 5 MW.

There are two main types of wholesale electricity markets in Austria: the future market, and the spot market (E-Control, n.d.-d).

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[1] Cf. *E-Control* (2011a). 10 Jahre Energiemarkt-Liberalisierung. p. 5 (available under: https://www.e-control.at/documents/1785851/1811255/bericht-10-jahre-energiemarktliberalisierung.pdf/418f0056-6db6-4b87-a835-091d1f512c9a?t=1413905309588).

[2] Energieliberalisierungsgesetz F.L.G. I No. 121/2000.

[3] Cf. *E-Control* (2011a). 10 Jahre Energiemarkt-Liberalisierung. p. 22 (available under: https://www.e-control.at/documents/1785851/1811255/bericht-10-jahre-energiemarktliberalisierung.pdf/418f0056-6db6-4b87-a835-091d1f512c9a?t=1413905309588).

[4] E-Control Website (n.d.-a): E-Control - Unsere Energie gehört der Zukunft - www.e-control.at.

[5] For a brief presentation of these charges, the E-Control website (n.d.-c) was consulted: https://www.e-control.at/en/marktteilnehmer/strom/netzentgelte.

[6] Bundesgesetz, mit dem die Organisation auf dem Gebiet der Elektrizitätswirtschaft neu geregelt wird (Elektrizitätswirtschafts- und –organisationsgesetz 2010 – ElWOG 2010) F.L.G. I No. 110/2010 last amended by F.L.G. I No. 17/2021.

[7] Verordnung der Regulierungskommission der E-Control, mit der die Entgelte für die Systemnutzung bestimmt werden (Systemnutzungsentgelte-Verordnung 2018 – SNE-V 2018) F.L.G. II No. 398/2017 last amended F.L.G. II No. 578/2020.

[8] § 7 No. 14 Electricity Act 2010 defined "withdrawing party" as "a consumer or a system operator taking off electricity from a transmission or distribution system".

[9] § 7 No. 10 Electricity Act 2010 defined "injecting party" as "a producer or an electricity undertaking which feeds electrical energy into a system".

[10] All system charges can be read here as a summary: https://www.e-control.at/en/marktteilnehmer/strom/netzentgelte.

Regarding futures, a specified amount of power is bought and delivered at a certain price, over a predefined future period of time. The main reason is not physical fulfilment but hedging against uncertainty about future spot prices. Futures products can be further distinguished as baseload or peak load contracts.

On the spot market, power is traded for delivery on the following day on an hourly basis (day-ahead market). Further, the intraday market operates on a quarter-hour basis, which sorts out the disparity between real demand realizations and the day-ahead forecasts.

In Austria, consumers and producers are bundled in balance groups. Each balance group is required to balance energy consumption and energy generation within the group on a quarter-hour basis. Electricity transaction schedules among balance groups within the control area have to be sent to the independent balance group coordinator APCS Power Clearing and Settlement AG on a daily basis for the following day. Schedules outside the control area have to be sent to the control area manager Austrian Power Grid AG (APG) (E-Control, n.d.-e). In the event of unanticipated fluctuations in generation (e.g., if power facilities fail or wind speeds change) or of discrepancies from the expected consumption level, the energy balance in the grid must be guaranteed by the control area manager APG through the connection or disconnection of power generating units (e.g., special backup power plants). The balance group that caused the respective fluctuation has to pay the costs for these balancing measures. Fluctuations are determined and billed through the independent balance group coordinator (APG, n.d.-b).

Infrastructure

According to E-Control (2021a), Austria's government regulator for electricity and natural gas markets, the Austrian electricity transmission grid totals about 7 000 km for long-distance transports. These are run by the operator Austrian Power Grid AG and comprise approximately 2 600 km, 3 200 km and 1 200 km of 380 kilovolt (kV), 220 kV and 110 kV grid, respectively. Further, 122 electricity system operators handle approximately 260 000 km of grid delivering electricity to consumers at high, medium and low voltage levels. Regarding gas, the 3 000 km transmission grid delivers energy to a 43 000 km distribution network that is handled by 21 gas system operators. Every gas or electricity distribution system operator is responsible for delivering energy in a specified geographic area. Nearly every Austrian household is connected to the electricity grid, and about a third of them also consume gas.

In 2019, Austria counted almost 143 000 power facilities, as shown in table 9. Over 97% of total facilities are solar power plants with a capacity of under 10 megawatts (MW). The capacity describes the maximum continuous power of a facility under normal circumstances. While hydro power plants make up only 2% of the total count, they account for 56% of total capacity, followed by thermal power plants with 26% and wind power plants with 12%. Lastly, solar power plants account for 6% of total capacity, which was 26 156 MW in 2019. Moreover, while there are only 316 facilities with a capacity over 10 MW, they account for around 80% of total capacity.

Table 9: Power Facilities, 2019. Data Source: E-Control (2021b)

Count	Hydro	Thermal	Wind	Solar	Geothermal	Total
<10 MW	2 913	499	516	138 715	2	142 645
>10 MW	163	64	89			316
Total	3 076	563	605	138 715	2	142 961
in %	2,15	0,39	0,42	97,03	0,00	100,00
Capacity (MW)						
<10 MW	1 433	421	1 459	1 619	1	4 933
>10 MW	13 165	6 310	1 749			21 224
Total	14 597	6 731	3 208	1 619	1	26 156
in %	55,81	25,73	12,27	6,19	0,00	100,00

Total capacity has increased by 50% from 1995 to 2019. Hydro- and thermal power facilities' total capacity has experienced slight but steady increases since 1995 and especially since 2005. Wind-, solar- and geothermal power facilities began to contribute noteworthy capacity starting in the early 2000's. While wind power facilities' uptake in count and capacity began around 2002, solar power plants' increase significantly since 2012 (see table 7).

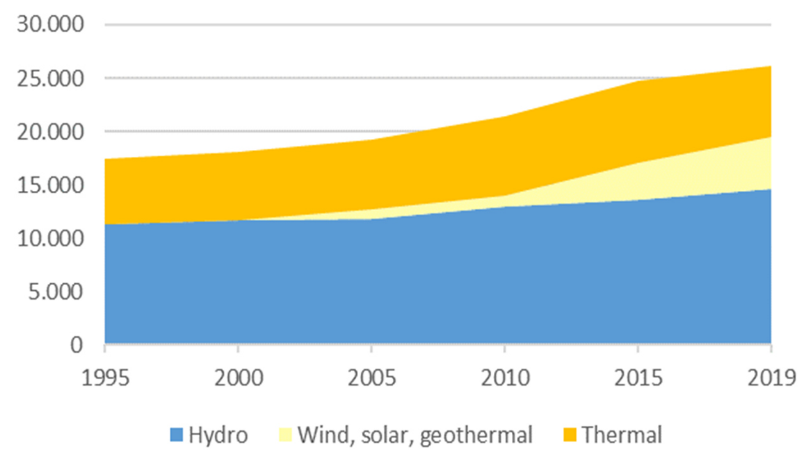

Figure 7: Capacity In Mw Since 1995. Data Source: E-Control (2021)

Solar power facilities are largely owned by private households, and thus greatly outnumber other types of facilities. It is therefore interesting to look at the spatial distribution of PV's. Figure 8 shows the number of PVs per 1000 inhabitants by municipality. PVs are especially densely distributed in parts of northern and eastern Austria, i.e. the states of Upper Austria, Lower Austria and Burgenland, but also in parts of Styria and Vorarlberg. The values range from a lower bound of 0.8 PV's per 1000 inhabitants in Vienna, to an extreme high of around 280 PV's per 1000 inhabitants in St. Stefan-Afiesl, a small municipality in Upper Austria.

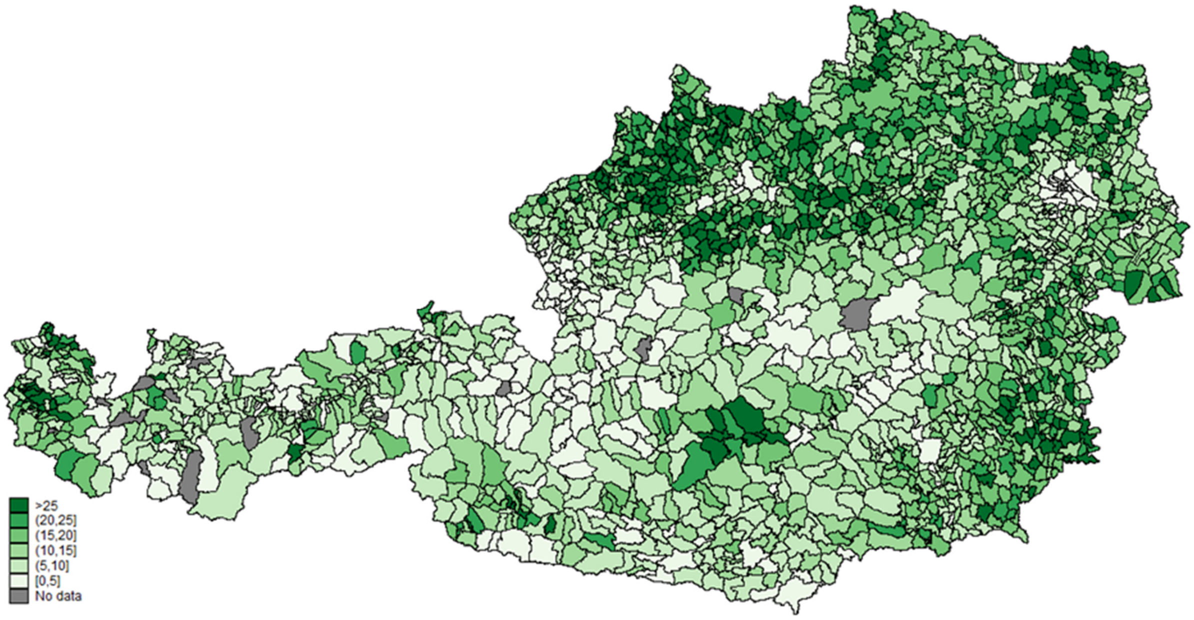

Figure 8: Number Of Pvs Per 1000 Inhabitants By Municipality, 2019. Data Source: Climate And Energy Fund (3/2020) And Oemag (4/2020), As Cited In Statistik Austria (2020e)

4.1.2 Legal and administrative Framework of Energy Communities under National Structure

4.1.2.1 National legal and administrative framework for the adoption of eCREW approach

The eCREW approach is in the area of (regional) electricity sharing. For this central topic, the relevant laws must be analyzed. In Austria, the field of energy (electricity, gas, heating and cooling) is regulated in various laws and administrative ordinances[11]. On the one hand, legal regulations are issued for the whole country ("federal laws"), and on the other, regulations are issued for specific areas ("provincial laws"). The energy law requirements come primarily from the European Union, either as regulations that apply directly or through directives that have to be transposed into national law and are introduced in Austria through national acts of transposition, as is the case with the following laws.

The core of Austrian electricity law is the Federal Act Providing New Rules for the Organization of the Electricity Sector[12] (Electricity Act 2010). This act includes the provisions for the generation, transmission, distribution and supply of electricity, as well as the organization of the electricity industry. It also contains regulations on system charges, as well as rules on billing, internal organization, unbundling and transparency of accounting of electricity companies. In addition, this law also defines the rights and obligations applicable to electricity companies[13].

[11] Parts of the elaborations in this document are based on the research projects InduGrid (Industrial Microgrids; Project-No. 86708) and PMO Umsetzung (Pocket Mannerhatten – Umsetzung kollaborativer Stadtstrukturen und räumlicher Sharing-Strategien in "Block 61"; Project No. 864967) and are further developed within this project.

[12] Bundesgesetz, mit dem die Organisation auf dem Gebiet der Elektrizitätswirtschaft neu geregelt wird (Elektrizitätswirtschafts- und –organisationsgesetz 2010 – ElWOG 2010) F.L.G. I No. 110/2010 last amended by F.L.G. I No. 17/2021.

[13] Cf. § 3 Electricity Act 2010.

Furthermore, in the area of renewable electricity, there is the Green Electricity Act 2012[14] with regulations and subsidies for electricity from renewable sources. In addition to these laws, there is the Natural Gas Sector Act 2011[15] and the Federal Energy Efficiency Act[16].

Electricity exchange

The exchange of electricity in the Austrian market is governed by the current regulations of the Electricity Act 2010[17]. There are three means of exchanging electricity, the electricity is exchanged through the public grid, a direct line between two parties, or electricity produced and consumed within a building. There are two main aspects, that of electricity production and that of electricity consumption. In other words, the electricity regulations concern two personal relationships, between the defined roles in Energy Act 2010, such as that of customer and that of electricity supplier[18].

Exchange of electricity via the public grid

For citizens (or companies) who generate electricity and aim to share it with others (the citizen is not active in the electricity sector), the exchange of electricity is not easy to organize (the focus here is on peer-to-peer trading) in the current legal framework. According to the current legal situation, the consumer, legally defined according to § 7 (1) No. 12 Energy Act 2010, means "a natural or legal person or a registered partnership purchasing electricity for own use". However, if the consumers wish to feed electricity generated by themselves into the public grid, they fall under the term "provider", which is defined as: a "natural or legal person or a registered partnership that provides electricity to other natural or legal persons".[19] Accordingly, this definition also covers electricity traders[20] and producer[21] who make electricity available for economic reasons[22].

In this context, the customer also becomes a "supplier" when selling electricity to neighbours (i.e. other customers) through the public grid. The reason for this is that this activity coincides with the legal definition of "supplier"[23] (also known as "Retailer"), that means "a natural or legal person or a registered partnership executing the function of supply".[24] Accordingly, "supply" means the sale of electricity to customers.[25] From these explanations about the classification of a customer as a provider/supplier wanting to share self-generated electricity, it follows that this

[14] Bundesgesetz über die Förderung der Elektrizitätserzeugung aus erneuerbaren Energieträgern (Ökostromgesetz 2012 – ÖSG 2012) F.L.G I No. 75/2011 last amended by F.L.G I No. 12/2021; The content of this law, in particular the funding measures, will be transferred to a new law and adapted in accordance with European requirements. However, parts of the Green Electricity Act 2012 will continue to exist.

[15] Bundesgesetz, mit dem Neuregelungen auf dem Gebiet der Erdgaswirtschaft erlassen werden (Gaswirtschaftsgesetz 2011 – GWG 2011) F.L.G. I No. 107/2011 last amended by F.L.G. I No. 108/2017.

[16] Bundesgesetz über die Steigerung der Energieeffizienz bei Unternehmen und dem Bund (Bundes-Energieeffizienzgesetz – EEffG) F.L.G. I No. 72/2014 last amended by F.L.G. I No. BGBl. I Nr. 68/2020.

[17] It should be underlined that not all provisions of the Electricity Act 2010 apply directly throughout Austria, as many provisions are made by implementing laws of the federal provinces.

[18] *Ennser*, Energierecht für (inter)aktive Kunden: Gemeinschaftliche Erzeugungsanlagen im ElWOG 2010 und andere Modelle der kollektiven Marktteilnahme, in Paulus (Ed.) Jahrbuch Regulierungsrecht (2017) p 167 (167).

[19] § 7 (1) No. 45 Electricity Act 2010.

[20] § 7 (1) No. 65 Electricity Act 2010.

[21] § 7 (1) No. 17 Electricity Act 2010.

[22] Cf. *K. Oberndorfer* in Hauer/K. Oberndorfer (Ed.), ElWOG (2007) § 43, Rz 4.

[23] § 7 (1) No. 74 Electricity Act 2010.

[24] Cf. *Ennser*, Energierecht für (inter)aktive Kunden: Gemeinschaftliche Erzeugungsanlagen im ElWOG 2010 und andere Modelle der kollektiven Marktteilnahme, in Paulus (Ed.) Jahrbuch Regulierungsrecht (2017) 167 (174).

[25] Cf. § 7 (1) No. 75 Electricity Act 2010.

person must comply with the corresponding rights and obligations of the Electricity Act 2010. This results in obligations, such as the membership of a balance group, electricity labelling and other obligations.[26]

Furthermore, it should be noted that the company will probably not be able to cover all the demand of the other household alone. Accordingly, the supplied customer also needs another supplier for the remaining electricity needs. From this, it follows that these supplied customers need two suppliers to be fully powered. It should be noted, however, that the metering point of this company can only be allocated to one supplier with regard to clearing or balancing energy determination. Accordingly, a contract must be concluded between the two suppliers to clarify who is responsible, for example, for the risk of balancing energy. It must also be highlighted that both suppliers must fulfil the obligations towards the customers according to §§ 75 ff and also § 85 Electricity Act 2010. It should not be forgotten that the use of the public network entails the corresponding system charges, charges and taxes. The explanations referred only to the simplest variant, that an individual citizen wants to supply electricity to another customer. If, on the other hand, several citizens are involved who wish to supply each other with electricity, the supplier obligations would apply to all participants who supply electricity via the public grid.

However, these obligations under electricity law represent a barrier for the simple citizen. In order that this citizen does not become a supplier by sharing surplus energy, it should be considered that a professional supplier takes the surplus electricity and delivers it to the neighbour or other persons. This is exactly the approach that eCREW follows with the support of suppliers. By participating in eCREW, a supplier becomes responsible for arranging the surplus electricity and can help citizens effectively share and benefit from their electricity through the tools offered (in the form of an app and website).

Exchange of electricity via direct line

Energy exchange is also possible without using the public grid, namely through a direct line. There is also a legal definition for this, which reads as follows: “direct line” means “either an electricity line that connects a single production site with a single customer or an electricity line that connects an electricity producer and electricity supplier with their own premises, subsidiaries and eligible customers for the purpose of direct supply; electricity lines within housing estates are not deemed direct lines”.[27] In this regard, the Electricity Act 2010stated in § 70 that the laws of the federal states shall provide for an option to install and operate direct lines.

It would appear that this option is not very relevant for the eCREW approach, becauseit requires several participants of a CREW to be able to exchange energy rather than a single customer being connected to an electricity producer or a supplier. In addition, other aspects of this regulation speak against practicability for the eCREW approach.

Exchange of electricity in a building

In Austria the possibility for the share of self-generated electricity in a building, with several apartments or business premises, has been implemented in 2017. The joint electricity remains in the building. That part of the electricity that is not consumed in the building by the participants can be sold to an electricity supplier and fed into the public grid.[28] This possibility of electricity sharing is regulated in § 16a Electricity Act 2010.[29] This is called a "joint generation facility".[30] This construct of shared electricity generation and use is limited to the building (exactly means the main line) with the metering points connected to it, but electricity not consumed can be sold as surplus. This requires a contract with an electricity supplier. The participation of such a community in eCREW could be considered as one member, since the legal regulation considers the focus on the generation and consumption of

[26] Cf. *Ennser*, Energierecht für (inter)aktive Kunden: Gemeinschaftliche Erzeugungsanlagen im ElWOG 2010 und andere Modelle der kollektiven Marktteilnahme, in Paulus (Ed.) Jahrbuch Regulierungsrecht (2017) 167 (174).
[27] § 7 (1) No. 8 Electricity Act 2010.
[28] Cf. § 16a Electricity Act 2010; *Stöger*, Die (nicht so) "Kleine Ökostromnovelle" 2017, ÖZW 2018, p 8 (12, 13).
[29] § 16a Electricity Act 2010 last amended by F.L.G. I No. 17/2021.
[30] In German: „gemeinschaftliche Erzeugungsanlage“.

the metering points in the building and just not allowed to act through the public grid. Therefore, the approach for eCREW here is that this community could participate as a member, at least in regard to feeding in their non-consumed electricity. Even if energy is generated in the house, it does not mean that the energy is sufficient. Individual participants in a joint generation facility still have the right to choose an electricity supplier to supply them with the remaining electricity they need. For the eCREW approach, this means that individuals can also be supplied by an electricity supplier that offers the eCREW approach.

In summary, a simple energy exchange between citizens is already possible either in the framework of a joint generation facility, but from the point of view that the energy is generated and consumed in the house. However, it is also possible to sell the surplus electricity to a supplier who exercises the electricity law requirements, so that the individual citizen does not become a supplier. This is the approach that eCREW follows, where the administrative and legal tasks are carried out by a professional supplier.

Austria is currently in the implementation phase of RED II and ED 2019. The legislative process started in 2020. In the process, a draft law was presented in October 2020 and subjected to a review process. After this procedure, changes were made which resulted in a new draft law, as a government bill, in March 2021. The so-called "Renewable Energy Expansion legislative package"[31] refers to several acts. A new legislative act will be introduced and existing legislation will be amended. In this government bill,[32] provisions from both RED II and ED 2019 are implemented. In this government bill, there are already concrete details on the introduction of a REC and CEC. However, there may still be changes before the new regulations in the energy sector come into force, because the Austrian legislative process has not yet been completed.

4.1.2.2 Data flow in eCREW under National Electricity Regulatory Framework (Data flow, Data from smart meter, processing of data from third parties)

In Austria, there are specific regulations for the reading and processing of data generated by smart meters. These regulations can be found in §§ 83, 84 and 84a Electricity Act 2010.

On the basis of the provisions from Electricity Act 2010, the Smart Meter Introduction Ordinance[33] (hereafter SMIO) was passed, which contains the requirements for the introduction of smart meters. By 2022, the proportion of smart meters should reach 95%, if technically feasible. This obligation is incumbent on the system operator. In § 84 Electricity Act 2010 in conjunction with § 1 (3) SMIO, it is specified that system operators must equip their customers with a smart meter if they do not already have a load profile meter.

§ 17 (2) Electricity Act 2010 describes the scope for the use of smart meters, which is defined as a limit by § 1 (7) SMIO. This is connected to the metering point. A metering point means any injection or withdrawal point where electricity volumes are metered and registered. This stipulates that metering points with an annual consumption of less than 100,000 kWh or a connected load of less than 50 kW must be equipped with a smart meter. This means that the values above this limit must be equipped with a load profile meter.[34]

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[31] In German: „Erneuerbaren-Ausbau-Gesetzespaket – EAG-Paket“. This government bill is accessible under: https://www.parlament.gv.at/PAKT/VHG/XXVII/I/I_00733/index.shtml#tab-Uebersicht (08-04-2021).

[32] Government bill is available under: https://www.parlament.gv.at/PAKT/VHG/XXVII/I/I_00733/fname_933183.pdf (08-04-2021).

[33] Verordnung des Bundesministers für Wirtschaft, Familie und Jugend, mit der die Einführung intelligenter Messgeräte festgelegt wird (Intelligente Messgeräte-Einführungsverordnung – IME-VO) F.L.G. II No. 138/2021 last amendet by F.L.G. II No. 383/2017.

[34] Explanatory Notes to the Smart Meter Requirement Ordinance 2011 (available under: https://www.e-control.at/documents/1785851/1811528/IMA-VO_Erlaeuterungen.pdf/f4c2870b-72c5-47d8-b5a8-0e9c24197c5e?t=1413912736271 [21-05-2021]).

The technical requirements for a smart meter and the requirements with regard to data transmission from system operators to suppliers and to customers are defined by Smart meter requirement Ordinance 2011[35] and by Data Format and Consumption Information Presentation Ordinance 2012[36].[37]

In Austria, there is already an obligation for the distribution system operator to display the **customer's consumption data** (measured with a smart meter) on a **customer-friendly website**. This obligation results from § 84 (2) Electricity Act 2012, where it is ordered that system operators must make consumption data measured by smart meters available free of charge via a customer-friendly web portal at least on a daily basis, or even (by contract or consent) quarter-hourly values at the latest after 12 hours of reading. It is specified that the reading of the consumption values from these meters must take place at least once a day. The website must meet minimum requirements, such as displaying consumption data in the smallest available time unit, and must also comply with data protection regulations.[38] In this context, it is still relevant, because customers can also authorize a third party to view their data and information. For this purpose, the customer must grant an authorization to this selected party. Thus, the data and information must be made available in a storable, printable and machine-readable form for further processing.[39] It should be emphasized that direct access to the web portal by an empowered third party is not permitted.[40]

In addition to the web portal, customers also have the option of viewing all the electricity consumption values recorded in the smart meter free of charge via an **unidirectional communication interface**. It is also stipulated that access to and specifications of the communications interface shall be given free of charge to all authorized parties in a non-discriminatory way.[41]

According to the legal requirements, the stored quarter-hour values are to be read out at least once a day, but it is doubtful whether a more frequent readout per day would also be possible. The wording allows the assumption that a data readout is also possible several times a day. If § 3 No. 4 Smart meter requirement Ordinance 2011 is also considered, it can be assumed that the values are only read once a day, because the technical requirements for smart meters stipulate that they must be able to output the measurement data to the system operator once a day via a communication interface. According to the wording of the Electricity Act 2010, multiple readings would be possible, but not mandatory. Related to this is also the wording for the display of consumption data in the web portal. Here, too, the wording shows that after the data has been read out, it must be made available in the web portal at the latest after 12 hours. This is welcome for the eCREW approach, because customers can view their energy consumption on the system operator's web portal the next day at the latest.

In addition, it is stipulated that the system operator may only read and use quarter-hourly data from customers with the express consent of the customer or if this is necessary to fulfil obligations arising from a supply contract based on quarter-hourly data selected by the customer.[42]

The system operator shall **provide the consumption data** not only to the customer but also **to the suppliers**. Although it is stipulated that the consumption data of the customer collected on a daily basis shall be made available

[35] Verordnung der E-Control, mit der die Anforderungen an intelligente Messgeräte bestimmt werden (Intelligente Messgeräte-AnforderungsVO 2011 – IMA-VO 2011) F.L.G. II No. 339/2011.
[36] Verordnung des Vorstands der E-Control, mit der die Anforderungen an die Datenübermittlung von Netzbetreiber zu Lieferant und die Verbrauchsinformationen an die Endkunden festgelegt werden (Datenformat- und VerbrauchsinformationsdarstellungsVO 2012 – DAVID-VO 2012) F.L.G. II No. 313/2012 last amended F.L.G. II No. 468/2013.
[37] Cf. *Veseli/Holzleitern/Cejka*, D.S.G.V.O.: Datenverwendung Smart Gemacht und Verbraucherfreundlich Organisiert, ZTR 2020, p 179 (180).
[38] § 3 Data Format and Consumption Information Presentation Ordinance 2012.
[39] § 4 Data Format and Consumption Information Presentation Ordinance 2012.
[40] § 84 (7) Electricity Act 2010.
[41] § 84 (5) Electricity Act 2010.
[42] § 84a Electricity Act 2010.

to the supplier, it shall only be transmitted by the system operator on a monthly basis.[43] The supplier receives the collected consumption values of the respective customer for the purpose of consumption and electricity list information (§ 81a Electricity Act 2010) and in order to invoice the supplied electricity. The supplier receives the quarter-hourly values only with the customer's consent or to fulfil contractual obligations.[44] Thus, in Austria, the customer must agree on the quarter-hourly reading of his consumption data, or this quarter-hourly measurement becomes necessary for the fulfilment of an electricity supply contract.

The supplier receives the consumption data of its clients, but not necessarily in fine-grained form, e.g it may be only on a monthly basis. For the eCREW approach, submitting data only once a month is rather unsatisfactory, but as shown above, there are two legal ways that customers can authorize third parties to preserve their data. This shows that the Austrian regulations on data use are not a barrier to the eCREW approach, but in fact, are beneficial. It should be noted that participants in eCREW must agree to have their energy consumption data read out on a quarter-hourly basis.

4.1.2.3 Progress concerning adoption of Renewable Energy Directive (RED II) 2018/2001/EU

Progress with regard to the implementation of RED II has so far been limited to the legislative process of the Renewable Energy Expansion legislative package. As mentioned above, there is one government bill (with several draft laws) that provides for the implementation of parts of RED II.

In this government bill, there are already concrete details on the regulatory intentions. These details are now presented, with the indication that this bill is not yet in force.

The government bill provides that the relevant provisions on renewable energy communities shall extend over two acts. On the one hand, general provisions are to be regulated in the new "Renewable Energy Expansion Act"[45]. On the other hand, more specific provisions will be introduced into the existing Electricity Act 2010, which relate to electricity.

The government explanatory notes[46] explain why Austria is concentrating on the electricity sector in regard to the **Renewable Energy Community** (hereafter REC) during the implementing of RED II. This is justified by the recitals of RED II, as these are primarily realized in the area of renewable electricity in the concept of self-supply and common supply. Accordingly, the central provisions on the REC in regard to electricity are anchored in §§ 16c to 16e Electricity Act 2010 of the government bill.

The general provisions on RECs in the Renewable Energy Expansion Act are formulated in an energy-neutral manner and stipulate that REC generation facilities are eligible for funding (§§ 79 to 80 Renewable Energy Expansion Act of government bill).

The **general provisions** of § 79 Renewable Energy Expansion Act stipulate the following:

A REC is permitted to generate energy from renewable sources and to consume, store, or sell its self-generated energy. In addition, the community is allowed to be active in the field of aggregation and to provide other energy services. However, regulations applicable to the particular activity must be observed. Participation in a REC does not affect the rights and obligations of consumers. This applies in particular to the free choice of supplier. The government explanatory notes also indicate that the generation facility may be owned by the community itself, by

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[43] § 2 Data Format and Consumption Information Presentation Ordinance 2012.

[44] § 84a (2) Electricity Act 2010.

[45] Bundesgesetz über den Ausbau von Energie aus erneuerbaren Quellen (Erneuerbaren-Ausbau-Gesetz – EAG); As shown above, the Renewable Energy Expansion Act is a part of the Renewable Energy Expansion legislative package, which is not yet in effect.

[46] Government explanatory notes are available under: https://www.parlament.gv.at/PAKT/VHG/XXVII/I/I_00733/fname_933186.pdf (08-04-2021).

its members or by third parties. As is already the case with joint generation facilities, the community can use a third party for operation and management. Contract and leasing models are also possible for REC.[47]

Members or shareholders of REC (regardless of their used renewable energy source) can be

- natural persons,
- municipalities,
- legal entities of public authorities in regard to local departments and other legal bodies under public law, or
- small and medium enterprises.

The REC must consist of at least two members/shareholders.[48] No possible participants are private companies that are large entries. There is no restriction for legal entities under public law, as there is for private companies.[49] In addition, there is another restriction for private companies, their participation is not allowed to correspond to their main commercial or professional activity. This excludes the participation of electricity and natural gas companies. Their participation in a REC would be incompatible with the objective of the REC.[50] The REC objective was formulated in such a way that it corresponds to the German version of RED II. The objective of the REC is not financial benefit, but primarily environmental, economic or social benefit to the shareholder/members or the local areas where REC operates. The participation is voluntary and open.

In particular, in the field of electricity, § 16c Electricity Act 2010 covers a specification. Participating producers are not allowed to be controlled[51] by a supplier, provider or electricity retailer within the meaning of Electricity Act 2010. Based on the phrases "located in the proximity of the renewable energy projects" according to Art 2 (16) of RED II the government assumes that also wind farms, hydropower or larger PV projects can participate. Thus, according to government explanation notes, it is possible that wind farms, hydropower or larger PV projects can also participate in REC, provided that these generation facilities are not controlled by energy companies.[52]

Form of establishment and rights and obligations of the community

REC must be organized either as an association, cooperative society, partnership[53], corporation[54] or similar association with legal personality. In the case of REC, two areas are to be differentiated, on the one hand the internal relationship and on the other hand the external relationship of REC. The internal relationship does not have to comply with the electricity law requirements. This applies to the generated and consumed electricity of the inside the community. The electricity inside the community is not assigned to the balance group system. In the group, the regulations of electricity traders or suppliers of Electricity Act 2010 are not applicable. For the share of electricity remaining in the community, no guarantees of origin, electricity (or gas) labelling and accounting obligations are to be fulfilled. Regarding the agreements between the participants, these are to be determined by civil law. In the

[47] Cf. Government explanatory notes, pp 18, 19.
[48] § 79 (1) Renewable Energy Expansion Act of government bill, p 37.
[49] Cf. Government explanatory notes, pp 18, 19.
[50] Cf. Government explanatory notes, 19.
[51] Cf. § 7 (1) No. 34 Electricity Act 2010 this paragraph defines "control": These are rights, contracts or other means which, individually or together and taking into account all the circumstances of fact or law, confer the possibility of exercising a decisive influence on the activities of an entity (in particular by a) rights of ownership or use of all or part of the company's assets; b) rights or contracts that grant a determining influence on the composition, deliberations or decisions of the company's bodies.
[52] Cf. government explanatory notes, p 27.
[53] Possible partnerships with legal personality in Austria are: "Offene Gesellschaft (OG)", "Kommanditgesellschaft (KG)", „GmbH & Co KG".
[54] Possible corporation in Austria are: "Aktiengesellschaft (AG)" or "Gesellschaft mit beschränkter Haftung (GmbH)".

external relationship, the respective rights and obligations are to be complied with, depending on the activity of REC. [55]

Multiple membership

The (multiple) membership is explicitly linked to the "consumption or generation facility". Thus, the participation of a member/shareholder in several CEC, REC or joint generation facilities according to

§ 16a Electricity Act 2010 is not possible at present, pursuant to the transitional provision § 111 (8) Electricity Act 2010 of government bill.[56] This results from the fact that the provision is formulated in such a way that multiple membership in CEC´s, REC´s or joint generation facilities will only be expressly permitted as of 1 January 2022. Thus, multiple membership is not considered permissible at present according to the government bill. The purpose of this regulation is to give the market participants involved (in particular system operators) time to prepare or adapt data processing procedures necessary for dual and multiple memberships. The resulting empirical values are to be used to supplement the market rules if necessary.[57]

The next point is the focus of the special rules for electricity.

Electricity law requirements

A REC can use any renewable energy source, but the focus of the legal regulations is on electricity from renewable sources. Therefore, the specific electricity law provisions are the focus of the further explanations. These electricity law provisions are found in the relevant law, Electricity Act 2010, which regulates the electricity market. Reference has already been made to this law at the appropriate points.

The REC is not legally defined in the Renewable Energy Expansion Act, but in § 7 (1) No. 15a Electricity Act 2010. The term "renewable energy community" already contains its essential points in its definition. Although this legal definition is found in an established electricity act, an energy-neutral formulation was also chosen here. Essential here is that the legal definition refers to the most important condition of REC, namely: its members/shareholders must be located in the proximity according to § 16c (2) Electricity Act.

Proximity definition in Austria

According to the governmental bill, the “proximity” will be divided into two possible areas. One area is called “local area”, and the other,“regional area”. These two areas are defined on the basis of the power grid levels and substations/transformer stations. In these two areas the electricity consumption facilities of the members/shareholders and the generation facilities can be connected.

- The consumption facilities of the members/shareholders must be connected to the generation facilities via a low-voltage distribution network[58] and the low-voltage part of the transformer station[59] (local area) or
- via the medium-voltage grid[60] and the medium-voltage busbar in the substation (regional area) in the concession area of a system operator.

The local area thus extends over grid level 7 to the low-voltage part of the transformer station, i.e. part of grid level 6, but not beyond the medium-voltage part of the transformer. This technical boundary is drawn as a clear dividing

[55] Cf. government explanatory notes, p 27.
[56] § 111 (8) Electricity Act 2010 of government bill, p 67.
[57] Cf. government explanatory notes, pp 28, 34.
[58] This low-voltage distribution network is the network level 7, with a voltage of 400 - 230 volts.
[59] The transformer station is network level 6.
[60] This is the medium voltage network on the network level 5, with a voltage of 1 - 36 kilovolts.

line. The purpose for this approach could be that a new connection can also be established in an existing transformer station.[61] Accordingly, a facility can also be connected to the low-voltage part of network level 6. This will be necessary for technical reasons, as the network operator has to determine the technically suitable connection point in the existing network.[62]

The regional area includes grid level 5 and the medium-voltage busbar of the substation, i.e. a part of grid level 4. This does not include the part of the substation that passes over the medium-voltage busbar and the transformation to the high-voltage level. Here, too, the clear technical boundary is drawn, which the system operator must observe when deciding on the appropriate connection point.[63]

The proximity is created by the fact that the connection of the consumption facilities of the members/shareholders with the generation facilities is via the low-voltage or medium-voltage distribution system of a system operator.[64] Thus, the local area is primarily limited to grid level 7 and the regional area to grid level 5. Both areas are also limited to the license area of a system operator, since the consumption facilities must be connected to the generation facilities in either the local area or the regional area.

The transmission of energy from generation facilities or storage facilities to consumer facilities using grid levels 1 to 4, up to the medium-voltage busbar in the transformer station, is expressly not permitted. Likewise, transmission through the grid of other system operators is not allowed.[65] The definition of proximity is reflected in the payment of the system utilization charge.

Related to proximity is the right to be informed according to § 16c (3) Renewable Energy Expansion Act. The grid users, i.e. the members/shareholders of a REC, have 14 days to obtain information on the part of the distribution system to which their consumption or generation facilities are connected. In the governmental explanation notes, reference is made to the persons who wish to form an REC. These persons may also make an inquiry. The system operator must inform them where their generation and/or consumption facilities are connected to the distribution system and whether the facilities are connected in the regional or local area.[66]

Brief overview: On the subject of heat, there are other regulations for RECs concerning local heating networks. These regulations are introduced by modifications in the Heat and Cold Pipeline Expansion Act[67] of the government bill. In this REC, members must be located in the proximity to the facility.[68] These members can operate a local heating network.[69] In addition, there are also promotions for local heating networks of REC.[70]

System utilization charge and support mechanisms

The above-mentioned definition of local and regional area of RECs is relevant for the system utilization charges. The government bill stipulates that for the members/shareholders of a REC, the system utilization charge is to be determined separately in relation to the consumption covered by the allocated energy fed into the grid from a generation facility of REC.[71] This regulation will be integrated into the existing regulation on system utilization charges. This regulation sets out how the system utilization charges are calculated for the electricity quantities that

[61] Cf. *E-Control*, Leitfaden Netzanschluss: Stromanschluss leicht gemacht (2016) p 16.
[62] Cf. *E-Control*, Leitfaden Netzanschluss: Stromanschluss leicht gemacht (2016) pp 6, 20.
[63] Cf. *E-Control*, Leitfaden Netzanschluss: Stromanschluss leicht gemacht (2016) pp 6, 20.
[64] Cf. government explanatory notes, p 27.
[65] § 16c Abs. 2 Electricity Act 2010 of government bill, p 28.
[66] Cf. government explanatory notes, p 28.
[67] Bundesgesetz, mit dem die Errichtung von Leitungen zum Transport von Nah- und Fernwärme sowie Nah- und Fernkälte gefördert wird (Wärme- und Kälteleitungsausbaugesetz – WKLG) F.L.G. I No. 113/2008 last amended by F.L.G. I No. 72/2014.
[68] § 3 (1) No. 13 Heat and Cold Pipeline Expansion Act of government bill, p 91.
[69] § 4 (7) Heat and Cold Pipeline Expansion Act of government bill, p 92.
[70] Cf. § 6 (1) No. 6 Heat and Cold Pipeline Expansion Act of government bill, p 91.
[71] § 52 (2a) Electricity Act 2010 of government bill, p 60.

are shared in the community. These charges take into account the network levels used. That is, for the determination of the system utilization charges, the costs for the local area of the grid level 7 and for the regional area the grid levels 5, 6 and 7 are used. The cascaded costs[72] of the higher-level networks are not included.[73] Thus, for each REC member/shareholder, the corresponding grid usage is calculated, i.e. that part which is purchased by the electricity retailer and that part which is generated and consumed within REC.

In addition to the consideration of local and regional areas in regard to system utilization charges, the government bill also provides for special provisions in the case of two support mechanisms. According to the Renewable Energy Expansion Act, consumers connected to the public grid are required to pay a renewable energy contribution and a green gas contribution. Consumers are exempt from this obligation to pay these contributions for the energy obtained within the REC.[74] As a result, the renewable and green gas contribution is reduced for the respective member/shareholder of the REC, as they still have to pay these contributions for the part that they receive from the electricity retailer.

The government bill also provides for a cost-benefit analysis, the results of which shall be published in 2024. This analysis is intended to provide information on whether RECs and CECs have ensured an appropriate and balanced participation in system costs. [75]

Funding provisions

Finally, it should be noted that § 80 of the Renewable Energy Expansion Act explicitly provides that RECs can be funded under the Renewable Energy Expansion Act promotion regulations, provided that the conditions in each case are fulfilled. This act determines which promotions are possible. An application must be submitted for each system.[76]

4.1.2.3.1 Joint provisions of REC and CEC on organization, metering and billing

As mentioned above, the REC and CEC are introduced in the government bill. Both energy communities can operate on the electricity market. For the electricity market, the Electricity Act 2010 will be amended to regulate the organizational rules as well as the metering and billing of energy communities. The following additional regulations apply to both energy communities.

System access and organization of participation

The § 16d Electricity Act 2010 contains the regulation on system access and organizational regulations. System users, i.e. members of RECs and CECs with their facilities, have a legal claim against the system operator to participate in a REC or CEC.[77] The purpose of these regulations is to require a system operator to cooperate with energy communities. This is to facilitate the transfer of energy within the communities as well as the input of surplus energy. The energy communities themselves are regarded as parties entitled to system access within the meaning of § 7 (1) No. 54 Electricity Act 2010.[78]

Furthermore, the system operators must be informed about the establishment of an energy community. The system operators must be provided with information on and changes to the following points:

[72] § 62 Electricity Act 2010 F.L.G. I No. 17/2021.
[73] § 52 (2a) Electricity Act 2010 of government bill, p 60.
[74] § 75 (1) in conjunction with (5) and § 76 (6) Renewable Energy Expansion Act of government bill, pp 35, 36.
[75] § 79 (3) Electricity Act 2010 of government bill, p 37.
[76] § 80 Electricity Act 2010 of government bill, p 38.
[77] § 16d Electricity Act 2010 of government bill, p 56.
[78] Cf. government explanatory notes, p 28.

- description of the operation of the generation facilities (and storage facilities), indicating the metering point;
- consumption facilities of the members/shareholder, stating the meter point;
- the proportion of the generation facility held by the members and the proportion of the energy generated;
- allocation of energy feed-in not consumed by members per quarter hour;
- admission and withdrawal of members;
- termination or dissolution of the renewable energy community[79] and dismantling of the generation facilities.[80]

In any case, this listed information must be communicated to the system operator. The communities must first agree on this information in order to be able to communicate it to the system operator.

It is also stipulated that energy communities shall enter into agreements with system operators, which shall include the following points:

- data management and data processing of energy data from the generation facilities and the consumption facilities of participating system users by system operator,
- operation, maintenance and servicing of generation facilities, as well as payment of costs,
- in addition, liability, and
- insurance, if any.

In summary, provisions of § 16d Electricity Act 2010 provide that the community has the right to be connected to a grid, the community has an obligation to provide information, and cooperation facilitation agreements are to be concluded.

Metering and billing of REC and CEC

Included among the Common Provisions of REC and CEC is the provision on metering and billing in energy communities under § 16e Electricity Act 2010.

For both communities, metering and billing are almost identical, but for CEC there is a separate section that relates to metering and data exchange. As this provision is coherent, further explanations on billing and metering are provided in the section on the adaptation of the ED 2019.

In summary, it should be noted that steps have already been taken in Austria to implement RED II. At present, the legislative process has not yet been completed, which means that changes are still possible. The above explanations refer only to the government bill, which is not legally binding. Accordingly, this is only an outlook on the possible REC regulations and not a conclusive analysis.

In the next point, the regulations on CEC are presented, which are planned according to the government bill.

[79] According to the government bill, the general provisions (which apply to RECs and CECs) literally mentioned the REC in this point. The question arises here as to whether information should actually be provided only about the termination of a REC, or also about the termination of a CEC.
[80] § 16d (2) Electricity Act 2010 of government bill, p 56.

4.1.2.4 Progress concerning of adoption Internal Electricity Market Directive (EU) 2019/944 (ED 2019)

As already stated above, it is planned to implement **the Citizens Energy Community** (hereafter CEC) in the Electricity Act 2010.

The government bill defines CEC pursuant to § 7 (1) No. 6a Electricity Act 2010, as a legal entity that generates, consumes, stores or sells electrical energy, is active in the field of aggregation or provides energy services to their members and is controlled by members or shareholders pursuant to § 16b (3) Electricity Act 2010.[81] The definition already provides the framework for the CEC, such as limitations on electricity, the members, as well as the control over the CEC. In the following, the CEC is further presented on the basis of the relevant provisions. The central provision of the CEC is § 16b Electricity Act 2010, which regulates the activities, members and control over the community.

According to the government bill on § 16b (1) Electricity Act 2010, it is stipulated that the CEC may generate electrical energy and consume, store or sell its own generated energy. Furthermore, the CEC may be active in the field of aggregation and provide energy services to its members, such as energy efficiency services or charging services for electric vehicles. The applicable regulations must be observed in the respective activities. By participating in the CEC, the rights and obligations of the individual members/shareholders remain unaffected, in particular the free choice of suppliers.[82] CEC thus defines itself by the electrical energy it generates and which it can consume, store or sell. The use of a different form of energy collectively is reserved for the RECs, as already stipulated by RED II as well as ED 2019.

The explanatory notes to the government bill state that the owners of a generation facility can be the community, members/shareholders or third parties. Contract and leasing models are also possible. For operation and maintenance, the CEC can use a third party, such as service providers or energy supply companies. [83]

The following **possible members/shareholders** of a CEC are envisaged:

- natural persons,
- legal entities and
- local authorities

Thus, in principle, the CEC is open to all types of legal entities in terms of membership, but the power of decision is restricted. In comparison with the definition of the CEC of the ED 2019, it results that the CEC also may only be effectively controlled by the possible members listed there.[84] For this purpose, the government bill has further regulated the control in the CEC, which will be discussed in more detail later.

A community shall consist of two or more members/shareholders. CEC must be organized as an association, cooperative society, partnership, corporation or a similar association with legal personality. These basic legal entities have also been presented in case of REC (see above).

Financial profit must not be the main purpose of a CEC. This aspect also implies that CECs may not be electricity traders within the meaning of § 7 (1) No. 65 Electricity Act 2010.[85] The primary purpose of CEC is to provide environmental, economic and social community benefits to its members or the areas in which it operates. In addition, participation is voluntary and open, which includes leaving the community.[86] The terms voluntary and open

[81] § 7 Electricity Act 2010 of government bill, p 55.
[82] § 16b (1) Electricity Act 2010 of government bill, p 55.
[83] Cf. government explanatory notes, p 26.
[84] Cf. Art. 2 (11) lit a ED 2019.
[85] Cf. government explanatory notes, p 27.
[86] Cf. *Cejka*, Energiegemeinschaften im Clean Energy Package der EU, ecolex 2020, p 338 (339).

could also explain the wide range of participants. Because it is stated in Article 2 No. 11 ED 20019 that the participation is open and voluntary, as well as effectively controlled by the members/shareholders, which are: natural persons, local authorities, including municipalities, or small enterprises. From this it can be concluded that the essential element is the control of certain members and otherwise participation is open to (almost) everyone.[87]

The legal definition already stipulates that CEC is controlled by the members pursuant to § 16b (3) Electricity Act 2010. Control is limited to natural persons, local authorities and small enterprises (unless they perform the function of an electricity undertaking within the meaning of § 7 (1) No. 11 Electricity Act 2010).[88] This restriction of control is in any case given if chosen corporate form includes a statutory majority which is held by stated members/shareholders. According to the explanation notes of the government bill, the necessity of limiting the power of control in CEC (as outlined above) is based on the open participation for all types of legal entities. Therefore, the main decision-making powers are limited to those members that do not engage in commercial activities on a large scale and the energy industry is not the actual area of their business activity. Thus, medium-sized and large companies, as well as companies which are electricity undertaking[89] , are excluded from control.[90]

Multiple membership and no territorial restriction

As already outlined for RECs, multiple membership in RECs, CECs and joint generation facilities will not be possible until 01 January 2022.

For completeness, it is to be noted that the regulations to CEC do not have a territorial restriction. The explanatory notes to the government bill already state that CEC can extend over the entire Austrian market area. The energy of CEC can flow through several concession areas of distribution system operators. It was also pointed out that there are no special regulations for CECs in regard to network charges. CECs have to pay all system charges according to Electricity Act 2010 and the System Charges Regulation[91].[92] This is due to the fact that the law does not provide for any reductions in system charges for CECs.

4.1.2.4.1 Joint provisions of metering and billing of REC and CEC

For CEC and REC there are common provisions, such as the organization of participation in an energy community (presented under 4.1.2.3.1 Joint provisions of REC and CEC). As already mentioned in REC, the other common provisions on metering and billing will now be discussed. This provision concerns both energy communities, but there is a special provision on CEC, which is why that provision is presented here. In this context, it should be underlined once again that CECs have no geographical limitation and extend their activities to the whole of Austria, which subsequently results in a special feature for CECs.

The government bill introduces a common provision (§ 16e Electricity Act 2010) dealing with the metering of energy and the billing of energy in the communities.

Metering

The government bill obliges the system operator to measure the energy flows by means of load profile meters or smart meters.[93] To this end, it must measure the consumption of participating system users, e.g. members'/shareholders', consumption facilities. In addition, the feed-in and the procurement of generation facilities

[87] This is also the view of recital 44 of the 2019 ED.
[88] § 16b (1) Electricity Act 2010 of government bill, p 55.
[89] Within the meaning of § 7 (1) No. 11 Electricity Act 2010.
[90] § 16b (3) Electricity Act 2010 of government bill, p 55; cf. government explanatory notes, p 27.
[91] Cf. Verordnung der Regulierungskommission der E-Control, mit der die Entgelte für die Systemnutzung bestimmt werden (Systemnutzungsentgelte-Verordnung 2018 – SNE-V 2018) last amended by F.L.G. I No. 578/2020.
[92] Cf. government explanatory notes, p 26.
[93] If a smart meter is to be used is defined by the limit of § 17 (2) Electricity Act 2010.

are to be measured. With regard to consumption facilities, the system operator is obliged to install a smart meter within 2 months if not already installed. Furthermore, there is a requirement that when smart meters are used, the energy values per quarter hour must be measured, read out and reduced by the allocated generated energy to be used for clearing in accordance with § 23 (5) Electricity Act 2010.[94]

The system operator is further obliged to make the measured quarter-hourly values of the generation facility and the consumption facilities of the members/shareholders available to the suppliers and the energy community[95] as soon as possible, at least on the following day. Furthermore, there is an obligation to make this information available to energy communities and their participants via a cost-free, customer-friendly web portal. The system operators shall take precautions for secure identification and authentication of energy communities on web portals, as well as for encrypted transmission of data according to the state of the art.[96]

The regulation concerning the provision of metering data applies to both energy communities. In addition, the government bill for CEC stipulates an exchange of data between all system operators[97], because this community can operate across several concession areas of system operators. This regulation specifies that in the case of CEC, the data, numerical and measured values of consumption facilities of members/shareholders and those of generation facilities must be made available to all system operators. All system operators in whose concession area a generation facility and/or consumption facility are connected receive this information. For this data exchange, the system operators shall (as far as technically possible) use an automation-supported data processing process (platform) existing for this purpose. These calculated data, numerical and measured values and the measured values (of consumption and generation facilities) shall be transmitted to the supplier as soon as possible, at the latest on the following day[98].[99]

The measurement of production and consumption data is essential for the functioning of an energy community. On the one hand, the technical requirements are necessary, whereby the installation period of 2 months for smart meters is very advantageous for members of an energy community. The provision of energy consumption and generation data by the distribution system operator is essential for the eCREW approach. For the eCREW approach to work, data availability is essential, allowing participants to effectively influence their electricity consumption.

Billing

In addition to measurement of generation and consumption data (and the associated data exchange in case of CEC), the government bill also contains provisions on billing in § 16 (3) Electricity 2010.

As shown above (see 4.1.2.3.1 Joint provisions of REC and CEC), participants of an energy community agree on how the generated energy is to be divided (static or dynamic shares in the generated energy). The system operator is obliged to allocate these amounts of generated energy to the respective members. In the case of CEC, this has to be done taking into account the data exchange mentioned above. For the determination of values, the government bill establishes the following regulations: i) the allocation shall be made per quarter hour and shall be capped at energy consumption of the participating member's respective facility in respective quarter hour; ii) in addition, the static or dynamic share of generated energy allocated to the metering point of participating member's installation shall be recorded separately and shown on the invoice.

As a result, the system operator also has the obligation to perform the calculation and allocation of respective usage and to present it on its invoice. This interaction of measurements, timely presentation of these measurement data,

[94] § 16e (1) No. 1 Electricity Act 2010 government bill, p 56.
[95] Market rules must be observed.
[96] § 16e (1) No. 2 Electricity Act 2010 of government bill, p 56.
[97] Cf. § 16 (2) Electricity Act 2010 of government bill, pp 56, 57.
[98] Market rules must be observed.
[99] § 16e (2) Electricity Act 2010 of government bill, p 57.

calculation of consumption and generation and presentation on the invoice are effective and facilitate regulations for the participation in energy communities.

As already mentioned at REC, these explanations refer to a government bill which does not assert? any legal binding force. The presentation on the CEC serves as a possible outlook on the future regulations on energy communities in Austria.

In summary, the CEC has a very wide scope in relation to its possible members, but the control powers are limited. The joint provisions for REC and CEC indicate that basically the same regulations are suitable for the organization of participation, metering and billing. Nevertheless, the specificity of CEC is taken into account in the form of data exchange among the system operators, because CEC can operate throughout Austria.

Essential differences refer, as already specified in the RED II and ED 2019, to the possible members, energy source and area of activity.

4.1.2.5 Progress concerning adoption of Energy Efficiency Directive (EED 2018) 2018/2002/EU

Due to the implementation of the Energy Efficiency Directive 2012[100], the Energy Efficiency Act[101] was created. According to the website of the Federal Ministry of the Republic of Austria for Climate Action, Environment, Energy, Mobility, Innovation and Technology, steps have already been taken for a new Energy Efficiency Act. Due to the requirements from EED 2018, an evaluation process was started in September 2018. In this process, many different stakeholders were invited to discuss experiences with the Energy Efficiency Act. In addition, topic-related workshops were held. This evaluation process finished June 2019. The results of the evaluation process, especially topics such as minimization of administrative burden, obligation system, audits, the energy poor, were also designated as support for a draft of the new Energy Efficiency Act (without prejudice if and in which form the results will be adopted in the draft law).[102] The Federal Ministry also announced on its website that it is currently working on the drafting of the new Energy Efficiency Act[103].[104]

4.1.3 Differences between national implementation and Directives with regard to the Renewable Energy Community (RED II) and Citizen Energy Community (ED 2019)

Based on current knowledge through the government bill, one difference between RED II and ED 2019 stands out. This difference between the European requirements and the current government bill is over whether or not both energy communities are enabled to own and operate a distribution grid. Art. 16 (2) lit b in conjunction with (4) of the ED 2019 stipulates that member states may provide that CECs may own and operate distribution networks, but there isno comparable provision in the RED II. According to the government bill, however, both energy communities shall be able to own and operate distribution grids. The regulations of the distribution system operator are to be applied. This is stipulated in the joint provisions of § 16d (4) Electricity Act 2010.[105] The explanatory notes to the government bill stipulate that the community may either operate the grid itself or have it operated by a licensed system operator.[106]

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100 Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC, OJ 2012 L 315/1.

101 Bundesgesetz über die Steigerung der Energieeffizienz bei Unternehmen und dem Bund (Bundes-Energieeffizienzgesetz – EEffG) F.L.G. I No. 72/2014 last amended by F.L.G. I No. 68/2020.

102 Cf. Website: https://www.bmk.gv.at/themen/energie/effizienz/recht/evaluierung_effg.html (retrieved on 26-04-2021).

103 Cf. Website: https://www.bmk.gv.at/themen/energie/effizienz/recht/effizienzgesetz.html (retrieved on 26-04-2021).

104 With the update of D5.1, there will be further explanations on the national implementation status.

105 § 16d (4) Electricity Act 2010 of government bill, p 56.

106 Cf. government explanatory notes, p 28.

Further differences in implementation will be examined when the Renewable Energy Expansion legislative package comes into force. At present, the law is not yet in force and therefore no concrete results can be drawn from the analysis, because the draft law could still change.

4.1.4 Adaptability of the eCREW approach

In Austria there are already possibilities for sharing electricity in the form of joint generation facilities, via direct line or when the surplus electricity of a private generation facility is sold to a supplier. The eCREW approach takes up in particular the variant that is currently possible in Austria, namely by giving the surplus electricity to a supplier. In this way, electricity can be shared without having to fulfil the obligations of an energy supplier under electricity law. In general, the eCREW approach fits well into the Austrian energy system; nevertheless, it will probably be required to make a few adaptations as a business model.

4.1.4.1 Interaction between legal and administrative framework (with reference to the eCrew approach)

In the current legal system, it is beneficial and necessary for citizens to use a professional electricity supplier to sell the surplus electricity from their generation facility. Without a supplier, the citizen would have to fulfil the rights and also the obligations of the Electricity Act 2010 of a supplier with the feed-in of the surplus electricity. The citizen would need to join a balancing group, fulfil electricity labelling and other obligations. In this context, the eCREW approach is an opportunity for citizens, but also for larger companies, to engage in collaborative electricity exchange without having to fulfil the obligations of a utility.

In Austria, it has been possible since 2017 to jointly generate and consume electricity within a building (§ 16a Electricity Act 2010 "joint generation facility"). The legal regulations stipulate that the surplus electricity can be supplied to the grid. The eCREW approach could also be applied here, so that the surplus electricity can be shared with other members participating in a CREW.

There are already regulations for smart meters in Austria that are essential for eCREW. Energy data is collected by smart meters, which are also subject to data protection regulations. The system operator is responsible for installing the smart meter and reading the data. In order for quarter-hour values to be measured, the consumer's consent is required or the consumer's contract makes this necessary. The data is read out once a day and then made available to consumers on a website of the system operator. Suppliers themselves receive the energy data of their customers monthly from the system operator. It is also possible that the consumer authorizes a third party to use his data. In this case, the system operator must provide the data and information in a storable and printable form for further processing. In Austria, it is also possible to use a unidirectional communication interface. Accordingly, there are several possibilities how the energy consumption data for eCREW approach could be obtained. When using the eCREW approach, the respective possibilities have to be considered.

As already shown above, in Austria, the eCREW approach is workable in principle. The regular system charges, which are paid for the purchase of electricity and the feed-in of electricity, have to be observed. The government bill provides system charge reductions reserved for RECs in accordance with RED II. Therefore, system charge reductions are generally not applied to eCREW unless all RED II criteria are fulfilled. With the above-mentioned government bill, the regulations on support for facilities that generate electricity from renewable energy sources will also change or be adapted. Further analyses will only take place after the implementation of the EU directives into national law.

4.1.4.2 Adaptability of eCREW as business model for energy retailer and energy communities (Foundation, Participants, energy retailer)

According to the current legal situation, the eCREW approach can be implemented in Austria, as the above explanations show. The eCREW approach pursues the idea of individual citizens and companies (without the establishment of a legal entity and without extensive electricity legal obligations) to share energy in a simple way. A citizen can provide his surplus electricity from his PV system to a supplier. This supplier delivers this surplus electricity to those natural and legal persons that the citizen chooses? The eCREW takes up this possibility and assumes the intermediary position between supplier and consumer, as well as the producer. Thereby, the energy exchange of surplus electricity takes place within a CREW. The supplier thus becomes an intermediary and assumes the administrative and legal obligations.

Further analysis can be conducted as soon as the transpositions into national law are completed.

4.1.5 Perspective from a Community and Citizen point of view

The survey carried out during the H2020 project ECHOES was mainly aimed at providing perspectives on the community and citizen points of view. The survey aimed at providing insights into individuals' energy choices within the context of an energy transition process. The survey covered 31 countries (EU 28 including the United Kingdom, plus Norway, Switzerland and Turkey). From a total of 18,037 participants in the 31 countries, 604 were from Austria. This online survey contained 114 questions.

4.1.5.1 Community perspective (Utilization the results of ECHOES survey)

43.2% of the respondents from Austria indicate that they would be interested in participating in a renewable energy investment, and 43.5%, that their pro-environmental behaviours are positively affected by their communities' views and opinions. This reflects an even stronger agreement, by 71.7%, that people can act together for energy transition. These results underscore the potential for RECs and CECs.

However, respondents' actual perception of how well the community is doing in terms of energy behaviours paints a different picture. 89.4% believe that human activities are at least equally responsible as natural causes for global warming, and 53.5% believe that human activities are the main reason. Further, 61.9% of the respondents from Austria report feeling anger that people in their community fail to save energy. 55.3% believe that a growing number in their community support policies in favour of energy transition, and 50.8% believe that a growing number will try to adopt energy-saving behaviours. However, only 38.8% of respondents observe that people in their communities are increasingly adopting energy saving behaviour regarding heating and cooling.

Regarding the extent to which respondents expect their community to support their energy-related behaviours, 38.8% think that they would receive social support if they opted for policies that favour energy transition. 50.8% feel certain that they would receive such support for consuming less energy, with 35.9% stating that their community would support energy savings regarding heating and cooling.

Energy savings through unconventional behaviours are expected to receive a much lower level of support from their communities. For instance, only 25.9% of respondents expect support from their communities for allowing their grid operator to remotely turn on/off non-critical appliances.

4.1.5.2 Current status of communities in terms of energy-related endeavours

According to Caramizaru and Uihlein (2020), energy communities are very heterogeneous in terms of both organisational and legal forms. Broughel and Hampl (2018) argue that in Austria, there are traditional concerns about the unspotted Alpine scenery and tourism, which impact socio-political acceptance of large-scale renewable energy installations. Further, direct citizen involvement might reduce the tension between renewable energy development and the willingness to protect natural environments. However, since Austria has a long tradition of citizen participation in different types of community-based initiatives (from banking services to dairy farms), there would be many reasons to believe that community renewable energy projects might have strong potential in Austria. In fact, in 2014, Austria hosted approximately 400 community renewable energy projects (Bauwens et al., 2016).

This is a relatively high number per capita compared to 1750 in Germany, 700 in Denmark, 500 in the Netherlands, 430 in the United Kingdom, 200 in Sweden or only 33 in Spain (Caramizaru and Uihlein, 2020).

Since 2017, joint generation facilities in apartment buildings are allowed (see § 16a Electricity Act 2010). Electricity produced by generating facilities within apartment buildings can be consumed by the residents via an internal grid. Prior to this law, renewable electricity, mostly generated by PV roof panels, was often not used directly in the building, but fed into the electricity grid. In 09/2020, 291 joint generation facilities were in operation and additional 460 were being planned (TP Smart Grids Austria, 2020).

In the following, three ongoing community energy initiatives operating in Austria are described. One of the most promising community initiatives is in a residential area within Leopoldstadt, a district of Austria's capital Vienna. The largest energy supplier of Austria, Wien Energie, is working on a 5-year project together with local residents to create new products and services in the fields of energy, mobility and smart living. The area includes more than 300 new apartments, local production and consumption of PV electricity and several mobility services, such as car-sharing. Also, peer-to-peer trading via blockchain technology, as well as a shared electricity storage with 70kWh are being tested. In the nearer future, heating and cooling supply will be improved with additional solar energy facilities, heat pumps, a local district heating network as well as a local district cooling opportunity. This project is the basis for future services that could be offered in energy communities (Wien Energie, n.d.).

In 2020, the OurPower Energy Cooperative established an online energy marketplace. Consumers can buy green electricity directly from regional energy producers. Consumers who participate in the marketplace and buy electricity thus directly contribute to the continuity of existing facilities and the expansion of new renewable energy plants. Also, in this way consumption and production of electricity both occur locally. Producers have to join the cooperative (minimum fee of 100€) to become sellers on the marketplace (OurPower, n.d.).

A smaller scale but interesting initiative is handled by the network operator Energienetze Steiermark in Heimschuh, a 2000-inhabitants municipality in southern Styria. In 2017, a 100kWh electricity storage system was implemented, shared by a small number of households that all produce electricity with solar energy. As a result, the self-consumption rate of these PVs increased from 30% to more than 70%. Since 2019, peer-to-peer trading via blockchain technology enabled households to sell their excess electricity directly to their neighbours (Energienetze Steiermark, n.d.).

4.1.6 Citizen perspective (Utilization the results of ECHOES survey)

Regarding attitudes towards RECs and CECs, the ECHOES survey reveals that 84.6% of the respondents in Austria are positive about the environmental benefit of renewables. Also, 66.6% state that they intend to use renewable energy in such a way as to support energy transition. Regarding economic benefits, 58.1% believe that the use of renewables will create employment.

Further, 79.6% of the respondents believe that global warming is in progress, underscoring the urgency of adopting green behaviour.

This perception is connected to actual behaviour, as 62.9% state that acting pro-environmentally is an important part of their lives. 72.5% feel obliged to be energy efficient, and 65.3 % feel obliged to adopt energy savings behaviour regarding household heating and cooling.

Lastly, 52.2% of the respondents from Austria are in favour of pro-environmental policies, even if they result in higher costs.

4.1.6.1 An overview of energy behaviours of citizens

Lifestyles and lifestyle choices are significant drivers of energy behaviours. The ECHOES survey provides insights into respondents' lifestyles and choices in Austria.

Most respondents, 58.12%, live in apartment blocks. Another 30.3% live in single-family homes. Regarding the floor areas of the dwellings, 34.1% are smaller than 70 square feet, and 22.7% are between 71 and 90 square feet. 12.3% live in larger dwellings of 91 to 110 square feet, and 9.6% between 111 and 130 square feet. 20.3% live in households of 131 square feet or larger.

In Austria, 51.7% of the respondents use central heating for domestic heating, 27.7% use district heating, 8.6% use one or more standalone stoves, and 7% use one or more stand alone electric heaters.

Accordingly, for heating, 29% of the households use gas, 21.4% oil, 14.1% wood, 7% a heat pump (geothermally) and 6.8%, electricity.

The energy used for heating and cooling depends on individuals' comfort temperature preferences. 41.4% of the respondents state that their comfort temperatures are close to the average, 37.4% prefer cooler temperatures, and 18.5% warmer temperatures.

82.5% of respondents in Austria do not own an air conditioner. 9.5% use them almost never or rarely, and 8.1% stated that they sometimes, regularly or often use air conditioners during hotter periods.

41% of respondents stated that they always or often disconnect electric appliances when not in use, 40.4% never or rarely, and 18.7% occasionally.

84.6% use energy-saving light bulbs at home, and 65.6% have at least a share of 75% of energy-saving light bulbs.

A considerable share of respondents, namely 45.2%, give no definite answer on whether their electricity provider has a particularly high share of renewable energy production. 47% confirm that their provider has a particularly high share of renewable energy production, while the remaining 7.8% confirm that theirs do not.

Next, mobility habits and the use of public transportation are also important drivers of energy behaviours. In Austria, 84.4% of respondents state that they drive private cars. 18.2% drive less than 5,000km annually, 23.5% drive between 5,000 and 10,000km, 14.7%, between 10,000 and 15,000km, 11.8%, between 15,000 and 20,000km and 7.3% between 20,000 and 30,000km.

17.1% almost always drive alone, whereas 50.8% drive alone at least 50% of the time. The vast majority (94.1%) of vehicles are petrol or diesel-fuelled. 3.1% are either hybrid-electric, plug-in hybrid, or fully electric.

Interestingly, 89.6% of the respondents from Austria have never participated in car-sharing. Of those, 54% never intend to, and the remaining 35.6% find the idea interesting. Most of the respondents who have tried car-sharing (8% of 10.4%) report positive experiences.

In terms of public transportation use, 40% believe that public transportation to be environmentally-friendly, 18.1% believe that it is not, and the remaining 41.8% are undecided. The following numbers might indicate that public transportation in Austria is underused. 52.8% of the respondents state that they rarely use public transportation (less than once per week on average), 17% use public transport 1-4 times per week, and 10.7%, 5- times per week. However, 19.6% use it more than 8 times per week.

Lastly, also travelling by plane relates to carbon footprints and thus energy-related behaviour. 50.5% of the respondents report taking at least one non-business flight within the last year. The total annual time for these flights is generally equal to or less than 10 hours (for 32.3%).

4.1.7 Interim conclusion

The demographic structure of a country could impose serious implications for the implementation of the eCREW strategy. However, Austria and its relatively homogeneous and educated population seems to provide favourable conditions for the success of eCREW.

While Austria presents considerable regional heterogeneity in terms of population density due to the west-east direction of the Austrian Alps, its population is rather homogenous with respect to education and income levels. These are relevant factors, since eCREW is a high-tech project that relies on modern technology and on the willingness to actively engage with technology that enables the monitoring of energy consumption and/or the production or storage of energy. In contrast, the ageing population might impose issues in that regard.

Next to income levels, unemployment can play a similar role in affecting perspectives on energy-related initiatives. Unemployment rates vary substantially by region. The average unemployment rate in Austria (national definition) was 9.9%. Upper Austria reported the lowest rate with 6.5%, and Vienna the highest rate with 15.1%, followed by Carinthia with 11.3%. Carinthia seems to be the region that, relatively speaking, stands out in several aspects: lower population density, higher unemployment, older population.

In addition, the number of PVs per 1000 inhabitants is also relatively low in Carinthia. PVs are especially densely distributed in the states of Upper Austria, Lower Austria and Burgenland, pointing towards a certain technological readiness and interest.

However, as indicated above, Austria has already implemented several projects that are concerned with the community aspect of energy, and these range from small scale initiatives in rural areas to larger scale projects in Austria's capital Vienna.

While 83% of total energy production stems from renewable sources, Austria still relies heavily on gas and oil imports. These account for about 78% of total gross available energy. However, the share of renewable energy in gross final energy consumption is increasing, and at 33,6%, close to the national target. Further, 77% of Austria's electricity production already stems from renewable sources. As part of the national climate and energy strategy, Austria plans to install one million photovoltaic power plants on residential rooftops in line with the aim to generate 100% of total electricity consumption from domestic renewable energy sources, contributing to the foundation of a successful implementation of the eCREW approach.

Energy behaviors of individuals and communities, as well as attitudes towards energy related matters, play a significant role in the success of the eCREW approach. Overall, results from the ECHOES survey suggest that respondents are aware of the importance of adopting green behavior and are willing to adapt their lifestyle to contribute to the necessary energy transition. In fact, 85% of the respondents in Austria are positive about the environmental benefit of renewables and two thirds state that acting pro-environmentally already is an important part of their lives. While energy-saving behaviour seems to play an important role in everyday life, the potential of alternative mobility is not fully utilized. Car-sharing possibilities are hardly explored, and more than half of the respondents rarely or never use the public transport system.

The ECHOES survey underscores the significance of the community aspect in energy related matters. More than 70% agree that people can act together for energy transition and more than 60% feel anger about others failing to save energy. Further, about half of the respondents believe that more and more people support policies in favour of energy transitions and actually adopt energy-saving behaviours, and feel certain that they would receive community-support for consuming less energy.

The current legal and regulatory framework enables the implementation of the eCREW approach. The climate and energy strategy of Austria also favours this approach, since it provides for the expansion of renewable energy, such as a million PV systems. eCREW can also be integrated into the existing legal regulations. eCREW offers the possibility for a large number to participate in the exchange of electricity from renewable sources.

4.2 Germany

4.2.1 Country Profile

4.2.1.1 Demographics

Germany is located in Central Europe and is composed of sixteen federal states (in German: Länder) including its capital and largest city, Berlin. With an area of around 357 600 km², Germany is the 6th largest country in Europe and the 4th largest in the European Union (EU). In 2019, its population was approximately 83.2 million, resulting in a population density of 233 inhabitants per km².

Table 10 shows the population according to age groups, revealing that 28% of the population is between 40 and 60 years old, 25% between 20 and 40and 22% between 60 and 80. 16% of the population is aged under 18.

Table 10: Population by age groups, 2019. Data source: Statistisches Bundesamt (Destatis) (2021a)

2019	Total	0-20	20-40	40-60	60-80	80+	>18	18+
Population	83 166 711	15 330 502	20 467 832	23 629 924	18 057 318	5 681 135	13 677 902	69 488 809
in %	100	18,4	24,6	28,4	21,7	6,8	16,4	83,6

The dependency ratio in 2019 (age-population ratio of those aged 15-64 typically not and typically in the labour force) is 55%, meaning the share of economically active is almost twice the share of economically inactive. This ratio has increased over the last three decades (World Bank, 2019). The age structure revealed in Figure 9 also points towards an increase in the future dependency ratio. The relatively large share of 50- to 60-year-olds and the relatively small share of under 10 years old might thus impose serious financial stress on Germany's future working population. The age pyramid further indicates a surplus of men in the under-60 populations, and a surplus of women in the over -60 population.

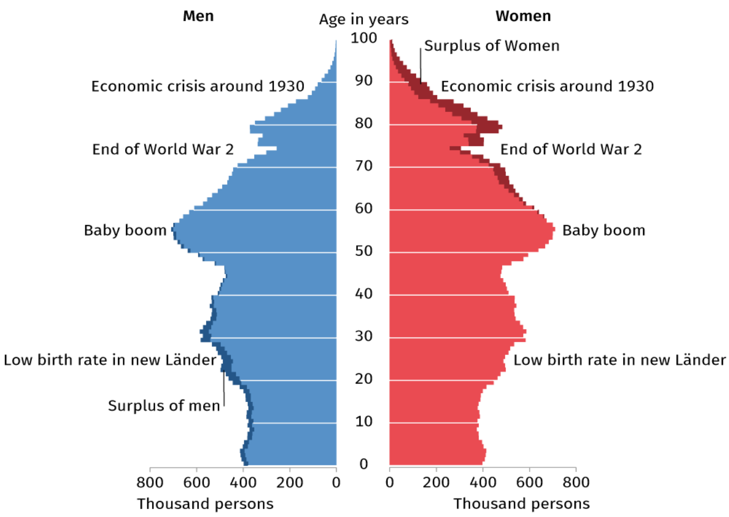

Figure 9: Age structure, 2019. Image source: Destatis (2021b)

Bavaria in the south is Germany's largest state by area, with 70 550 km², followed by Lower Saxony and Baden-Württemberg. North Rhein-Westphalia in the west is the largest state by population, with almost 18 million inhabitants, followed by Bavaria and Baden-Württemberg. Figure 10 depicts Germany's population density by administrative districts (in German: Kreise/Landkreise). The east is much less populated than the west, and especially the area of former East Germany has many relatively sparsely populated regions. 77.4% of Germany's population is urban, 22.6% is rural (World Bank, 2019).

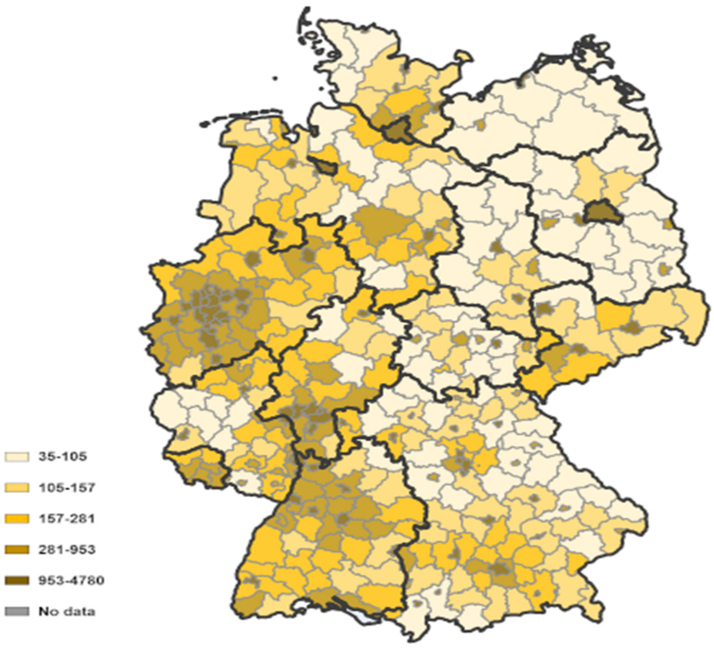

Figure 10: Population density by administrative district, 2019. Image source: Destatis (2021c). Legend was added.

In 2019, 29.9% of the population aged between 25 and 64 had a tertiary education attainment (ISCED classification). This is below the OECD average of 38% (OECD, 2021). However, regarding upper secondary education attainment, with 57%, Germany is well above the OECD average of 41%. Figure 11 further details tertiary education attainment by state. While population density shows a west-east divergence, there is a considerable south-north divergence with regards to education attainment. In general, states in southern Germany have attainment shares around or above the German average, and states in the northern half, below average. Important exceptions are Hamburg and Berlin, with shares of 33% and 43%, respectively.

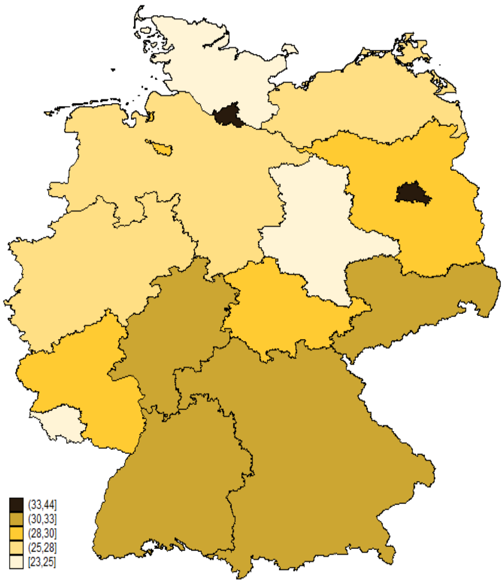

Figure 11: Percentage of the population aged between 25 and 64 with tertiary education attainment (ISCED) by state, 2019. Data source: Destatis (2020a)

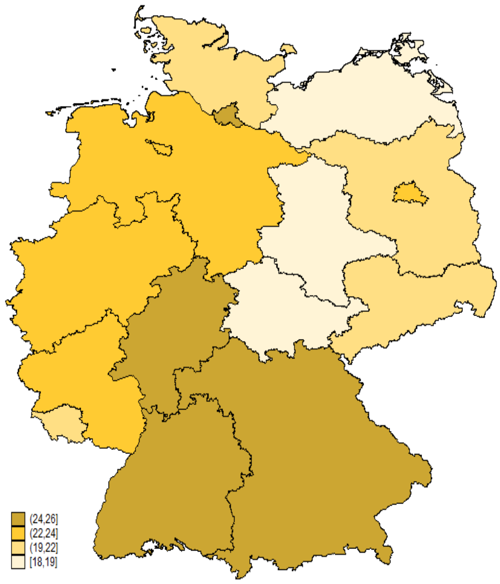

Figure 12: Gross hourly wage of employees by state, 2019. Data source: Destatis (2020b)

Figure 12 depicts employees' average gross hourly wage (without special paymentsin 2020 by state. At a first glance, Figure 11 and Figure 12 look similar. Southern states show the highest hourly wages. However, again, the west-east divergence is much more than the south-north. While the hourly? wages in the "New federal states" (in German: "Neue Länder"[107]) of former East Germany are all below the German average of 23.2€, the wages in western states are mostly above average. Berlin marks an extreme in this comparison. While Berlin shows an unusually high share of tertiary education attainment, the hourly wage is barely above the average.

For historical reasons, the east is less economically developed than the west, as well illustrated by the unemployment rate. . Figure 13 shows the unemployment rate for Germany, the states of former West Germany and the former East Germany (including Berlin) since 2005.

[107] "New federal states" refers to those states that reintegrated into Germany after the fall of the Berlin Wall and reunification in 1990 (cf. https://www.bpb.de/geschichte/deutsche-einheit/deutsche-teilung-deutsche-einheit/43695/geschichte-der-mauer; https://www.bundesregierung.de/breg-de/suche/neue-laender-und-landtagswahlen-436624).

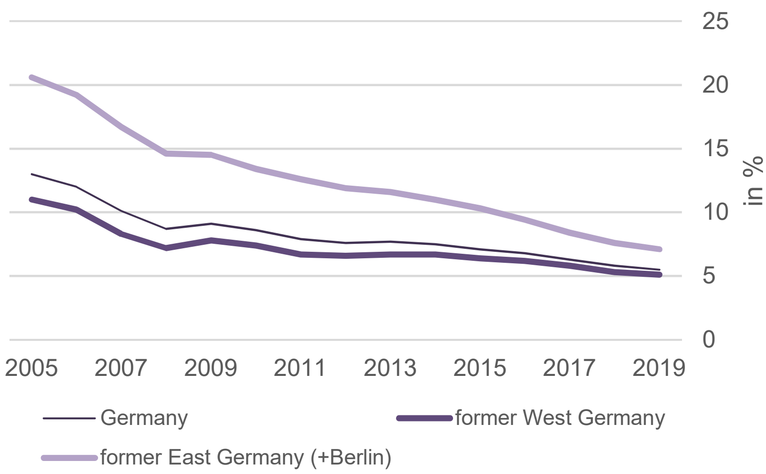

Figure 13: Unemployment rate since 2019, East- and West Germany.Data source: Destatis (2021d)

In 2005, there was still a massive gap between the east and the west. Unemployment rates were above 20% in the states of former East Germany. However, this gap decreased annually, and was only around 2 percentage points in 2019, with 5.1% in the west and 7.1% in the east. The working population in Germany is approximately 45 million workers. As Figure 14 shows, in 2019, 1.3% worked in the primary sector, 24% in the secondary, and 75% in the tertiary sector. While the percentage in the primary (1.7%) and secondary sectors (26%) slightly decreased since 2005, it marginally increased in the tertiary sector (73%).

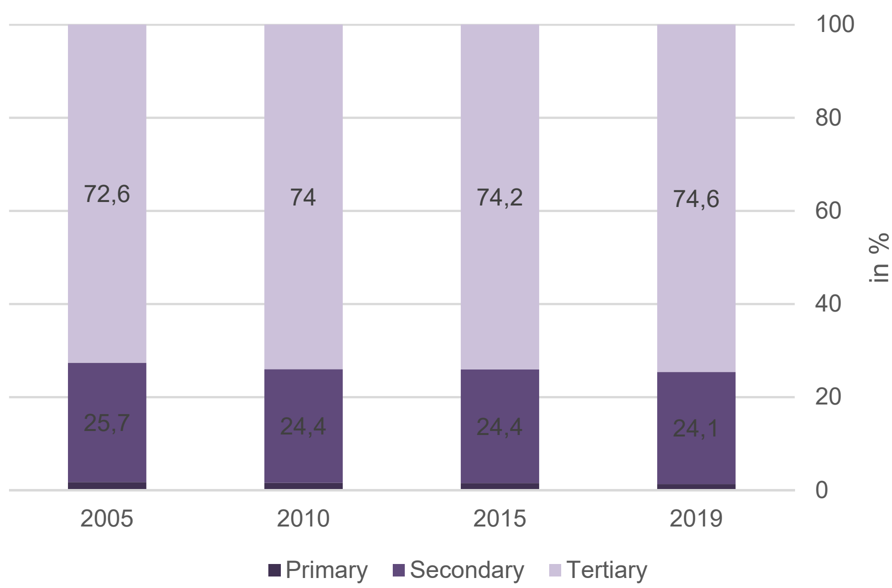

Figure 14: Share of workers by economic sector since 2005. Data source: Destatis (2021e)

4.2.1.2 Energy profile (production, supply, consumption etc.)

Table 11 provides Germany's energy balance in 2019, measured in Terajoule (TJ). Energy from renewable sources makes up 53% of Germany's national energy production, followed by coal with 33%. Gas, oil and energy from other sources, such as district heating and combustible waste, make up the remaining 14%. Germany is heavily reliant on coal, oil and gas imports, equivalent to 95% of the gross available energy. In 2019, gross final energy consumption was 8973 Petajoule (PJ). In the Renewable Energy Directive (2009/28/EC) Germany's goal to achieve a 18% share of renewable energy in its gross final energy consumption by 2020 was surpassed with a share of 19.3% (Umweltbundesamt, 2021).

Consumers can be divided into three broad categories. Firstly, households, commerce and services consume 42% of gross final energy consumption. Private households account for 65% of the total. Secondly, the transport sector consumes 30% and road transport accounts for 82% of the total consumption. Thirdly, the mining and industry sector consumes 28%. The largest shares in this sector are consumed by the metal- and the basic chemicals industries, with approximately 20% each.

Table 11: Energy balance, 2019. Data source: AGEB (2021)

	Coal	Oil	Gas	Renewables	Electricity	Nuclear	Others	Total
1. Production	1 189 900	81 891	201 841	1 919 764			218 423	3 611 819
2. Import	1 179 949	5 445 622	5 570 651	88 695	144 450	818 952	57	13 248 377
3. Export	63 848	916 803	2 393 964	104 006	262 055		183	3 740 857
4. Stocks	58 817	99 317	156 662					314 796
5. Gross available energy (1+2-3-4)	2 247 184	4 511 393	3 221 866	1 904 453	-117 605	818 952	218 297	12 804 543
6. Conversion loss	2 245 179	4 514 866	881 128	1 185 536	29 056	818 952	139 667	9 814 384
7. Conversion output	379 809	4 419 966	229 166		2 193 469		457 786	7 680 195
8. Consumption of energy sector	7 608	230 855	150 232	20 157	148 153		15 994	572 999
9. Transport loss			15 655	3 081	98 906		40 772	158 414
10. Nonenergy Consumption	17 207	763 774	143 999					924 981
11. Statistical differences	60 749	-26 339	-75 013					-40 603
12. Gross final energy consumption (5+7-(6+8+9+10+11))	417 748	3 395 525	2 185 005	695 679	1 799 749		479 650	8 973 357
Mining, industry	403 196	84 531	873 233	112 737	786 411		251 642	2 511 751
Transport	-	2 562 089	5 848	112 160	41 792			2 721 889
Households, commerce, services	14 551	748 903	1 305 925	470 782	971 546		228 008	3 739 716

Figure 15 depicts Germany's energy mix from 2010 to 2019 in PJ. Gross final energy consumption has been relatively stable in the last decade and decreased by around 335 PJ since 2010. Moreover, no significant changes in the composition of the energy mix can be observed.

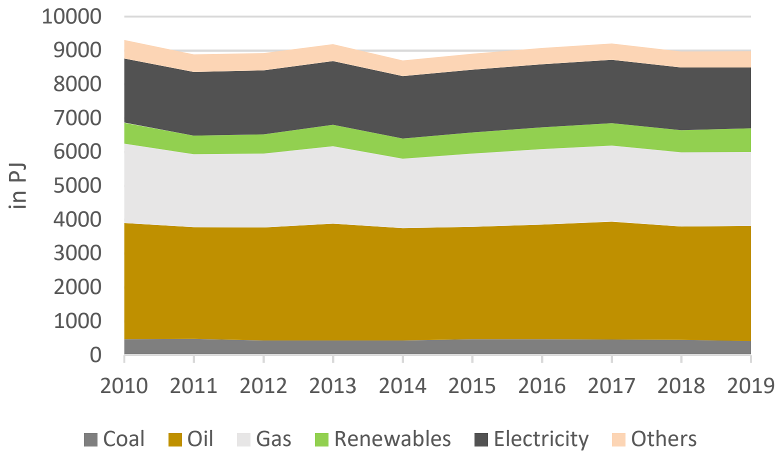

Figure 15: Energy mix in PJ, 2010-2019. Data source: AGEB (2020a)

Figure 16 shows Germany's energy mix in 2019. 38% of total gross final energy consumption was oil based, 24% gas based, and 20%,electric energy. Germany relies heavily on imports of oil and gas, which play a significant role in overall energy consumption.

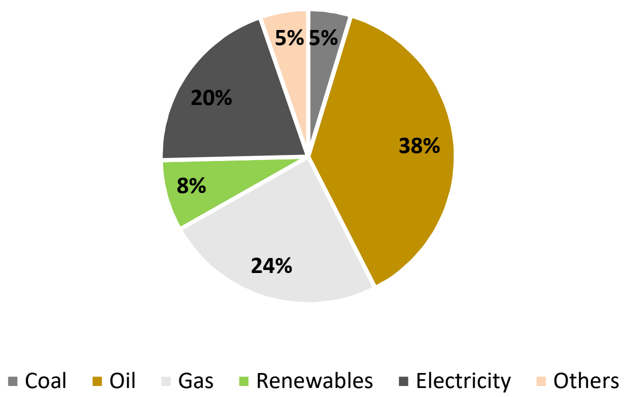

Figure 16: Energy mix in %, 2019. Data source: AGEB (2020a)

Germany's gross domestic electricity production equaled 2194 PJ in 2019, slightly below the level of 2010. As shown in Figure 17, over the course of the decade, electricity production has fluctuated to some degree, reaching its decade low in 2019, and its high in 2017, with 2353 PJ. Since 2010, the shares of both coal and oil have decreased by approximately 30%. This is a necessary development if Germany intends to reach its goal of ending the use of coal-powered energy by 2038. This Coal Phase-Out Act[108] entered into force in Germany in 2020. Coal-powered energy is to be gradually reduced and no new coal-based facilities (with exceptions) are being commissioned. Further, financial compensation to operators of such facilities is offered (Bundesregierung, 2021a). While the share of gas has remained relatively stable, electricity from renewable sources has more than doubled. As Germany plans to phase out electricity produced by nuclear power plants by 2022, its share has decreased substantially since 2010.

[108] Gesetz zur Reduzierung und zur Beendigung der Kohleverstromung und zur Änderung weiterer Gesetze (Kohleausstiegsgesetz) Kohleausstiegsgesetz from 8. August 2020 (F.L.G. I p. 1818), last amended by article 3b of the Act from 3. December 2020 (F.L.G. I p. 2682).

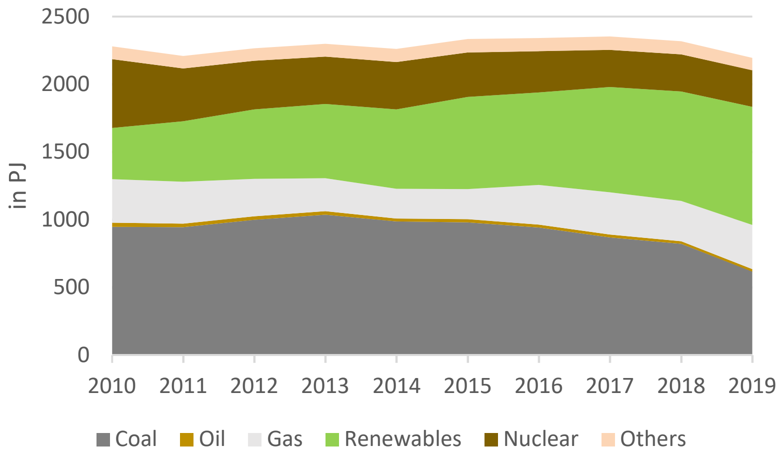

Figure 17: Gross domestic electricity production by source in PJ, 2010-2019. Data source: AGEB (2020b)

In 2019, 28% of domestic electricity production originated from coal, and 28% from wind and solar energy. Gas contributes 15%, followed by nuclear energy with 13%. In 2019, Germany produced approximately 40% of the gross national electricity production from renewable sources (see Figure 18). 65% of Germany's final electricity consumption is to come from renewable sources by 2030, according to the revised German Renewable Energy Act effective in 2021[109]. Further, by 2050, the goal is to produce 100% of all electricity from renewable sources (Bundesregierung, 2021b).

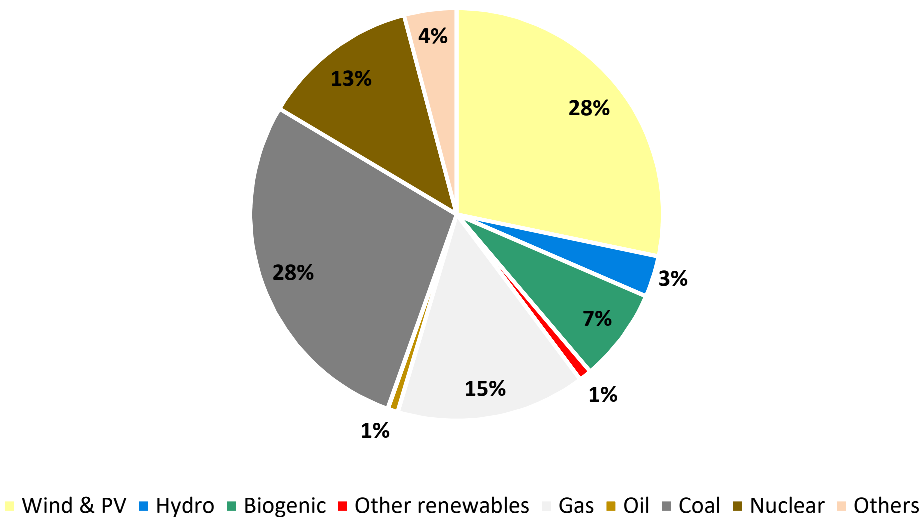

Figure 18: Gross domestic electricity production by source in %, 2019. Data source: AGEB (2020b)

By sector, industry accounts for 44% of gross final electricity consumption, followed by the commerce and services sector with 29%, and private households with 25% (see Figure 19).

[109] Gesetz für den Ausbau erneuerbarer Energien (Erneuerbare-Energien-Gesetz - EEG 2021) Erneuerbare-Energien-Gesetz from 21. July 2014 (F.L.G. I p. 1066), last amended by article 1 of the Act from 21. December 2020 (F.L.G. I p. 3138).

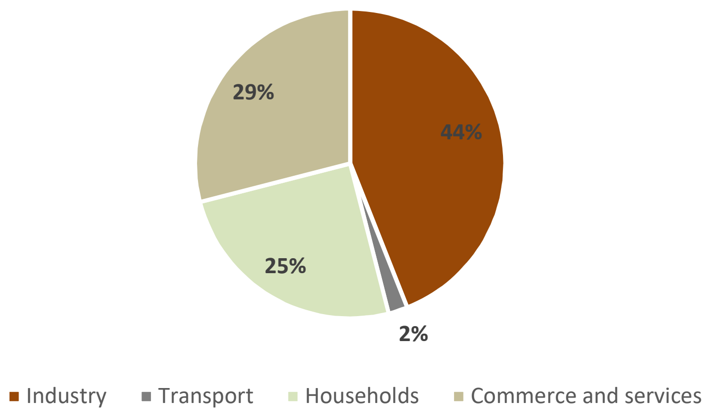

Figure 19: Gross final electricity consumption by sector, 2019. Data source: AGEB (2020a)

4.2.1.3 Energy market and infrastructure

Energy market

The German energy market was liberalized on April 29, 1998[110], and since then, all electricity customers have been free to choose their electricity supplier, and the number of electricity suppliers has sharply increased to more than 1000 by 2021, (Bundesnetzagentur, 2021a). In Germany, the Federal Network Agency (in German: Bundesnetzagentur) is responsible for regulating electricity, gas, telecommunications, post and railway markets.

On the German market, there are several system charges, duties and taxes for electricity. In addition to the base energy price, there are other cost components. On average, in 2019 for households with a yearly electricity consumption of 2500 to 5000kWh, the Bundesnetzagentur (n.d.-a) determined the following consumer electricity price composition: The energy price accounts for about 25%, system charges for 23%, the EEG surcharge (in German: EEG-Umlage) for 21%, and the rest (duties, taxes, etc.), for 31%.

The energy price is composed of a monthly base price with the addition of the price per kilowatt hour consumed. System charges are made up of the following: The system utilization charge (in German: Netznutzungsentgelt) covers costs incurred by system operators for the construction, operation and expansion of their networks. The metering charge (in German: Entgelte für Messung und Messstellenbetrieb) covers the costs of installation, maintenance and reading of metering points. The EEG surcharge finances the fixed feed-in remuneration of electricity from renewable energy sources into the national grid and was around 6,5c/kWh in 2019.

The two main types of wholesale electricity markets in Germany are the future market and the spot market (BMWi, n.d.).

On the future market, electricity can be ordered as much as six years in advance. In this way buyers can hedge against uncertainty and avoid increasing prices, and producers can secure long-term revenue. Futures products can be further distinguished as base load or peak load contracts.

Short-term trade is possible on the spot market, and is crucial for balancing production and consumption. The spot market can be split into the day-ahead market and the intraday market. Electricity supply for the following day is traded on the day-ahead market on an hourly basis. Buyers and sellers have to submit their offers by 12pm. On the intraday market, electricity can be traded on a quarter-hour basis up to 30 minutes before delivery to a different

[110] The liberalization took place through the "Act on the New Regulation of the Energy Industry Law" published of 28. April 1998 (F.G.L. I p. 731), which novelized the Energy Act (in German: Energiewirtschaftsgesetz).

control area, or 5 minutes within the same control area. Since 2012, Germany has been divided into four control areas, each managed by one of the four existing Transmission System Operators (TSO): Amperion, TransnetBW, Trennet TSO and 50Hertz Transmission.

In Germany, every producer and consumer is part of one of the hundreds of balance groups. Each group is required to balance energy consumption and generation within the group, on the basis of quarter-hourly demand and generation forecasts. Electricity transaction schedules have to be sent to the respective TSO the day before by the balancing responsible party (in German: Bilanzkreisverantwortlicher). In the event of unanticipated fluctuations in generation or discrepancies from the expected consumption level, the energy balance in the grid must be guaranteed by the respective TSO through different types of balancing services. The balance group that caused the respective fluctuation has to pay the costs for these balancing measures. Since the costs of balancing energy are generally higher than on the wholesale market, these costs act as a penalty payment for deviations from the registered schedules (Bundesnetzagentur, n.d.-b).

Energy infrastructure

The German electricity grid consists of approximately 37 000 km of maximum voltage network, 86 000 km of high-voltage network, 520 000 km of medium-voltage network and 1.2 million km of low-voltage network (BdEW, 2018). Long distance transports are managed by the four Transmission System Operators, Amperion, TransnetBW, Trennet TSO and 50Hertz Transmission, Further, over 900 electricity system operators distribute electricity to consumers. Regarding gas, roughly 50 000 km of high-pressure network and 500 000 km of distribution network are installed. 50% of all households in Germany are connected to the gas network (BMWi, 2021).

Germany's total capacity was 229 170 MW at the beginning of 2021 (see Figure 20). Renewable energy sources account for 56% of the total, and conventional energy sources, for 44%. Regarding non-renewables, natural gas makes up 13% of total capacity, followed by stone coal, with 10%. Nuclear energy still accounts for 3.5%. Regarding renewables, onshore wind energy accounts for 23% and solar energy for 22% of the total. Hydro power plays a minor role, with 2%.

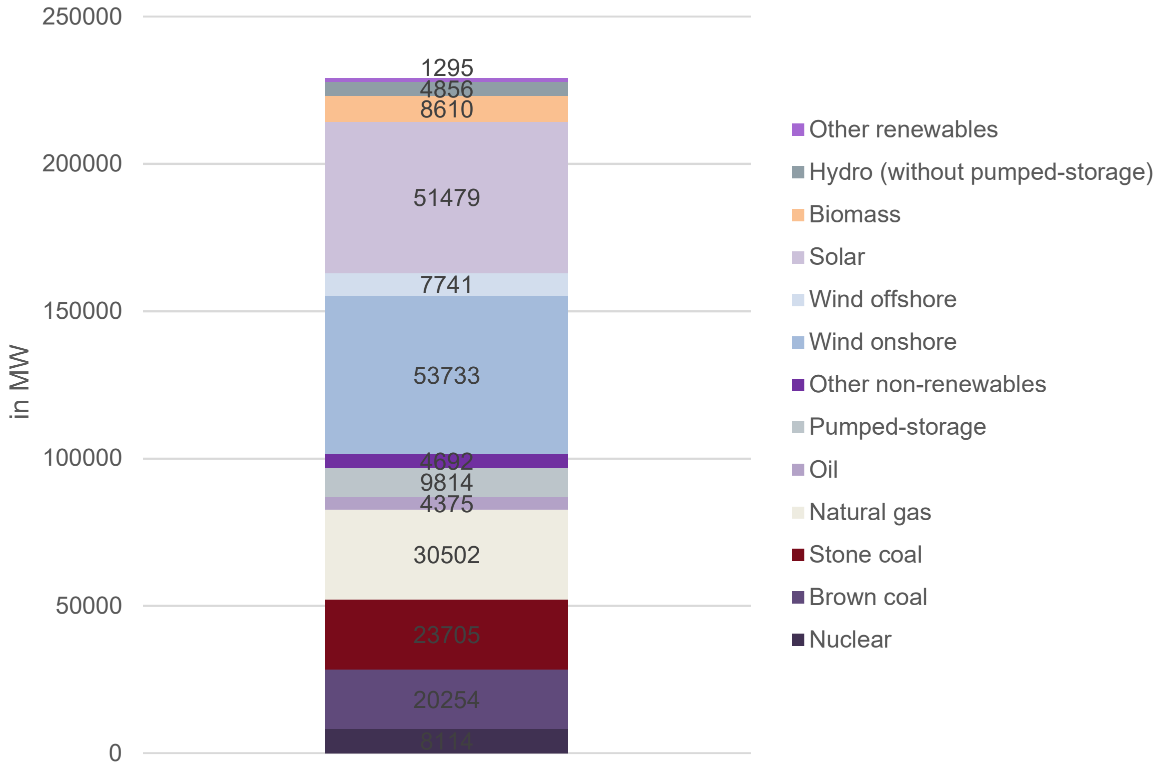

Figure 20: Capacity in MW by source, 2019. Data source: Bundesnetzagentur (2021b)

Figure 21 depicts the evolution of the total capacity from renewable sources in gigawatts (GW). Since 2000, capacity has increased every year. In the 2000's wind energy was the main driver, but in the last decade, both wind and solar energy experienced considerable increases. Hydro power is at the same level as in 1995, and energy from biomass but still makes up less than 10%, despite an increase in the last 20 years..

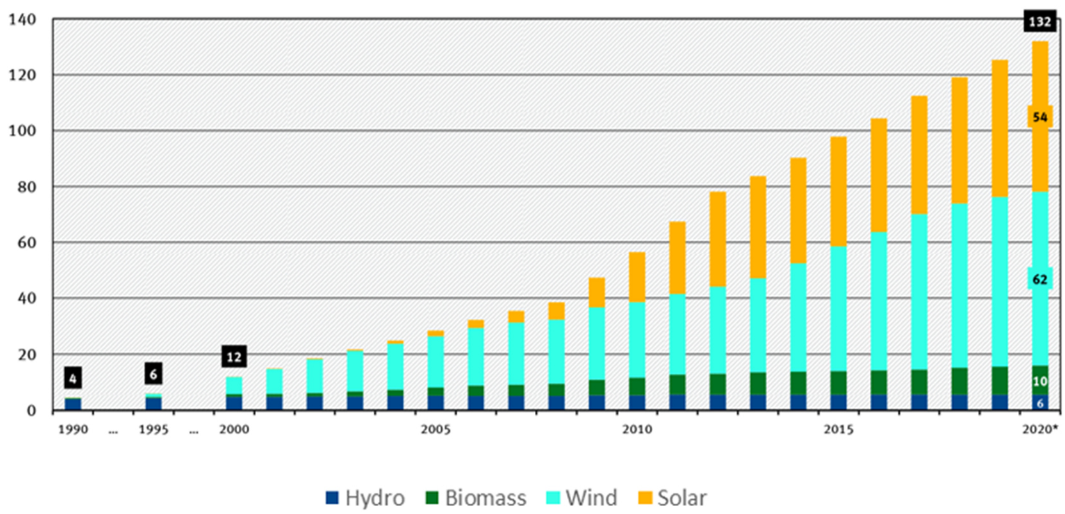

Figure 21: Capacity from renewable sources in GW since 1990. Image source: Umweltbundesamt (2021). Numbers for 2020 are preliminary. Legend was added.

Figure 22 presents Germany's capacity in MW per state in 2021. Most capacity is within Northrhine-Westphalia with 42 500 MW and Bavaria with 30 500 MW. 43% of Northrhine-Westphalia's capacity consist of coal-based facilities and another 20% of gas-based facilities. In Bavaria on the other hand, solar energy contributes 46%, followed by gas with 14%. In general, solar energy plays the most important role in the southern half and wind energy in the northern half of Germany. Nuclear energy is still utilized in four states. These are Bavaria, Lower Saxony, Schleswig-Holstein and Baden-Württemberg.

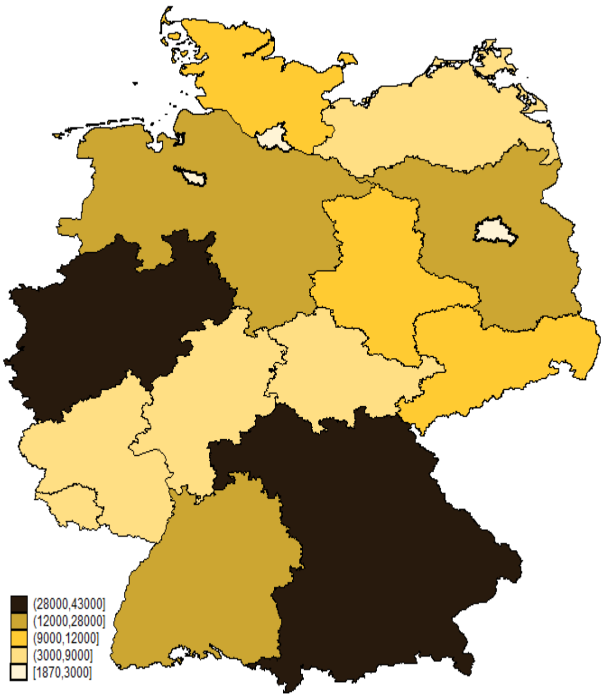

Figure 22: Capacity in MW by state, 2021. Data source: Bundesnetzagentur (2021b)

Regarding PVs, the southern states of Bavaria and Baden-Württemberg report the highest totalcapacities, and Bavaria stands out both in capacity total and capacity per km². However, while Bavaria still shows relatively high PV-capacity per 1000 inhabitants, the eastern states of Saxony-Anhalt, Brandenburg and Mecklenburg Western Pomerania, states with low total PV-capacity, report the highest PV-capacities per 1000 inhabitants. Thus, in these states the number of PVs is high relative to population density. (Bundesnetzagentur, 2019, as cited in Agentur für Erneuerbare Energien, n.d.)

4.2.2 Legal and administrative Framework of Energy Communities under National Structure

4.2.2.1 National legal and administrative framework for the adoption of eCREW approach

In Germany, in the field of energy, there are the central laws Energy Act[111] and Renewable Energy Act 2021[112]. The purpose of the Energy Act is to provide the most secure, affordable, consumer-friendly, efficient, and environmentally sound grid-based supply of electricity and gas to the public, increasingly based on renewable

[111] Gesetz über die Elektrizitäts- und Gasversorgung (Energiewirtschaftsgesetz - EnWG) Energiewirtschaftsgesetz from 7. July 2005 (F.L.G. I p. 1970, 3621), last amended by article 2 of the Act from 25. Februar 2021 (F.L.G. I p. 298).

[112] Gesetz für den Ausbau erneuerbarer Energien (Erneuerbare-Energien-Gesetz - EEG 2021) Erneuerbare-Energien-Gesetz from 21. July 2014 (F.L.G. I p. 1066), last amended by article 1 of the Act from 21. December 2020 (F.L.G. I p. 3138).

energy.[113] Although the Energy Act also includes the reference to environmentally compatible energy provision, there is also a more recent Renewable Energy Act in 2021. The purpose of the 2021 Act is to enable the sustainable development of energy provision, in particular in the interest of climate and environmental protection, to reduce the economic costs of energy provision also by including long-term external effects, to conserve fossil energy resources and to promote the further development of technologies for the generation of electricity from renewable energies.[114] These two laws are the central regulatory concepts in Germany[115] that are relevant to the eCREW approach.

The eCREW approach focuses on renewable electricity generated and consumed by participants in a CREW. This concept is offered by a local energy retailer via a contract that offers incentives for the electricity fed into the grid, and also for the electricity consumed by the participants. At the same time, the remaining electricity required by the participants in a CREW is supplied by the energy retailer. This concept is analyzed below based on the legal and regulatory framework.

At the beginning of the year (01.01.2021), an amendment to the Energy Act came into force introducing adjustments to the Energy Act and the Renewable Energy Act 2021 (and other electricity provisions). as well as a further amendment to these laws (and other provisions). In this modification, the focus was on the implementation of Electricity market directive 2019 (such as adjustments in the area of customers) and provisions on hydrogen in the Energy Act.[116]

The eCREW approach's fit with the existing law was ensured by a legal framework for the joint generation of electricity which existed before the Renewable Energy Directive 2018 (hereinafter RED II) and the Electricity Market Directive 2019 (hereinafter ED 2019).

4.2.2.1.1 Sharing renewable electricity through the public grid

First, it is necessary to clarify the legal situation when a citizen (or company) intends to feed its surplus/whole electricity into the public grid in order to share this electricity. The focus of eCREW is on the efficient local use of renewable electricity, therefore the regulations on renewable electricity are considered in particular.

The German Renewable Energy Act 2021 requires the system operator to physically assume, transmit, and distribute all electricity from renewable energy or from mine gas on a priority basis without delay.[117] This refers to the electricity that is sold through the forms of sale provided for in § 21 (1) of the Renewable Energy Act 2021. The forms of sale under § 21 (1) Renewable Energy Act 2021 are the market premium (in German: Marktprämie), feed-in tariff (in German: Einspeisevergütung) and other direct marketing (in German: sonstige Direktvermarktung).[118] Both the physical acceptance of the system operator, and also the commercial purchase of the fed-in electricity are required if the system operator is entitled to the feed-in tariff, and has asserted this right.[119] The electricity from renewable energy (or mine gas) is to be incorporated, transmitted and distributed by the system operator into the grid without time limit. The financial purchase of this electricity on the basis of the feed-in tariff, is limited to the period of 20 years (maximum 21 years).[120]

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[113] § 1 Energy Act.

[114] § 1 Renewable Energy Act 2021.

[115] The necessary further acts and regulations are consulted selectively, as far as they are useful for the analysis.

[116] Cf. Website of Federal Ministry for Economic Affairs and Energy: https://www.bmwi.de/Redaktion/DE/Artikel/Service/Gesetzesvorhaben/referentenentwurf-enwg-novelle.html (28.04.2021).

[117] Cf. § 11 (1) Renewable Energy Act 2021.

[118] Cf. *Woltering*, EEG 2017 § 11 Abnahme, Übertragung und Verteilung, in Greb/Boewe, BeckOK EEG [11. Edition] (Stand 16.11.2020) Rn 9-12.

[119] Cf. § 21 (1) second phrase Renewable Energy Act 2021.

[120] Cf. § 21 (1) in connection with § 25 Renewable Energy Act 2021; *Woltering*, EEG 2017 § 11 Abnahme, Übertragung und Verteilung, in Greb/Boewe, BeckOK EEG [11. Edition] (Stand 16.11.2020) Rn 9-12.

The obligations of § 21 (1) Renewable Energy Act 2021 do not exist to the extent permitted by the Renewable Energy Ordinance.[121] In § 14 Renewable Energy Act 2021 there is an exception to the obligation to physically accept the electricity. This exception relates to feed-in management, which entitles the system operator in exceptional cases and under certain conditions to reject electricity from renewable energies (or mine gas, or combined heat and power) or to accept it at a reduced rate in the event of grid bottlenecks.[122]

This is an overall benefit for eCREW, as electricity from renewable sources has to be physically purchased according to the Renewable Energy Act 2021 and even bought by the system operator, if a feed-in tariff has been legally claimed. This provides a good basis for the eCREW approach, which focuses on renewable electricity and involves the use of the public grid.

In the context of direct marketing, there are two ways to use the public grid for sharing electricity. Under direct marketing, on the one hand, the facility operators can market the electricity themselves or use a direct marketer that markets the electricity on their behalf. . Depending on which form is chosen, different provisions apply. These are outlined below.

According to the Renewable Energy Act 2021, it is possible to market electricity directly. The definition of direct marketing in § 3 No 16 Renewable Energy Act 2021 must be taken into account. This **direct marketing** is the "sale of electricity from renewable energies or from mine gas to third parties, unless the electricity is consumed in the immediate vicinity of the facility and is not passed through a grid". The definition shows that in this case, the electricity is marketed to third parties through the public grid.[123] The use of the public grid results when the feed-in of a facility is assigned to an entry point (according to § 4 Electricity Grid Access Ordinance[124]) and thus to a balancing group.[125] The definition does not include electricity sharing that is not transmitted through the public grid and is located in the immediate vicinity of the facility. In connection with "sale" to "third parties", the amount of payments, if any, are not important, the key is the term "marketing", as this implies the aim to supply the generated electricity to a third party on the energy market. The third party is any natural or legal person, and usually the electricity is sold to direct marketing companies. Marketing to an end consumer is also possible.[126] This direct marketing becomes relevant in connection with the forms of sale (see 4.2.2.1.2).

The other possibility is, as described above, to use a “direct marketing operator” to sell renewable electricity. A **direct marketer** is someone “who is commissioned by the facility operator with the direct marketing of electricity from renewable energies or from mine gas, or who commercially purchases electricity from renewable energies or from mine gas without being an end consumer of this electricity or a system operator”.[127] On the one hand, the direct marketing contractor can be commissioned. In this case, the activity is to be based on the energy sector. The difference to the commercial acceptance is that the commissioning is carried out as a transaction under the law of obligations vis-à-vis a third party. In this case, the performance (electricity delivery) is provided by the facility operator directly to the third party by the direct marketing contractor. The contract is executed directly between the

[121] Erneuerbare-Energien-Verordnung from 17. Februar 2015 (F.L.G. I p. 146), last amended of the article 10 of the Act from 21. December 2020 (F.L.G. I p. 3138).
[122] Cf. *Woltering*, EEG 2017 § 11 Abnahme, Übertragung und Verteilung, in Greb/Boewe, BeckOK EEG [11. Edition] (Stand 16.11.2020) Rn 23.
[123] Cf. *Sösemann*, EEG 2017 § 3 Nr. 16 (Direktvermarktung), in BeckOK EEG, Greb/Boewe [11. Edition] (Stand: 16.11.2020, beck-online.de) Rn 10-13.
[124] Stromnetzzugangsverordnung from 25. July 2005 (F.L.G. I p. 2243), last amended by article 3 of the Act from 21. December 2020 (F.L.G. I p. 3138).
[125] Cf. *Sösemann*, EEG 2017 § 3 Nr. 16 (Direktvermarktung), in BeckOK EEG, Greb/Boewe [11. Edition] (Stand: 16.11.2020, beck-online.de) Rn 13.
[126] Cf. *Sösemann*, EEG 2017 § 3 Nr. 16 (Direktvermarktung), in BeckOK EEG, Greb/Boewe [11. Edition] (Stand: 16.11.2020, beck-online.de) Rn 8-9.
[127] § 3 No. 17 Renewable Energy Act 2021.

facility operator and the host. This procedure is mainly used if the direct marketing contractor does not have its own balancing group. Even without a balancing group, the facility operator's electricity can be sold to a third party, such as an electricity trader. In this case, the facility operator must ensure that the feed-in point is assigned to the appropriate balancing group so that the direct marketer can fulfill the service vis-à-vis the third party.[128] On the other hand, the direct marketer can also purchase the electricity commercially, whereby its own balancing group is managed. In this case, the direct marketer is not only contractually obligated to purchase the electricity (from facility operators) and to deliver it (to third parties) (as above), but also fulfills the transaction so that the claim is settled.[129]

The direct marketer is distinguished from the end consumer and system operator with regard to market role. It is possible for a legal entity to fulfill several market roles, unless prohibited by law. The direct marketer is between the end consumer and generator, being a system user and therefore referred to as a supplier.[130] It must be emphasized that the system operator can only purchase electricity within the framework of the feed-in tariff. It is also possible for a legal entity to have two lines of business, one for network operation and one for direct marketing. This is the case with municipal utilities if they have less than 100,000 connected customers, because they do not fall under the regulations of unbundling (separation of distribution and grid) according to § 7 (2) Energy Act.[131] This makes it possible for a regional municipal utility, which is not subject to unbundling, to carry out system operation and also act as a direct marketer.

With the definitions of direct marketing, there is another essential provision for facility operators to fulfill in connection with the requirements. This provision was inserted with the last amendment (see 4.2.2.1). The Renewable Energy Act 2021 provides regulations for direct marketing. Facility operators who generate electricity in their facilities and market it directly must meet these criteria:

"1. equip their installations with technical devices via which direct marketer or other person to whom the electricity is sold may, at any time

a) call up the actual feed-in capacity; and

b) can regulate the feed-in power in steps or, as soon as technically feasible, in a continuously variable manner,

and

2. grant the direct marketer or the other person to whom the electricity is sold the authority to at any time

a) retrieve the actual feed-in; and

b) to regulate the feed-in power remotely to an extent that is necessary to feed in the electricity in accordance with demand and that is not demonstrably excluded under the requirements of the licensing law."[132]

The further technical requirements for direct marketing can be found in § 10b (2) Renewable Energy Act 2021.[133]

[128] Cf. *Sösemann*, EEG 2017 § 3 Nr. 17 (Direktvermarktungsunternehmen), in BeckOK EEG, Greb/Boewe [11. Edition] (Stand: 16.11.2020, beck-online.de) Rn 3-6.
[129] Cf. *Sösemann*, EEG 2017 § 3 Nr. 17 (Direktvermarktungsunternehmen), in BeckOK EEG, Greb/Boewe [11. Edition] (Stand: 16.11.2020, beck-online.de) Rn 7.
[130] Cf. *Sösemann*, EEG 2017 § 3 Nr. 17 (Direktvermarktungsunternehmen), in BeckOK EEG, Greb/Boewe [11. Edition] (Stand: 16.11.2020, beck-online.de) Rn 8-10.
[131] Cf. *Sösemann*, EEG 2017 § 3 Nr. 17 (Direktvermarktungsunternehmen), in BeckOK EEG, Greb/Boewe [11. Edition] (Stand: 16.11.2020, beck-online.de) Rn 11.
[132] § 10 (1) Renewable Energy Act 2021.
[133] Draft legislation of the German Federal Government: „Gesetz zur Änderung des Erneuerbare-Energien-Gesetzes und weiterer energierechtlicher Vorschriften" (BR-Drucksache 569/20) p. 119 (available under https://dip.bundestag.de/vorgang/.../267786 [15.06.2021]).

This obligation concerns the actual feed-in and the remote controllability that the facility operator must enable, and authorize for the direct marketer or a third party. Both aspects are welcome for the eCREW approach, in which the data about the actual feed-in is essential for the efficient use of the electricity in a CREW. More accurate data about the power feed-in allows a higher efficiency of the electricity exchange. The opportunity for providing electricity through an energy provider offering direct marketing, such as municipal utilities, allows eCREW to fulfill its intermediary activity between producers and/or consumers. eCREW approach is offered by local energy retailers, which can market the electricity between the individual CREW members and supply the required remaining electricity to the participants.

Further obligations exist for those areas where the facility operator sells electricity directly to end consumers or Power Exchanges (in German: Strombörse), where it also exercises the above-mentioned powers of direct marketing companies/third parties.[134] However, the regulations for facility operators who market their electricity without a direct marketer are not relevant for eCREW and will therefore not be further examined.

The possibility for an owner of a production facility or a facility operator to use a direct marketing contractor is a benefit for the eCREW approach, which also sees itself as an intermediary between the facility operator who generates electricity, and the end customer who purchasesit. This makes it possible for the eCREW concept to operate within the German legal framework. Furthermore, the forms of sales have to be considered, which will also be further investigated with regard to the eCREW approach.

4.2.2.1.2 Legally defined forms of sale of renewable electricity

In detail, there are the following forms of **sale of electricity** under current Renewable Energy Act 2021:

In Germany, there are four forms of sales that a facility operator must assign to each facility[135] according § 21b Renewable Energy Act 2021. These are, on the one hand, the three forms of sale subsidized under § 19 (1) Renewable Energy Act 2021 and, on the other, "other direct marketing" (in German: sonstige Direktvermarktung) ineligible for payment under § 19 (1) Renewable Energy Act 2021. These provisions were amended and/or modified in the latest amendment to the Renewable Energy Act 2021 (see 4.2.2.1).

According to § 19 Renewable Energy Act 2021, a promotion is awarded for operators of electricity generation facilities that exclusively use renewable energy (or mine gas). In this context, the system operator is obliged to pay the subsidies for the market premium[136] or feed-in tariff[137] or tenant electricity surcharge[138] (in German "Mieterstromzuschlag"). This claim for payment (§ 19 (1) Renewable Energy Act 2021) against the system operator exists only if the facility operator does not claim an avoided charge for the electricity (according to § 18 (1) No. 1 Electricity System Charges Ordinance[139]). In principle, it is possible to alternate between the forms of sale on a monthly basis.[140]

a) Market premium

[134] Cf. Draft legislation of the German Federal Government: „Gesetz zur Änderung des Erneuerbare-Energien-Gesetzes und weiterer energierechtlicher Vorschriften" (BR-Drucksache 569/20) p. 119 (available under https://dip.bundestag.de/vorgang/.../267786 [15.06.2021]).

[135] According to the legal definition § 3 No. 1 Renewable Energy Act 2021, a "facility is: "any facility for the generation of electricity from renewable energy sources or from mine gas, and in the case of solar energy systems, each module is a stand-alone facility; facilities that receive temporarily stored energy derived exclusively from renewable energy sources or mine gas and convert it into electrical energy are also considered facilities."

[136] § 20 Renewable Energy Act 2021.

[137] § 21 (1) No. 1, 2 or 3 Renewable Energy Act 2021.

[138] § 21 (3) Renewable Energy Act 2021.

[139] Stromnetzentgeltverordnung from 25. July 2005 (F.L.G. I p. 2225), last amended by article 1 of the Act from 30. October 2020 (F.L.G. I p. 2269).

[140] § 21b (1) Renewable Energy Act 2021.

The eligibility for payment of a market premium exists for those calendar months in which the electricity is directly marketed. In this context, the facility operator shall grant the system operator the right to use the electricity as an "electricity from renewable energy sources or mine gas, financed from the EEG surcharge". [141] In addition, the electricity must be balanced in a balancing or sub-balancing group, with balancing in only one of the following balancing groups:

- "a) where electricity from renewable energy sources or from mine gas that is directly marketed in the sale form of the market premium or
- b) those where electricity does not fall under letter a) and whose placement in the balancing or sub-balancing group is not the responsibility of the facility operator or the direct marketing operator".[142]

In order to receive the market premium, it is required that the electricity is marketed directly, as already described above (see 4.2.2.1.1). This form represents subsidized direct marketing, where the subsidy is paid by the system operator. This regulation essentially corresponds to the previous regulation (§ 20 Renewable Energy Act 2017) and has been adjusted for the content of direct marketing requirements (§ 10b Renewable Energy Act 2021).[143] The market premium is therefore a subsidy to the electricity price achieved through direct marketing.[144]

For the eCREW approach, this subsidy is to be considered in the development of the business model for facilities that are supported by the market premium. Incentives are to be created that promote energy efficiency in the CREWs.

b) Feed-in tariff

The feed-in tariff is regulated in § 21 (1) and (2) Renewable Energy Act 2021. The entitlement to payment of the feed-in tariff (according to § 19 (1) No. 2 Renewable Energy Act 2021) exists only for those calendar months in which the facility operator feeds the electricity into a grid and makes it available to the system operator according to § 11 Renewable Energy Act 2021 (hereafter REA 2021).

The system operator purchases the electricity commercially, i.e. the system operator buys the electricity.[145] According to § 21 (2) Renewable Energy Act 2010, the facility operator claiming the feed-in tariff must make available to the system operator all electricity generated in this facility that is not consumed in the immediate vicinity of the facility and is transmitted through a grid. Furthermore, this facility may not be used to participate in the balancing energy market. In this case, the surplus electricity is transferred to the system operator and the facility operator receives the feed-in tariff. The feed-in tariff is eligible, fundamentally, for certain smaller and older facilities.[146]

This form of divestiture is not attractive to eCREW approach, which involves local energy retailers who are expected to take the generated electricity from CREW members and make it available to other participants without generation facilities.

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[141] § 20 Renewable Energy Act 2021.
[142] § 20 No. 3 Renewable Energy Act 2021.
[143] Cf. Draft legislation of the German Federal Government: „Gesetz zur Änderung des Erneuerbare-Energien-Gesetzes und weiterer energierechtlicher Vorschriften" (BR-Drucksache 569/20) p. 113 (available under https://dip.bundestag.de/vorgang/.../267786 [15.06.2021]).
[144] *Schlacke/Kröger*, EEG 2017 § 20 Marktprämie, in Theobald/Kühling, Energierecht Werkstand: 109 (Januar 2021) Rn 7.
[145] Cf. § 21 (2) Renewable Energy Act 2021; cf. *Schlacke/Kröger*, EEG 2017 § 21 Einspeisevergütung und Mieterstromzuschlag, in Theobald/Kühling et al, Energierecht Werkstand: 109 (Januar 2021) Rn 7.
[146] Cf. *Wiemer*, EEG 2017 19 Zahlungsanspruch, in BeckOK EEG, Greb/Boewe 11. Edition (Stand: 16.11.2020, beck-online.de) Rn 23.

c) Tenant electricity surcharge

The Renewable Energy Act 2021 has already established a provision for the generation of electricity by a PV system on, at or in a residential building.[147] § 21 (3) Renewable Energy Act 2021 regulates the requirements for entitlement to payment of the tenant electricity surcharge under § 19 (1) No. 3 Renewable Energy Act 2021. This provision was last amended at the end of 2020.[148] This is basically a claim for the payment of the tenant electricity surcharge (from the system operator to the facility operator), however, the principles are set out in § 21 (3) Renewable Energy Act. Renters' electricity is electricity generated by a solar system (with a maximum capacity of 100 kilowatts) installed on, at or in a residential building, provided that the electricity is supplied and consumed by the facility operator, or a third party as? an end consumer. This supply and consumption to end consumers must take place within the building/apartment/annex building in the same district in which this building (with solar system) is also located and without transmission through the public grid.[149] The supply of electricity may be supplied to tenants as well as apartment owners, provided that there is a difference of persons between the facility operator and the end customer.[150]

The amendment deals with clarification for the supply chain model developed in practice. This involves the following actors: Facility operator/landlord, an energy service provider/tenant electricity supplier, and the tenants/end consumers. This model offers the advantage that the market role of the electricity supplier is transferred to an energy sector experienced by a third party. This clarifies that tenant electricity also exists when electricity is not supplied by the facility operator but also by a third party (under the supply chain model).[151]

§ 42a of the Energy Act must be observed in the context of tenant electricity. A tenant electricity contract must be concluded. The penultimate sentence of § 42a (2) of the Energy Act is essential. It stipulates that the tenant electricity contract must also provide for full supply to the end customer for those times when the tenant electricity cannot be supplied.[152] Thus, the tenant power contract is a full supply contract. The facility operator/tenant power supplier is thus required to find its own electricity supplier for the remaining electricity required and is obligated to fulfill the customer's entire electricity supply.[153]

This states that the boundary for tenant electricity is the public grid. This limit was not a barrier to the eCREW approach, as this regulation concerns payments to the solar facility operator, and not in itself a barrier about sharing energy across the building. With tenant electricity, the tenants themselves can participate in eCREW, as their remaining electricity not covered by tenant electricity must be covered by other electricity supply. Under the tenant electricity contract, the facility operator/tenant electricity supplier could purchase the residual electricity from an energy supply company that offers eCREW facilities. The eCREW approach also pursues the goal of first consuming the self-generated electricity in a CREW, and then purchasing the additional electricity from the energy supply company. In doing so, the tenant electricity supplier could share surplus tenant electricity by participating in a CREW.

Time-limited promotion of the forms of sales: Generally, market premiums, feed-in tariffs, or tenant power surcharges must be paid for a period of 20 years each (unless provisions of the Renewable Energy Act 2021 state

[147] Cf. *Hakenberg*, Mieterstrom in Creifelds, Rechtswörterbuch “Mieterstrom”[26. Edition] 2021 (Stand 29.04.2021, beck-online.de).

[148] Renewable Energy Act 2021 last amended by F.L.G I 2020 No. 65 28.12.2020 (in force since 01.01.2021).

[149] § 21 (3) Renewable Energy Act 2021.

[150] Cf. *Lippert*, EEG 2017 § 21 Einspeisevergütung und Mieterstromzuschlag, in BeckOK EEG, Greb/Boewe [11. Edition] (Stand: 16.11.2020, beck-online.de) Rn 52.

[151] Cf. Draft legislation of the German Federal Government: „Gesetz zur Änderung des Erneuerbare-Energien-Gesetzes und weiterer energierechtlicher Vorschriften“ (BR-Drucksache 569/20) p. 113 (available under https://dip.bundestag.de/vorgang/.../267786 [15.06.2021]).

[152] § 42a Energy Act 2021.

[153] Cf. *Ehring*, Grundlagen der vertraglichen Gestaltung von Mieterstromverträgen, EnW 2018, 213 (204).

otherwise). The essential point of reference is the time the facility was brought into operation.[154] For the feed-in tariff (§ 19 (2) No. 2 in conjunction with § 21 (1) No. 3 REA 2021), there is a deviating regulation for de-subsidized facilities, whereby the payment period is extended, depending on the fulfillment of the requirements.[155]

The eCREW approach offers in this context a very interesting possibility for facility operators whose subsidies have expired. This offers people the possibility to continue sharing their electricity especially with those people with which they form a CREW.

d) Other direct marketing

According to § 21a Renewable Energy Act 2021, the facility operator has the right to directly market the electricity of its facility (without a payment according to § 19 (1) Renewable Energy Act 2021). As outlined above, the system operator must also physically assume, transmit and distribute this electricity. Although this form of marketing is not subsidized, distributed generation facilities receive a payment from the distribution system operator under § 18 Electricity System Charges Ordinance. According to § 3 No. 11 Energy Act, distributed generation facilities are "a generation facility connected to the distribution grid that is close to consumption and load". Operators of distributed generation facilities receive a payment from the operator of an electricity grid into whose grid the electricity is fed.[156] This payment excludes, for example, the subsidized forms of sale under § 19 Renewable Energy Act 2021. The decentralized generation facilities must have been operated before 1.1.2023. Specifically, for facilities with volatile generation, the facility must have been placed in service before 1.1.2018. These requirements result from § 120 Energy Act, as it provides for the phasing out of payments for distributed generation facilities; this has the advantage that when a renewable electricity is marketed, a certificate of origin can also be issued.[157]

As already shown in the explanations on direct marketing, the end consumers can use a direct marketer for the surplus electricity of their PV system (see 4.2.2.1.1). The regulations on other direct marketing are not an obstacle for eCREW.

As already explained, electricity generation facilities must be assigned to a form of sale. Selling electricity itself using the public grid and supplying the electricity to a nearby customer or electricity trader makes the facility operator an energy supplier by definition of the Energy Act.[158] According to § 3 No. 18 Energy Act these are those “natural or legal persons who supply energy to others, operate an energy supply system or have ownership rights to an energy supply system; the operation of a customer installation or a customer installation for operational self-supply does not make the operator an energy supply company”. According to the definition of § 3 No. 20 Renewable Energy Act 2021, electricity suppliers are "any natural or legal person that supplies electricity to end consumers." Thus, both definitions of electricity supply companies assume that energy is supplied to an end consumer. With the legal classification as an energy supplier, legal obligations must also be fulfilled. So that these obligations do not have to be fulfilled, there is the possibility that the electricity is served by a specialized service provider, such as a direct marketer (as shown above).

With the order that generated renewable electricity must be marketed in any of the four forms of sale, it is for eCREW to make the necessary adjustments depending on the participant. For each participant, these forms of sale with and without subsidies must be taken into account in order to create a sufficient incentive for participation in

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154 § 25 Renewable Energy Act 2021; cf. *Schlacke/Kröger*, EEG 2017 § 25 Beginn, Dauer und Beendigung des Anspruchs, in Theobald/Kühling, Energierecht Werkstand: 108 (September 2020) Rn 1.
155 § 25 (2) Renewable Energy Act 2021.
156 Cf. *Schlacke/Kröger*, EEG 2017 § 21a Sonstige Direktvermarktung, in Theobald/Kühling, Energierecht Werkstand: 109 (Januar 2021) Rn 3.
157 Cf. § 79 (1) Renewable Energy Act 2021; cf. *Schlacke/Kröger*, EEG 2017 § 21a Sonstige Direktvermarktung, in Theobald/Kühling, Energierecht Werkstand: 109 (Januar 2021) Rn 3.
158 Cf. Website: https://www.energie-experten.org/erneuerbare-energien/photovoltaik/direktvermarktung (Stand 05.07.2021).

this business model. Through a bonus system, those participants with a power generation facility can benefit as well as those participants without storage or power generation facilities. The eCREW approach is attractive for those natural persons and legal entities whose subsidies for their renewable electricity generation facilities are expiring, or for those who highly value non-monetary incentives, such as the participation in a community and contributing to the environment.

4.2.2.2 Data flow in eCREW under National Electricity Regulatory Framework (Data flow, Data from smart meter, processing of data from third parties)

For the functioning of the eCREW approach, data about energy consumption and generation are essential to apply the incentives and thus also the effective use of the available energy in a CREW. In Germany, the Metering Point Operation Act [159] (hereafter: MPOA) came into force in 2016. This law is intended to contribute to the digitalization of the energy transition and regulates the measurement and metering system in a new way.[160] MPOA regulates, for example, the equipment with measuring devices, rights and obligations in connection with metering point operation, as well as data communication and also data protection and data security.

MPOA separates in two types of electricity metering instruments: modern metering devices (in German: moderne Messeinrichtung)[161] and smart metering systems (in German: intelligentes Messsystem)[162].[163] The difference between the two meters is that the modern metering device is not integrated into a communication network - such as the telecommunications network, and remote reading is not possible. Nevertheless, this digital meter displays the current power drawn in kilowatts and it is possible to read the electricity consumption of the previous day, previous month and the annual consumption.[164] A smart metering system is also a digital meter that is integrated with a secure and standardized communication unit. The meter can thus be read remotely. Via an interface, it is possible to view the consumption data on a digital end device.[165]

The rollout of the smart metering systems was initiated on February 24th, 2000 by a General Order of the German Federal Office for Information Security (in German: Bundesamt für Sicherheit in der Informationstechnik).[166] The rollout will provide universtal? smart metering systems in a staggered manner by 2028.[167]

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159 Gesetz über den Messstellenbetrieb und die Datenkommunikation in intelligenten Energienetzen (Messstellenbetriebsgesetz - MsbG) Messstellenbetriebsgesetz from 29. August 2016 (F.L.G. I p. 2034), last amended by article 5 of the Act from 21. December 2020 (F.L.G. I p. 3138).

160 Cf. Website of Bundesnetzagentur (as a regulatory agency): https://www.bundesnetzagentur.de/DE/Sachgebiete/ElektrizitaetundGas/Unternehmen_Institutionen/Netzzugang_Messwesen/netzzugangundmesswesen-node.html (28.04.2021).

161 § 2 No. 15 MPOA.

162 § 2 No. 7 MPOA.

163 Cf. Website of Bundesnetzagentur: https://www.bundesnetzagentur.de/DE/Sachgebiete/ElektrizitaetundGas/Verbraucher/Metering/start.html (28-04-2021).

164 *Bundesnetzagentur*, Energie Moderne Messeinrichtungen (folder available under: https://www.bundesnetzagentur.de/SharedDocs/Mediathek/Verbraucherhefte/Energie/ModerneMesseinrichtungStrom.pdf?__blob=publicationFile&v=2 [Stand 08.06.2021]).

165 *Bundesnetzagentur*, Energie Intelligentes Messsystem (folder available under: https://www.bundesnetzagentur.de/SharedDocs/Mediathek/Verbraucherhefte/Energie/IntelligentesMessystem_SmartMeter.pdf?__blob=publicationFile&v=4 [Stand 08.06.2021]).

166 Cf. Link to the General Order of the German Federal Office for Information Security: https://www.bsi.bund.de/SharedDocs/Downloads/DE/BSI/SmartMeter/Marktanalysen/Allgemeinverfuegung_Feststellung_Einbau_01_2020.pdf?__blob=publicationFile&v=4 (Stand 08.06.2021).

167 Cf. § 31 MPOA; cf. *Dix*, MsbG § 1 Anwendungsbereich, in Theobald/Kühling, Energierecht Werkstand: 109 (Januar 2021) Rn 6.

The metering point operator (in German: Messstellenbetreiber) is obliged to install smart metering systems, provided that the requirements of the MPOA are fulfilled. For this, § 29 MPOA stipulates that end consumers with an annual electricity consumption above 6,000 kilowatt hours and those with an agreement pursuant to § 14a Energy Act (on controllable consumption devices) must be equipped with a smart metering system. Facility operators with an installed capacity of more than 7 kilowatts must also be equipped with a smart metering system.[168] The meter operator also has the option of equipping end consumers under 6,000 kilowatt hours and facilities with an installed capacity of over 1 and up to and including 7 kilowatts with a smart metering system.[169] Both variants, on the one hand the obligation and on the other hand the possibility of the metering point operator must be seen in connection with the technical possibility (§ 30 MPOA) and economic justifiability (§ 31 MPOA). A modern metering device is provided for those cases where the law has not provided for equipment with a smart metering system and the installation of modern metering devices is economically justifiable (§ 32 MPOA). According to this, all consumers should eventually be equipped with a modern measuring device by 2032.[170]

For the participation of an end consumer in eCREW, it requires a smart metering system, since the measured values are digitally available and can be read remotely. The rollout of smart metering systems is beneficial for the eCREW approach, as it increases the number of potential participants now and in the future.

In principle, the measured data from the smart metering system is transmitted once a month to the metering point operator, who forwards the data to the supplier and the system operator. It is possible that electricity tariffs chosen by end consumers will require more frequent measurement and data transmission.[171]

MPOA also includes specific regulations on data protection that cover data communication in smart energy networks. These regulations relate to the collection of metering data by the metering point operator and its use by authorized bodies. In this context, § 49 MPOA lists the authorized bodies. In addition to the system operator, this also includes the energy supplier and third parties who have the consent of the end consumer. Based on these authorized bodies, reference should be made to § 60 MPOA. It is specified that the data of the smart metering system is transmitted directly to the authorized entities via so-called smart meter gateway.[172] This device is the communication unit of a smart metering system, which must comply with the technical and data protection requirements of this law.[173]

§ 60 MPOA provides that the metering point operator transmits the data on feed-in and consumption from the metering point operator to the distribution system operator, transmission system operator as well as balancing group coordinator and to the supplier.[174] This regulation fundamentally stipulates that the metering point operator must process and transmit the metering data[175] to the required extent to the authorized bodies as often as needed to fulfill their tasks[176]. In this regard, there is an obligation for suppliers to receive the previous day's data on a daily basis if it is mandatory for the purpose under § 69 MPOA, such as billing for the energy supply contract.[177]

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[168] § 29 (1) MPOA.
[169] § 29 (2) MPOA.
[170] § 29 (3) MPOA.
[171] *Bundesnetzagentur*, Energie Intelligentes Messsystem (folder available under: https://www.bundesnetzagentur.de/SharedDocs/Mediathek/Verbraucherhefte/Energie/IntelligentesMessystem_SmartMeter.pdf?__blob=publicationFile&v=4 [Stand 08.06.2021]).
[172] Cf. *Bartsch*, MsbG § 49 Verarbeitung personenbezogener Daten, in Theobald/Kühling, Energierecht Werkstand: 109 (Januar 2021) Rn 1-3.
[173] Cf. § 2 No. 19 MPOA.
[174] Cf. *Schäfer-Stradowsky/Timmermann*, Verschiebung von Kompetenzen zwischen ÜNB und VNB durch die Digitalisierung der Energiewende, EnWZ 2018, p. 202.
[175] This refers to the data presented in §§ 55 to 59 MPOA, such as electricity consumption data.
[176] By tasks are those arising from §§ 50 in conjunction with §§ 61 to 73 MPOA, such as those involving the supply of energy and billing.
[177] § 60 MPOA; Thereby the authorized persons are listed, who receive the data and in which time frame.

Furthermore, the metering point operator must provide the facility operator (if an intelligent metering system is available) with information in a timely manner. This includes information about feed-in and consumption as well as feed-in values of the last 24 months.[178]

In principle, the metering point operator is the distribution system operator, but the distribution system operator may delegate the responsibility to a third party via contract.[179]

It should be emphasized that, depending on the constellation, separate authorizations are required to obtain energy data from the smart meters. In § 50 MPOA, the permissibility and scope of data processing is regulated. This processing refers to those data that result from or with the help of various measurement possibilities (according to § 50 (1) MPOA[180]). A distinction is made as to whether the consent of the connection user (i.e. end consumer and/or feeder) is required or whether it is necessary for the fulfillment of the contract, pre-contractual measures, legal obligations or for the tasks of the system operator.[181]

If the energy supplier is also the distribution system operator, and thus the metering point operator, there will be no difficulty in obtaining data on consumption and feed-in for the eCREW approach. This is the case in the exception of § 7 Energy Act applies, where no unbundling requirements exist, namely, when fewer than 100,000 customers are directly or indirectly connected to the supply network/distribution system.[182] Furthermore, the contractual design of the eCREW approach in the form of an electricity supply contract also provides a basis for data collection. Another case is when due to unbundling regulations, the energy supplier itself does not operate the distribution system, and receives the energy data on the following day.

The regulations on the data exchange of the metering operator to the respective authorized parties are helpful for the eCREW approach. Depending on the constellation and provider of the eCREW approach, the respective provisions of the MPOA must be observed.

4.2.2.3 Progress concerning the adoption of the Renewable Energy Directive (RED II) 2018/2001/EU

The national implementation acts of the provisions of RED II that are relevant for eCREW are examined. The focus is on the introduction of Renewable Energy Communities (REC) in Germany. The German National Energy and Climate Plan (NECP) of 2020 identifies the REC as having great potential for the expansion of renewable energies. Its comments refer to the fact that Germany has created a regulatory framework, supports and promotes the development of REC. It is emphasized that the regulatory framework opens up essential aspects, such as the access of end consumers to RECs on a non-discriminatory basis and also enables access to existing support provisions.[183]

[178] § 62 MPOA.
[179] Cf. § 2 No. 4 and § 43 MPOA; *Schäfer-Stradowsky/Timmermann*, Verschiebung von Kompetenzen zwischen ÜNB und VNB durch die Digitalisierung der Energiewende, EnWZ 2018, p. 118 (207).
[180] That are the following measurement possibilities: measuring device, modern measuring device, measuring system and intelligent measuring system.
[181] Cf. § 50 MPOA.
[182] Cf. *Finke,* § 7 EnWG Rechtliche Entflechtung von Verteilernetzbetreibern, in Theobald/Kühling, Energierecht Werkstand: 108 (September 2020) Rn 26-28.
[183] Cf. *Federal Ministry for Economic Affairs and Energy*, Integrierter Nationaler Energie-und Klimaplan (2020) p 86.

Under the currently existing electricity regulations, there is no legal definition of REC as contained in RED II. However, there are regulations for "citizen energy corporation"[184] and tenant electricity model[185]. The Renewable Energy Act 2021 also provides for a preferential grid connection for facilities that generate electricity from renewable energy. This regulation obliges the system operator to connect such a generation facility to its grid "without delay" and "with priority".[186]

As the project progresses, the Clean Energy Package implementation acts will continue to be monitored and subsequently analyzed.

There are no obstacles for the eCREW approach within the framework of the already existing energy law regulations because eCREW requires no establishment of an association or company, but only a contract with an energy supplier, responsible for the intermediation and administration, as well as the further supply of the remaining required electricity.

4.2.2.4 Progress concerning the adoption of the Internal Electricity Market Directive (EU) 2019/944 (ED 2019)

In Germany, there are already initial acts of implementation from the requirements of the Clean Energy Package. The ED 2019 includes provisions related to citizen energy communities (CEC). Due to the relevance for eCREW, the progress of the implementation of the CEC into German law is examined. In the draft law of the Federal Ministry, it is explained that in Germany it is not required to introduce a new legal entity in order to establish the CEC. The explanation refers to the fact that a merger of citizens into legal entities is already possible. As an example, the possible merger on the basis of a cooperative is cited.[187] This possibility has already been discussed under point 4.2.2.3.

According to the draft law, active customers can offer products or services alone or bundled, directly or indirectly, as well as provide aggregators on a contractual basis. In this context, the German government points out that these options are already possible in many ways under German energy law, such as through power generation facilities that can be established and controlled.[188] To this end, the draft law includes provisions such as the definition of aggregators[189] and their integration into the existing system. For this purpose, new regulations or adjustments in the area of end-user markets are introduced in the Energy Act in order to implement the protection and the new role of consumers.[190]

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184 Cf. Website of Bundesnetzagentur: https://www.bundesnetzagentur.de/DE/Sachgebiete/ElektrizitaetundGas/Unternehmen_Institutionen/Ausschreibungen/Wind_Onshore/Buergerenergiegesellschaften/Buergerenergiegesell_node.html (Stand 28.05.2021).

185 Cf. Website of Bundesnetzagentur: https://www.bundesnetzagentur.de/DE/Sachgebiete/ElektrizitaetundGas/Unternehmen_Institutionen/ErneuerbareEnergien/EEGAufsicht/Mieterstrom/Mieterstrom_node.html (Stand 28.05.2021).

186 § 8 Renewable Energy Act 2021.

187 Cf. Draft law of Federal Ministry of Economic Affairs and Energy submitted to the German Parliament, p 55 (available under: https://dip21.bundestag.de/dip21/btd/19/274/1927453.pdf [28-04-2021]); This draft law of the Federal Ministry for Economic Affairs and Energy, p 54 (first published on 10.02.2021; available under: https://www.bmwi.de/Redaktion/DE/Downloads/Gesetz/referentenentwurf-enwg-novelle.pdf?__blob=publicationFile&v=8 [28-04-2021]).

188 Cf. Draft Law of Federal Ministry of Economic Affairs and Energy submitted to the German Parliament, p 55 (available under: https://dip21.bundestag.de/dip21/btd/19/274/1927453.pdf [28-04-2021]).

189 § 3 No. 1a Energy Act in draft Law of the Federal Ministry of Economic Affairs and Energy submitted to the German Parliament, p 8.

190 Cf. Draft law of Federal Ministry of Economic Affairs and Energy submitted to the German Parliament, p 59.

This draft law was prepared in 2020 and has been in force since 1.1.2021. The explanations in point 4.2.2.1 already refer to the currently applicable law.

It should be noted that there is currently no definition of CEC in German energy law, as there is in ED 2019. Whether further provisions from ED 2019 will be implemented, and if so, which ones will become clear in the course of the project.

In the following subsection, the current German regulations in relation to joint energy use are presented.

4.2.1.1.1. Excursus on legally established “citizen energy corporations” and cooperative:

In the current German law, it is **possible to share energy**. On the one hand, there is the possibility of cooperatives and on the other hand, there is energy sharing in the form of tenant electricity models, which was already presented above (see 4.2.2.1.1).

Possibility to form cooperatives

As mentioned above (see 4.2.2.3), the federal Government of Germany states that a legal framework for RECs is already in place. In this context, it should be mentioned that in Germany, it has already been possible for some time for citizens to join together to form cooperatives and generate energy in the process. This is based not on electricity law, but on civil law provisions, such as the Cooperative Act[191]. Fundamentally, a cooperative is defined as a company with a non-closed number of members whose purpose is to promote the acquisition or the economy of its members or their social or cultural interests through joint business operations (cooperatives).[192] These previously listed purposes represent the "promotion mission" that must take place within the corporation. In this regard, each cooperative must be considered according to the type of cooperative and statute chosen. It should be emphasized that the cooperative is not committed to making a profit, but it is expected to do so. It is important that the purpose of the cooperative directly benefits its members. In the case of energy cooperatives, it is precisely the motivation of the citizens that is essential, such as their own energy supply, joint action, ecological aspects and as an ecological capital investment. With it also the aspect exists that the members are possible by idealistic promotion due to the social interests specified in the statute.[193]

This raises the question of whether this actually corresponds to the nature of RECs under RED II. If a statute should correspond to the purpose of RED II, and not precisely aimed at financial gain, it would be possible for a REC to be established as a cooperative. These comments relate directly to existing law, which was not prompted by RED II. The association of citizens to use energy collectively is therefore legally possible, but not necessary for the eCREW approach. The eCREW approach does not require the establishment of a cooperative to share electricity. eCREW acts on the basis of a contract. The participants are divided into CREWs and can share electricity within them and effectively use it collectively.

The possible formation of a cooperative should not be confused with the legally established citizen energy corporation. Citizen energy corporation is an extended possibility of how cooperatives with fulfillment of the prerequisites (see below) can obtain a special bidding provision in onshore wind turbines.

For the implementation of the RED II in the area of renewable energy community, one could most likely refer to the already existing regulation on "citizen energy corporations[194]" in the meaning of § 3 No. 16 Renewable Energy Act 2021. Although citizen energy companies are not introduced by RED II, this regulation has already allowed

[191] Genossenschaftsgesetz in the version of the announcement of 16. October 2006 (F.L.G. I p. 2230), last amended by article 17 of the Act from 22. December 2020 (F.L.G. I p. 3256).
[192] § 1 (1) Cooperative Act.
[193] Cf. *Althanns*, Genossenschaftliche Modelle bei der Realisierung von Anlagen der erneuerbaren Energien, ZfBR-Beil. 2012, p. 36 (39).
[194] In German: “Bürgerenergiegesellschaften”.

cooperatives since 2017 to obtain a special preference in the field of onshore wind turbines by meeting the prerequisites (see legal definition below).[195, 196]

According to § 3 No. 15 Renewable Energy Act 2021, a "**citizen energy corporations**" is any corporation,

- which consists of at least ten natural persons as voting members or voting shareholders,
- in which at least 51% of the voting rights are held by natural persons who have been registered with their principal residence (in accordance with § 21 or § 22 of the Federal Registration Act) for at least one year prior to the submission of the bid in the independent town[197] or district[198] in which the planned onshore wind energy system is to be installed, and
- in which no member or shareholder of the corporation holds more than 10% of the voting rights in the corporation,
- whereby, in the case of a merger of several legal entities or partnerships into one corporation, it shall be enough if each member of the corporation fulfills requirements under subparagraphs a) to c).

This legal definition is related to § 36g Renewable Energy Act 2021.[199] In § 36g (1) Renewable Energy Act 2021, special provisions are provided that are effective for bids for up to six onshore wind turbines with a capacity of 18 megawatts or less. This participation of citizens in renewable energy is because the legislature aimed to involve more local operators of wind energy facilities.[200] This community effort is supported by the simplified bidding conditions for citizen energy corporations in relation to subsidies for onshore wind turbines.[201]

For the eCREW approach, these regulations are not an obstacle, because eCREW follows a simple way, without the establishment of a corporation, association or other legal entity.

4.2.2.5 Progress concerning adoption of Energy Efficiency Directive (EED 2019) 2018/2002/EU

The German government has adopted a national energy efficiency target for 2030 of minus 30% primary energy consumption compared to 2008 as part of its Energy Efficiency Strategy 2050[202].[203]

Currently, there is a proposal for a regulation that deals with the implementation of the requirements for district heating and cooling.[204] This proposal refers to requirements from the EED 2018 and the RED II. The objective of

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195 Renewable Energy Act 2017 (in force since 1.1.2017, by the law of 13.10.2016 [F.L.G. I p. 2258]).

196 Cf. *Vollprecht/Lehnert/Kather*, Die neue Erneuerbare-Energien-Richtlinie (RED II): Steife Brise oder laues Lüftchen aus Europa? ZUR 2020, pp 204 (213 and 214).

197 In German: „kreisfreie Stadt".

198 In German: „Landkreis".

199 Cf. *Lülsdor*, Die neuen Ausschreibungen nach dem EEG 2017 Einführung und Überblick, in Theobald/Kühling et al, Energierecht [Werkstand: 108] (September 2020) Rn 45-52.

200 Cf. *Hakenberg*, Bürgerenergiegesellschaften in Creifelds, Rechtswörterbuch "Bürgerenergiegesellschaften"[26. Edition] 2021 (Stand 27.04.2021, beck-online.de).

201 Cf. *Schulz/Losch*, Die geplante Neufassung der Erneuerbare-Energien-Richtlinie, EnWZ 2017, p. 107 (113).

202 Cf. *Bundesministerium für Wirtschaft und Energie*, Energieeffizienzstrategie 2050 (2019) (available under https://www.bmwi.de/Redaktion/DE/Publikationen/Energie/energieeffiezienzstrategie-2050.html [Stand 28.06.2021]).

203 Cf. *Bundesministerium für Wirtschaft und Energie*, Integrierter Nationaler Energie- und Klimaplan (2020) p. 54 (available under: https://www.bmwi.de/Redaktion/DE/Textsammlungen/Energie/necp.html (Stand 28.06.2021).

204 Cf. Website of Bundesnetzagentur: https://www.bmwi.de/Redaktion/DE/Artikel/Service/Gesetzesvorhaben/entwurf-einer-verordnung-zur-umsetzung-der-energieeffizienzrichtlinie-2018-2002.html (Stand 28.06.2021).

this regulation is to raise customers' awareness and improve information about their energy consumption, and additional reductions should contribute to achieving the EU's energy efficiency target by 2030.[205]

4.2.3 Differences between national implementation and Directives with regard to the Renewable Energy Community (RED II) and Citizen Energy Community (ED 2019)

Differences between the implementation of the directives in Germany and the ED 2019 as well as RED II are not easy to investigate under present conditions, as the implementation process is still underway. The legislative amendments and draft laws implemented so far do not yet include specific regulations on energy communities.

4.2.4 Adaptability of the eCREW approach

For the implementation of the eCREW approach, the German legal and regulatory framework has to be considered. Renewable electricity can be fed into the public grid, and there are four legally defined forms of sale for marketing renewable electricity. These forms should be considered under the split-incentives approach (SIA), since three of the forms are subsidized. eCREW may be of particular interest to those renewable electricity facilities whose subsidies are expiring and which must sell electricity via "other direct marketing". In Germany, therefore, SIAs must be adjusted for participants whose feed-in the public grid is subsidized and for those whose feed-in is not.

The existing regulations on data flows are favourable for the implementation of the eCREW approach. On the one hand, there is the obligation to allow retrieval of actual feed-in through direct marketing. On the other hand, there are the metering point operators who transmit the necessary data to the entitled parties for the fulfillment of their obligations. In this context, the consumption values must be transmitted to the electricity supplier once a day. This provides the necessary data for the users of eCREW, such as local energy retailers. With this data, CREW members can be provided with this information in order to support them in energy efficient behavior.

4.2.4.1 Interaction between legal and administrative framework (with reference to the eCREW approach)

In Germany, there are several possibilities to share and/or sell renewable electricity, which have different legal consequences. Either the renewable electricity is sold through the public grid, or communities can be formed to jointly generate electricity. There is also the tenant electricity model, which does not use the public grid to share electricity with tenants/apartment owners.

Since the eCREW concept uses the public grid, the grid fees must also be taken into account. In addition, the focus of eCREW is on the effective use of renewable electricity, so the four forms of sale with the legal requirements must be observed.

According to § 21b Renewable Energy Act 2021, facility operators have to allocate each facility under the following forms of sale: Market premium (§ 20 Renewable Energy Act 2021); feed-in tariff (§21 (1) and (2) Renewable Energy Act 2021); tenant electricity surcharge (§ 21 (3) Renewable Energy Act 2021), or other direct marketing (§ 21a Renewable Energy Act 2021).

The feed-in tariff, market premium and other direct marketing operates via the use of the public grid. The tenant electricity model alone remains within the building/quarter, and only the surplus electricity, i.e, that is not consumed by tenants themselves, can be sold via the public grid.

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[205] Cf. Draft of the Federal Ministry for Economic Affairs and Energy: „Verordnung zur Umsetzung der Energieeffizienzrichtlinie 2018/2002/EU im Bereich der Fernwärme und Fernkälte", p. 1 (available under: https://www.bmwi.de/Redaktion/DE/Downloads/E/entwurf-einer-verordnung-zur-umsetzung-der-energieeffizienzrichtlinie-2018-2002.pdf?__blob=publicationFile&v=6 [Stand 01.07.2021]).

With the market premium, the electricity is remunerated by the system operator, but not sold to this person. In the case of feed-in tariffs, all the electricity not consumed by the operator of the facility is sold to the system operator[206], thus, this type of sale does not fit into the eCREW concept. Since the electricity is sold to the system operator, this type of subsidized system is not suitable for the eCREW approach.

The situation is different for generation facilities that are subsidized via the market premium. With the market premium, the system operator receives the green power title? Here, the electricity can be sold by the facility operator or to a direct marketer[207] and does not have to be sold to the system operator. Such facilities should be included in SIAs and other incentives offered to build a utility's customer base, and help participants engage in energy efficient behaviors.

The tenant electricity model refers to the electricity that is shared outside the public grid, except for surplus electricity, which can be sold by using the public grid. Within this model, the tenant electricity supplier can also apply or participate in the eCREW approach. On the one hand, the individual tenants can participate as CREW members; on the other, the surplus tenant electricity can be sold to a CREW via the public grid. For this, the contractual requirements of the tenant electricity contract must be fulfilled.

Three of the four forms of divestment are subsidized, which must be considered when participating in a CREW and in the split-incentives approach (SIA). The subsidies are time-limited, making the eCREW approach a possible incentive for generators to participate in a CREW.

Without subsidies, the electricity can also be marketed directly by a direct marketer or by the facility operator himself. Specialized direct marketing companies can be contracted for this purpose. The eCREW approach is executed by local energy retailers, where they can also offer direct marketing. This variant allows the eCREW approach to be used with the split-incentives approach for the open market. eCREW can thus use the direct marketer regulations.

When the facility operator sells electricity by himself, the facility operator falls under the definition of an energy supply company. This also entails obligations under German electricity law. In order not to be subject to these obligations, the facility operator can sell the electricity to a specialized service provider, such as a direct marketing operator. By supplying electricity to an end consumer, the facility operator falls under the definition of an electricity supply company (see § 3 No. 20 Renewable Energy Act 2021).

The required data exchange regarding generation and consumption are beneficial for the eCREW approach carried out by electricity suppliers/retailers. The data on consumption and generation are either available after 24 hours or are transmitted immediately. This data exchange is facilitated by the contractual commitment between the provider of eCREW and the individual participants. The data flows result on the one hand from the direct marketing of electricity, whereby the retrieval of the actual generation must be provided, and on the other, the required data is forwarded to the authorized persons by the metering point operator. This results in a data transmission appropriate for eCREW.

Based on these explanations, it can be summarized that the application of the eCREW approach is possible in Germany.

[206] Cf. § 21 (2) Renewable Energy Act 2021; cf. *Schlacke/Kröger*, EEG 2017 § 21 Einspeisevergütung und Mieterstromzuschlag, in Theobald/Kühling et al, Energierecht Werkstand: 109 (Januar 2021) Rn 7.

[207] Cf. *Schlacke/Kröger*, EEG 2017 § 20 Marktprämie, in Theobald/Kühling et al, Energierecht Werkstand: 109 (Januar 2021) Rn 7.

4.2.4.2 Adaptability of eCREW as business model for energy retailer and energy communities (Foundation, Participants, energy retailer)

As explained above, citizens can participate in the energy transition under the currently valid law. Citizens can join together and form cooperatives, but this is not necessary for the eCREW approach, which in turn facilitates participation in the energy transition. Since eCREW shares electricity via the public grid, the relevant grid charges must be observed. The citizens and facility operators do not have to form a cooperative but can sell the electricity themselves. Since eCREW focuses on renewable energy sources, the relevant forms of sale for electricity from renewable energy are relevant.

In Germany, facility operators can consume self-generated electricity and sell their surplus. This is possible by way of direct marketing, whereby there are two options. Either the facility operator sells (i.e. markets) the electricity himself, or he uses a specialized service provider, such as a direct marketing operator. This service provider can also be an energy supply company that offers marketing. Thus, the eCREW approach can be offered by these energy suppliers. A market premium is available for both forms of direct sale of electricity.

eCREW's split-incentive approach (SIAs) must be adjusted for the power generation facilities, depending on whether and which subsidies (forms of sale) apply to these facilities. The subsidy through the feed-in tariff is the only one that is a challenge for eCREW, since all the excess electricity goes to the distribution system operator.

In relation to the provision of data for the eCREW tool, the data on energy consumption and energy production of the individual CREW members are required. Due to the legal situation, these required data can be processed for the eCREW approach. On the one hand, the participants are in a contractual relationship with the eCREW provider, in which consent to data processing is given, on the other hand, the regulations for direct marketing and data distribution due to the Metering Point Operation Act are beneficial.

4.2.5 Perspective from a Community and Citizen point of view

The survey carried out during the H2020 project ECHOES was mainly aimed at providing perspectives on the community and citizen points of view. The survey aimed at providing insights into individuals' energy choices within the context of an energy transition process. The survey covered 31 countries (EU 28 including the United Kingdom, plus Norway, Switzerland and Turkey). From a total of 18,037 participants in the 31 countries, 603 were from Germany. This online survey contained 114 questions.

4.2.5.1 Community perspective (Utilization the results of ECHOES survey)

Of all the respondents from Germany, 36.8% stated that they would be interested in participating in a renewable energy investment, and 40.5%, that their pro-environmental behaviours are positively affected by their communities' views and opinions. A much larger share, 72.3%, agreed that people can act together for energy transition. These results point toward a great potential interest in RECs and CECs.

Respondents have rather divided perceptions of how well the community is doing in terms of energy behaviours. While 90.9% of the respondents believe that human activities are at least equally responsible as natural causes for global warming, only 52.6% believe that these are the main reasons. Further, 55.9% of the respondents from Germany claim to feel anger that people in their community fail to save energy. 56% believe that a growing number of people in their community support policies in favour of energy transition, and 50.1% believe that a growing number of people in their communities will try to adopt energy-saving behaviours. However, only 37% of respondents observe that people in their communities are increasingly adopting energy saving behaviour regarding heating and cooling.

Regarding the extent to which respondents expect their community to support their energy-related behaviours, 45.8% consider that they would receive social support if they opted for policies that favour energy transition. 49.9%

feel certain that they would receive such support for consuming less energy, with 35% stating that their community would support energy savings regarding heating and cooling.

Energy savings through unconventional behaviours are expected to experience a much lower level of support from respondents' communities. For instance, only 22% of respondents expect support from their community for allowing their grid operator to remotely turn on/off non-critical appliances.

4.2.5.2 Current status of communities in terms of energy-related endeavours

Energy communities are very heterogeneous in terms of both organisational and legal frameworks. (Caramizaru and Uihlein, 2020). Individuals might have different reasons to join or invest in such projects. Profit maximization is often described as one, or even the main, aspect of individual decision making. However, a study of the Leuphana University of Lüneburg and Nestle (2014) reports that for German citizens, financial reasons are not the main drivers of involvement in community initiatives. Instead, contributing to an energy transition, protecting the environment and supporting the local economy are reported to be the most important factors. Accordingly, out of the nine countries that were analyzed in Caramizaru and Uihlein (2020) in 2019, Germany hosted the largest number of citizen-led energy organisations, 1750 compared to 700 in Denmark, 500 in the Netherlands, 431 in the United Kingdom, 200 in Sweden, 70 in France, 34 in both Belgium and Poland, and 33 in Spain.

In 2017, the law on the promotion of tenant electricity[208] entered into force. Tenant electricity describes electricity from solar energy produced within an apartment building or its immediate surroundings, and directly distributed to and consumed by the tenants. Excess electricity is fed into the national grid. Tenant electricity is therefore exempt from several extra payments, such as system charges and electricity taxes. In addition, the operator of the generating facility receives a remuneration for every kWh produced and consumed locally. The marginal remuneration depends on the capacity of the PV. In 2019, 1169 tenant electricity facilities with a total capacity of 24,5 megawatts were in operation. 72 PVs were installed in 2017, 355 in 2018 and 722 in 2019 (BMWi, 2020).

In the following, two examples of community projects in Germany are described. The first example of a community energy initiative in Germany is Elektrizitäts Werke Schönau (EWS), a community-owned energy cooperative. Schönau is a rural 2400-inhabitant town in southwest Germany. It started as a citizens' initiative in the aftermath of the Chernobyl disaster in 1986 to foster green energy. In the late 1990's, it took over the local electricity grid and supply. As of 2019, the cooperative has more than 8000 members. EWS and its several subsidiaries, amongst other activities, handle electricity and gas grids in Schönau and surrounding municipalities, offer green electricity and energy services nationwide, and build and operate own and external green energy generating facilities (EWS, n.d.).

The second example of a community energy initiative in Germany is the Sprakebüll energy cooperative. Sprakebüll is a settlement of 247 inhabitants in the district of North Friesland, located within the state of Schleswig Holstein, which hosts more than 300 community energy projects. This is the largest number per capita of all 16 states in Germany. The town has more than two decades of experience with energy community projects. It started in 1998, when 22 local villagers set up the first wind park with 5 wind turbines, soon followed by a second wind park set up and owned by 183 local citizens. Several additional investments and repowering measures followed. In 2009, a local family constructed a 100 megawatts solar energy installation and sold the panels to local investors. Further, the villagers also utilize a privately owned biogas plant. A district heating network distributes the heat to local inhabitants (Isakovic, 2019).

[208] Gesetz zur Förderung von Mieterstrom und zur Änderung weiterer Vorschriften des Erneuerbare-Energien-Gesetzes, F.L.G. I No. 49, in force since 24. July 2017 (available under: https://www.bmwi.de/Redaktion/DE/Downloads/M-O/mieterstrom-gesetz-bgbl.pdf?__blob=publicationFile&v=4 [Stand 16.07.2021]).

4.2.6 Citizen perspective (Utilization the results of ECHOES survey)

Regarding attitudes towards RECs and CECs, the ECHOES survey suggests that 80.8% of the respondents in Germany are positive about the environmental benefit of renewables. Moreover, 65.2% state that they intend to use renewable energy in such a way as to support energy transition. Regarding economic benefits, 47.1% believe that the use of renewables will create employment.

Further, 76.5% of the respondents believe that global warming is in progress, underscoring the urgency of adopting green behaviour. Only 2.2% are convinced that global warming is not real. Accordingly, 60.4% state that acting pro-environmentally is an important part of their lives. Further, 68.7% feel obliged to be energy efficient, and 66.4 % feel obliged to adopt energy savings behaviour regarding household heating and cooling.

Lastly, 46.3% of the respondents from Germany are in favour of pro-environmental policies, even if these result in higher costs.

4.2.6.1 An overview of energy behaviours of citizens

Lifestyles and lifestyle choices are significant drivers of energy behaviours. The ECHOES survey provides insights into respondents' lifestyles and choices in Germany.

Most respondents, 54.7%, live in apartment blocks. Another 25% live in single-family homes and 16.6% in semi-detached or terraced homes. Regarding the floor areas of the dwellings, 37.3% are smaller than 70 square feet, and 20% are between 71 and 90 square feet. 12.1% live in larger dwellings of 91 to 110 square feet, and 13.8% between 111 and 130 square feet. 15.1% live in households of 131 square feet or larger.

In Germany, 68.78 of the respondents use central heating for domestic heating, 16.1% use district heating, 4.5% use one or more standalone stoves and 4.2% use one or more standalone electric heaters.

Accordingly, 46.1% of the households use gas for heating, 18.6% oil, and 4.8% electricity. 19.2% reported not knowing.

The energy used for heating and cooling depends on individuals' comfort temperature preferences. 46.4% of the respondents state that their comfort temperatures are close to the average, 38% prefer cooler temperatures, and 13.6%, warmer temperatures.

87.9% of respondents in Germany do not own an air conditioner. 7.5% use them almost never or rarely and 4.5%, sometimes, regularly or often use air conditioners during hotter periods.

54.7% of respondents stated that they always or often disconnect electric appliances when not in use, 25.4% never or rarely and 19.9% occasionally.

89.7% use energy-saving light bulbs at home and 74.6% have at least a share of 75% of energy-saving light bulbs.

35.8% of the respondents confirm that their energy provider has a particularly high share of renewable energy production, and a considerable share of respondents, 42.6%, gave no definite answer for this item. . The remaining 21.6% confirm that theirs do not.

Next, mobility habits and the use of public transportation are also important drivers of energy behaviours. In Germany, 82.9% of respondents state that they drive private cars. 14.4% drive less than 5,000km annually, 22.7% drive between 5,000 and 10,000km, 17.9%, between 10,000 and 15,000km, 11.4%, between 15,000 and 20,000km and 6.3% between 20,000 and 30,000km.

70.4% drive alone at least 50% of the time. Of those, 20.8% almost always drive alone. 10.8% almost never drive alone. The majority (94.4%) of vehicles are petrol or diesel-fuelled. Only 2.2% are either hybrid-electric or plug-in hybrid, and another 2.2% gas-fuelled.

89.7% of the respondents from Germany have never participated in car-sharing. Of those, 60.4% never intend to try, and the remaining 29.4% find the idea interesting. However, most who have tried car-sharing, namely 7.8% of 10.3%, report positive experiences.

Regarding public transportation use, 29.3% believe that public transportation to be environmentally-friendly, 22.3% believe that it is not, and the remaining 48.3% are undecided. 58.5% of the respondents state that they rarely use public transportation (less than once per week on average), 18.7% 1-4 times per week, and 8.2% 5-8 times per week. However, 14.7% use the public transport system in Germany more than 8 times per week.

Lastly, air travel is also a substantial aspect of energy-related behaviour. More than half of the respondents, namely 56.4%, report at least one non-business flight within the last year. The total annual time for these flights is generally equal to or less than 10 hours (for 29.4% of the total answers). 7.2% report flight times of more than 20 hours, which indicates either frequent flyers or long-distance flights.

4.2.7 Interim conclusion

It is important to consider the demographic characteristics of a country as they could potentially affect the success of the eCREW approach. While, overall, Germany seems to present rather advantageous conditions, the partly significant east-west divergence in several aspects should be a factor considered in the implementation of eCREW.

The eastern half of Germany is considerably less densely populated than the western half, and especially the area of former East Germany has many relatively sparsely populated regions. While overall, the German population is well educated, tertiary education attainment rates show a significant south-north divergence. In general, southern states present above average attainment rates. Regarding unemployment, former East Germany has historically higher rates than the rest of the country. and correspondingly lower hourly rates of pay. Southern states report the highest hourly wages. eCREW is a highly technical project that is based on modern technology and on the willingness to actively engage with technology that enables the monitoring of energy consumption and/or the production or storage of energy. Thus, the above characteristics are highly relevant for the eCREW approach. Further, PVs are especially relevant in the South, total PV capacity is by far the highest in Bavaria. However, in terms of PV-capacity per 1000 inhabitants, the eastern states report the highest numbers. Altogether, the South presents ideal conditions for a smooth implementation of the eCREW approach, while the East lacks some of the necessary characteristics.

53% of total energy production stems from renewable sources. Germany relies heavily on gas and oil imports. These imports are equivalent to 95% of gross available energy. The share of renewable energy in gross final energy consumption is increasing, but still below 20%. 40% of Germany's electricity production stems from renewable sources. However, as Germany plans to halt production of electricity from nuclear power and coal-based energy, this percentage is indeed increasing, as well as the number of newly installed PVs, paving the way for a successful implementation of the eCREW approach all over Germany.

Individuals' energy behaviours, as well as attitudes towards energy related matters, are another key factor in the success of eCREW. The results from the ECHOES survey suggest that respondents are aware of the importance of adopting sustainable energy behavior, and are willing to adapt their lifestyles to contribute to the energy transition. More than 80% of the respondents in Germany are positive about the environmental benefit of renewables, and more than 60% state that acting pro-environmentally is an important part of their lives. While the answers suggest that energy saving behavior is being incorporated in everyday life, mobility seems to lag behind in this regard. Most of the respondents have never tried car-sharing possibilities and nearly 60% rarely or never use the German public transport system.

Lastly, eCREW is supported by communities. The ECHOES survey underscores the importance of the community aspect in energy related matters in Germany. More than 72% agree that people can act together for the energy transition and 56% feel anger about others failing to save energy. About half of the respondents believe that people increasingly support policies in favor of the energy transition and that more and more people adopt energy-saving behaviours. Importantly, also half of the respondents believe that they would receive community-support for consuming less energy.

The legal framework in Germany already provides a basis for participation in community projects to generate and share renewable energy. So far, the basic support for renewable energy in the field of electricity is based on three defined types of subsidized sales of renewable electricity. A further sale type does not receive a subsidy. It must be emphasized that every sale of electricity must be assigned to one category. Since the first three subsidized sale types are limited in time, the sale type without subsidy becomes obligatory after that time. The application of eCREW approach has to consider the respective forms of sale and provide incentives accordingly. For those facilities that are no longer accessible to subsidized sales, the eCREW approach is particularly interesting as an intermediary such as a direct marketer can be involved. Since they lose the subsidy as a support for the price, eCREW could pursue an approach that on the one hand offers them a good price for their surplus electricity, and on the other hand supports the efficient use of electricity within a CREW. Participants who require only locally-produced renewable electricity would also benefit from a better electricity price. The activity of a direct marketer can also be offered by an energy supplier company, so that the latter would also be able to apply the eCREW approach.

eCREW joins the sales system in which it can act as a direct marketing concept itself, with the difference that the electricity is not sold to the power exchange or only to a specific third party, but is transmitted to a defined group, namely the CREW. In particular, when a retail company, such as a municipal utility, uses this concept, it acts as an intermediary between the CREW members, as well as a supplier that provides the rest of the electricity needed.

The data transmission required by eCREW for its effective use of electricity in a CREW is also made possible by German legal regulations. With the processed information, the participants can check their behavior in relation to electricity consumption and adjust their behavior if necessary.

4.3 Greece

4.3.1 Country Profile

4.3.1.1 Demographics

Greece has a population of 10.37 million (Worldometer Greece Demographics, 2020). The land area of Greece is approximately 129,000 square kilometres, translating into a population density of 80.38 per kilometre.

The population of Greece has been decreasing over the last decade, with an average yearly change rate of -0.47%. Table 12 and Figure 22 below demonstrate the population trend of Greece over the time period 1955 to 2020.

Table 12: Population and Yearly Change Percentages in Greece 1955-2020 Data Source: (Worldometer Greece Demographics, 2020)

Year	Population	% Yearly Change
1955	8,011,124	0.88%
1960	8,273,629	0.65%
1965	8,453,821	0.43%
1970	8,663,571	0.49%
1975	9,014,085	0.80%
1980	9,627,002	1.32%
1985	9,968,238	0.70%
1990	10,225,992	0.51%
1995	10,745,503	1.00%
2000	11,082,104	0.62%
2005	11,224,791	0.26%
2010	10,887,637	-0.61%
2015	10,659,750	-0.42%
2016	10,615,185	-0.42%
2017	10,569,450	-0.43%
2018	10,522,246	-0.45%
2019	10,473,455	-0.46%
2020	10,423,054	-0.48%

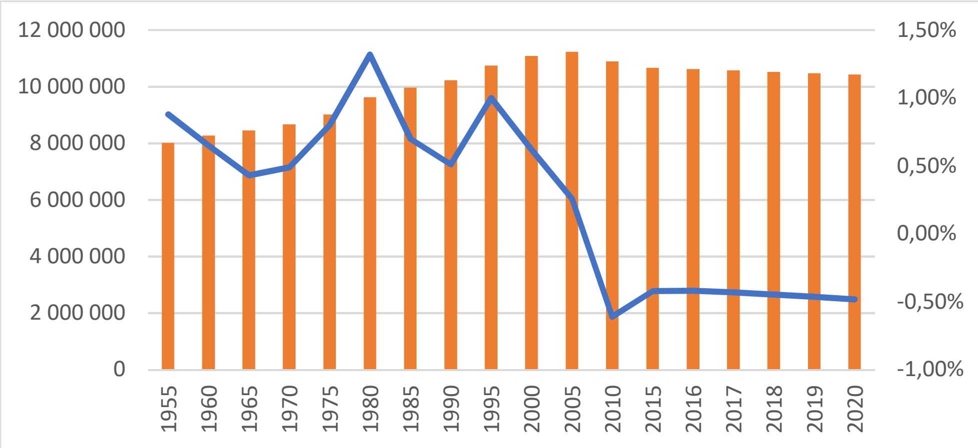


Figure 23: Population Trends in Greece 1955-2020 (Data Source: Worldometer Greece Demographics, 2020)

84.9% of the population lives in urban areas, marking an increase from the level of 80.2% in 2010, and 73.1% in 2000 (Worldometer Greece Demographics, 2020)

Table 13: Urban and Rural Population in Greece 1980-2020 (Data Source: EURYDICE Greece Overview)

	1965	1970	1975	1980	1990	2000	2010	2020
Urban Population (%)	55.9	64.2	66.9	69.4	71.6	73.1	80.2	84.9
Rural Population (%)	44.1	35.8	33.1	30.6	28.4	26.9	19.8	15.1

As of 2020, the median age in Greece is 45.6 years, also demonstrating a steady increase trend from the 200 level of 37.8, 2005 level of 39.3, 2010 level of 41, and 2015 level of 43.3. Figure 24 below shows the changes in median age of Greece's population from 1955 to 2020.

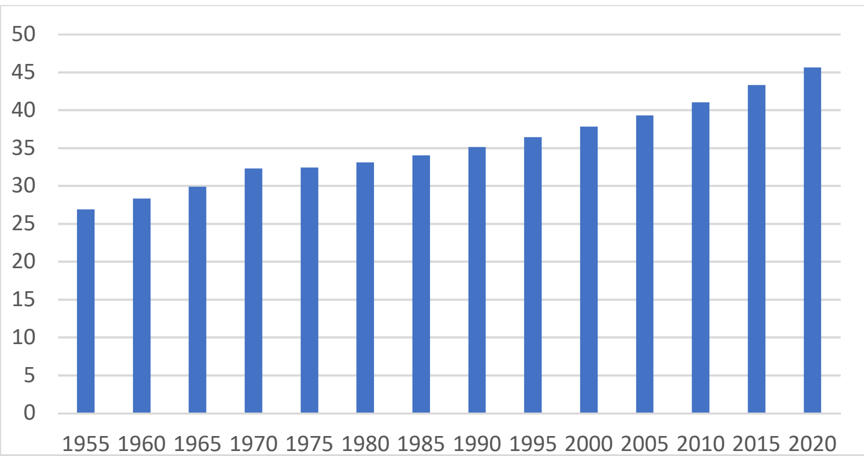


Figure 24: Median Age in Greece 1955-2020 (Data Source: Ourworldindata Greece: Demographics)

The population pyramid shows that the age groups with the highest percentages are 45-59, corresponding to 22% of the population, followed by the 30-44 age group with 20.3%. Share of the population between the ages of 60 to

74 is 17.3%. The younger population age groups have shares of 13.6% for 0-14, and 15.2% for 15-29. Finally, the share of the population aged 75 and above is 11.4%. Figure 25 shows the population pyramid of Greece for 2020.

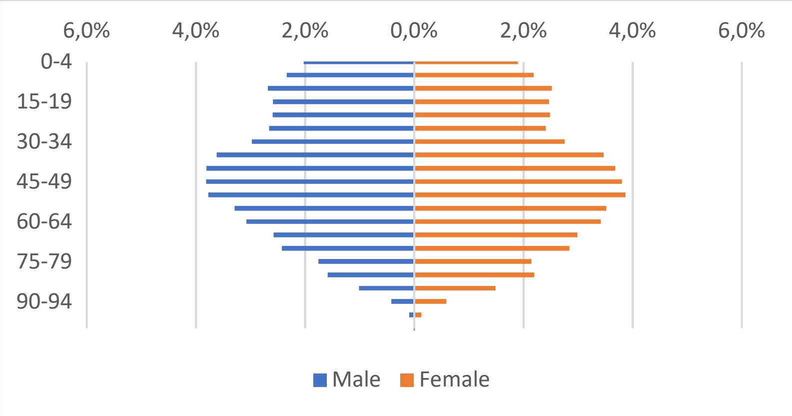


Figure 25: Population Pyramid of Greece (2020) (Data Source: Population Pyramid Website, 2020)

Table 14: Population Distribution of Greece 2000, 2010, and 2019 (Data Source: EURYDICE Greece Overview)

	0-14	15-29	30-44	45-59	60-74	75+
2020	13.6%	15.2%	20.3%	22.0%	17.3%	11.4%
2019	13.9%	15.2%	20.7%	21.8%	17.0%	11.3%
2015	14.6%	15.9%	22.0%	21.0%	15.4%	11.0%
2010	15,0%	18.3%	22.6%	19.2%	15.2%	9.6%
2005	14.7%	20.4%	23.1%	19.2%	15.0%	7.5%
2000	15.1%	22.4%	22.8%	17.6%	15.8%	6.2%

In 2020, the life expectancy for females in Greece was 85.1 years, with 80.3 years for males, resulting in an overall life expectancy of 82.8 years. This shows an increase from 2010 figures, which were 83.7 years for females, 78.5 years for males, and 81.1 years overall, and from 2000 figures, which were 81.9 years for females, 76.4 years for males and 79.1 years overall. Table 15 shows the life expectancy figures in Greece from 1980 to 2020.

Table 15: Life Expectancy for Females, Males, and Overall in Greece 1980-2020 (Data Sources: EURYDICE Greece Overview; Worldometer Greece Demographics, 2020)

Year	1980	1990	2000	2010	2020
Life Expectancy (years) for Females	77.8	80.0	81.9	83.7	85.1
Life Expectancy (years) for Males	71.4	74.8	76.4	78.5	80.3
Life Expectancy (years) Overall	74.5	77.4	79.1	81.1	82.8

Changes in the population pyramid of Greece from 2000 to 2020, along with the increasing median age, decreasing population and increasing life expectancy show that the population in Greece is ageing. This also increases the age dependency ratio in Greece, defined as the ratio of the young (aged 0 to 14) and the elderly population (ages 65 and higher) to the working age population (aged from 15 to 64). The age dependency ratio is expressed in terms of number of dependents per 100 people in the working age. Table 16 below shows the age dependency ratio in Greece from 1970 to 2020.

Table 16: Age dependency ratio in Greece 1970-2020 (Data Sources: EURYDICE Greece Overview; Ourworldindata Age Dependency Greece, 2020)

Year	1970	1980	1990	2000	2010	2015	2020
Age dependency ratio (per 100 working-age population)	56.87	56.51	49.94	46.70	49.85	52.66	56.10

Regarding education levels, as of 2018, the share of the 25-34 age group having an educational attainment below secondary education is 13%, slightly below the OECD average. The share of people with upper secondary or postsecondary, but not not-tertiary education is 44%, which is higher than the OECD average of 41%. Share of the 25-34 age group with tertiary education in Greece is 43%, slightly behind the OECD average of 44%. As compared to the 2009 figures, this achievement corresponds to an increase of 13% in terms of tertiary education attainment of the 25-34 age group, a corresponding 1% decrease in the upper secondary or postsecondary, but not not-tertiary education attainment, and a 12% decrease in the share of 25-34 age population that have below secondary education (OECD Education at a Glance, 2019).

In this young adult group (ages 25-34), the share of females with tertiary education is considerably higher (by 40%) as compared to the share of males with tertiary education. This figure is very close to the EU-23 average of 38%. Regarding the other age groups in the 25-64 age group, the share of females with tertiary education is 9% higher than the share of males. Within this age group, the EU-23 average of females with tertiary education is 25% higher than that of males. For the 55-64 age group, females in Greece have a 25% lower rate of tertiary education as compared to males, whereas the EU-23 average is 10% higher for females as compared to males. Hence, although Greece has lower tertiary education rates for females in older age groups covering ages 35 to 64 as compared to the EU-23 average, the percentages are likely to increase in the future because of the attainment in the young adult group (OECD Education at a Glance, 2019).

Figures in terms of education levels are also improving. Tables 17 and 18 below demonstrate the evolution of enrolment rates for primary and secondary education in Greece by gender, respectively (UNESCO Education and Literacy in Greece).

Table 17: Enrolment Rates for Primary Education in Greece by Gender 2011-2018 (Data Source: UNESCO Education and Literacy in Greece)

Year	2011	2012	2013	2014	2015	2016	2017	2018
Female (%)	96.1	96.9	96.8	96.2	97.1	97.9	98.5	98.4
Male (%)	97.8	98.5	98.1	96.9	97.5	98	98	97.7
Overall (%)	97	97.7	97.5	96.5	97.3	97.9	98.2	98

Table 18: Enrolment Rates for Secondary Education in Greece by Gender 2013-2018 (Data Source: UNESCO Education and Literacy in Greece)

Year	2013	2014	2015	2016	2017	2018
Female (%)	93.2	90.7	91.7	91.7	92.6	93.2
Male (%)	93.6	91.9	93.2	93.2	94	94.6
Overall (%)	93.4	91.3	92.5	92.5	93.3	93.9

As of the fourth quarter of 2020, the employment rate for Greece is 56.8%. This rate is considerably lower than the OECD average of 66.6%, and the EU-27 average of 67.8% for the same period. The analysis of the employment rate in Greece from 2000 to 2020 shows a steady increase from 56.5% to 61.4% over the time period from the fourth quarter of 2001 to the third quarter of 2008, followed by a continuous decrease until the second quarter of 2013 to 48.5%. The increase in the employment rate from the second quarter of 2013 continued until the third quarter of 2019, when the employment rate increased to 56.9%. With small fluctuations in the following five quarters, the employment rate has remained almost constant since then, with 56.8% in the fourth quarter 2020. Figure 26 demonstrates the quarterly changes in the employment rate in Greece from 2000 to 2020.

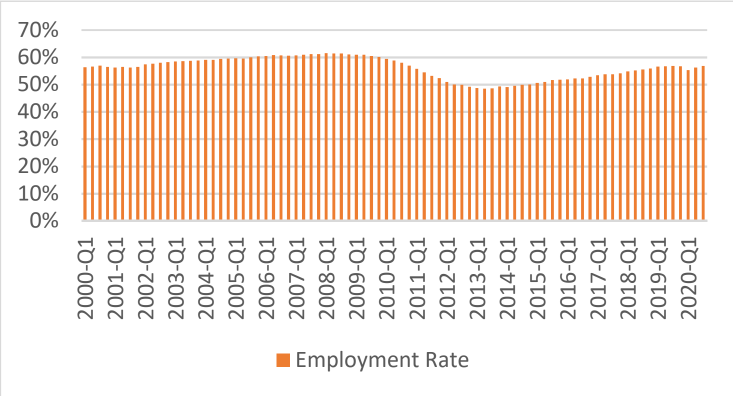


Figure 26: Quarterly Employment Rate in Greece 2000 – 2020 (Data Source: OECD Employment Rate Greece)

The employment rate varies by age groups, where the 25-54 age group has the highest employment rate, followed by the older (55-64) and the younger (15-24) age groups. The employment rate within the 55-64 age group demonstrates an increasing trend, in parallel to the situation as demonstrated by the OECD and the EU-27 averages (OECD Employment Rate by Age Group Greece), as demonstrated in Table 19.

Table 19: Employment Rate in Greece by Age Group 2010-2020 (Data Source: OECD Employment Rate by Age Group Greece)

	Employment Rate in the Age Group (%)		
Age Group	15-24	25-54	55-64
2010	20.1	73.1	42.3
2011	16.1	68.8	39.5
2012	13.0	63.8	36.5
2013	11.8	61.3	35.6
2014	13.3	62.4	34.0
2015	13.0	64.5	34.3
2016	13.0	66.0	36.3
2017	14.1	67.4	38.2
2018	14.0	69.0	41.0
2019	14.5	70.8	43.2
2020	13.8	70.4	44.6

The employment rate in Greece also varies by education level. For the time period between 2010 and 2019, the employment rates increase with the level of education. However, the employment rates are lower than those of the

OECD average. For individuals with below upper secondary education, the employment rate in Greece is 7-8% lower than the OECD average for the period 2013-2019. For individuals with upper secondary, non-tertiary education, the employment rate in Greece was 19% below the OECD average in 2013. With the employment rate increasing at a higher pace as compared to the OECD average, the gap is at 14.3% in 2019 (OECD Employment Rate by Education Level Greece). Table 20 demonstrates the employment rates with respect to education levels in Greece from 2010 to 2019.

Table 20: Employment Rate in Greece by Education Level 2010-2019 (Data Source: OECD Employment Rate by Education Level Greece)

	Employment Rate for Individuals with the Education Level (%)		
Education Level	Below Upper Secondary	Upper Secondary, Non-Tertiary	Tertiary
2010	58.1	66.4	79.8
2011	53.9	62.0	74.8
2012	48.4	57.1	71.1
2013	46.3	54.1	69.1
2014	46.9	54.5	68.5
2015	48.5	56.4	68.7
2016	48.5	58.1	70.4
2017	49.6	59.3	71.8
2018	50.4	60.9	74.1
2019	52.4	62.3	76.0

As of the fourth quarter of 2020, Greece has an unemployment rate of 16.1%, more than double that of the OECD average and the EU-27 average values, which are 7.0%, and 7.5% for the same period, respectively. Although with fluctuations, the unemployment rate in Greece at the beginning of 2004 was similar to its value in the first quarter of 2000, even with a slight decrease (11.6% versus 11.0%). This was followed by a significant decrease trend, reaching 7.5% in the third quarter of 2008. However, a wave of increases brought the unemployment level to 27.9% by the end of 2013. Despite the steady decrease trend from 2014 to 2020, the unemployment rate in the first quarter of 2020 was at 16.0%. With small fluctuations in 2020, the unemployment rate remained almost the same, at a value of 16.1% in the fourth quarter 2020. Figure 26 demonstrates the quarterly changes in the employment rate from 2000 to 2020 (OECD Unemployment Rate Greece). Figure 27 demonstrates the unemployment rate in Greece from 2000 to 2020.

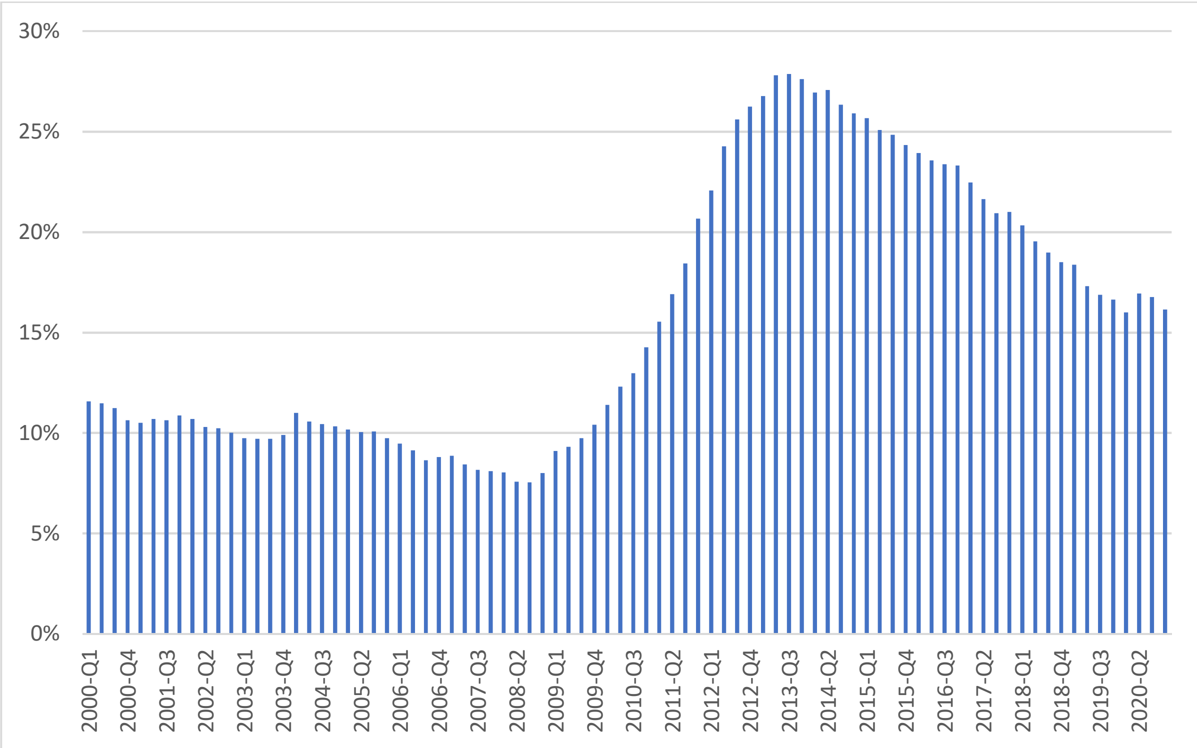


Figure 27: Quarterly Unemployment Rate in Greece 2000 – 2020 (Data Source: OECD Unemployment Rate Greece)

The effect of age groups on the unemployment rate in Greece can be observed by analysing the rates for the age group 15-24 versus the age group 25-74. The rate is much higher for the 15-24 age group, with the gap closing from a differential of 33% in 2013 to 19.5% in 2020. Despite a fairly steady decrease in the unemployment rates for all age groups, the rates are still much higher as compared to those of the OECD average and EU-27 average. For both age groups, there was a consistent decrease in these differences from 2013 to 2020. However, as of 2020, the unemployment rate for the 15-24 age group was still around 19% higher than the OECD or EU-27 average values, and for the 25-74 age the difference with the OECD or EU-27 average is around 9%. Table 21 demonstrates the unemployment rates in Greece for the age groups, along with a comparison with OECD and EU-27 averages.

Table 21: Unemployment Rates in Greece, OECD Average, and EU-27 Average by Age Group 2010-2020 (Data Source: OECD Unemployment Rate by Age Group Greece)

	Age Group					
	15-24			25-74		
	Greece	OECD Average	EU-27 Average	Greece	OECD Average	EU-27 Average
2010	33.0	17.4	21.8	11.2	7.2	8.6
2011	44.7	16.8	21.9	16.0	6.9	8.6
2012	55.3	16.7	23.8	22.4	6.9	9.6
2013	58.4	16.4	24.5	25.4	6.8	10.1
2014	52.5	15.4	23.5	24.8	6.3	9.7
2015	49.8	14.2	21.8	23.4	5.9	9.0
2016	47.4	13.3	20.1	22.2	5.5	8.1
2017	43.6	12.4	18.0	20.2	5.0	7.2
2018	39.9	11.7	16.1	18.2	4.7	6.4
2019	35.3	11.8	15.1	16.4	4.6	5.9
2020	35.0	15.1	16.6	15.5	6.2	6.3

Individuals with tertiary education have the lowest unemployment rate, decreasing from 19.4% in 2013 to 11.6% in 2019. Individuals with below upper secondary education have slightly higher unemployment rate as compared to those with effect of education level on unemployment on upper secondary, non-tertiary education. As of 2019, these values are 20.0% and 18.8%, respectively. This demonstrates a consistent decreasing trend from the 2013 values of 28.7% and 28.1%, respectively (OECD Unemployment Rate by Education Level Group Greece). Table 22 demonstrates the employment rates with respect to education levels in Greece from 2010 to 2019.

Table 22: Unemployment Rate in Greece by Education Level 2010-2019 (Data Source: OECD Unemployment Rate by Education Level Group Greece)

	Unemployment Rate for Individuals with the Education Level (%)		
Education Level	Below Upper Secondary	Upper Secondary, Non-Tertiary	Tertiary
2010	11.9	12.8	8.9
2011	17.0	17.9	13.0
2012	25.1	24.6	17.2
2013	28.7	28.1	19.4
2014	27.7	27.7	19.1
2015	26.3	25.5	19.0
2016	26.2	24.2	17.2
2017	23.9	22.3	15.7
2018	22.0	20.3	13.7
2019	20.0	18.8	11.6

4.3.1.2 Energy profile (production, supply, consumption etc.)

The total energy supply of Greece in 2019 was 21,270 ktoe. This value is very close to the total supply of 1990, which was at 21,379 ktoe, pointing to a fluctuation in supply. The total energy supply increased between 1990 and 2005 by 40.3%, translating into an average annual increase of 3.75%. From 2005, the total energy supply of Greece decreased to the level of 21,270 ktoe. This corresponds to an overall 29% decrease. The annual decrease is around 2.07% (IEA Greece).

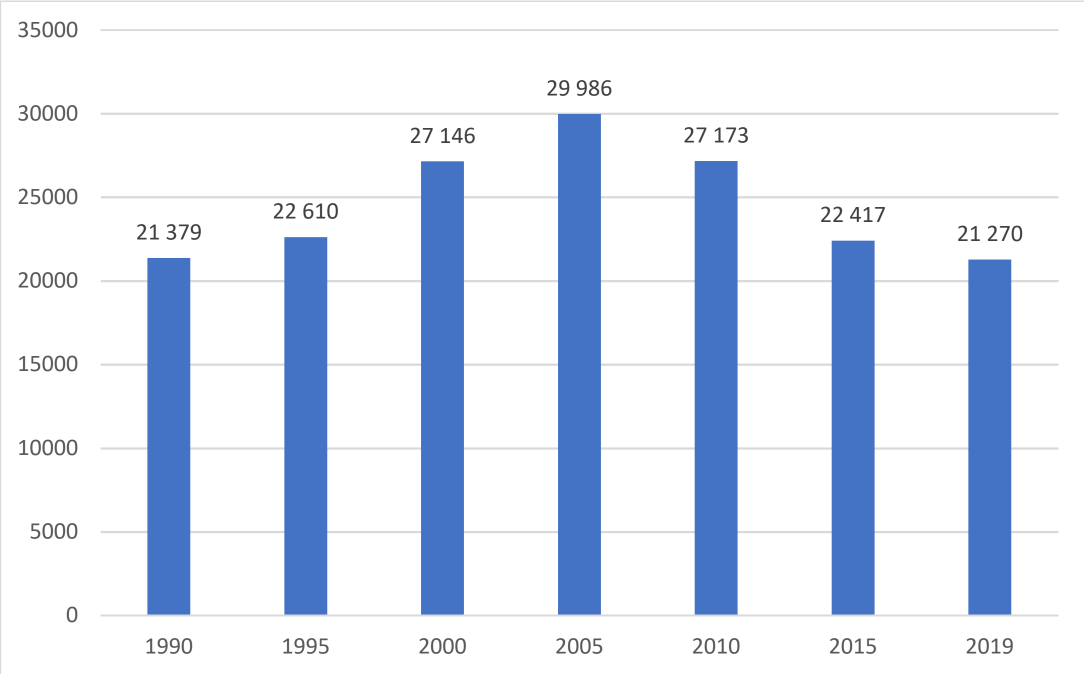


Figure 28: Energy Supply of Greece 1990-2019 (Ktoe) (Data Source: IEA Greece)

Based on 2019 values, oil by far has the largest share in the energy supply of Greece, at 49.9%. Natural gas has a share of 21.2%, whereas coal has a 15.4% share. Biofuels and waste and renewables have shares of 5.9% each. Finally, hydro has a share of 1.6% (IEA Greece).

Table 23: Energy Supply of Greece by Source 1990-2019 (Ktoe) (Data Source: IEA Greece)

Year	Oil	Natural gas	Coal	Biofuels and waste	Renewables (Wind, solar, etc.)	Hydro	Total
1990	12071	138	8066	893	59	152	21379
1995	12851	44	8389	935	88	303	22610
2000	14879	1705	9038	1009	197	318	27146
2005	16951	2354	8952	1015	283	431	29986
2010	13854	3235	7863	1076	504	641	27173
2015	11210	2677	5606	1398	1002	524	22417
2019	10613	4503	3285	1262	1261	346	21270

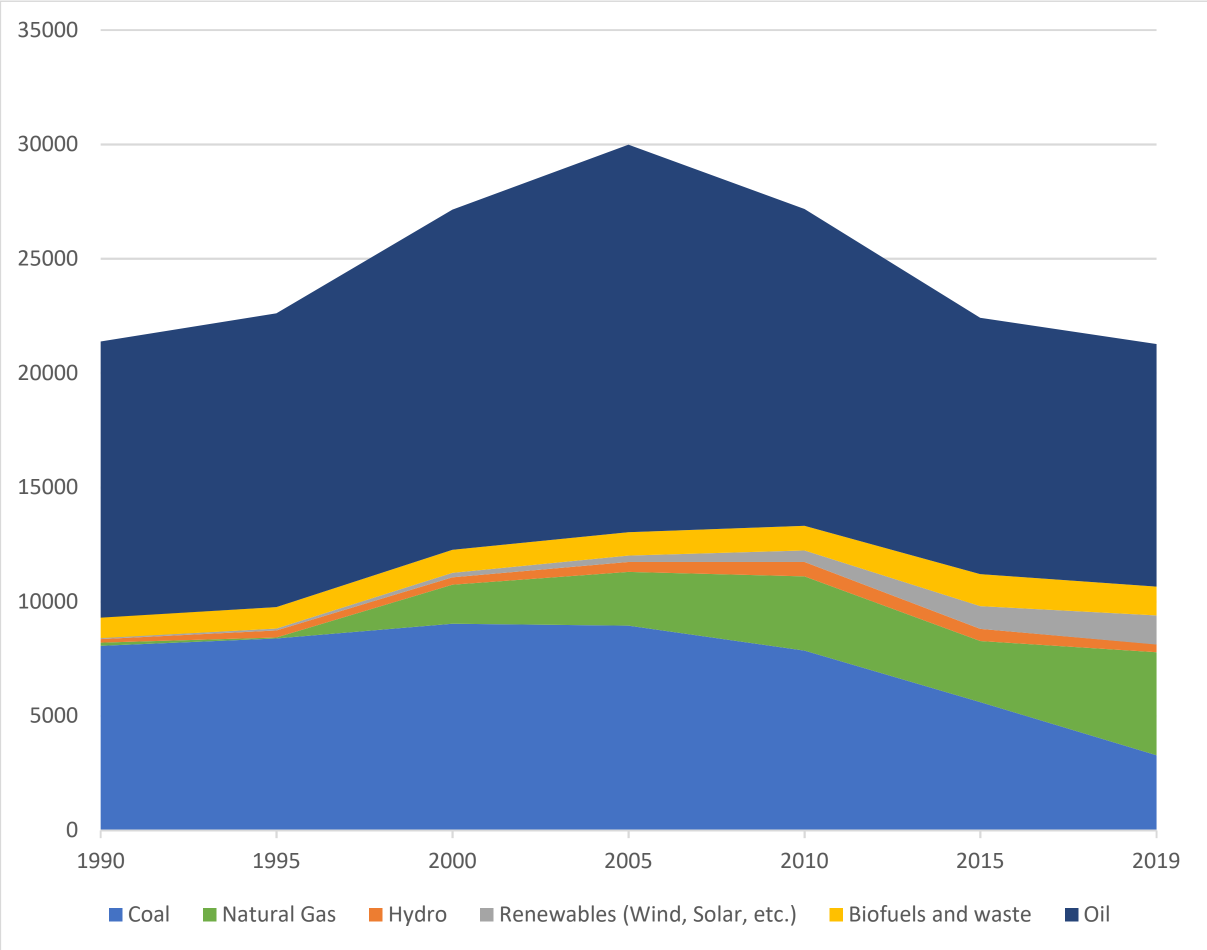


Figure 29: Energy Supply of Greece by Source 1990-2019 (Ktoe) (Data Source: IEA Greece)

Although diminishing over the time period between 1990 and 2019, oil has the highest share in the energy supply portfolio of Greece. In 1990, the share of oil was 56.5%, which decreased to 49.9% in 2019. Coal had the second place between 1990 and 2015, with shares of 37.7% in 1990, and 25% in 2015. The share of natural gas increased from 0.6% in 1990 to 21.2% in 2019, taking second place. The total share of fossil fuels in Greece was 94.8% in 1990. With decreasing shares of oil and coal and increasing share of natural gas, the share of fossil fuels decreased to 86.5% in 2019, rather high as compared to other sources. This decrease in the share of fossil fuels is compensated mainly by the deployment of renewables, biofuels and waste. In 1990, the share of renewables was 0.3%, which reached 5.9% in 2019. The share of biofuels and waste had a smaller increase, from 4.2% in 1990 to 5.9% in 2019. The share of hydro remained rather low, still with an increase of 0.7% in 1990 to 1.6% in 2019.

The two main pillars of Greece's energy policy are diversification of energy sources and reduction of the CO_2 intensity of the sectors, hence, the economy. One of the steps taken by the Greek government in this direction is the replacement of coal with natural gas. However, since natural gas is imported, this has increased import-dependence. Regarding oil imports, the main crude oil suppliers are Iraq, Kazakhstan, Russia, and Iran. As of 2018, Iraq covers 45% of Greece's oil imports, Kazakhstan has a share of 13%, Russia and Iran have shares of 11% and 10%, respectively. Hence, these four main suppliers provide 80% of oil imports. The refining market is dominated by two main companies, namely, Hellenic Petroleum, and Motor Oil Hellas. These two companies account for 90% of the demand.

Concerning both decreasing the CO_2 emissions and diversification of energy sources, Greece also places an emphasis on increasing the deployment of renewables. The share of renewables increased to 6.2% in 2019.

Although still a low share, this increasing trend is promising, considering the almost zero (0.3%) share in 1990.The use of renewables in the energy mix of Greece has increased, particularly in the generation of electricity (OECD Inventory of Support Measures for Fossil Fuels: Country Notes Greece). The shares of wind and solar in electricity production reached 23% in 2019, a considerable increase from 0.01% in 1990, to 5% in 2010, 16.4% in 2015, and finally, to 23% in 2019. When the share of hydro is also included, as of 2019, wind, solar, and hydro accounted for 31.4% of the electricity production in Greece (IEA Greece).

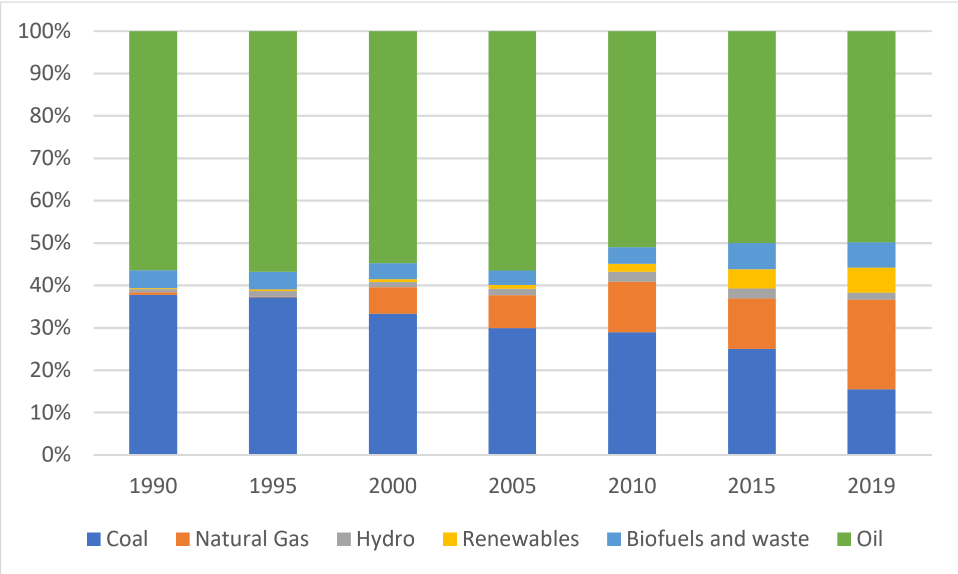


Figure 30: Energy Supply Mix of Greece by Source 1990-2019 (Data Source: IEA Greece)

Regarding energy consumption, the total energy consumption in Greece has slightly increased from 14,494 Ktoe in 1990 to 15,684 Ktoe in 2018, marking an 8.2% increase over 28 years, or an annual average increase of 0.3% in energy consumption. Similar to the pattern of energy supply, total energy consumption in Greece demonstrates a steady increase from 1990 to 2005, with a total increase of 43.5%. This corresponds to a yearly average increase of 2.9%. From 2005 to 2018, there is a steady decrease in the total energy consumption of Greece. The total decrease within this period is 25%, which translates into an average yearly decrease rate of 1.9%.

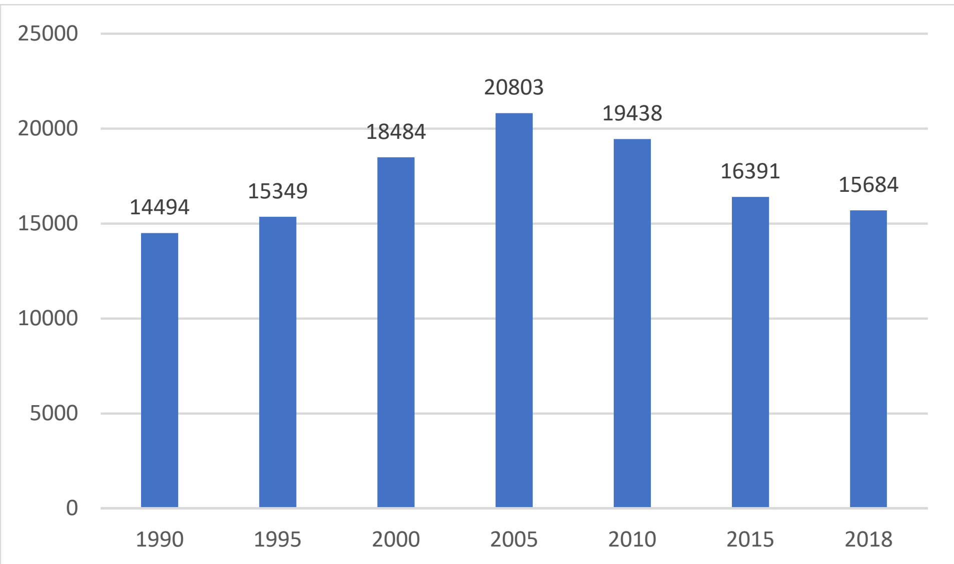


Figure 31: Energy Consumption of Greece 1990-2018 (Ktoe) (Data Source: IEA Greece)

Table 24: Energy Consumption of Greece by Source 1990-2018 (Ktoe) (Data Source: IEA Greece)

Year	Coal	Oil products	Natural gas	Renewable	Biofuels and waste	Electricity	Total
1990	1218	9779	97	59	893	2448	14494
1995	1050	10382	4	85	897	2931	15349
2000	878	12414	378	158	946	3710	18484
2005	443	14133	714	174	962	4377	20803
2010	302	12182	1135	257	995	4567	19438
2015	224	8919	1317	269	1295	4367	16391
2018	282	8493	1297	286	1072	4254	15684

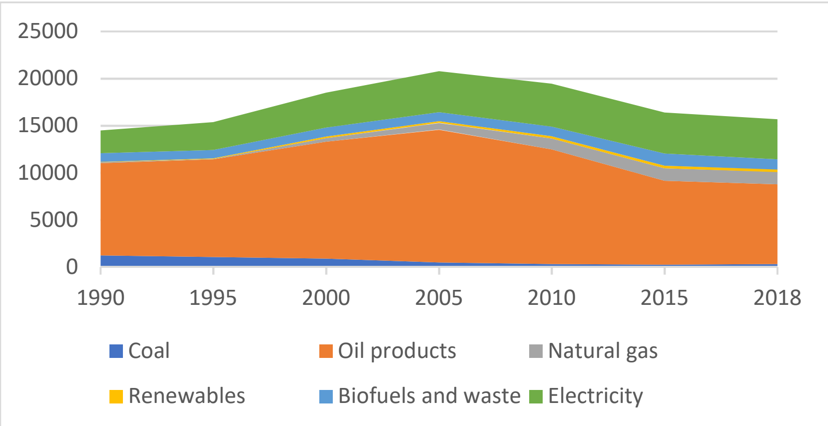


Figure 32: Energy Consumption of Greece by Source 1990-2018 (Ktoe) (Data Source:IEA Greece)

The share of oil product has the first place in the energy consumption mix of Greece over the period 1990 to 2018. Although a decrease from 67.5% in 1990 to 54.2% in 2018 is observed, the share of oil products in the energy consumption mix is still double that of electricity, which has the second highest share, 27.1%, in 2018. Similarly, the share of electricity in 1990 was 16.9%. From 1990 to 2019, the share of coal decreased from 8.4% to 1.8%, whereas the share of natural gas increased from 0.7% to 8.3%. Despite an increase from 0.4 to 1.8%, renewables still have the smallest share in the energy consumption mix. In order to decrease fossil resources in the energy mix, Greece has a number of initiatives in place. The value added tax for oil products increased from the 1990 level of 19% to 23% in 2011, and to 24% in 2016. Moreover, additional charges and fees plus indirect excise tax was applied to oil products for heating. As of 2012, the use of lignite (coal) by the PPC (Public Power Corporation) of Greece is also subject to a special fee at the rate of €2/MWh for the electricity generated using coal in the power facilities. Moreover, in order to account for its mining operations to the environment, the PPC also pays a special tax called the *communities' tax*, corresponding to 0.5% of PPC's annual turnover and paid to the communities affected by PPC mining.

In the context of the EU's European Stability Mechanism, the Government of Greece and the European Commission have signed a Memorandum of Understanding in 2015. Accordingly, the Government has established supporting mechanisms for the use of fossil fuels in several areas. For instance, a preferential tax treatment is implemented for farmers' use of diesel. Similarly, tax deductions are applied for heating oil used by households with low income (OECD Inventory of Support Measures for Fossil Fuels: Country Notes Greece).

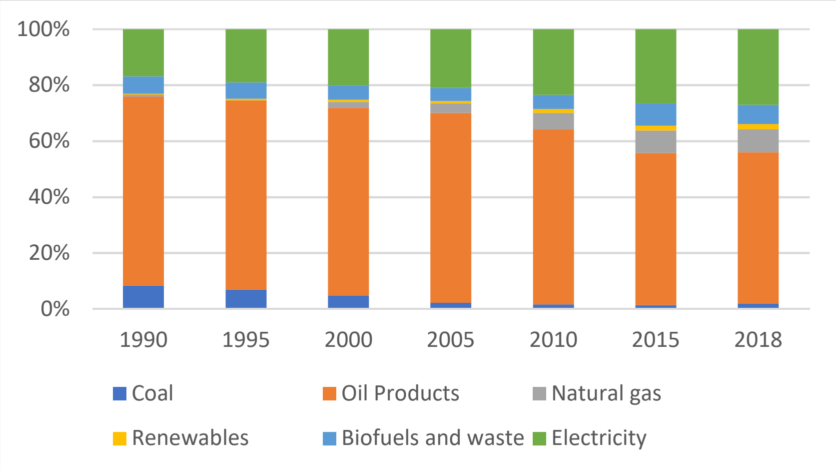


Figure 33: Energy Consumption Mix of Greece by Source 1990-2018 (Data Source: IEA Greece)

The transport sector has the highest share in the energy consumption of Greece, accounting for a steadily increasing share from 29% in 1990 to 34% in 2018. Electricity has a steadily increasing share from 1990 to 2018, attaining the second largest share, 23%, in 2018. The share of electricity was 16% in 1990, taking only fourth place after transportation (33%), industry (26%), and residential (20%) sectors. The residential sector has the second share in 2018, with 20%. The share of the residential sector within the time period 1990 to 2018 fluctuates between 20% to 24%. The industry sector, on the other hand, has a decreasing rate from 26% in 1990 values to 14%, almost half, in 2018. Finally, the commercial sector accounts for 10% of the energy consumption in Greece in 2018, twice the 1990 share of the commercial sector in energy consumption.

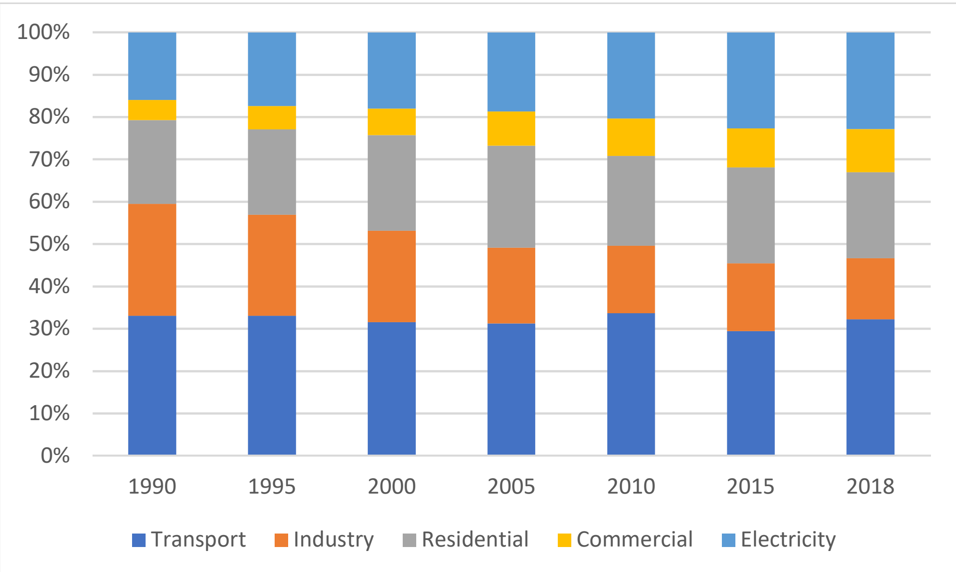


Figure 34: Energy Consumption Mix of Greece by Sector 1990-2018 (Ktoe) (Data Source: IEA Greece)

4.3.1.3 Energy market and infrastructure

Electricity generation in Greece traditionally relies mainly on coal (lignite) and oil. The total shares of coal and oil in electricity production were 94% in 1990. Starting from 2000's, the shares of coal and oil decreased, with natural gas taking the second place. As of 2019, the total share of fossil fuels in electricity generation was 64.8%, of which natural gas had a share of 33.5%, Coal hada share of 22.2%, and oil, a share of 9.2%. The decrease in the shares of fossil fuels is accounted for by renewables, with wind having a share of 14.8% and solar, 8.1%.

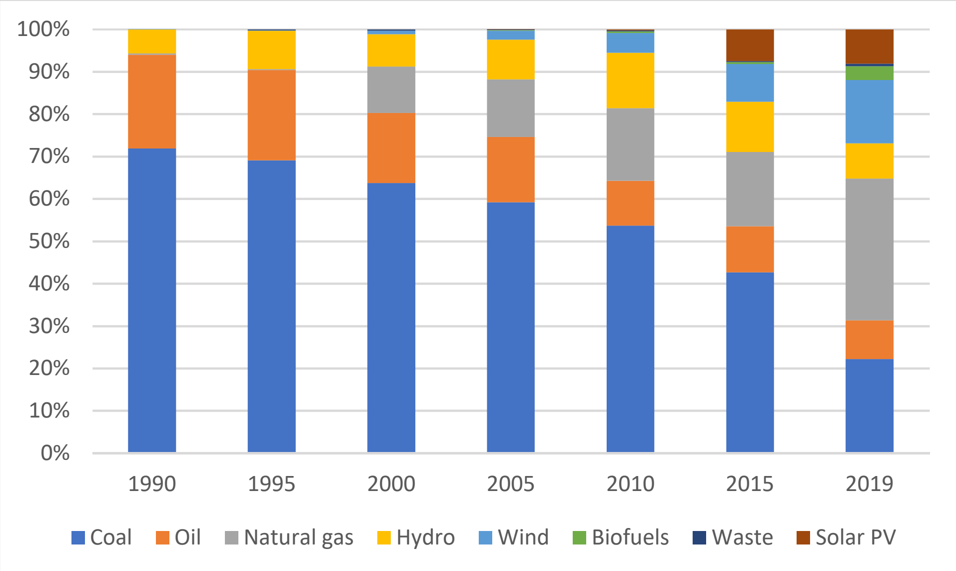


Figure 35: Electricity Production in Greece by Source 1990-2018 (Ktoe) (Data Source: IEA Greece)

However, renewable energy investments are failing to accelerate the uptake of renewables in electricity generation. Within the four-year period between 2019 and 2014, the renewable capacity increase in Greece was 3,000MW. In the following 4-year period, from 2014 to 2018, the renewable capacity investment remained at 1,000MW, whereby the installed renewable generation capacity in Greece reached 5,800 MW. The slowing rate of renewable investments is attributed to the economic crisis and the changes in the support and incentive mechanisms in effect since 2015.

The Regulatory Authority for Energy (RAE) is the energy regulatory authority in Greece. RAE was established in 1999, with the aim of monitoring the operation of all sectors and participants of the energy market, of providing regulative advice to the government, and of contributing to the liberalisation of the electricity market and the natural gas market, by adopting relevant regulatory measures. Following the Third European Energy Package, in 2009, the role of RAE became more significant, with financial and administrative autonomy along with the authority to make binding decisions pertaining to the regulations, to the proper functioning of the electricity market and the natural gas market.

The Monitoring and surveillance of energy market

RAE is responsible for monitoring and supervising the energy market in terms of effective competition, prices, distortions or restrictions on competition, and compatibility of terms in contracts, and compliance with the special regulatory obligations. RAE also monitors the level of transparency in prices and energy-related activities.

Other responsibilities of RAE involve consumer protection (according to Energy Law 400/2011), monitoring Greece's energy security of supply, considering the current and future supply, demand and system capacity, licensing, monitoring of Independent Transmission System Operators, approval of tariffs for non-competitive activities, granting exemption from third party access obligations, monitoring access to energy interconnections, and regulatory measures for the effective functioning of energy markets (RAE Website).

In Greece, the earlier Day-Ahead Scheduling Transaction System (DAS) and the Mandatory Pool model was replaced through Law 4425/2016 with the separate electricity markets. These are the Day-Ahead Market, the Intraday Market, the Balancing Market and Electricity Financial Market. Participants in the Day-Ahead Market and Intraday Market are required to realize physical delivery within the next day, called the Physical Delivery Day. Hellenic Energy Exchange S.A. collaborates with the ADMIE S.A. as the TSO (transmission system operator) to operate these markets. The legislations for these markets are defined by the Energy Exchange Regulations. Within the Day-Ahead Market, purchase or sale offers are submitted on the day before the Physical Delivery Day. For the Intra-Day Market, offers are submitted on the Physical Delivery Day. In this way, participants can adjust their positions due to forecasting errors or changes in demand and supply (RAE Electricity; RAE Day Ahead Market; RAE Intraday Market; EnEx Website).

The Balancing Market is composed of the Balancing Capacity Market, the Balancing Energy Market as well as the Deviation Clearing process. For the Balancing Energy Market and the Balancing Capacity Market, the participants submitting bids are required to perform physical delivery. The Balancing Market is operated by ADMIE, following the Balancing Market Regulation. ADMIE is also responsible for the physical balancing of the National Transmission Electricity System.

The deviation clearing processes in the Day-Ahead Market, Intraday Market, Balancing Capacity Market and the Balancing Energy Market are performed by the Energy Exchange Clearing Company S.A., established by Hellenic Energy Exchange S.A., based on Markets, Article 117C of Law 4001/2011.

By the decision of the RAE, the Day-Ahead, Intraday and Balancing Markets started operation as of 1st November 2020 (https://www.rae.gr/wholesale-market/?lang=en). Prior to this change in the electricity market structure, Greece was the only country in Europe not to have switched to the European 'target model' (NewEurope, 2020).

The Forward Market in Greece also became operational as of 2020, following the approval by the Hellenic Capital Market Commission. The Forward Market serves as a tool for mitigating price volatility risks. The Forward Market is operated by HENEX S.A. Within the Forward Market, future contracts of electricity can be traded, based on specified time, quantity, and price for the transaction. The transaction can be performed either Over-The-Counter (by the participants bilaterally), or through the Forward Market (the Energy Exchange). Clearing processes of the Forward Market are carried out by ATHEXClear, which is a subsidiary of Hellenic Stock Exchange Group (RAE Forward Market).

As another step in the direction of integrating Greece's wholesale market with the EU market by means of the target model, the day-ahead markets of Italy and Greece were joined in December 2020. The next step is the uniting of the day-ahead markets of Greece and Bulgaria, planned for the end of May 2021 (Serbia Energy, 2021).

Recently, in March 2021, the European Commission has started an investigation concerning the Power Corporation (PPC) operating in the wholesale market of Greece's electricity sector. The subject of the investigation concerns the restriction of competition by the PPC's bidding behaviour in the wholesale market (EC Antitrust: PPC, 2021)

4.3.2 Legal and administrative Framework of Energy Communities under National Structure

4.3.2.1 National legal and administrative framework for the adoption of eCREW approach

As in other countries, the energy regulation in Greece was very conservative for most of the 20th century. The market activities were strictly ruled and governed by the state. People were forbidden to generate electricity for their own consumption. The liberalisation of Greek energy market followed the same path with that of EU (Vlados et al., 2021)

The first energy packet adopted by the Directive 1996/92/EC was introduced into the Greek legislation by the law 2773/1999. The law established an independent administrative authority - Regulatory Authority for Energy (RAE) –

and created two subdivisions within the electricity market, as “production” and “distribution”. The second energy packet of the Directive 2003/54/EC was introduced by the amendment 3426/2005. Besides unbundling the Distribution Network Operator, the law also gave customers freedom to choose their own suppliers (İliadu, 2009). Following this amendment, the law 3468/2006 was enacted a year later in order to promote the generation of electricity from renewables. The law established a guaranteed tariff in order to support the generation from renewables and the right for generators to enter into the contract with grid operators. Another important aspect of the law was the introduction of the concept of net metering system for autonomous generators. The amendment made on the law, by Law 4203/2013 permitted the installation of Renewable Energy Sources (RES) stations and storage systems of the energy produced by self-generators to cover their own needs.

The law requires an authorization from the Ministry of Development for the generation of electricity using renewable energy sources (RES). The affirmative opinion of the RAE should also be acquired prior to such an authorization, the criteria for which are set forth clearly in the law. Article 4 of the law regulates the exemptions from the obligation of being granted a production authorization (as amended by the law 4513/2018 and 4643/2019). Natural persons or legal entities producing electricity under the following categories of RES or Combined Heat and Power High Performance stations (CHP) installations are exempt from the obligation to obtain a power production licence:

- geothermal stations with an installed capacity of less than or equal to half (0,5) MW
- biomass, biogas and biofuels stations with an installed capacity of less than or equal to one (1) MW
- photovoltaic or solar thermal stations with an installed capacity of less than or equal to one (1) MWp
- wind farms with an installed capacity of less than or equal to one hundred (100) kW
- CHP stations with an installed capacity of less than or equal to one (1) MWe
- RES or CHP stations with an installed capacity of up to five (5) MWe, installed by public or private educational or research organizations for as long as these stations operate exclusively for educational or research purposes, as well as stations installed by the Centre for Renewable Energy Sources and Saving (CRES), for as long as these stations operate for certifications or measurements
- autonomous RES or CHP stations not connected to the System or Grid, with an installed capacity of less than or equal to five (5) MWe, with no possibility to modify their autonomous operation
- Small Hydroelectric Power Plants with installed electrical power less than or equal to half (0.5) MW installed in water supply or irrigation or sewerage networks.
- other stations with installed electric power less than or equal to fifty (50) kW, if these stations use RES.

The acceptance of Greek law 4001/2011 that regulates electricity and natural gas markets allowed the import of the legal framework created by the third energy packet of the Directive 2009/72/EC and 2009/73/EC. This is still the main legislation of Greece’s electricity market.

The law 4001/2011 requires a license for the generation of electricity from all sources. It also exempts some generation activities from the obligation of obtaining a license. According to article 132, the following are exempted from the obligation to hold a production license:

- power plants up to 20 KW;
- backup power stations, regardless of their power, which operate only in the event of a power outage due to failure or limitations of the System or the Grid. If these plants operate for purposes other than those specified, a production license is required,
- power plants up to 2MW installed by educational or research bodies for educational or experimental purposes only;
- stations installed by the Centre for Renewable Energy Sources (RES) for reasons of certification or measurements and for as long as measurements are carried out or certification is carried out; and
- persons, in the installations or units of which electricity is produced by non-conventional methods and as a consequence of exercising their main activity, other than the production of electricity.

Another important aspect of this law is the introduction of the concept of the “intelligent measurement systems”. This actually refers to the smart metering system within the e-CREW approach. Article 59 of the law states that, besides being more efficient and economical in operation, the intelligent measurement system that should replace the old existing system will contribute to the active participation of consumers in the energy market.

The law 4001/2011 is followed by three important legal developments: The first was the passing of the law 4425/2016 on the reorganisation of the Greek wholesale electricity market to make it comply with the European Target Model (Serbia Energy, 2017); the second was the acceptance of the law 4512/2018, which established Hellenic Energy Exchange S.A. to transform the Greek energy market from being Day-Ahead Market into Intra-Day Market (Gli Energy 2021 Greece). The third, and by far the most important development for the e-CREW approach, is the law 4513/2018 that introduces the concept of “energy communities” into the Greek legislation. The law was accepted on January 23, 2018, approximately a year before the EU legislation (Directive 2018/2001) on the subject. The explanatory report of the law states that the proposed bill took into account the proposal of EU Directive (Douvitsa, 2018). Therefore, one may conclude that Greece is a forerunner within the EU to import the concept of energy community into its own legislation. Prior to that, cooperatives (known by the legal community to have the authority to be an actor in the energy market in most countries) were not allowed to generate electricity. According to the Article 1 of the Law, Energy Communities are civil cooperatives with an exclusive purpose of promoting the social economy, solidarity and innovation in the energy sector to reduce energy poverty and to promote energy sustainability, production, storage, self-consumption, distribution and supply of energy, to enhance energy self-sufficiency and security in island municipalities, to improve end-use energy efficiency and promote the rational use of energy and sustainable transport.

In Greece, there are two subdivisions of cooperatives (Douvitsa, 2018). The first is civil cooperatives, defined and regulated under the law 1667/1986, and the second is agricultural cooperatives, regulated by Law 4384/2016. The energy cooperatives fall under the branch of civil cooperatives (Art. 7 of the Law 4513/2018). Natural and legal persons are allowed to be a member of the ECs. Legal entities under public law outside the local self-government organizations (OTA) of first (municipalities, communities) and second tier (prefectural self-governments) (OECD, 1997) are also allowed to be a member in ECs.

The minimum number of members an EC can hold is also regulated in the Law according to their qualities. Article 2 of the Law states that EC cannot hold less than:

- Five (5) members, if the members are legal entities under public law outside the Local Authorities. or legal persons under private law or natural persons,
- three (3) members, if the members are legal entities of public or private law or natural persons, of which at least two (2) are Local Authorities,
- two (2) members, if the members are only OTA first tier island areas with a population of less than three thousand one hundred (3,100) inhabitants according to the latest census.

Regardless of the size of the community, at least fifty percent plus one of the members must be located near the headquarters of EC. One member's share cannot exceed more than 20% of the cooperative's total capital. OTA's however, can hold as much as 50% of the total share.

The activities an EC can carry specified as follows:

- Production, storage, self-consumption or sale of energy,
- management, such as the collection, transport, treatment, storage or disposal of raw materials for the production of energy
- supply for members of energy products, appliances and installations, with the aim of reducing energy consumption and improving energy efficiency;
- supply for members of electric vehicles, and vehicles using alternative fuels in general;
- distribution of electricity within the Region where it is located;
- development of network, management and exploitation of alternative fuel infrastructures,
- installation and operation of water desalination units using RES.

The ECs, apart from the one stated above, have the authority:

- to raise funds for the realization of investments for the exploitation of RES or CHP or interventions for the improvement of energy efficiency;
- to prepare of studies for the utilization of RES or CHP;
- to implement energy efficiency improvement interventions or provision of technical support to members in the above areas;
- To manage or participate in programs funded by national or European Union resources;
- to advise on the management or participation of its members in programs funded by national or European Union resources;
- to inform, to educate and to raise awareness at local and regional level on energy sustainability issues;
- to take actions to tackle energy poverty for vulnerable consumers or citizens below the poverty threshold, regardless of whether they are members of the energy community.

The ECs can also form a federation to coordinate and promote their activities (Art. 10). The federation, however, does not hold the power to act as a separate EC, or generate, sell and/or use the other powers? given to the ECs. The financial incentives system of Greek government shall also cover the ECs.

The new amendments on each law stated above were enacted as required during this time frame.

The final stage of liberalisation and free competition of European Energy Market came with the introduction of the Directive 2019/943/EU and 2019/944/EU. Greece was one of the first countries in Europe to adopt the regulative change. The law 4643/2019 was enacted in the same year with European legislation. It contains provisions on liberalization of the energy market as well as modernization on administrative authority.

4.3.2.2 Data flow in eCREW under National Electricity Regulatory Framework (Data flow, Data from smart meter, processing of data from third parties)

Energy efficiency has been an important subject of the EU since 2002 Barcelona European Council. The Presidency Conclusion of the Council clearly states that the Council "agrees on the need for the European Union to show substantial progress in enhancing energy efficiency by 2010". Energy saving, which is an essential part of efficiency, is also seen as important, and many legislative and policy actions were taken. As stated above, the concept of net metering system for self-generators was introduced in Greece with the Law 3468/2006, a few years after the Barcelona European Council.

Technological developments afterwards allowed the production of a new generation of measurement devices that can precisely measure electricity consumption. These are called "smart metering systems". Greece has updated its legislation accordingly.

The first step was the adoption of Directive 2006/32 / EC of the European Parliament and of the Council of 5 April 2006 "on energy efficiency in end-use and energy services". This was made into Law 3855/2010. The aim of the regulation was to improve energy efficiency in end-use energy and to develop the energy services market. To achieve this goal, the regulation stated that:

- National energy-saving targets should be set; the necessary institutional and legal framework should be established; the appropriate financial means, incentives to achieve these targets should be provided, and the necessary energy efficiency mechanisms to remove market barriers and imperfections should be provided.
- The necessary conditions should be created for the development and promotion of the energy services market and other measures to improve energy efficiency to the final consumer.

The Law set a 6% yearly energy saving target by the end of 2016, to be achieved by the help of energy services and energy efficiency improvement measures. The law required the measurements to be started by January 2008.

The law 4001/2011 introduced the concept of the "intelligent measurement systems". This actually refers to the smart metering system within the e-CREW approach. Article 59 of the law states that, besides being more efficient and economical in operation, the intelligent measurement system that should replace the old existing system will contribute to the active participation of consumers in the energy market. The motive behind the application of intelligent measurement systems was to raise the energy efficiency and the active participation of consumers. This was followed by the law 4203/2013, which allows net metering for PV systems (Tselepsis, 2015).

The law 4342/2015, which transposed the Directive 2012/27/EU on energy efficiency, also included important regulations towards smart measurements. Energy distributors and energy retailers were obliged to install smart meters to provide real time information on actual energy consumption when replacing an existing meter or in times of radical renovation of the buildings, and for new connections to new buildings. The energy distributors, distribution network operators and energy retailers should:

- ensure that metering systems provide end-users with actual time-of-use information and meet the minimum operating requirements laid down in the applicable technical regulations for such systems;
- ensure the security of smart meters and data exchanges, as well as the privacy of final consumers, in accordance with existing data protection and privacy legislation;
- in the case of electricity, at the request of the final consumer, ensure that the meters can take into account the electricity supplied to the grid by the final consumer's premises;
- ensure that, if the final consumers so request, the metering data for their production or consumption of electricity are made available to themselves or to third parties acting on behalf of the final consumer, in an easily understandable form which they can use to compare similar offers,
- provide appropriate advice and information to consumers at the time of installation of smart meters, in particular on all their possibilities regarding the use of meter readings and the monitoring of energy consumption.

Ministerial Decrees also play an important role in the regulation of net metering and data flow. The Decree 24461 of 30 December 2014 constituted a net metering system for self-production from PV. The consumers gained the right to generate electricity with PV for their own consumption and to share any surplus generation on the electricity grid for future consumption. The law 4416/2016 extended these net metering systems on PV to other generation systems, such as wind and biogas systems. The Ministerial Decree 175067 of 19 April 2017 was issued to specify and detail provisions of this law.

The regulation of energy communities with the law 4513/2018 required a new Decree to extend the previous provisions on net metering and data sharing to ECs. This was made by the Ministerial Decree 15084/382 of 10 September 2019. The Decree includes articles about Net metering for self-producers and virtual net metering for ECs, legal entities of public or private law, pursuing public or other public interest purposes of general or local scope and those registered in the Register of Farmers and Agricultural Holdings (PV, small wind turbines, biogas, bioliquids, CHP, small hydro).

All this data guarantees the legal infrastructure for the collection of data for the smartphone application, to be created within the scope of the e-CREW approach.

4.3.2.3 Progress concerning the adoption and/or transposition of relevant EU directives to national legislation

It is seen that Greece acts in conformity complying with the EU Directives in the subject of REC/CEC.

Greece historically was one of the first countries to adopt EU regulations into the national legislation in terms of energy packets.

The first energy packet adopted by the Directive 1996/92/EC was introduced into the Greek legislation by the law 2773/1999. The second energy packet of the Directive 2003/54/EC was introduced by the amendment of Law 3426/2005. The third energy packet of Directive 2009/72/EC and 2009/73/EC was imported into the Greek legislation by Law 4001/2011. The energy communities were defined and allowed to operate in the energy market with the Law 4513/2018, accepted in January 2018, prior to the approval of the Directive 2018/2001. The definition of energy communities as “urban cooperatives with an exclusive purpose of promoting the social economy, solidarity and innovation in the energy sector to reduce energy poverty and to promote energy sustainability, production, storage, self-consumption, distribution and supply of energy, to enhance energy self-sufficiency, security in island municipalities, to improve end-use energy efficiency, the rational use of energy and sustainable transport” is in conformity with “EU acquis Communautaire”. The explanatory report of the law states that the proposed bill (of law 4513/2018) took into account the proposal of EU Directive. Thus, the conformity is not a legal coincidence, but actually shows the Greek government’s will to adopt the concept of energy communities to fight with energy poverty, to improve energy efficiency, and to create solidarity. Finally, the regulations of the fourth energy packet of the Directive 2019/943/EU and 2019/944/EU was also adopted by the Greek law 4643/2019 in the same year as the Directive.

Though Greek legislative body has adopted the whole energy EU packet, it decided on a single definition of energy communities and did not differentiate between “citizen energy communities” and “renewable energy communities”. But, as energy communities are able to operate in all of the energy market, including generation and related activities from renewable energy sources, the Greek definition might be found in conformity with both Directives 2018/2001/EU and 2019/944 of the European Union on this issue.

The regulation in paragraph 71 of the preface of 2018/2001/EU Renewable Energy Communities Directive 2018 states that “renewable energy communities should be autonomous from individual members and other traditional market actors” in order to ensure broad participation and to prevent abuse. Greek legislation defined the energy community as a civil cooperative. A civil cooperative is a separate legal body autonomous from its members under the Greek law 1667/1986. That means that, Greek energy communities are in conformity with EU legislation in this manner as well.

The subjects of net metering and smart metering, which are integral parts of CEC/RECs and e-CREW approach, were also focused on during these legal developments. The acceptance of 4001/2011 is a cornerstone on this subject. The law introduced the concept of “intelligent measurement systems” in Greek energy market. The law is followed by parallel legal instruments on virtual net metering in the last decade. The Ministerial Decree 15084/382 extended the application of regulations on virtual net metering and data sharing to ECs.

The National Energy and Climate Plan of Greece for 2021 – 2030 highlights and puts forward the political understanding about RECs / CECs for the near future. The plan states that innovative technologies and the emergence of start-ups will be important aspects of the next decade and new institutions — such as energy communities, etc. — and smart grids will play a major role. The plan emphasizes the relation between consumers’ involvement in the energy sector and net metering, stating “they will contribute both to the implementation of RES and energy saving investments and to the more active participation of the local community”. The plan assigns an important role to energy communities for an increase in RES projects. It, thus, suggests a support mechanism by the use of licensing and operational incentives. The “support for the deployment of RES energy projects by energy communities also through the use of specialised financing tools” is set as a main policy measure in the Plan. The processing of data is another important aspect of the Plan. To reach the goal of properly functioning and competitive domestic energy markets and to enable energy efficiency the use of digital technology is essential. The digital technology however does not provide the required result by itself unless the data collected is processed accordingly. The secure handling of consumer data, therefore, seems important. The use of smart grids is also set as a main policy measure.

All these legal and political documents show that adoption of EU Directives is in progress in Greece, and one might expect new legal and administrative instruments for this purpose in upcoming years.

4.3.2.4 4.3.2.4 Progress concerning of adoption Internal Electricity Market Directive (EU) 2019/944

4.3.2.5 4.3.2.5 Progress concerning adoption of Energy Efficiency Directive (EED 2019) 2018/2002/EU

Greece's adoption of the EU directives into national legislation has been considered as prompt and timely compared to the earlier examples, this is true for the EU Directive 2019/944; Greece adopted the directive in the same year, through national law 4643/2019. However, there are differences of interpretation and articulation between the EU Directive and Greece's national legislation. For instance, the Greek law treats citizen energy communities and renewable energy communities under the general topic of energy communities. This may bring about flexibility in the implementation of energy communities, but may as well pose complications, especially when restrictions or privileges regarding one of these types of initiatives are targeted.

The process of adoption of Directive 2019/944 is still ongoing in terms of supporting national legislation and the administrative structure.

Regarding the adoption of the Directive 2018/2012 of the EU, Greece adopted the national law 4342/2015 for transposing the initial version of the Directive, which is the 2012 energy efficiency directive (Directive 2012/27/EU). Following the amendment of this directive in 2018 as part of the Clean Energy for All Europeans Package, Greece updated the targets in its NCEP in terms of renewables, energy efficiency, and electric mobility (EC, 2020).

4.3.3 Differences between national implementation and EU Directives with regard to the concepts of the Renewable Energy Community (RED II) and Citizen Energy Community (ED 2019)

The only possible way to establish an energy community in Greece is in the form of cooperation. Citizens are able to join or form a cooperative that will allow them to be a part of the energy market as a community. As known, the cooperatives are the most common form of a legal body that can operate as REC/CEC in Europe. They are, however, not the only legal bodies to be counted as REC/CEC. The lack of alternative legal institutions for citizens to play a role in the energy market as a community is the main difference between national implementation and EU Directives.

Another difference is a single definition in Greek law towards the RECs and CECs. As known, RECs and CECs are similar, but regulated by different European legislation, namely Directives 2018/2001/EU and 2019/944. Although the Greek legislative body, inspired by the proposal of EU Directive (2018/2201/EU), made a definition of energy communities in the Law 4513/2018, this definition did not limit the activities of the community to renewable energy. This made the definition of energy communities in Greek law conform not only to the concept of REC under the Directives 2018/2001/EU but also to the concept of CEC under the Directive 2019/944.

As a result, one can conclude that, in the future, Greece may develop its energy communities legislation to allow citizens to be a part of other legal bodies other than cooperatives. The National Energy and Climate Plan of Greece for 2021 – 2030, however, makes no reference to the subject.

4.3.4 Adaptability of the eCREW approach

4.3.4.1 4.3.4.1 Interaction between legal and administrative framework (with reference to the eCrew approach)

As expressed previously, Greece rapidly adopted all energy packets accepted by the EU, including the regulation on energy communities. As of 2018, people are free to establish or to join cooperatives that will operate in the electricity market. The cooperatives are regulated by the Law 1667/1986. A cooperative is legally defined as a voluntary association of persons with a financial purpose, aiming in particular the cooperation of its members in the economic, social, cultural development and the improvement of their quality of life in general. Energy Communities are civil cooperatives with an exclusive purpose of promoting the social economy, solidarity and innovation in the energy sector. This definition matches the definition of REC and CEC. It is a fact that Greek legislation limits citizens' collective involvement in the energy market to a single legal body: the cooperative, with no sign of effort to create or extend alternative models. Cooperatives, however, are the most common legal bodies accepted as RECs and CECs in Europe. The Greek legislation, therefore, permits the adaptability of the eCREW approach to this extent.

Smart metering regulations and data flow, another important foundation stone of eCREW approach, have been developed since 2011. The responsible party for the implementation of necessary regulations and the access to metering data is the distribution service operator, namely Hellenic Electricity Distribution Network Operator (HEDNO), under the Law 4001/2011. The supply, installation, maintenance, proper operation and replacement of metering devices are all considered as the main duties of HEDNO. Art. 128 of the law requires the creation of "network management code" for HEDNO. The specifications of the meters, the process of installation and control of the meters and the management of the measurements, the ownership of the meter data and the related responsibilities, the rules of data provision and data exchange regarding the measurements and the winding are all to be determined by the network management code. Hellenic Electricity Distribution Network Code was approved by the Decision 395/2016 of RAE. The protection of personal data and confidentiality are set as principles on data sharing.

The Ministerial Decree 15084/382 of 10 September 2019 regulates net metering for self-producers and virtual net metering for ECs. In the National Energy and Climate Plan of Greece for 2021 – 2030 the relation between consumers' involvement in the energy sector and net metering are emphasized: "they will contribute both to the implementation of RES and energy saving investments and to the more active participation of the local community". The Plan also puts emphasis on smart metering, smart grids and data processing, stating that innovative technologies will play an important role in the next decade. It set the policy measures accordingly.

One can conclude that the Greek legislation allows the adaptability of eCREW approach in this manner as well.

4.3.4.2 4.3.4.2 Adaptability of eCREW as business model for energy retailer and energy communities (Foundation, Participants, energy retailer)

Adaptability of the eCREW as a business model relies on the possibility of establishing energy communities as commercial entities. Energy communities are defined in Greece's national legislation by Law 4513/2018. The definition of energy communities in the legislation highlights production, sustainability, and self-consumption, but also includes energy supply and distribution. According to the legislation, energy communities may include individuals, local authorities as well as public entities and legal persons under private law. The criterion for locality needs to be satisfied, meaning that majority (at least 51%) of the energy community members must be connected to the location of the energy community headquarters. For individuals, the locality criterion translates into owning or having the usage rights of a property, or being a citizen of the municipality in the location of the energy community. For legal entities, this means the requirement for the headquarters to be in the location of the energy community.

The support framework for energy communities covers production, supply, and distribution of electricity produced from renewable sources or from combined heat and power. Although the main aim of the legislation is to foster individuals' and local governments' participation in local energy initiatives, commercial initiatives may also benefit from new provisions, such as enabling the separation of the locations of production and consumption through virtual metering and power sharing investments. Figure 36 below demonstrates the steps for establishing an energy community in Greece.

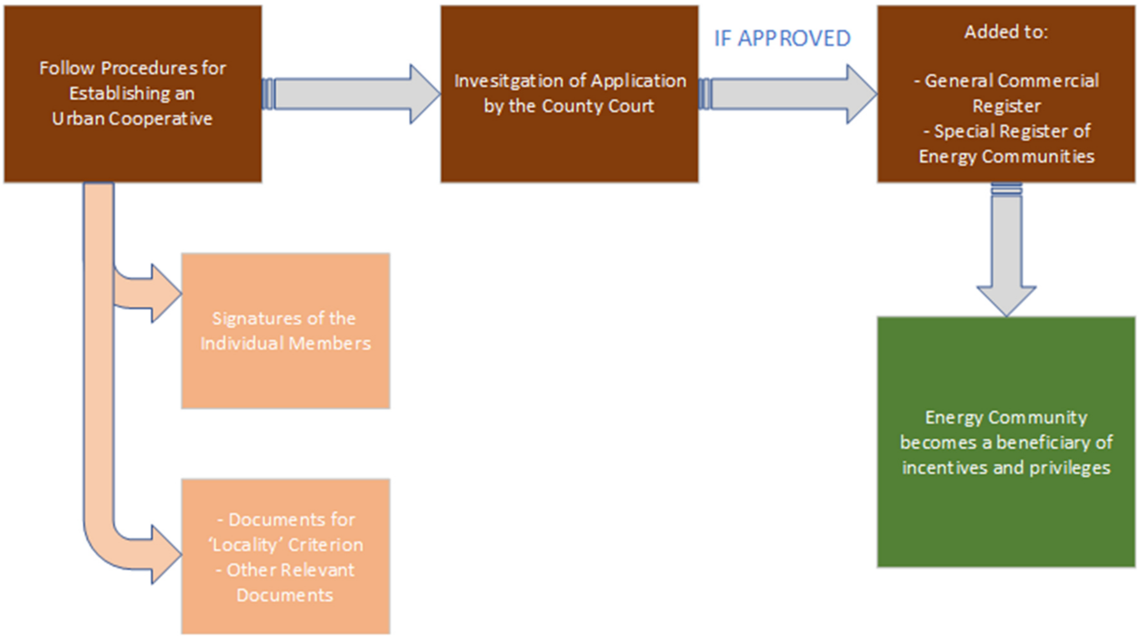


Figure 36: Steps for Establishing an Energy Community in Greece (Source: Tsekeris, 2018)

Activities of an energy community can include supplying electricity to the final customers, provided that they are located in the same region as the headquarters, demand management for reducing electricity use, activities related with charging stations for electric vehicles, and providing energy services. Energy communities can also utilize external funds for investments in their areas of operation. These activities allow for developing business models for energy retailers, energy services companies (ESCOs), and energy communities (Interreg Infopack, 2019).

4.3.5 4.3.5 Perspective from a Community and Citizen point of view

Perspectives from the community and citizens were elaborated using the results of the ECHOES international survey. The survey carried out during the H2020 project ECHOES was mainly aimed at providing community and citizen perspectives in Greece (ECHOES Cordis Website). The survey aimed at providing insights into individuals' energy choices within the context of the energy transition process. The survey's geographical coverage was 31 countries (EU 28 including the United Kingdom, with Norway, Switzerland and Turkey). Of the total 18,000 participants in 31 countries, 604 were from Greece. This online survey contained 114 questions.

4.3.5.1 4.3.5.1 Community perspective (Utilization the results of ECHOES survey)

Regarding energy communities, respondents were asked about their willingness to participate in a renewable energy investment; among the respondents from Greece, 68.5% showed interest. 47% stated that their pro-environmental behaviours are positively affected by behaviours of their communities. This tendency supports the ideas behind RECs and CECs, and is strongly observed, with 67.5% of the respondents believing that people in their community can act together for energy transition.

The share of respondents who perceive themselves as the citizens of Greece is only 42.6%, suggesting that the preceding results are attributable to community attachment rather than citizenship. However, the respondents' perspectives on the society and their communities are also not very positive. 82.3% believe that the world's temperature is rising, and 93.9% believe that human activities are at least equally responsible as other factors for the temperature rise, and 67.7% believe that the global temperature rise is mainly a result of human activities.

Moreover, 68.9% of the respondents from Greece state that they are angry about those in their community who do not save energy.

The perspectives of the respondents on their communities are not entirely negative. 54% believe that people in their communities support pro-energy transition policies and 54.9% observe that a growing number of people in their communities are making efforts to save energy, and 52.7% of the respondents state that an increasing number of people in their communities are adopting energy savings behaviour for heating and cooling.

Considering the community support regarding individuals' energy-related behaviours, only 38.9% expect that their community would support them if they favoured pro-energy transition policies, and a higher 40.4% is undecided on this issue. A considerably higher 57.8% feel certain that they would receive such support if they used less energy, and for using less energy, with 51.7% expecting support from their communities if they decreased their energy consumption for heating and cooling. These findings suggest that, compared to their own? behaviours, individuals expect much less support from their communities regarding policies pointing to the negative perception associated with energy-related policies.

This is also reflected in the behaviours including companies, such as grid operators. Only 28.4% of the respondents expect support from their communities if they allowed their grid operator to remotely turn on/off non-critical appliances for demand management.

4.3.5.2 4.3.5.2 Current status of communities in terms of energy-related endeavours

The concept of energy communities was acknowledged by the Clean Energy Package of the European Commission in 2018. Renewable Energy Directive (EU) 2018/2001 was transposed into Greece's national regulation by Law 4513 in 2018, where energy communities were defined. The concept of energy communities paves the way for the establishment of local community initiatives, and for individuals to play active roles in these initiatives. Following the Clean Energy Package, energy communities were established in Greece, as in all EU countries. According to a recent study, as of December 2020, there are around 400 energy communities in Greece. The majority of these are based on the mainland, with fewer than 10 in the islands. Most of the energy communities in Greece are focused on solar PV, with smaller shares for wind power generation and biomass.

The most common reason for joining energy initiatives in Greece is the economic benefits, followed by a desire to contribute to the energy transition, and creation of new jobs. Contribution to energy transition or increasing the deployment of renewables is not only targeted through establishing more renewable capacity, but also through increasing awareness, providing education, and promoting energy self-sufficiency. Around 100 community energy initiatives have also started providing support for vulnerable energy consumers.

On the financial assets side, most of the energy communities in Greece have low cooperative capital. Only around 15 of the 400 energy communities have capitals larger than €100,000, another 140 have between €10,000 and €100,000, whereas the remaining 250 have below €10,000.

Since all the energy communities were established after 2018, most have not yet started producing energy. The energy communities that have started operating mainly target commercial marketing of the produced energy, rather than the self-consumption of their members.

The members of the energy communities point out to the problems of insufficient communication among the members, and the level of communication diminishing after the launch of the initiative. One other challenge faced is not being able to set up and follow an appropriate financial plan.

The introduction of energy communities in the legislative framework is very recent, posing issues with the gradual evolution of the institutional and administrative frameworks. The current and expected changes bring about uncertainties regarding energy communities. For instance, the expected benefits from common virtual net metering continue to be affected by uncertainties (Mapping of Energy Communities in Greece, 2020; Rescoop Energy Communties).

4.3.6 4.3.6 Citizen perspective (Utilization the results of ECHOES survey)

The ECHOES international survey provides significant evidence for the citizens' perspectives regarding RECs and CECs.

Among the respondents from Greece, 57% believe that renewables benefit the environment. It is also worthwhile noting that 29.3% are yet undecided about the issue. Regarding the support of citizens in this respect, 71% of respondents state that they intend to use renewable energy to support energy transition, and 26% are undecided. 70.5% of the respondents believe that deployment of renewables will create new jobs, and 29.1% are undecided.

A significant 82.3% of the respondents believe that global warming is in progress, which suggests that they would favour the adoption of pro-environmental behaviour. Regarding whether this perception converts into actual behaviour, a smaller 76.7% of respondents state that acting pro-environmentally is an important part of their lives. 75.1% state that they feel obliged to be energy efficient, and

77% feel obliged to be energy efficient, with a higher 80.2% stating that they feel obliged to adopt energy savings behaviour regarding household heating and cooling.

However, the policy support of citizens in Greece is rather low. Only 51% of the respondents report that they would support pro-environmental energy policies, even if these policies result in higher costs.

4.3.6.1 4.3.6.1 An overview of energy behaviours of citizens

Energy behaviours of citizens are mostly reflected by their lifestyles and lifestyle choices. The ECHOES international survey provides insights to the lifestyles and choices in Greece.

A majority of the respondents from Greece (58.7%) live in apartment blocks. 32.3% live in single-family homes. Regarding the floor areas for the dwellings, 29.4% are smaller than 70 square feet, with 18.4% between 50 and 70 square feet. Another 26% of the respondents live in dwellings between 71 and 90 square feet. 23% live in larger dwellings of 91 to 110 square feet. The remaining 21% live in dwellings larger than 110 square feet, and 10.8% among these in dwellings larger than 130 square feet.

In Greece, 53.6% of the respondents use domestic central heating, and 19% use district heating. 15.6% use one or more standalone electric heaters, and 10.3% use one or more standalone stoves for heating their homes. Regarding primary fuel for heating, 44% of the respondents use oil, 23.2% use electricity, 18.7% use gas, and 9.3% use wood.

Comfort temperature preferences of individuals significantly affect the energy consumption behaviours. 44.9% of the respondents state that their comfort temperatures are about the average of the other people, 23.5%, that they have slightly cooler comfort temperatures, and 13.9%, slightly warmer comfort temperatures.

76% of the respondents in Greece state that they use air conditioners during the summer. 23.3% use them often, and 22.5%, regularly. 31.6% use their home air conditioners rarely or almost never during summer.

36.5% of respondents state that they always or often disconnect electric appliances when not in use, and 43.2%, rarely or never.

93.6% of the respondents use energy-saving light bulbs at home, and 75.6% have 75% or more energy-saving light bulbs.

49.5% of the respondents are not certain whether they purchase their electricity from a provider with a particularly high share of renewable energy production. 24% confirm that their electricity provider has a particularly high share of renewable energy production, and the remaining 26.5% confirm that theirs do not.

Driving habits, usage patterns of public transportation, and perceptions on public transportation and also significant use of public transportation are also important indicators of energy behaviours. Out of the respondents from Greece, 85.9% state that they drive cars, and 19.4% drive less than 5,000km in year, 23% drive between 5,000 and 10,000km annually, 18.2% between 10,000 and 15,000km, 8.1% between 15,000 and 20,000km, 5.6% between and 25,000km, and 5.7% more than 25,000km per year. 64.9% drive alone in the car at least 50% of the time, 15% almost always drive alone, whereas 61.6% drive alone more than 50% of the time, and 41% drive alone very often.

87.6% of the cars are petrol or diesel fuelled, with another 8.5% running on gas (LPG or CNG). Only 3.3% are either hybrid-electric, plug-in hybrid, or fully electric.

92.1% of the respondents have never experienced car-sharing. 39.1% are strictly against car-sharing, have not tried, and are not interested. 53% have not tried but find the idea interesting. 7.3% have tried and liked it. This corresponds to more than 90% of the respondents that have tried car-sharing. The remaining 0.7% have tried car-sharing and not liked it.

Only 10.1% of the respondents believe that the public transportation system in their area is environmentally friendly, whereas 29.6% are undecided. Usage rate of public transportation is not very high. 44.1% of the respondents rarely use public transportation, 24% use it for 1-4 trips per week, 13.7% for 5-8 trips, 7.7% for 9-12 trips, and 10.6% for more than 12 trips per week.

Air travel habits relate to carbon footprints and hence energy-related behaviour. 62.3% of the respondents report taking private-purpose (non-business) air journeys within the previous year. The total annual flight time for these trips is generally 10 hours or less (49% out of 62.3%).

4.3.7 4.3.7 Interim conclusion

In parallel with the European countries, the demographics of Greece point to an ageing population, increased life expectancy, and increasing age dependency ratios. This outlook points to potential challenges to the CEC and REC initiatives, which are recent concepts, and need support from the dynamic and young population.

Greece performs almost in pace with the OECD average in terms of upper secondary and tertiary education levels. Moreover, the shares of individuals with upper secondary and tertiary education are increasing. This trend is promising because individuals with higher education levels are expected to have higher awareness levels and more positive approaches in terms of energy-related endeavours.

Energy initiatives are mostly initially assessed in terms of their economic burdens. The employment rates in Greece are considerably lower and the unemployment rates are considerably higher as compared to OECD and EU-27 averages. In this sense, these rates are likely to pose barriers against the implementations of CECs and RECs.

The evidence from the energy profile of Greece also provides information pertaining to the deployment of RECs and CECs. Despite the fluctuations, the total energy supply and the total energy consumption of Greece changed little between 1990 and 2018. Oil preserves its share of 50% in supply, the decrease in the share of coal has been accounted for by the increase in the share of natural gas. Hence, fossil fuels have a share of 86.5% in the energy supply of Greece. The deployment of renewables is rather recent, with a total share of 5.9% in 2018. On the positive side, electricity generation from renewables has increased from almost zero in 1990 to 23% in 2018. These shares are not on the desired levels, but are promising for the future. Increase in CECs and RECs is also expected to support the deployment of renewables.

Greece's energy market is the last in Europe to adopt the European 'target model'. The new market structure became operational only in November 2020. Following this, the integration of the wholesale market with the wholesale market of Italy was realized in December 2020, and the integration with the wholesale market of Bulgaria is expected to be completed by the end of May 2021. Although the restructuring has lagged behind other European countries, the deregulation and liberalisation of the energy market in Greece is promising in terms of establishing the environment and the administrative setup for renewable energy generation. In this direction, the energy sector authority RAE has been empowered to manage the relevant processes.

Greece has proven to be prompt in the transformation of the EU regulation into national legislations. The national regulation for energy communities has been in operation since 2018. However, uncertainties and changing regulations are negatively affecting individuals in terms of RECs and CECs.

Although the legislation regarding energy communities is very recent and has been in operation since 2018, there are more than 400 energy communities in Greece as of the end of 2020. A very limited number of these energy communities have started operation and energy production. Individuals report that they participate in energy communities mainly for the expected economic benefits. Most of the energy communities face challenges with operating capitals, financial planning, and communications.

The perceptions and behaviours of citizens and communities significantly impact CEC and REC adoption. To this end, the international survey of the ECHOES project provides valuable insights.

According to the ECHOES survey, the proportion of respondents from Greece who believe in the positive impacts of renewables on the environment is only 57%, a low share as compared to many other countries. 29% of the respondents are undecided about the benefit of renewables to the environment; these relatively high rates reveal the importance of awareness raising and education campaigns regarding environmental issues and energy transition. 71% of the respondents from Greece claim that they intend to use energy in a way to support energy transition. However, this intention is not reflected in terms of action, according to the responses.

A level of around 76% is seen in terms of respondents taking pro-environmental behaviour as an important part of their lives and feeling obliged to be energy efficient.

Results of the ECHOES survey also shows that, for the respondents in Greece, community attachment is important in terms of pro-environmental behaviour and support for community energy initiatives.

In contrast to their own behaviour, the respondents are not satisfied with their communities in terms of energy-related behaviour. The low support for energy policies is also likely to be an important factor.

4.4 Italy

4.4.1 Country Profile

4.4.1.1 Demographics

Italy's population density doubles the EU average, and almost half of the population is concentrated in the North (Table 25).

Table 25 – Population by macroarea, 2019

Macroarea	Surface (km²)	Surface (%)	Population	Population (%)	Density
North	123.664	40,9	27.746.113	46,0	224,4
Center	75.227	24,9	12.016.009	19,9	159,7
South & Islands	103.180	34,2	20.597.424	34,1	199,6
ITALY	302.072	100,0	60.359.546	100,0	199,8
EU27	4.233.262	-	447.706.209		105,8

Although the average income is in line with the rest of the EU, this statistical effect hides enormous differences among regions and macro areas (Eurostat, 2019a). People in the 'richest' region (Lombardia, 25.400€) account for an average income more than double (+218%) than the 'poorest' region (Calabria, 11.300€). See Figure 36 for details.

Macroarea	Average income (€)
North	23501
Center	20168
South & Islands	12895
ITALY	19218
EU27	19300

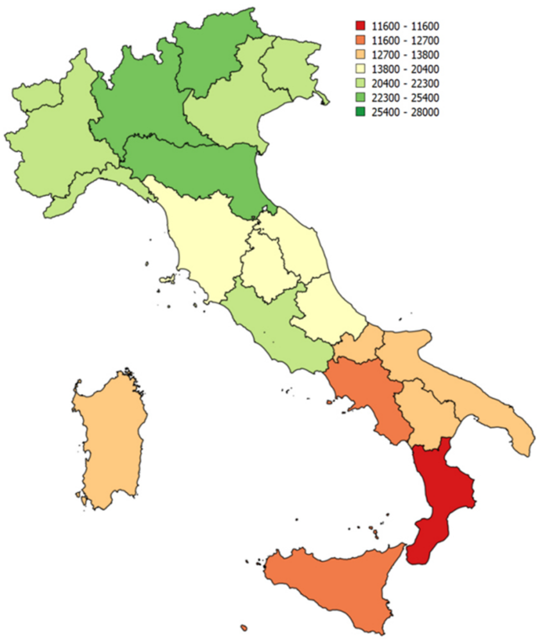


Figure 37: Households income by macro area and region, 2019

Source: Eurostat. 2017

Excluding the outliers, a dramatic educational gap is shown by the overall gap between the averages of Italy and the EU27for primary and tertiary education (respectively 37.8% vs 21.6% and 19.6% vs 31.6%).

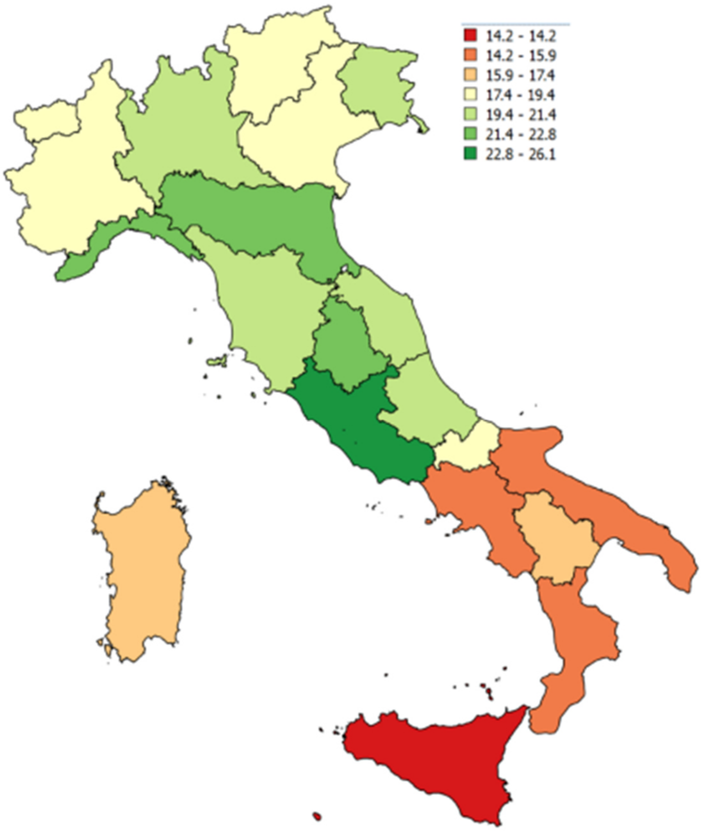


Figure 38: Tertiary education attainment by region (age 25-64), 2019

Source: Eurostat, 2019b

The situation of the labour market, and the territorial gap is illustrated by the decreasing employment rate moving away from the industrial North towards the agricultural south. The territorial gap is made even wider by the gender gap, with an employment rate for males in the north (75%) that is more than double (i.e., 2.3 times) that of women in the south (33%) (see Figure 39).

Macroarea	Employment rate		
	Total	Males	Females
North	67,7	74,9	60,3
Center	63,3	70,4	56,3
South & Islands	44,6	56,2	33,1
ITALY	58,8	67,5	50,0

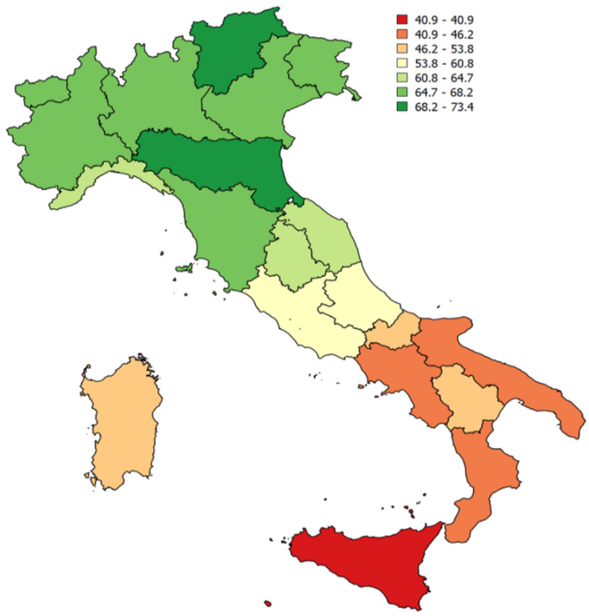
EU27	67,6	72,7	62,4	

Figure 39: Employment rate by macroarea and region (age 15-64), 2019

Source: Eurostat, 2019c

The North is home to half of the country's enterprises, and almost 60% of its entire workforce (3 times more employees than in the Southern region, which accounts for 23.4% of the entire population). When it comes to the most strategic economic sectors for the innovation and competitiveness of the socio-economic system, there are even wider regional gaps, in particular, for manufacturing (ISTAT, 2018).

4.4.1.2 Energy profile (production, supply, consumption etc.)

In this section, firstly, data are reported about the Italian energy balance and its evolution over the past 6 years (from 2014 to 2019), before focusing on electricity production and consumption.

Table 26 reports the Italian energy balance in 2014 and 2019. Between 2014 and 2019, the Gross Available Energy increased from 165.97 to 169.08 (+ 1.9%) and the energy mix has evolved with a noticeable increase of the share of gas from 30.5% to 36.1%. Small decreases characterized the consumption of electricity (from 5.8% to 4.97%) and solid fuels (from 8.25% to 3.91%), while consumption of oil (from 34.51% to 34.19%) and renewables (from 20.89% to 20.86%) remained stable.

National production decreased from 44.58 Mtoe to 42.59 Mtoe (-4.46%), with important share decreases in solid (-34.3%), gases (-32.25%) and oil (-25.82%), and a slight share increase in renewables (+ 4.6%). Net Imports have slightly increased from 121.28 Mtoe to 126.94 Mtoe (+4.7%), rising from 73.07% in 2014 to 75.07% in 2019 of the Gross Available Energy, a proxy of the overseas dependence of the national energy system. This increase is particularly relevant for gases (+ 27.4%), while oil imports have remained relatively stable (+ 3.6%) and renewables showed an important decrease (-38.5%).

In terms of final consumption, the distribution among the final uses has remained stable, with a slight increase for transport and households (rising respectively from 31.8% to 32.1%, and from 36.3% to 37.7%), and a slight reduction of the industrial sector (from 23.3% to 21.4%).

Table 26 – Italian energy balance, 2014 – 2019 (MToe)

	2014						2019					
	solid	gases	Oil	renewables	electricity	total	solid	gases	oil	renewables	electricity	total
1.Production	0,35	5,86	5,77	32,61		44,58	0,23	3,97	4,28	34,11	0	42,59
2.Import	13,46	45,67	71,19	2,22	10,28	142,83	6,84	58,2	80,62	1,55	9,68	156,89
3.Export	0,24	0,19	20,31	0,14	0,67	21,55	0,23	0,27	27,9	0,27	1,28	29,95
4.Stocks	-0,12	0,62	-0,63	0,02		-0,11	0,23	0,92	-0,82	0,12	0	0,45
5. Gross Available energy (1+2-3-4)	13,69	50,71	57,27	34,67	9,62	165,97	6,61	60,99	57,81	35,27	8,4	169,08
6.Losses	-0,12	-1,68	-3,55	-0,01	-40,84	-46,2	-0,1	-1,97	-3,7	0	-37,52	-43,29
7.Transformation in Electricity	-10,65	-14,65	-2,34	-27,79	55,43		-4,26	-21,85	-1,63	-26,42	54,15	0
8. Available for final consumption (5+6+7)	2,93	34,39	51,38	6,87	24,21	119,7	2,25	37,18	52,48	8,85	25,03	125,7
- industry	2,85	11,87	3,98	0,03	9,2	27,93	2,2	12,44	2,92	0,11	9,23	26,9
- transport	-	0,86	35,33	1,03	0,9	38,12	-	0,96	37,16	1,28	1,02	40,42
- private households	0,00	21,02	2,94	5,8	13,65	43,42	0	22,99	2,7	7,42	14,28	47,39
- agricolture		0,12	2,13	0,01	0,46	2,72	0	0,14	2,21	0,04	0,49	2,89
- others	0,08	0,51	7,0	0	-	7,6	0,06	0,64	7,5	0	-	8,19

Source: Ministry of Economic Development (2020)

As for electricity, in 2019, the gross domestic production of electrical energy was equal to 289.9 TWh. For more than a decade, the production of the latter has represented the largest share of thermoelectric energy production, favoured over time also by the replacement of outdated oil conventional cycles with innovative natural gas combined cycles plants, Figure 40.

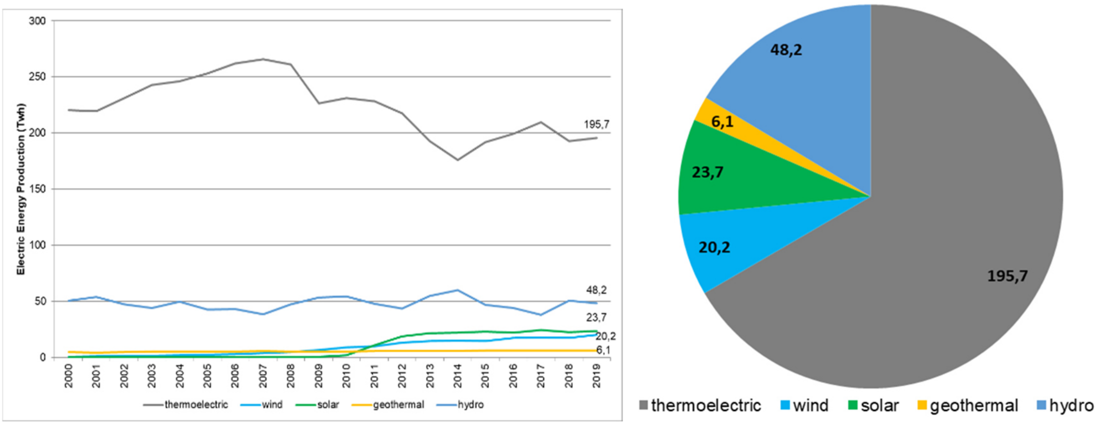


Figure 40: Electricity Production by sources: trend 2000-2019 (left) and the share in 2019 (right)

Source: TERNA, 2020

The demand for electricity in 2019 was 318.6 TWh (provisional data). In 2019, 88.0% of the electricity demand was met by domestic production, which equalled 280.4 TWh.

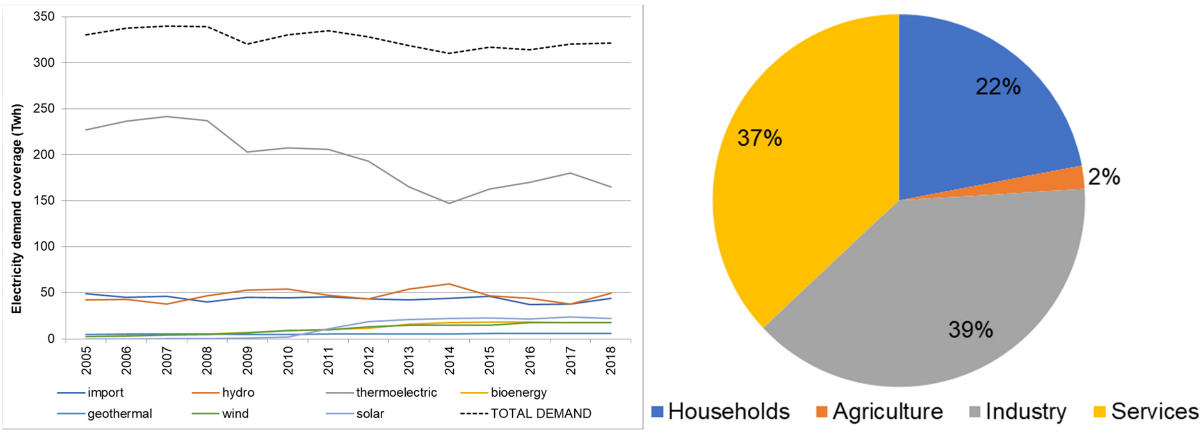


Figure 41: Electricity Demand coverage: trend 2005-2018 and consumption

4.4.1.3 Energy market and infrastructure

In terms of capacity, the gross generation power installed in Italy, as of 2020, was 119.3 million kW, of which 53.6% is generated by thermoelectric plants (64 GW), 19.2% by hydroelectric plants (23.0 GW), and finally, 27.2% by wind, photovoltaics and geothermal plants (around 32,4 GW). (MISE p. 19)

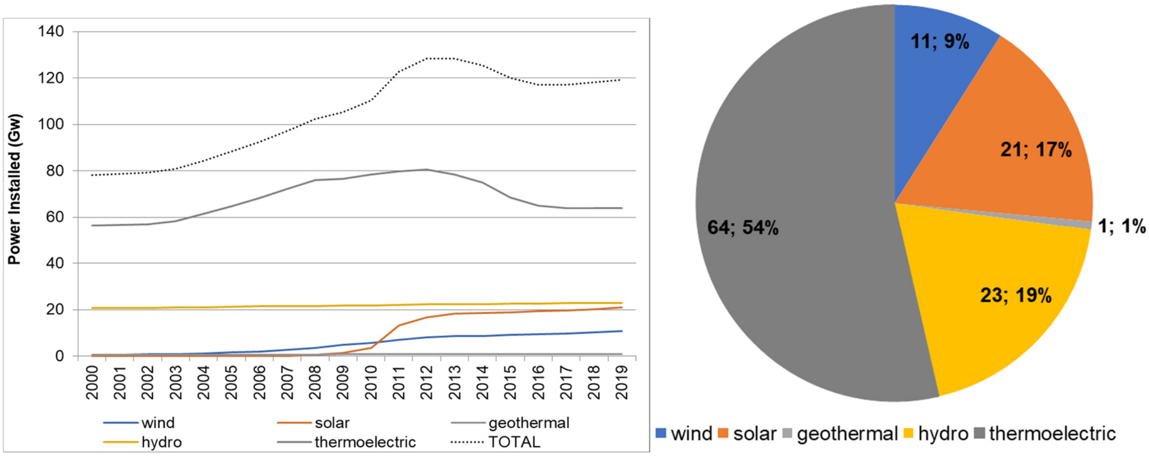


Figure 42: Power installed by technology: trend 2000-2019 (left) and the share at 2019 (right)

Source: TERNA, 2020

According to the Ministry of Economic Development (2019), the transmission grid in Italy in 2017 was composed of 861 stations for a total 66000 km of cables and lines.

The overload of the network in the north-west of the country is related to the lines that import energy from Switzerland and France and to the hydroelectric power plants in Liguria and Lombardy. In the North-East, this risk has been moderated by the construction of the new power line between Redipuglia and Udine.

As for central Italy, structural problems are evident in particular on the Adriatic Coast, a region that plays a crucial role for the transmission of power from the south. Recently, more capacity has been installed from conventional and renewable sources, and this development is at the centre of future policy in the energy field. The concentration of production from renewable sources in the areas of Avellino, Foggia and Benevento, and from traditional sources in Apulia and Calabria, show greater energy transference in the direction south – central southern region, predominantly on the Adriatic coast, and along the high-voltage lines extending northwards from Calabria.

In the south, the production from renewable sources is particularly relevant in the areas of Avellino, Benevento and Foggia while in Calabria and Puglia traditional sources are still the most relevant basis of the transference of energy along the direction south- central south with a crucial role played by high-voltage infrastructures that extend northwards from Calabria.

Transmission criticalities can be detected for Sardinia, caused by problems with the 150 Kv network in Gallura, and by the structural lack of plants able to guarantee more flexible services. In Sicily, also, the situation is critical due to the reduced transfer capacity between the west and east regions, and the inability to fully exploit the potential of the submarine connections with Calabria.

As for the distribution (264,000 GWh in 2016), Italian network is made up of 391,000 km of medium-voltage network (MV) and 865,000 km of low-voltage (LV) network, with 154 distributors, supplying more than 29 million domestic users and 7.4 million non-domestic users.

Likewise, 743,000 plants were connected to the distribution networks, including 731,000 PV, with a total of 30.6 GW and gross production of 62.9 TWh, including 78.2% RES, and an average self-consumption share of 22.4%.

As for the production of electricity from renewables plants, Table 27 shows an overview of the Italian endowment.

Table 27 – Renewables plant in Italy by macroarea, 2020

	Number of Plants									Power installed (MW)								
Values	bio gas	bio mass	wind	geo thermal	hydro	solar	waste	other	total	bio gas	bio mass	wind	geo thermal	hydro	solar	waste	other	total
North	1477	565	124	0	2903	431380	34	1177	437660	994	733	107	0	6173	8320	1021	3296	20643
Center	204	162	197	24	442	135485	10	224	136748	157	134	216	729	1082	3383	92	224	6017
South & Islands	240	105	4484	0	192	211433	11	94	216559	161	1708	9095	0	530	6716	82	479	18770
ITALY	1921	832	4805	24	3537	778298	55	1495	790967	1312	2575	9417	729	7785	18419	1195	3999	45431
IT %	0,24	0,11	0,61	0,00	0,45	98,40	0,01	0,19	100	2,9	5,7	20,7	1,6	17,1	40,5	2,6	8,8	100
%	bio gas	bio mass	wind	geo thermal	hydro	solar	waste	other	total	bio gas	biomass	wind	geo thermal	hydro	solar	waste	other	total
North	77	68	3	0	82	55	62	79	55	76	28	1	0	79	45	85	82	45
Center	11	19	4	100	12	17	18	15	17	12	5	2	100	14	18	8	6	13
South & Islands	12	13	93	0	5	27	20	6	27	12	66	97	0	7	36	7	12	41
ITALIA	100									100								

(Source: GSE, 2020)

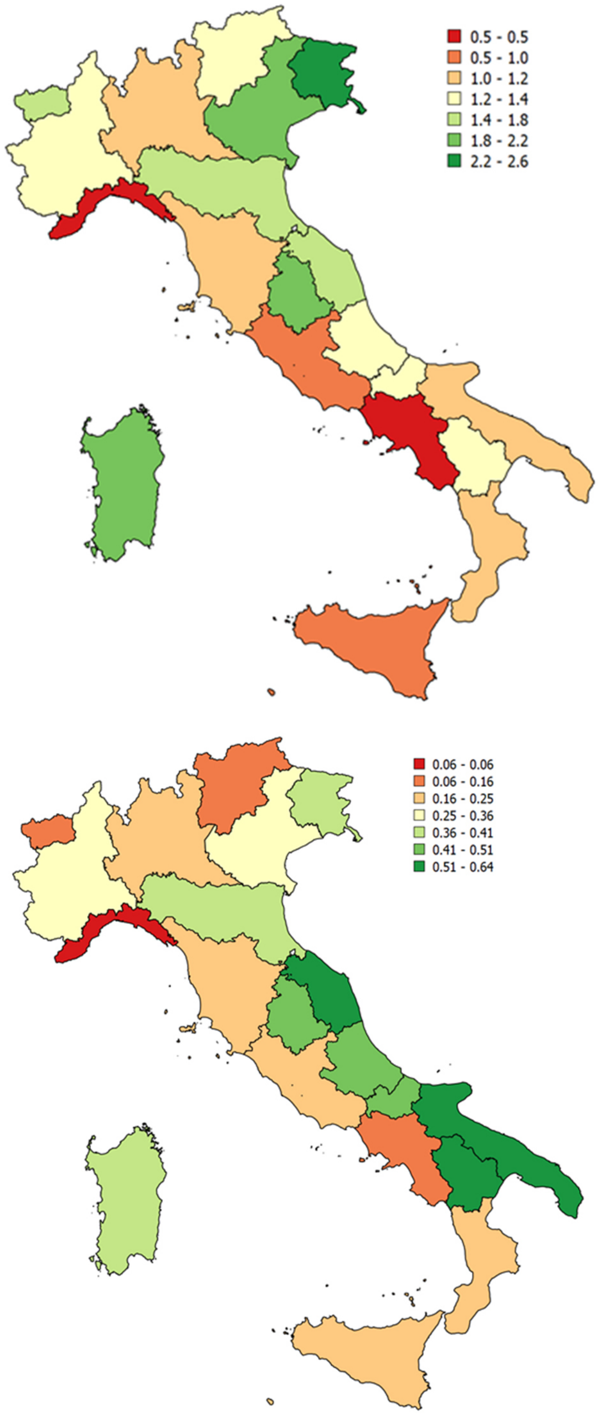


Figure 43: Regional distribution of PV plants: number of plants per 100 inhabitants (left) and Power installed (Kw per capita), right.

Source: Agrillo et al., 2019; GSE, 2020

In 2017, 9,600 km of national natural gas network and 22,900 km of regional natural gas network was in operation. Natural gas is distributed by a total of 261,000 km of network, 57.5% at low pressure, 41.8% at medium pressure and 0.67% at high pressure, 21% of which is owned by the municipalities.

According to ARERA, there are 21.7 million domestic users, 219,000 landlords, 97,000 public service activities and 1.5 million other uses with a total consumption of 31.8 billion m3. Total net consumption was 75.2 billion m3 (Ministry of Economic Development, 2019).

4.4.2 Legal and administrative Framework of Energy Communities under National Structure

4.4.2.1 National legal and administrative framework for the adoption of eCREW approach

The matter of renewable energy is governed by Legislative Decree n. 28/2011, which establishes the objectives and purposes of the energy policy. This decree also provides for the administrative paths for the issue of permits to produce renewable energy, and it establishes certain economic incentives.

The Italian regulatory framework provides for the involvement of various public authorities in accordance with the principles of subsidiarity and adequacy.

The Ministry of Economic Development (MISE) is tasked with implementing the Italian National Energy Strategy (SEN), a ten–year plan drawn up by the Italian government to anticipate and manage the shift in the national energy system.

On 21 January 2020, the Ministry of Economic Development announced the submission of the final version of the Integrated National Energy and Climate Plan (NCEP) for the years 2021-2030 to the European Commission. The Plan was drafted by the Ministry of Economic Development in accordance with the Ministry of Environment and Protection of the Territory and Sea (MATTM) and the Ministry of Infrastructure and Transport (MIT).

The most important objectives of the Italian NCEP (Chamber of Deputy, 2020b) are:

- a 30% percentage of renewable energy sources in the Final Gross Consumption of energy, in accordance with the objectives established for Italy by the European Commission;
- a 22% share of renewable energy sources in the Final Gross Consumption of energy in transports, compared to the 14% established by the European Commission;
- a 43% reduction of primary energy consumption compared to the PRIMES 2007 scenario;
- a 33% reduction of “greenhouse gases” by comparison to 2005, for all the non-ETS (buildings, transport, agriculture and industry) sectors.

Moreover, within the framework of a low-carbon economy, the NCEP proposes carbon “phase out” in electric generation by around 2025.

In addition to the NECP, the Legislative Decree n. 47 of 9 June 2020, in accordance with the delegation contained in art. 23 of the European Delegation Law 2018, the Law n. 117/2019, transposed into national law the Directive EU 2018/410, which establishes the functioning of the European Emissions Trading System during the phase IV of the System (2012-2030).

The following Legislative Decree, n. 48 of 10 June 2020, also adopted in accordance with the delegation contained in Law n. 117/2019, was transposed into national law the Directive 2018/844 regarding the energy performance of buildings.

Lastly, the Legislative Decree n. 73 of 14 July 2020, in accordance with the delegation contained in Law n. 117/2019, transposed the Directive EU 2018/2002 regarding energy-efficiency.

Moreover, the Legislative Decree n. 102 of 14 July 2014 transposed into national law the former Directive concerning energy-efficiency, the Directive EU 2012/27, which was repealed by the Directive EU 2019/944.

The Legislative Decree n. 102/2014 points out that the national energy savings target consists in the reduction, before 2020, of primary energy consumption by 20 million tons of oil equivalent.

One of the most important provisions of the aforementioned Legislative Decree is provided in the art. 9, which is dedicated to “Metering and billing the energy consumption”, and establishes the mandatory measurement of energy on an individual basis must come across the whole national territory from 1 January 2017 onwards.

Beginning in 2009, there was a “significant rise in installed capacity of renewable energy was driven by the rapid growth of photovoltaic production. This was the result of the introduction in 2005 of a very generous feed-in tariff (FiT) scheme, together with a net-metering system, for solar electricity (called Conto energia)”(Brondi et al. 2014).

This ended in June 2013, nevertheless a remaining quota of plants admitted to the fifth FiT scheme was installed from July 2013 to 2016. With Conto Energia, annual installations rose from 6.5 MW (0.0065 GW) in 2006 to 3.64 GW in 2012, with a compound annual growth rate (CAGR) of 120%. This continued market placement was accompanied by a noteworthy discount in PV system prices, especially from 2008 onwards (Politecnico di Milano, 2014).

Unsurprisingly, most Italian energy communities developed between 2008 and 2013, when FiT were implemented to support deployment and cost reduction of photovoltaic systems. The strong policy support, combined with remarkable reductions in costs of photovoltaic modules and installation since 2010, has increased the profitability and reduced the risks of photovoltaic investments in the wider context of the Italian energy sector. The reduction of FiT support in 2013 resulted in a shrinking of the Italian PV market from 3.5 GW/year of installed PV between 2008 and 2013, to 385 MW/year between 2013 and 2018, with corresponding declines in the Italian CE sector (Candelise and Ruggieri, 2020).

4.4.2.2 Data flow in eCREW under National Electricity Regulatory Framework (Data flow, Data from smart meter, processing of data from third parties)

Italy was the first European country to introduce electric smart meters on a large scale for low voltage end customers, and is still the world leader in the number of electric energy smart meters in service (over 35 million). According to a recent report by the European Commission, with the replacement of traditional meters beginning in 2001, the Italian smart metering system became the most efficient in Europe (European Commission, 2014).

The first phase dates back to the early 2000s and is marked by spontaneous initiatives undertaken by economic operators in the sector (ENEL, ACEA and A2A – former ASM). At that time, there were no binding rules, but only operational guidelines for economic operators.

Resolution no. 292/2006 of ARERA opens the second phase, in which the first regulation appeared. . In particular, the installation of electronic meters was required for all distribution companies. This obligation was to be fulfilled between 2008 to 2011.

In the meantime, Resolution no. 11/07 of ARERA introduced the unbundling obligations between distribution companies, which also perform the measurement, and sales companies in the electricity sector.The Legislative Decree of 1 June 2011, n. 93, directives 2009/72/EC, 2009/73/ EC and 2008/92/EC led to implementation of common rules for the internal market in electricity and natural gas. This provision governs the use of intelligent metering systems.

The art. 1 of the Decree Law 23 December 2013, n. 145, converted with Law 21 February 2014, n. 9, has entrusted to ARERA the adoption of a discipline for the promotion of the installation of these meters by the economic operators and for the implementation of the transparency of the data in favor of the final consumers.

The matter was then reformed as a whole by the Legislative Decree 4 July 2014, n. 102, which led to the Directive 2012/27/EU on energy efficiency. Article 2 defines smart metering systems as those capable of measuring energy consumption by providing more information than a conventional device, and of transmitting and receiving data using a form of electronic communication. Moreover, article 9 attributes to ARERA the power to prepare technical specifications of intelligent metering systems, to which the distribution companies as operators of metering activities are required to comply, so that the smart metering systems provide end customers with precise information on billing, based on actual consumption and time bands of energy use. Finally, article 16 provides for a system of sanctions. In fact, if the economic operator provides intelligent metering systems that do not comply with the technical specifications, ARERA can apply a pecuniary administrative sanction.

This detailed regulation was adopted by ARERA with Resolution July 16, 2019 306/2019/R/eel. The text was updated with resolution 105/2021/R/eel and it is still in force.

4.4.2.3 Progress concerning the adoption and/or transposition of relevant EU directives to national legislation

There is an experimental and transitory regulation addressing? the complete transposition of Articles 21 and 22 of the Directive EU 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources. Notably, the Italian legislator adopted Article 42-bis of Legislative Decree December 30, 2019, n. 162, introduced with Law February 28, 2020, n. 8, that allows small-scale collective self-consumption of renewable energy plants below 200 kW for customers linked to the same low voltage distribution sub-grid. The current definition by Italian regulatory context is the same as Renewable Energy Community introduced by Directive EU 2018/2001.

The aforementioned Article 42-bis defines the methods and conditions for activating collective self-consumption from renewable sources, and for the creation of renewable energy communities. In addition, some regions adopted a specific regulation on the subject. For instance, Piedmont adopted the L.R. August 3, 2018, n. 12 in order to promote the establishment of energy communities.

4.4.2.4 Progress concerning of adoption Internal Electricity Market Directive (EU) 2019/944

To date, the Directive EU 2019/944 has not yet been implemented by the Italian legislator.

Therefore, the Italian Parliament has set up the procedure for the transposal of the REM Directive at the beginning of 2020.The Draft Law of European Delegation for the years 2019-2020 was recently approved by the Senate Chamber, on 29 October 2020, and has been under examination by the Chamber of Deputies since 11 November 2020.

The Draft Law contains the delegation to the Government for the implementation of the Directives EU 2018/2001, 2019/944 and 2019/943. In particular, Article 12 of the Draft Law provides for principles and guiding criteria for the implementation of the Directive EU 2019/944.

According to the version approved by the Senate Chamber (Draft Law n. 1721), the Government is required to:

- define the discipline regarding the Citizen Energy Community;
- update and simplify the legislative framework concerning the final self-consumption and the distribution systems;
- define the legislative framework for the development and the diffusion of storage systems;
- establish harmonized and simplified authorization procedures for the construction and the exercise of energy build-ups;
- define the mechanisms for long-term market solutions in order to provide stability to investments;

- define a single discipline for energy communities, collective self-consumption, energy build-ups and forecast the beginning of experimentation for a gradual shift to a self-dispatching system designed to promote a more active role of the operators;
- update and reorganize the legislative framework of the measures designed for the protection of vulnerable customers and those suffering of energy poverty;
- reorganize the discipline regarding the national transmission network development plan and coordinate it with the authorization procedures;
- introduce administrative pecuniary sanctions in case of non-respect of the obligations under the Directive EU 2019/944 by the electricity companies.

4.4.2.5 Progress concerning adoption of Energy Efficiency Directive (EED 2019) 2018/2002/EU

Article 1, paragraph 1, of law no. 117/2019 delegated the Government to adopt the legislative decrees for the implementation of the directives listed in Annex A, among which the 2018/2002 directive is mentioned, referred to in n. 25.

4.4.3 Differences between national implementation and EU Directives with regard to the concepts of the Renewable Energy Community (RED II) and Citizen Energy Community (ED 2019)

The directive 2019/944 on Citizen Energy Communities has yet to be implemented, making it impossible to compare this concept with Renewable Energy Communities within the Italian legal system.

4.4.4 Adaptability of the eCREW approach

In principle, the eCrew approach would appear to be compatible with the Italian law as it provides for the involvement of energy operators already in possession of authorization.

It is clear that the integration of these concepts in the positive system entails a distortion of the classical paradigm, initially centered on monopolistic positions. Following the liberalization of the sector, influenced by European law, the system was opened to competition from economic operators, in any case subject to dense public regulation, especially with regard to the methods of distribution and dispatching of the energy produced.

4.4.4.1 Interaction between legal and administrative framework (with reference to the eCrew approach)

It is uncertain whether the Italian Government, through the decrees issued mainly by the Ministry of Economic Development, will be able to put into effect the content of the three aforementioned Directives.

In order to verify whether the new regulatory framework will be compatible with the eCREW approach, it must be remembered that a major barrier is the extensive reorganization that these measures will require; in particular, it will be necessary to extensively revise the legislation concerning the production, transmission, distribution and sale of electricity.

Furthermore, as explained below, the implementation of all these measures will necessarily imply the availability of economic resources.

4.4.4.2 Adaptability of eCREW as business model for energy retailer and energy communities (Foundation, Participants, energy retailer)

Pending the definitive transposition of the Renewable Energy Directive 2018/2001/EU and Revised Energy Market Directive 2019/944 the actual legal and administrative framework could be changed.

However, recent legislative regulation appears to be suitable for the implementation of eCREW approach. In fact, as argued in the previous chapter, some local entities (such as municipalities, cooperatives, associations) have started to create and develop successful energy communities in Italy. For example, on 12 March 2021, the Municipality of Magliano Alpi, which adopted the approach of energy collective self-consumption, inaugurated the first Italian Energy Community based on the aforementioned art. 42-bis of Legislative Decree n. 162/2019. In this way a public local entity, the Malignano Alpi Municipality, became a market actor in the energy sector.

The current situation regarding the number of energy communities, as well as citizens communities, is not particularly relevant because the potential interested actors, such as energy retailers, cooperatives and municipalities, have yet to be given a definitive and clearer regulatory framework. In this direction, the Integrated National Energy and Climate Plan of Italy underlines the importance of "*citizens and businesses (in particular SMEs), in such a way that they become key players and beneficiaries of the energy transition and not just the financiers of active policies*".

Italy possesses all necessary legal, administrative and technological requirements to successfully implement eCREW approach; in particular, as explained within the All. A to the Resolution 306/2019/R/EEL – Text coordinated with additions and amendments made by the Resolution 105/2021/R/eel adopted by ARERA, since 2015, Italy has adopted second-generation smart metering. Compared to the first generation ones, these have the following benefits: increased reading efficiency, making validated measurements available to vendors within 24 hours, delivering real-time data to customer, and allowing the meter to spontaneously forward messages to the system (i.e. interruption).

With regards to the accessibility and communication of data related to smart metering and smart distribution system AGCOM (Authority for Communication Guarantees), within *ad hoc* committee, has conducted an analysis on data communication technologies in smart metering systems, which considers the role of stakeholders, the most frequently-used business models, and the regulatory, performance and functional requirements.

4.4.5 Perspective from a Community and Citizen point of view

The survey carried out during the H2020 project ECHOES was mainly aimed at providing perspectives on the community and citizens in Italy (ECHOES Cordis Website). The survey aimed at providing insights into individuals' energy choices within the context of the energy transition process. The survey's geographical coverage was 31 countries (EU 28 including the United Kingdom, with Norway, Switzerland and Turkey). Of the total 18,000 participants in 31 countries, 602 were from Italy. This online survey contained 114 questions.

4.4.5.1 Community perspective (Utilization the results of ECHOES survey)

Among the respondents from Italy, 40% stated that they would be interested in participating in a renewable energy investment (Q17), and 48.5%, that their pro-environmental behaviours are positively affected by their communities' perspectives. This reflects an even stronger belief, held by 59.2%, that people can act together for energy transition. These results point to a significant potential for RECs and CECs. Only 37% of the respondents from Italy perceive themselves as citizens of the country they live in, therefore, the foregoing results suggest strong foundations for community attachment in terms of energy-related endeavours (Q35).

However, individuals' actual perception about how well the community is doing in terms of energy behaviours is rather negative. 35% believe that human activities are at least equally responsible as natural causes for global warming, and 58% believe that human activities are the main reasons (Q34). Given this, 71% of the respondents from Italy claim to feel anger that people in their community fail to save energy(Q28). The perspectives for the future are more promising; 49% believe that a growing number of people in their community's support policies in favour of energy transition (Q37), and 50% believe that a growing number of people in their communities will try to adopt energy-saving behaviours (Q38). However, regarding actual practice, only 37% of respondents observe that more people in their communities are adopting energy saving behaviour for heating and cooling (Q41).

Regarding the extent to which respondents expect their community to support their energy-related behaviours, 43%hope that they would receive social support if they opted for policies that favour energy transition (Q39). A more substantial 51% feel certain that they would receive such support for using less energy (Q36), with 51% stating that their community would support energy savings in heating and cooling (Q40).

For unconventional behaviours for energy savings, individuals expect a much lower level of support from their communities. For instance, only 35% of respondents expect support from their communities if they allow the grid operator to remotely turn on/off non-critical appliances (Q45).

4.4.5.2 Current status of communities in terms of energy-related endeavours

In Italy, self-consumption in 2019 amounted to 4,718 GWh, equal to 19.9% of the total production of photovoltaic systems and 38.6% of the production of only systems that self-consume. The highest level of self-consumption is registered in July, while the highest self-consumption rates are found in the winter months (Ministry of Economic Development, 2020). Table 28 shows the heterogeneity of self-consumption in Italy by region and macroarea. In absolute value, the highest self-consumption is in Lombardy and the lowest in the Aosta Valley, while the ratio between self-consumption and the net production of self-consuming plants was highest in the provinces of Trento and Bolzano, and is generally higher in Northern Italy.

Table 28 – Electricity self-consumption by macroarea and region, 2019 (GwH).

Macroarea	Gwh	Macroarea	Region	Gwh	Macroarea	Region	Gwh
North	2622,7	North	Piemonte	376,5	Center	Marche	190,8
Center	781,5	North	Valle d'Aosta	7,8	Center	Lazio	251,7
South & Islands	1313,7	North	Lombardia	785,6	S&I	Abruzzo	121,4
ITALY	4717,9	North	Trentino A.A.	161,3	S&I	Molise	19,4
		North	Veneto	584,3	S&I	Campania	235
		North	Friuli Venezia Giulia	141,9	S&I	Puglia	295,1
		North	Liguria	39,6	S&I	Basilicata	42,3
		North	Emilia Romagna	525,7	S&I	Calabria	124,4
		Center	Toscana	243,4	S&I	Sicilia	268,3
		Center	Umbria	95,6	S&I	Sardegna	207,8

Although all the households owning photovoltaic systems are self-consuming, the highest percentages of self-consumption are found in the tertiary and industrial sectors. Of the 23,689 GWh produced in Italy in 2019, 52% was generated by the industrial sector (which also includes photovoltaic power plants), 20% by the tertiary sector, 15% by the domestic sector and 13% by the agricultural sector. The industrial sector is characterized by the highest self-consumption (34% of the 4,718 GWh self-consumed in Italy in 2019), followed by the tertiary sector (30%), the domestic sector (26%) and the agricultural sector (10%) (Ministry of Economic Development, 2020).

Regarding the community endeavour projects in the energy fields, Magnani and Osti (2016) provided an extensive study about the involvement of civil society in the production and management of renewable energy that dates back to the first half of the 20th century, although limited to Trentino Alto Adige, a small region in the northern-east alps. The so-called "historic hydroelectric cooperatives" were established at that time in that area to support the social and economic development of the alpine region through the provision of electricity produced from hydroelectric plants. The regulatory framework favoured this process since the nationalization of the electricity grid allowed these cooperatives to retain ownership of the local grid. Today, thirty cooperatives still exist in this area and after decades of development they are now large organizations with thousands of customers. In addition to hydroelectric production, in this area can also be found many communities built upon the use of wood biomass for producing heat, that sometimes contribute to district heating systems. Behind the success of the community based model in this area (an exception in Italy), there is a long tradition of local cooperation taking advantage of a contingent regulatory framework, a combination of enabling factors that is not easily replicable elsewhere (Magnani and Osti, 2016).

In more recent years, Candelise and Ruggeri (2020) noticed that following a period of inaction, the CE sector in Italy encountered another wave of development around 2010 with the improvement of activities focused on people engagement in the energy field. Small local energy communities were the main actors of this development, mostly focused on production of electricity from PV plants below 100kW, while far there were fewer wider initiatives able to develop megawatt size plants. The pivotal leverage for this new wave was the Feed in Tariffs scheme, implemented in Italy in the first decade of 2000, which made investments in PV development at the same time profitable and low risk, thus paving the way for people to share ownership of small local projects. But the discontinuity of incentive mechanisms such as the Feed in Tariff and the reintroduction of more market-oriented and auction-based mechanisms reduced the potential of the sector scaling-up to the development of large plants or the replication of the smaller projects, and showed that new approaches were needed.

At present, in Italy there are around 35 Ecovillages (https://ecovillaggi.it/), around 60 Alpine Coops (a heritage of the historic hydroelectric cooperatives, see www.sev.bz.it) and around 20 2nd wave Energy communities described by Candelise and Ruggeri (2020), the most relevant of which are reported in Table 29.

Table 29 - Energy Communities in Italy, 2020

Initiatives	Start Date	Primary Activity	Technology	Geographical scope
Retenergie	2008	Electricity Production & Services	PV	National
Dosso Energia	2010	Electricity Production	PV	Local
Società LEDRO	2007	Electricity Production & Services	PV	Local

èNostra	2014	Electricity Supply		National
Melpignano	2011	Electricity Production & Services	PV	Local
Kennedy Energia	2013	Electricity Production	PV	Local
Sole per tutti	2011	Electricity Production	PV	Local
Comunità Energetica San Lazzaro	2011	Electricity Production	PV	Local
Comunità Solare Locale	2011	Electricity Production & Services	PV	Local
Un ettaro di cielo	2008	Electricity Production	PV	Local
Impianto Eolico Monte Mesa	2014	Electricity Production	Wind	Local
Energyland	2011	Electricity Production	PV	Local
Masseria del Sole	2013	Electricity Production	PV	National
Fattoria del Sole	2015	Electricity Production	PV	National
Fattorie del Salento 1	2017	Electricity Production	PV	National
Fattorie del Salento 2	2017	Electricity Production	PV	National
Energia Positiva	2016	Electricity Production	PV, wind, hydro, energy saving	National

Source: Candelise and Ruggeri (2020)

4.4.6 Citizen perspective (Utilization the results of ECHOES survey)

Important evidence from the ECHOES survey regarding attitudes towards RECs and CECs is that 71% of the respondents in Italy are positive about the environmental benefit of renewables (Q31). Also, 74% state that they intend to use renewable energy to support energy transition (Q63). Regarding economic benefits, 64% foresee that the use of renewables will create employment (Q32).

84.3% of the respondents believe that global warming is in progress, pointing to the urgency of adopting pro-environmental behaviour.

Looking at how far these perceptions result in actual behaviour change, 70% state that acting pro-environmentally is an important part of their lives (Q61). 72% feel obliged to be energy efficient (Q53), with a similar 74% reporting feeling obliged to adopt energy savings behaviour regarding household heating and cooling (Q55).

Regarding pro-environmental energy policies, 49% of respondents from Italy are in favour of such policies, even if the result is higher costs (Q64), while 59.2% of the respondent's state that they would support such policies even at the cost of some discomfort, i.e., a fall in their desired standard of living (Q65).

4.4.6.1 An overview of energy behaviours of citizens

In addition to the survey carried out by the ECHOES project, the analysis in this chapter incorporates data collected by the Eurobarometer. Indeed, the use of two datasets enables us to show how citizens behave in relation to environmental issues from two different perspectives.

In particular, the data extrapolated from the Eurobarometer survey are more focused on the general citizens' ideas, values and concerns in environmental matters.

As for the concerns about environmental issues (Eurobarometer, 2019c), Italians seem to be aware of the relevance, but slightly less concerned than other EU citizens. 94% of Italian respondents to the Special 501 declared that protecting the environment (QA1) is important, very important for 43% (Vs 53% of EU citizens) and fairly important for 51% (vs 41% of EU citizens). Regarding the most effective solutions for environmental problems (QA10), Italians seem to feel less confident in the role that citizens can directly play in driving changes (28% Vs EU 33% identify changing the way we consume as an option), while, in comparison with EU citizens, they are more dependent on public interventions in demanding more information, stricter legislation and related fines and stronger enforcement of legislation.

Regarding energy policy (Eurobarometer, 2019b), in line with EU citizens, Italians consider it mainly as a tool to shift from fossil fuels to renewables (QB1, the highest share among the available modalities with a 37% of respondents, in any case a smaller number than 41% of other EU citizens), but a substantial proportion consider it also as a way to contribute to economic growth and innovation (QB4, 34%, a share considerably higher than the EU 24%).

In terms of the prioritizing of energy issues by the EU (QB9), Italians are in line with the EU citizens identifying the development of clean energy technologies as the main driver (42% Vs EU 47%), followed by energy costs (34% vs EU 37%). Quite surprisingly, they are more in favour of better information to increase awareness in energy choices (providers, savings, etc.) (30% vs EU 26%).

Regarding energy consumption, if we take the knowledge about the energy efficiency EU label (A to G classes) as a proxy of awareness, Italians are less consumer-aware than the EU average (QB6). Only 67% of the Italian respondents declare that they understand labels and meanings (vs EU 79%) while 19% report understanding labels but ignoring meanings (vs EU 14%) and 13% (vs EU 7%) do not understand them. Surprisingly, and perhaps additional evidence of a relatively low level of awareness, the EU label seems to affect purchasing choices of Italians, 85% of whom (vs EU 79%) report taking into consideration the label when choosing electric appliances.

Finally, regarding Climate Change (Eurobarometer, 2019a) more than eight in ten of those surveyed in Italy consider climate change to be a 'very serious' problem (QB2, 84%, above the EU average of 79%). Almost one in five believe it is the single most serious problem facing the world (19%, under the EU average of 23%), an increase of 12 percentage points (pp) since the last survey in 2017. Just over half say that they have taken personal action to fight climate change in the past six months (QB5, 52% vs the EU average of 60%), a significant increase of 18 pp since 2017. The proportion increases to 88% (QB6, vs the EU average of 93%) when given specific examples of climate actions. An increased number of respondents take lower energy consumption into account when buying new household appliances (an increase of four pp since 2017 to 39%, though less than the EU average of 48%), and that regularly use environmentally-friendly alternatives to private cars (an increase of six pp to 19%, though this remains below the EU average of 37%). The proportion who agree that adapting to the adverse impacts of climate change can have positive outcomes for citizens is 62%, compared to the EU average of 70%. Those surveyed in Italy are more likely now than in 2017 to agree with the importance of their national government supporting improved energy efficiency by 2030 (up five pp to 91% vs the EU average of 89%). Most importantly, 92% of respondents (equal to the EU average) support the aim of a climate-neutral EU by 2050.

Different from the aspects highlighted by the Eurobarometer survey, ECHOES survey also collected some general information concerning respondents. The following reveals Italians citizens' living environment and feelings about a few very specific themes.

Lifestyles and lifestyle choices are significant drivers of energy behaviours. The ECHOES survey provides insights into respondents' lifestyles and choices in Italy.

Most respondents, 60%, live in apartment blocks. Another 24% live in single-family homes (Q94). Regarding the floor areas for the dwellings, 21% are smaller than 70 square feet, and 25% are between 71 to 90 square feet. 21% live in larger dwellings of 91 to 110 square feet, and 13%, of between 111 and 130 square feet. The remaining 16% live in households of 131 square feet or larger (Q95).

In Italy, 62% of respondents' use central heating for domestic heating, 16% use one or more standalone stoves, 11% use one or more stand alone electric heaters, and 6% use district heating (Q96).

Accordingly, 66% of the households use gas for heating, and 9% use electricity (Q97).

The amount of energy used for heating and cooling depends on individuals' comfort temperature preferences. 54% of the respondents state that their comfort temperatures are close to the average, 21% prefer slightly cooler temperatures, and 14% slightly warmer temperatures (Q98).

96% of respondents in Italy have domestic air conditioners; however, 55% stated that they rarely or almost never use these during hotter periods (Q99).

56% of respondents state that they always or often disconnect electric appliances when not in use (Q102).

97% use energy-saving light bulbs at home, and 79% have at least 75% energy-saving light bulbs (Q103).

Interestingly, 58% of the respondents say that they do not know if their electricity provider has a particularly high share of renewable energy production (Q104). 23% confirm that their provider has a particularly high share of renewable energy production, and the remaining 19% confirm that theirs do not.

Driving habits and use of public transportation are also important determinants of energy behaviours. In Italy, 93% of respondents state that they drive private cars. 25% drive less than 5,000km annually, 24% drive between 5,000 and 10,000km, 19%, between 10,000 and 15,000km, 14%, between 15,000 and 20,000km, and 7%, between 20,000 and 30,000km(Q75).

19% almost always drive alone, whereas 24% drive alone more than 50% of the time (Q76).

The great majority (81%) of vehicles are petrol or diesel fuelled. Only 2% are either hybrid-electric, plug-in hybrid, or fully electric (Q78).

84% of the respondents from Italy have never participated in car-sharing. Out of these, 44% never intend to try it, and the remaining 40% find the idea interesting. Most of the respondents who have tried car-sharing (13% of 2%) report positive experiences (13%) (Q91).

In terms of public transportation use, only 18% believe that public transportation in their living area to be environmentally friendly, 47% believe that it is not, and the remaining 36% are undecided (Q19). The usage rate of public transportation is not very high. 66% state that they rarely use public transportation (less than once per week on average), 16% use public transport 1-4 times per week, and 8%, 5-8 public times per week (Q20).

Air travel habits relate to carbon footprints and hence energy-related behaviour. 56% of the respondents report taking private-purpose (non-business) air journeys within the last year. The total annual flight time for these trips is generally 10 hours or less (32% out of 56%)(Q92).

4.4.7 Interim conclusion

Italy is a considerably heterogeneous country, therefore, to ensure eCREW success, the implementation strategy should take into account:

-age and education of population (eCREW is a high-tech project)

- income and energy consumption and use (eCREW requires awareness about energy)

- economic profile of the target area (as a proxy of technological readiness of the area)

For instance, implementation in Emilia Romagna, with its highly paid, well-educated employees in manufacturing, is different than in Calabria or Sicily.

Renewables have gained relevance in recent years, but Italy is still a fossil-based energy system with a strong dependence on gas imports, which, jointly with oil, feed the thermoelectric power production that continues to provide around 65% of the total power installed.

With respect to the institutional and regulatory landscape, it is worth highlighting that Italy is among the first countries in the EU to adopt a temporary transposition of the EU directive. Nevertheless, in light of both its heterogeneity and the temporariness of the current legislation, the Italian Parliament should allow for regional differences and, consequently, enable the development of the most backward territories.

There are a number of policies that could stimulate the emergence and development of the eCrew approach; divided into direct and indirect support instruments. Direct instruments include, for example, specific loans or guarantees schemes, technical assistance and capacity building, partnerships with government agencies and small or medium-sized enterprises.

Regarding specific loans and guarantees schemes, the recent Decree of the Ministry of Economic Development September 16, 2020, in application of paragraph 9, Article 42-bis of Legislative Decree n. 162/2019, allows combining the PV economic incentive with tax credit derived from energy efficiency works on buildings.

Indirect instruments include the promotion of renewable energy, the eco-social requisites in public tenders, etc.

Concerning law and administrative path, it appears to be important to provide different measures and strategies in accordance with legislative and administrative regional specific characteristics.

The RSE (Research Energetic System) – an Italian public society owned by the GSE (Manager of Energy Services) is conducting a study on 9 pilot projects analysing the energetic, economic, environmental and social costs and benefits, both for the subjects involved in the pilot projects and for the entire system (RSE Magazine, Dossier 17/2020).

Given that in those pilot projects RSE is playing a role of coordination, research (also from a regulatory and technological point of view), monitoring and evaluation of results, it would be useful for eCREW to analyse the results of RSE project, expected in 2021.

4.5 Spain

4.5.1 Country Profile

4.5.1.1 Demographics

As of 2020, the population of Spain was approximately 47.1 million. With a land area of 506 thousand square kilometres, this corresponds to a population density of 92.5 per square kilometre.

In 2020, an 80% majority of the population of Spain lived in urban regions, with a steady increase from the 76% of 2000, and 78% of 2010 (Worldometer Spain Demographics, 2020)

Table 30: Urban and Rural Population in Spain 1980-2020 (Data Source: EURYDICE)

	1980	1990	2000	2010	2020
Urban Population (%)	73	76	76	78	80
Rural Population (%)	27	24	24	22	20

The mean age in Spain is 43.4 years. The population pyramid shows that the age groups with the highest percentages are 45-59, corresponding to 23% of the population, and 30-44 with 21.5%. One significant conclusion from the pyramid is that the population is ageing. From 2000 to 2019, the proportion of 45-59 year olds increased from 17% to 23%, 60-74 year olds, from 14.3% to 16%, and 75 year olds and over, from 8.7% to 10%. This also translates into a slight decrease in the percentage of the 0-14 age group, from 14.7% to 14.6%, a more striking decrease from 12.2% to 15.3% in the 15-29 age group, and from 23.3% to 21.5% in the 30-44 age group from 2000 to 2019. This is also reflected in the dependency ratio, which is 54% (EURYDICE).

Table 31: Population Distribution of Spain 2000, 2010, and 2019 (Data Source: EURYDICE)

	0-14	15-29	30-44	45-59	60-74	75+
2019	14.6	15.3	21.5	23	16	10
2010	15.0	18.0	25.5	19.8	13.5	8.7
2000	14.7	23.2	23.3	17	14.3	8.7

In 2020, the life expectancy for females in Spain was 86.7 years, with 81.3 years for males, resulting in an overall life expectancy of 84 years. This shows an increase from 2010 figures, which were 83.3 years for females, 76.5 years for males, and 83.3 years overall, and from 2000 figures, which were 85.3 years for females, 79.6 years for males and 82.5 years overall.

Table 32: Life Expectancy for Females, Males, and Overall in Spain 1980-2020 (Data Source: EURYDICE, Worldometer Life Expectancy)

Life Expectancy	1980	1990	2000	2010	2020
Females	79.2	81.3	83.3	85.3	86.7
Males	72.9	74.0	76.5	79.6	81.3
Overall	76.1	77.6	79.9	82.5	84.0

According to 2019 figures, within the 25-64 age group, 38.6% of the population completed higher education, 22.7%, upper secondary education, and 38.7% did not complete secondary education. These figures demonstrate a significant shift from the 2010 percentages. From 2010 to 2019, the percentage of the 25-64 age group with below secondary education decreased by 8.4%, from 47.1% to 38.7%, while there was a corresponding rise of 7.6% for those with higher education, from 31.0% to 38.6%. Similar changes are observed in all age groups.

Table 33: Education Levels with Respect to Age Groups in Spain 2010 and 2019 (Data Source: EURYDICE)

	Below upper secondary ed.		Upper secondary ed.		Higher education	
	2010	2019	2010	2019	2010	2019
25-64	47.1	38.7	21.9	22.7	31.0	38.6
25-34	34.7	30.2	25.0	23.3	40.3	46.5
35-44	40.5	32.2	23.8	23.4	35.7	44.4
45-54	52.9	39.8	21.8	23.0	25.3	37.2
55-64	68.0	52.3	14.3	21.0	17.6	26.7

The employment rate in 2019 is at 50.3%, an increase from the 2000 level of 46.7%, as well as the 2010 level of 48.3%. However, the unemployment rate has also increased from 13.4% to 14.1% between 2000 and 2019, reaching 19.8% in 2010 which is higher than both 2000 and 2019 levels.

The unemployment rate for females in 2019 was 16%, against 12.4% for males.

Unemployment rates also differ by age groups and education levels. The overall unemployment rate in 2019 was 16.2% for the 25-34 age group, 11.5% for the 35-44 age group, 12.0% for the 45-54 age group, and 12.6% for the 55-64 age group. These rates also demonstrate a decrease when compared to 2010 figures, although the age group with the highest unemployment rate in 2010 was again the 25-34 age group. In 2010, overall unemployment rate was 17.9%, which is 5% higher than the 2019 value. Similarly, the unemployment rate in 2010 for the 25-34 age group was 21.6% (4.9% higher than the 2019 value), 17.6% for the 35-44 age group (6.1% higher than the 2019 value), 15.3% for the 45-54 age group (3.3% higher than the 2019 value), and 14.2% for the 55-64 age group (1.6% higher than the 2019 value). Thus, the diminishing unemployment rate has disproportionately benefited the younger age groups.

Across all education levels, the younger population has higher levels of unemployment, with the highest among the 25-34 age group. For instance, in 2019, for the higher education group, the unemployment rate according to age groups was as follows: 25-34 age group, 11.8%; 35-44, 6.9%; 45-54, 7.0%; and 55-64, 6.7%. Similarly, for the lower secondary education group, the unemployment rate shows a decrease with increasing age. The unemployment rates for age groups are as follows: for the 25-34 age group, 28.8%, for 35-44, 23.1%, for 45-54, 18.6%; and for 55-64, 15.2%.

Likewise, for all age groups, the unemployment rate decreases with increasing education levels. For instance, within the 25-34 age group, the unemployment rate in 2019 was 34.3% for the lower secondary education group, 21.4% for the lower secondary education group, 16.5% for upper secondary, and 11.8% for higher education groups. This pattern of unemployment rate is repeated within the 45-54 age group: 28.2% for the lower secondary education group, 16.3% for the lower secondary education group, 10.9% for upper secondary, and 7.0% for higher education groups (EURYDICE).

Table 34: Unemployment with Respect to Age Groups and Education Levels in Spain 2010 and 2019 (Data Source: EURYDICE)

	Below lower secondary		Lower secondary		Upper secondary		Higher education		TOTAL	
	2010	2019	2010	2019	2010	2019	2010	2019	2010	2019
25-64	27.9	26.0	22.8	17.3	17.2	12.7	10.4	8.1	17.9	12.9
25-34	39.8	34.3	28.8	21.4	21.5	16.5	13.9	11.8	21.6	16.2
35-44	32.9	25.8	23.1	16.5	17.7	12.2	9.8	6.9	17.6	11.5
45-54	26.1	28.2	18.6	16.3	12.6	10.9	7.1	7.0	15.3	12.0
55-64	20.4	20.6	15.2	16.2	11.5	11.9	5.5	6.7	14.2	12.6

4.5.1.2 Energy profile (production, supply, consumption etc.)

In 2019, the total energy supply of Spain was 121.130 ktoe. Between 1990 and 2019, the energy supply of Spain experienced fluctuations. From 1990 to 2005, a steady increase was observed, from 90,200 ktoe of 1990 to 141,500 ktoe of 2005, a 3.8% yearly increase, and 57% increase in total energy supply over the 15 years. The period from 2005 to 2015, however, demonstrates a progressive but slow decrease from 141,500 ktoe in 2005 to 118,400 ktoe in 2015. This corresponds to an annual decrease of 1.64%, totalling 16.4% over 10 years. From 2015 to 2019, the total energy supply of Spain increased by 2.3%, reaching to 121,100 ktoe (IEA Spain).

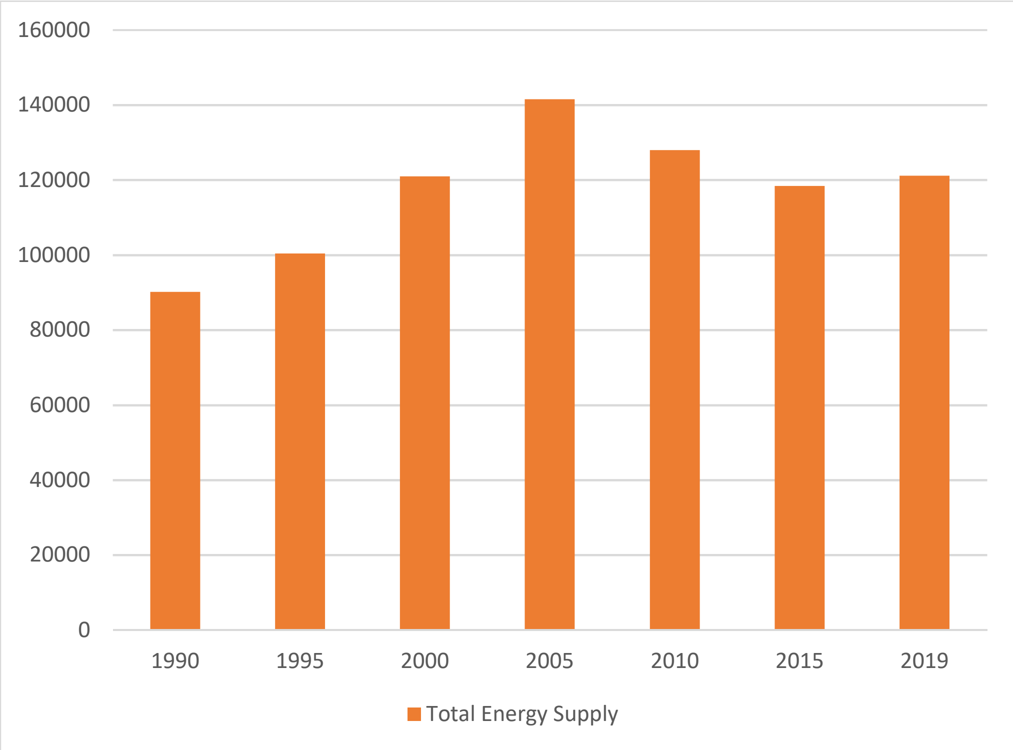


Figure 44: Energy Supply of Spain 1990-2019 (Ktoe) (Data Source:IEA Spain)

Oil had the highest share in the energy supply of Spain, with 42.8% in 2019, followed by natural gas, with a share of 25.5%. The third highest contribution was from nuclear, with 12.6%. The remaining sources were renewable sources, wind and solar, with 6.8%, biofuels, with 6.6%, coal with 4.1 %, and hydro with 1.7% (IEA Spain.

Table 35: Energy Supply of Spain by Source 1990-2019 (Ktoe) (Data Source: IEA Spain)

	Coal	Natural gas	Nuclear	Hydro	Wind, solar, etc.	Biofuels and waste	Oil	Total
1990	19267	4970	14140	2190	26	4067	45469	90129
1995	18996	7722	14449	1985	52	3684	53508	100396
2000	20940	15219	16208	2430	444	4131	61606	120978
2005	20566	29844	14992	1582	1894	5115	67548	141541
2010	7763	31129	16152	3637	4857	6744	57701	127983
2015	13353	24538	14903	2420	7444	7030	48693	118381
2019	4913	30897	15229	2104	8183	7941	51863	121130

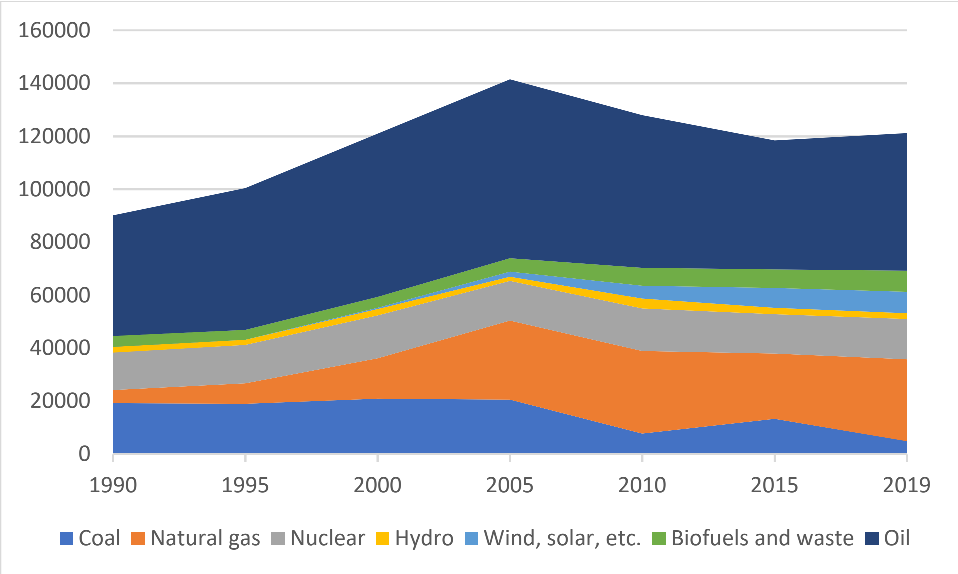


Figure 45: Energy Supply of Spain by Source 1990-2019 (Ktoe) (Data Source: IEA Spain)

Within the energy supply mix of Spain, oil preserves its foremost role, despite a decrease from 50.4% in 1990 to 42.8% in 2018. Coal, with 21.4% corresponding to the second highest share in 1990, sharply decreased to 4.1% in 2018. This decrease was compensated by the increase in the share of natural gas from 5.5% to 25.5% and wind and solar from 0 in 1990 to 6.8% over the same period. The shares of nuclear, hydro, and biofuels have remained rather steady over this time.

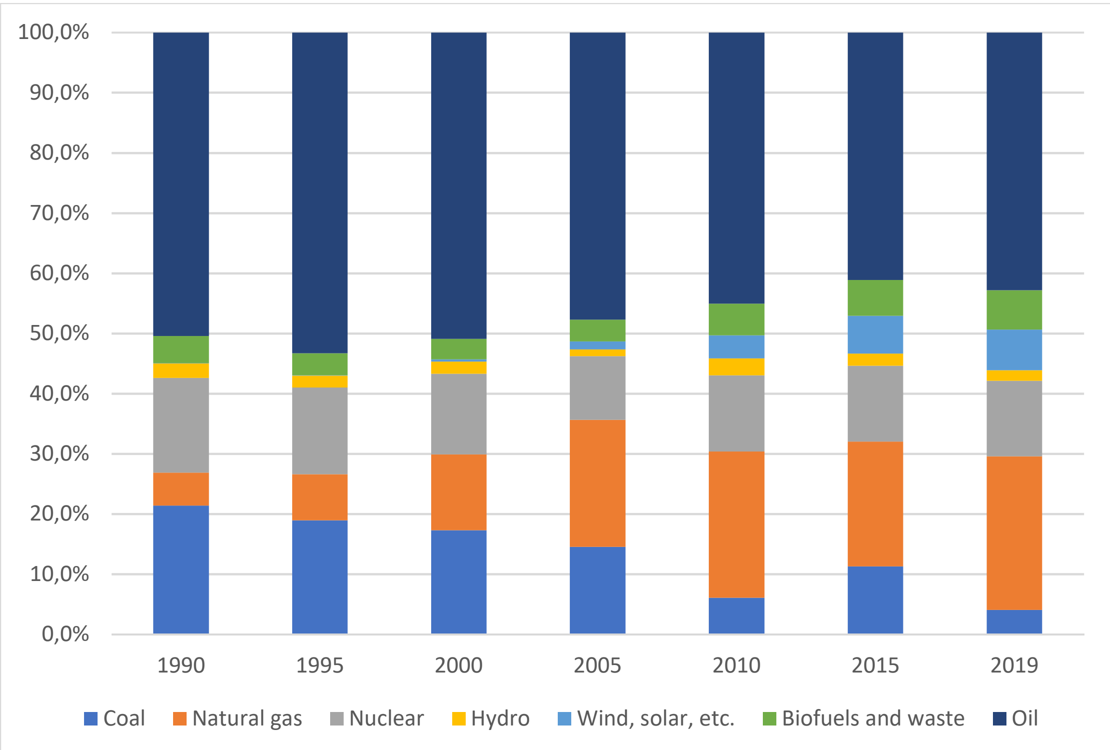


Figure 46: Energy Supply Mix of Spain by Source 1990-2019 (Data Source: IEA Spain)

On the energy consumption side, the total energy consumption per capita in 2019 is 2.6 toe, 15% below the EU average. Regarding the trends in energy consumption, from 1990 to 2018, there was a similar pattern to energy supply, with higher rates of change from 2000 onwards. From 1990 to 2015, the energy consumption of Spain increased from 60,600 to 102,000 ktoe, a 68.3% increase over 15 years, and an 11.2% annual increase. From 2005 to 2015, there was an overall 22% and yearly 2.2% decrease, from 102,000to 79,700 ktoe. Similar to the pattern in energy supply, consumption increased from 2015 to 2018, by 8% overall, i.e., an annual average of 2.7%.

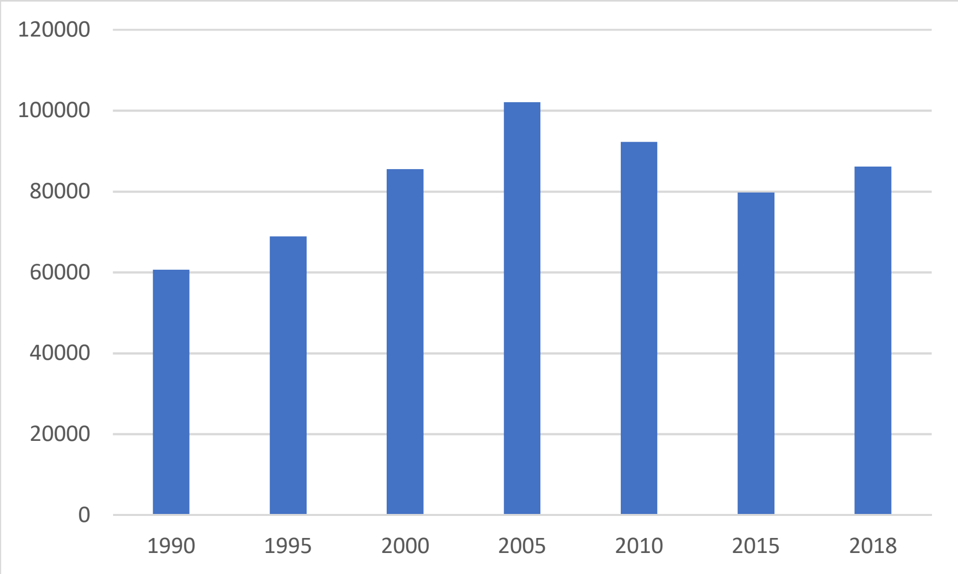


Figure 47: Energy Consumption of Spain 1990-2018 (Ktoe) (Data Source: IEA Spain)

Table 36: Energy Consumption of Spain by Source 1990-2018 (Ktoe) (Data Source: IEA Spain)

	Coal	Crude oil	Oil products	Natural gas	Wind, solar, etc.	Biofuels and waste	Electricity	Total
1990	3395	29	38124	4325	24	3922	10817	60636
1995	1942	14	44646	6807	27	3306	12116	68858
2000	1366	12	52148	12294	37	3433	16205	85495
2005	1473	12	57824	18133	69	3725	20827	102063
2010	1023	12	49972	14817	199	5184	21049	92256
2015	674	0	40199	13576	296	5021	19952	79718
2018	886	0	43774	14735	343	5911	20504	86153

The transport sector accounts for almost 60% of the oil products consumption (59% in 2019), with power plants accounting for just 6% of oil demand. A small share, 6%, of the demand for oil products comes from power plants (Enerdata Spain Energy Information).

The power sector was the main consumer of natural gas, accounting for 44% of consumption in 2019. This shows a significant increase from 33% in 2018. The industry sector consumes another 28% and the residential and service sector, 19% (Enerdata Spain Energy Information).

The decrease in the consumption of coal (both in supply and consumption) mainly is a result of closing of coal-fired plants in the industry sector. With the decreasing use of coal in the industry sector, the overall consumption has fallen, leaving power plants as the main consumers, which now account for 73%. The remaining 27% is consumed by the industry sector (Enerdata Spain Energy Information).

Spain's 2020 target was to attain a 22.7% share of renewables in total final energy consumption (According to the National Action Plan for Renewable Energies PANER, 2010). By 2018, the achieved level was 17.5%. The PANER further targets a 40% share of renewables in electricity generation by 2020 (according to 2018 figures, the achieved share was 35%), a 18.9% share of renewables in heating and cooling (the achieved level in 2018 was 17.5%), and 13.6% for transport(the achieved level in 2018 was 6.9%) (Enerdata Spain Energy Information).

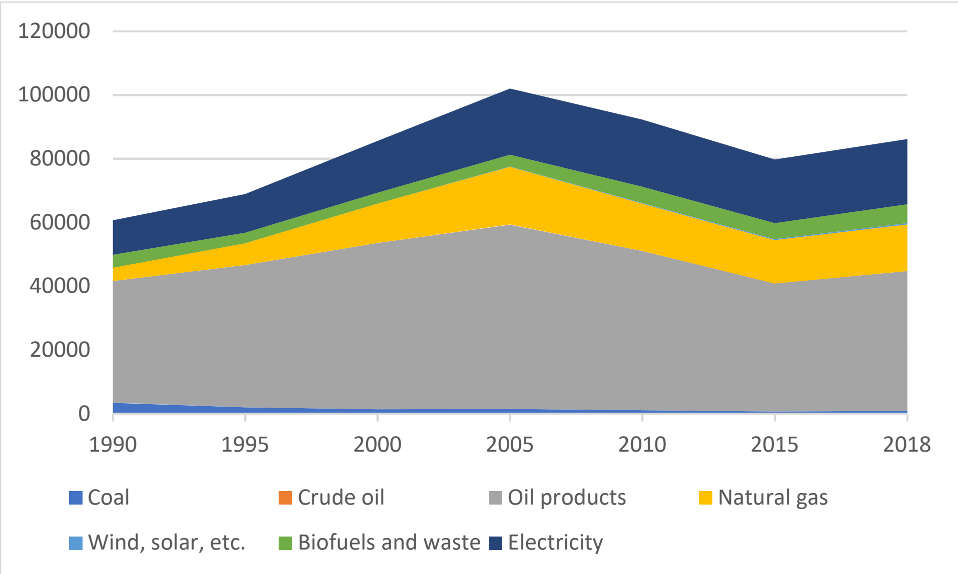


Figure 48: Energy Consumption of Spain by Source 1990-2018 (Ktoe) (Data Source:IEA)

Of Spain's total energy consumption, oil products have the largest share, with 50.8% in 2018. The second and third highest are for electricity, 23.8%, and natural gas, 17.1%. In 2018, the share of biofuels and waste was 6.9%, with other sources providing minor contributions: coal 1%, and wind and solar 0.4%. The evolution of Spain's shares of sources in energy consumption from 1990 to 2018 show that oil products continue to dominate, although decreasing from 62.9% in 1990, to 50.8% in 2018. Within the same time period, the share of electricity increased from 17.8% to 23.8%, and natural gas from 7.1% to 17.1%, while the share of coal decreased from 5.6% to 1%. The increase in wind and solar is very slight, from 0% to 0.4%, and the shares of biofuels and waste have remained very stable (6.9% versus 6.5%) across the period.

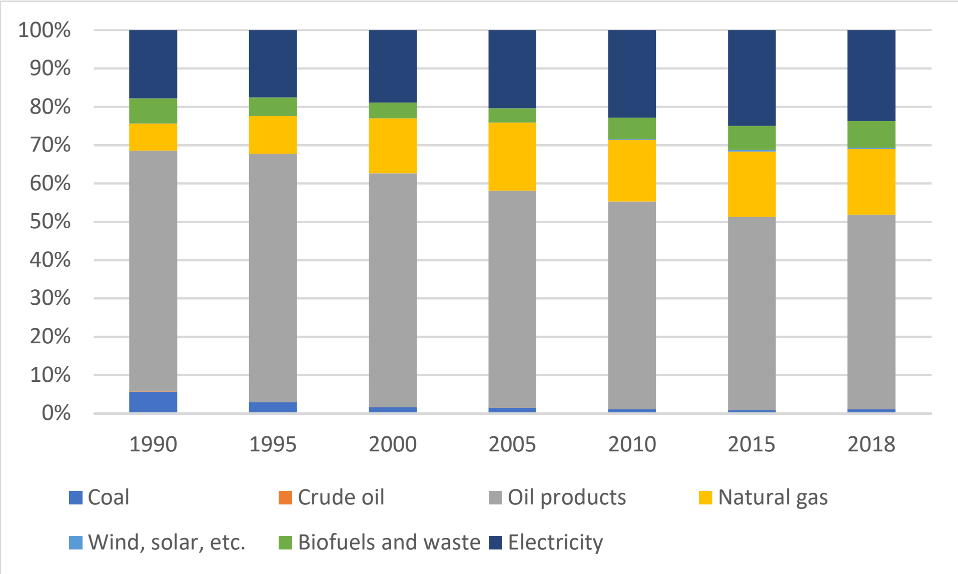


Figure 49: Energy Consumption Mix of Spain by Source 1990-2018 (Data Source:IEA)

The consumption figures show that the energy consumption per GDP has decreased by 25.9% from 2015 to 2019 (Ourworldindata Spain: Energy Country Profile).

Spain's greenhouse gas emissions decreased by 27% between 2007 and 2013, as a result of the slowdown in economic activities. However, average annual emissions increased by 1.4% between 2013 and 2017, mainly as a result of increasing transport-related emissions, and the replacement of hydro power with thermal power generation. In 2018, GHG emissions decreased again by 1.4%, to 352 Mt CO_2 equivalent, although still 20% higher than in the 1990's (Ourworldindata Spain: Energy Country Profile).

4.5.1.3 Energy market and infrastructure

The first step in the liberalisation of the electricity market in Spain was Law 54/1997 (General Electricity Law 54/1997), aimed at decreasing the government's role and influence in the energy system and its management. Law 54/1997 enabled third parties to carry out activities in the electricity networks, and created an organised energy negotiation market.

Further, in 2013, Law 24/2013 (Electricity sector regulation - Electricity Law 24/2013) established the guidelines for regulated and non-regulated electricity market activities. As a result of this law, consumers were given the freedom to select and change their suppliers, based on their knowledge of the market.

There are three types of wholesale electricity markets in Spain: the forward and future market, day-ahead market, and intraday market (Omie Website).

The forward and future market covers longer term operations which may extend over weeks or even years. The contracts are based on fixed-price agreements. Through the forward and future market, it is possible to buy and sell electricity between trade zones However, this requires the extra charge for using the cross-border transmission capacity, which has to be purchased a priori (Omie Website).

The day-ahead market concerns the trade of electricity one day ahead of the actual delivery. The main purpose of the day-ahead market is to balance a zone's planned electricity generation for the next day, according to the demand forecast, through buying deficits or selling surpluses. Also, cross-border allocation is maintained by the day-ahead market through contracts for generation and transmission capacities. At the end of the day, BRPs (Balance Responsible Parties) submit their portfolio balances to the Transport System Operator (TSO), Red Eléctrica Española (REE). The day-ahead market is operated by OMIE, through auctions which award contracts to the lowest-price bidder for the particular electricity generation needed. REE checks and ensures that the overall day-ahead generation schedule and trade is feasible, making any adjustments needed. REE also utilizes the Ancillary Service markets to achieve the balancing of the grids countrywide. The DSOs (Distribution companies) are regional and local operators responsible for conducting delivery and metering services to consumers via their established medium-voltage and low-voltage grids (Omie Day-Ahead Market Operation).

The intraday market operates on the resolution of quarter-hour intervals, which resolves the discrepancies between the day-ahead forecasts and actual demand realizations. The intraday imbalances that may occur in a BRP's portfolio are further resolved through the imbalance settlement market (Omie Details of the Intraday Market's Operation).

Renewable energy generators with generation capacities of 50 MW or higher can also trade (sell) in the wholesale market.

In contrast, the retail market is an open market where retail suppliers can operate and offer tariffs to the household consumers as well as to industrial consumers. The consumers can select from different suppliers and different types of contracts. The National Regulatory Authority (NRA) and the Agency for the Cooperation of Energy Regulators (ACER) are tasked with maintaining fair competition in the retail market. The NRA in Spain is the National Commission for Markets and Competition (CNMC). CNMC is also responsible for assuring that the market is regulated, and that operation conforms to EU policy, and taking the necessary actions to ensure that operators follow the regulatory framework, implementing sanctions where necessary (CNMC Website).

Residential consumers can select the government-regulated tariff or choose a supplier from the market offering a different tariff. The government-regulated tariff (PVPC: Precio de Venta a Pequeño Consumidor) is the Default Regulated Retail Market Tariff for residential consumers in Spain), defined by the government, and only selected traders are entitled to provide service to consumers who choose this tariff. The PVPC tariff bill consists of three components. The fixed part of the PVPC bill is typically around 45-50% of the total. Another 25-30% is based on actual consumption, that is, the variable part, determined based on the wholesale market price. The remaining approximate 25% is formed of taxes (Value Added Tax at 21%, and Electricity Tax at 5%) (REE Website).

Demand response Market

Since the rollout of smart meters was completed in 2018, hourly data and hourly spot prices can be utilized for demand response. However, the hourly prices are utilized only for the variable part of the government-regulated PVPC tariff. Moreover, the lowest and highest-price hours differ only by 0.01€ daily and 0.02-0.03€ yearly, resulting in very low impact on demand response.

Even though the smart meters allow reporting of consumption data on a real-time basis, distribution companies generally only use and report on a daily basis. Hence, the smart meter rollout is not yet utilized for demand response adoption.

Currently, REE manages the only deployed scheme for demand response, the interruptible load programme. The programme is regulated by the aforementioned Law (Electricity sector regulation - Electricity Law 24/2013), and is explicitly for pre-qualified, high-consumption industrial consumers. The interruptible load programme provides congestion management for emergency actions, and is utilized in cases where the generation system loses capacity, and the balance resources do not suffice to account for all demand. The demand reduction capacity is 3,000 MW, used in bulks of 5 or 90 MW. This capacity is only for aggregated loads. The programme excludes aggregate demand directly to the DSO or to the TSO. If the pre-qualified industrial consumer is within its network, the DSO takes no part in the interruptible load programme. The TSO accounts for the imbalance of the retailer, considering its demand reduction activity. The auction for the interruptible demand programme in 2016 resulted in the allocation of 2,890 MW demand, at a cost of 503 million € (Bertoldi, Zancanella, and Boza-Kiss B, 2016).

4.5.2 Legal and administrative Framework of Energy Communities under National Structure

4.5.2.1 National legal and administrative framework for the adoption of eCREW approach

Historically, Spain had a very conservative energy regulation in the 20th century, with strict state governance of all market activities. The change in economic understanding of the 1970's, however, started to show its effects by the turn of the century. The neoliberal movement pushed the government to pass new laws challenging this conservatism in the energy sector in general and in the electricity sector (Renewable Energy Cooperatives as an instrument towards the energy transition in Spain). The change was also affected by the developments in the EU. The EU Directive 96/92/CE concerning common rules for the internal market in electricity was the major force behind the acceptance of Spanish Law 54/1997, which opened the electricity market to competition.

The basic goal of the Law was to establish the regulation of the electricity sector with the traditional triple aim of ensuring the electricity supply, its quality, and the lowest possible cost. The explanatory statement in the beginning of the Law clearly stated that, unlike previous regulations, (1) the government intervention would be limited, (2) the State would not reserve for itself the exercise of any of the activities that contribute to the electricity supply and (3) the notion of public service would be abandoned. Free competition was at the heart of this Law.

Another important development of the 1990's was the acceptance of Royal Decree 2366/1994, on the production of electrical energy by hydraulic, cogeneration and other installations supplied by renewable energy sources or resources. Any reference to renewable energy is important, since it facilitates self-generation, which is the basis of RECs. Historically, self-generation was only considered to be made by hydroelectric production, therefore, the Decree specifically referred to non-hydraulic renewable energy sources such as solar, wind, tidal, and geothermal.

The regulations that followed, until 2012, were all in favour of promoting the electricity generation from renewable energy sources. The major financial incentive system was created especially with Royal Decree 436/2004, which repealed its precedent the Royal Decree 2818/1998. Generators who sell their production either to a distributor or on the free market are entitled to incentives. The Decree stated that the tariffs will take effect for 25 years. Three years later, the Royal Decree 661/2007) on the same subject was accepted, extending the length of the incentives and premiums paid to generators up to 30 years.

Since 2012 however, the liberalising currents have slowed. The costs of financing the system rose with the numbers of generation facilities, causing tariff deficit and accumulated debt each year (Sustainable energy communities: a study contrasting Spain and Germany). This led the government to take the same precautionary measurements; legal regulations were once again the main instrument of the State.

The Royal Decree 1/2012 eliminated the economic incentives for new electricity generation facilities using co-generation, renewable energy and residual waste. The Law 15/2012, of the same year, on fiscal measures for energy sustainability, established a new tax on the value of the production of electrical energy. These two measures, however, were not enough to eliminate the deficit in the electricity system, and in 2013 two royal decree-laws and an extraordinary credit were adopted in the budget of the Ministry of Industry, Energy and Tourism for this purpose. A year later, Royal Decree 413/2014, regulating the activity of electricity production from renewable energy sources, cogeneration and waste, redesigned the incentive scheme on Spanish renewable electricity generation. The Decree brought cuts in incentives for existing installations with a retroactive effect (Sustainable energy communities: a study contrasting Spain and Germany).

An important development in Spanish Electricity Sector was the acceptance of a new Law (Law 24/2013). Its basic purpose was to establish the regulation of the electricity sector, guaranteeing the electricity supply with the required quality at the lowest cost, ensuring the economic and financial sustainability of the system, and allowing a level of effective competition in the electricity sector, all within the contemporary principles of environmental protection. Another important aspect of the Law was to regulate the concept of self-consumption as an alternative source of electricity generation, outside the main electricity system, which, at that time, had no specific legal and regulatory framework.

According to the new Law (Art. 6) electricity generators may be natural and legal persons, whereas the market operator, the system operator and the carrier can only be commercial companies. The distribution and the sale activities, on the other hand, might be carried out by commercial companies, and cooperative societies of consumers and users. This is an important innovation, since according to Spanish legislation, cooperatives (a main means of establishing REC in most countries) are not recognised as commercial companies, and have to be inscribed into a special registry established for this sole purpose.

According to Art. 9 of the Law, self-consumption shall be understood to be the consumption by one or more people of electrical energy from production facilities which is close to, and associated with them.

Production facilities not exceeding 100 kW of power associated with modes of supply with self-consumption with surpluses will be exempt from the obligation involved in the administrative register, a condition that is applied to all other market activities.

Additional pressure on the Spanish legislator for regulation also came from Directive 2009/28 / EC, of the European Parliament and of the Council, of April 23, 2009, which urges the establishment of simplified authorization procedures for the generation and usage of energy from renewable sources.

The emphasis on self-consumption in Spanish Law has increased since then. Royal Decree 900/2015 entered into force by late 2015, regulating the administrative, technical and economic conditions of the modes of electricity supply with self-consumption, and production with self-consumption.

The Decree defines the concept of self-consumption in parallel with the Law 24/2013 on Electricity Sector, and clarifies the requirements. In case of self-consumption without surpluses – where a physical device installed prevents the injection of any excess energy into the transmission or distribution network – the requirements are as follows:

- The consumer's contracted power should not exceed 100 kW.
- The sum of installed generation powers should be equal to or less than the power contracted by the consumer.
- The owner of the supply point should be the same as that of all consumption equipment and generation facilities connected to its network.
- The generation facilities and the supply point must comply with the technical requirements contained in the electricity sector regulations and in the related industrial quality and safety regulations.

In case of self-consumption with surpluses – where the generation facilities can, in addition to supplying energy for self-consumption, inject surplus energy into the transmission and distribution networks – the requirements are as follows:

- The sum of the installed powers of the production facilities should be equal to or less than the power contracted by the consumer.
- In the event that there are several production facilities, the owner of each and every one of them must be the same natural or legal person.
- The production facilities must comply with the technical requirements contained in the electricity sector regulations and in the applicable industrial quality and safety regulations

- The production facilities should be jointly liable for non-compliance with the precepts contained in this royal decree, provided that they share infrastructures for connection to the transmission or distribution network or are connected to the internal network of a consumer.

Energy prices in Spain rose significantly in 2018 due to high prices of raw materials and the increase in the costs of CO2 emission rights after the adoption of EU rules. This led the government to take urgent energy transition and consumer protection measures by issuing Royal Decree 15/2018. One important aspect of the regulation is to provide customers with more information on their electricity usage, and on the contracting possibilities available. The access to certain information regarding consumption was also made available.

As seen from all these legal regulations, up until 2019, people had limited ability to participate in electricity generation. Other than establishing a commercial company, people could only participate via self-consumption or establishing some form of cooperative. No cooperatives were established for the purpose of generating electricity prior to 2010. As the previous legislation required all of the market players to be commercial entities (registered to the Commercial Registry), and, for the purpose of this law, this excluded cooperatives, which can only be registered to an especially established registry. The current law (Law 24/2013), on the other hand, allows the cooperatives to distribute and market electricity. This change, and the regulation about the self-consumption led to the growth of cooperatives in Spain during the last decade; however, the limitation of the incentives starting from 2012 has severely restricted this growth.

The Revised Renewable Energy Directive 2018/2001/EU enacted in December 2018 and the Revised Energy Market Directive 2019/944, enacted in June 2019 changed the political view on REC in Spain. A natural person's tendency towards electricity generation with renewable energy via self-consumption was already increasing in the country. As put forward by explanatory statement of the Royal Decree 15/2018, renewable electricity self-consumption was found an essential route to cleaner and cheaper energy for consumers. The Decree was important in terms of introducing three fundamental principles that will enable people to join self-consumption activities: i) the recognition of the right to self-consume electricity without charges ii) the recognition of the right to shared self-consumption by one or more consumers to take advantage of economies of scale; and iii) the principle of administrative and technical simplification, especially for small power installations.

One of the last and most important changes in Spain's legislation towards the implementation of e-CREW approach was enacted in 2019, namely, the Royal Decree 244/2019, accepted on 5 April 2019. The motivation behind the Decree was the promotion of the development of self-consumption. The Decree regulates the administrative, technical and economic conditions of the self-consumption of electrical energy, and is innovative in four respects: (1) the definition of the concept of nearby facilities for self-consumption purposes; (2) the development of individual and collective self-consumption; (3) the simplified compensation mechanism between deficits of self-consumers and surpluses of their associated production facilities; and (4) the organization, as well as the procedure of registration and communication of data to the administrative register of self-consumption of electricity. In addition, the regulation enabled the deployment of domestic rooftop PV installations, and eliminated the notorious PV generation tax.

Collective self-consumption is defined as a consumer group fed with electrical energy from production facilities close by and associated with them. In the case of collective self-consumption, all participating consumers associated with the same generation installation must belong to the same mode of self-consumption and must communicate individually to the distribution company as the person in charge. Previously, self-consumption was only possible if the generation facilities were located in the consumer's own dwelling. This change allows a group of apartment owners or administrators of industrial estates to cooperate in collective self-consumption (Collective self-consumption and energy communities: Overview of emerging regulatory approaches in Europe).

Finally, a major step came during the pandemic, with a new Decree aimed to revitalise the economy. The Royal Decree 23/2020 was accepted on 23 June 2020. While broad in its scope, the Decree is important since it introduced two new concepts.

The first one is the "independent aggregator", participants in the electricity production market who provide aggregation services and are not related to the customer's supplier. In terms of the Decree, aggregation implies the activity carried out by natural or legal persons that combine multiple consumptions of electricity generated from consumers, producers or storage facilities for sale or purchase in the electricity production market.

The second one – and the most important for the current issue – is the term "renewable energy communities", as defined by The Revised Renewable Energy Directive 2018/2001/EU: "*a legal entity: (a) which is based on open and voluntary participation, is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity; (b) the shareholders or members of which are natural persons, SMEs or local authorities, including municipalities; (c) the primary purpose of which is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where it operates, rather than financial profits*".

The REC was added to article 6 of the Law 24/2013 on Electricity Sector as a legal entity that can carry out the activities referred in article 1.2, which are: generation, transport, distribution, energy recharge services, intra-community and international trading and exchanges, as well as the economic and technical management of the electrical system. The same article 6 of the Law, however, retains separate definitions for the electric power producers, the market operator, the system operator, the carrier, distributor and the marketer. According to these definitions, only commercial companies may be given the authority as a market operator, a system operator and a carrier, whereas commercial companies and cooperative societies alike may be distributors or marketers. There is a conflict of definitions in the Law, and the ability of RECs to practice these activities is still ambiguous, leading to a need for secondary legislation to clarify the issue. The electric power generators, on the other hand, may be natural or legal persons, a definition that allows the RECs, defined as legal entities in terms of the law, to practice electricity generation.

With all these large scale of legislation in mind, it can be concluded that, community-based collective generation in Spain is possible under the legal form of a cooperative, collective self-consumption (collectively and with aggregating consumption), and RECs, however, the latter is in need of further regulation, since its current inclusion to the regulation produces a conflict of understanding.

4.5.2.2 Data flow in eCREW under National Electricity Regulatory Framework (Data flow, Data from smart meter, processing of data from third parties)

Energy efficiency has been an important subject of the EU since 2002 Barcelona European Council. The Presidency Conclusion of the Council clearly states that the Council "*agrees on the need for the European Union to show substantial progress in enhancing energy efficiency by 2010*". Energy saving, which is an essential part of efficiency, is also seen as important and many legislative and policy actions were taken.

The subject also became popular in Spain in the first decade of the 20th century. One of the initiatives taken was the measurement of the electricity usage in a timely manner, and remote management of the system, enabled by the Royal Decree 1634/2006. The Decree required the Ministry of Industry, Tourism and Commerce to produce a replacement plan for all Spanish domestic meters with contracted power lower than 15 Kw, by July 2017. The plan was declared by the Order ITC/3860/2007 of December 28. According to the plan, the replacement obligation was laid on the shoulders of the distribution companies. Each distribution company was obliged to replace:

- 30 percent of the total number of meters of up to 15 kW between January 1, 2008 and December 31, 2010;
- 20 percent of the total number of meters of up to 15 kW between January 1, 2011 and December 31, 2012;
- 20 percent of the total number of meters of up to 15 kW between January 1, 2013 and December 31, 2015; and
- 30 percent of the total number of meters of up to 15 kW between January 1, 2016 and December 31, 2018.

The measurement equipment to be installed must comply with the requirements established in the Unified Regulation of Measurement Points of the Electrical System, approved by Royal Decree 1110/2007, of August 24, and in Order ITC / 3022/2007, of 10 of October. Both regulations are detailed.

The system operator is the body responsible for receiving and processing the information on measures. Complementary technical instructions laid down the conditions of access to information and associated security measures, and the way in which each participant in the measurement can directly access the measurement equipment through a portable terminal or through visual reading. The last of these complementary technical instructions is accepted by Order TEC / 1281/2019, of December 19.

According to the complementary technical instructions, the measurement system consists of the secondary concentrators, the main concentrators, the distributors and the system operator.

In order to obtain the data of measures, the main concentrator will process the information from the points for which it is responsible, together with information from the rest of the secondary concentrators. The distributors will process their allotted measurement data and will transmit the information to the system operator. The system operator will process the measurement data for its allotted points in the main electrical measurement concentrator. The process of collecting information is also regulated in the instructions; according to Article 9.2, those charged with reading should facilitate the relevant participants' access to the measurement data in the main and / or secondary concentrator.

Apart from these regulations, the Royal Decree 15/2018 allows the marketers to access certain information regarding consumer consumption in order to provide a range of energy efficiency measures, either directly or through energy service companies, however, personal data must be protected.

Spain's National Energy and Climate Plan for 2021 – 2030, published in the first month of 2020, contained the measure "demand management, storage and flexibility". This measure states that "*in an increasingly digitalised society, the significant deployment of smart meters will enable consumers to access information on their energy consumption data in real time, to become more involved in the energy market and to adjust their consumption according to market signals*".

All these data combined guarantee the legal infrastructure necessary to allow the collection of data for the smartphone application planned within the scope of the e-CREW approach.

4.5.2.3 Progress concerning the adoption and/or transposition of relevant EU directives to national legislation

It is seen that Spain acts in conformity complying with the EU Directives in the subject of REC/CEC.

Although the economic conditions of the first half of 2010s forced the government to take steps that might be regarded as resisting the public's involvement in energy generation from renewables, by the second half of the decade, the political view clearly changed significantly.

The Law 24/2013 on the electricity sector regulates the concept of self-consumption, collective self-consumption, independent aggregator as an alternative source of electricity generation outside the classical electricity system. The Law allows exemption from the administrative register obligations for generation facilities not exceeding 100 kW of power associated with modes of supply with self-consumption, which produce surpluses. This means a simplified procedure for people's inclusion to the market.

As stated previously, the Royal Decree 15/2018 regulated the necessity of collecting and sharing more information with customers on their electricity usage and the contracting opportunities available. The full inclusion of smart meters into the system by the end of 2018 made it possible to collect and process the necessary data.

4.5.2.4 Progress concerning of adoption Internal Electricity Market Directive (EU) 2019/944 and Energy Efficiency Directive (EED 2019) 2018/2002/EU

Both developments are an important part of The Revised Renewable Energy Directive 2018/2001/EU and Revised Energy Market Directive 2019/944 in terms of reducing complexity for project developers and RECs/CECs participation in the energy market on an equal footing with large-scale participants.

The inclusion of the "renewable energy communities" to the legislation was realized two years after Directive (EU) 2018/2001, and a year after Directive (EU) 2019/944, a reasonably prompt response. The analysis of energy legislation, on the other hand, reveals a need for further legislative regulations in order to eliminate the possible conflict of understanding arising from the definitions of market actors.

The National Energy and Climate Plan of Spain for 2021 – 2030 highlights and promotes the political significance of RECs / CECs for the near future. The government expects an increase in projects in renewable energy generation as a result of the promotion of local energy communities. Thus, the National Plan focuses on RECs and proposes regulatory development to enable them to generate, consume and sell renewable energy. It also proposes "*instruments and measures to facilitate and reinforce the role of local energy communities as well as guaranteeing the right of access to energy*". The government sees the Royal Decree 244/2019, which introduced the concept of collective self-consumption, as the starting point for RECs. The Plan directly refers to Directive (EU) 2018/2001 and Directive (EU) 2019/944, and includes "Measure 1.13", solely concerning RECs/CECs. The two legal entities defined by EU Directives seem identical but have certain differences. The CECs is designed to develop not only generation, but any projects in the energy sector, including, but not limited to, energy storage, and aggregation. The Royal Decree 23/2020 imported the concept of REC into the Law 24/2013 on Electricity Sector as a legal entity; however, the CEC still does not exist in Spanish legislation. Seeing its lack, measure 1.13 mentions the necessity of its introduction to the legislation. Despite the wide range of the new legislation, the introduction of these legal entities to the market is insufficient to deal with the classical system and its barriers for any new business models. The elimination of these barriers, and the facilitation of administrative procedures, therefore, is recognised as an important aspect of measure 1.13. The government also proposes training and capacity building programmes for RECs / CECs.

All these legal and political documents show that adoption of EU Directives is in progress in Spain, leading to the expectation of new legal and administrative instruments for this purpose in upcoming years.

4.5.3 Differences between national implementation and EU Directives with regard to the concepts of the Renewable Energy Community (RED II) and Citizen Energy Community (ED 2019)

The natural and legal persons are individually free (with administrative authorization) to generate electricity from renewable sources for their own consumption needs in Spain. The collective self-consumption – within the same community (such as a residents' association, a neighbourhood, or an industrial park) – is another approach to involving citizens in electricity generation. As the majority of the population are not able to meet these criteria, they are excluded from forming or joining a local community. Cooperatives, on the other hand, are accepted as a legal body that can distribute and sale (market) the electricity. Article 6 of the Law 24/2013 allows natural and legal persons to generate electricity, which extends this right to cooperatives. Citizens, thus, are able to join or form a cooperative that will allow them to trade in the energy market as a community. As known, the cooperatives are the most common form of a legal body permitted to operate as REC in Europe.

RECs, as a legal entity, have recently been introduced into the legislation of Spain. The definition is in conformity with the EU Directive, and it can be concluded that RECs are permitted to apply for the administrative authority to generate electricity from renewables. The Law 24/2013 on Electricity Sector, however, absolutely prohibits legal entities other than commercial companies and cooperatives from assuming the authority of a market operator, a system operator, a carrier, a distributor or a marketer. This constitutes a serious practical barrier to RECs becoming an actor in the energy market. Spain therefore needs to make regulatory changes, and redefine all these market actors to enable RECs to enter into the energy market on equal bases.

There is no definition of CEC in Spanish legislation, and no new regulation is accepted in accordance with Directive (EU) 2019/944. The politicians and bureaucrats are aware of this deficiency and are planning to introduce more regulations concerning the CECs in the National Energy and Climate Plan of Spain for 2021 – 2030.

4.5.4 Adaptability of the eCREW approach

4.5.4.1 Interaction between legal and administrative framework (with reference to the eCrew approach)

The legal framework in Spain is suitable for the uptake of CECs and RECs. This provides a convenient basis for the implementation of the eCREW approach. There are examples of energy communities and renewable energy initiatives that demonstrate effective exploitation of the legislative and administrative frameworks. Two such examples are the renewable energy cooperative Som Energia and the sustainable mobility cooperative Som Mobilitat.

However, the number and spectra of community initiatives such as energy cooperatives is far below that expected within such an advantageous framework. This points out to issues with the administrative framework, particularly that it does not fully support the operationalisation of similar pro-energy transition initiatives, despite no barriers from the legislative structure.

Another area where the interaction between legal and administrative frameworks has an important role is related with the smart meters. Smart meters allow two-way real time data flow between the consumers and the grid or the utility companies. This data flow is significant in enhancing the active and informed participation of citizens as consumers in the energy system. Hence, it may also serve as an important component of the implementation of the eCREW approach, where, for instance, the savings from CREWs may be closely tracked in real time by their members. Although Spain completed the smart meter rollout in 2018, the distribution companies do not utilize this real time data, they rather report on a daily resolution. Thus, the administrative counterpart lags behind the legislative structure in enhancing the use of smart meter data. Another driver of the under exploitation of smart meter data is the government-regulated electricity tariff and the electricity tariffs that are realised in the market. Since there is a very small difference in the lowest and highest prices, demand response has very small effect.

Likewise, demand management is closely related with the implementation of the eCREW approach. In this case, the market structure allows only a limited implementation of demand management, only under certain conditions. In this case, both the legal and the administrative structures need to be improved to support the uptake of approaches such as the eCREW approach.

One can conclude that the legal structure in Spain, in general, establishes the sufficient environment for the pro-energy initiatives. The administrative structure needs further improvements. Moreover, the harmonization of the legal and administrative frameworks would also contribute to the suitability of the eCREW approach.

4.5.4.2 Adaptability of eCREW as business model for energy retailer and energy communities (Foundation, Participants, energy retailer)

After the necessary changes have been introduced, all the legislative regulations point to the possibility of the adaptation of the eCREW approach. People have been free to establish or to join cooperatives and generate electricity since the beginning of the last decade. There are a number of examples of successful cooperatives in Spain. The approach of collective self-consumption also allows people in communities (e.g., residents' association, a neighbourhood, or an industrial park) to become a market actor in the energy sector. The RECs are already introduced in the law, but further regulation that will eliminate the conflict of understanding has yet to be put into practice. However, the National Energy and Climate Plan of Spain for 2021 – 2030 strongly indicates that the necessary legal changes will be made in the near future. The same plan proposes the introduction of CEC, separate from the REC, into the legislation, due to slight differences between the two communities, according to the Revised Renewable Energy Directive 2018/2001/EU and Revised Energy Market Directive 2019/944.

Spain possesses the necessary and required legal infrastructure for data flow, which is an important foundation stone of eCREW approach. Spain started the transformation to smart meters as early as 2008, and full transformation was completed at the end of the last decade. Currently, meter data is processed by the system operator and the distributor. The complementary technical instructions published in the Order TEC / 1281/2019, of December 19 provide strict regulations for the conditions of access to information and associated security measures, and the way in which each participant in the measurement system can directly access the measurement equipment via a portable terminal or visual reading. The Royal Decree 15/2018 allows the marketers to access certain information regarding their consumption, in order to offer consumers a range of energy efficiency measures, either directly or through energy service companies, while respecting the privacy of personal data. It can be concluded that it is possible to use smartphone applications in the e-CREW approach in Spain.

4.5.5 Perspective from a Community and Citizen point of view

The survey carried out during the H2020 project ECHOES was mainly aimed at providing perspectives on the community, and citizen points of view in Spain (ECHOES Cordis Website). The survey aimed at providing insights into individuals' energy choices within the context of the energy transition process. The survey's geographical coverage was 31 countries (EU 28 including the United Kingdom, with Norway, Switzerland and Turkey). Of the total 18,000 participants in 31 countries, 600 were from Spain. This online survey contained 114 questions.

4.5.5.1 Community perspective (Utilization the results of ECHOES survey)

Among the respondents from Spain, 48% stated that they would be interested in participating in a renewable energy investment, and 48.5%, that their pro-environmental behaviours are positively affected by their communities' perspectives. This reflects an even stronger belief, held by 59.2%, that people can act together for energy transition. These results point to a significant potential for RECs and CECs. Only 50% of the respondents from Spain perceive themselves as citizens of the country they live in, therefore, the foregoing results suggest strong foundations for community attachment in terms of energy-related endeavours.

In contrast, individuals' actual perception about how well the community is doing in terms of energy behaviours is rather negative. As many as 95% believe that human activities are at least equally responsible as natural causes for global warming, and 69% believe that human activities are the main reasons. Given this, 71% of the respondents from Spain claim to feel anger that people in their community fail to save energy. The perspectives for the future are more promising; 58.7% believe that a growing number of people in their communities support policies in favour of energy transition, and 59.2% believe that a growing number of people in their communities will try to adopt energy-saving behaviours. However, regarding actual practice, only 41.6% of respondents observe that more people in their communities are adopting energy saving behaviour for heating and cooling.

Regarding the extent to which respondents expect their community to support their energy-related behaviours, 55.2% hope that they would receive social support if they opted for policies that favour energy transition. A more substantial 69.5% feel certain that they would receive such support for using less energy, with 59.9% stating that their community would support energy savings in heating and cooling.

For unconventional behaviours for energy savings, individuals expect a much lower level of support from their communities. For instance, only 34.2% of respondents expect support from their communities if they allow the grid operator to remotely turn on/off non-critical appliances.

4.5.5.2 Current status of communities in terms of energy-related endeavours

Community energy initiatives are mainly concerned with energy generation, using renewable sources, wind or solar power. A comparison of the number of community energy initiatives in European countries shows that Germany leads with 1,750 initiatives. Denmark, Netherlands, and the United Kingdom follow, with 700, 500, and 430, respectively, while Spain is reported to have only 33. This is even fewer than the number of such initiatives in Poland, Belgium (34 each), France (70), and Sweden (200) (Caramizaru and Uihlein, 2020). Despite having the suitable legislative and administrative structure, Spain does not seem to have sufficiently utilized this potential.

Weather conditions in Spain are suitable for the establishment of solar power energy initiatives; biogas is also another area for energy initiatives, such as in the example of Som Energia from Spain, which invests in and purchases biogas (Caramizaru and Uihlein, 2020).

A primary set of drivers for energy initiatives pertains to economic conditions. In some cases, policies that cause economic loss through higher prices may have the effect of triggering the establishment of energy initiatives. In the case of Spain, for instance, a number of energy cooperatives were established following increased electricity prices in 2012. Among other benefits, these cooperatives aimed at utilizing the lower costs of renewable energy sources (Capellán-Pérez, Campos-Celador, and Terés-Zubiaga, 2018). Som Energia, in response to the cuts in subsidies for renewables, established a financing scheme for its members, offering interest-free loans, and electricity priced at generation cost. The members are given annual compensations based on their electricity bills. Members of the cooperative sell their generated electricity to the cooperative, for redistribution by Som Energia to the members based on their usages (Caramizaru and Uihlein, 2020).

Som Mobilitat is another community initiative in Spain, involved in car-sharing. The non-profit consumer cooperative Mobilitat purchases electric cars and rents parking spaces to offer car-sharing service to its consumer-members. The electric vehicles are charged using electricity generated from renewable sources (Caramizaru and Uihlein, 2020).

Two of the main community initiatives in Spain are Som Energia and Som Mobilitat.

The Som Energia is the first renewable energy cooperative in Spain. The cooperative targets citizen involvement in developing and implementing sustainable development initiatives. Established in 2010, with currently around 60,000 members, Som Energia deals with the generation and supply of renewable energy, using solar, wind, hydro, and biogas as sources. The yearly generation capacity of Som Energia is around 14 GWh (Som Energia Website)

Som Mobilitat, on the other hand, stands out as Spain's first cooperative aiming at a transition to sustainable mobility, starting from local communities. The non-profit cooperative provides its members with fully electric car-sharing services. The cooperative positions its business models against profit-oriented private mobility. Som Mobilitat was established in 2016, and currently has around 1500 members (Som Mobilitat Website).

4.5.6 Citizen perspective (Utilization the results of ECHOES survey)

Important evidence from the ECHOES survey regarding attitudes towards RECs and CECs is that 89.1% of the respondents in Spain are positive about the environmental benefit of renewables. Additionally, 66.8% state that they intend to use renewable energy in such a way as to support energy transition. Regarding economic benefits, 64.7% foresee that the use of renewables will create employment.

84.3% of the respondents believe that global warming is in progress, pointing to the urgency of adopting pro-environmental behaviour.

Looking at how far these perceptions result in actual behaviour change, 74.1% state that acting pro-environmentally is an important part of their lives. 77% feel obliged to be energy efficient, with a similar 73.1 % reporting feeling obliged to adopt energy savings behaviour regarding household heating and cooling.

Regarding pro-environmental energy policies, 56.2% of respondents from Spain are in favour of such policies, even if the result is higher costs. A slightly higher 59.2% of the respondents state that they would support such policies even at the cost of some discomfort, i.e., a fall in their desired standard of living.

4.5.6.1 An overview of energy behaviours of citizens

Lifestyles and lifestyle choices are significant drivers of energy behaviours. The ECHOES survey provides insights into respondents' lifestyles and choices in Spain.

Most respondents, 68.3%, live in apartment blocks. Another 18.8% live in single-family homes. Regarding the floor areas for the dwellings, 25% are smaller than 70 square feet, and 25.3% are between 71 to 90 square feet. 21% live in larger dwellings of 91 to 110 square feet, and 11.7%, of between 111 and 130 square feet. The remaining 17% live in households of 131 square feet or larger.

In Spain, 43.3% of respondents use central heating for domestic heating, 21.3% use one or more standalone stoves,17.8% use one or more standalone electric heaters, and 11% use district heating.

Accordingly, 40.8% of the households use gas for heating, and 32.8% use electricity.

The energy used for heating and cooling depends on individuals' comfort temperature preferences. 45.3% of the respondents state that their comfort temperatures are close to the average, 35.2% prefer cooler temperatures, and 19.5, warmer temperatures.

95.2% of respondents in Spain own air domestic conditioners; however, 51% stated that they rarely or almost never use these during hotter periods.

46.3% of respondents state that they always or often disconnect electric appliances when not in use.

94.5% use energy-saving light bulbs at home, and 78.7% have at least 75% energy-saving light bulbs.

Interestingly, 63.8% of the respondents give no definite answer on whether their electricity provider has a particularly high share of renewable energy production. 21.3% confirm that their provider has a particularly high share of renewable energy production, and the remaining 14.8% confirm that theirs do not.

Driving habits and use of public transportation are also important determinants of energy behaviours. In Spain, 92.8% of respondents state that they drive private cars. 23.2% drive less than 5,000km annually, 21.5% drive between 5,000 and 10,000km, 14.7%, between 10,000 and 15,000km, 12.5%, between 15,000 and 20,000km, and 8%, between 20,000 and 25,000km.

15% almost always drive alone, whereas 61.6% drive alone more than 50% of the time.

The great majority (93.7%) of vehicles are petrol or diesel fuelled. Only 1.8% are either hybrid-electric, plug-in hybrid, or fully electric.

85.2% of the respondents from Spain have never participated in car-sharing. Out of these, 40% never intend to try it, and the remaining 45.2% find the idea interesting. Most of the respondents who have tried car-sharing (13.2% of 14.9%) report positive experiences.

In terms of public transportation use, only 30.6% believe that public transportation to be environmentally friendly, 36% believe that it is not, and the remaining 33.4% are undecided. The usage rate of public transportation is rather low. 45% state that they rarely use public transportation (less than once per week on average), 24.6% use public transport 1-4 times per week, and 13.6%, 5-8 times per week.

Air travel habits relate to carbon footprints and hence energy-related behaviour. 61.7% of the respondents report taking private-purpose (non-business) air journeys within the last year. The total annual flight time for these trips is generally 10 hours or less (46.4% out of 61.7%).

4.5.7 Interim conclusion

The demographic outlook of Spain is very similar to the rest of Europe. Increasing life expectancy and an ageing population is likely to pose issues regarding CEC and REC implementations.

On the other hand, unemployment levels also have a potential to affect citizens' perspectives on energy-related initiatives. The foreseen costs of renewable energy investments or house renovations are much harder to pursue under conditions of unemployment.

Clearly, there are also advantages that would foster CECs and RECs. The education level of the population is high and is continuing to rise. Higher education levels generally mean higher levels of awareness and interest in energy-related initiatives.

The energy profile of Spain also provides pointers regarding CECs and RECs. The share of coal in Spain's energy mix demonstrates a sharp decrease from 21.4% of the consumption in 1990 to 4.1% in 2019. This decrease clearly benefits the environment and also provides opportunities for further deployment of renewable energy generation. However, the national energy profile is still dominated by fossil sources (oil products), and the potential for renewables is insufficiently utilized. The share of renewables in energy supply has increased from 0% in 1990 to only 6.8% in 2019, considerably under the desired level.

The energy market has reached a mature state after the process of deregulation. Another significant advance in the electricity market, in 2018, was the completion of smart meter rollout, which can be utilized to significantly enhance the consumer's role in the electricity market, via information empowerment. This approach would also foster interest in, and further support the operationalization of CECs and RECs. The electricity market in Spain has yet to fully utilize the smart meter rollout, as required in demand management.

The relevant legislative structure in Spain provides a highly suitable environment for energy initiatives. Individuals can freely join energy cooperatives and generate electricity, allowing the establishment of successful cooperatives (such as Som Energia), and promoting collective self-consumption. These community initiatives (e.g., residents' associations, neighbourhoods, or industrial parks) can also participate as actors in the energy market.

Currently, the regulations regarding RECs require further regulation for operationalisation. Evidence from the National Energy and Climate Plan of Spain, covering 2021-2030, shows that the required further legislation is planned in the near future.

Clearly, the adoption of CECs and RECS heavily rely on energy behaviours of individuals and communities, highlighting the importance of the insights from the international ECHOES survey.

According to the ECHOES survey, almost 90% of respondents from Spain are positive about the impacts of renewables on the environment. About two-thirds of these individuals state their intentions to support energy transition through their use of renewable energy. However, such intention is not matched by the same level of practical action.

The majority also state the need to act pro-environmentally, and report feeling the obligation to be energy efficient, and to adopt energy savings behaviour regarding household heating and cooling.

Pro-environmental energy policies are positively perceived by individuals, despite their awareness of the burdens in terms of increased costs or decreased living standards.

Individuals primarily consider the economic burdens and benefits when evaluating energy-related initiatives; however, the ECHOES survey shows that community attachment is also an important mechanism in the promotion of energy initiatives. A high percent of ECHOES survey respondents in Spain point to the significance of the community perceptions and responses to individuals' energy behaviours.

On the other hand, there seems to be a lack of approval of the energy behaviours of other individuals in communities. More than 70% of the respondents from Spain, for instance, feel anger towards those who do not save energy. However, despite these feelings, most individuals believe that the community is moving towards adopting energy-savings behaviour and supporting pro-environmental policies.

4.6 Turkey

4.6.1 Country Profile

4.6.1.1 Demographics

Turkey occupies a 770,000 square km area in the intersection of Europe and Asia. Turkey's European area is named as Thrace, and the area in Asia is named as Anatolia (Asia Minor). Turkey has borders with Greece and Bulgaria to the northwest, and also a 1,700 km coastline on the north to the Black Sea. The northeast neighbour of Turkey is Georgia, and to the east, Turkey has borders with Armenia, Azerbaijan and Iran. Finally, to the south, Turkey has borders with Iraq and Syria and a 1,600 km coastline to Mediterranean. This 2,800 km coastline extends to the Aegean Sea in the west of Turkey. The Marmara Sea connects the Black and Aegean Seas through the Dardanelles and the Bosporus straits.

According to 2019 figures, the population of Turkey was 83.3 million, with a 1.39% annual population growth rate. The gender distribution shows that 50.2% of the population is male, 49.8% is female. The population is projected to reach 88.3 million by 2025, 100 million by 2040, and 108 million by 2060 (Census Statistics, 2019a).

The GDP per capita in Turkey, as of 2019, was around 9,125 USD. This shows a considerable increase from 3,140 USD in 2001s, but lower than 12,615 USD in 2013 (Worldbank, 2020).

Regarding residence areas, 92.8% of the population is located in urban areas, a 0.54% increase as compared to 2018. This points to the continuing shift in the population from rural to urban areas.

Around 37% of the population is located in 5 major cities, Istanbul, Ankara, Izmir, Bursa, and Antalya. The population of İstanbul is 15.5 million (18.7% of the population), followed by 5.6 million (6.8%) in Ankara, the capital city located in central Anatolia, and 4.4 million (5.2%) in the western city of Izmir. Bursa hosts 1.5 million (3.68%), and Antalya, 1.26 million (3%).

The shares of age groups within the population for 2007 (on the left) and 2019 (on the right) are given in Figure 50 below. Comparison of the population pyramids from 2007 and 2019 show that the share of older age groups is increasing mainly due to a decrease in birth and mortality rates (Census Statistics, 2019a).

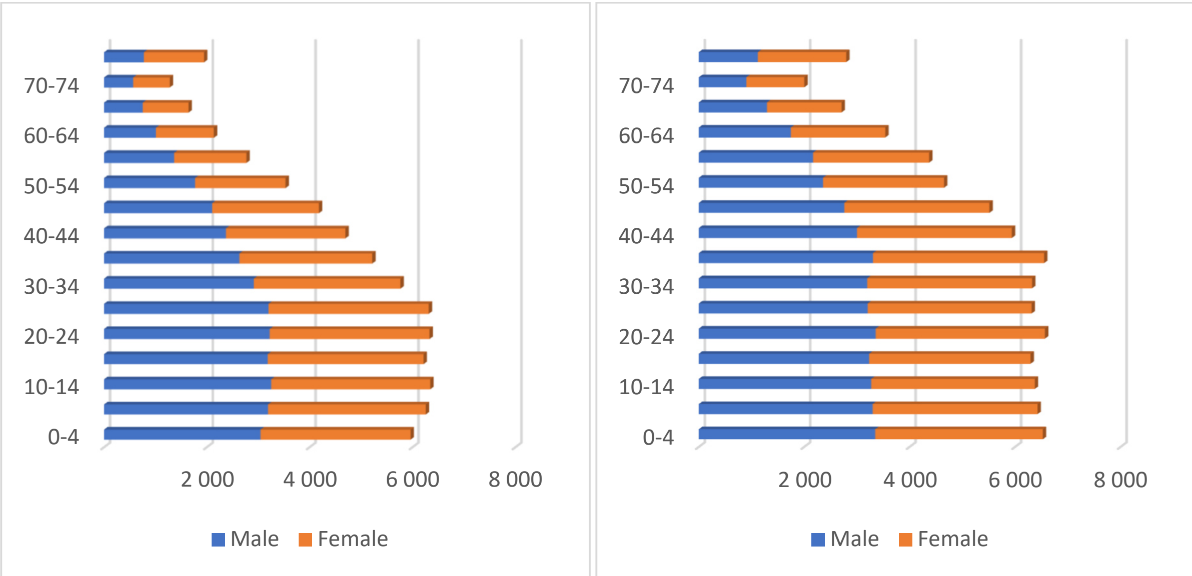


Figure 50: Shares of Age groups within the population for 2007 (left) and 2019 (right)

The share of the young population (15-24 age group) is projected to decrease from 15.6% to 14% as of 2030, and 11% by 2080. These rates are still higher than the European Union average of 10.7% in 2019 (TUIK Youth Statistics, 2019).

The median age in Turkey, as of 2019, is 32.4 (31.7 for males, and 33.1 for females), demonstrating a continuous increase in the last decade and a half, from 28.2 in 2007 to 30.7 in 2014 and 32 in 2018.

Changes in the population structure has also resulted in an increase in the share of the working age population (i.e. the 15-64 age group) to 67.8% in 2019, from the 2007 level of 66.5%. Within the same time period, the share of children (0-14 age group) decreased from 26.4% to 23.1%, and the share of elderly (65+ age group) increased from 7.1% to 9.1%. These figures point to a decrease in the child dependency ratio (from 35.4% in 2015 to 34.1% in 2019), defined as the number of children that economically depend on a working age individual, and an increase in the elderly dependence rate (from 12.2% in 2015 to 13.4% in 2019), defined as the number of elderly economically dependent on a working age individual. Although the total dependence rate is almost constant (around 47.5%), this is expected to increase due to changes in the population structure (Census Statistics, 2019a).

Within the 2017-2019 period, the life expectancy at birth was 78.6 years, showing an increase from the 2013-2015 value of 78 years. Females have a life expectancy at birth, 81.3 years, and males, a life expectancy of 75.9 years (TUIK Life Expectancy Tables, 2019).

The average population density (population per square km) in 2019 is 108. Istanbul, with 2,987 per square km, is by far the densest, followed by Izmit, with 541 per square km. Izmir is the third most densely populated city, with 364 per square km. The eastern cities of Tunceli, Ardahan, and Erzincan have the lowest population densities, with 11, 20, and 20 people per square km, respectively (Census Statistics, 2019b).

As of October 2020, the unemployment rate in Turkey was 12.7%, and the employment rate, 43.6% (Employment Statistics, 2020).

In terms of education levels, 58.3% of the 25-64 age group in Turkey have a level below upper secondary education, considerably more than the OECD average of 21.3%. Regarding upper secondary education (grades 10,11, and

12), the share of people with upper secondary education within the 25-64 age group in Turkey is 20%, less than half the OECD average of 41%. 22% of the 25-64 age group in Turkey has tertiary education (undergraduate and graduate education), well below the OECD average of 38% (OECD, 2020)

4.6.1.2 Energy profile (production, supply, consumption etc.)

Turkey's economy can be considered as energy intensive. According to 2019 figures, Turkey's total energy production was around 44.8 MTep. Coal had the leading share (36.4%), followed by geothermal (21.5%), and hydro (17%). Bioenergy and crude oil had similar shares of 7.04% and 7%, respectively. In 2019, energy generated from wind accounted for 4.17%, of and solar energy, for 3.62% of energy production Production statistics show that renewable sources (hydro, geothermal, bioenergy, wind, and solar) had a total share of 53.3%.

Turkey is heavily dependent on imports for energy supply. In 2019 115.4 Mtep equivalent of energy was imported, and 9.7 Mtep was exported and 6.5 Mtep was used as bunker fuel (for aircrafts and maritime vessels). Major import components, in terms of Mtep, are natural gas, with 32.3%, crude oil with 28.3%, coal with 20.6%, and oil products with 18.2%.

On the consumption side, a total of 33.5 Mtep is consumed during energy production, including production losses, contributing to a total final energy consumption of Turkey in 2019 of 110.8 Mtep.

The breakdown of this consumption by sources shows that the highest shares of Turkey's total energy consumption in 2019 were in oil products (37.1%), followed by natural gas (23.2%). Electricity consumption corresponds to another 19.8%, and coal, 12%.

When the industry-wise consumption is considered, the industry sector used 34.5 Mtep of energy in 2019, 31.5% of the total consumption. The transportation sector accounted for 27.7 Mtep, 25.2% of the total, and other sectors had a share of 36.8%. (housing 21.2%, commercial, 11.4%, and agribusiness, 4.2%). The remaining 7 Mtep (6.4%) was classified as non-energy consumption, explained as the losses and internal consumption for oil products and internal consumption of oil refineries (Ministry of Energy, 2019).

In terms of electricity, the total electricity generation of Turkey in 2019 was 303.9 TWh. The leading resource in electricity production was coal (37.1%), followed by hydro (29.2%), and natural gas (18.9%). Wind power has a share of 7.1%, solar power, 3%, geothermal, 2.95%, and waste heat, 1.5%.

The electricity consumption of Turkey in 2019 was almost parallel to production, amounting to a demand of 303.3TWh, including 2.2TWh of electricity imports and 2.8TWwh of exports in the total of? 303.8TWH of production. Both production and demand values have increased by around 56% between 2009 and 2019 (TEIAS, 2020). Turkish Ministry of Energy and Natural Resources expects a yearly 5% increase in electricity demand, amounting to around 370 TWh as of 2023 (Republic of Turkey Ministry of Energy and Natural Resources, 2020a).

With this energy profile, the main pillars of Turkey's energy policy are decreasing energy intensity, increasing energy efficiency and energy savings, utilizing indigenous resources, and decreasing carbon emissions. The National Energy Efficiency Action Plan (NEEAP) for the timeline 2017-2023 has the target of decreasing energy intensity by 20% -with reference to 2011 rates- by 2023. To this end, the National Energy Action Plan calls for an energy savings of 24 Mtoe, through an investment of 11 billion USD to fund 55 actions in 5 sectors by 2023 (YEGM, 2018).

Energy plans include investments, action plans and policies of Turkey's Ministry of Energy and Natural Resources targeting energy savings, energy efficiency and the protection of the environment. These are further supported by training programs (in the context of social projects and training of energy managers), empowering stakeholders (including energy efficiency consultancy, academic institutions, and trade organizations), energy audits and monitoring (e.g., by smart meter rollout), incentives, and activities for increasing awareness on energy and Greenhouse Gas Emissions (Republic of Turkey Ministry of Energy and Natural Resources, 2020b).

The NEEAP of Turkey focuses primarily on five areas: buildings and services, industry and technology, energy, transport, and agriculture.

The growth in the building sector in Turkey led to a 4.4% average annual rate of increase in the energy demand in the sector. The share of the building sector in the final energy consumption has reached in excess of 30% (YEGM, 2018), making energy savings and energy conservation in the sector crucial components of the NEEAP. The pertaining actions in NEEAP include defining energy demand levels for buildings, setting limits on emissions, penalizing carbon emissions exceeding allowable limits, decreasing energy demands and carbon emissions of buildings, and increasing the use of renewable energy in buildings (YEGM, 2018). To achieve these goals, the action plan promotes public-private cooperation. As an important step, the Regulation on Energy Performance for Buildings was amended in 2017 to require Energy Performance Certificates (at least C class) for new buildings (Energy Performance in buildings Regulation, 2008). Likewise, the Climate Change Action Plan covering 2011 to 2023 also includes targets for increasing the share of renewables in electricity consumption, as well as energy efficiency goals (Republic of Turkey Ministry of Environment and Urbanization, 2011).

For industries, energy costs are important cost components, and their reduction is important for all companies in Turkey, providing a natural motivation for energy conservation and energy efficiency. This motivation is supported in legal terms by the Energy Efficiency Law (2007) that requires energy efficiency audits and the establishment of an organizational framework for energy management (Republic of Turkey Ministry of Energy and Natural Resources, 2007). The Energy Efficiency Strategy aims to decrease energy intensity, and thus, contribution of technological energy efficiency developments is of particular importance.

Transmission and distribution losses in the energy sector of Turkey are around 8%, pointing to an above-OECD average figure (YEGM, 2018). To this end, the NEEAP and Tenth Development Plan involve actions with the broader aims of increasing energy efficiency, as well as sustainability of the energy sector.

The growing transportation sector, accounting for more than 25% of the final energy consumption, also constitutes an important component of Turkey's energy strategy. In terms of energy supply security, the dependence on imported oil products for road transport is a key factor. The transportation sector is also responsible for significant adverse effects on the environment, including air and noise pollution, caused by transportation activities and resulting traffic congestion. The share of road transportation in the overall energy consumption of the transport sector is above 90%, and this is the primary focus of energy conservation and energy efficiency actions in this sector. For instance, the Transport and Communications Strategy Goal 2023 aims to decrease the share of road transportation in freight transport and passenger transport, by increasing the share of railway transport. The goal is to achieve a share of 15% in railway freight transport and 10% in railway passenger transportation by 2023 (Republic of Turkey Ministry of Energy and Natural Resources, 2019). Alongside these objectives, National Intelligent Transport Systems Strategy (2014-2023), fostered by the Ministry of Transport and Infrastructure, follows the overarching objectives of sustainable transportation, application of clean car technologies, and use of alternative fuels.

The NEEAP also includes principles and action plans for the agricultural sector of Turkey. These mainly rely on increasing energy efficiency and conservation through the increased application of emerging technologies. Examples include the replacement of conventional equipment (e.g., tractors, harvesting machines) with more efficient new-technology counterparts, using drip irrigation or other efficient irrigation methods that enhance energy and water conservation, and incentivizing the use of renewable energy (e.g., biomass, wind energy) in agriculture (YEGM, 2018).

4.6.1.3 Energy market and infrastructure

This electricity production was realized with an installed generation capacity of 91.3 GW. When compared with the installed electricity generation capacity of 44.7 GW in 2009, this points to a 103% increase in installed capacity. Figure 51 below demonstrates the evolution of the installed electricity generation capacity of Turkey from 1979 to 2019.

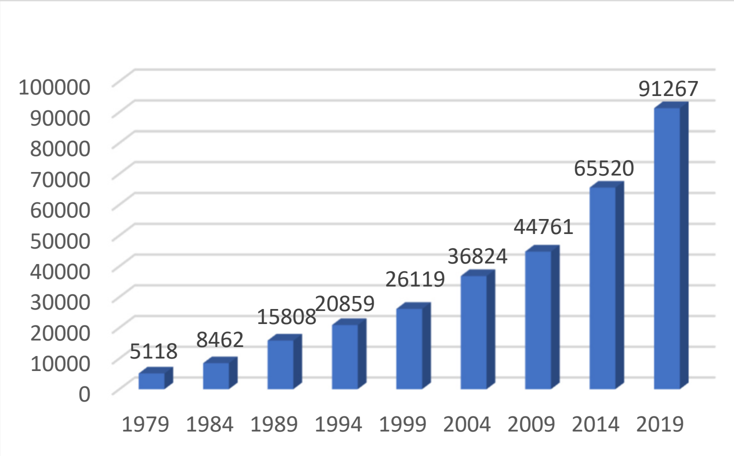


Figure 51: Evolution of installed electricity generation capacity of Turkey (MW) from 1979 to 2019

As of 2019, hydro has the highest share in the installed electricity generation capacity with 31.2% followed by natural gas, with 23.9% and coal, with 21.4%. Looking at the renewable sources, wind accounted for 8.3% of Turkey's installed electricity generation capacity in 2019, solar, for 6.6%, geothermal for 1.7, and renewable waste and waste heat, for 1.3%.

There was a remarkable increase in the shares of renewables from 2009 to 2019. The share of wind increased from 1.77% to 8.3%, and solar, from 0 to 6.6%. These changes led to decreased shares of coal and natural gas by around 3% each, and hydro, by around 1.3% (TEIAS, 2020).

The electricity market in Turkey was fully centralised and regulated in 1994, when the state owned and run TEK (Turkish Electricity Agency), responsible for electricity production and distribution, was separated into two companies: TEDAS (Turkish Electricity Distribution Corporation) and TEAS (Turkish Electricity Production and Transmission Corporation, which later, in 2018, was incorporated into EUAS. Following this first important action towards deregulation in 1994, three important steps were taken in 2001. The first was the reorganization of TEAS into three companies: TEIAS (Turkish Electricity Transmission Corporation), EUAS (Electricity Production Corporation), and TETAS (Turkish Electricity Trade and Contract Corporation). The second was the establishment of EPDK (Energy Market Regulatory Authority), and the third was the issuance of the electricity Market Law (No. 4628). EPDK is responsible for regulating the electricity market, as well as the natural gas, LNG (Liquefied Natural Gas), and downstream petroleum markets.

As of 2020, the electricity market is a multiplayer free competitive market. The share of state-owned EUAS in installed electricity generation capacity has decreased to 21%. Figure 52 below shows the shares of state and private companies in the installed electricity generation capacity from 2009 to 2019.

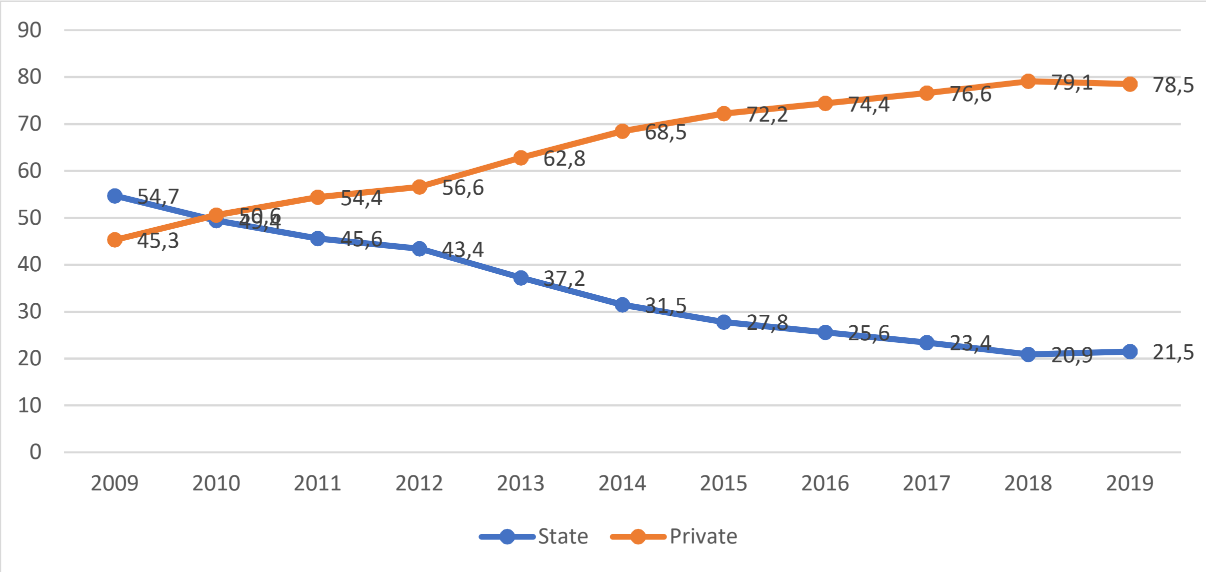


Figure 52: Shares of state and private companies (in %) in the installed electricity generation capacity from 2009 to 2019.

Figure 53 below shows the shares in the installed electricity generation capacity of Turkey in 2019 by type of company.

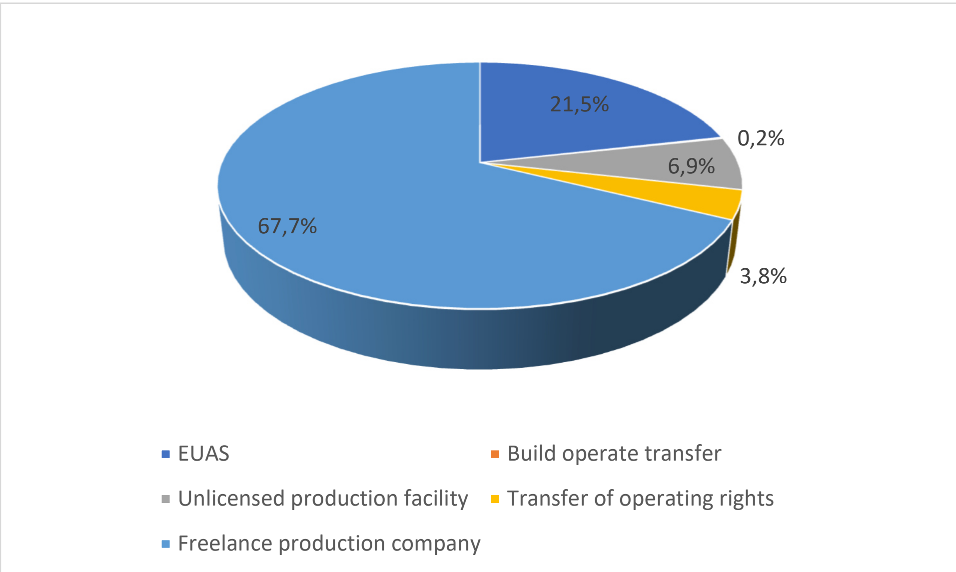


Figure 53: Shares in the installed electricity generation capacity of Turkey in 2019 by type of company.

TEIAS acts as the system operator, and is also responsible for the operation of the balancing market and the auxiliary services market for the electricity sector. TEDAS, initially responsible for the delivery process, first divided the country into 21 zones, which, through privatization, were allocated to private delivery companies between 2009 and 2013.

In addition to this structure of the market for production, transmission, and delivery, EPIAS (Energy Exchange Istanbul- EXIST) was established in 2015 for the operation of wholesale electricity market, and establishing financial arbitration in the intraday market, day ahead market, and balancing market (EPIAS, 2020).

Natural Gas Market Law (No: 4646) specifies market activities for the natural gas market, and sets forth that legal persons aiming to be involved in market activities need to obtain a license. Within these activities, natural gas production is not considered as a market activity, it is rather in the scope of search and operation certificates, under the jurisdiction of Petroleum Law (No: 6491). For the producing company to sell the natural gas, however, an export or wholesale license is required. The Natural Gas Market Licensing Regulation specifies the details of the processes for the granting of licenses, valid for a period of between 10 and 30 years. The licenses are in the categories of import, export, wholesale, storage, transmission, CNG (compressed natural gas), distribution license. As of 2017, the following numbers of licences were in effect: 72 for distribution, 9 for storage, 8 for export, 17 for transmission, 60 for import, 96 for CNG, and 49 for wholesale (EMRA Activity Report, 2017).

The state-owned BOTAS (Petroleum Pipeline Company), initially established for transporting crude oil from Iraq to Turkey in 1974, later acted as the sole company for the natural gas trade, transportation, and pipeline operation. Following the first import agreement with the USSR (as it then was), natural gas was first imported in 1987, and the following year, was introduced for household and industry use (Botas, 2020).

The first LNG import agreement was signed with Algeria in 1988, and the first LNG terminal became operational in 1994, and another in 2006. The first was the BOTAS-owned Marmara Ereglisi terminal, and the second, the private Egegaz-owned Aliaga terminal. In 1995, the second LNG import agreement was signed with Nigeria.

The first natural gas purchase agreement with Iran in 1996 was followed by similar agreements with Russia, (Blue Stream) in 1997, and (West) in 1998, with Turkmenistan in 1999, and with Azerbaijan in 2001. The first delivery was received from Iran in 2001, and from Russia through the Blue Stream Pipeline in 2002. The 396 km Blue Stream Pipeline has an annual capacity of 16 bcm (Gazprom, 2020).

The Natural Gas Market Law (No: 4646), of 2001 paved the way for deregulation, and increased the share of the private sector companies in the market. The first remarkable step in this direction in 2005 was the involvement of private sector companies in negotiations for natural gas alongside the state-owned BOTAS. In 2009, private sector operations accounted for 4 bcm in exports and wholesales. In 2012, private sector companies agreed a 6 bcm import contract with Gazprom, following the expiry of Botas's Gazprom-West contract.

The construction of the Turkey-Greece natural gas pipeline took place between 2005 and 2007. The pipeline is 296 km long, and has an annual capacity of 7 bcm.

Another significant pipeline, TANAP, started in 2015. Gas flow from the TANAP pipeline started in 2018, with a planned maximum capacity utilization of 16 bcm per year by 2022. The 1850 km pipeline delivers natural gas received on the Georgian border via the South Caucasus Pipeline to Turkey, further connecting to the Trans Adriatic Pipeline (TAP) on the Greece border. TANAP shareholders are the Azerbaijani South Corridor Natural Gas Company (SGC) with 51%, SOCAR Turkey with 7%, BOTAS with 30%, and BP Pipelines (TANAP) with 12% (Tanap Project Leaflet, 2014).

Regarding the storage infrastructure, in 2016, two storage facilities, Silivri Storage Facility and Tuz Lake Storage Facility went into operation. In the same year, a tender was completed for delivering natural gas to all cities in Turkey.

In 2018, another step was taken towards the deregulation of the natural gas market in Turkey, the establishment of the Organized Wholesale Market, under the operation of EXIST (Petform, 2020).

4.6.2 Legal and administrative Framework of Energy Communities under National Structure

4.6.2.1 National legal and administrative framework for the adoption of eCREW approach

In the context of Citizen Energy Communities (CEC) and Renewable Energy Communities (REC), Turkey's energy legislation involves three important legal regulations. These are: (1) *Act No. 6446 on Electricity Market 2013*, (2) *Act No. 5346 on Utilization of Renewable Energy Sources for the Purposes of Generating Electrical Energy 2005* and (3) *Regulation on Unlicensed Electricity Generation in Electricity Market 2019*.

The main regulation in electricity generation in Turkish Law is the *Act No. 6446 on Electricity Market 2013*.

In accordance with the Act, electricity generation and distribution can only be carried out by the legal entities duly licensed by the Energy Market Regulatory Board (EMRA). These entities must have the status of a joint stock company or a limited liability company (art. 4/3). In addition, organized industrial zones (OIZs) are permitted to carry out generation and distribution activities (art. 7 and art. 13). These specified legal entities are permitted to operate in the electricity market, after obtaining the required license.

The Act also regulates that some market activities are exempt from the requirement for a license, allowing electricity to be generated without a license in specific circumstances. These specific activities, stated by the article 14 of the Act, are limited in number (numerus clauses) and are as follows:

- Emergency generator groups and generation facility which is not connected with the transmission or distribution grid,
- Generation facility with a maximum of 1 megawatt power generation capacity based on renewable energy sources,
- Electricity generation facility that is established for purposes of disposal of the mud from the municipality treatment facilities and solid waste facilities,
- Micro-generation facilities and co-generation facilities that operate under the category determined by the EMRA, and that meet the productivity levels determined by the Ministry of Energy and Natural Resources,
- Generation facility based on renewable energy sources that consumes all energy generated without feeding to the transmission or distribution system, and that has a single generation and consumption measurement point.
- Market activities carried out within the scope of participation of electricity storage and demand parties, provided that they remain within the framework of the limits, procedures and principles as will be determined by EMRA, following recommendations of the Ministry of Energy and Natural Resources.
- Generation facility, based on renewable energy resources, established and run by the General Directorate of State Hydraulic Works, for the purpose of meeting the electricity needs of the agricultural irrigation facilities, whose electricity costs are covered by General Directorate of State Hydraulic Works, provided that the installed power is limited to the agricultural irrigational facility's contractual power requirements in the connection agreement.
- Generation facilities based on renewable energy resources provided that the electricity generation is limited to the contractual power in the connection agreement.

Among these, in terms of e- CREW, particularly important exemptions are item *b)* "generation facility that has a maximum of one megawatt power generation capacity based on renewable energy sources" and item *h)* "generation facilities based on renewable energy resources with the limitation of contractual power in the connection agreement". Both exemptions were essentially legitimised with the aim of promoting consumers' generation of the electricity for their own needs. The exemption in item *h)*, waiving the obligation to obtain a license granted to "generation facilities based on renewable energy resources with the limitation of contractual power in the connection agreement" has been adopted in a very recent law amendment (Act No. 7257 on Amendment on Act on Electricity Market and Some Others, 2020), and clearly reveals the government's current policy orientation on the issue. This last amendment essentially aims to facilitate the procedure for consumers' generation of their own electricity. However, the required update for this amendment to take effect has yet to be made in the relevant regulation.

The president has the authority to increase the upper limit by up to five times for installed power referenced in the above exemptions, on a resource basis. The President so far used this authority once, on May 10, 2019, increasing the upper limit of installed power to 5 megawatts for generation facilities based on renewable energy sources. (Presidential Decree No. 1044, 2019).

Article 14 of the *Act No. 6446 on Electricity Market 2013* states that a regulation will be issued on unlicensed generation and distribution of electricity. Relevant "Regulation on Unlicensed Electricity Generation in the Electricity Market" was published in the Official Gazette No. 30772 dated 12.05.2019 and entered into force.

The second important legal regulation pertaining to CEC and REC is the *Act No. 5346 on Utilization of Renewable Energy Sources for the Purposes of Generating Electrical Energy 2005*. In this law, there is a reference to Act No. 6446 regarding persons who can carry out generation activities. In addition, the law is important in terms of regulating the support mechanism for generation and sales activities. Article 6/A of the Act regulates unlicensed electricity generation activity. The relevant article allows for the creation of the legal foundations for real and legal persons to generate unlicensed electrical energy from renewable energy sources for their own consumption needs, the delivery of the surplus electricity generated to the distribution system, the obligation of the supply company to receive the excess amount, and the necessary support mechanism.

The third important legal regulation to be considered in the context of CEC and REC in Turkish energy legislation is the *Regulation on Unlicensed Electricity Generation in Electricity Market 2019* issued in accordance with Article 14 of the *Act No. 6446 on Electricity Market 2013* and Article 6/A of the *Act. No. 5346 Utilization of Renewable Energy Sources for the Purposes of Generating Electrical Energy* 2005. This Regulation, dated 12.05.2019, states in its first article that the main purpose is to enable the consumers to meet their electricity needs from their own generation facility, located as close as possible to the point of consumption. This purpose in the new regulation is a clear indication of the government's current energy generation policy orientation.

This regulation recognises the right to generate unlicensed electricity to legal persons as well as to natural persons. For those allowed to generate electricity without a license, the consumption facilities should be located in the same distribution zone as the generation facilities. At this point, the definition of those permitted to generate electricity without a license is the same as for those specified in Article 14 of *Act No. 6446*.

Although the Regulation states that authorized persons can generate electricity without a license, it should be noted that further requirements must be met before the establishment of an electricity generation plant is allowed in this context. Those wishing to generate electricity must apply to the relevant network operator – TEİAS, distribution company or Organized Industrial Zone (art. 10). The applications will be examined by a commission established by the network operator. The commission's review is subject to an assessment made in terms of both documentation and technical aspects, after which a letter of invitation is issued for the appropriate applications. Upon receiving the letter of invitation, applicants sign a contract for a connection agreement within the required period.

For unlicensed electricity generation based on renewable energy, the rules are different: there is no limitation on the application period, the application can be made in any month, there is no obligation to measure the performance parameters, and there is no need to deposit a security for the application offers significant advantages to the applicant in terms of administrative review.

It is essential that the generation activity of natural persons and legal persons engaged in unlicensed electricity generation should be limited to their own needs (art. 23). However, the production of electricity generated in these facilities may exceed the needs of the consumption facility or facilities established at the same location with the production facility. This surplus can be transferred to another consumption facility or facilities belonging to the same person, provided that it is in the same distribution region. The method of evaluating the surplus electricity is also specified in Article 24.

An important tool that the Regulation adds to the Turkish energy legislation is the consumption aggregation method. According to Article 29 of the Regulation, one or more natural persons and/or legal persons included in the same tariff group using the same connection point, or whose electrical energy consumption can be measured with a common meter, may establish generation facility or facilities by aggregation of their consumption (e.g., office block, shopping mall and industrial estate). In this case, each person participating in the consumption aggregation must have a separate consumption facility or facilities. Within the scope of the regulation, the consumption aggregation method allows two or more natural or legal persons to come together to generate and consume electricity without creating a separate legal personality. This arrangement allows a production system that conforms to the CEC and REC definitions. However, it is seen that this opportunity in Turkish legislation has limitations, and not every group of natural or legal persons is permitted to generate and consume electricity by combining consumption. This production can only be made in facilities belonging to one or more real and/or legal persons that are in the same tariff group and connected to the same connection point, or whose electrical energy consumption can be measured with a single common meter. This condition by itself limits the implementation of CEC and REC's in Turkey within the scope of relevant Directives.

Another issue that may prevent more than one person from participating in electricity generation by the consumption aggregation method is the principle of official authorization of only one among the group. Within the scope of the Regulation, the person authorized for the relevant administrative procedures will also take the legal responsibilities in administrative terms, regarding both generation and consumption. The system where the responsibility for the compliance of multiple people with the legal requirement of generating and consuming electricity by aggregation falls on only one person is bound to have a negative effect on the implementations.

Cooperatives have a special place in the legislation concerning legal persons who are entitled to generate electricity through consumption aggregation method According to paragraph 11 of Article 29 of the *Regulation on Unlicensed Electricity Generation in Electricity Market 2019*, energy production cooperatives can be authorized in terms of electricity generation without consumption facilities. What differs for the cooperatives, as compared to other forms of consumption aggregation systems, is that the authority is given to the legal personality of the cooperative, rather than a person. This is an arrangement that removes the inconvenience that is explained in the above paragraph. The regulation in paragraph 71 of the preface of 2018/2001/EU of the Renewable Energy Communities Directive states that renewable energy communities should be autonomous from individual members and other traditional market actors, in order to ensure broad participation and to prevent abuse. The separate legal personality of a cooperative (Coskun, 2019) and the granting of authority for unlicensed production to a legal person rather than a natural person are important developments for Turkish legislation.

The lack of necessary additional explanations in the regulation, however, raises a question. If the cooperative has no consumption facility, how would the authorization of electricity generation by consumption aggregation method work? The answer lies in the definition of the notion of "cooperative" in Turkish law. In the first article of *Act No. 1163 on Cooperatives 1969*, a cooperative is defined as "*a legal body with variable members, variable capital, and legal identity that is established by natural and public legal entities and private administrations, municipalities, villages, societies, and associations in order to ensure and maintain certain economic interests and specifically, the needs of their members toward professional life and living standards by means of mutual assistance, solidarity and service as trustees to each other*". As seen from the definition, energy generation cooperatives can also be established for the purpose of ensuring and protecting members' economic interests, in this case, the generation of electricity. In this manner, as different from the system explained earlier in previous paragraphs, it is possible for natural and legal persons to establish a separate legal entity (cooperative) to fulfil their personal consumption needs. It can be inferred that the purpose of the legislator here is the aggregation of natural and legal person's consumptions within the cooperative's legal entity.

In this context, it has become possible for persons to use the "cooperative" umbrella to fulfil their own energy needs from renewable energy sources at a local community level. Unfortunately, the full regulation states that, in order to legally establish an energy generation cooperative, members should be in the same tariff group and connected to the same connection point or their electrical energy consumption could be measured with a single common meter. This condition hinders the establishment of cooperatives for this purpose.

It is important to point out the first *Regulation on Unlicensed Electricity Generation in the Electricity Market*, published in the Official Gazette dated 02.10.2013, on this matter. The former Regulation was significantly amended in 2016, and for electricity generation cooperatives, it was then decided to waive the condition of being connected to the same connection point or measuring consumption with a single common meter. As a result of the amendment, it was possible for a group of at least 7 persons within the same tariff group and with the same membership plan to establish cooperatives for electricity generation by consumption aggregation. As of 2018, the number of cooperatives established through this regulation was 22 (Özgül, Kaçar & Eryaşar, 2018).

Unfortunately, the first regulation was abolished by the *Regulation on Unlicensed Electricity Generation in the Electricity Market* dated 12.05.2019. This arrangement formerly provided specifically to cooperatives was abolished with the new Regulation. Thereafter, generating electricity via a cooperative was permitted only for persons using the same connection point or whose consumption can be measured from a single common meter.

Electricity generating cooperatives, however, being a legal body with variable members and variable capital, coincides with the principles of open and voluntary participation of REC and CEC. According to the Turkish legislation, persons are free to register to a cooperative and terminate their membership at any time (Coskun, 2019).

Cooperatives are regarded as commercial corporations; nevertheless, they have a significant characteristic distinguishing them from other commercial entities, i.e., the universally accepted principle of social responsibility (Ayanoglu, 2014). According to the principle, cooperatives should carry out activities for the benefit of the society, in addition to those in the interests of their members.

General Directorate of Merchants, Artisans and Cooperatives of the Ministry of Trade of the Republic of Turkey encouraged initiatives in establishing renewable energy generating cooperatives, emphasizing that, as well as contributing to the interests of the members by aggregating consumption, they are also helping the protection of the environment, the balanced distribution of local resources, and the prioritization of social interests (Ministry of Trade, 2016). Indeed, with a well-planned cooperative strategy, it is possible to:

- Reduce foreign dependency of the country via the local sustainable production,
- Make rational investments based on the identification of regional energy needs and resources, and thus reducing the losses in the energy system,
- Realize local and sustainable development,
- Create an alternative investment model in the sector,
- Create regional added value by producing energy at the point of consumption.

- Re-establishing the right of those located in the same distribution region to establish cooperatives to generate electricity by aggregating their consumption will also be an important step towards compliance with EU's relevant directives.

- Taking into account all these regulations and within the scope of the legislation in force, the following conclusions can be drawn:
  - Existing enterprises in the organized industrial zone (OIZ) have the right to establish a licensed electricity generating facility under the legal entity of the OIZ.
  - Natural or legal persons, individually, have the right to establish an unlicensed renewable energy electricity generating facility of maximum 1 megawatt for their own consumption.
  - Natural or legal persons, individually, have the right to establish an unlicensed renewable energy electricity generating facility within the limitation of the contractual power of the connection agreement.
  - Natural or legal persons in the same tariff group and using the same connection point have the right to establish an unlicensed electricity generating facility by the consumption aggregation method under the name of a legal representative person chosen from the group.
  - Natural or legal persons in the same tariff group and using the same connection point have the right to establish an unlicensed electricity generating facility by the consumption aggregation method under the legal entity of a cooperative.
  - Natural or legal persons whose electrical energy consumption can be measured with a single common meter have the right to establish an unlicensed electricity generating facility by the consumption aggregation method under the name of a legal representative person chosen from the group.
  - Natural or legal persons whose electrical energy consumption can be measured with a single common meter have the right to establish an unlicensed electricity generating facility by the consumption aggregation method under the legal entity of a cooperative.

Based on this data and current legislation, the scope of application of Renewable Energy Communities in Turkey appears quite narrow. First of all, the licensed market activity is only recognized for joint stock companies and limited companies, and the main purpose of these legal entities is to profit from the free sale of electricity in the market, rather than meeting its partners' electricity consumption needs. This aim is an obstacle against the formation of a community that can carry out licensed generation in another legal form. In Turkish Law, generation of electricity with or without a licence is limited to joint stock companies and limited companies, and not permitted for associations, non-profit organizations or SMEs.

The regulation that paved the way for the establishment of energy production cooperatives without being subject to license was issued in March 2016, even prior to the European Union *Directives 2018/2001/EU* and *2019/944*, resulted in the creation of a constructive legal infrastructure in line with EU's REC/CEC policy. As defined in the relevant directives, cooperatives are legal persons, conforming to REC and CEC, and demonstrating the following characteristics: having an autonomous structure, being subject to the principle of free participation and separation, carrying the main purpose of ensuring and maintaining economic interests of their members, and providing solidarity among them rather than making a profit. In this context, 23 electricity generating cooperatives were established in

Turkey over a period of approximately 3 years. Unfortunately, the amendment of May 2019 that made prohibitive regulatory changes for the establishment of these types of cooperatives has had a negative impact on the implementation of REC / CEC's in Turkey.

While there is a legal infrastructure of individual electricity generation for own need, there are very limited opportunities for community based collective electricity generation.

Community based collective generation in the form of a cooperative or a community without legal personality in compliance with REC/CEC is only possible for natural or legal persons in the same tariff group and with the same connection point, or for those whose consumption can be measured with a single common meter. In the case of forming a community without legal personality, however, it is necessary to delegate a natural person within the community to be responsible for generating electricity. The generation and consumption of the community must be accepted as the personal generation and consumption of this delegate. The necessity of transferring the legal responsibilities and burden of the community to the delegated person is a hindrance to the establishment of such communities and the applicability of the REC/CEC is not common in Turkey.

In this regard, it would be desirable to return to the legislation that permitted electricity generation cooperatives without the condition of a common connection point. Moreover, significant support would be provided by enacting the necessary legal regulations enabling the establishment of such communities under the legal personality of municipalities by aggregating their consumption.

4.6.2.2 Data flow in eCREW under National Electricity Regulatory Framework (Data flow, Data from smart meter, processing of data from third parties)

In the main legislation, *Act No. 6446 on Electricity Market 2013*, there is no fundamental regulation regarding the collection of data from meters, neither has regulation been introduced regarding meters in the *Act No. 5346 on Utilization of Renewable Energy Sources for the Purposes of Generating Electrical Energy 2005*. The subject is regulated in a separate article (art. 21) titled "meters, remote monitoring, protection and control systems" in the *Regulation on Unlicensed Electricity Generation in the Electricity Market 2019*. This article made the use of meters in the production of unlicensed electricity obligatory "in a way that can provide the communication required by the settlement mechanism". The daily data from this meter are presented by the relevant persons in accordance with the format requested by the Authority. For production facilities with installed power of 50 KW and above, meters must be compatible with the automatic meter reading system. According to the *Electricity Market Balancing and Settlement Regulation* dated 14.04.2009, automatic meter refers to "*the system to be set up by TEIAS and distribution license holder legal entities to automatically read the meter data remotely, transfer data to a central system, verify, fill in the missing data, store the data and present it in the desired format, and includes the necessary software, hardware and communication infrastructure*". This definition complies with the smart meter system in *Directive 2019/944* and in the e-CREW approach, and enables the implementation of smart meters. Meter data are read, collected and stored by legal entities holding the relevant distribution and transmission license.

Another issue to be examined at this point is whether the consumer is legally entitled to access data from the automatic meter reading system (OSOS) data collected by distribution companies. The regulation regarding this issue was made in the *Procedures and Principles Regarding the Scope of Automatic Meter Reading Systems and Determination of Meter Evaluation*, accepted within Energy Market Regulatory Authority's Decision No. 5707- dated 30.07.2015, and published in the Official Gazette dated 08 August 2015. Article 6 of the Commemorated Procedures and Principles states that the data in the automatic meter reading system database will be shared with the suppliers and, if requested, with the relevant producer and/or consumer with no additional fee. According to the Regulation, a request from the relevant producer/consumer is required before data is made available, and no fee shall be charged for this service.

4.6.2.3 Progress concerning the adoption and/or transposition of relevant EU directives to national legislation

There are inconsistencies in efforts in Turkey towards the compliance with the EU directives in the subject of REC/CEC.

First of all, the goal of increasing the use of renewable energy sources is among the main pillars of the national energy policy, as clearly stated in the *11th Development Plan of the Republic of Turkey* for the period of 2019-2023 (Presidency of the Republic of Turkey, 2019). The plan is also in line with the EU's energy efficiency policies, as seen in the objectives of "increasing the number of buildings that are more efficient and can produce their own energy", and "establishing a National Green Building Certificate System". In addition to these, the Development Plan incorporates targets to increase the implementations of unlicensed solar power plants and wind power plants for personal electricity needs, and to spread smart grid applications.

In addition to the 11th Development Plan, Turkey's National Energy Efficiency Action Plan for the period 2017-2023 is also adopted by the Higher Planning Council (YPK) Decision No. 2017/50 dated 29.12.2017, and the relevant plans have been published in the Official Gazette dated 02.01.2018. The related Action Plan, clearly states the need for the actions of "providing a comparable and more detailed billing information to the consumer, creating an energy data platform for intelligent management of measurement information" and "aligning the regulatory framework for reading electricity meters with the principles of the European Union (Dissemination of Smart Meters)" (Higher Planning Council, 2017). These actions also foster information opportunities, including information on energy consumption amounts, billing information, comparison of energy consumption amounts of similar consumer groups, energy efficiency improvement measures, and energy saving possibilities. As a result, electricity and natural gas consumers will be encouraged to analyse their energy consumption behaviours. In the action for the dissemination of smart meters, referring to the EU acquis, it was stated that targets for smart metering systems would be extended to a similar extent.

When the 11th Development Plan and Turkey's National Energy Efficiency Action Plan for the period 2017-2023 are examined, it is evident that emphasis is placed on adopting a policy to enable consumers to make their own production independent of other producers, and to highlight smart grid applications. These are also the basis of the e-CREW approach. It is important to note that the Electricity Market Balancing and Reconciliation Regulation and the Procedures and Principles Regarding the Scope of Automatic Meter Reading Systems and Determination of Meter Evaluation have been adopted as the legal infrastructure for smart grid applications.

The content of the 11th Development Plan, and the Reports of the Specialized Commission on Energy Supply Security and Efficiency of the 11th Development Plan, predominantly emphasizes (1) the importance of utilizing renewable energy sources for end consumers in meeting personal needs; (2) encouraging and supporting renewable energy generating cooperatives for organisations such as OIZs, small industrial sites, collective workplaces, summer residence sites, villages and agricultural irrigation facilities; (3) the establishment of a sustainable financing model for cooperatives (Ministry of Industry and Technology, 2017). To achieve these goals, it is essential to encourage and support energy generating cooperatives, classified as REC/CECs.

An amendment was made in the *repealed Regulation on Unlicensed Electricity Generation in Electricity Market 2013* on 23.03.2016, exempting cooperatives from the conditions of having a common connection point or measuring consumption with a single common meter in unlicensed generation. With this regulation, the way was opened for natural or legal persons with different connection points to establish an electricity generating cooperative and to aggregate consumption. In their legal qualities, cooperatives can be considered as a CEC/REC mechanism within the scope of EU directives. This arrangement paved the way for such a community to enter the Turkish electricity market.

Unfortunately, this advantage was removed in the new *Regulation on Unlicensed Electricity Generation in Electricity Market 2019*, which entered into force on 12.05.2019. Under the current legislation, for the cooperatives to generate electricity as CEC / REC, members must have a common connection point or consumption must be measured with a single common meter. This, in turn, has led to a regulation that further restricts the establishment of energy generating cooperatives.

One can conclude that, despite positive developments, as in the dissemination of smart meters and establishment of an energy data platform, Turkey's short-term goals do not include a policy supporting community electricity generation by aggregation of consumption.

4.6.3 Differences between national implementation and EU Directives with regard to the concepts of the Renewable Energy Community (RED II) and Citizen Energy Community (ED 2019)

While the natural and legal persons are individually free (with administrative authorization) to generate electricity from renewable sources for personal consumption, their ability to do this collectively as REC/CEC is limited by the legislation. Community based collective generation in the form of a cooperative or a community without legal personality – in compliance with REC/CEC – is only possible for natural or legal persons in the same tariff group with the same connection point, or for those whose consumption can be measured with a single common meter. In practice, these conditions are valid for limited numbers of organisations, such as office blocks, shopping malls and small industrial estates. The majority of the population would not qualify to form or join a REC/CEC.

It is theoretically possible for people who meet the relevant criteria to generate electricity collectively as a REC/CEC without a legal personality. Such a synergy however, is subject to other legal and administrative restrictions. To be able to fulfil administrative procedures, this collective action needs to delegate a natural person within the community, who will be recognised by law as the person to generate and consume electricity from renewables on behalf of the community. This legal confusion, unfortunately, will place all the legal responsibilities on to one person, in a system where a group, i.e., the community – have the authority. In other terms, within the current legal system, all the members of the REC/CEC will have the authority to generate and consume electricity, but, for administrative purposes, if one flouts the legal restrictions, the burden will nevertheless fall on the delegated person. This restrictive condition obstructs the applicability of the RECs / CECs in Turkey. It was possible for electricity generating cooperatives to be established without these restrictions until the legal amendment of 2019, after which the conditions applied had a negative impact on the subject. These unfavourable legal changes prevent the establishment of REC/CEC under the guidance of, or with the direct participation of the municipalities and local authorities.

4.6.4 Adaptability of the eCREW approach

The adaptability of the eCREW approach in Turkey is limited as explained previously. While people were free to establish or to join cooperatives and generate electricity between 2016 – 2019, the restrictive amendment of legal regulations removed this opportunity. The legal and administrative framework during that time was very suitable for the establishment of communities to generate electricity. The government's step towards the prohibition of malicious acts on financial support schemes (by some cooperatives) instead of raising the incentives for REC's / CEC's had negatively affected the applicability of eCREW in Turkey. One can conclude, therefore, that Turkey actually knows and has the experience of a legal and administrative framework that will pave the way for the adaptability of eCREW approach. A small amendment in legal regulations will make the Turkish system compatible with EU's relevant directives on REC / CEC.

The necessary and required legal infrastructure for data flow, which is an important foundation stone of eCREW approach, exists in Turkey. The primary and secondary legal regulations are already enacted. Currently meter data are read, collected and stored by legal entities holding the relevant distribution and transmission license. Sharing of this data is also regulated clearly under the legislation. The principle of sharing the date that exists in the automatic meter reading system database with the relevant producer and / or consumer without demanding an additional fee is accepted. As the same rules about the collecting and sharing the data shall be applied to REC's / CEC's, it will be possible to use the smart phone applications in the e-CREW approach in Turkey.

4.6.5 Perspective from a Community and Citizen point of view

The discussions on the community and citizen perspectives are mainly derived from the analysis of the results of ECHOES international survey. The survey was carried out within the context of the H2020 ECHOES project (ECHOES Cordis Website), with the aim of providing insights to individuals' energy choices in the energy transition process. The survey was carried out in 31 countries (EU 28 including the United Kingdom, with Norway, Switzerland, and Turkey. A total of 18,000 respondents, including 594 from Turkey, participated in the 114 question online survey.

4.6.5.1 Community perspective (Utilization the results of ECHOES survey)

34% of the respondents from Turkey showed interest in the possibility of making a substantial investment in renewable energy.

Regarding perspectives about the community, people have around 70-75% attachment to the energy behaviours of their communities. That is, 70% expressed anger about energy waste in their community, and 75% would feel pride if their community saved more energy. A similar proportion, 77%, stated that they would adopt more environmentally-friendly behaviour if the majority did. These attachment levels can be exploited for the adaptability of the eCREW approach.

However, the expectations regarding the community's perspective are less strong. A slightly lower proportion, 69%, believed that the community would support lower energy use,and 49% believe that they would receive community support for favouring pro-energy transition policies.

Similarly, 54% believe that a growing number in their communities are trying to save energy, and the same proportion believe that a growing number in their communities favour pro-energy transition policies.

The results are slightly more promising when residential buildings are considered. 62% expect future community support towards decreasing energy consumption for heating or cooling, and 50% believe that a growing number in their communities have already decreased this type of energy consumption.

Two other factors may help overcome resistance to renewable energy endeavours. First, 87% of the respondents from Turkey believe that the use of renewable energy sources will benefit the environment. This is important in overcoming significant social resistance to such initiatives, based on the claim that these initiatives actually harm the environment. Second, 83% affirmed that use of renewable energy sources would lead to the creation of new jobs.

Regarding energy savings through grid operator intervention (e.g., by the grid operator remotely turning on/off non-critical appliances), only 43% believed that they would get community support if they undertook such interventions for themselves.

As a result, 37% are convinced that community action will be able to achieve the energy transition.

4.6.5.2 Current status of communities in terms of energy-related endeavours

In terms of energy related endeavours, most communities in Turkey are bound by the limitations in the legislation. As a striking example, 23 energy cooperatives were established between 2016 and 2019, following the issuance of the legislation that paved the way for community energy cooperatives. However, after a change in the legislation in 2019, there were no further additions due to new difficulties in establishing community energy cooperatives.

Although the legislation has a number of aforementioned provisions that could support communities' energy-related endeavours, the associated actions needed for compliance are very challenging.

Figure 54 below depicts the procedure for an OIZ regarding electricity generation without a license, given that the persons are qualified by the legislation to do so.

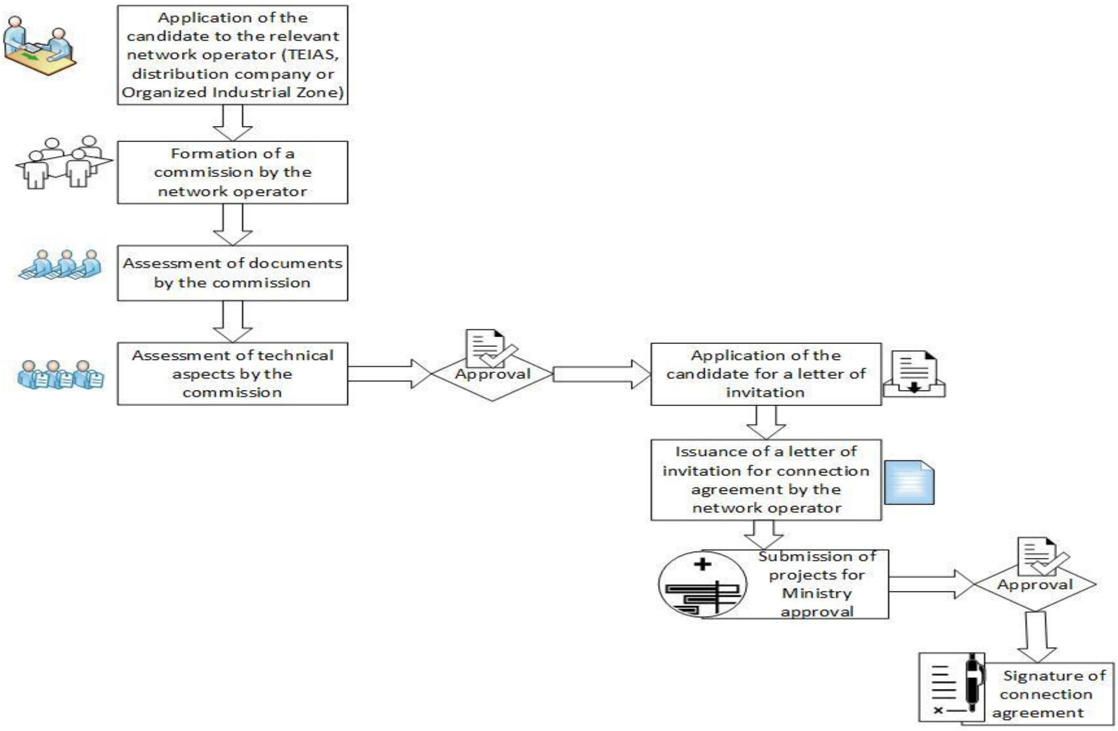


Figure 54: Procedure for an OIZ regarding electricity generation without a license

4.6.6 Citizen perspective (Utilization the results of ECHOES survey)

More than 87% of Turkish participants agreed that the world's temperature is rising, and more than 90% of these participants also agree that this is a result of human activity.

86% of respondents from Turkey state that pro-environmental behaviour is an important part of their identity.

83% stated that they feel a personal obligation to be energy efficient, and 80% feel obliged to decrease their energy consumption for household heating and cooling Similarly, 80% would feel very or moderately happy if this saving was around 10%. When it comes to actions, 81% expressed an intention to use energy in a way that supports the transition to a renewable energy system.

On the policy support side, a lower 75% felt an obligation to support pro-energy transition policies. However, only 67% stated that they would accept energy policies that protect the environment if these induce higher costs or some loss in comfort.

Regarding interventions, 43% stated that they would feel happy about allowing their grid operator to remotely switch on and off their non-critical home appliances.

4.6.6.1 An overview of energy behaviours of citizens

An overview of the energy behaviours of individuals can be derived from their daily life choices, as evidenced from the ECHOES international survey.

The majority of the respondents (71%) live in flats in blocks. Indoor living spaces are 71 to 90 square meters for 14% of the respondents, between 91 and 110 square meters for 22.2%, between 111 and 130 square meters for 21.2%, and 131 to 150 square meters for 16%.

Regarding driving preferences, 86.5% of the Turkish respondents drive private cars, at an annual average of 15,000km. 34% drive alone very or extremely often, and another 24% drive alone more than 50% of the time. The median number of people in the car is 2, and the average is approximately 2.5. Petrol (27%), diesel (52%), and gas (13.5%) fuelled cars form the majority, amounting to a total of 92.5%. The primary heating type is central heating (65%), and 14% of the respondents use district heating. The primary heating fuel is gas (80%), followed by electricity (10%).

Individual preferences regarding comfort temperature are also significant for heating and cooling energy use.50% stated that their comfort temperatures were about average, 25%, slightly warmer, and 16%, slightly cooler than the average.

95.5% of the respondents have air conditioners, and 45% use these very rarely during summer.

555 of the respondents often or always disconnect electric appliances when not in use, and 86% use energy saving light bulbs at least 75% of the time.

In terms of public transportation use, 91% of respondents reported using public transportation. With respect to modes, 71% use the bus, 13.3% use train, 32.7% use tram or streetcar, and 47.6 use the underground in daily routines.

75% of the respondents have never experienced car sharing, and 36% are not at all interested. Of the 25% that have tried it, 23.7% have positive experiences.

Air travel is an important component of energy behaviour, in terms of carbon footprint. 27.9% made no air journeys in the previous year, and the average annual flight time is below 10 hours for respondents in Turkey.

4.6.7 Interim conclusion

Turkey's geographical position means it has great potential for renewable energy generation including wind, solar, and geothermal and biomass.

Turkey's demographic structure, with 15.6% of the population in the 'young' age group (compared to the much lower EU average of 10.7%) provides advantages towards CEC and REC implementations. However, the structure of the age pyramid is changing in Turkey in favour of older groups, thus increasing median age, making it a priority to cultivate a culture of renewable energy, energy communities, and energy transition in general.

These demographics also pose several challenges to energy initiatives. The unemployment rate is high, especially for the young population. There is an increase in the dependence ratio, that is, the average number of children, or elderly that are dependent on an individual in the working age. Also, the adult education level for upper secondary and tertiary education is below the OECD average.

Turkey's energy profile is characterised by high import dependence, coupled with a high usage rate of fossil resources. These disadvantages pose threats to energy security, yet can be utilized to trigger mechanisms that favour policy-making to strengthen energy security, increasing the use of indigenous resources, increasing the share of renewables in the energy mix, empowering practices of energy savings and energy conservation. The statistics reveal some, but not yet sufficient, progress is achieved in these areas.

Deregulation of the energy markets is also another significant factor supporting the renewable energy initiatives and community energy initiatives. The electricity and natural gas markets, previously under full state control, with state-owned-only actors, have achieved considerable progress towards deregulation and implementation of free market principles. State companies' share in electricity decreased to 20% in 2019, from 55% in 2009.The distribution of electricity is now fully privatized. Private sector companies imported more than 10 bcm of LNG in 2019. Moreover, the shares of renewables in Turkey's electricity generation have also increased considerably; between 2009 and 2019, the share of wind in electricity generation increased from 1.77% to 8.3%, and solar from 0 to 6.6%.

These developments are supported by a strong policy set, defining Turkey's energy strategies. Turkish national energy policy and the action plans, such as the NEEAP, include an important renewable energy component, along with scheduled investments to support such components.

However, the legislative structure is less promising. There are challenges regarding the implementation of CEC and REC. A community energy cooperative can only be established when all members' energy consumptions are read through a single common meter. Moreover, there are uncertainties and changes in the legislation that negatively affects the trust and commitment of individuals and communities for endeavours such as CEC and REC.

The infrastructure uses and relevant policy-making can only be effective through the participation of individuals and communities in the energy initiatives. To better understand the factors influencing this participation, valuable insight is provided into individual and community behaviours by the international ECHOES survey.

Individuals in Turkey have a reasonable degree of awareness regarding environmental issues and climate change, but are more hesitant when it comes to action for the environment, and participating in renewable energy investments. Survey respondents from Turkey demonstrate strong attachment to community, therefore, if the individual observes a positive attitude in the community, s/he is also more likely to reflect the same attitude. This result can be utilized to enhance CEC and REC. However, it is important not to ignore the barriers to energy related initiatives caused by investment costs, administrative burden, and legislative structure.

5 Conclusion

5.1 Austria

There exists no definition of REC / CEC in Austria's legislation. The country is currently in the implementation phase of RED II and ED 2019. The legislative process has already started in 2020 and a government bill is presented in March 2021. The provisions of both Directives are included in this government bill and concrete details defined on the introduction of a REC and CEC.

Apart from REC / CEC, a way of community based collective electricity generation – through consumption aggregation – is accepted by law and put into effect in 2017. The system is called a "joint generation facility". This allows the residents of a building, with several apartments or business premises, to generate electricity together for the use of the building. The surplus can be sold and if the generated electricity is not enough the residents are free to buy their remaining required electricity from the suppliers they will choose.

These developments mean that the eCREW approach is currently applicable for joint generation facilities and its implementation will expand once the proposed bill is accepted and the REC / CEC's are introduced into the energy legislation.

The replacement of the old metering systems and the installation of smart meters began after 2010 in Austria. The installation process is planned to be mostly finished (by 95%) by 2022. In Austria, there is already an obligation for the distribution system operator to display the customer's consumption data (measured with a smart meter) on a customer-friendly website, free of charge on a daily basis. The law allows the customers to require the data reading to be made on a quarter-hourly basis. The displayed data should be in the smallest available time unit and must also comply with data protection regulations. In addition to the web portal, customers also have the option of viewing all the electricity consumption values recorded in the smart meter free of charge via a unidirectional communication interface. The customer can also authorize a third party to view his data and information. The system operator shall provide the consumption data not only to the customer but also to the suppliers. The data shall only be transmitted by the system operator on a monthly basis. The current regulation on data reading and flow is suitable for the application of the eCREW approach.

5.2 Germany

In Germany, there exist two major laws in the field of energy: Energy Act and Renewable Energy Act. While the first one, which was enacted in 2005, is amended in 2021 after Renewable Energy Directive 2018 (RED II) and the Electricity Market Directive 2019 (ED 2019), the second one is enacted in 2021 with the sole purpose of focusing on renewables. Collective electricity generation, however, was already possible prior to this development. Tenants are free to install solar systems on residential buildings for their own needs. They are also entitled to sell the excess power to end customers. The sale must take place within the building/apartment/annex building in the same district in which this building (with solar system) is also located and without transmission through the public grid.

Under the existing electricity regulations, there is no legal definition of REC as contained in RED II and CEC as contained in ED 2019. The German National Energy and Climate Plan (NECP) of 2020 identifies the REC as having great potential for the expansion of renewable energies. The Renewable Energy Act of 2021, does not define the concept of REC. It introduced, however, the concept of citizen energy corporations. The citizen energy corporations are not a new form of legal entity. Any company can be called as citizen energy corporations if (a) it consists of at least ten natural persons as voting members or voting shareholders; (b) at least 51 percent of the voting rights are held by natural persons; (c) no member or shareholder of the company holds more than 10 percent of the voting rights. So, the law allows the citizens to form or join a citizen energy corporation to be a market player in the renewable energy sector.

A draft law of the Federal Ministry, prepared after ED 2019, which is about Clean Energy Package, explains it is not required to introduce a new legal entity (CEC) in Germany since collective based electricity generation is possible by forming cooperatives, citizen energy companies and tenant electricity model.

In Germany, the Metering Point Operation Act came into force in 2016. This law is intended to contribute to the digitalization of the energy transition and regulates the measurement and metering system in a new way. The law defines and regulates smart metering systems. The metering point operator is obliged to install smart metering systems. The smart metering system is expected to be fully installed by 2028. The measured data from the smart metering system is transmitted to the metering point operator, who forwards the data to the supplier and the system operator. It is possible that end consumers choose electricity tariffs that require more frequent measurement and data transmission. Thus, the existing regulations on data flows are favourable for the implementation of the eCREW approach. On the one hand, it must be possible to retrieve the actual feed-in through direct marketing. On the other hand, there are the metering point operators, who transmit the necessary data to the entitled parties for the fulfilment of their obligations.

5.3 Greece

Community based collective electricity generation was not possible in Greece up until recently. Therefore, the cooperatives were not role players in Greek energy market. Greece, historically was one of the first countries to adopt EU regulations into the national legislation in terms of energy packets. The country followed the same habit in the introduction of energy communities into the legislation. The law 4513/2018 that introduces the concept of "energy communities" into the Greek legislation. The "energy communities" are accepted to be the civil cooperatives with an exclusive purpose of promoting the social economy, solidarity and innovation in the energy sector to reduce energy poverty and to promote energy sustainability, production, storage, self-consumption, distribution and supply of energy, to enhance energy self-sufficiency, security in island municipalities, to improve end-use energy efficiency, the rational use of energy and sustainable transport. As seen, the law came up with a single definition of energy communities and did not differentiate between "citizen energy communities" and "renewable energy communities". As energy communities are able to operate in all of the energy market, including generation and related activities from renewable energy sources, one can conclude that the definition is in conformity with relevant EU Directives. The main and the only way to establish an energy community in Greece, however, is in the form of a cooperative. The cooperatives are the most common form of a legal body that can operate as REC/CEC in Europe. They, however, are not the only legal bodies to be counted as REC/CEC. The lack of other legal institutions for citizens to play a role in the energy market as a community is the main difference between national implementation and EU Directives.

Smart metering regulations and data flow, another important foundation stone of eCREW approach, are in force and developing since 2011. Energy distributors and energy retailers are under the obligation to install smart meters that will provide real time information on actual energy consumption when replacing an existing meter or in times of radical renovation of the buildings, and for new connections to new buildings. The Ministerial Decree 15084/382 of 10 September 2019 regulates net metering for self-producers and virtual net metering for ECs. The National Energy and Climate Plan of Greece for 2021 – 2030 emphasizes the relation between consumers' involvement in the energy sector and net metering. The Plan also put emphasis on smart metering, smart grids and data processing. One can conclude that there exists a legal infrastructure for the collection of data for the smartphone application to be created within the scope of the e-CREW approach.

5.4 Italy

The Directive 2018/2001/EU on renewable energy communities was transposed into the Italian energy legislation in February 2020. The law allows small-scale collective self-consumption of renewable energy plants below 200 kW for customers linked to the same low voltage distribution sub-grid. The ability of generating electricity from renewable energy resources via collective self-consumption model suits the definition of REC made by Directive 2018/2001/EU.

The Directive EU 2019/944 on citizen energy communities has not yet been implemented by the Italian legislator. A draft law on the subject was approved by the Senate Chamber on 29 October 2020 and has been under examination by the Chamber of Deputies since 11 November 2020.

As far as today, the number of energy communities is limited since the potential interested actors, such as energy retailers, cooperatives and municipalities, are waiting for the secondary legislation that will clarify the regulatory and administrative framework. The National Energy and Climate Plan of Italy underlines the importance of citizens and businesses as key players and beneficiaries of the energy transition.

Italy was the first European country to introduce electric smart meters on a large scale for low voltage end customers and is still the first country in the world for the number of electric energy smart meters in service. The regulations on smart metering systems require distribution companies as operators of metering activities to provide end customers with information on billing precisely, based on actual consumption and time bands of energy use.

Overall, the e-CREW approach seems applicable in Italy in its current situation. There exists, however, a need to expand the scope of collective self-consumption and to import the concept of CEC into the legislation. The secondary regulations that will clarify the functioning of collective self-consumption will allow the RECs to flourish in the market.

5.5 Spain

People's ability to participate in the electricity generation was limited in Spain up until 2019. People could only participate in the system, other than establishing a commercial company, via self-consumption or establishing a cooperative to some degree. The introduction of a new law in 2013, that enabled the cooperatives to distribute and market the energy, was an important step; but, the limitation of the financial incentives showed its negative effects and the number of the cooperatives established for this purpose stayed low. The Revised Renewable Energy Directive 2018/2001/EU which was enacted in December 2018 and the Revised Energy Market Directive 2019/944 which was enacted in June 2019 changed the political view on energy communities in Spain. The legal developments that occurred in 2018 and later constituted a legal framework for collective self – consumption and community based collective generation activities. The participating consumers must belong to the same mode of self-consumption and must communicate individually to the distribution company as the person in charge. This change allows a group of apartment owners or administrators of industrial estates to attend into the practice of collective self-consumption.

The Royal Decree 23/2020 introduced and defined the REC as defined by the Directive 2018/2001/EU. The REC's are also accepted among the legal entities that can generate, transport, distribute and give other services in the energy market. The article 6 of the Law 24/2013 on Electricity Sector, however, still requires the market operators, the system operators and carriers to be commercial companies; the distributors and marketers to be commercial companies and cooperative societies. So there exists a conflict of definitions in the Law and the ability of RECs to practice these activities is still ambiguous. There is a further need for secondary legislation to clarify the issue. The electric power generators, on the other hand, may be both natural or legal persons, a definition that allows the RECs which are defined as legal entities in terms of the law, to practice electricity generation.

With all these large scale of legislation in mind, it can be concluded that, community based collective generation in Spain is possible under the legal form of a cooperative, collective self-consumption (collectively and with aggregating consumption) and RECs where the latter is in need of further regulation since its inclusion to the regulation causes a conflict of understanding.

There is no definition of CEC in Spanish legislation, and no new regulation is accepted in accordance with Directive (EU) 2019/944. The politicians and the bureaucrats are aware of this deficiency so they include the necessity to introduce more regulations towards the CECs in the National Energy and Climate Plan of Spain for 2021 – 2030.

The necessary and required legal infrastructure for data flow, which is an important foundation stone of eCREW approach, exists in Spain. Spain started the transformation of its old metering systems with smart meters as early as 2008 and full transformation was completed at the end of the last decade. Currently the meter data is processed by the system operator and the distributor. The law allows the marketers to access certain information regarding consumer consumption in order to offer them all types of energy efficiency measures while respecting the protection of personal data.

5.6 Turkey

The concept of REC / CEC is not introduced in Turkey. Community based collective generation – through consumption aggregation - is only possible for natural or legal persons or cooperatives who are in the same tariff group and connected to the same connection point, or for those whose electrical energy consumption can be measured with a single common meter. Very limited numbers of households, commercial / industrial entities, etc. can meet this criterion. The kind of community other than the cooperative, however, is not granted any legal personality. The community, therefore, has to delegate a natural person, within the members of that community, for authorization and administration procedures. This necessity lays the legal responsibilities (burden) of the community to the delegated person. These facts make the applicability of community based collective generation an exception.

People were free to establish or to join cooperatives and generate electricity, without the restrictions mentioned in the previous paragraph, between 2016 – 2019. The legal and administrative framework during that time was very suitable for the establishment of communities to generate electricity. The government, unfortunately, took a step towards the prohibition of malicious acts on financial support schemes and restricted the formation of energy generation cooperatives.

One can conclude, therefore, that Turkey actually has the knowledge and experience on the legal and administrative framework that will pave the way for the adaptability of eCREW approach. A small amendment in legal regulations will make the Turkish system incompatible with EU's relevant directives on REC / CEC.

The necessary and required legal infrastructure for data flow, which is an important foundation stone of eCREW approach, exists in Turkey. The primary and secondary legal regulations are already enacted. Smart metering systems have the right to read, collect and store the data of the consumers. Sharing of this data is also regulated clearly under the legislation.

5.7 General Conclusions

The following table demonstrates a comparison of the current situation related with RECs and CECs, the legislative framework regarding community based collective energy generation, smart meter rollout, and data flow in the selected countries. An analysis of the table reveals that the countries are in different levels of progress regarding these issues, and all countries need to show more progress regarding the adaptation of the directives RRED and REMD, hence the adaptability of the eCREW approach.

	REC/CEC	Community Based Collective Generation	Smart Meters	Data Flow
Austria	* Not defined but a bill is introduced in March 2021	*Joint generation facility"allows the residents of a building, with several apartments or business premises, to generate electricity with consumption aggregation	* Mostly implemented. % 95 implementation expected by 2022.	* Regulated and permitted
Germany	* Not defined but community based collective generation is compatible with REC/CEC to a certain extent	* Tenant electricity model are free to install solar system on a residential building and share the electricity with end customers *Cooperatives are free to operate in the electricity market *Citizen energy corporations (a company established under the existing company forms with special provisions) are free to operate in the electricity market	* Mostly implemented * Full implementation expected by 2028.	* Regulated and permitted
Greece	* EC is defined * No distinction exist for REC/CEC	* Possible in form of EC	*Legal infrastructure exist *Ongoing implementation	* Regulated and permitted
Italy	* Not defined * But collective self consumption regulations is compatible with the definition of REC to a certain extent	* Small-scale collective self-consumption of renewable energy plants below 200 kW for customers linked to the same low voltage distribution sub-grid.	* Implemented on large scale	* Regulated and permitted
Spain	*REC is Defined : Need further secondary legislation *CEC is not defined	*Collective self - consumption defined. *Cooperatives are allowed for limited activities	* Implemented	* Regulated and permitted
Turkey	* Not Defined	*Very limited *Only possible for those who are in the same tariff group and connected to the same connection point, or for those whose electrical energy consumption can be measured with a single common meter	*Legal Infrastructure exist *Implementation is limited	* Regulated and permitted

The Renewable Energy Directive (RED II) is introduced in 2018 and Internal Electricity Market Directive is introduced in 2019. As of 2021, it is seen that the countries studied in the e-CREW approach (namely Austria, Germany, Greece, Italy, Spain and Turkey) did not yet fully harmonize their legislation with the concept of renewable energy communities (REC) and citizens energy communities (CEC).

Some countries have already transposed some parts of regulation into their own legislation. Greece, for example, is a forerunner on this matter. The concept of energy community was introduced in 2018 with no distinction made between REC and CEC. The main and the only way to establish an energy community in Greece, however, is limited to the form of a cooperative. Spain is the second country that updated its legislation after the EU Directives. There exists a definition of REC in accordance with the Directive 2018/2001/EU. CEC, on the other hand, has no legal foundations yet. Since the concept of REC is not introduced in the the main law on Electricity Sector (Law 24/2013), there exists a conflict of laws that limits the implementation of RECs in Spain. Austria introduced a new bill in March 2021 in which the provisions of both Directives are included. Germany also introduced a draft law which explains that there exists no need of defining CEC in Germany since the current collective based electricity generation systems already allows the citizens to join in the electricity market. Germany allows the citizens to generate electricity by forming or joining a cooperative or a “citizen energy corporation”, a regular company with special provision. Italy and Turkey have not taken any steps so far for the introduction of REC/CEC in their legislation.

The citizens of the countries studied have all the right to self-generate electricity for their own consumption needs. Community based collective generation, however, differs from county to country. In Austria, the residents of a building, with several apartments or business premises are allowed to generate electricity for the use of it in the building from 2017. They are also free to sell the surplus in the market. The system called "joint generation facility” is the only way in Austria for collective generation. In Germany, a similar system, called the tenant electricity model in the study, exists as well. In Turkey, only those who are in the same tariff group and connected to the same connection point, or those whose electrical energy consumption can be measured with a single common meter are allowed to collective generation. Very limited numbers of households, commercial / industrial entities, etc. meet these criteria. The legal developments that occurred since 2018 in Spain allowed collective generation activities for those who belong to the same mode of self-consumption. This allows a group of apartment owners or administrators of industrial estates to attend into the practice of collective self-consumption. In Italy, the law allows small-scale collective self-consumption of renewable energy plants below 200 kW for customers linked to the same low voltage distribution sub-grid. In Greece, community based collective generation has become possible under the form of energy communities with the law enacted in 2018.

Apart from that, though the concept of REC/CEC is not introduced, the cooperatives, the most common form of a legal body that can operate as REC/CEC in Europe, are allowed to generate electricity in some countries. In Germany, cooperatives have the right to operate in the electricity market as any other commercial companies. Spain is another country that let the cooperatives operate in the electricity market but for limited activities (the limitation of financial incentives negatively affected their establishment as well). In Austria and Italy, the cooperatives are not allowed to be a player in the energy market. In Turkey, where the cooperatives were allowed to generate electricity between 2016 – 2019, the government restricted its activities to prevent malicious acts on financial support schemes. Currently, no new cooperative can be established in order to generate electricity.

Though REC / CEC is not fully transposed to countries’ legislations and further legal actions are needed, the existing schemes allow the implementation of eCREW approach on national level.

The regulations on smart meters, data flow and data sharing exist and are similar in all countries and this is in favour of the eCREW approach. Apart from Turkey, the other countries have mostly implemented the installation of smart meters.

The situation regarding energy cooperatives is also different from country to country. The most favourable conditions are in Germany, where energy cooperatives are allowed to become active players in the energy markets, without restrictions. In Spain, energy cooperatives can participate in energy markets, however they can be involved in a restricted set of activities. On the other hand, in Austria and Italy, energy cooperatives cannot be involved in the energy markets.

The demographics of the European countries mostly point to a similar outlook characterized by ageing population, increasing life expectancies, increasing levels of education, and increasing dependency rates. On the other hand, the unemployment levels are above-average for some of the countries. In spite of the more promising education and life expectancy figures, these results do not provide a totally promising environment for the adaptability of the eCREW approach. This is mainly due to the ageing population pointing to a less-dynamic society with further considerations such as increasing dependence rates, which may lack sufficient motives for rather new endeavours such as CREWs.

The ECHOES international survey also provides pointers to the perceptions of individuals regarding energy-related issues. The general outlook suggests that the individuals have sufficient levels of awareness regarding climate change and environmental issues. However, this awareness does not seem to translate into individual or community action. Although the majority of the respondents agree on the importance of community initiatives, they do not seem to have sufficient trust in their communities so as to participate in such initiatives.

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