



Work Package 5 Policy Brief Series: Turkey

*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

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1 Introduction

This policy brief aims to analyse Turkey's demographic, geographical, economic situation, as well as energy market and infrastructure in terms of the applicability of eCREW approach. The current administrative and legal framework of the country is also studied to see whether or not it is possible to implement EU Directives on energy communities - namely the Renewable Energy Directive 2018/2001/EU (Renewable Energy Community) (RED II, 2018) and Internal Electricity Market Directive 2019/944 (Citizen Energy Community) (REMD, 2019). The regulatory and administrative barriers are especially important, since they affect people's decision to join the energy market and the potential development of energy communities. A SWOT analysis is also prepared to summarize legal, administrative and practical framework with respect to the eCREW approach.

The research conducted in preparation for this Policy Brief was conducted as part of eCREW's Work Package 5, which was led by Turkey's Izmir University of Economics.

2 eCrew approach

The goal of the eCREW project is to activate and promote the inherent and underutilized forces of community-driven collective action projects (CAI). Empowering citizens and providing them with the tools they need to generate, store, and consume energy is a critical and necessary step toward a more stable, secure, energy-efficient, and climate-neutral future energy system. A great impact on this collective thinking was made by the acceptance of the Directive 2018/2001/EU of the European Parliament and of the Council (RED II, 2018) on the promotion of the use of energy from renewable sources and the Directive 2019/944 of the European Parliament and of the Council (REMD, 2019) on common rules for the internal market in electricity.

A CREW (Community Renewable Energy Web) is a group of citizens who work together to generate and store renewable energy at the household level, and create CREWs as the third pillar of citizens' energy-related cooperation, alongside citizen energy communities (CECs) and renewable energy communities (RECs). eCREW provides a powerful opportunity for households without access to CECs and RECs to collaborate for their energy needs. Collaboration will be through various means, including physical meetings and direct interaction. A smartphone app will serve as the primary hub for distributing regular updates, facilitating participant exchanges of ideas and experiences, and providing easy access to household-level accomplishments and benefits.

eCREW's primary objective is to create and disseminate a system that allows individuals to collaborate and make informed decisions in groups. For small and medium-sized groups, eCREW will become regarded as the best method for generating, storing and using electricity with a focus on minimizing system-level energy usage.

3 Country profile

3.1 Demographics

Turkey, a country that bridges Europe with Asia, is located in southeast Europe. It has an area of 780.000 square kilometres of which 755.688 are located in Asia (Anatolia), and the remaining in Europe (Thrace) (Görçerioğlu, 1974). Turkey is surrounded by Black Sea in the North, Aegean Sea in the West and Mediterranean Sea in the Southwest and South. The total coastline length is 8.300 kilometres (Yıldırım & Okumuş, 2004). Thrace, in north-eastern Turkey, shares borders Greece and Bulgaria. Georgia is the neighbouring country to the northeast. In the east, Turkey shares borders with Azerbaijan, Armenia, and Iran. Turkey also has borders with Syria and Iraq in the southeast (Kırımhan, 2010).



Figure 1: Map of Turkey
Source: (Harita Genel Müdürlüğü, 2021)

3.1.1 Demographic structure

Turkey has a population of more than 83 million, of which 50.1% is male and 49.9% is female. 93% of the population is located in urban areas (TÜİK, Adrese Dayalı Nüfus Kayıt Sistemi Sonuçları, 2020). Around 37% of the population is located in 5 major cities, Istanbul, Ankara, Izmir, Bursa, and Antalya. 24 cities of 81 have more than 1 million residents. Those under the age of 19 number around 25 million, nearly 30% of the total population. The proportion of the population of 65 years and older are around 8 million. Youth population, those who are between the ages of 15 and 24, accounted for 15.4% of the overall population. Statistics show that Turkey has the highest youth population in Europe (TÜİK, Youth Statistics 2020, 2021). Half the population is under the age of 31 (Çavlin, Adalı, & Kumaş, 2016). The map below shows the proportion of youth population by provinces in Turkey. As seen, the provinces in the East and Southeast have a larger share of youth population than the rest of the county. 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, but remain higher than the European Union average of 10.7% of 2019 (TÜİK, Youth Statistics 2019, 2020).

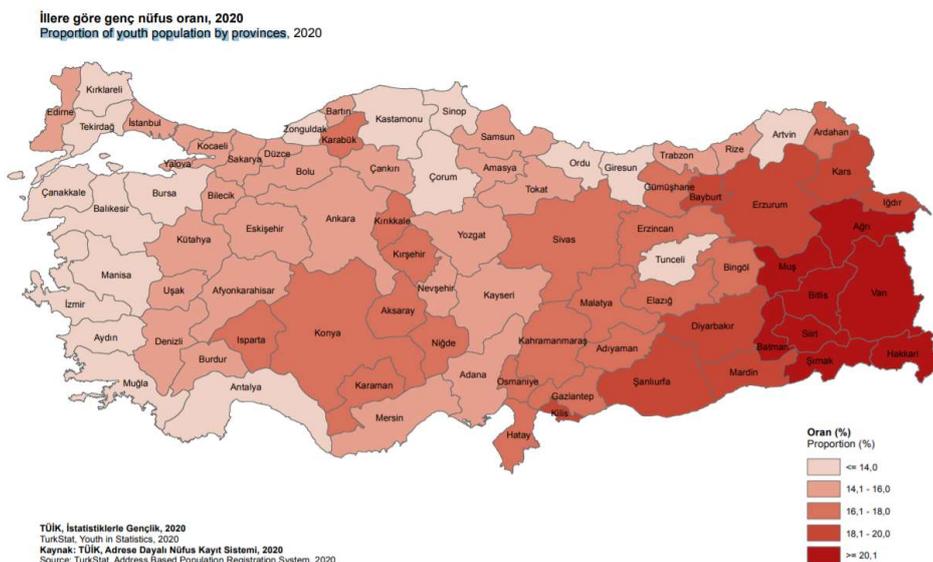


Figure 2: Proportion of youth population by provinces

Source: (TÜİK, Youth Statistics 2020, 2021)

The median age in Turkey continuously increased in the last decade and a half, from 28.2 in 2007 to 30.7 in 2014 and 32.7 in 2020 (TÜİK, Elderly Statistics, 2020, 2021). The shares of age groups within the population for 2007 (on the left) and 2019 (on the right) are given in Figure 3 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 (TÜİK, Address Based Population Registration System Results 2019, 2020).

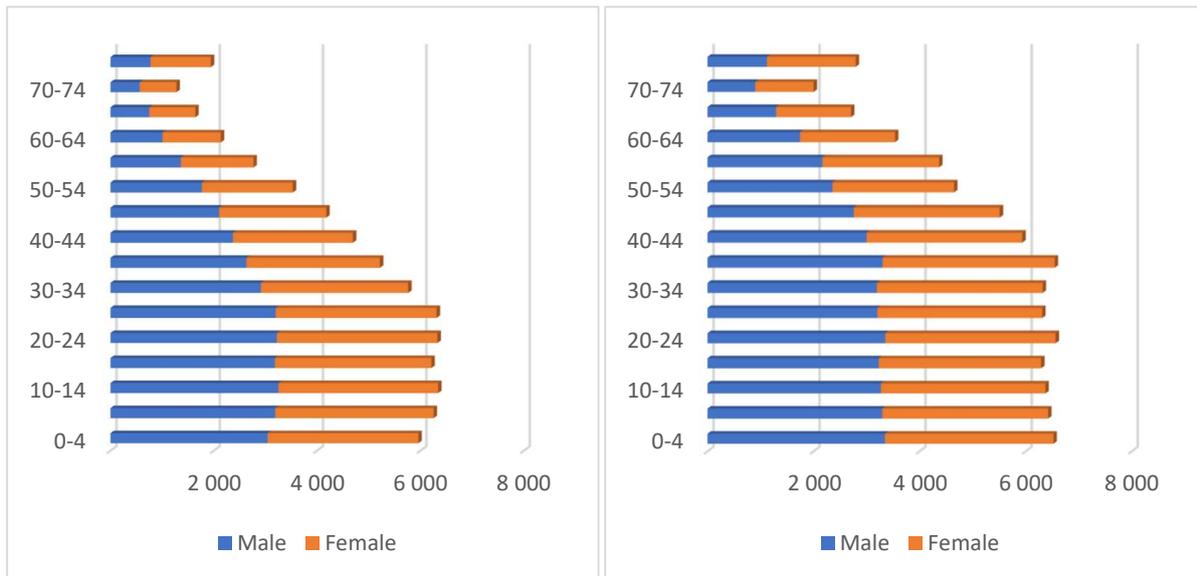


Figure 3: Shares of Age groups within the population for 2007 (left) and 2019 (right)

Sources: (TÜİK, Address Based Population Registration System Results 2019, 2020)

The annual population growth rate of Turkey (Figure 4), around 13% for the last decade, was recorded as 5.5 per thousand in 2020 (TÜİK, Adrese Dayalı Nüfus Kayıt Sistemi Sonuçları, 2020).

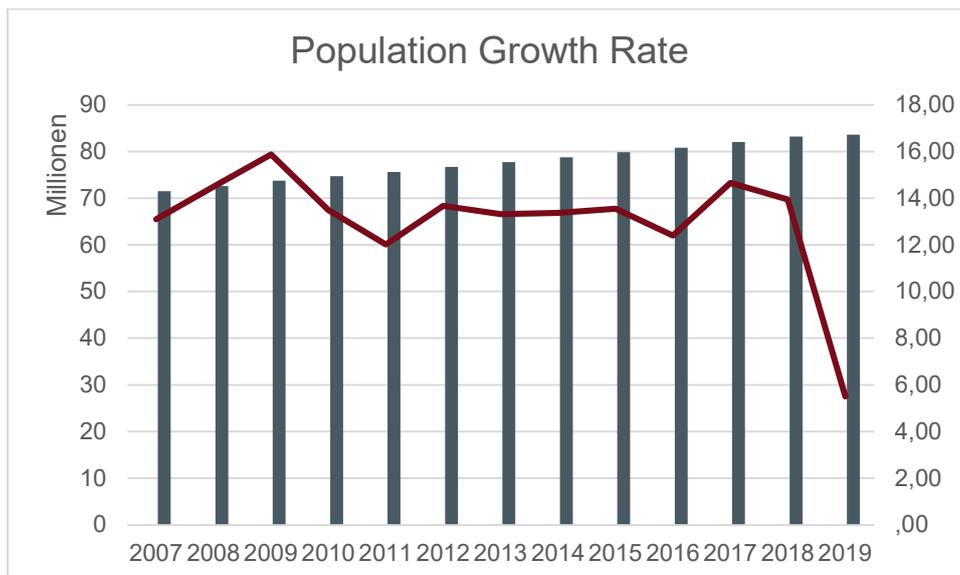


Figure 4: Population growth rate by year

Source: Authors' own illustration based on data extracted from (TÜİK, Address Based Population Registration System Results 2019, 2020)

The total population is expected to reach 100 million people in the next 20 years as seen in Figure 5 (TÜİK, Population Projections 2018-2080, 2018).

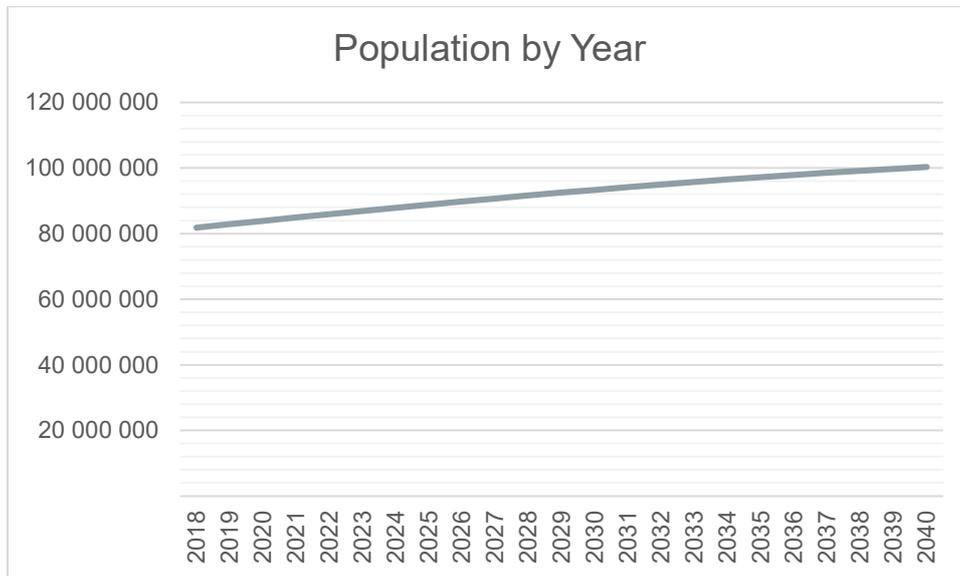


Figure 5: Population projection

Source: Authors' own illustration based on data extracted from (TÜİK, Population Projections 2018-2080, 2018)

The migration is also another important aspect of the demographic factor in Turkey. More than 2 million people move to another city each year, as seen in Figure 6 (The Directorate General of Migration Management, 2021). Apart from national migration, international migration also affects the demographic structure of Turkey. The number of legal international migrants in Turkey is 677 thousand in 2019, a 17.2% increase as compared to 2018. Apart from these legal immigrants, 3 million 721 thousand people are receiving temporary protection as of 2021 due to Syrian conflict (The Directorate General of Migration Management, 2021). The number constitutes 4.5% of total population.

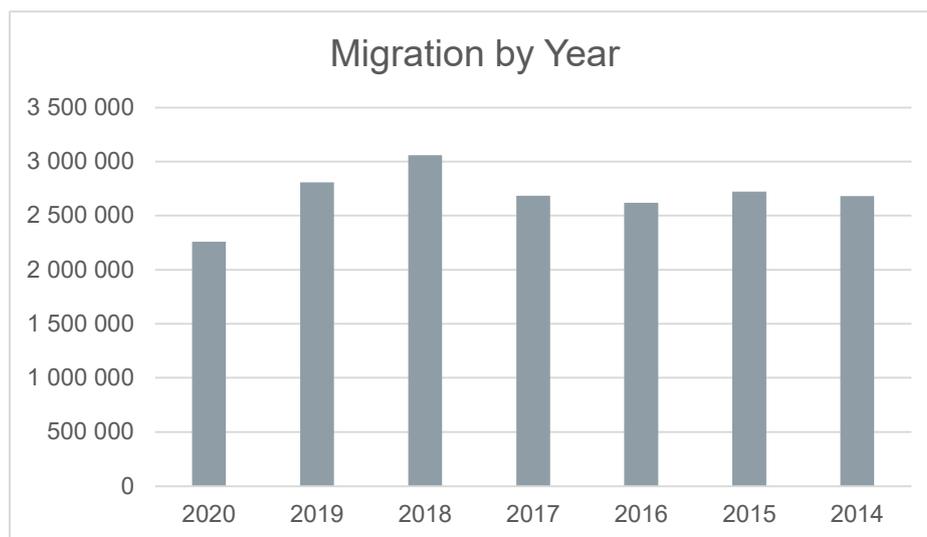


Figure 6: Migration by year

Source: Authors' own illustration based on data extracted from (The Directorate General of Migration Management, 2021)

3.1.2 Geographical/spatial description

The surface area of Turkey is about 780.000 square kilometres (Görçerioğlu, 1974). The area of agricultural lands in Turkey is 37.762.000 hectare as of 2020, approximately 8% less than 20 years ago (TÜİK, Agricultural Land, Crop Production Statistics, 2021). Total arable land is about 23.000.000 hectares. The arable land per capita is 0.28 hectare, 27% more than that of EU (The World Bank, 2018). The forest area, on the other hand is 22.740.000 hectare, constituting nearly 29% of Turkey’s surface area. The Figure 7 shows the total area of agricultural land and forests for the last two decades (TÜİK, Agricultural Land and Forest Area, Crop Production Statistics, 2021).

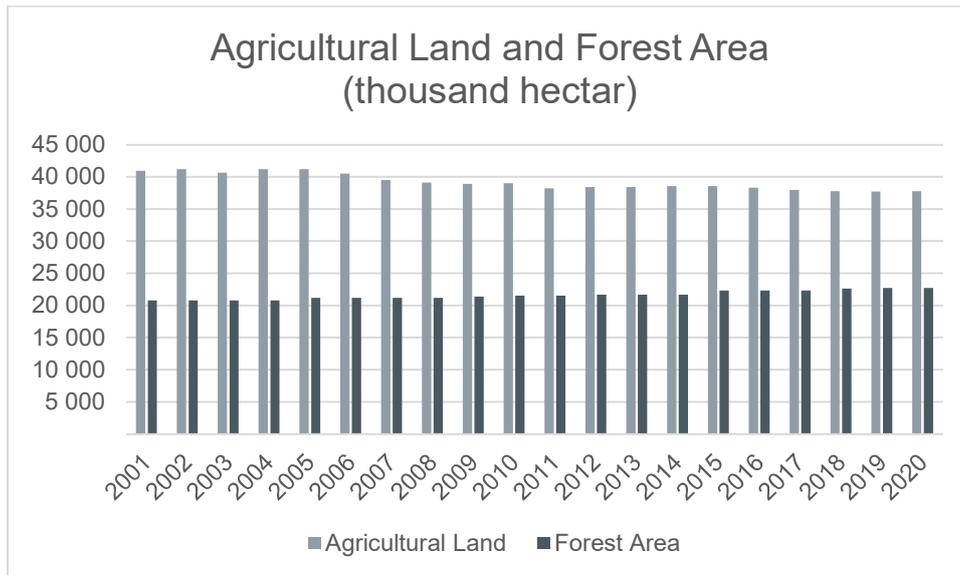


Figure 7: The size of agricultural land and forest areas by year

Source: Authors’ own illustration based on data extracted from (TÜİK, Agricultural Land and Forest Area, Crop Production Statistics, 2021)

The statistics on occupancy permits (Figure 8) shows that nearly 86% of all the buildings are built for residential purposes whereas the trade buildings account for 7.5% and industrial buildings accounts for 3%. Of 1.255.543 occupancy permits given since 2009, 1.078.931 were residential, 95.784 were for offices and commercial buildings, and 35.229 were for industrial buildings and warehouses (TÜİK, Occupancy Permits Statistics, 2021).

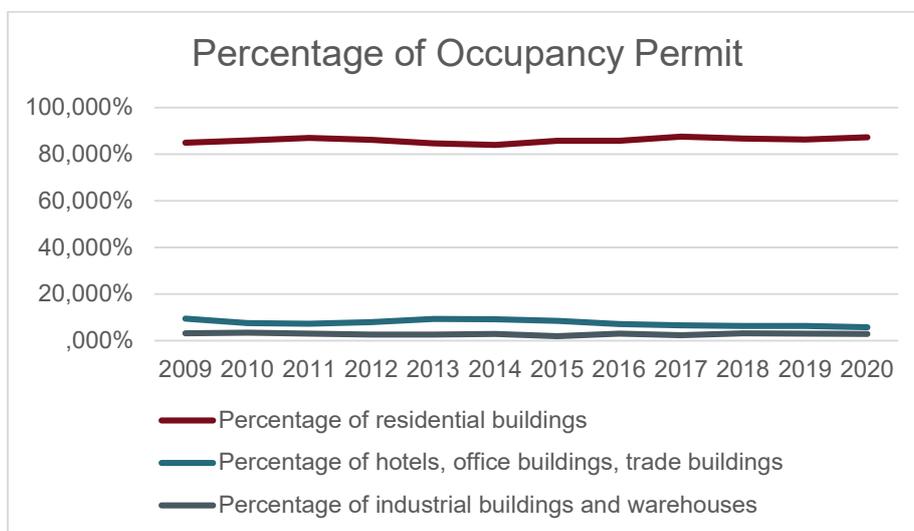


Figure 8: Percentage of occupancy permit

Source: Authors’s own illustration based on data extracted from (TÜİK, Occupancy Permits Statistics, 2021)

3.1.3 Income and education

More than 72 million Turkish citizens are literate as of 2020 (TÜİK, Population by literacy and sex, Education statistics, 2021). This number has steadily risen since 2008, from 55 million people. The literacy rate for the population of 6 years of age and over is 97.4%; 95.5% for women and 99.3% for men (TÜİK, Population by literacy and sex, Education statistics, 2021). This shows an education inequality according to gender. Of all the literate people, 21.5% are holding a higher education diploma (including master and doctorate degrees) (TÜİK, Distribution of population by the level of education completed, 2008-2020, 2021). Those who hold a diploma of a high and vocational high school account for another 21.5 %. 49% of male citizens hold at least a high school diploma in contrast to 36.9% for female citizens.

This inequality affects the participation to labour force. Of 31.357.000 male citizens who are 15 years and over, 21.692.000 are in labour force, a participation level of 69,2 % (TÜİK, Labor Force Statistics, November 2021, 2021). Women’s participation in the labour force remains very low (31.2%) with only 9.976.000 female citizens in employment of a total of 31.963.000. This rate is well below that of EU, which is nearly 68% in 2021.

The unemployment rate is 12.4% for the second quarter of 2021, down from 13% of previous quarter (a possible effect of the recovery from Covid-19 pandemics) (TÜİK, Labor Force Statistics, November 2021, 2021). 1/3 of this population are unemployed for a year or longer, which points to a long term, structural unemployment problem (TÜİK, Labor Force Statistics, Quarter I: 2021, 2021). More than half of the employed people are in service sector. The sector in which employs fewest is construction. Figure 9 shows the employment rate by sectors.

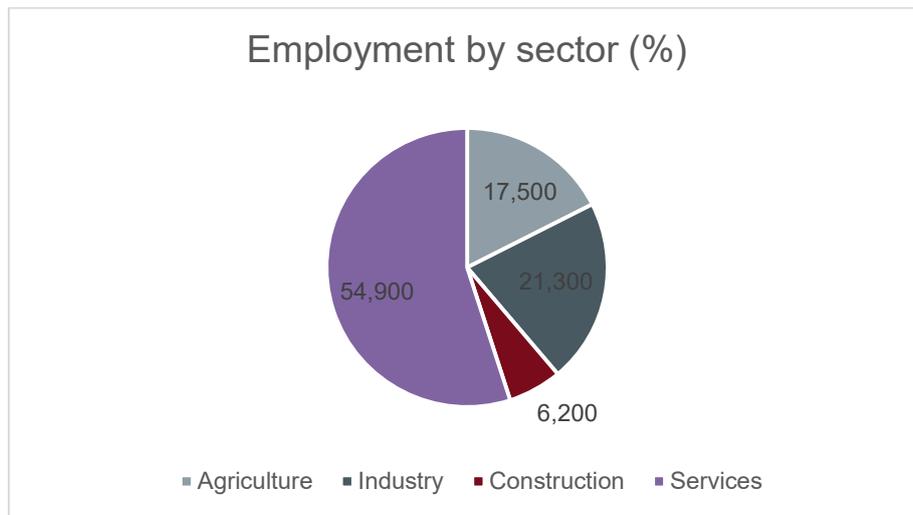


Figure 9: Employment rate by sector

Source: Authors’ own illustration based on data extracted from (TÜİK, Labor Force Statistics, Quarter I: 2021, 2021)

The mean annual household disposable income is 69.349-TL (nearly 9.800-USD, according the average exchange rate in 2020) (TÜİK, Income and Living Conditions Survey, 2020, 2021). The annual income increases by level of education, as expected. Graduates of higher education institutes earn nearly 4 times more than the illiterate. The richest 20% of the total population’s share from the disposable income is 47.5% while the income of the poorest 20% constitutes only 5.9% share (TÜİK, Income and Living Conditions Survey, 2020, 2021). The gross domestic product (GDP) of Turkey in 2020 is 5.046.883.507.000-TL (716.902.000.000-USD) (TÜİK, Annual Gross Domestic Product, 2020, 2021).The distribution of the GDP by economic activity is given in Figure 10. As seen, the manufacturing, wholesale and retail trade are the activities contributing most to the national GDP. GDP per capita is 8.597-USD, falling for the last 7 years due to currency devaluation.

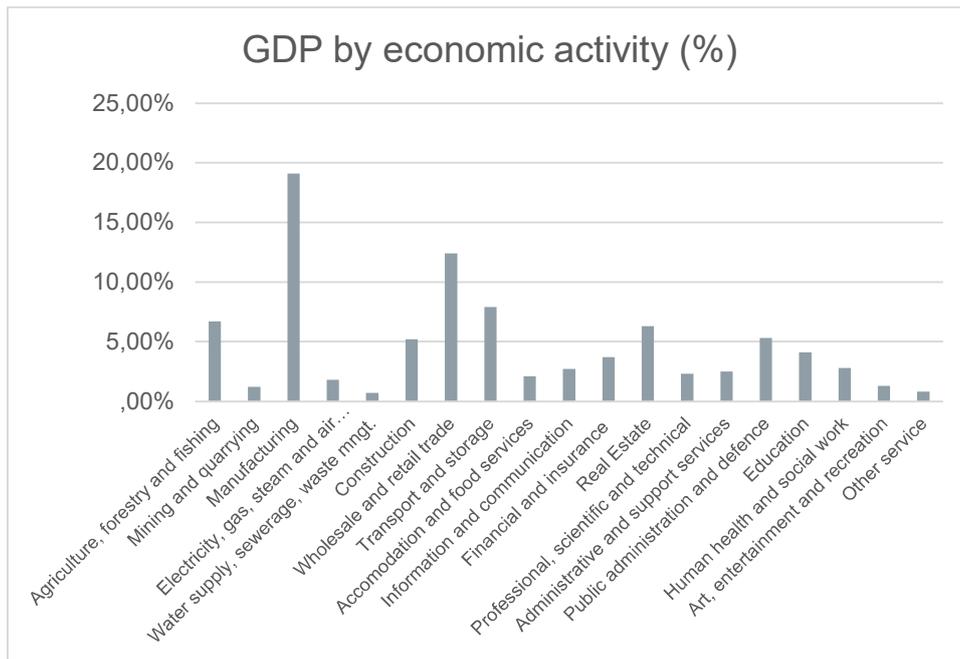


Figure 10: GDP by economic activity (%)

Source: Authors' own illustration based on data extracted from (TÜİK, Annual Gross Domestic Product, 2020, 2021)

3.2 Energy profile

Turkey's overall energy output was around 99 Gwh (Gigawatt Hours) as of October 2021 with an average growth of 4.6 GWh per year between 2011 and 2021 (TSKB, 2021). As seen in Figure 11, hydro was the most popular energy source (31,8 percent), followed by natural gas and coal which held 25,8 percent and 20,5 percent of share consecutively (TEİAŞ, Ekim 2021 Kurulu Güç Raporu, 2021). Wind energy accounted for 10.4 percent of total energy output in 2021, while solar energy accounted for 7.7 percent. Renewable energy sources (hydro, geothermal, bioenergy, wind, and sun) has the highest share of total production.

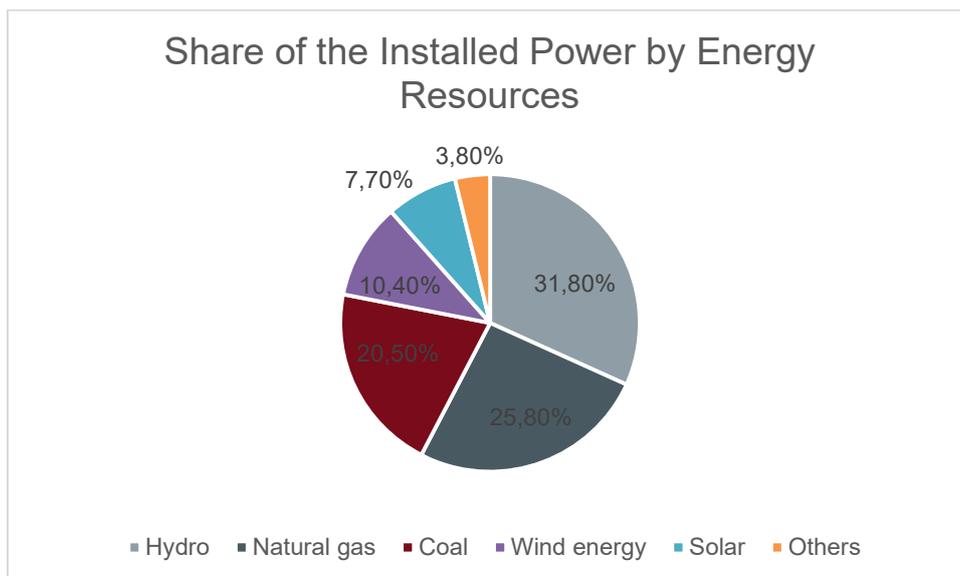


Figure 11: Share of the Installed Power by Energy Resources

Source: Authors' own illustration based on data extracted from (TEİAŞ, Ekim 2021 Kurulu Güç Raporu, 2021)

Total electricity generation of Turkey was 306.703,01 Gwh in 2020. Thermal power generation accounted more than half of total generation with 182.802,6 Gwh. The share of the renewables and wastes, on the other hand, was 16,8 percent (TEİAŞ, 2020 Yılı Elektrik Üretim-Tüketim Raporu, 2021)

Turkey's energy supply is mainly reliant on imports. In 2020, energy equivalents of 114.3 Mtoe (million tonnes of oil equivalent) were imported, 8.8 Mtoe were exported, and 2.5 Mtoe were used as bunker fuel (for aircrafts and maritime vessels) (Ministry of Energy and Natural Resources, Denge Tablosu 2020, 2021). Major import components, in terms of Mtoe, are natural gas, with 34.7%, crude oil with 26.9%, coal with 22.6%, and oil products with 15.9%.

Turkey's total energy consumption in 2020 was 113.6 Mtoe. Oil products account for the largest amount of energy consumption (36.6%), followed by natural gas (23.2 percent). Another 19.6% is accounted for by electricity, and coal accounts for 12,9% (Ministry of Energy and Natural Resources, Denge Tablosu 2020, 2021).

The energy generation from renewables has increased significantly in the last decade, form 2.337 GW in 2009 to around 44.500 GW in 2019 (TÜİK, Electricity generation and shares by energy resources, 2021). The average rate of increase per year is 35%. Figure 12 shows the change in share of the energy resources in electricity generation per year. The decline in the share of natural gas and the increase in the share of renewables are noteworthy.

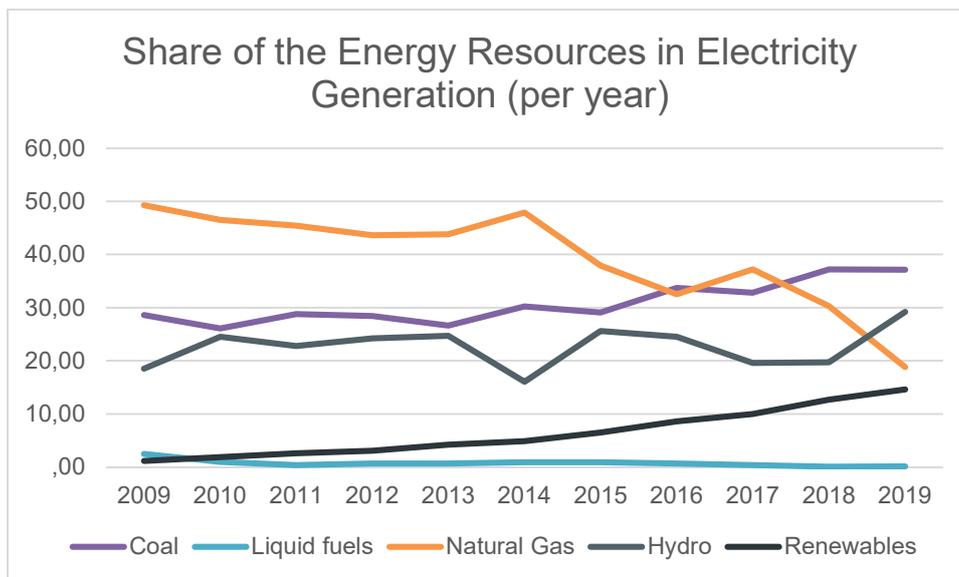


Figure 12: Share of the energy resources in electricity generation

Source: Authors' own illustration based on data extracted from (TÜİK, Electricity generation and shares by energy resources, 2021)

The industrial sector consumes 45 % of the total net consumption, around 257.000 GWh (TÜİK, Distribution of net electricity consumption by sectors , 2021). Household and commercial activities follow, with 21.8% and 19.3% shares respectively (Figure 13). It is important to notice that the commercial sector's share in energy consumption has doubled in the last two decades, while all other sectors' have decreased (Figure 14) (TÜİK, Distribution of net electricity consumption by sectors , 2021).

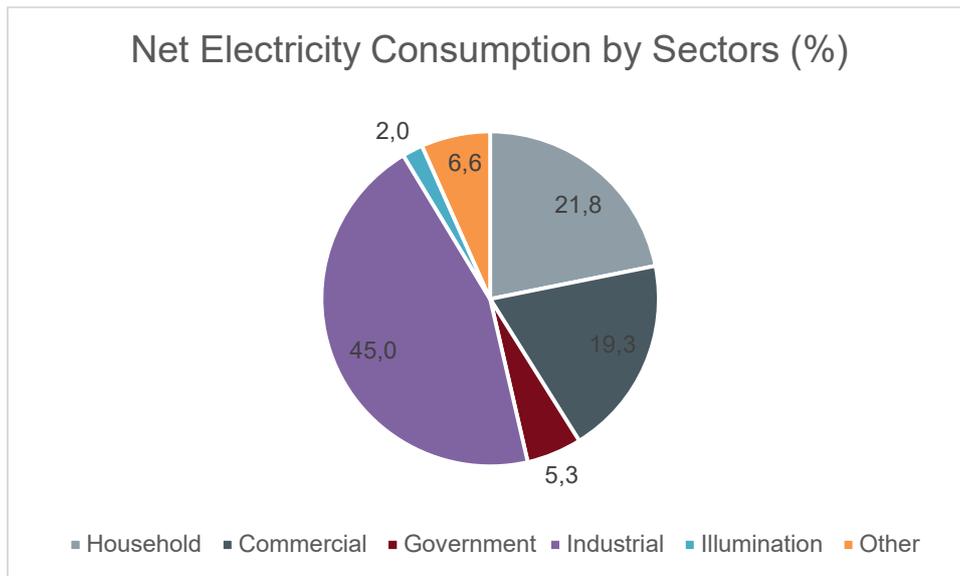


Figure 13: Net electricity consumption by sectors (%)

Source: Authors' own illustration based on data extracted from (TÜİK, Distribution of net electricity consumption by sectors , 2021)

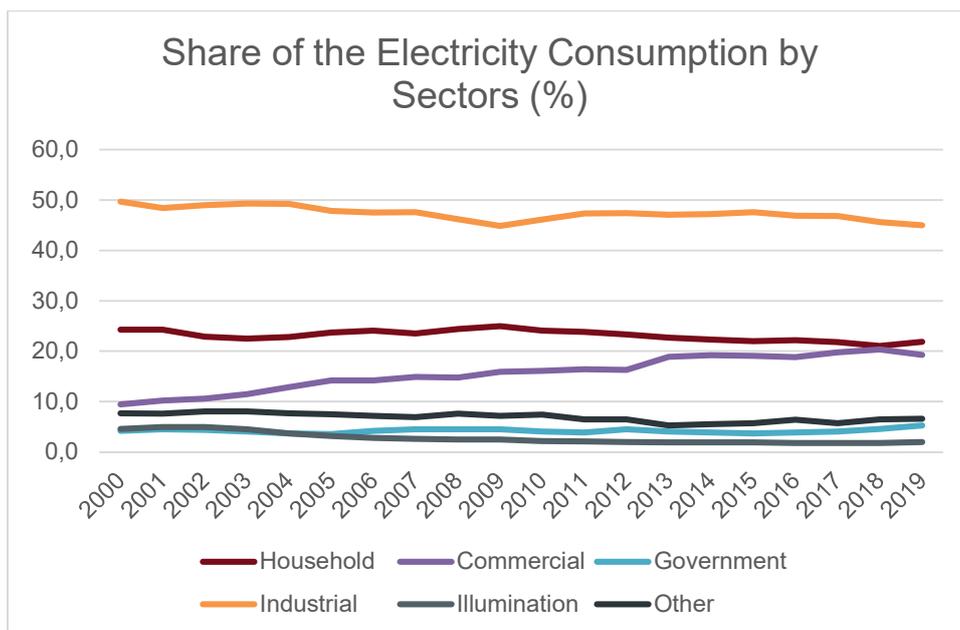


Figure 14: Share of the electricity consumption by sectors (%)

Source: Authors' own illustration based on data extracted from (TÜİK, Distribution of net electricity consumption by sectors , 2021)

Turkish Ministry of Energy and Natural Resources forecasts a 5% annual rise in energy demand, amounting to roughly 370 TWh in 2023 (Ministry of Energy and Natural Resources, Bilgi Merkezi - Elektrik, 2021).

The four major pillars of Turkey's energy policy are decreasing energy intensity, boosting energy efficiency and savings, harnessing indigenous resources, and reducing carbon emissions. The goal of the National Energy Efficiency Action Plan (NEEAP) for 2017-2023 (Ministry of Energy and Natural Resources, National Energy Efficiency Action Plan 2017 - 2023, 2018) is to reduce energy intensity by 20% till 2023, compared to 2011 levels. For this purpose, the Plan calls for a 24 Mtoe reduction in energy use with an investment of 11 billion USD to fund

55 initiatives in five sectors (Ministry of Energy and Natural Resources, National Energy Efficiency Action Plan 2017 - 2023, 2018).

NEEAP comprises investments, action plans, and policies aimed at energy conservation, efficiency, and environmental preservation. Support takes the form of training programs, empowering stakeholders, energy audits and monitoring incentives, and activities to raise awareness about energy and greenhouse gas emissions (Ministry of Energy and Natural Resources, Enerji Verimliliği, 2021).

The NEEAP is divided into five sections: buildings and services, industry and technology, energy, transportation, and agriculture.

Turkey's construction sector grew at a 4.4 percent annual rate, resulting a parallel increase in energy demand. Because the construction sector accounts for more than 30% of total energy consumption, energy savings and conservation in the sector are critical components of the NEEAP (Ministry of Energy and Natural Resources, National Energy Efficiency Action Plan 2017 - 2023, 2018). Measures to be taken in the NEEAP include defining energy demand levels for buildings, setting emission limits, penalizing carbon emissions above permitted limits, reducing energy needs and carbon emissions of buildings, and boosting the use of renewable energy in buildings (Ministry of Energy and Natural Resources, National Energy Efficiency Action Plan 2017 - 2023, 2018). The action plan encourages public-private collaboration to achieve these objectives. The Regulation on Energy Performance for Buildings was amended in 2017 to mandate Energy Performance Certificates (at least C class) for new buildings, which is a significant step forward (REPB, 2008). Similarly, the Climate Change Action Plan, which covers the years 2011 to 2023, includes goals for increasing the share of renewable energy in power consumption as well as energy efficiency standards (Ministry of Environment and Urbanization, 2011).

Lowering energy costs, essential cost components for industries, is crucial for all Turkish companies, offering a natural motive for energy conservation and efficiency. This drive is bolstered by the Energy Efficiency Law (EEL, 2007), which mandates energy efficiency audits and the construction of an organizational framework for energy management. The Energy Efficiency Strategy intends to reduce energy intensity, highlighting the key role of technological advancements in energy efficiency (Ministry of Energy and Natural Resources, 2019-2023 Stratejik Plan, 2019).

Turkey's energy system has about 8% transmission and distribution losses, higher than the OECD average (Ministry of Energy and Natural Resources, National Energy Efficiency Action Plan 2017 - 2023, 2018). The NEEAP and Eleventh Development Plan include activities aimed at improving energy efficiency and ensuring the sector's long-term viability (Presidency of Strategy and Budget, Eleventh Development Plan, 2019).

The growing transportation sector, which accounts for more than 25% of total energy consumption, is also a critical part of Turkey's energy policy. The reliance on imported oil products for road transport is a crucial factor that needs to be addressed in energy supply security. The transportation industry is also responsible for considerable adverse environmental effects, such as air and noise pollution, as a result of transportation activities and traffic congestion. Road transportation accounts for more than 90% of the total energy consumed by the transportation industry, and thus is the primary target of energy conservation and efficiency efforts in this sector. The Transport and Communications Strategy Goal 2023, for example, aims to reduce the share of road transportation in freight and passenger transit by increasing the share of railway transportation (Ministry of Transport, 2011). The 2023 targets are a 15% share of railway freight transport and a 10% share of railway passenger transit (Ministry of Energy and Natural Resources, 2019-2023 Stratejik Plan, 2019). Along with these goals, the Ministry of Transport and Infrastructure is promoting the National Intelligent Mobility Systems Strategy (Ministry of Transport and Infrastructure, 2020), which focuses on sustainable transportation, clean car technology, and alternative fuels.

Principles and action plans for Turkey's agricultural sector are also included in the NEEAP (Ministry of Energy and Natural Resources, National Energy Efficiency Action Plan 2017 - 2023, 2018). These generally rely on the use of developing technologies for improvements in energy efficiency and conservation. Examples include replacement

of conventional equipment with more efficient new-technology counterparts, the use of drip irrigation or other energy and water-saving irrigation methods, and incentivizing the use of renewable energy in agriculture (Ministry of Energy and Natural Resources, National Energy Efficiency Action Plan 2017 - 2023, 2018).

3.3 Energy market and infrastructure

The installed generation capacity of Turkey is about 99 GWh and is doubled since 2009 (TSKB, 2021). The evolution of Turkey's installed power generation capacity from 1979 to 2020 is depicted in Figure 15.

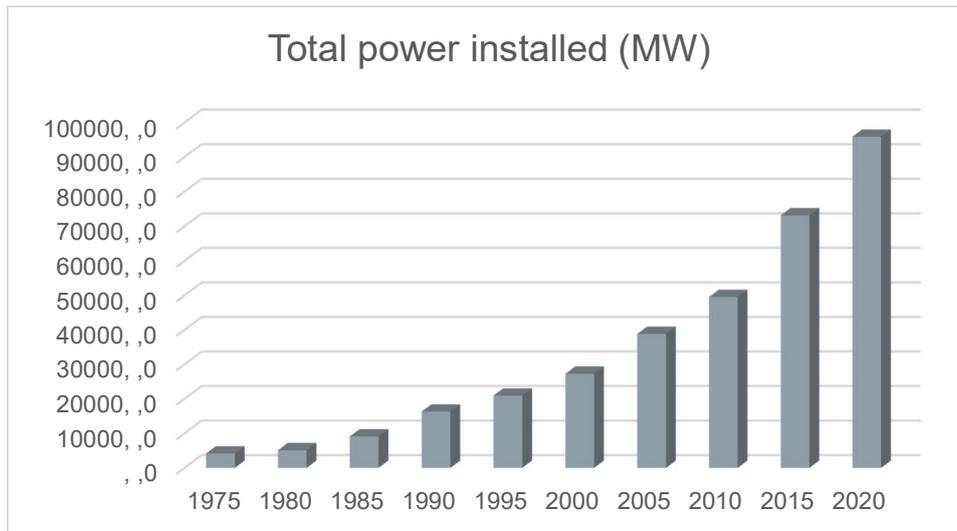


Figure 15: Evolution of installed electricity generation capacity of Turkey (MW) from 1979 to 2020

Source: Authors' own illustration based on data extracted from (TSKB, 2021)

As of 2020, hydroelectric power accounts for 32.3 percent of installed electrical generation capacity, followed by natural gas (27.2 percent) and coal (21.2 percent). Wind accounted for 9.2 percent, followed by solar, at 7.0 percent, geothermal, at 1.7, and renewable waste and waste heat, at 1.2 percent (TEİAŞ, 2020 Yılı Elektrik Üretim-Tüketim Raporu, 2021).

There was a remarkable increase in the market shares of renewables between 2009 and 2019. Wind's share climbed from 1.77 percent to 8.3 percent (Ministry of Energy and Natural Resources, Rüzgar, 2021), and solar power's increased from 0 to 3.6 percent (Ministry of Energy and Natural Resources, Güneş, 2021). As a result of these developments, coal and natural gas lost about 3%, while hydro lost about 1.3 percent (TEİAŞ, 2020 Yılı Elektrik Üretim-Tüketim Raporu, 2021)

The Turkish electricity market was fully centralised and regulated in 1994, when the state-owned and operated TEK (Turkish Electricity Agency), responsible for electricity production and distribution, was divided into two companies: TEDAS (Turkish Electricity Distribution Corporation), and TEAS (Turkish Electricity Production and Transmission Corporation), which was later absorbed into EUAS in 2018. In 2001, three key steps were taken in the direction of deregulation, following the first important step achieved in 1994. The first was the division 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 (EPK, 2013). The EPDK is responsible regulating the electricity, natural gas, LNG (Liquefied Natural Gas), and downstream petroleum markets.

As of 2020, the electricity market became a free competitive market. The state-owned EUAS's share of installed energy producing capacity has since fallen to 21% (EPDK, 2020). The changes in the shares of state and private firms in installed power producing capacity between 2009 to 2019 are shown in Figure 16.

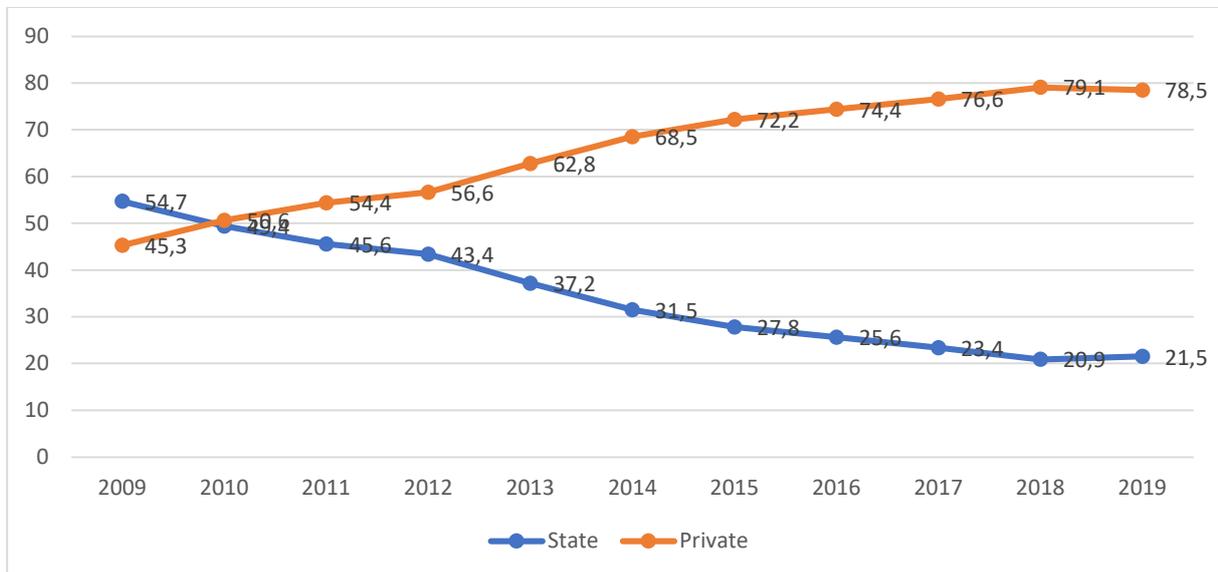


Figure 16: Shares of state and private companies (in %) in the installed electricity generation capacity from 2009 to 2019.
Source: (EPDK, 2020)

The shares of installed electricity production capacity in Turkey by type of company are shown in Figure 17.

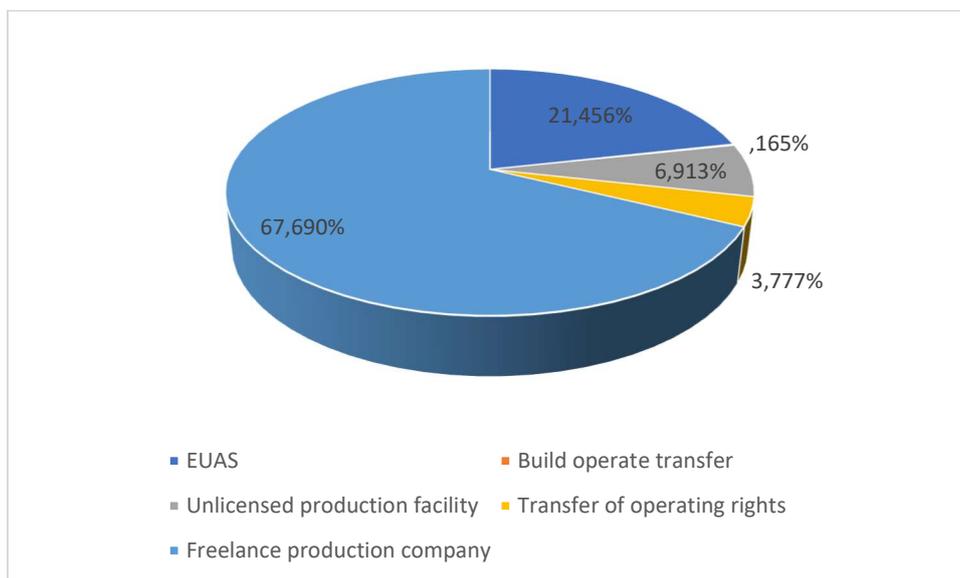


Figure 17: Shares in the installed electricity generation capacity of Turkey in 2019 by type of company.
Source: (EPDK, 2020)

TEIAS is both the system operator for the electricity sector, and the operator of the balancing market and the auxiliary services market. TEDAS, previously in charge of distribution, divided the country into 21 zones, which were privatized and assigned to commercial delivery companies between 2009 and 2013.

EPIAS (Energy Exchange Istanbul- EXIST) was formed in 2015 to operate the wholesale electricity market and establish financial arbitration in the intraday market, day ahead market, and balancing market, in addition to this structure of the market for production, transmission, and delivery (EPIAS, 2021).

The Natural Gas Market Law (NGML, 2001) defines market activities for this market and requires a licence for legal persons interested in participating in market activities. Natural gas production is not considered a market activity, but rather falls under the category of search and operation certificates, regulated by the Petroleum Law (PL, 2013). However, an export or wholesale license is required for a generating business to be allowed sell natural gas. The Natural Gas Market Licensing Regulation lays out the requirements of granting licenses valid for a minimum of 10 and maximum of 30 years. Import, export, wholesale, storage, transmission, CNG (compressed natural gas), and distribution permits are among the license categories (NGMLR, 2002). As of 2017, the following had been granted: 72 distribution licenses, 9 storage licenses, 8 export licenses, 17 transmission licenses, 60 import licenses, 96 CNG licenses, and 49 wholesale licenses (EMRA, 2017).

BOTAS (Petroleum Pipeline Business), founded in 1974 to carry crude oil from Iraq to Turkey, eventually became the sole company overseeing natural gas trade, transportation, and pipeline operations. Natural gas has been used in the residential and industrial sectors since 1989 (BOTAS, 2021).

Following the initial natural gas purchase agreement with Iran in 1996, similar agreements were signed with Russia in 1997 (Blue Stream) and 1998 (West), Turkmenistan in 1999, and Azerbaijan in 2001. Delivery from Iran in 2001 was followed in the next year by delivery from Russia via the Blue Stream Pipeline. The yearly capacity of the 396-kilometer Blue Stream Pipeline is 16 billion cubic meters (Gazprom, 2021).

The Natural Gas Market Law, passed in 2001, opened the way for deregulation and boosted the market share of private enterprises (NGML, 2001). The first notable step in this direction was the participation of private sector enterprises in natural gas discussions, alongside the state-owned BOTAS in 2005. Private sector businesses accounted for 4 billion dollars in exports and wholesales in 2009. Following the expiration of Botas' Gazprom-West contract in 2012, private sector entities agreed to a new 6 billion cubic meter import contract with Gazprom.

The natural gas pipeline between Turkey and Greece, built between 2005 and 2007, is 296 kilometers long and has a capacity of 7 billion cubic meters per year.

TANAP, another large pipeline project, began construction in 2015. The delivery on TANAP pipeline began in 2018, with an expected maximum capacity utilization of 16 billion cubic meters per year by 2022 (Erkul Kaya, 2021). The 1850 km pipeline extends from the South Caucasus Pipeline on the Georgian border, and connects with the Trans Adriatic Pipeline (TAP) on the Greece border, delivering natural gas from the Georgian border to Turkey. TANAP is 51-percent owned by the Azerbaijani South Corridor Natural Gas Company (SGC), with smaller shares held by SOCAR Turkey (7 percent), BOTAS (30 percent), and BP Pipelines (TANAP) (12 percent) (TANAP Project Leaflet, 2014).

In terms of natural gas storage infrastructure, two new facilities were opened in 2016, Silivri Storage Facility and Tuz Lake Storage Facility. In the same year, a tender was agreed for distributing natural gas to all Turkish cities.

In 2018, Turkey took another step toward deregulation of the natural gas industry, by establishing the Organized Wholesale Market, run by EXIST (Petform, 2021).

4 Analysis of the legislative and administrative framework

4.1 A review of Revised Renewable Energy Directive (RED II) 2018/2001/EU (defining “renewable energy communities”)

Directive 2018/2001/EU (RED II, 2018) on the promotion of the use of energy from renewable sources is a part of the Clean Energy Package, aiming to facilitate the transition to a clean energy economy. It was also intended to provide a common framework for promoting renewable energy and establishing binding union targets for its overall share.

The RED II stipulates a binding Union target of 32% renewable energy in the European Union by 2030, with an upward revision clause by 2023. No national targets are defined in the directive, unlike the prior directives that it replaced. It also benefits investors through reduced administrative responsibilities and costs. There are also proposals to boost renewable energy production through a cost-effective, market-based support scheme, and a regulatory framework for the right to self-consumption.

The RED II aims to establish guiding principles for financial support schemes, renewable energy self-consumption, energy communities, and district heating. Its goals include improving cross-border cooperation mechanisms, streamlining administrative processes, improving sustainability and greenhouse gas emission criteria for biofuels, and integrating the use of renewable energy sources in transportation, heating, and cooling.

Article 4 of the regulation states that the 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*” (RED II, 2018). It also specifies that “*support for electricity from renewable sources is granted in an open, transparent, competitive, non-discriminatory and cost-effective manner.*”

The Directive establishes sustainability and greenhouse gas emission reduction criteria for biofuels, bio liquids, and fuels derived from biomass, which correspond to conditions existing at the date of commissioning of the facilities.

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” with the primary purpose of providing “*environmental, economic, or social community benefits for its shareholders or members, or for the local areas where it operates, rather than financial profits*”.

Members of RECs should be in close proximity to community-developed renewable energy projects. It is worth noting that a renewable energy community is allowed to function in any renewable energy market and, according to Article 22, has the right to “*produce, consume, store, and sell renewable energy, including through renewable energy power purchase agreements*” (RED II, 2018). The activities that RECs can engage in, however, are not restricted to these, and it is permitted supply energy or provide aggregation or other commercial energy services.

Member States are under the obligation to eliminate unjustified regulatory barriers and administrative procedures for such communities. They should allow the distribution system operator to work with energy communities.

RED II also defines the concept of “renewable self-consumers” 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. Renewable self-consumers are allowed to act jointly when located in the same building or multi-apartment block. This type of collective generation is not fall, however, under the concept of “community”.

4.2 A review of Revised Energy Market Directive (REMD) 2019/944 (defining “citizen energy communities”)

The Directive 2019/944 (REMD, 2019) on common rules for the internal market in electricity aims to organize competitive electricity markets, provide new business opportunities, competitive prices, efficient investment signals, and higher service standards, and contribute to supply security and sustainability.

The Directive lays forth standards for energy generation, transmission, distribution, supply, and storage, as well as consumer protection issues, with the goal of creating integrated competitive, consumer-centric, flexible, fair, and transparent electrical markets across the EU. Cooperation among member states was determined to be necessary in order to attain the stated objectives.

The Directive highlights customer rights, billing, aggregation, public participation in energy generation activities, access to data, electro mobility, sustainable energy, and new obligations for distribution and transmission system operators, as well as national energy regulators. As with RED II, facilitating administrative procedures and overcoming cumbersome bureaucracy are among the topics that have received most attention.

Among other rules, the Directives include two essential features based on the e-CREW concept. The first is a law governing the concept of a "citizen energy community" (CEC), and the second is the smart meter and data sharing regulation.

The Directive permits a group of final customers to take collective action to consume or store electricity generated within their premises, as well as participate in energy saving initiatives, as long as these activities are not their major business or professional activity.

According to REMD, a CEC is a legal entity based on voluntary and open participation, with the primary goal of providing members, shareholders and the local community with environmental, economic, or social community benefits, rather than generating financial profits. CEC may engage in a variety of energy market operations, including generation, distribution, consumption, aggregation, and storage (REMD, 2019).

The Directive requires member states to provide CEC with non-discriminatory access to all electricity markets, whether directly or through aggregation.

Metering (including smart metering) and data sharing activities are given significant attention by REMD. The primary goals of this rule are energy efficiency and consumer empowerment. Installation of smart metering systems is the responsibility of member states. The development of smart grids is also prioritized. Significant smart metering system functions are the measurement of actual power consumption, the supply of information to final customers on actual time of use, the privacy of final customers, and the security of data. In addition, the general concepts of data management are outlined. Data managers have a legal obligation to provide necessary persons/institutions with access to data from smart metering systems while maintaining personal data security.

4.3 Current progress

The March 2016 amendment on the Regulation on Unlicensed Electricity Generation in the Electricity Market license (UEGEM, Elektrik Piyasasında Lisanssız Elektrik Üretimine İlişkin Yönetmelik, 2013) allowed people to establish cooperatives to generate electricity without being subject to license. The legal framework established by the Regulation was consistent with the EU's REC/CEC policy. This change in legislation resulted in the establishment of energy cooperatives, allowing RECs/CECs, to be initially established in Turkey prior to the European Union Directives of 2018/2001/EU and 2019/944. According to their legal position in Turkey, the cooperatives should meet the RED II and REMD criteria for RECs and CECs. In this framework, over three years, around 50 electricity generating cooperatives were created in Turkey (Elüstün, 2021). Unfortunately, a revision in

May 2019 removed the privilege in order to prevent fraudulent conduct on financial support schemes (UEGEM, Elektrik Piyasında Lisanssız Elektrik Üretim Yönetmeliği, 2019).

The notion of REC and CEC has yet to be implemented in Turkey. Participation in community-based collective generation through consumption aggregation is limited to natural or legal persons or cooperatives in the same tariff group using the same connection point, or those whose electrical energy consumption can be monitored with a single common meter. This requirement severely limits the number of homes, business / industrial entities, and other entities that can benefit.

As a result, one may conclude that Turkey possesses the legal and administrative framework knowledge and experience necessary to facilitate the adaption of the RED II and REMD; however, a minor but important change in legal restrictions could render the Turkish system compatible with relevant EU directives.

Turkey possesses the necessary legal infrastructure for data transfer, an important component of the REMD. The fundamental and secondary legal frameworks were already established prior to EU regulation, and as a result, consumer data can be read, collected, and stored via smart metering systems. The sharing of this information is likewise expressly regulated under the rule.

4.4 Evidence from implementations

Following the regulatory amendment that allowed the formation of community energy cooperatives, around 50 energy cooperatives were founded between 2016 and 2019 (Elüstün, 2021). As of 2020, 91 percent of these are active, with a total of 715 members, and an average of 14. The statistics show that people approach energy communities with caution after new challenges in forming community energy cooperatives with the changes in 2019, and no new cooperatives have been formed.

The experiences of existing cooperatives have shown that time is needed to form cooperatives for the purpose of energy generation, particularly land allocation procedures. It is claimed that some administrative institutions fail to respond to authorisation requests in a timely manner. Individual engagement in cooperatives is negatively impacted by the economic burden involved (Troya Çevre Derneği, 2017).

According to a poll conducted in Turkey as part of the H2020 ECHOES Project (ECHOES, 2019), 70-75 percent of people are attached to their communities' energy behaviours, and a comparable amount, 77 percent would embrace more ecologically beneficial behaviour if the majority did. Expectations for the community's perspective, on the other hand, are lower. A relatively lower proportion, 69 percent, believed the community would support decreased energy use, while only 49 percent believed they personally would gain community support for supporting pro-energy transition measures (ECHOES, 2019).

Only 43% of respondents believed they would receive community support if they attempted energy savings through grid operator intervention (e.g., by remotely turning on/off non-critical appliances). 37% believe that community action will be sufficient to complete the energy transition (ECHOES, 2019).

4.5 Barriers & Motivators

All generation and distribution activities in the electrical market, in general, require a license, and applicants must be a joint-stock company, a limited liability company, or an organized industrial zone. However, under The Act No. 6446 on the Electricity Market the following are exempt from the requirement for a license: renewable energy generation facilities with a maximum capacity of one megawatt, and renewable energy resources with a contractual power limitation in the connection agreement. The President of the Republic, who has the appropriate authority, extended the limit of unlicensed generation capacity to 5 megawatts in 2019 (Presidential Decision, 2019).

Self-consumption (without a license requirement) from renewable sources is regulated by Act No. 5346 on Utilization of Renewable Energy Sources for the Purposes of Generating Electrical Energy (URESPGEE, 2005).

The law allows all natural and legal persons to participate in self-consumption, and also surplus power to be delivered to the distribution system, requiring the supply firm to accept the excess amount. A financial incentive plan has also been implemented for self-consumption of renewable energy.

The 2019 Regulation on Unlicensed Electricity Generation in Electricity Market, on the other hand, specifies legal and natural persons' rights to generate unlicensed electricity (UEGEM, Elektrik Piyasasında Lisanssız Elektrik Üretim Yönetmeliği, 2019). Those wishing to exercise these rights must first apply to the relevant network operator, who will form a commission to review the application. The assessment will be focused on complete documentation, as well as technical considerations. The exact duration of this examination is unclear, but experience shows that these procedures are time-consuming, and act as an administrative barrier to self-consumption and unlicensed generation.

The inclusion of the consumption aggregation method is another new feature of the Regulation (UEGEM, Elektrik Piyasasında Lisanssız Elektrik Üretim Yönetmeliği, 2019). By aggregating their consumption, one or more legal or natural persons may construct a generation facility or facilities. This privilege, however, depends on all participants in the aggregation being in the same tariff group and utilizing the same connection point, or being linked to the same meter. Few office buildings, shopping malls, industrial estates, and other structures will be able to meet these stringent to conditions. Furthermore, the Regulation demands that individuals who will engage in the aggregation technique are represented by a single person, who will also have legal and administrative responsibilities, thus, forming another legal barrier.

Cooperatives may also apply for and receive approval to use the consumption aggregation method on behalf of their members/shareholders. Members, on the other hand, must be in the same tariff group and use the same connection point or connection to a common meter (UEGEM, Elektrik Piyasasında Lisanssız Elektrik Üretim Yönetmeliği, 2019).

Applicability of the consumption aggregation approach and community-based self-consumption is severely limited under existing regulatory restrictions.

It is also worth noting that there is no definition of the concept of "energy communities" in Turkish law.

4.6 Conformity to existing legislative framework

As stated in the 11th Development Plan for the period 2019-2023 (Presidency of Strategy and Budget, 2019), increasing the use of renewable energy sources is one of the primary pillars of national energy policy. The plan also aligns with EU energy efficiency standards, which include *"raising the number of buildings that are more efficient and can generate their own energy."* Furthermore, the Development Plan includes goals for increasing the use of unlicensed solar and wind generating facilities for personal electricity needs, as well as the growth of smart grid applications.

The abolished Regulation on Unlicensed Electricity Generation in the Electricity Market was amended in 2016 (UEGEM, Elektrik Piyasasında Lisanssız Elektrik Üretimine İlişkin Yönetmelik, 2013), allowing for the creation of cooperatives with no restrictions on electricity generation. As many as 50 new energy cooperatives came into being thereafter. Cooperatives might be deemed a CEC/REC mechanism under EU rules, due to their legal characteristics.

With the new Regulation on Unlicensed Electricity Generation in the Electricity Market (UEGEM, Elektrik Piyasasında Lisanssız Elektrik Üretim Yönetmeliği, 2019), the government took action to prohibit malicious conduct on financial support schemes, but as a result, the advantages of cooperatives were lost. Under current legislation, members of generating cooperatives must have a common connection point or consumption must be measured with a single

common meter t as for CEC / REC. This has a constraining effect on the formation of energy-generating cooperatives.

The Regulation on Unlicensed Electricity Generation in the Electricity Market 2019 regulates the collecting of data from meters, data flow, and processing (UEGEM, Elektrik Piyasında Lisanssız Elektrik Üretim Yönetmeliği, 2019). The law also requires the use of a meter in the production of unauthorized electricity. Meters with an automatic reading system are required for facilities with installed power of 50 KW or higher. The smart meter system in REMD corresponds to the concept of automatic meter reading system in the Electricity Market Balancing and Settlement Regulation dated 14.04.2009 (EMBSR, 2009).

The Energy Market Regulatory Authority's Decision No. 5707 of 2015 granted approval for Procedures and Principles Regarding the Scope of Automatic Meter Reading Systems and Determination of Meter Evaluation (PPRSAMRSDME, 2015). This allows for the free sharing of data from the automatic meter reading system database with suppliers and, if requested, with the relevant producer and/or consumer.

As a result, one can conclude that Turkey understands and has experience with a legislative and administrative structure that will facilitate energy communities, and a minor change in legislation will bring the Turkish system into compliance with the EU's relevant REC/CEC guidelines.

5 Practical framework

5.1 Energy behaviours of citizens and how they would associate with the eCrew approach, barriers, motivators

Concerning the energy behaviours of citizens in Turkey, evidence can be obtained from the ECHOES International Survey. In addition to the energy behaviours of citizens, the survey also includes results regarding respondents' community perspectives, which relate to the eCREW approach. The ECHOES International Survey was conducted online in the context of the H2020 ECHOES project and provides individuals' perspectives on the choices regarding energy transition, through 114 questions. 18,000 respondents from 31 countries (EU 28 including the United Kingdom, as well as Norway, Switzerland, and Turkey) participated the survey, including 594 from Turkey (ECHOES, 2019).

The ECHOES survey provides pointers to individuals' energy behaviours, based on their lifestyles and energy-related choices. In Turkey, 71% of respondents live in apartment blocks, and of these, 43.4% have indoor living spaces of 91 to 130 square meters. Central heating is the most common type, with 65%, followed by district heating (14%). For 80% of the respondents in Turkey, the primary heating fuel for households is gas 80%, and 10% use electricity. Concerning cooling, 95.5% state that they have air conditioners, however, 45% use air conditioners very rarely, even during summer.

When the energy saving behaviours are concerned, 55% of the respondent's state that they often or always disconnect electric appliances when not in use. A much higher 86% use energy saving light bulbs (ECHOES, 2019).

The driving preferences demonstrate a high level of using private vehicles. That is, 86.5% of the respondents from Turkey drive private cars, with a 15,000km annual average. Around 60% drive alone more than half of the time, and 34%, very often or extremely often. The majority of the vehicles (79%) have petrol or diesel propulsion, and 13.5% are fuelled by LPG or CNG, totalling a 92.5% for fossil-fuelled vehicles. Concerning car sharing, 75% of the respondent's state that they have never experienced car sharing. However, 94.8% of those who have tried car sharing report positive experiences (ECHOES, 2019).

When public transportation is concerned, 91% state that they use public transportation. The most often used mode in the daily routines of the respondents is taking the bus (71%), followed by underground (47.6%) (ECHOES, 2019).

A motivator that can be exploited concerning the implementation of the eCREW approach, as evidenced by the ECHOES survey, is the high level of support for renewable energy initiatives. Among the respondents from Turkey, 87% positively associate renewable energy sources with the environment, stating that renewable energy has clear benefits. A slightly lower 93% believe in the economic and social contributions of renewable energy, stating that the use of these sources will create new jobs (ECHOES, 2019).

One of the questions that relates to the eCREW approach concerned the willingness to invest in renewable energy initiatives, where 34% of the respondents from Turkey affirmed that they would be interested.

Another aspect of the ECHOES survey pertaining to the eCREW approach inquires the individuals' relation with their communities, particularly concerning the energy behaviours. High levels of community attachment is expected to act as a motivator regarding individuals' likelihood of joining Crews. Results of the ECHOES survey demonstrate that around 75% of the respondents are in favour of these energy behaviours in their communities. For instance, 77% of the respondents from Turkey stated that if the majority in their community adopted more environmentally friendly behaviour, they themselves would also. Similarly, 75% stated that they would feel proud if those in their community saved more energy. The same pattern is also observed in the counter direction, as a barrier; 70% would feel angry if the people in their community neglected energy saving (ECHOES, 2019).

At this point, it is also worthwhile noting a potential barrier regarding the implementation of the eCREW approach. That is, many individuals are not optimistic about their communities in terms of energy initiatives. Among the respondents from Turkey, 69% expect support from their communities if they used less energy. A smaller, 54% perceive that a growing number of people in their communities are actually trying to do this. The perception of such community support decreases to 49% when the provision of energy policies that support the energy transition are considered. A slightly higher, but still relatively low 54% of the respondents from Turkey state that a growing number in their community's favour pro-energy transition policies. Likewise, only 37% agree that people can act together to achieve the energy transition (ECHOES, 2019).

One motivator that can be utilized concerning the eCREW approach is the higher importance individuals place on the energy consumed for heating and cooling in households. 62% expect community support if they decreased their personal energy consumption for heating or cooling. 50% state that a growing number of people in their communities have decreased the energy consumed for heating and cooling in their dwellings (ECHOES, 2019).

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

Until 2019, around 50 energy generation cooperatives were founded in Turkey, with the legislation allowing members from various connection points to join (Elüstün, 2021). As of 2020, 91 percent of these, with a total of 715 members were still active. However, a revision to a related legislation aimed at combating fraudulent behaviour on financial support schemes had a negative impact on the formation of new communities. The law allows cooperatives to be formed as long as members share a similar connection point and their consumptions are measured with a single meter, however, only a small number of people fall into this category.

5.3 Role of central government in energy transition – with special emphasis on their positions with respect to the eCREW approach

The central government of Turkey has legislative power and the capacity to prepare national development and strategic plans.

The Republic of Turkey's 11th Development Plan for the years 2019-2023 stated as its goals the raising of the number of energy efficient and energy self-sufficient buildings as well as creating a National Green Building Certificate System (Presidency of Strategy and Budget, 2019). In addition, the Development Plan includes goals for increasing the number of unlicensed solar and wind generating facilities for personal electricity needs and the expansion of the use of smart grid applications.

The National Energy Efficiency Action Plan for the period 2017-2023 calls for actions such as providing consumers with more detailed and comparable billing information, establishing an energy data platform for intelligent measurement, and aligning the regulatory system for electricity meter reading with European Union principles (Ministry of Energy and Natural Resources, National Energy Efficiency Action Plan 2017 - 2023, 2018).

The Development and Action Plans puts strong emphasis on enacting policies that allow users to produce their own energy independent of other providers, as well as highlighting smart grid applications.

Final consumers' utilisation of renewable energy sources for their own needs, and the dissemination of renewable energy generating cooperatives, are among the issues emphasized in the 11th Development Plan (Presidency of Strategy and Budget, 2019) and the Specialized Commission on Energy Supply Security and Efficiency's Reports (Presidency of Strategy and Budget, The Report of the Specialized Commission on Energy Supply Security and Efficiency of the 11th Development Plan, 2019).

5.4 Role of local administrations (e.g. regional, municipalities) in energy transition – with special emphasis on their positions with respect to the eCREW approach, barriers, motivators

The major local administration unit in Turkey are municipalities. Legislative power belongs to the national government, and therefore, municipalities and other local administrative bodies (namely provincial administration and villages) have no authority to act independently in energy transition unless given specific authority by law. Being a public legal person, the municipalities have the legal authority to join a cooperative and are therefore free to develop and participate in projects on the establishment of energy cooperatives or other types of energy communities.

Municipalities have the right to establish strategic plans, investment and work programs within their borders, as a public legal person with its own budget. All of Turkey's major metropolitan municipalities (Ankara, Istanbul, Izmir, and others) have their own short-term strategic plans. These plans' aims include the construction of new renewable energy facilities, the utilization of renewable energy sources in energy generation, raising awareness about clean energy and energy conservation techniques, and improving energy efficiency. The Istanbul Metropolitan Municipality's Strategic Plan for 2020-2024, for instance, aims to increase by more than ten-fold the amount of renewable energy installed power, from 2.000 Kwp to 25.000 Kwp (İstanbul Büyükşehir Belediyesi, 2020); while the Izmir Metropolitan Municipality's plan anticipates the completion of ten new renewable power plants during the same period (İzmir Büyükşehir Belediyesi, 2020).

6 Conclusion

6.1 Country Profile

Turkey's energy supply is highly reliant on imports but Renewable energy as a source of energy generation and energy communities has great potential to reduce this. Renewable energy generation has expanded dramatically over the last decade, with an average annual increase of 35 percent. Wind energy accounts for 8.1 percent of total energy output, and solar energy, 3.7 percent (2020). However, installed wind and solar PV capacity remains far below the EU average.

The REC and CEC, as a concept, have yet to be adopted by Turkish legislation. There are many difficulties in generating electricity collectively; apart from having to establish commercial companies and acquire the necessary licenses, persons must also be in the same electricity tariff group and connected to the same connection point. Their consumption should also be measured using a single meter. A minimal number of residences, businesses/industrial entities, and other entities can meet this requirement.

Prior to 2019, the legislative provisions governing the energy sector permitted people to form cooperatives to generate power without the need for a license or meeting the standards outlined in the preceding paragraph. This legal framework was in line with the REC/CEC policy of the EU. However, a 2019 revision to energy legislation stripped cooperatives of these rights.

As a result, Turkey gained the legal and administrative knowledge and experience needed to make the RED II and REMD more applicable, and a slight but important change in legal limits will make the Turkish system consistent with relevant EU directives.

Turkey has the legal framework in place for data transfer, which is critical to the REMD's success. Even prior to EU regulation, the fundamental and secondary legal frameworks had been created. Smart metering systems are allowed to read, gather, and store consumer data, and data dissemination is also regulated.

6.2 A quick SWOT analysis of the legislative, administrative and practical framework with respect to the eCrew approach

6.2.1 Pointers from legislation

	Legislative Framework
Strengths	Legal structure allowed the cooperatives to play the role of REC or CEC between 2016 - 2019; Legislation allows the implementation of smart meters; Collection of data, its processing and data sharing is in conformity with EU regulations.
Weaknesses	The RED II and REMD (including REC and CEC) are not regulated under Turkish law; The change in legislation against the formation of energy cooperatives without limitations shows a development in the opposite direction to EU
Opportunities	Increasing the use of renewable energy sources, the number of buildings producing their own energy, and the implementation of unlicensed solar and wind power plants for self-consumption are part of both the national development plan and also the energy efficiency action plan, and all in line with relevant EU Directives.
Threats	The political attitude aimed at preventing fraudulent conduct on financial support schemes might cause the government to withdraw support for REC / CEC.

6.2.2 Pointers from administrative framework

	Administrative Framework
Strengths	11th Development Plan and The National Energy Efficiency Action Plan favours energy efficiency and self-sufficiency, and proposes action for simplifying and accelerating the administrative procedures

Weaknesses	The current procedures for unlicensed energy generation, especially from renewables, are cumbersome and time consuming
Opportunities	The willingness to adapt EU <i>acquis communautaire</i> might result in the government taking positive steps toward the adaption of EU Directives
Threats	People have a generally negative attitude to collective action in energy transition and energy saving

6.2.3 Pointers from practical framework

Practical Framework	
Strengths	The country has experience in energy generating cooperatives prior the EU directives; the climate is suitable for exploiting renewable sources of energy
Weaknesses	The participation level of people in existing cooperatives shows hesitancy over collective action in energy generation
Opportunities	The geographical profile of the country provides great advantages for those aiming to generate electricity from renewables (especially from wind and solar PV); the technology related to energy has the potential to get cheaper by time.
Threats	Existing major companies might perceive the energy communities as direct competitors, and use their lobbying power against any legal developments.

6.3 Suggestions for the wider uptake and further development of the eCrew approach

In Turkey, the concepts of REC and CEC do not yet exist. However, the country possesses the legislative and administrative framework knowledge and expertise that will allow easy adaptation to the eCREW method. A positive step toward implementing the eCREW approach would be a small amendment in legislation that restores cooperatives' rights to generate electricity free from the restrictions imposed on citizens. Furthermore, Turkey should seriously consider incorporating relevant EU Directives into its legislation, as citizens' collaborative efforts have a significant potential to improve energy efficiency. This will also have a positive impact on the country's energy dependence.

The report of the Specialized Commission on Energy Supply Security and Efficiency of the 11th Development Plan emphasizes the need for improvement in the permission and approval processes for electricity generation from renewable sources (Presidency of Strategy and Budget, The Report of the Specialized Commission on Energy Supply Security and Efficiency of the 11th Development Plan, 2019). Previous experience has shown that time is needed to establish energy generation cooperatives, particularly to process land allocation procedures. Some administrative institutions are accused of failing to respond to permission requests in a timely manner. Future legislative action should include measures aimed at reducing bureaucracy and simplifying the administrative process for unlicensed electricity generation.

The current regulations on automatic meter reading system, data gathering, and processing are in line with those of the EU. Smart meters are permitted according to Turkish law. However, there are no plans to replace existing

metering equipment with smart meters in the near future. Such an endeavour, if realised, would benefit the development of the eCREW approach.

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