



Work Package 5 Policy Brief Series: Spain

*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 is one of the six eCREW Policy briefs. The policy briefs analyse the regulatory and administrative setups in Italy, Austria, Greece, Turkey, Spain and Germany. In addition, the policy briefs concentrate on how the current administrative and regulatory frameworks might be anticipated to improve the adoption of the eCREW strategy in the European Union and Turkey. Spain's regulatory and administrative infrastructures, which are particularly crucial to the eCREW strategy, are the focus of this policy brief.

The country profile for Spain is presented in this policy brief from the perspective of an eCREW, regulatory and administrative obstacles as well as opportunities for eCREW development in Spain are noted.

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

2 eCREW approach

Community renewable energy webs (CREWs) are networks of individuals collaborating to build and maintain renewable energy infrastructure at the residential scale. Together with CECs and RECs, CREWs are critical frameworks for fostering citizen cooperation in energy-related initiatives. Signing a CREW contract is all needed to become a member; there are no upfront expenditures, no need to incorporate, and minimal or no loss of potential.

To secure economic growth, reduce greenhouse gas emissions, and protect the environment, citizens must be given the means to produce, store, and use energy for their own purposes. These are important actions for a future energy system that is sustainable, secure, energy efficient, and climate neutral. Recent changes in EU law have paved the way for the formation of Citizen Energy Communities (CECs) and Renewable Energy Communities (RECs), which will aid in realizing the full potential of such locally-led endeavours. For this end, the European Union will provide funding (RECs). However, to attract as many people as possible to these CAIs, new business models, financially feasible solutions, reliable ICT tools, and low entry barriers are needed.

eCREW's primary objective is to promote a system whereby individuals and teams can collaborate and make well-informed decisions. As a result, the eCREW strategy is viewed as the most effective means of encouraging cooperation between small and medium-sized groups for electricity generation, storage, and consumption, emphasising lowering overall system energy consumption.

3 Country profile

Spain is located in southwestern Europe and has a surface area of 505.990 square kilometres. This number makes Spain the second largest country in the EU after France. The official language is Spanish. Spain, a European Union member country since the 1st of January 1986, joined the Eurozone on 1st of January 1999 (European Union - Spain).

Spain's western neighbour is Portugal, its southern neighbours are Gibraltar and Morocco, and its northern neighbours are France and Andorra. It should be noted that the borders of Spain extend beyond the mainland. The country's sovereignty includes islands on the Mediterranean Sea (Balearic Islands), as well as the Atlantic Ocean (the Canary Islands), etc. This makes the seashores an essential part of Spain's geography.

Spain consists of seventeen autonomous communities and two autonomous cities. The autonomous communities are comprised of 50 provinces made up of municipalities.

3.1 Social and Economic

3.1.1 Demographic structure

Spain's population is about 47,4 million in 2022, according to Eurostat (Eurostat – Demographic Balance). The total population changed slightly during the last decade, from 46,8 million in 2012 to its current number, and increased by 34,110 people in 2021. As a result, the annual growth of the population was 0.07% in 2021, from 0.14% in 2020. Figure 1 shows the change in total population in the last decade, whereas Figure 2 shows its distribution by sex. Therefore, it can be concluded that the female-to-male ratio in the total population is balanced.

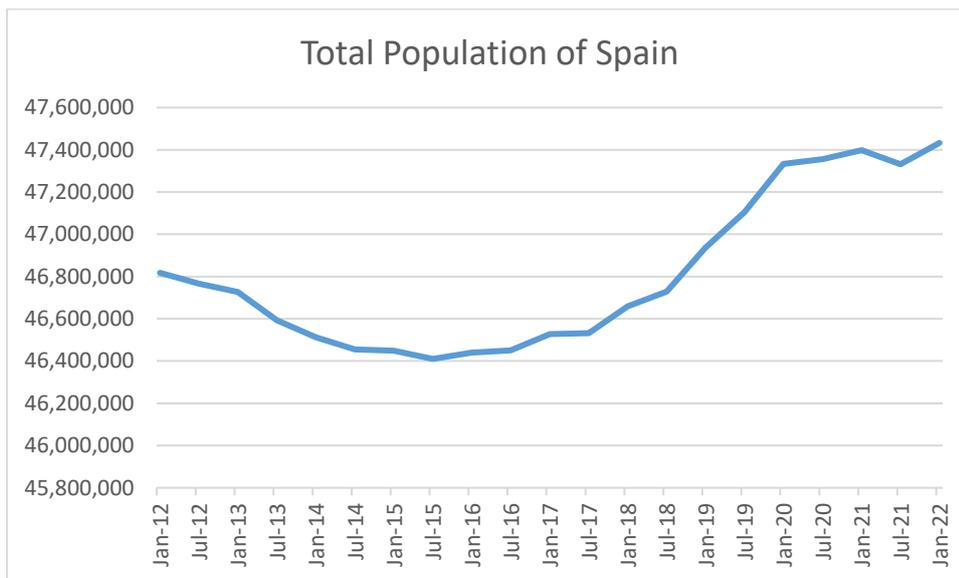


Figure 1: Total Population of Spain (Source: INE – Population Figures)

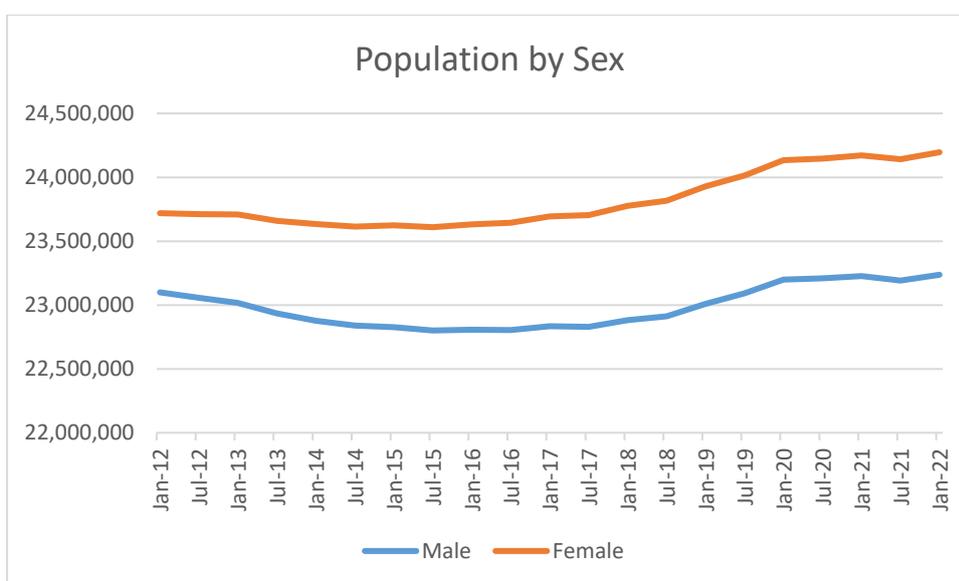


Figure 2: Population of Spain by Sex (Source: INE – Population Figures)

Figure 3 shows that the population of Spain has been aging for at least 40 years. The median age increased from 30 in 1980 to about 45 in 2020. The median age in Spain is slightly higher than the EU's average of 44.1 (Eurostat - Median Age).

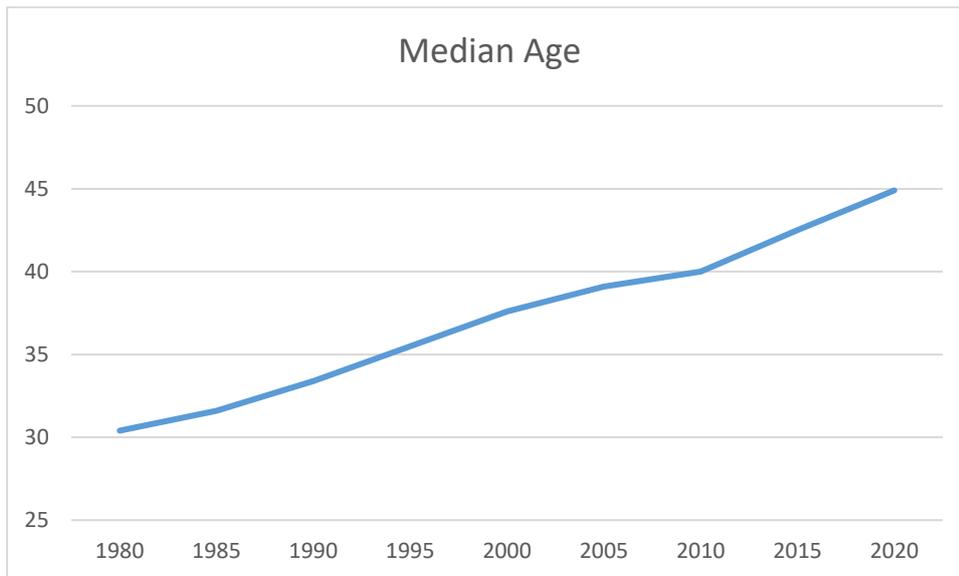


Figure 3: Median Age of Population of Spain (Source: INE – Population Figures)

If similar demographic trends continue, the population is expected to gain 1 million people in 15 years, and the population aged 65 and over to form 26,5% of the total population by 2035 (INE – Population Rejection). In addition, the constantly decreasing fertility rate since the 1970s is another factor in the aging trend (World Bank - Fertility Rate).

There are only two cities in Spain, of which the main municipalities have more than 1 million inhabitants, namely Madrid, the capital and Barcelona (World Population Review - Spain). These two cities constitute around 10% of the total population, whereas the largest ten cities constitute approximately 25%. With few exemptions, Spain's most populous areas are found along the coastline. The population of autonomous communities in Spain is given in Figure 4.

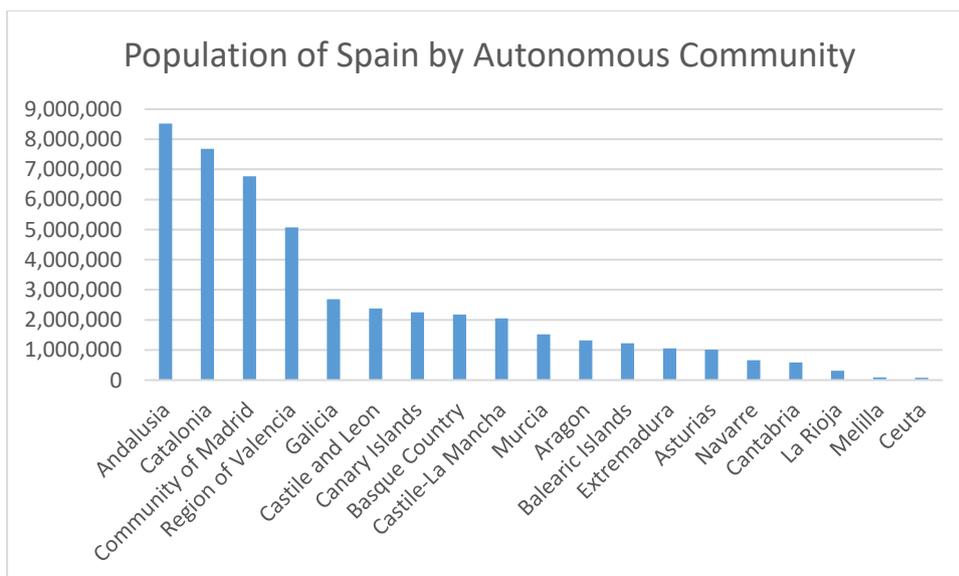


Figure 4: Population of Spain by Autonomous Community (Source: INE – Population Figures)

The World Bank calculates that 80% of the total population lives in urban areas, an increase from 70% in the 1970s (Worldbank).

Migration is an essential factor in the population structure of Spain. A total of 530,401 people from abroad established their residences in Spain in 2021. This number is 13.4% more than in 2020. The World Bank study estimated the total number of migrants in 2015 as 5,852 million, constituting 12,7% of the total population (World Bank – International Migrant Stock Statistics).

3.1.2 Geographical/spatial description

Spain has a surface area of 505.990 thousand square kilometres, and 4,964 km of coastline on the Atlantic and Mediterranean coasts. In addition, the country has about 100 islands representing about 2,5 % of the national territory. The sea, therefore, is a crucial factor in the daily life of many.

Spain is a highly mountainous country with a large central plateau. The total agricultural area represents about 30 million hectares, of which more than 70% is used. However, the World Bank estimates that the percentage of the agricultural land area has decreased from 66% in 1991 to 52% in 2020. The illustration may be seen in Figure 5.

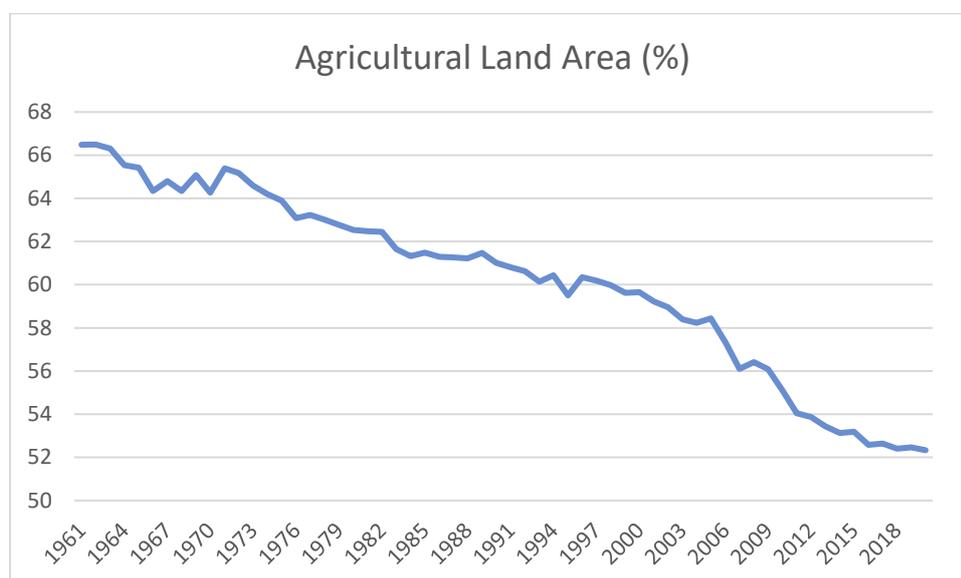


Figure 5: Agricultural Land Area of Spain (%) (Source: World Bank)

On the other hand, forests are expanding and cover more than one-third of the total land area; nevertheless, a disproportionately small amount of agricultural production comes from the forests.

Just under 1.2 million metric tons of fish and seafood are harvested annually in Spain, making it the EU's largest fish producer (Eurofish). Eurostat estimates that more than 20% of the EU's fisheries production belongs to Spain, contributing nearly the same amount to the national labour force (Eurostat – Fishing Production).

3.1.3 Education and Employment

As Figure 6 shows, more than 35% of the population (age group 18 – 64) in Spain have at least post-secondary education, according to a survey conducted by the national statistics agency in 2016. The same survey includes statistics on the educational level in different communities in Spain (Figure 7). In 2016, 25.5% of the population aged 18 to 64 had a university degree (5.0 points more than in 2011). By sex, the percentages of studies completed by men and women are similar at most levels. However, it should be noted that 29.5% of women had a degree in college, compared to 21.5% of men.

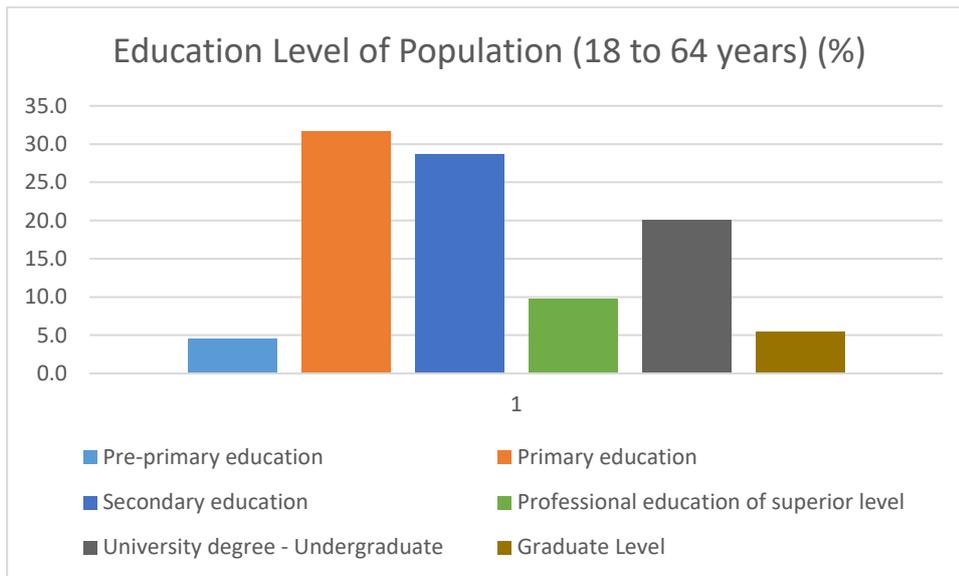


Figure 6: Education Level of Population (18 to 64 years) (%) (Source: INE – Education and Culture)

Education Level in Different Communities (18 to 64 years) (%)

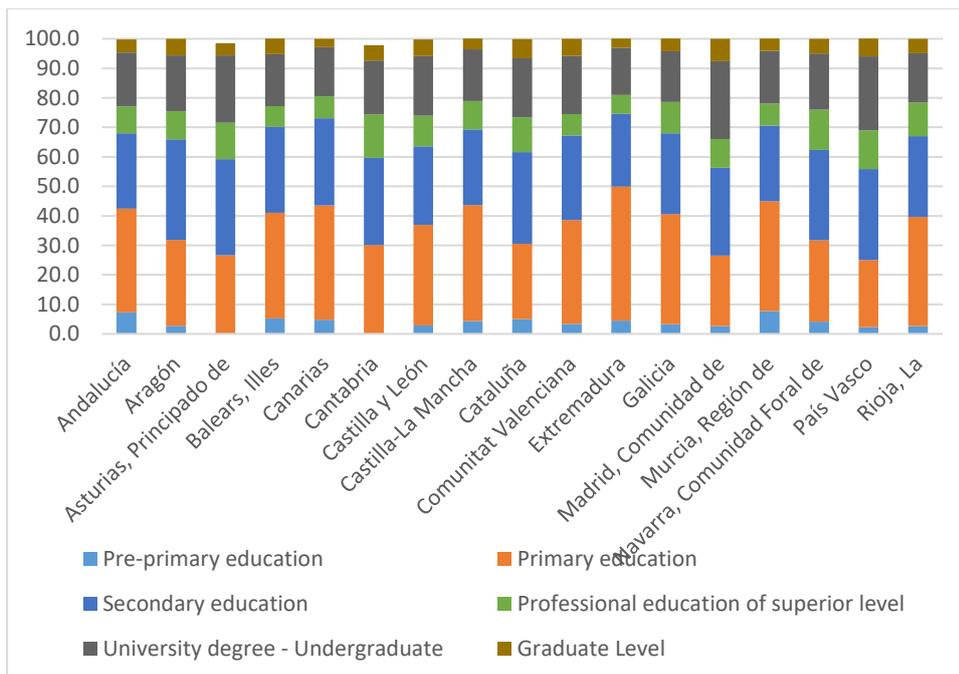


Figure 7: Education Level in Different Autonomous Communities (18 to 64 years) (%) (Source: INE – Education and Culture)

The fight against unemployment seems successful– after the Spanish financial crises of 2008-2014. – The unemployment rate constantly decreases since 2013. Once as high as 27%, the unemployment rate is currently about 12,5%. This number is still high comparing the EU average. The unemployment rate in Spain is shown in Figure 8. It is seen that Spain’s employment policy needs to make more effort to increase the employment level to be on the EU average. It should be noted that the fight against the financial crises and the employment policy so far has broken the equality of gender in employment numbers. A decade after the crises, the return of the male population to the labour force was much more numerous than their female counterparts, resulting in a gender gap

in unemployment rates. As of the third quartile of 2022, the male unemployment level is 10,7% compared to 14,8% for the female population.

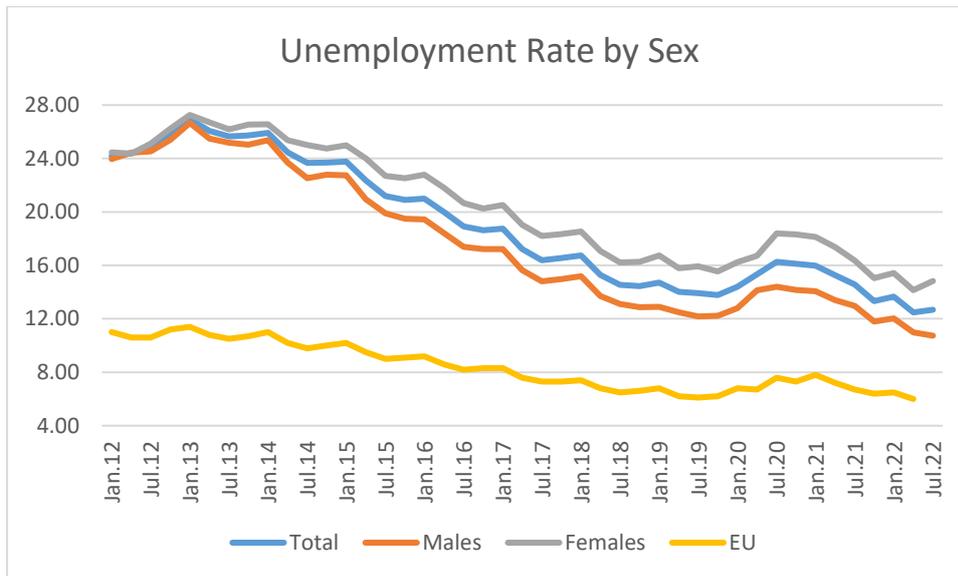


Figure 8: Unemployment rate by sex (Source: INE – Economically Active Population Survey)

Table 1 gives the unemployment rate in different autonomous communities and cities of Spain. Compared with the national average, unemployment is the lowest in Illes Balears (5,79%) and the highest in Ceuta (30,82%).

	Jul.13	Jul.14	Jul.15	Jul.16	Jul.17	Jul.18	Jul.19	Jul.20	Jul.21	Jul.22
Andalucía	36,19	35,21	31,73	28,52	25,41	22,85	21,83	23,80	22,41	18,98
Aragón	20,38	18,36	14,97	14,88	10,50	9,87	9,69	11,90	8,79	9,08
Asturias, Principado de	24,15	19,96	16,97	17,05	12,95	13,45	14,43	14,16	12,32	12,81
Balears, Illes	16,93	15,94	13,88	10,60	9,25	7,16	8,18	13,28	10,57	5,79
Canarias	34,76	33,36	28,56	26,01	21,87	19,64	21,19	25,04	23,89	17,73
Cantabria	18,84	19,04	16,19	12,53	12,67	8,99	8,73	12,02	10,04	8,61
Castilla y León	20,91	19,40	16,59	13,91	13,02	11,30	11,18	12,49	10,05	8,91
Castilla - La Mancha	29,41	28,49	24,72	22,67	18,60	16,71	16,10	18,34	15,29	14,41
Cataluña	22,55	19,10	17,49	14,63	12,54	10,63	10,87	13,23	10,92	9,31
Comunitat Valenciana	27,70	25,54	22,37	20,17	17,50	15,29	13,91	17,26	16,12	13,50
Extremadura	33,33	27,64	28,51	25,61	24,76	21,68	19,68	20,88	17,92	15,85
Galicia	21,62	20,25	17,66	16,35	14,49	12,24	11,49	11,80	10,23	10,80
Madrid, Comunidad de	19,41	17,53	16,27	15,19	12,35	11,86	10,26	13,25	11,84	11,33
Murcia, Región de	28,72	26,25	23,49	19,75	18,11	16,33	14,16	17,21	14,65	14,54
Navarra, Comunidad Foral de	17,92	14,92	13,57	12,41	10,52	9,65	8,19	9,94	10,70	8,99
País Vasco	16,45	15,21	13,76	12,80	11,56	9,42	9,26	10,34	9,91	8,29
Rioja, La	19,70	18,23	13,59	13,57	12,62	9,60	8,99	11,52	12,21	8,03
Ceuta	30,96	31,95	30,59	24,64	22,36	30,79	28,76	27,14	27,07	30,82
Melilla	39,19	30,49	31,40	31,22	26,16	24,01	28,99	24,14	19,44	18,16

Table 1: Unemployment Rates in Autonomous Communities and Cities (Source: INE – Economically Active Population Survey)

Youth unemployment is a problem in Spain's economy. As seen in Table 2, there is a huge unemployment rate gap among those under 25 years of age and older. While the unemployment rate of those between 25 to 54 years old

and those who are 55 and more years old are about at the national unemployment level, youth unemployment resists staying above the 30% threshold.

	Jul.13	Jul.14	Jul.15	Jul.16	Jul.17	Jul.18	Jul.19	Jul.20	Jul.21	Jul.22
Under 25 years of age	54,14	52,39	46,58	41,94	35,97	33,00	31,68	40,45	31,15	31,01
From 25 to 54 years	23,98	21,89	19,48	17,50	15,02	13,39	12,72	15,12	13,13	11,40
55 and more years	19,05	18,83	17,78	15,98	14,27	12,13	11,79	12,07	13,91	10,48

Table 2: Unemployment Rates by Different Age Groups (Source: INE – Economically Active Population Survey)

As the younger generations tend to continue more on having a higher degree, it is hard to establish a positive correlation between educational level and unemployment. However, many factors have been pointed to as causes of Spain's high youth unemployment rate, including the country's increasingly fragmented labour market, ineffective employment policies, and flawed educational system (Garcia, 2011).

There is, however, a strong correlation between education level and employment. A more significant proportion of those who have completed higher education tends to be employed by employers. Figure 9 shows that a higher educational level means higher attendance in the labour market.

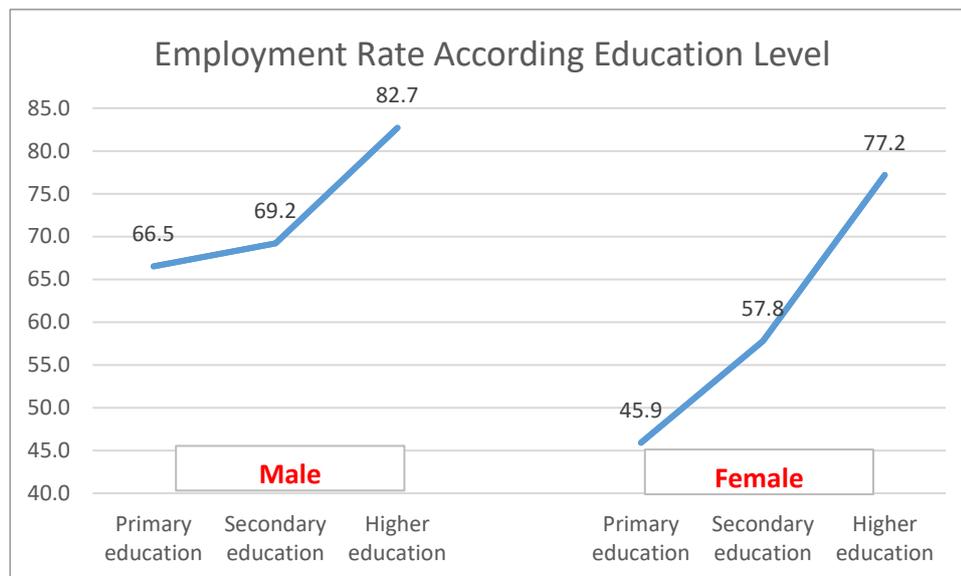


Figure 9: Employment Rate According to Education Level (Source: INE – Economically Active Population Survey)

There is a strong correlation between educational level and unemployment. Those who have completed their upper or post-secondary education and tertiary education are more likely to be employed.

Services constitute the sector which provides the most employment in Spain. More than 70% of the active population work in services. The industry is the second biggest sector, where 12,6% of the active population is employed. These two sectors are followed by construction (6.1%) and agriculture (3,8 %) (Figure 10).

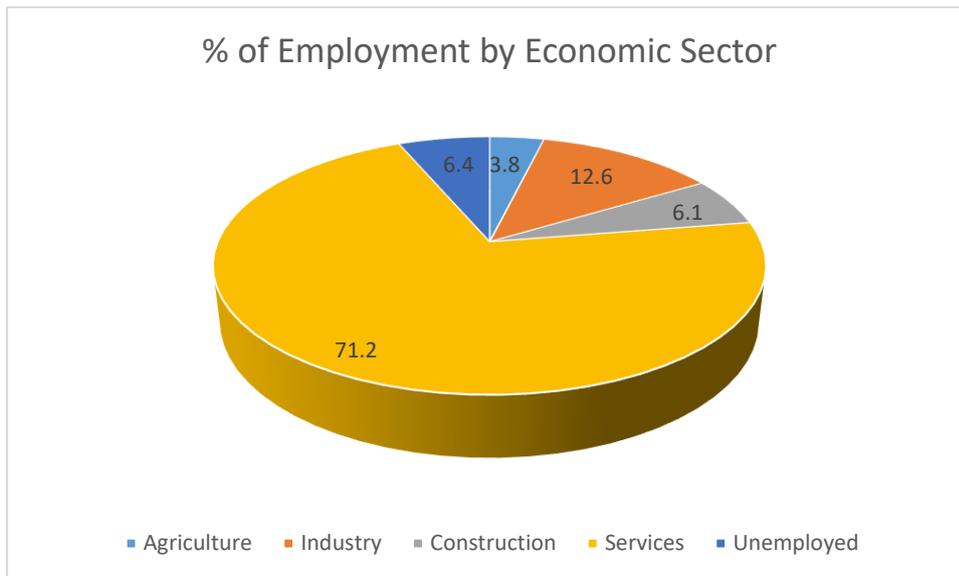


Figure 10: Percentage distribution of the Active persons by economic sector (Source: INE – Economically Active Population Survey)

In a detailed analysis, one should notice the employment percentage by branch of activities in Figure 11. For the purpose of this research that, it should be noted that the employment in the energy sector is relatively minimal in Spain.



Figure 11: Percentage of employment by branch of activity (Source: INE – Economically Active Population Survey)

Around 20 million are employed in Spain. Nearly 17 million of these are in full-time employment while the remaining work part-time. Figure 12 shows the trend in full-time and part-time jobs during the last decade. As can be seen, the ratio of part-time workers to those who work under full-time contracts has remained the same since 2012. The statistics kept by INE (National Statistics Institute) prove that part-time work is more common for female workers who are about 10.5% than male counterparts (3.5%)

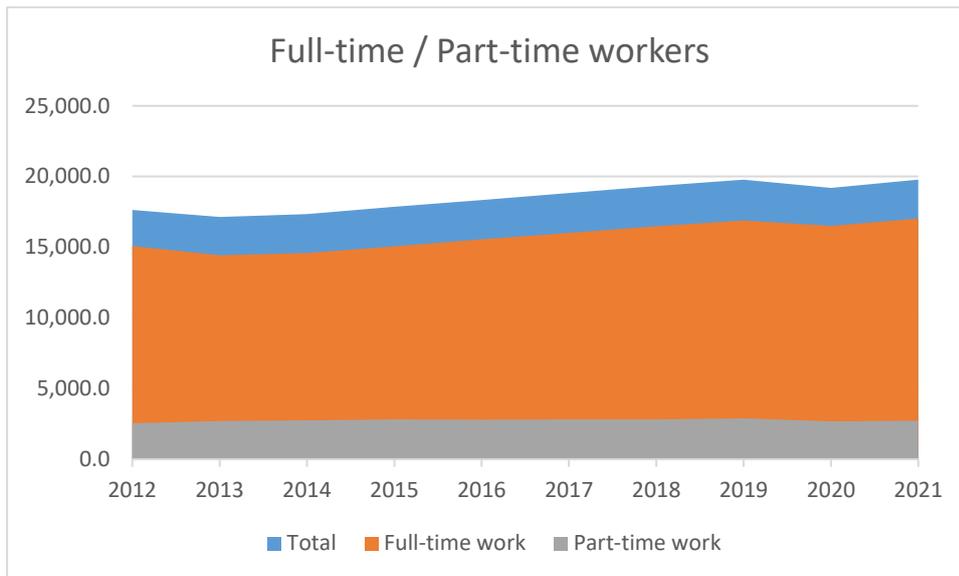


Figure 12: Numbers of workers who work with full-time and part-time working contracts (Source: INE – Economically Active Population Survey)

3.1.4 Economy

As Figures 13 on quarterly changes in the GDP of Spain demonstrate, the gross domestic product is affected much by the financial situation of the country. The financial crisis of 2008-2014 shows its effects as Spain experienced an economic downturn during this period. Apart from these crises, Spain’s economic growth was consistent except for the recent pandemic caused by COVID-19. The restriction applied to people’s daily life caused the economy shrink by nearly 20%, which is then recovered after the post-pandemic era.

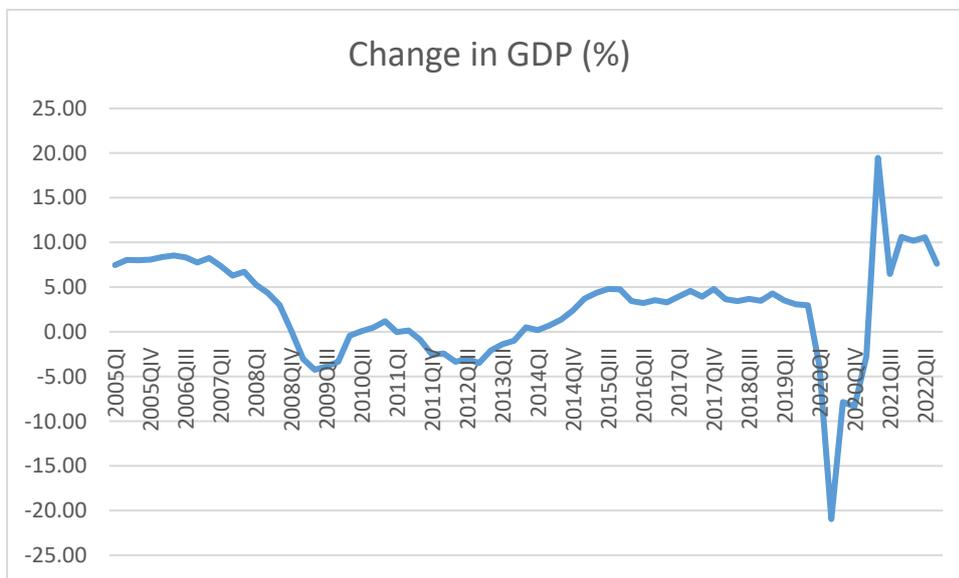


Figure 13: Change in GDP (Source: INE – Economic Accounts)

The annual GDP growth was 7.9%, bringing the GDP value for 2021 to 1,206,842 million euros. This increases the GDP per capita of Spain to about 25,400 euros after the big plunge of the previous year in which the GDP per capita was 23,693 euros. Figure 14 shows the numbers that belong to autonomous communities and cities in 2020.

In 2020, Comunidad de Madrid had the highest GDP per capita at 32,048 euros. Afterwards came País Vasco (30,401 euros), and then Comunidad Foral de Navarra (29,314 euros).

Andalucía had the lowest GDP per resident at 17,747 euros, followed by Canarias at 17,448 euros and Melilla's Autonomous City at 17,900 euros.

The average national income was 23,693 euros, while the EU average was 29,890 euros. Six regions surpassed the national average, and two regions in Europe.

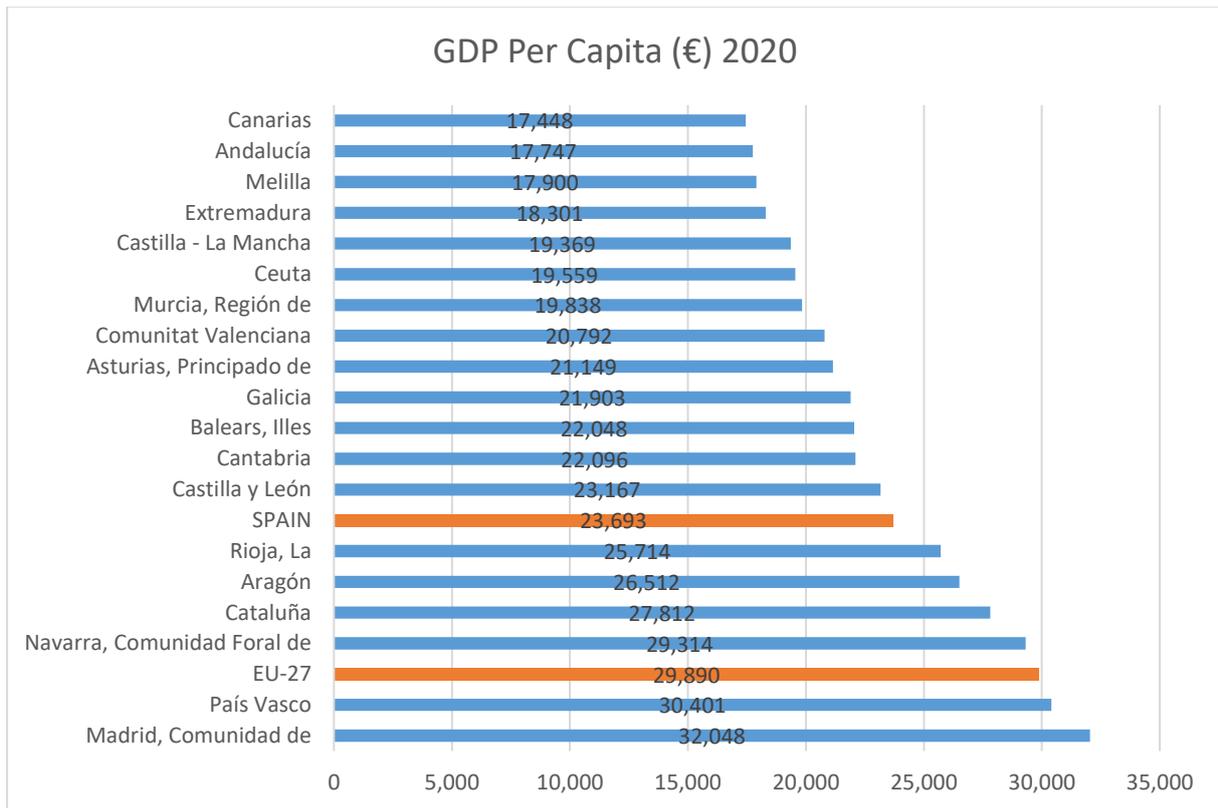


Figure 14: GDP per Capita in 2020 (Source: INE – Economic Accounts)

As of 2021, the sectors with the highest shares in Spain's economy are the manufacturing industry and wholesale and retail trade. The production in these two sectors constitutes nearly 45% of the total production in Spain. In addition, "Public administration and defense; compulsory social security; education; health and social service activities", "Professional, scientific and technical activities; administrative activities and auxiliary services", construction and real estate services follow these two leading sectors after that (Figure 15).

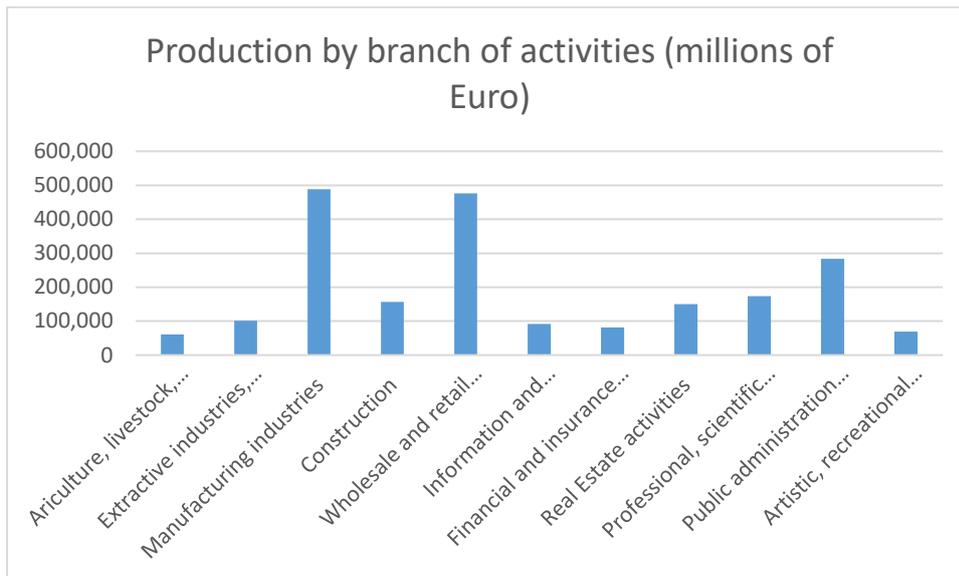


Figure 15: Production by branch of activities 2021 (Source: INE – Economic Accounts)

The latest estimate of the National Statistic Institute – INE projects that CPI annual inflation will be 7.3% in October 2022. This means 1.5 percentage points decrease from the previous month. The fall in electricity and gas prices is accepted as the primary factor behind this improvement. The change in annual CPI since 2010 is projected in Figure 16, and a comparison is made with the EU. It can be concluded that inflation follows a similar path to the EU numbers. Post-pandemic economic, political and inter-governmental situations affecting the entire world economy show its effects in Spain as well. These are the reason for the rise of inflation during the last year.

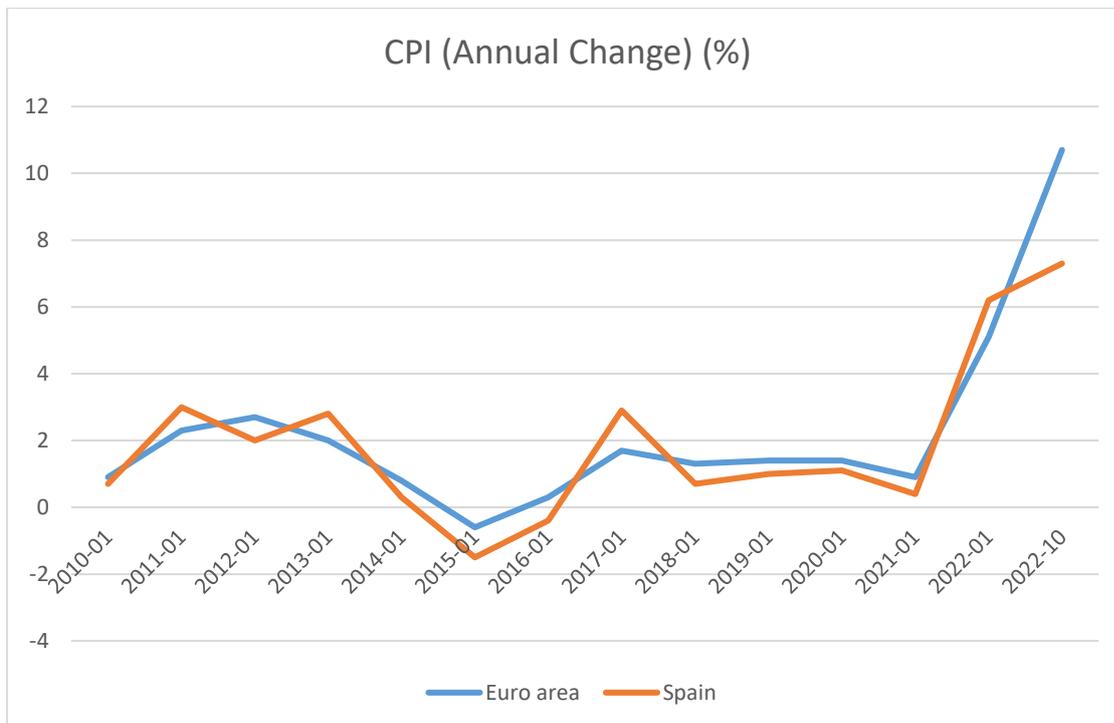


Figure 16: Change in Annual CPI (Source: Eurostat - CPI)

According to the International Trade Report published by the Ministry of Industry, Trade and Tourism of Spain, Spain's exports increased by 31.7% year-on-year in nominal terms to 29,090.9 million euros, and imports expanded by 42.6% to 37,028.1 million euros in August 2022 making the trade balance deficit of 7,937.2 million euros (COMEX, 2022)

Spain's main exporting sectors are food, beverages and tobacco, capital goods, chemical products and energy. In contrast, the main importing sectors are energy, capital goods, chemical products and food, beverages and tobacco (COMEX, 2022).

Around 60% of Spain's exports are to EU countries, where France, Germany, Italy, and Portugal are leading partners. In terms of imports, 40% originate from EU Member States, while outside the EU, China provides 10% of total imports and is the leading partner.

3.2 Energy sector

3.2.1 Energy profile

In 2020, the total energy supply of Spain was 108,76 ktoe, down from the 121.130 ktoe supply of the previous year. Between 1990 and 2019, the energy supply of Spain experienced fluctuations. The total energy supply increased by 57% from 1990 to 2005, going from 90,200 ktoe to 141,500 ktoe, or an average annual increase of 3.8%. However, from 2005-2015, we see a gradual decline from 141,500 ktoe to 118,400 ktoe. This equates to a yearly drop of 1.64 percent, or 16.4 percent over a decade. Furthermore, while there was an average increase of 2.3% from 2015 to 2019, economic recessions led by the Covid-19 pandemic showed its effect and took down the total energy supply to 108,76 ktoe (IEA Spain). These developments are summarized in Figure 17.

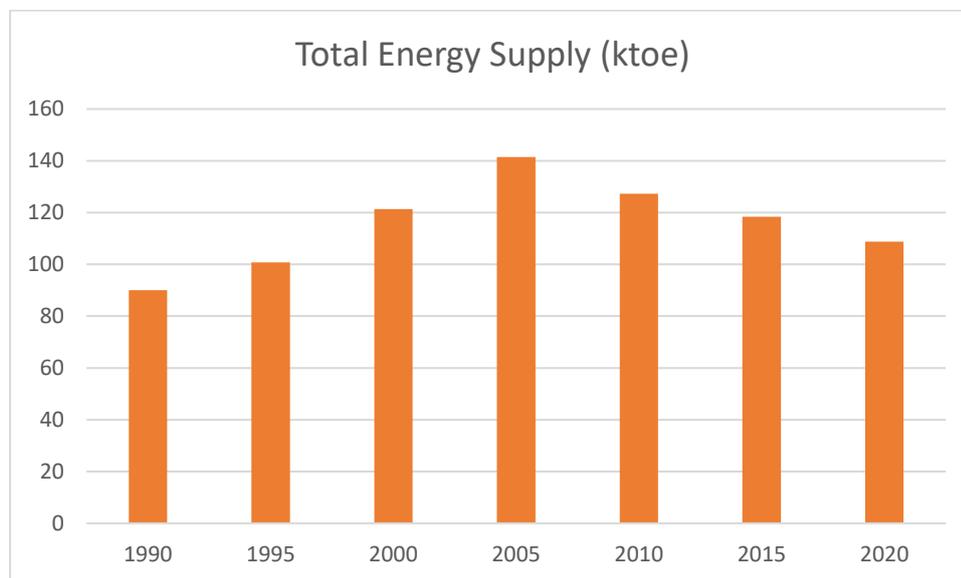


Figure 17: Energy Supply of Spain 1990-2020 (Ktoe) (Source:IEA Spain)

Oil accounted for 40.15 percent of Spain's energy supply in 2020, with natural gas coming in at a distant second at 25.7 percent. Nuclear power accounted for 14%, making it the third largest contributor overall. In addition, 7.8% came from wind and solar, 7.3% from biofuels, 2.55% from coal, and 2.4% from hydropower. (IEA Spain).

The share of each source in Spain's total energy production since 1990 is given in Table 3 and Figure 18.

	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
2020	2767	27911	15185	2613	8510	7941	43551	108760

Table 3: Energy Supply of Spain by Source 1990-2020 (Ktoe) (Data Source: IEA Spain)

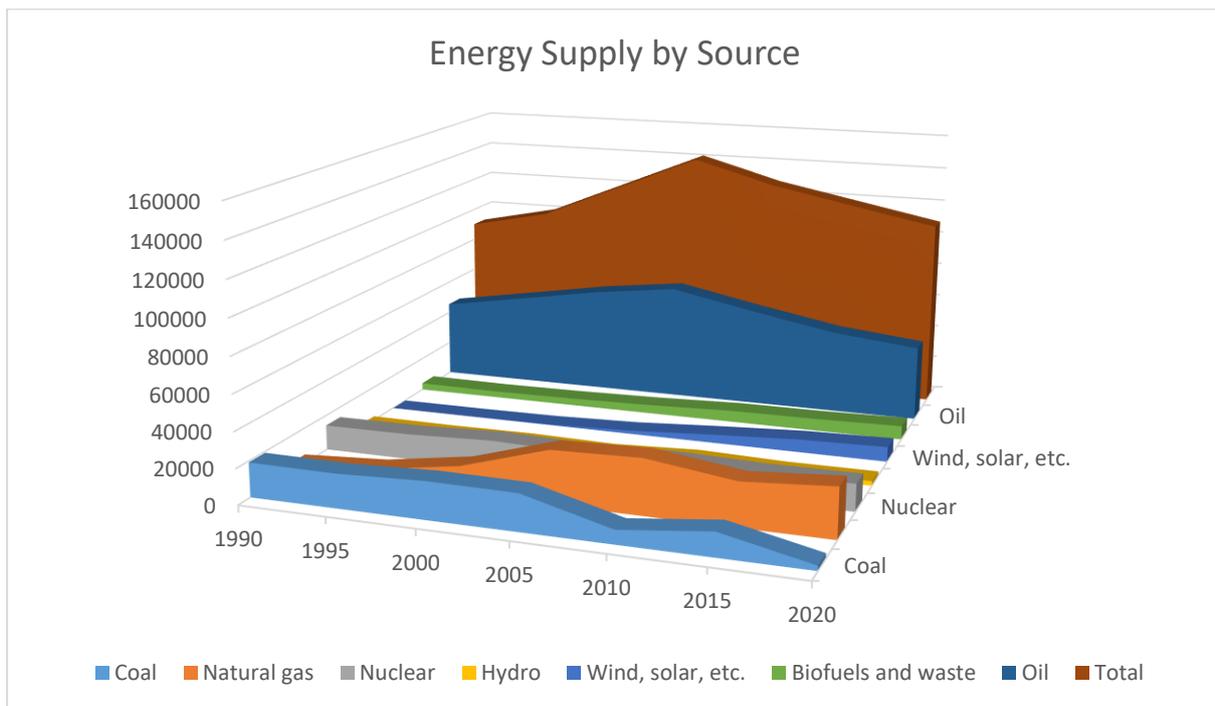


Figure 18: Energy Supply of Spain by Source 1990-2019 (Ktoe) (Data Source: IEA Spain)

The energy consumption follows the same pattern as the country's energy supply. Spanish energy consumption increased from 60,600 ktoe in 1990 to 102,000 ktoe in 2015, an increase of 11.2 percent per year. However, there was a 22% drop from 2005-2015, from 102,000 to 79,700 ktoe. This represents a 2.2% annual decline. Total energy consumption, which had declined by 1.6%/year between 2017 and 2019, decreased by 10% in 2020 before recovering by 5% in 2021 to 114 Mtoe (Enerdata, 2022). This makes the total energy consumption per capita in 2021 is 2.4 toes, 19% below the EU average. Table 4 shows the energy consumption of Spain by sources.

	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

Table 4: Energy Consumption of Spain by Source 1990-2018 (Ktoe) (Data Source: IEA Spain)

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, 2022).

The industrial sector's total energy expenditures in 2019 totalled 11,227 million euros, up 6.7% from 2017. Electricity (56.7% of the total), gas (30%), and petroleum products (7.8%) were the most common forms of energy used in manufacturing (INE – Industry, Energy and Construction).

Considering the monetary terms (euro spent), electricity has maintained its position as the most widely used energy source, with consumption rates ranging from 51.7 percent to 59.5 percent, over the past decade. In 2019, 56.7% of the industrial sector's total energy consumption was accounted for by electricity.

On the other hand, petroleum product consumption has declined, falling to 7.8% of total consumption from 13.7% a decade earlier.

If the analysis is made according to the tonne of oil equivalent, on the other hand, the results are read differently.

As of 2018, oil products accounted for 50.8% of Spain's total energy consumption. Electricity comes in at 23.8 % and Natural gas at 17.1%, respectively. There were also small contributions from coal (1% in 2018) and wind and solar (0.4%), bringing the total share of biofuels and waste to 6.9% in 2018. Even though their percentage of total energy consumption has decreased from 62.9% in 1990 to 50.8% in 2018, oil products continue to be the primary source of energy in Spain. Comparatively, during this period, the percentage of electricity used rose from 17.8% to 23.8%, the percentage of natural gas rose from 7.1% to 17.8%, and the percentage of coal used dropped from 5.6% to 1%. Wind and solar have seen a slight increase, from 0% to 0.4%, while biofuels and waste have maintained essentially the same share of the energy mix (6.9% versus 6.5%).

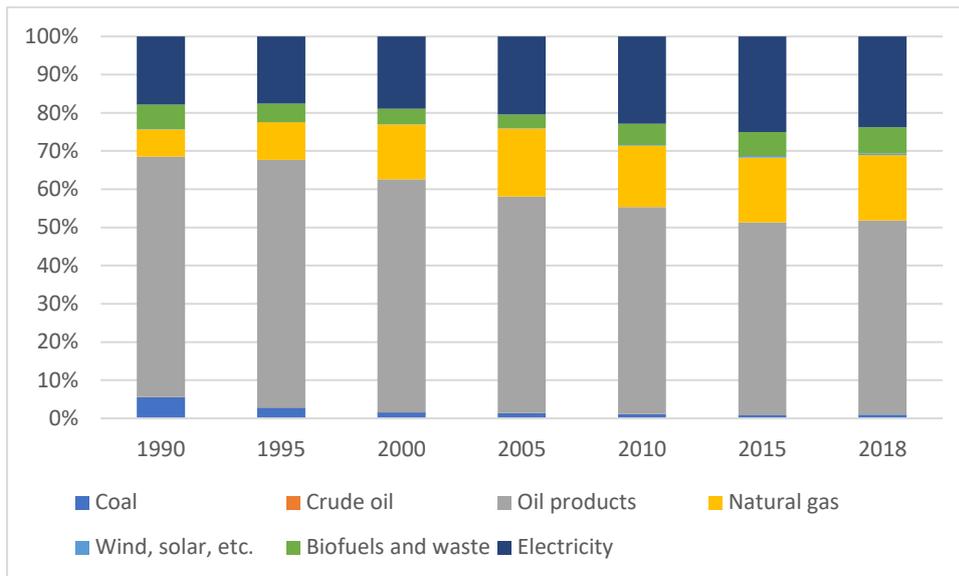


Figure 19: Energy Consumption Mix of Spain by Source 1990-2018 (Source: IEA Spain)

3.2.2 Energy infrastructure

In Spain, wholesale electricity is divided into three distinct markets: forward and future, day-ahead and intraday market (Omie Website).

The forward and future market covers longer-term operations, which may extend over weeks or even years. All of the contracts are based on fixed prices. You can buy and sell power between different economic zones on the forward and future markets. However, this requires an extra charge for using the cross-border transmission capacity, which has to be purchased a priori.

Together, coal, natural gas, and oil comprised 72% of Spain's total energy supply and 68% of the country's total final consumption in 2019. Domestic production of total energy supply amounted to just 25%, with the remaining 75% being imported.

Nuclear power accounts for 45% of domestic production, with the remaining 55% coming from renewable sources, including wind, solar and biofuel recovered from the trash. Between 2009 and 2019, renewable energy production climbed by 47%, accounting for 55% of total domestic production in 2019 (IEA Spain).

Spain experienced a 12% rise in domestic energy production in 2010s. As stated in the previous paragraph, a significant portion of this generation comes from nuclear energy. On the other hand, coal's contribution dropped by about 80% during the same period, with production ceasing altogether in 2019.

Energy output from renewable sources, including bioenergy and waste, wind, and solar, has increased steadily. However, renewable energy investments fell between 2013 and 2018 due to a shortage of funding, although they started to rise again in 2019. As a result, renewable energy sources, including non-renewable waste, now account for 38% of the nation's electricity, up from 24% in 2009.

Spain plans to install 60 GW of renewable energy capacity from 2021 to 2030 (6 GW each year via auctions). In 2019, installed wind capacity reached 25.5 GW, up 9 percent over 2018. Following a period of stagnation in recent years, PV's installed capacity increased by 88% in 2019 compared to 2018, reaching 8.9 GW (Frederic, 2019).

Spain has constructed more than 50 combined cycle power plants since the turn of the century. This is the third highest number in Europe. A recent study found that over the seven years from 2011 to 2018, such plants were only utilised at less than 17% of their capacity (Frederic, 2019)

Spain continues to be primarily dependent on foreign energy supplies (73%). On the other hand, its oil and gas sources are rather well diversified, and the government has effective emergency response structures in place in the event of a disruption.

The transmission grid in Spain is solely managed by Red Eléctrica de España (REE). Transmission grid maintenance and expansion, as well as real-time management of energy demand, involving constant communication with generators so that they can start and stop production as needed, fall under its purview (Alvarez, 2022).

In Spain, there are 336 distributors and no more are allowed to be established by law. In addition to reading the customers' meters, the electricity distributors inform the energy retailer how much energy each customer should be invoiced for. They also bear responsibility for installation maintenance, ensuring that metering equipment is in good condition and responding swiftly to power outages.

The National Energy and Climate Plan (NECP) of Spain involves the objective of phasing out the use of carbon in the energy market until 2050. It also set a goal of lowering greenhouse emissions by 26% of its level of 2005. The target for energy security is to reduce energy dependence to 59% by 2030. The draft plan estimates that, between 2021 and 2030, a total of EUR 236 billion, or around 2% of GDP per year, will be needed for investments, of which 20% will come from public sources.

4 Analysis of the legislative and administrative framework

4.1 Clean Energy Package for all Europeans

The "2030 Climate and Energy Policy Framework" from 2014 provides a foundation for EU policy on energy and climate change (European Commission – Energy Framework). The Climate and Energy Framework covers the years 2020 through 2030 and emphasizes the role and empowerment of citizens in terms of energy and climate measures. The framework is designed to help the European Union achieve its energy policy goals and ambitions "by building a trustworthy and transparent governing structure free of administrative costs." The "Clean Energy Package for all Europeans" has significantly boosted this framework. Within the context of the Clean Energy Package for all Europeans, the following were introduced: the Internal Market for Electricity Directive, the Energy Efficiency Directive, the Energy Performance of Buildings Directive, and the Regulation for the Governance of Energy Union (Henrich Böll Stiftung, 2020).

These bills have one thing in common: they aim to make ordinary people the focal point of energy policy. It is now widely accepted that citizen empowerment and engagement in the energy market are essential elements of Europe's energy transformation. To this end, the European Commission has made it a priority in its energy strategy to remove obstacles to entry and increase consumer engagement in the energy market. Considering the conventional roles of consumers in the energy market, this calls for a shift toward prosumers (generating and selling energy) as well as storage, sharing, and trading of energy. Energy Communities play a crucial role in assisting customers in adapting to their new roles in the energy system and therefore bolstering the energy transition process. Energy communities will also contribute to reducing energy poverty in this way. Energy communities also equip people with tools for monitoring their energy consumption, adapting to price fluctuations in the energy market, and altering their habits to aid in the shift toward cleaner energy sources (Henrich Böll Stiftung, 2020).

The Clean Energy Package for all Europeans in 2016 consists of eight measures that will have far-reaching effects on the environment, the economy, and the lives of individual participants in Europe's energy system. By passing these laws, the EU affirms its status as a leader in the fight against climate change and lends its support to the ambition of making Europe carbon-neutral by 2050. (European Union – Clean Energy).

In 2018, the European Union set an ambitious goal of 32% renewable energy in the energy mix by 2030, as specified in the Renewable Energy Directive (2018/2001/EU) (European Union – Clean Energy).

Provisions regarding the power market are included in the Clean Energy Package for all of Europe. The package aims to create a more adaptable power market and raise the percentage of electricity generated by renewable sources. Planned actions include elevating the status of ACER (Agency for the Cooperation of Energy Regulators) in this regard (European Union – Clean Energy).

4.2 Revised Renewable Energy Directive 2018/2001/EU and Revised Renewable Energy Directive 2019/944/EU

The Directive 2018/2001/EU (RED II) on the Promotion of the Use of Energy from Renewable Sources and the Directive 2019/944 (REMD) on Common Rules for the Internal Market for Electricity introduce two concepts: the Promotion of the CEC and the REC are both recognized legal entities that are built on the principles of open and voluntary participation. Pursuing financial profits is not one of the core goals of either CECs or RECS. Along with making positive contributions to the environment, the primary goal here is to offer social and economic benefits to the company's shareholders. In addition to these parallels, the REMD mandates the regulation of smart metering systems and the sharing of data to further the cause of energy efficiency and the empowerment of consumers.

In addition, the instructions state that member states are expected to create and implement frameworks that will make these communities easier to use. Consequently, it is a priority to eliminate unjustifiable regulatory hurdles and administrative procedures that these communities have to go through.

In light of the fact that the process of adoption typically takes two years, the member states of the EU have until the end of 2020 to pass the laws needed for the implementation of REMD, and they have until the middle of 2021 to pass the laws necessary for the implementation of RED II. Therefore, this process can be utilized by the Member States to adapt their national legislation in a manner that facilitates the stronger roles that individuals and communities play in the energy system, fosters the decentralization of energy production, and facilitates the deployment of renewable sources in the production of energy.

The contributions of energy communities become more important in terms of assisting the transition to clean energy, given that the RED II target level of 32 percent for the share of renewables in the energy mix of the European Union is a mandatory requirement.

The Royal Decree 23/2020 introduced and defined the REC in Spanish legislation as defined by Directive 2018/2001/EU, two years after Directive (EU) 2018/2001. Consequently, there is no definition of CEC in Spanish legislation, and no new regulation is accepted in accordance with Directive (EU) 2019/944.

4.3 National Energy and Climate Plan of Spain

Spain's National Energy and Climate Plan for 2021 – 2030 was published in the first month of 2020 (European Commission – NECP). The plan sets the goal of reducing emissions of greenhouse gases by 26% from 2005 levels until 2030 (NECP). To reach its goal of reducing national greenhouse gas emissions by 23 percent from 1990 levels, Spain expects to surpass its effort sharing regulation (ESR) target by 13 percent while still meeting its land use, land use change and forestry no-debit commitment. The plan's primary focus is on implementing actions within the transportation sector to achieve a 30% reduction in emissions.

Spain's national objective is to be able to obtain 42% of its gross final energy consumption from renewables by 2030 (NECP). To reach this goal, Spain expects to raise the share of renewable energy to 24% by 2022, 30% by 2025 and 34 % by 2027.

To reach the EU's energy efficiency goal, Spain aims to cut its primary energy usage by 39.5% (NECP). To accomplish this goal, Spain needs to cut 98.5 Mtoe for primary energy consumption, and 73.6 Mtoe for final energy consumption. However, the government believes reaching this target will only be possible by renovating 1,200,000 residential buildings by 2030 and renovating the heating and cooling technical building systems of nearly 300,000 residential buildings per year.

The NECP's goal for energy security is to cut dependence on foreign sources from 74% in 2017 to 61% in 2030.

Market integration and tariff deficit reduction are also among the goals set by NECP on the internal energy market topic. Furthermore, raising the interconnection capacity from its current level of 10% to 15% by 2030 and implementing key infrastructure projects (including the ones on the grid system) are facts that will contribute to the development of the internal market.

The total investments in the energy sector from 2021 to 2030 are planned to be worth 241.4 billion euros, including all significant industries and dimensions. The private and public sector share in these investments shall be 20% and 80%, respectively.

4.3.1 RES Objectives

As stated above, the NECP of Spain expects that 42% of its gross final energy consumption will originate from renewable sources by 2030. To reach this goal, Spain expects to raise the share renewable energy to 24% by 2022, 30% by 2025 and 34 % by 2027 (NECP).

When broken into three major industries, 74% of the consumption in electricity sector, 34% of the heating and cooling sector and 22% of the transportation sector are expected to come from renewable sources. In addition, the plan details how each industry, as well as certain fields specified in "Annex I", will take part in promoting renewable energy.

From 2021 through 2030, auctions in the electricity sector are expected to be the primary tool for installing 57 GW of new investments.

Revisions to the building's technical code, the implementation of guarantees of origin, and the creation of assistance schemes are only a few of the steps included in the draft plan to encourage the adoption of renewables in the heating and cooling sectors.

The plan details initiatives to increase the use of renewable energy and electricity in transportation and indicates that fuel suppliers will be subject to both a general responsibility and a more particular obligation related to the provision of advanced biofuels.

Aside from promoting self-consumption, supporting renewables in industry, promoting renewable gas (biogas, hydrogen), repowering installations whose lifespans will expire in the next decade, encouraging power purchase agreements, maximizing biomass potential, streamlining administrative processes, generating information and training, and promoting renewables in the islands are all included in the plan.

4.3.2 Net metering and energy community schemes

NECP contained the measure titled "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"*.

NECP also states that the implementation of smart meters that started in 2008 was finished in 2017, enabling customers to have a fundamental resource for tracking their electricity use on an hourly basis, improving their energy efficiency, and adapting to fluctuating electricity rates. As a result, the demand curve can be shifted by consumers who shift their consumption to times of lower market prices, which in turn helps to bring down the cost of electricity.

The Plan (NECP) proposes regulatory changes that would enable renewable energy certificates (RECs) to be used in renewable energy production, consumption, and resale. It also states *"instruments and measures to facilitate and reinforce the role of local energy communities as well as guaranteeing the right of access to energy"*.

The Plan recognizes the political importance of RECs / CECs and foresees that renewable energy projects will increase as a result of the promotion of local energy communities (NECP). The Government considers introducing the concept of collective self-consumption, already developed in Royal Decree 244/2019, as the beginning of RECs. The Plan specifically addresses RECs/CECs, and refers to Directive (EU) 2018/2001 and Directive (EU) 2019/944.

4.4 Current Progress

Spain electricity sector is mainly regulated by Law 24/2013. The primary objective of the Law is to set up a regulatory framework for the electricity sector, guaranteeing a supply of electricity of the necessary quality at the lowest cost, ensuring the system's long-term economic and financial viability, and allowing for some degree of effective competition within the sector, all while adhering to modern standards of environmental protection. In addition, the Law regulated the notion of self-consumption as a source of electricity generation outside of the main electricity system, which at the time had no formal legal and regulatory structure.

Art. 6 of the new law specifies that both natural and legal people can generate energy, but only corporations can act as a market operator, system operator, or transporter. On the other hand, businesses and consumer cooperatives may handle the marketing, selling, and delivery processes. This is a significant development because, under Spanish law, cooperatives (the primary vehicle for forming REC in most countries) are not treated as legal entities and must instead be registered in a separate registration.

In accordance with Article 9 of the Law, "self-consumption" is defined as the use of electrical energy generated by facilities located near and related with the user(s).

Facilities producing less than 100 kW of power linked with self-consumption with surpluses will be excused from the requirement involved in the administrative register, a condition that is applied to all other market operations.

Another major regulation of the last decade on the electricity market is the Royal Decree 900/2015, which regulates the administrative, technical and economic conditions of the modes of electricity supply with self-consumption and production with self-consumption. The definition of self-consumption in both Law 24/2013 and Royal Decree 900/2015 is compatible. However, the Decree differs between self-consumption with surpluses and without surpluses and recognizes different conditions for its implementation.

4.4.1 Energy Communities

No cooperatives were established in Spain prior 2010 to generate electricity (Climate Action Network). On the other hand, Law 24/2014 gives authorisation to cooperatives – not to generate but – to distribute and market the electricity. Despite this possibility, the limitation implemented on financial incentives in the energy sector in 2012 enabled the cooperative to flourish. The Revised Renewable Energy Directive 2018/2001/EU, enacted in December 2018 and the Revised Energy Market Directive 2019/944, passed in June 2019, changed the political view on collective electricity generation of citizens and RECs in Spain.

The Royal Decree 244/2019, passed on 5th April 2019, regulates the administrative, technical and economic conditions of the self-consumption of electric energy. One major concept defined and regulated on this Decree is collective self-consumption. It is defined as a consumer group fed with electrical energy from production facilities nearby and associated with them. In the case of collective self-consumption, all participating consumers related to the same generation installation must belong to the same mode of self-consumption and 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 dwelling. This change allows a group of apartment owners or administrators of industrial estates to cooperate in collective self-consumption

But the most significant development in energy communities occurred in 2020 with the acceptance of the Royal Decree 23/2020. The Decree introduced the concept of renewable energy communities in Spain's legislation. The definition

is similar to the definition made by 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 is also accepted as a legal entity that can carry out generation, transport, distribution, energy recharge services, intra-community and international trading and exchanges, as well as the electricity sector's economic and technical management activities. Since the market operator, the system operator and the carrier should be established as commercial companies – by law – one can conclude that there is a conflict of definition in Law and the ability of RECs to practice these activities is still ambiguous.

It should be noted that the concept of CEC and still needs to be defined in the Laws of Spain.

4.4.2 Net metering and virtual net metering

Royal Decree 1634/2006 allowed real-time electricity consumption monitoring and remote system administration. The Decree ordered the Ministry of Industry, Tourism and Commerce to prepare a replacement plan by July 2017 for all residential meters in Spain with contracted power below 15 kW.

The plan was declared by the Order ITC/3860/2007 on December 28. According to the plan, the replacement obligation was laid on the shoulders of the distribution companies. A replacement calendar has been prepared and implemented as of 2017. The specifications of the measurement equipment are detailed in 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 October.

The system operator is responsible for receiving and analysing measurement data. Each participant in the measurement will have immediate access to the measurement equipment via a portable terminal or by visually reading the instructions provided. Order TEC / 1281/2019, of December 19, lays down all the technical instructions in the process of data measurement and analysis.

Spain's National Energy and Climate Plan (NECP) for 2021 – 2030 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”.

NECP states that the implementation of smart meters should be seen as a critical process of the measure taken to protect gas consumers.

4.5 Barriers and motivators

Spain has already adopted Directive 2018/2001/EU into its legislation, and the concept of a renewable energy community is defined in conformity with the European definition. The concept of citizen energy community, on the other hand, has yet to be imported into the national legislation so far. So the lack of necessary legislation might work as a barrier in front of free collective energy generation.

Although the law defines the RECs as legal entities that can carry out activities such as generation, transportation, distribution, etc., another articles of the law, Law 24/2013 on Electricity Sector, specifically requires the market operators, system operators and carriers to be established as commercial companies. In Spanish law, cooperatives, for instance, are not accepted as commercial companies and are required to be registered in a special registry. These regulations create conflict of definitions and make it ambiguous whether RECs will be allowed to operate in these market activities.

Another obstacle to enforcing EU directives is the expense of creating energy communities. There exists no financial incentive system designed explicitly for RECs in Spain. This increases the financial risk of any potential investments.

Administrative bureaucracy always works as a barrier in the energy market. While Spain has made it easy to become a licensed supplier in the electricity market, more regulations are needed to facilitate unlicensed generation activities to increase the application of RECs.

Spain has a decentralised system of government. The authorization of power plants and energy networks, among other things, falls under the autonomous communities' purview. Regional and local governments benefit from decentralisation because they can collaborate more closely with consumers to facilitate behavioural shifts in energy and transportation use. Yet the gap between methods, and criteria from one region to another, can lead to a lack of uniformity in the rollout of new policies. Results could be better if municipal and regional authorities were better trained and the tendering process was standardised.

5 Practical framework (Spain)

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

Survey results from the H2020 project ECHOES were primarily intended to shed light on community issues and citizen sentiment in Spain (ECHOES Cordis Website). The survey's stated goal was to shed light on people's energy habits in the context of the ongoing energy transition. A total of 31 nations were included in the survey (EU 28, including the United Kingdom, with Norway, Switzerland and Turkey). There were a total of 18,000 people from 31 different countries, 600 of whom were from Spain. There were 114 questions in this online poll.

In a survey conducted in Spain, 48% of respondents indicated an interest in investing in renewable energy, and 48.5% claimed that the opinions and actions of those around them had a positive impact on their pro-environmental stance. As a result, 59.2 per cent of the population thinks that collective action is possible to facilitate the energy transition. These findings suggest that RECs and CECs have enormous potential.

But people have a rather pessimistic view of how well the community is doing regarding energy behaviours. Ninety-five per cent think that humans are at least partly to blame for global warming, with another 69 per cent putting humans at the top of the list. As a result, 71% of Spanish respondents say they are frustrated by the lack of energy conservation in their community. The expectations are brightening, with 58.7% of respondents saying that they expect a growing percentage of their community members to support policies favourable to the energy transition and 59.2% saying they expect an increasing percentage of their community members to try to adopt energy-saving behaviours. While a majority of respondents believe that more people in their communities are adopting energy-saving heating and cooling habits, only 41.6% have seen this in practice.

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 households use gas for heating, and 32.8% use electricity.

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

Energy generation from renewable sources like wind and solar is at the heart of most community-based energy projects. Despite having the necessary institutional framework in place, it appears that Spain still needs to make optimal use of this opportunity.

Spain's climate makes it an ideal place to launch solar power energy projects, and the country is also home to companies like Som Energia, which invests in and buys biogas (Caramizaru and Uihlein, 2020).

Economic factors are among the most influential in determining the success or failure of energy projects. Policies that result in financial loss due to higher prices may, in some cases, have the effect of promoting the launch of energy initiatives. Rising electricity costs in 2012 produced a number of Spanish residents to form energy cooperatives. One of the goals of these cooperatives was to take advantage of the cost savings associated with renewable energy sources (Capellán-Pérez, Campos-Celador, and Terés-Zubiaga, 2018).

Another community-based organisation in Spain that facilitates carpooling is called Som Mobilitat. Mobilitat, a non-profit consumer co-op, provides its consumer members with access to a car-sharing program by purchasing electric vehicles and leasing parking lots. The electricity used to charge the EVs comes from environmentally friendly sources (Caramizaru and Uihlein, 2020).

Som Energia and Som Mobilitat are two major community initiatives in Spain.

The Som Energia cooperative was the country's first of its kind. The cooperative's goal is to get regular people involved in planning and carrying out sustainable development projects. Som Energia was founded in 2010 and now has close to 60,000 members. The organisation is concerned with the production and distribution of renewable energy derived from sources such as the sun, the wind, the water, and biogas. Som Energia has an approximate 14 GWh annual generation capacity (Som Energia Website)

In contrast, Som Mobilitat is unique in Spain because it is the first cooperative with the explicit goal of facilitating a shift toward sustainable mobility, beginning at the community level. For its members' convenience, the non-profit cooperative offers a car-sharing program that uses only electric vehicles. The cooperative is taking a stand against for-profit personal transportation. Som Mobilitat was founded in 2016, and it has approximately 1500 active users at the moment (Som Mobilitat Website).

5.3 Role of central government and local administrations in the energy transition

Spain has a decentralised system of government. Spain consists of seventeen autonomous communities and two autonomous cities. The autonomous communities comprised of 50 provinces made up of municipalities.

Since many of the energy sector's policy initiatives are delegated to state and local governments, these bodies must work together and share resources and expertise if these initiatives are to be successful.

The central government has the power to bring legislative regulations and set principles on energy transition. The preparation of strategic plans falls also under the jurisdiction of central government.

Spain's energy and climate change policies prioritise the energy transition. On May 20, 2021, the Law on Climate Change and Energy Transition became effective. This law makes the goal of achieving climate neutrality by 2050 legally binding in Spain. The ultimate goal is to switch to 100% renewable electricity by 2050, thereby decarbonising the economy. It aims to improve energy efficiency by cutting primary energy use by at least 39.5% by 2030, and it seeks to reduce greenhouse gas emissions by at least 23% compared to 1990.

The Law bans the permits or exploitation concessions for new hydrocarbon explorations (art. 9) and promotes the use of renewable gases such as biogas, biomethane, hydrogen, and others. (art. 12)

A sustainable urban mobility plan and mitigation measures must be implemented by 2023 in cities with more than 50,000 residents and island territories. (art.14)

The Spanish autonomous communities each have their parliament. Certain power plants and energy networks require authorisation from the autonomous regions, among other responsibilities in this sector. Power plants with capacities below 50 MW, as well as electricity and gas distribution networks, fall under the jurisdiction of the autonomous communities' energy law. Additionally, they play a significant role in developing and enforcing regional policies concerning climate change, energy efficiency, and renewable energy (IEA, 2021). The scope of the regulatory authority of autonomous communities extends to the imposition of taxes that affect energy policy.

The Ministry for the Ecological Transition and the Demographic Challenge typically coordinates with autonomous communities to create policies and measures at the regional and municipal levels to improve energy efficiency.

6 Conclusion

6.1 Country Profile

Spain's total energy output in 2020 was 108.76 kilowatt hours of energy (ktoe). In 2020, oil provided 40.15 per cent of Spain's energy, with natural gas providing 25.7 per cent. At 14%, nuclear energy was the third most influential source. There was 2.45% from coal and 2.4% from hydropower; 7.8% came from wind and solar, and 7.3% came from biofuels.

Spain still relies heavily on oil products even though their share of total energy consumption has dropped from 62.9% in 1990 to 50.8% in 2018. While natural gas increased from 7.1% to 17.8% and coal decreased from 5.6% to 1%, electricity use increased from 17.8% to 23.8% during this time period. There has been a slight uptick in the percentage of energy coming from wind and solar, from 0 to 0.4%, while the share coming from biofuels and waste has stayed roughly the same.

The energy transition is a top goal of Spanish energy and climate change policies. Effective as of May 20, 2021, the Law on Climate Change and Energy Transition was enacted. With the passing of this law, the Spanish government has made the target of reaching carbon neutrality by the year 2050 legally binding. The end goal is to decarbonise the economy by making the switch to renewable electricity sources of 100% by the year 2050.

In 2018, the rollout of smart meters was completed, another significant development in the electricity market that can be used to significantly increase the consumer's role in the electricity market through information empowerment. This method would also increase enthusiasm for, and help with, the implementation of CECs and RECs. Demand management in Spain's electricity market relies on the widespread installation of smart meters, which has yet to be implemented to its full potential.

By the Directive 2018/2001/EU, the REC was introduced and defined by the Royal Decree 23/2020. The RECs are recognised by the legal entities that can produce, transport, distribute, and provide other services in the energy market. Article 6 of Law 24/2013 on the 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. As a result, the ability of RECs to engage in these activities remains unclear, and there is a conflict between definitions in the Law.

6.2 SWOT analysis of the legislative and administrative framework with respect to the eCREW approach

	Legislative Framework
Strengths	The REC is defined under the Royal Decree 23/2020 in conformity with EU legislation. Legislation on smart meters exist. Collection of data, its processing and data sharing conforms with EU regulations.

Weaknesses	The concept of CEC still needs to be imported to national legislation. There exist no separate financial incentive scheme for the implementation of energy communities. As the governmental system is decentralised, the separate governmental decisions lead to a lack of uniformity on a national level.
Opportunities	The Law on Climate Change and Energy Transition (2021) prioritise and set goals for the energy transition. Spain is one of the first countries in Europe to replace old metering systems with smart meters, and legal foundations are all in effect.
Threats	Economic developments might affect the acceptance of financial incentive schemes. Cooperation between the central government and local administration might only be in conformity sometimes due to political views.

Table 5: SWOT Analysis on Legislative Framework

6.3 A quick SWOT analysis for the practical framework with respect of the eCREW approach

	Practical Framework
Strengths	The country has some experience with cooperatives who are active in energy market prior the EU directives; The geography and the climate are suitable for generation energy from renewable sources.
Weaknesses	Energy transition and collective generation are relatively new subjects and people might hesitate to be forerunners on participating in energy communities.
Opportunities	Strategic plans prove that the governmental support for energy communities and any renewables projects will continue in upcoming decades.
Threats	Big companies might perceive the energy communities as direct competitors; global economic and political developments might change, effect and postpone the energy transition plans of countries / as well as EU.

Table 6: SWOT Analysis on Practical Framework

6.4 Suggestions for the wider uptake and further development of the eCREW approach

Spain's favourable legal framework creates ideal setting for energy projects. People have the freedom to join energy cooperatives and produce their power, paving the way for the flourishing of such organizations and encouraging the practice of collective consumption. Local groups (like HOAs, neighbourhoods, and business parks) can also be active market participants in the energy sector.

In 2018 and later, a legal framework was established that allowed for community-based collective generation and self-consumption groups to operate freely within the law. All customers must belong to the same mode of self-consumption

and coordinate with the distribution firm separately to participate. This shift makes it possible for a community of apartment owners or industrial park administrators to engage in collective self-consumption.

RECs are recognised among legal entities that can generate, transport, distribute, or provide other services in the energy market and were introduced and defined by Royal Decree 23/2020 following Directive 2018/2001/EU. Market operators, system operators, and carriers are still required to be commercial companies under article 6 of Law 24/2013 on the Electricity Sector, while distributors and marketers can be either commercial companies or cooperative societies. As a result, the ability of RECs to engage in these activities remains unclear since REC itself is not accepted as a commercial company in law. A secondary law is needed for further clarification. In contrast, electricity generators can be either natural or legal persons, making it possible for RECs, which are themselves defined as legal entities, to generate electricity.

In light of all this expansive legislation, we can deduce 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, the latter of which requires further regulation due to its inclusion in the regulation causing a conflict of understanding.

The term "CEC" is not defined in Spanish law, and no new regulations are being accepted in line with Directive (EU) 2019/944. As a result of this shortcoming, the Spanish government, with the acceptance of the National Energy and Climate Plan for the years 2021–2030, undertook to introduce more regulations for the implementation of CECs.

Spain has the necessary legal framework for data flow, a crucial tenet of the eCREW approach. In 2008, Spain began replacing its antiquated metering infrastructure with modern smart meters, and by the end of the previous decade, the process had been completed. The system operator and distributor are currently responsible for processing the meter data. Without jeopardising the privacy of their customers' sensitive information, marketers now have legal access to a broader range of data about consumers' energy use, allowing them to provide a wider range of energy-efficiency options.

Evidence from Spain's 2021-2030 National Energy and Climate Plan shows that the necessary additional legislation is being considered for imminent implementation.

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