Work Package 5 Policy Brief Series: Greece

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 examines the regulatory and administrative frameworks applied in Greece, with a focus on how well existing regulatory and administrative infrastructures can be expected to support the implementation of the eCREW approach in the European Union and Turkey.

This policy brief focus on specific issues that Greece should consider in order to create an appropriate framework for energy communities, that is introduced via RED II (Renewable Energy Directive) 2018/2001/EU (Renewable Energy Community) and the Internal Electricity Market Directive (ED 2019) 2019/944 (Citizen Energy Community), as well as the Clean Energy for All Europeans Package's broader goals.

The Policy Brief provides an overview of the regulatory and administrative impediments as well as opportunities for eCREW development in Greece.

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

A CREW (Community Renewable Energy Web) is a group of citizens who work together to generate and store renewable power at the household level. CREWs are significant constructs through which citizens cooperate in energy-related initiatives, alongside CECs and RECs. Joining simply involves signing a CREW contract, with no advance payments or the requirement to form a legal corporation, involving very small or zero opportunity costs. The sizes of CREWs vary from small neighborhood groups to entire city districts.

The eCREW approach intends to activate and promote the inherent forces of community-based collective action projects (CAI). There is a need to empowering citizens and provide them with the tools to generate, store, and consume energy for their own needs, to ensure the prosperity of the economy, and combat climate change. These are critical steps toward a sustainable, secure, energy-efficient, and climate-neutral future energy system. Recent developments in EU law have prepared the way for the creation of Citizen Energy Communities (CECs) and Renewable Energy Communities (RECs), which will help to unleash the potential of such community-based initiatives. The EU will be providing with a certain amount of support for this (RECs). New business models, financially viable solutions, trustworthy ICT tools, and minimal entry barriers are required to engage as many as possible into such CAIs.

The main goal of eCREW is to establish and disseminate a way for people to make informed decisions and work together in groups. Thus, the eCREW approach is considered as the best method of creating collaboration among small to medium-sized groups to generate, store, and consume electricity, with a focus on reducing energy consumption at the system level.

3 Country profile

Greece is located in southeast Europe and has a surface area of 132.049 thousand square kilometers. The official language is Greek. Greece, a European Union member country since the 1st of January 1981, joined the Eurozone on 1st of January 2001 (European Union).

Greece's north-western neighbour is Albania, northern neighbours are Bulgaria and Macedonia, and the north-eastern neighbour is Turkey in the northeast. Greece has extensive seashores with Aegean Sea, Mediterranean Sea and Ionian Sea surrounding the east, south, and west, respectively.

Greece consists of thirteen administrative regions with a total of 74 regional units and 325 municipalities.

3.1 Social and Economic

3.1.1 Demographic structure

Greece's population was 10.718.565 million in 2020 according to Eurostat. As Table 1 and Table 2 show, the population decline as well as the median age increase can be linked to the severe economic crises and the following wave of emigration (Greek Energy Market Report, 2019). The constantly decreasing fertility rate between 1976 and 1999 was also another factor in the decline (World Bank Fertility Rate Statistics).

Table 1: Population by area (NUTS 2) (Source: Eurostat Greece)

	2016	2017	2018	2019	2020
Attiki	3.781.274	3.773.559	3.756.453	3.742.235	3.738.901
Aegean Islands and Creta	1.163.257	1.174.757	1.185.513	1.200.055	1.213.532
North Greece	3.098.520	3.089.659	3.080.730	3.074.204	3.068.650
Central Greece	2.740.697	2.730.218	2.718.469	2.708.105	2.697.482
Total	10.783.748	10.768.193	10.741.165	10.724.599	10.718.565

There are eight cities in Greece with more than 100.000 inhabitants (World Population Review, 2021). These 8 cities constitute around 17.5% of the total population. 84.9% is located in the urban regions, an increase from the level of 80.2% in 2010, and 73.1% in 2000 (Worldometer Greece, 2020) Table 2 shows the distribution of population and the median age by gender in the last 5 years. It can be concluded that female to male ratio in total population is balanced. The median age in Greece is slightly higher than EU's average of 43.9 (Eurostat Median Age of Population).

Table 2: Population and Median age by sex (Source: Eurostat Greece)

		Female	Male
2016	**Population**	5.559.538	5.224.210
	Median age	45.2	42.5
2017	**Population**	5.546.916	5.221.277
	Median age	45.6	42.8
2018	**Population**	5.531.125	5.210.040
	Median age	46.0	43.1
2019	**Population**	5.516.306	5.208.293
	Median age	46.4	43.3
2020	**Population**	5.503.077	5.215.488
	Median age	46.7	43.6

The population structure of the main regions of the Greece is given in Table 3. The youth population (those under 15) is around 13.6% of the total, fewer than the elderly population (65 and older), about 22.2%. One may conclude that the population is aging, in parallel with Europe.

Table 3: Population by age group (Number/People) and by NUTS 2 regions in 2020 (Source: Eurostat Greece)

	North Greece	Attiki	Central Greece	Aegean Islands and Crete
Less than 5 years	120.825	170.929	106.478	63.723
From 5 to 9 years	141.194	179.932	125.135	65.697
From 10 to 14 years	158.834	186.601	139.213	68.958
From 15 to 19 years	160.543	184.735	136.509	67.918
From 20 to 24 years	165.262	191.688	133.550	69.106
From 25 to 29 years	160.005	197.971	133.313	73.387
From 30 to 34 years	161.446	210.839	147.115	77.038
From 35 to 39 years	199.935	269.525	180.460	86.875
From 40 to 44 years	219.881	299.472	191.392	89.044
From 45 to 49 years	224.034	291.279	197.238	87.165
From 50 to 54 years	231.313	284.075	198.494	83.939
From 55 to 59 years	207.564	252.623	182.412	75.052
From 60 to 64 years	199.583	235.297	178.516	69.253
From 65 to 69 years	179.606	207.776	159.936	61.684
From 70 to 74 years	163.411	194.841	150.244	59.783
75 years or over	375.214	381.318	337.477	114.910

The population of Greece is expected to reach 11.5 million by 2050 (Hellenic Statistical Authority), consisting of 50.5% male and 49.5% female.

The migration is an important factor in the population structure of Greece. The country is used by many migrants aiming to reach other parts of Europe. It is estimated that 850.000 people passed through Greece in so-called 2015 migration crisis (Stevis-Gridneff et al., 2020). The number of immigrants in 2019 was around 130.000. A World Bank study estimated the total migrants in 2015 as 1,242 million, constituting nearly 10% of the total population (World Bank International Migrant Stock Statistics).

3.1.2 Geographical/spatial description

Greece has a surface are of 131.960 square kilometres, of which around 112.000 may be categorized as rural. The country is characterized by topographic diversity, including mountains, coastline and 6.000 islands that represent about 20% of the national territory, of which only 227 are inhabited. The sea, therefore, is an important factor of the daily life of many.

About 50% of Greece's land area is agricultural area. Agricultural land constituted 75.000 square kilometres until the mid-1990s, but has declined since. Forests, on the other hand, are expending and cover around 32% of the total surface. Only 2% of Greece's area is composed of inland waters. (OECD Land Cover Statistics).

Table 4: Land use (in square kilometers) overview by NUTS 2 regions in 2018 (Source: Eurostat Greece)

	North Greece	Attiki	Central Greece	Aegean Islands and Crete
Agriculture	17.864	793	22.094	7.778
Forestry	19.068	756	16.216	1.681
Fishing and aquaculture	498	-	239	-
Land use with heavy environmental impact	1.800	357	1.766	711
Services and residential area	983	541	1.108	533
Unused and abandoned areas	11.372	1.413	17.339	6.750

Other primary sector activities	15	-	10	6
Mining and quarrying	175	37	122	24
Energy production	156	-	148	17
Industry and manufacturing	29	16	42	25
Water and waste treatment	248	5	134	87
Construction	38	6	32	21
Transport, telecommunication, energy distribution, storage, protective works	1.155	293	1.289	537
Commercial, financial, professional and information services	51	61	58	34
Community services	101	32	89	46
Arts, entertainment and recreation	209	39	169	47
Residential area	622	408	792	406

3.1.3 Education and employment

As Figure 1 shows, the graduates with upper-secondary education or higher correspond to 79% of population (age group 25 – 64) in 2020, and this proportion has risen during the last decade. Table 5, on the other hand, shows the percentage who hold a diploma of tertiary education in different geographical parts in Greece; those with tertiary education attainment correspond to 41% of population between 25 – 64 in Attiki, and to 25.62% in Central Greece (Eurostat Greece).

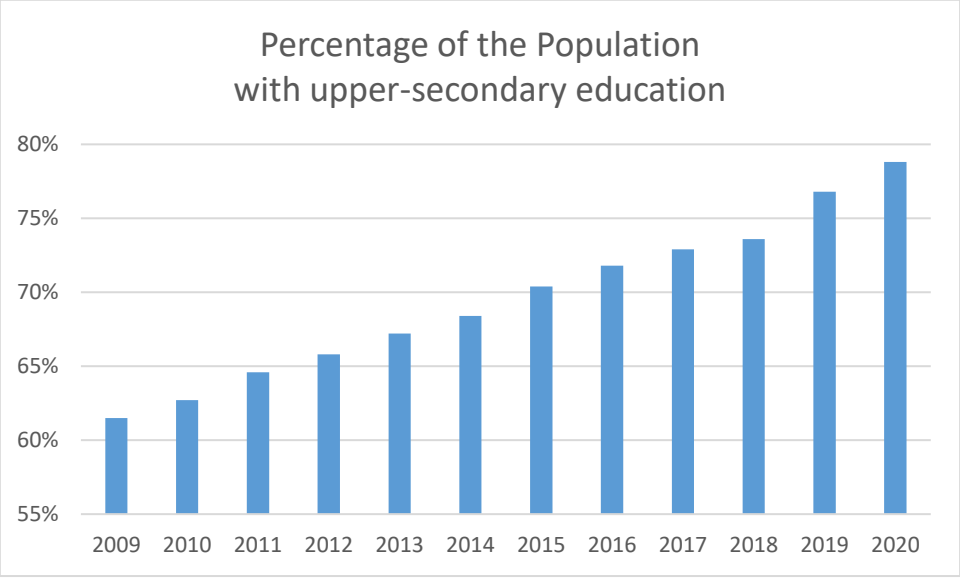


Figure 1: Percentage of individuals (ages 25-64) in Greece with upper secondary education or higher (Source: Eurostat Greece)

Table 5: Share of individuals (25-64 ages) with tertiary education with respect to regions (Source: Eurostat Greece)

	2016	2017	2018	2019	2020
Attiki	38.00	38.40	39.30	40.20	41.00
Aegean Islands and Creta	23.27	24.17	23.97	25.13	26.60
North Greece	26.48	27.70	29.15	28.52	28.70
Central Greece	22.32	23.80	24.84	24.80	25.62

Despite a strong upward trend to the educational attainment in Greece over the years, the unemployment increased between 2008 and 2013 following the financial crises, and the Greek Debt Crisis, which caused a deep recession. The unemployment rate in Greece is shown in Figure 2. It is clearly seen that the financial crises of 2008 had a negative effect on the unemployment rate, especially when compared to that of EU. Although the economic recovery helped reduce unemployment since 2013, Greece (with Spain) has still the highest rate within the EU in 2021, 15.1%.

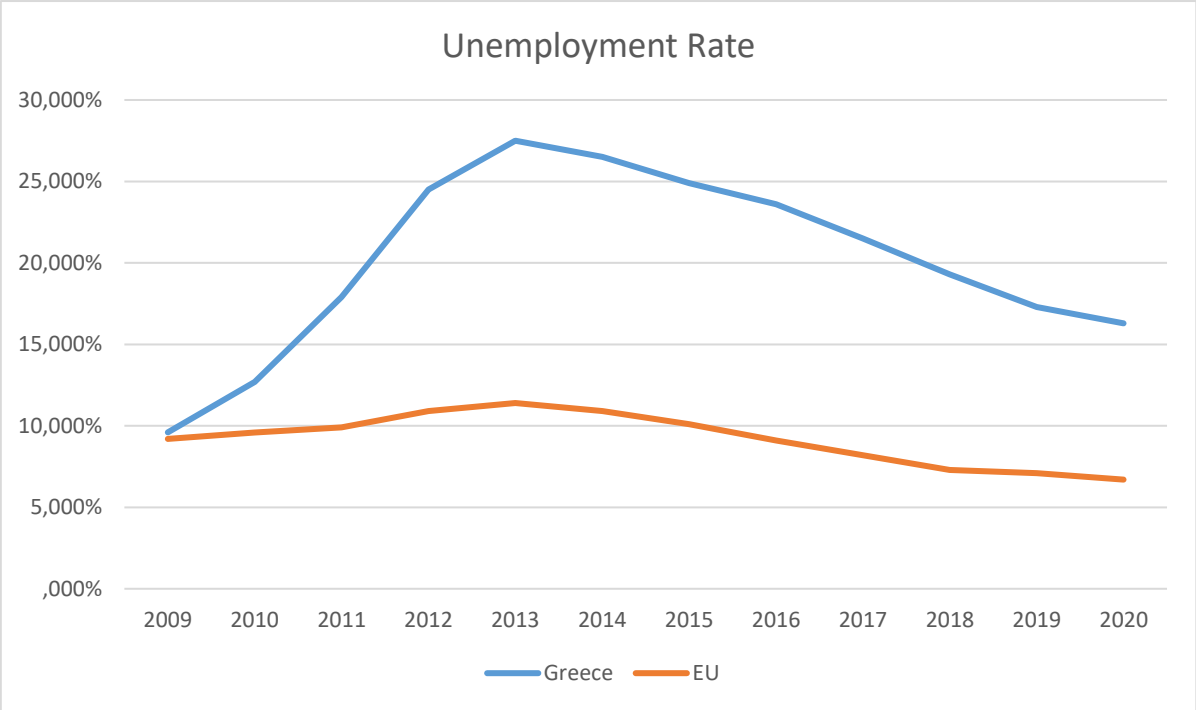


Figure 2: Total unemployment rate, age group 15 – 74 (Source: Eurostat Greece)

The Table 6 gives the unemployment rate in different regions of Greece. In comparison with the national average, unemployment is lowest in Attiki (14%) and highest in North Greece (18.3%).

Table 5: Percentage of Unemployment rate, age group 15 years or over, by area (NUTS 2) (Source: Eurostat Greece)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Attiki	12.6	18	25..8	28..7	27..3	25..2	23.0	21.6	19.9	16.9	14.0
Aegean Islands and Creta	12.0	15.3	19.8	22.7	22.1	19.0	19.4	18.7	17.5	14.3	16.3
North Greece	14.05	19.9	25.3	29.0	26.8	26.1	25.7	24.1	20.9	19.2	18.3
Central Greece	12.1	16.3	22.0	24.4	25.1	24.5	23.1	20.8	18.3	16.8	16.9

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. Table 7 shows that while 75% of the graduates of tertiary education are employed, the rate falls as low as 50% for those without primary education or who graduated from primary and lower secondary schools.

Table 6: Percentage (From 20 to 64 years) of Employment by educational attainment level (Source: Eurostat Greece)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Secondary education or lower (levels 0-2)	53.5	48.0	45.8	46.5	48.1	48.1	49.2	49.9	50.2	49.9
Upper or post-secondary education (levels 3 and 4)	56.3	51.4	48.7	49.2	51.1	52.5	54.1	55.5	57.4	57.2
Tertiary education (levels 5-8)	74.0	70.3	68.2	67.6	67.9	69.6	70.8	73.3	75.2	74.5

Around 4 million are employed in Greece. Nearly 3.6 million of these are in full time employment while the remaining work part time or with temporary contracts. The number in each category is given in Table 8.

Table 7: Part-time employment and temporary contracts (From 20 to 64 years) in Thousand Person during 2011-2020 (Source: Eurostat Greece)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Employed persons working part-time	260	274	285	318	330	349	354	336	343	319
Employed persons with temporary contract	300	236	221	259	275	266	278	283	327	262
Underemployed persons working part-time	156	186	211	236	241	264	256	241	229	205

The employment rate varies by age groups, where the 25-54 age group has the highest employment rate, followed by the older (55-64) and the younger (15-24) groups. The employment rate within the 55-64 age group demonstrates an increasing trend, in parallel to the situation as demonstrated by the OECD and the EU-27 averages (OECD Employment Rate Statistics), as demonstrated in Table 9.

Table 8: Employment Rate in Greece by Age Group 2010-2020 (Data Source: OECD Employment Rate Statistics)

	Employment Rate in the Age Group (%)		
Age Group	15-24	25-54	55-64
2010	20.1	73.1	42.3
2011	16.1	68.8	39.5
2012	13.0	63.8	36.5
2013	11.8	61.3	35.6

2014	13.3	62.4	34.0
2015	13.0	64.5	34.3
2016	13.0	66.0	36.3
2017	14.1	67.4	38.2
2018	14.0	69.0	41.0
2019	14.5	70.8	43.2
2020	13.8	70.4	44.6

3.1.4 Economy

As Figures 3 and 4 demonstrate, there was an increase in the net national income per capita and the gross domestic product per capita of Greece in first decade of the second millennium. However, the financial crisis of 2008 followed by the Debt Crisis caused the sharp decrease in both. Only after 2017 did the Greek Economy showed positive signs, as the Gross domestic product has showed an upward trend, even if rather weak. It is worth noting that according to the Summer 2021 Economic Forecast (European Commission), in case of Greece, the Gross domestic product growth was +1.9% in 2019, but it was -8.2% in 2020 due to the pandemic situation. The inflation follows the trend of the Gross domestic product growth and so, the inflation was +0.5% in 2019, but -1.3% in 2020 (EC Summer 2021 Economic Forecast).

As of 2018, the sectors with the highest shares in the Greek economy are trade (wholesale and retail), transportation, accommodation and construction, and food services industry, with a total share of 25.1%. On the other hand, education, defense, health and social work and public administration sectors account for 20.3%, and the real estate sector accounts for 16.3% (European Union).

53% of Greece's exports are to EU countries, with Italy (10% of Greece's exports), Germany (6% of Greece's exports), and Cyprus (6% of Greece's exports) having the highest shares. Out of the non-EU exports, Turkey and Lebanon have the highest shares with 6% and 4%, respectively (European Union).

In terms of imports, 51% originate from EU Member States (Germany 11% and Italy 8%), while outside the EU, Iraq and Russia both provide 8%, and China, 7% (European Union).

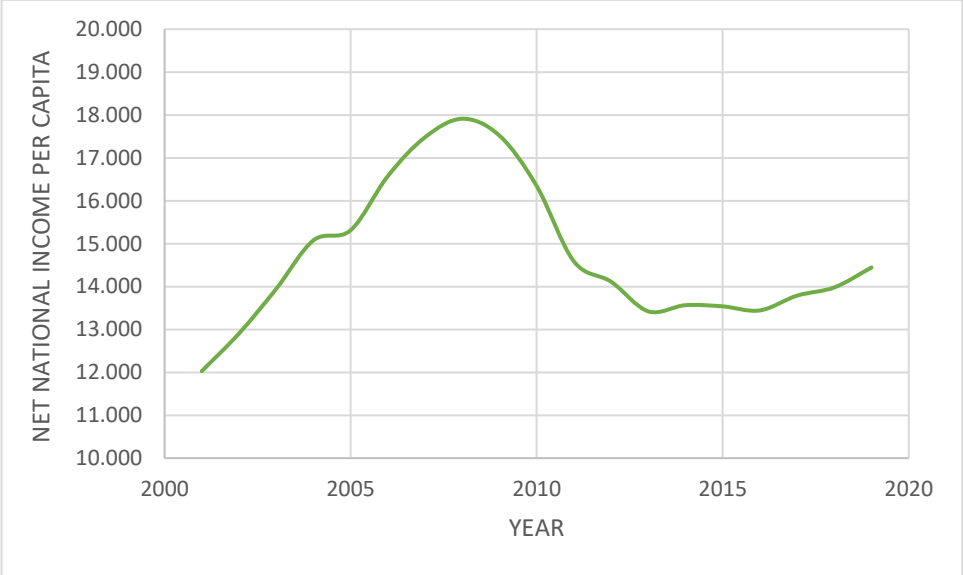


Figure 3: Net national income per capita in Greece (in €) (Hellenic Statistical Authority)

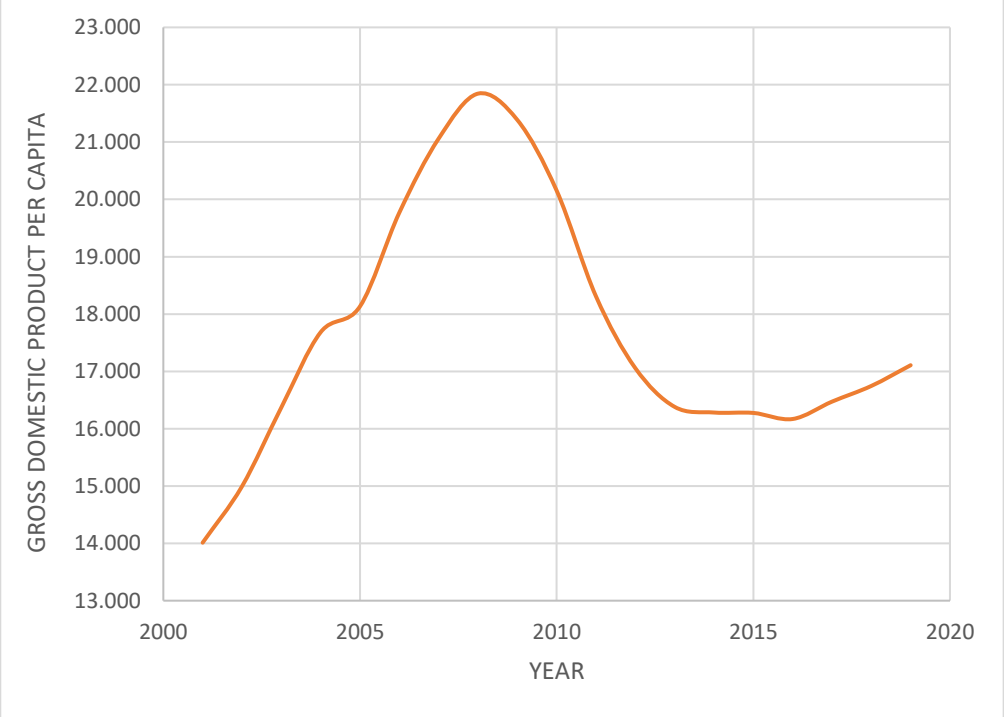


Figure 4: Gross domestic product per capita in Greece (in €) (Hellenic Statistical Authority)

3.2 Energy sector

3.2.1 Energy profile

The Energy sector is a leading sector for Greece's economy, as it had contributed approximately 6 billion Euros (€) in 2017, corresponding to 3.8% of the total domestic value added (Vettas et al., 2021).

Even though the Greek economy contracted after the financial crisis of 2008 and debt crisis, the energy sector appeared to have sustained only slight losses. In fact, there is an increase in terms of the share of the energy sector in Greece's GDP from the 2008 level of 2.7% to the level of 3.8% in 2017 (Vettas et al., 2021).

More specifically, the contribution of Energy sector to the gross domestic product is estimated at € 9.3 billion in 2017. When the indirect effects of the energy sector are also considered, 6,236 million Euros (€) of the GDP is directly associated with the Energy sector. The main contributions in this respect are based on the electricity sector, oil refineries, and the gas sector). The remaining amount (3,052 million in terms of GDP) is linked to the indirect effect. Therefore, every euro GDP of the Energy sector generates, either directly or indirectly, € 1.5 GDP in the Greek economy (Vettas et al., 2021).

The energy sector also contributes significantly to the employment levels. In 2017, 102.6 thousand jobs (in full – time equivalence), corresponding to 2.5% of total employment in Greece, was related to Energy sector. Of these 102,6 thousand jobs, it is estimated that the number employed directly in Energy sector was 45.2 thousand, and indirectly, 57.4 thousand. As a result, one new job in the Energy sector led to another 1.27 new jobs in Greek economy. Finally, it is noteworthy that the proportion of employment in Energy sector (compared to the total employment) remained stable during 2008-2017, even though the employment in the sector decreased by 10.5 thousand jobs (Vettas et al., 2021).

The net imports in energy sector play a crucial role in Greek economy. In early 2000s, the exports of energy products corresponded to approximately 15% of total Greek exports, equivalent 2 billion Euros (€). However, by 2019, the exports of energy products, 97% related to oil and 2% in electricity and gas, corresponded to 31.5%, equivalent to 10,7 billion Euros (€) (REScoop). On the other hand, while in early 2000s, the energy imports represented 12% of total Greek imports, in 2019 the percentage rose to 27%, representing 15 billion Euros (€). The main energy products are crude oil and petroleum products, and imports of each exceeded 13 billion Euros (€) in 2019. The value of imports of natural gas and electricity were 1.4 billion Euros (€) and 500 million Euros (€) respectively in 2019 (Vettas et al., 2021).

Greece's energy profile is summarized in Table 10. The effect and the importance of energy importing activities can easily be seen, as the primary production is insufficient to meet the final energy consumption. One can conclude, therefore, that Greece is among the energy dependent countries.

Table 9: Greek Energy Balance (in ktoe) (Source: Eurostat Greece)

	2011	2012	2013	2014	2015	2016	2017	2018	2019
Primary production	9.679	10.476	9.366	8.860	8.530	6.772	7.491	7.535	6.367
Net imports	19.590	19.444	16.172	16.926	18.381	18.500	18.910	18.380	19.321
Gross available energy (+/- Change in stock)	30.290	29.511	26.189	25.859	25.871	25.374	26.529	26.009	26.070
Transformation (Electricity and heat generation, Refinery)	6.755	6.751	6.028	5.322	4.505	3.623	4.612	4.301	3.927
Energy sector	1.514	1.896	1.943	1.843	1.785	1.921	2.069	1.996	1.741
Distribution losses	258	158	335	357	429	350	104	461	336
Available for final consumption	18.270	17.800	15.090	15.694	16.546	16.883	16.623	15.977	16.417
Final consumption (non-energy)	883	725	650	705	700	593	869	906	921
Final consumption (energy)	18.185	16.403	14.668	14.804	15.741	15.879	15.721	15.169	15.402

The energy consumption of different sectors is given in Table 11. As seen, the transportation activities and household usage constitute nearly 2/3 of total final consumption, while industrial consumption is still at a lower level than a decade ago.

Table 10: Final energy consumption per sector (in ktoe) (Source: Eurostat Greece)

		2011	2012	2013	2014	2015	2016	2017	2018	2019
Industry		3.323	2.995	2.836	3.088	3.128	3.073	2.763	2.739	2.588
Transport		6.706	5.616	5.609	5.635	5.753	5.897	5.815	5.897	6.046
Other sectors	Services	1.870	1.941	1.821	1.714	1.875	2.038	2.192	2.093	2.135
	Households	5.526	5.096	3.821	3.845	4.461	4.349	4.413	3.914	4.114
	Agriculture & forestry, Fishing, Not elsewhere specified	761	755	582	521	523	522	538	509	519

The National Energy and Climate Plan (NECP), which sets out specific energy and climate objectives by 2030, gives special importance to the transportation sector, which has the biggest share of total final energy consumption by sector. Transport is also important since it is the primary cause of air pollution, noise, congestion, and traffic accidents, which is a threat to a clean future.

Currently, petroleum products account for 96% of total consumption, while bioenergy accounts for nearly 3%. The remaining consumption comes from natural gas and electricity. The NECP foresees a decline in the use of petroleum products (from 96% to 91%) by 2030 while the use of electricity and natural gas are expected to increase from 0,26% to 2,18% and 0,40% to 1,44% respectively. The Figure below shows the targets for energy consumption in the transport sector set by NECP.

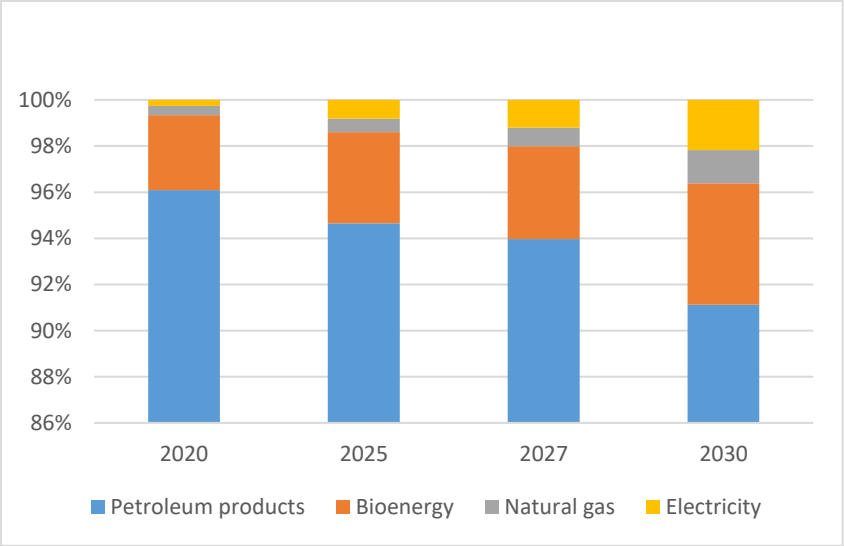


Figure 5: Percentage of final energy consumption in the transport sector until 2030 (National Energy and Climate Plan)

A major category of tax revenue is related to energy products due to the inelastic demand for energy products, as well as the target regarding the negative externalities linked to environmental and other impacts. Furthermore, an excise duty (VAT) is applied on energy products (oil, electricity and gas), from which the tax revenue in Greece amounted to 4.28 billion Euros (€) in 2019 (Vettas et al., 2021).

3.2.2 Energy infrastructure

Based on the Eurostat data, Table 12 shows the gross electricity production by fuel in Greece from 2014 until 2019. A significant reduction in electricity production by lignite was possible thanks to an increase on the share of renewable sources (mostly solar photovoltaic and wind) and natural gas in electricity production.

Table 11: Gross electricity production by fuel (in GWh) (Source: Eurostat Greece

		2014	2015	2016	2017	2018	2019
Solid fossil fuels	Lignite	25.746	22.107	18.883	18.765	17.185	12.124
Natural gas and manufactured gases	Natural gas	6.776	9.090	14.868	17.113	14.080	11.347
Oil and petroleum products	Refinery gas	726	779	567	384	634	630
	Liquified petroleum gases	14	0	105	15	5	0
	Gas oil and diesel oil	986	1.106	1.080	1.203	1.115	1.104
	Fuel oil	3.818	3.778	3.813	3.908	3.793	3.777
Renewables and Biofuels	Hydro	4.607	6.150	5.565	4.040	5.760	4.051
	Wind	3.689	4.621	5.146	5.537	6.300	7.266
	Solar Photovoltaic	3.792	3.900	3.930	3.991	3.791	4.429
	Biogases	220	230	270	300	302	378
Non-renewable wastes	Industrial waste (non renewable)	100	112	207	0	286	290

Within the four main coal mine fields, around 7.5 billion tons of lignite is estimated to be deposited. 80% of Greece' coal production is supplied from the coal mines in Western Macedonia (a reserve of 1.5 billion tons) (Hebda, 2021).

In parallel with the expansion in the gas sector in Greece in the recent years, new power plants fuelled by gas are being established. At present, there are 13 gas-fuelled plants, and these are located close to the gas pipelines (Hebda, 2021).

Greece has one mainland electrical system and 29 autonomous systems in non-interconnected islands. The energy demands of the islands (e.g., Chios, Crete, Euboea, Rhodes) were provided through power plants that use oil as fuel. There is a recent transformation of these oil-fired plants to gas-fired plants (e.g., Chania plant in Crete, Aliveri plant in Euboea, and Soroni plant in Rhodes) (Hebda, 2021).

As Table 12 and Table 13 show, the installed power of RES in Greece is increasing. However, the installed power of solar roofs has remained stable, because of the program designed for enhancing the deployment of rooftop photovoltaic systems. This program was effect for mainland Greece as well as the interconnected islands, between 2009 and 2019 (Gkarakis, 2015).

It is known that the new Special Program for roof-mounted photovoltaic systems will be launched with reduced capacity per installation to 6 kWp.

Table 12: Power Installed and Energy Generation per technology in May 2019, May 2020 and May 2021 (Source: DAPEEP)

	May 2019		May 2020		May 2021	
	Power Installed (MW)	Energy Generation (GWh)	Power Installed (MW)	Energy Generation (GWh)	Power Installed (MW)	Energy Generation (GWh)
Wind	3.059.32	684.01	3.875.6	557.7	4.350.0	675.7
Photovoltaic	2.275.69	350.80	2.511.8	399.7	3.096.1	518.9
Solar roof	375.1	42.76	375.1	31.4	375.3	39.4
Biomass & Biogas	84.24	30.55	89.9	36.1	104.5	41.6
Small hydroelectric	240.82	76.31	233.5	50.1	245.5	57.2
Hydroelectric	0.40	0.07	2.95	0.10	2.95	0.16
Cogeneration of high efficiency heat and power	228.77	83.29	237.4	89.2	236.5	94.9

The National Energy and Climate Plan (NECP) of Greece involves the objective of phasing out the use of lignite for power generation until 2028. One significant step towards this objective is the closing of all lignite-fired power plants in Greece by 2023. Accordingly, the share or renewable sources in power generation is targeted to increase. The policymaking in this respect needs to consider the dynamics of the electricity market as well as overcoming the economic effects (such as on those regions where the economy depends highly on coal mining). Therefore, specific transition policies are planned, along with a strategy for their finance (EC Summer 2021 Economic Forecast). For this reason, a comprehensive plan for such transition in Greece, "Just Transition Development Plan of lignite areas", was introduced in 2020.

4 Analysis of the legislative and administrative framework

4.1 Clean Energy Package for all Europeans

The framework for the energy and climate related policies of the European Union are established by the "2030 Climate and Energy Policy Framework" of 2014. Covering the period from 2020 to 2030, the Climate and Energy Framework emphasizes the role and empowerment of citizens in terms of energy and climate actions. To this end, it is stated that the framework will "by developing a reliable and transparent governing system free of administrative burdens will assist the European Union in achieving the intended energy policy objectives and targets". This framework has been further supported by the "Clean Energy Package for all Europeans". In what follows, 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 were introduced within the context of the Clean Energy Package for all Europeans, (Henrich Böll Stiftung, 2020).

These legislations share a common perspective of placing the citizens in the core of the energy system. Empowerment and active participation of individuals in the energy market are established as key components of the energy transition for Europe. For this purpose, one of the key policy goals of the European Commission is to alleviate the barriers and enhance the individuals to participate in the energy market. Considering the traditional roles of consumers in the energy market, this, in turn, requires a transformation involving becoming prosumers (producing and selling energy), as well as storing, sharing, and exchanging energy. At this point, Energy Communities are very significant in terms of facilitating the consumers to take on their new roles in the energy system, hence, supporting energy transition. In doing so, energy communities will also help alleviate energy poverty. Energy communities also provide individuals with means of tracking their energy usage, responding to changes in energy prices, as well as achieving behavioural change supporting the process of transitioning to cleaner energy (Henrich Böll Stiftung, 2020).

The Clean Energy Package for all Europeans of 2016 introduces 8 laws, with significant implications concerning individuals in the energy system as well as the environmental and economic aspects. Through these legislations, the EU marks its pioneering role in terms of climate action and supports the target of achieving a carbon-neutral Europe by 2050 (European Union).

The 2030 target for the European Union in terms of the share of renewable sources in the energy mix is stated in the Renewable Energy Directive (2018/2001/EU) of 2018, at an ambitious level of 32% (European Union).

The Clean Energy Package for all Europeans also involves provisions on the electricity market. More specifically, the package targets to increase the share of renewable resources in electricity production, while establishing a more flexible electricity market. In this respect, the position of ACER (Agency for the Cooperation of Energy Regulators) is also planned to be strengthened (European Union).

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, citizen energy community (CEC) and renewable energy community (REC), as well as putting forth standards for energy generation, transmission, distribution, supply, etc. and establishing guiding principles for financial support schemes, renewable energy self-consumption, and district heating. Both CEC and REC are legal entities based on open and voluntary participation. Both for CECs and RECS, the primary aims are not financial profits. The objective is rather to provide social community or economic benefits to its shareholders, along with environmental contributions. Apart from these similarities, the REMD also includes regulation of smart metering systems and data sharing to promote energy efficiency and consumer empowerment.

The directives further note that Member States are expected to develop and operationalize frameworks that will facilitate these communities. Elimination of unjustified regulatory barriers and administrative procedures for such communities is therefore a priority.

Based on the 2-year adoption process periods, the EU Member States need to introduce the national laws regarding the implementation of REMD by the end of 2020, and those regarding the implementation of RED II by mid-2021. The Member States can utilize this process towards adapting their national legislation in a way that facilitates the stronger roles of individuals and communities in the energy system, fosters the decentralization of energy production, and the deployment of renewable sources in energy production.

Considering the fact that the targeted level of 32% in RED II for the share of renewables in the energy mix of the European Union is binding the contributions of energy communities become more critical in terms of supporting clean energy transition.

The Directive 2018/2001 has not yet been transposed into Greek law but is expected to be implemented as soon as possible.

Regarding the implementation of Directive 2019/944, this has not been finished yet, except from the paragraph 5 (a) of Article 70, which has been transposed by law 4643/2019 and 4342/2015.

4.3 National Energy and Climate Plan of Greece

The Greek government has introduced the National Energy and Climate Plan (NECP) in 2019, towards establishing Greece's strategies concerning energy and climate-related issues. The NECP of Greece also aims at providing a roadmap towards the achievement of the 2030 climate and energy targets 2030. To this end, the plan involves the definition of priorities and policies as well as a set of related development activities and economic action plans (Greece National Energy and Climate Plan, 2019).

The objectives of National Energy and Climate Plan for 2030 are stated as follows:

- reduction of GHG (greenhouse gas) emissions by at least 42% as compared to 1990 levels, and at least 56% as compared to 2005 levels,
- increasing the share of renewables in the final energy consumption to at least 35%,
- achieving an improvement of 38% in energy efficiency (Greece National Energy and Climate Plan, 2019).

The aforementioned phase out of the coal-fired power plants by 2028 is also stated among the goals of the NECP. (Greece National Energy and Climate Plan, 2019).

Moreover, the NECP of Greece also identifies priorities in terms of the electricity production and distribution infrastructures (e.g., achieving the digital transformation of the energy networks, modernizing the islands' interconnection, improving the energy storage capacity), energy market structure towards better flexibility and competitiveness, utilization of technological innovations in the energy field, supporting research and development for the energy sector, increasing the availability of financial instruments for the energy sector, and supporting the deployment of e-mobility (Greece National Energy and Climate Plan, 2019).

The targets of NECP for 2030 in terms of core indicators, energy consumption, power generation, and buildings are summarized in Table 14 (Greece National Energy and Climate Plan, 2019).

Table 13: Key energy system targets for 2030 (NECP) (Source: National Energy and Climate Plan, 2019)

Core indicators	
Total GHG emissions ($MtCO_2eq$)	60,6
RES share in gross final energy consumption [%]	35%
RES share in final consumption for heating and cooling [%]	43%
RES share in gross electricity consumption [%]	61%
RES share in final consumption for transport [%]	19%
Energy productivity [EUR million '10/ktoe]	11,03
Energy consumption	
Gross domestic consumption	22.19
Primary energy consumption [Mtoe]	20.55
Final energy consumption [Mtoe]	17.38
Final energy consumption (without ambient heat) [Mtoe]	16.51
Power generation	
Installed capacity [GW]	
Lignite	0.00
Natural Gas	6.91
Wind farms	7.05
Photovoltaics	7.66

Total installed RES capacity for power generation	19.03
Gross power generation [TWh]	**57.93**
Net power generation [TWh]	**57.22**
Lignite	0.00
Petroleum products	0.83*
Natural Gas	18.30
Bioenergy	1.58
Hydro	6.60
Wind farms	17.21
Photovoltaics	11.82
Solar thermal	0.26
Geothermal	0.63
Net power generation from fossil fuels [TWh]	19.13
NET electricity imports [TWh]	**4.58**
Total electricity supply [TWh]**	**61.80**
Final electricity consumption [TWh]	**56.4**
Buildings	
Total number of residential buildings renovated by 2030	600.000

*It concerns almost exclusively power generation in the energy sector, refineries in particular
**The total electricity supply is defined as the sum of the net power generation and net electricity imports.

4.3.1 RES Objectives

The NECP of Greece involves a targeted level of 35% concerning the share of renewables in the final energy consumption is at least 35% (Greece National Energy and Climate Plan, 2019).

When the details of this target are analysed, Greece targets to supply at least 60% of the gross final electricity demand from renewable energy sources by 2030. For heating and cooling, this target is at 40%. The transportation sector is also significant in terms of energy demand. The NECP targets at least 14% of the final energy consumption in transportation to be supplied by renewable energy sources by 2030 (Greece National Energy and Climate Plan, 2019).

The NECP also involves measures concerning the energy used in buildings. In this respect, the installation of renewable energy systems to meet the energy demand in buildings, along with net metering systems is promoted. The expected level of renewable energy systems for meeting the energy demand of households in Greece by 2030 is around 1 GW. Such capacity is estimated to serve around 330.000 households (Greece National Energy and Climate Plan, 2019).

4.3.2 Net metering and energy community schemes

The deployment of net metering systems is expected to support the energy transition in several ways. The foremost benefit is through the real-time tracking, enhancing the implementation of renewable energy investments and energy savings. Along with the concept of energy communities, net metering systems also foster the more active roles of individuals and the local communities in the energy system. Innovative implementations of net metering systems for production and consumption of energy are also expected to decentralised energy systems based on local production and consumption. The NECP of Greece targets to deploy net metering systems by 2030 to cover a consumption of 600 MW. Through these systems, it is also aimed to involve individuals in energy markets, and aggregators as potential participants of energy communities (Greece National Energy and Climate Plan, 2019).

4.4 Current Progress

The main statutory instruments of Greek energy law are the following:

- Law no. 4001/2011, as amended and in force, (the Energy Framework Law);

- Law no. 4425/2016, as amended by the law 4512/2018, (OJ A'5/17.01.2018) regulating the establishment and operations of the Energy Exchange, (the Energy Exchange Law); and
- Law 4389/2016 (the NOME Law), regulating the quarterly electricity forward products' auctions.

The electricity market of Greece is mainly regulated by the Law no 4001/2011. The legal framework created by the law is consistent with EU's third energy package. The law which requires a license for main generation activities also allows unlicensed generation in certain circumstances.

Law 3468/2006 concerns the renewable energy systems. Supporting regulations such as the regulation for the licensing of renewable energy systems are also in effect. In 2016, Law no. 4414/2016 was introduced to amend the support schemes for renewable energy systems and introduced the FiP (the Feed in Premium) scheme. Further regulations to operationalize the support system were introduced by the Ministry of the Environment and Energy and by RAE (the Regulatory Authority for Energy) (Broumas, 2020).

Law 4685/2020, on the other hand, was introduced in 2020 and concerned the renewable energy systems licensing and the amendments to the environmental legislation. Through Law 4685/2020, the licensing process was simplified and accelerated (Zepos and Yanoppoulos, 2020).

4.4.1 Energy Communities

Law 4513/2018 (amended by the law 4618/2019 and 4759/2020) was the first Greek legislation to define ECs (Energy Communities). This law enhanced people including businesses and local governments as well to contribute to the clean energy package (REScoop). The law was accepted on January 23, 2018, approximately a year before the EU legislation (Directive 2018/2001) on the subject. The explanatory report of the law states that the proposed bill considered the proposal of EU Directive (Douvitsa, 2018), making Greece a forerunner within the EU in terms of transposing the EU directives to define energy communities in the national legislation.

Through the legislation on ECs, individuals can start playing a key role in terms of the transition to clean energy. Along with individuals, local governments, municipalities, small businesses also have means for such participation. This, in turn, supports energy democracy. The roles of citizens are redefined as prosumers, through collaboration with their communities. The decision-making process within energy communities is designed as one where every participant has equal rights (Art.3). A defining factor in the legislation for ECs is locality (Law 4513/2018 of the Greek Parliament), where energy initiatives are focused on meeting the local energy demand through the use of renewable energy sources, while utilizing the opportunities for energy savings. The Greek legislation regarding ECs also takes into consideration the specific geographical features of the Greek islands. For instance, special provisions are included to support regions that have population less than 3.100. A significant component of the legislation involves financial aspects. These include support schemes such as incentives towards ECs or unions of ECs (Henrich Böll Stiftung, 2020)

The activities of the ECs, as provided by law 4513/2018, are divided into core and additional activities. ECs must carry out at least one from the core, and any number of additional activities.

Table 14: Core and additional activities of ECs

Core activities	Additional activities
Production, storage, self-consumption or sale of electricity or thermal or cooling energy from RES or CHP or Hybrid Stations	Raising funds for RES or CHP implementations or for energy efficiency improvement schemes
Production, distribution and supply of electricity, heating or cooling energy	Management or participation in programs funded by national or European Union resources
Supply of electricity or gas to end consumers	Advising on the management or participation of its members in EU or nationally-funded programs
Management of raw material for the production of energy from biomass or bioliquids or biogas	Preparation of studies for the utilization of RES or Combined Heat and Power (CHP) or implementation of interventions to improve energy efficiency
Supply to its members of energy products, hybrid or fully electric vehicles, and alternative fuel vehicles	Information, education and awareness-raising at local and regional level on energy sustainability issues
Development, management and operation of alternative fuel infrastructures or management of sustainable means of transport within the Region where the headquarters of the EC is located	Actions to tackle energy poverty for vulnerable consumers or citizens below the poverty threshold, regardless of whether they are members of the energy community, such as energy supply or offsetting, energy upgrading of homes or other measures to reduce residential energy consumption
Installation and operation of water desalination units using RES within the region where the headquarters of the EC is located	
Demand management to reduce electricity end-use and representation of producers and consumers in the electricity market	
Provision of energy services	

If a first- or second-degree local authority takes the initiative to establish an EC, it will select from the above, the activities that best meet the local needs.

The type of EC is selected during its establishment, recorded in its statute and remains throughout its duration. ECs can be for-profit or non-profit. For ECs of a non-profit nature, at least 10% from the annual surpluses is allocated the formation of the EC's operating reserve. The annual surpluses are not distributed to the members, but remain in the EC, in the form of reserves, available for EC's needs. Part or all the surpluses for the use of the EC may be allocated only for services of general interest (SGIs) of a local nature, related to the adequacy and supply of raw materials, fuel and water after the withholding of its regular reserve, for:

- ECs in which participate only local authorities of first- or second-degree
- ECs that are based in an island municipality with a population of less than 3.100 inhabitants, and in which a local authority of first- or second-degree participates.

For-profit ECs can distribute the annual surpluses to their members after the deduction of the regular reserve, if there is a relevant provision in the statute. Unlike the other ECs, they may also transfer the licenses of their power plants from RES, CHP and Hybrid Stations to an EC of another character.

Once a local authority of first- or second-degree takes the initiative to set up an EC, it will choose the type of EC that will best serve its purposes. In either case, the local authority should seek to ensure the efficient operation of the chosen activities, ensuring adequate mechanisms for monitoring, evaluation and control, because it is accountable to the local community for the results of the EC.

Table 15: Characteristics depending on the nature of each EC

	For Profit	Non-profit
Distribution of surpluses	Yes (after the operating reserve)	No
Minimum number of members	50% plus one of the members consists of natural persons during the establishment of the EC and throughout its duration	5 members if they are legal entities under public law other than local authorities or legal entities under private law or natural persons
	15 members	3 members if they are legal entities under public or private law or natural persons, of which at least 2 are local authorities
	10 members if the EC is based in an island municipality with a population of less than 3.100 inhabitants	2 members if they are only for first degree local authorities of island areas with a population of less than 3.100 inhabitants
Locality	50% plus one of the members must be associated with the place where the headquarters of the EC is located 50%. Specifically:	➢ Natural persons - members: full or partial ownership or usufruct of a property within the Region that the EC is based or citizens of the Municipality of this Region
		➢ Legal Entities - members: their base should be in the region that the EC is based
Cooperative shares	One or more shares per member with a maximum participation of 20% of the cooperative capital	
	With exemption for the Local Government Organisations with maximum percentage:	➢ 50% for the first-degree local authorities of island areas with a population of fewer than 3.100 inhabitants
		➢ 40% for the other local authorities

4.4.2 Net metering and virtual net metering

Greece's net metering policy was introduced in December 2014, and afterwards, the scheme was expanded twice as Table 17 shows in detail.

Table 16: Net metering schemes in Greece

Ministerial decree	Net metering or/and virtual net metering	Address	Technology (RES)
24461 of 30 December 2014	Net metering	Self - producers	Photovoltaic
175067 of 19 April 2017	Net metering	Self - producers	Photovoltaic
	Virtual net metering		
15084/382 of 10 September 2019	Net metering	Self - producers	Photovoltaic, small wind power plants, biogas, bioliquids, CHP, small hydro
	Virtual net metering	Legal entities of public or private law, pursuing public or other public interest purposes of general or local scope and those registered in the Register of Farmers and Agricultural Holdings	
		Energy Communities	

The installation capacity depends on the location of the station. More specifically, in case of the interconnected islands and mainland, the installed capacity of each RES station can be up to 20 kWp, or up to 50% of the total the total consumption that will be offset, if this exceeds 20 kWp. Especially for legal entities, public law or private law, the power of each photovoltaic station can be at most 100% of the sum of the agreed power of the total consumption to be offset, to an upper ultimate limit of 1 MW. For the non-interconnected Islands, the power of systems installed under this can be up to 10 kWp (for Crete, up to 20 kWp), or up to 50% of the sum of the agreed power of the total of consumption, if this value is higher than the above limit of 10 kWp or 20 kWp respectively. Especially for legal entities, public or private law, that pursue public or other purposes of public or local interest, the maximum power of each photovoltaic station can be up to 100% of the sum of the agreed power of the total offset consumption, to an upper ultimate limit varying from 100 kW in most non-interconnected power systems, to 500 kW in Crete.

4.4.3 Special Program for roof-mounted photovoltaic systems

The Special Program for roof-mounted photovoltaic systems in Greece covered the mainland areas as well as the interconnected islands was in effect from 2009 to 2019. The program involved the analysis of the potential in the non-interconnected islands as the first step. Following this step, the implementation started in 2011 (Gkarakis, 2015).

The legislative framework supporting the for roof-mounting developed photovoltaic systems involve the Joint Ministerial Decree 1079/04.06.2009, where amendments were made through the Joint Ministerial Decrees 1557/22.09.2010, 1557/22.09.2010 and 2317/10.08.2012, and Law 4254/2014 (Gkarakis, 2015).

In terms of the special program, the capacity was up to 5 kWp per installation for the non-interconnected islands, and 10 kWp for the implementations in the remaining areas (Gkarakis, 2015).

The special program provided flexibility in terms of the types of buildings for the installation of photovoltaic systems as well as in terms of who would be able to demand the installation of these systems. The main requirement was that the

full owner, usufruct or bare owner (provided that the consent of the usufructuary is taken) applied for the installation (Gkarakis, 2015).

Also, it was required that the building was equipped with working power supply, registered to the owner of the photovoltaic system (Gkarakis, 2015).

As another requirement of the Joint Ministerial Decision, in the case that the building where the photovoltaic system will be installed is used as a residence, renewable energy sources needed to be used for hot water. According to the same Joint Ministerial Decision, the photovoltaic installation that is subject to the Special Program for roof-mounted photovoltaic systems cannot utilize any other funding schemes (Gkarakis, 2015).

The Greek government has plans to implement a similar special program for roof-mounted photovoltaic systems in the future, however, with smaller maximum capacity (i.e., 6 kWp per installation).

4.5 Barriers and motivators

Greece has already adopted the Directive 2018/2001/EU into its legislation and the concept of energy community is defined as an early example within European countries. The process of adoption of Directive 2019/944 is still ongoing. The existing legislation, however, does not differentiate between citizen energy communities (CEC) and renewable energy communities (REC). This may allow for more flexibility in the development of ECs, but it may also cause issues, particularly when one of these types of initiatives is targeted for limits or privileges.

It should be noted that ECs should be established only as civil cooperatives under Greek Law. EU directives, on the other hand, have no limitation on legal status of ECs and allows a high variety of existing legal entities to be considered in the context of ECs under national laws. Negative perceptions on cooperatives due to prior experiences might affect the decision to join to such communities.

Another aspect that may act as a barrier in the implementation of EU Directives is geographical factors. As explained in the countries' geographical profile, nearly 6000 islands in Greek territory constitute about 20% of the surface area. The establishment of necessary energy infrastructure that will absorb the energy produced by the communities in the island is much more challenging than that of mainland.

The financial cost of establishing ECs is also a barrier in the implementation of the EU directives. A financial incentive system in Greece may overcome this issue. The fit-in-tariff scheme designed for energy investments has a minimum installed capacity requirement for entitlement, and this minimum limit is a risk for investments made by ECs.

The last regulations deal with easing of administrative bureaucracy for the necessary authorization for the operation of communities. The implementation of these regulations should be supervised since the amount of bureaucracy involved might depend on the personality of the officials.

A recent regulation (Law 4579/2020) removed the incentives for all persons, including ECs, in bidding process for operational support of RES projects. This means that ECs, a legal entity that is formed for non-profits, will compete with private investors whose sole purpose is financial gain. This may negatively affect the spread of ECs.

5 Practical framework (Greece)

5.1 Energy consumption of households

As Figure 5 shows, the total energy consumption and the final consumption of households has the same orientation over the years, due to high percentage of energy consumption of households, as Table 18 shows. The households' energy consumption is almost up to ¼ of total final energy consumption over the last decade.

Table 17: Percentage of households' energy consumption (over the total final energy consumption) (Source: Eurostat Greece)

	2011	2012	2013	2014	2015	2016	2017	2018	2019
Percentage of households energy consumption	30,4 %	31,1 %	26,0 %	26,0 %	28,3 %	27,4 %	28,1 %	25,8 %	26,7 %

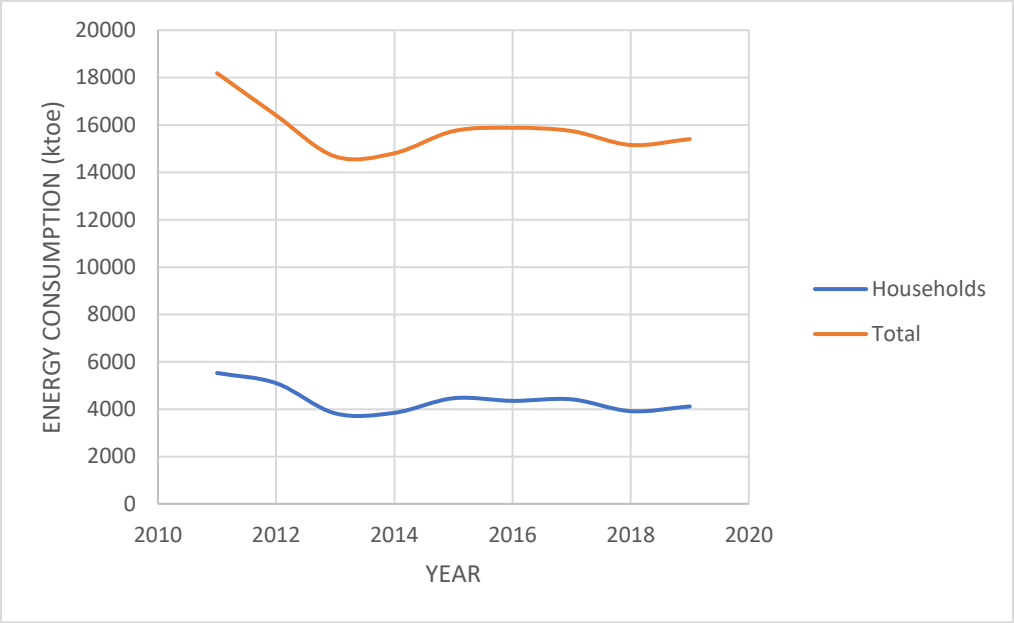


Figure 6: Total energy consumption and the final consumption of households (in ktoe) from 2011 until 2019 (Source: Eurostat Greece)

Of the total energy consumption of households (on monetary basis), electricity constitutes nearly 60% of the expenditure. The remaining proportion is represented mainly by liquid and solid fuels (Kostakis, 2020). 70% of the energy expenditure of the residents of Attica regions is for electricity. The main reason for this high proportion may be the high level of urbanization in this region. Another factor that effects energy expenditure is higher earnings per capita. Regions with higher income tend to fulfil more of their energy need from electricity.

The heating of the living area is the greatest energy need for households. Nearly 2/3 of total energy consumption is for space heating, while cooking and appliances, in total, constitutes ¼. These are followed by hot water and lightning (Hellenic Survey Authority, 2012). Research points out that lower income families pay more electricity cost per person than higher income families, who often live in newer, more energy efficient buildings (Santamouris et al., 2013).

5.2 Energy poverty and Electricity prices for household consumers

Even though household electricity prices in Greece are below the relevant EU27 average (Table 19), the share of Greek households with debts on electricity bills is extremely high, and significantly higher than EU average (Table 20). However, it should be noted that this trend is decreasing.

Table 18: Electricity pricing schemes (households) in Greece 2016-2021 (Source: Eurostat Greece)

	2nd Semester of 2016	1st Semester of 2017	2nd Semester of 2017	1st Semester of 2018	2nd Semester of 2018	1st Semester of 2019	2nd Semester of 2019	1st Semester of 2020	2nd Semester of 2020	1st Semester of 2021
Greece	0.1723	0.1711	0.1620	0.1672	0.1646	0.1595	0.1551	0.1674	0.1641	0.1680
EU27	0.2069	0.2086	0.2087	0.2099	0.2146	0.2170	0.2170	0.2134	0.2134	-

Table 19: Percentage of households with electricity bill debts in Greece (2016 – 2018) (Source: Bouzarovski et al., 2020)

	2016	2017	2018
Greece	42.2	38.5	35.6
EU	6.6	7.0	8.1

Moreover, the Greek share of households unable to adequately heat their home during 2016 – 2018 was among top three among to EU countries, despite a downward trend.

Table 20: Percentage of households in Greece who cannot keep dwellings sufficiently warm (2016 – 2018) (Source: Bouzarovski et al., 2020)

	2016	2017	2018
Greece	29.1	25.5	22.7
EU	8.7	7.8	7.3

Recent research found that as much as 58% of the population is threatened by energy poverty in Greece (Papada and Kaliampakos, 2016). About 11 % of the population spent more than 10% of revenue on energy, while 2% spent more than 20%. Energy poverty is an issue for low-income families. Nearly 20% of the low-income groups falls under the category of severely energy poor, spending more than 20% of their income for energy (Santamouris et al., 2013). More than 50% of the Greek population consider that their residence is inadequately heated (Henrich Böll Stiftung, 2020).

5.3 Energy communities in Greece

As Table 22 shows, the highest percentage of ECs are located in North Greece, and the lowest, on Aegean Islands and Crete, due to the fact that the Non-Interconnected islands are autonomous and they deal with their own issues regarding power supply (Spuridoula, 2020). As seen, the number of ECs is increasing annually as secondary legislation takes effect.

Apart from citizens, local authorities are also keen to take part in ECs. The municipalities of Kozani, Florina and Prespa of the Western Macedonia region lead the way (Balkan Green Energy News). A study points out that northern regions of Greece are more focused on ECs than southern parts, while the developments in the islands are limited (Spuridoula, 2020). Crete is a leading island, with 5 active ECs by 2020.

Table 21: Number of "new" Energy Communities per year and per area (Nuts 2) (Source: Spuridoula, 2020)

	2018	2019	2020	Total
Attiki	0	12	16	**28**
Aegean Islands and Crete	0	2	3	**5**
North Greece	15	134	163	**312**
Central Greece	4	56	95	**155**
Greece (Total)	**19**	**204**	**277**	**500**

It is worth noting that, during 2020, the ECs connected to the grid represented the 57.5% of total photovoltaic parks (Tsolakidis, 2021) and their installed capacity has reached 300 MW (Tratsa, 2021).

The amendment made by the laws 4579/2020 and 4876/2021 made it compulsory for the ECs aiming to benefit from operational aid for solar power generation to participate in the competitive bidding process with other private investors. The regulations seem to contradict the rule of eliminating the unjustified regulatory barriers for ECs, a principle accepted in article 21 of the Directive 2018/2001/EU. The long-term effects of this amendments have yet to be seen.

5.4 Special Program for roof-mounted photovoltaic systems

At first sight, the level of Installed Power and the Energy Production, as Table 23 shows, may seem unimpressive. However, considering that, according to the Special Program, a maximum level of 10 kWp per installation was in effect for the mainland, the interconnected islands, and Crete. For the non-interconnected islands, the maximum capacity was 5kWp. The Special Program has attracted a high level of response from Greeks.

Table 22: Installed Power and Energy Production of roof-mounted photovoltaic systems (Source: DAPEEP)

Year	Installed Power (MW)	Energy Production (GWh)
2016	351	468
2017	374,8	511,5
2018	375,0	488,7
2019	240,6	493,7

5.5 Role of central government in energy transition

Generally, general national policy and its implementation is overseen by the central level of governance (the Ministry of Environment and Energy in matters of environment, of the spatial and urban planning of the country, and of the energy and the minerals raw materials, in line with the sustainable development principles).

The role of Ministry of Environment and Energy is to establish the legal framework, as well as to ensure its alignment with EU framework related to ECs. Law 4513/2018 was the legal milestone in the establishment of ECs in Greece, making it one of the first countries to adopt the concept of ECs. The Ministry of Environment and Energy (in cooperation with other related Ministries such as Ministry of Finance) has adopted ministerial decisions and amendments of the law in order to implement measures and provide incentives with aim to promote ECs.

The central government allowed some exemptions regarding the ECs as a party in bidding procedures for operational support in RES projects in an attempt to engage more citizens and local authorities in ECs, and thus to the transition of the country towards clean energy sources. According to new regulation (Law 4759/2020 and Law 4685/2020), even though each EC is required to participate in bidding procedures started from 1/1/2021, there are exemptions for ECs with more than 60 members, of which 50 are citizens or ECs with a Local Authority as its member.

5.6 Role of local administrations in energy transition

One of the main objectives of law 4513/2018 was to provide municipalities and local authorities with the opportunity for direct participation in RES projects. Municipalities are already attempting to establish local ECs; more specifically, the majority are establishing ECs in cooperation with other public stakeholders, such as municipal development companies and public entities.

Moreover, municipalities are playing a key role in the support and advancement of ECs by supporting groups and workshops. Also, it is noted that they are making efforts to support special categories of citizens by introducing a positive approach to concession on publicly available infrastructures, such as municipal buildings' rooftops for community projects owned by ECs. In this case, the municipality is compensated by either a rent or a share of the produced energy.

6 Conclusion

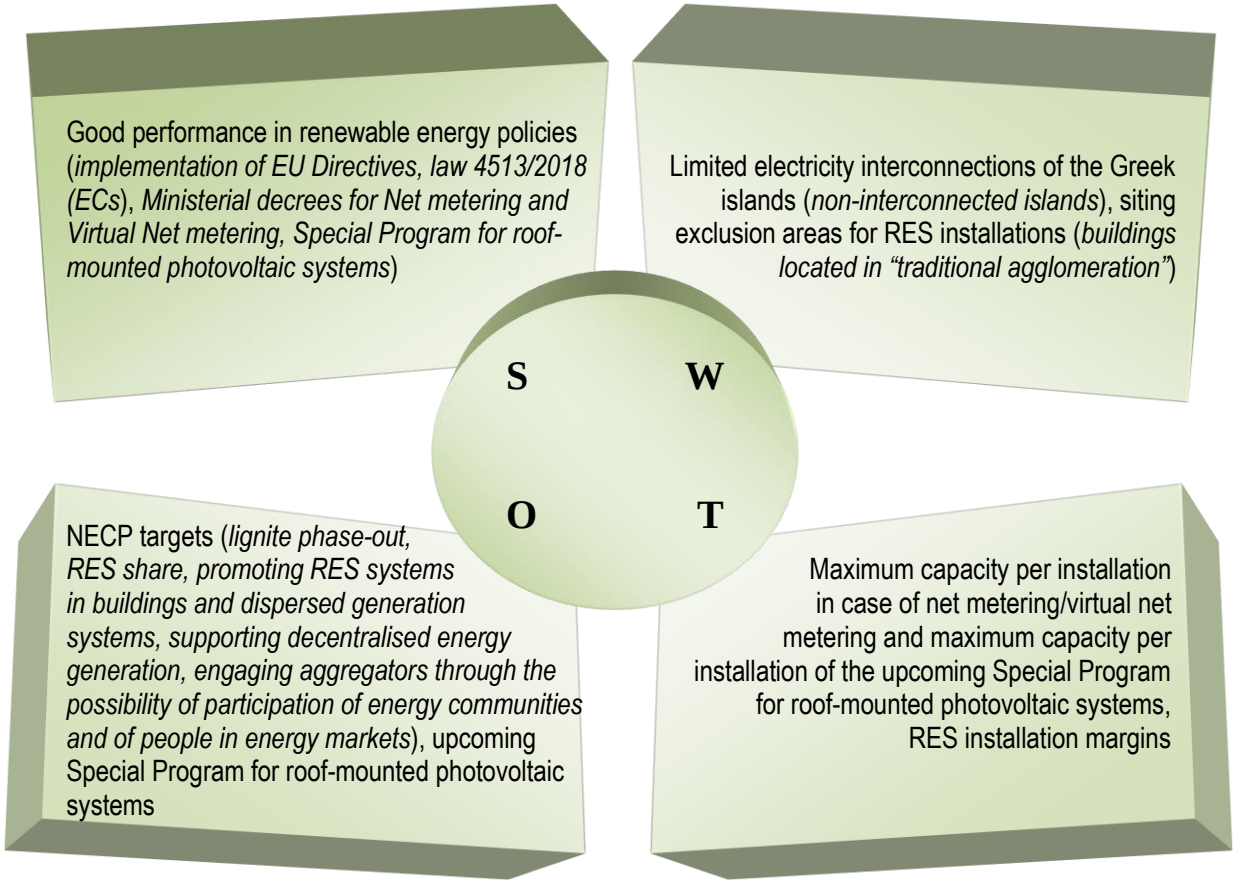
6.1 Country Profile

The energy sector is a major contributor to the Greek economy, accounting for almost 6 billion Euros (€) in 2017, or 3.8% of total domestic value added, and its contribution climbed from 2.7% in 2008 to 3.8% in 2017. Transportation and household usage account for approximately two-thirds of overall final consumption.

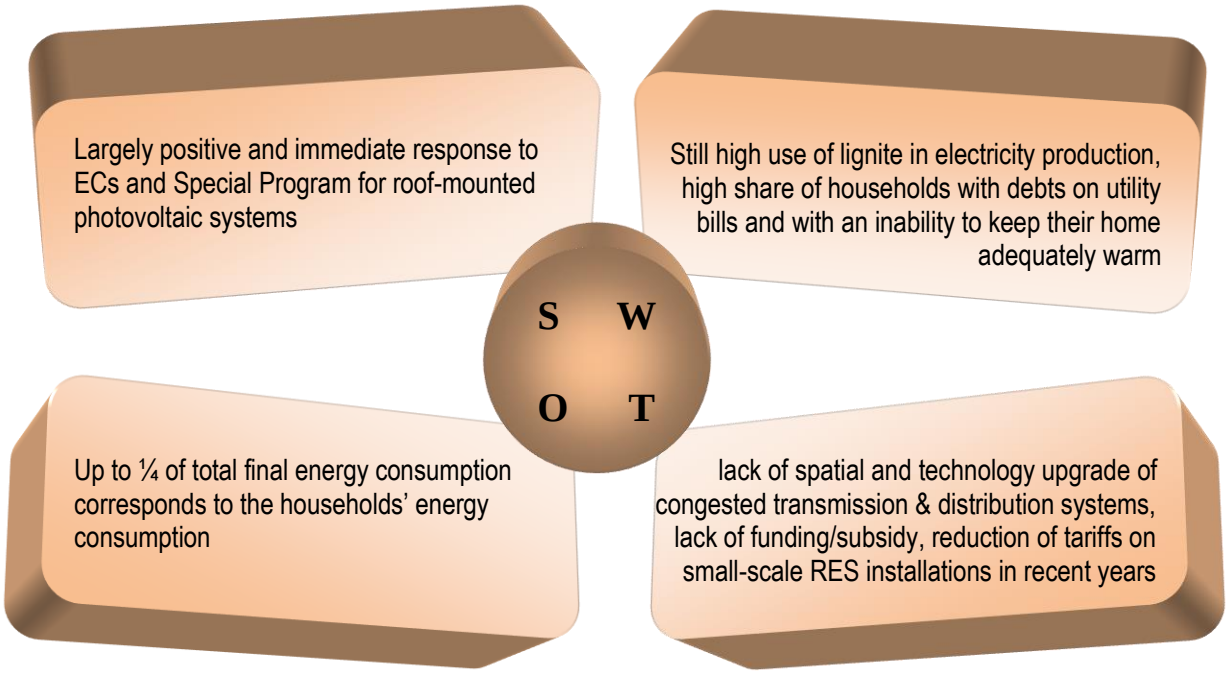
The primary sources of energy in Greece are lignite and natural gas. Over the last decade, there has been a rise in share of generation from renewable sources, particularly wind power. The National Energy and Climate Plan aims to permanently reduce the use of lignite in power generation.

Greece is a forerunner within the EU in terms of importing the concept of energy communities into its own legislation. The law 4513/2018 was accepted and put into effect in 2018. The term "energy community" is defined in accordance with EU Directive 2018/2001/EU. The law provides a single definition of energy communities (ECs), with no differentiation between “citizen energy communities” and “renewable energy communities”. Because ECs can operate across the whole energy market, including renewable energy generation and related activities, arguably, the definition complies with applicable EU Directives. However, the only means of establishing an EC in Greece is through a cooperative. The fundamental difference between national implementation and EU Directives is the lack of other legal forms for citizens to participate in the energy market as a community. The law on smart meters and data flow, another crucial pillar of the eCREW strategy, has been in place since 2011 and is still evolving. When replacing an existing meter or during a substantial renovation of a building, energy distributors and retailers are required to install smart meters that offer real-time information on actual energy consumption, as well as for new connections to new buildings. It can be concluded that a legal framework exists for the collection of data for the smartphone application to be developed as part of the e-CREW strategy.

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



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



6.4 A general assessment of legislative and practical framework with respect to the eCREW approach

Greece's population has decreased and the median age has increased over recent years. However, there is a positive upward trend in the percentage of population with at least upper secondary educational attainment, as well as tertiary educational attainment. In the economic field, the net national income decreased sharply after 2008, and only showed signs of slight improvement after 2016. This worrying situation is linked to the economic crises and the wave of emigration that followed.

Moreover, in the energy sector, there is a significant reduction in electricity production using lignite due to the increase on the electricity production by RES as well as by Natural Gas. It is known that, according to the NECP, lignite power generation in Greece will end by 2028 and a Master Plan for the transition of Greece's lignite regions to the post-lignite period was announced at the end of 2020.

In addition, the concept of Energy Communities as well as net metering have been successfully introduced in recent years.

Therefore, bearing in mind the above, and NECP objectives in combination with the Special Program for roof-mounted photovoltaic systems launched on July 2009 and ended in 2019, it seems that the eCREW approach will be easily adopted after adjustments in Greece.

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

eCREW approach as an innovative scheme of household cooperation in energy management could be the next major theme in energy sector, focusing on the local energy system. However, there are some issues that may arise.

First of all, a specific policy should be reviewed regarding the motivations citizen would need in order to join a Community Renewable Energy Web. These motivations should be customized per region, and categorized into

economic and social motives. For example, tax incentives may be a suggestion/economic motive in areas with high tax rates.

Also, bearing in mind the economic impacts of Covid-19 pandemic and the few years of upward economic trend after the economic crises, subsidies, a strategy that includes capital grants and low interest loans may encourage citizens to join a CREW.

Another issue that may arise is the energy storage. Especially in the case of non-interconnected electrical systems, even though the eCREW approach seems the best solution, due to difference in demand for electric energy, the approach may face severe problems without the storage scenario.

Moreover, the electricity distribution network operators should be included in the strategy for an effective and smooth response (smart meters, etc.). This is needed to schedule a spatial and technology upgrade of congested transmission & distribution systems.

Finally, and importantly, key element is the information/education of citizens regarding the approach, in particular, in ultra-peripheral areas.

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