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Development in Energy Policies in Türkiye and Investigation of Primary Energy Supply Within NUTS 1 Regions [1*]

Türkiye'de Enerji Politikalarındaki Gelişmeler ve Birincil Enerji Arzının Düzey 1 Bölgeleri Kapsamında İncelenmesi

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Abstract

Energy is a vital issue, which is directly related to development. As of 2021, Türkiye is foreign dependent at a rate of 70% in energy. Therefore, energy imports constitute a tremendous economic charge for Türkiye. For this reason, within the scope of this research, energy policies and the process of Türkiye in energy are discussed.

First, the policies developed regarding energy policies in eleven development plans were examined. Then, by focusing on the recent past, fundamental economic indicators and energy indicators in Türkiye's NUTS1 regions, a regional analysis was carried out. Finally, the regions' energy installed capacities, energy consumption, and production data are emphasized and maps were made.

"How is the energy sources distribution in NUTS1 regions in Türkiye?" and "What kind of path has been followed in the last 20 years on renewable energy, and what is the latest situation?" questions were answered in this study.

When all the data and policies are examined, it is concluded that each region has different potentials, the energy production-consumption balance cannot be achieved in the regions, and the increased energy imports due to the weakness in production have a negative impact on national development.

Keywords: *Energy Resources, Energy Consumption, Energy Policies, Regional Plan.*

JEL Codes: *O, Q, R*

INTRODUCTION

Energy is an irreplaceable subject in human life. All people's basic needs, such as nutrition, shelter, heating, and lighting require it. For countries, energy is the basis of progress in technology and industry to meet social needs and development. For this reason, nations aim to strengthen their energy resources locally. Independence in energy and ensuring energy security are essential requirements for an independent economy. The energy issue impacts political, economic, and environmental factors. Therefore, development and energy are directly related. When the literature is examined, it is seen that many studies are proving that there is a bidirectional causality between energy and development in many studies. For this reason, it is not wrong to say that the more a country wants to develop and develop, the more its energy needs increase.

Today, Türkiye is a country that is 70% foreign-dependent in energy. Since it is a developing country, investments in technology and industrial growth increase the need for power. The increase in energy needs brings with it the necessity of accessing clean, reliable, and cheap energy. Energy resources exist in nature in two forms: fossil and renewable resources. During the 20th century, the rapid and excessive consumption of fossil resources brought along many environmental problems. Renewable energy sources are the most critical issue in the 21st century since fossil resources are exhaustible, and the damage they cause to the environment and the policies that countries have developed to ensure energy independence. Furthermore, fossil resources are not evenly distributed around the world, so many countries import resources such as natural gas and oil. This situation means a significant charge for the economy of energy-importing countries. In addition, carbon emissions that occur during the use of fossil fuels are also the trigger of global warming and climate change. Considering all these conditions, we can understand why countries energy policies have changed.

In this study, which presents a review of Türkiye, first, to examine the relationship between energy and development, the change in the policies developed on energy in all development plans and related reports since its establishment have been reviewed.

Literature research and the policies of developed European countries have made integrated spatial energy plans. In this way, it is planned to establish urban energy systems, develop the existing potentials of the regions, create positive energy zones, and maximize energy efficiency. Based on integrated spatial energy plans, installed capacity and energy production/consumption data are examined in the second part of this study to understand the current situation in NUTS1 regions in Türkiye.

1. ENERGY POLICIES IN TURKIYE

1.1. Early Republican Period Energy Policies In 1923-1960

Energy-related policies and strategies are related to developments in the economy. With the establishment of the Republic of Türkiye, the Izmir Economy Congress was held in the same year. The prevailing view on energy in the decisions taken economically in this congress is to meet the energy needs with domestic resources, especially coal, except for mandatory situations. These decisions formed the basis of the energy policies adopted until the 1950s. Since it is a process where the industry is moderate, energy is mainly consumed for heating and lighting purposes in residences.

In 1926, petroleum law was legislated, and with this law, all oil exploration rights within the country's borders were given directly to the government. Thus, the state has taken its first steps towards becoming an actor in the energy field. One of the duties of the Industry and Mining Bank of Türkiye, which was established in the same year, was determined to provide loans to Turkish industrialists and miners. (Çetinkaya, 2019).

The main subject of the Industry Incentive Law enacted in 1927 is to provide various exemptions, concessions, and incentives to enterprises that will make industrial investments in every field. Until the 1930s, the state's perspective on the economy and investments and its policies were regulated according to liberal economic rules. Until the adoption of the principle of statism, which would dominate after this date, this law remained in force for about 15 years with various changes (Ökçün, 1975). The republic's first years when electricity was available only in some economically backward provinces the annual electricity consumption per capita was 5KWh (Yurtoğlu, 2017). Electricity production was emphasized. Still, the lack of operation and capital made it necessary to establish production activities with foreign capital partnerships, Ankara, Urfa, Adana, Konya, Malatya, Bursa, Mersin, Balıkesir, and Gaziantep. Concessionary electricity companies were established in provinces such as Tekirdağ, Edirne, İzmir, Antalya, and Trabzon. (Çetinkaya, 2019)

During the economic depression in 1930, statist policies were dominant in Türkiye. It was aimed at protecting coal, which was the essential energy source of Türkiye for that period, from foreign competition and to providing its energy consumption with domestic resources. In this period, the share of mining and energy investments in total investments is almost 27%. Etibank / MTA (Mineral Research and Exploration) and other national energy companies were established in 1935. Many international companies have established to implement energy policies developed with the principle of statism (Çetinkaya, 2019). From the end of 1930 until the middle of 1940, these companies were bought by the state, and their authorities were transferred to the municipalities. The period between 1940 and 1950 is the period that coincides with the years of the Second World War. For this reason, in this period, as in the rest of the world, economic shrinkage was experienced in Türkiye as well, electricity consumption decreased, and the reflections of statist policies were seen more intensely.

After 1950, it transitioned to a multi-party and economically more liberal term. In this period, urbanization, industrialization, and economic growth were accelerated (Demir, 1980). Energy consumption in Türkiye increased by an average of 4,3 percent per year from 1950 to 1960 (State Planning Organization, 1963).

1.2. Planned Development and Statist Policies Period Energy Policies In 1961-1980

With the preparation of the First Development Plan in 1963, an economic process was started in which planned, and statist policies were developed. We see that three development plans were prepared between 1960 and 1980. When we look at the targets and strategies developed on energy in the development plans, it is stated that the energy and water facilities are under the state's rule.

Considering the energy policies produced in this period it was aimed at using energy resources effectively and minimizing production costs. Savings in energy was encouraged, pricing was determined according to the cost, and the local-imported quality of energy prices and the quality of local resource use was emphasized. In this period of industrialization and urbanization, the primary energy supply issue has gained more importance. The Turkish Electricity Authority

(TEK) was established in 1970. With the national growth, increasing urban population, and industrial growth, energy consumption demands have also increased. Therefore, the search for local resources has increased to increase the supply against this situation. The fact that energy consumption increases during periods of economic revival and decreases during periods of stagnation reveal the relationship between economic growth and energy. (State Planning Organization, 1973)

After the establishment of the Turkish Atomic Energy Agency (TAEK) in 1956 within the scope of uranium and thorium energy resources research in the context of nuclear energy, the Çekmece Nuclear Research Training Centre (ÇNAEM) was established in Istanbul in 1962, and the Nuclear Research Center in Ankara in 1967. However, Türkiye has no government policy on nuclear energy. They are seen as promising as domestic production and export may be questioned when the uranium and thorium reserves are used. (State Planning Organization, 1968).

1.3. Energy Policies in The Liberalization Period In 1981-2000

In this period, it was stated that there needed to be more in the energy sector, rural-urban inter-regional, and intra-regional imbalances brought about by rapid urbanization. It is aimed to eliminate these deficiencies and follow the balanced development method. The domestic demand for primary energy supply has increased by an average of 16.4% per year. Oil investments account for 40.9%, and coal investments for 59.1%. For the first time, nuclear energy is mentioned in the fourth development plan. Considering the development potential of nuclear energy, it has been stated that exploration and investigation studies will be initiated to determine the presence of radioactive mineral resources in the country. The General Secretarial of the Atomic Energy Commission, established in 1956 with Law No. 6821, was restructured in 1982 with Law No. 2690 under TAEK under the Prime Ministry (State Planning Organization, 1985).

After 1985, it is predicted that energy production will increase by an average of 7.7% per year. It is aimed to provide this increase due to lignite and natural gas. When the shares of resources in primary energy production are analyzed, it is estimated that lignite production, which was 9.8% at the beginning of the V. Plan period, will approach 38% at the end. The share of hydraulic energy will rise to 20%. The percentage of crude oil will decrease.

It has been stated that the energy sector will have a structure that supports economic development and that investments for energy purposes will continue to be emphasized. Furthermore, it has been mentioned that non-public resources will be used in the exploration and production of energy raw materials, and private sector and foreign capital initiatives will be supported in this regard. (Tunç, Türüt Aşık, & Akbostancı, 2009). For the first time in the V. Development Plan, under the subject of giving priority to reliable and cheap energy sources. The initiatives related to alternative energy sources were supported, and the preparation of the Energy Master Plan was mentioned for the first time in this plan period. The primary purpose is to provide reliable, cheap, and quality energy for all user, on-site and on time, to support economic and social development. The tendency to import resources has increased due to the need for a more and higher quality of local resources.

In this period, it was aimed to commission hydroelectric power plants and a thermal power plant based on imported coal, and this target was achieved. It was emphasized that a comprehensive

study is required to determine the long-term position of natural gas imports, new natural gas pipelines, city distribution networks and connection line investments, and the place of natural gas in Türkiye's general energy balance. It was stated that to reduce environmental pollution in energy production, technology transfer and Research and Development studies in accordance with the characteristics of both existing and new facilities will be emphasized, and R&D programs will be supported to benefit from the potential of renewable alternative energy sources (State Planning Organization, 1990)

In the 1990s, energy import rates increased to 49%. Build-operate-transfer models were introduced to establish the power plant, creating financial difficulties. In this period, domestic oil supply reached 20% of the total share, and joint production initiatives were made in the field of oil abroad. Establishing a reliable and low-cost energy supply system in the long term has been seen as an essential requirement. In this direction, it has been stated that necessary projects will be initiated for the development of domestic energy resources, the increase in its share in consumption over time, and the supply of imported resources (State Planning Organization, 1996).

When foreign expansion and liberal policies were adopted, it is seen that energy imports have increased by moving away from being statist and self-sufficient statist policies. While natural gas imports started, alternative energy sources were discussed for the first time, and R&D studies started to be carried out. As a result, the primary energy supply increased in this period, especially from the hydraulic energy source.

1.4. Energy Policies in The Sustainable Policies Period After 2001

In this period, it has been stated that necessary measures will be taken to meet the energy demand reliably and continuously at low cost in 2000 and beyond. The energy sector will be liberalized, and arrangements will be continued to ensure the participation of the private sector. In this context, build-operate and build-operate-transfer models began to exist, subject to regulations preventing them from leading to anti-competitive practices. It was deemed necessary to make the energy sector market competitive and to carry out regulatory audits in this context. (State Planning Organization, 2001) As of 2014, development plans indicated that energy imports constitute ¼ of the total imports. Therefore, it is necessary to reduce external dependence on energy. Alternative energy policies should create. Over time, the share of the private sector in the energy market has increased. For this purpose, renewable energy production continued to be supported to increase energy supply security. Domestic coal resources were opened to the private sector for electricity generation, studies on the construction of nuclear power plants were started, regulations were made to increase energy efficiency, and various programs were put into practice. As the 2023 target, it has been stated that the energy is to be provided continuously, with high quality, sustainable, safe, and bearable costs (Ministry of Development, 2013).

It is remarked that cooperation projects in the fields of transportation, communication, and energy will be given importance and especially the projects related to the Baku-Ceyhan Oil Pipeline and the Caspian transit Turkmen Natural Gas to European countries via Türkiye will bring Türkiye to the position of a country where the most critical energy transmission lines of the region intersect. R&D studies on the search for raw materials for geothermal and nuclear energy continued in this period. Baku-Tbilisi 26 Ceyhan Main Export Pipeline project was completed in 2006. With the agreement made with the Russian Federation, the Samsun-Ankara Natural Gas

Transmission Line was completed, and gas purchases from this line began in 2003. (State Planning Organization, 2006)

Moreover, an agreement was signed with the Russian Federation to construct the Akkuyu Nuclear Power Plant (NGS). In addition, an agreement was signed with Japan for the establishment of a second NPP in Sinop. Furthermore, a bilateral cooperation agreement was signed with the United Arab Emirates (UAE) to utilize Afsin-Elbistan lignite deposits in electricity generation. A bilateral intergovernmental agreement was signed with Azerbaijan to realize of the Trans-Anatolian Natural Gas Pipeline (TANAP) project. Thus, an active role will be assumed in the sale and transmission of gas to Europe. (Republic of Türkiye Ministry of National Defense, 2023)

A sustainable development approach is aimed to consume energy at a minimum amount and cost, and thus supply, which will support economic and social development, destroy the environment at a minimum level. In 2001, the Energy Markets Supervision Agency was established. To increase the share of renewable energy sources in electricity generation, Law No. 5346 on the Use of Renewable Energy Resources for Electricity Generation was enacted during this period. However, the share of imported products in electricity production continues to be high and is seen as a risk factor in supply security. With the Energy Efficiency Law, regulations that encourage and oblige the efficient use of energy have been introduced. The Energy Efficiency Strategy Document published in 2012 aims to reduce energy intensity by at least 20 percent by 2023. (Republic of Türkiye Presidency of Strategy and Budget, 2019)

- Inclusion of the nuclear power plant in the energy supply portfolio,
- Activation of Nuclear Technical Support Joint Stock Company,
- Increasing the use of lignite reserves in electrical energy production following environmental standards, supporting R&D projects related to clean coal technologies.
- Increasing the total underground natural gas storage capacity by completing the Tuz Lake Underground Natural Gas Storage Project and the Northern Marmara Natural Gas Storage Expansion Project,
- Increasing the share of renewable energy resources in production, realizing plans and investments in this direction,
- promoting energy efficiency, spreading more efficient and self-powered buildings,
- Completion of Tortum – Georgia energy transmission line project,
- Energy Market Operations Inc. (EPİAŞ) to continue activities effectively for the development of electricity and natural gas trading platforms with new market products,
- Completion of Turkish Stream Onshore Section-1 Natural Gas Pipeline Project,

Conducting studies on developing the National Smart Grid Management System (National SCADA) for use in energy SEEs are the energy policies for 2019-2023.

2. CHANGE OF PRIMARY ENERGY SUPPLY IN TURKIYE

Energy is a crucial factor and one of the fundamental requirements of countries' economic and social development. The presence of energy in the world has become an indicator of the level of

development. The state of having an energy source and the amount of energy production affect growth directly. Developing countries import energy; therefore, it is a prominent issue for them to be able to provide their energy needs to make their development sustainable.

The increasing population of the country since 1923, sectoral diversification, and the developing country's economy increased energy consumption (Figure 2.1). In addition, the energy supply is also increasing with the growing population, the country's economy, and the development of the industry and services sectors.

In this study, in which the alteration of primary energy supply in terms of quantity and type over the years and the energy policies developed from 1923 to the present are discussed in the context of development plans, it is seen that urbanization, industrialization, development goals, and energy have a direct relationship.

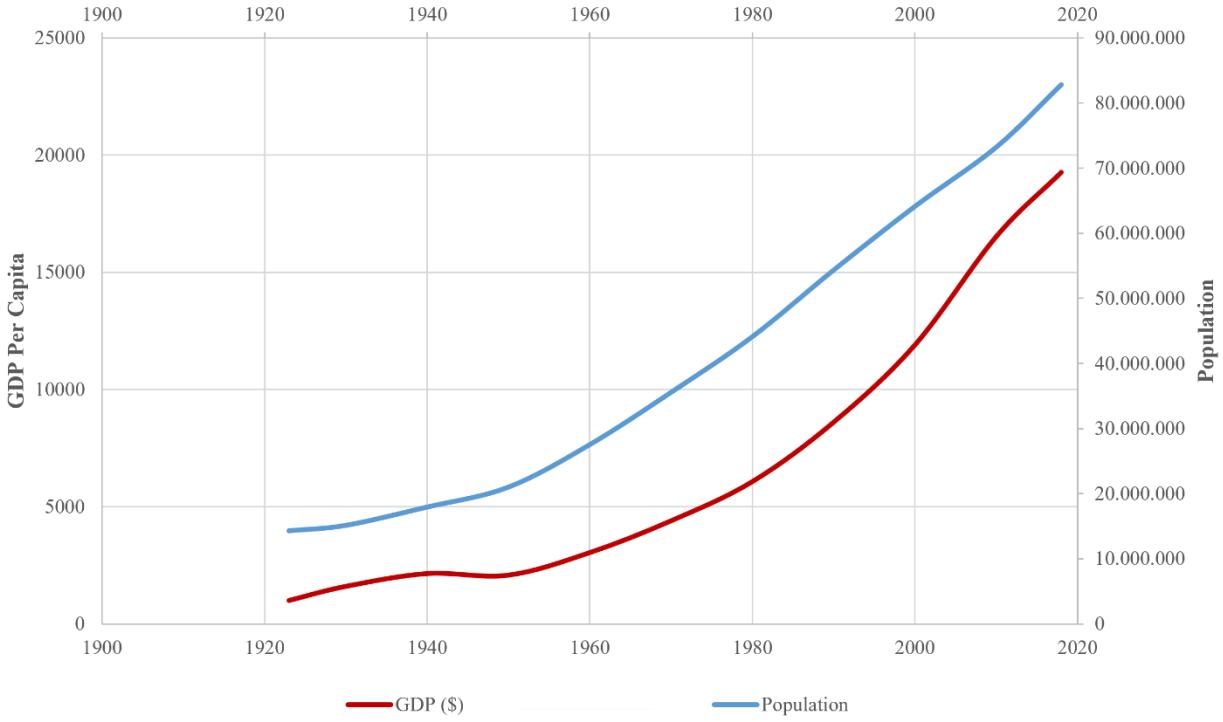

Figure 2. 1. Alteration of Türkiye's Population and GDP Per Capita from 1923 to 2020 (Source: www.ourworldindata.com)

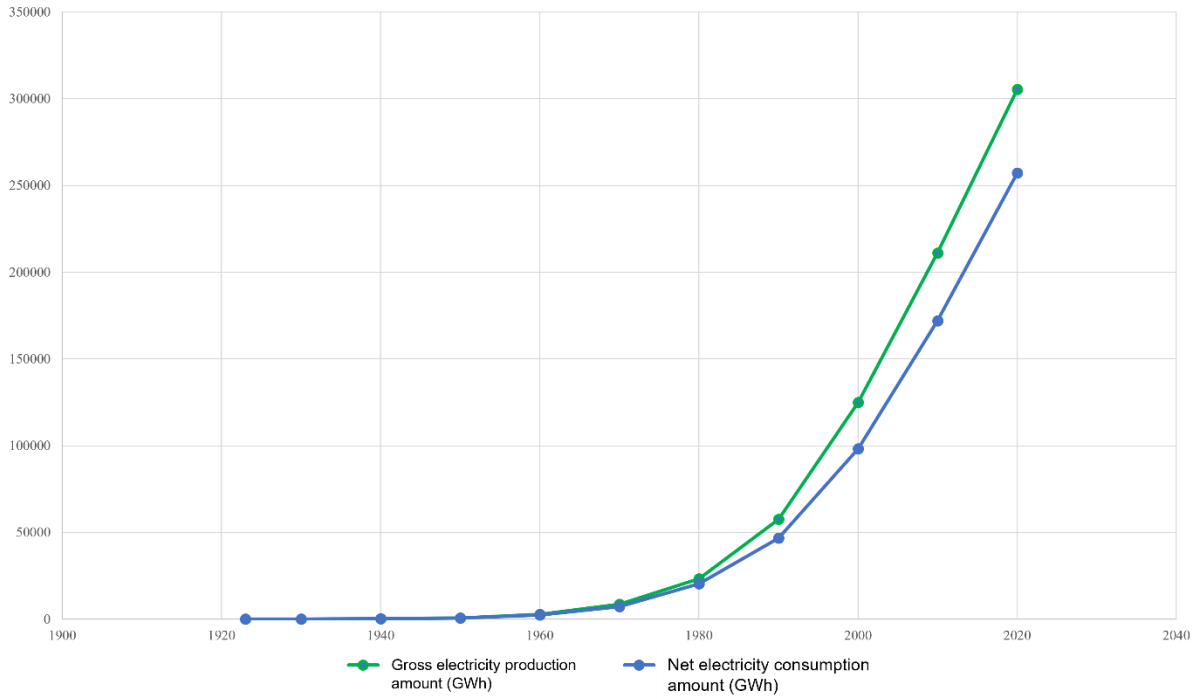

Figure 2. 2. 1923-2020 Amount of Electricity Consumption (Source: TEIAS- TEDAS)

It has been stated that during the Early Republican Period, coal, lignite, and non-commercial energy sources were used intensively from conventional energy sources in the development plans. Since the 1950s, with the increase in urbanization and industrialization, petroleum reserves were explored, and then oil imports were made. With the start of economic growth and development, it is seen that the energy demand has increased intensely, and the country's resources are not enough to meet this demand, so energy imports inevitably increase. As can be seen in Figure 2.2, the amount of energy production and consumption has increased rapidly, especially after 1980. In the 1980s, liberal policies and the globalization process started in Türkiye. With the country's globalization, upward momentum is seen in economic growth, and economic growth is the most crucial reason for the increase in energy demand. Other reasons for the increase in energy demand; are high birth rates (population growth), higher living standards, industrialization, and a rise in the rate of the young population (Öztürk, Yılancı, & Atalay, 2007). Urbanization and the increase and diversification of machinery and vehicles with new technological improvements are the factors that change consumption habits and increase energy demand (Gürbüz, 2009).

As in the entire world, the energy demand in Türkiye is increasing rapidly. Industrialization and urbanization gained upward momentum in this period. According to British Petroleum World Energy Outlook Statistics, conventional resources such as coal and oil were used intensively in Türkiye until 1980. After 1980, natural gas usage started, and thus the tendency towards oil and coal decreased.

Today, 18.6% of Türkiye's total imports in 2021 are seen to be energy imports, and 70.7% of Türkiye's primary energy supply consists of imported energy resources (TEIAS, 2022). Fluctuations in energy prices also trigger inflation, unemployment, economic recession, and

recession in Türkiye. According to EUROSTAT 2020 data, Türkiye's dependence on foreign energy is 71%. This rate is given as 58% on average in European countries.

In the last 20 years between 2000 and 2020, Türkiye's total energy supply has increased by 85.3%, while oil has risen by 25.4%; coal is 77.3%; natural gas is 219.8%; sh hydraulic energy is 152.8%; geothermal, solar and wind increased by 1386%. By contrast with the total share of bioenergy, wood, and waste decreased by 52.2%. Crude oil and natural gas resources have the largest share in Türkiye's energy imports (MMO, 2022). It is observed that the use of alternative energy sources in energy supply started to increase, especially after 2015 (Figure 2.3).

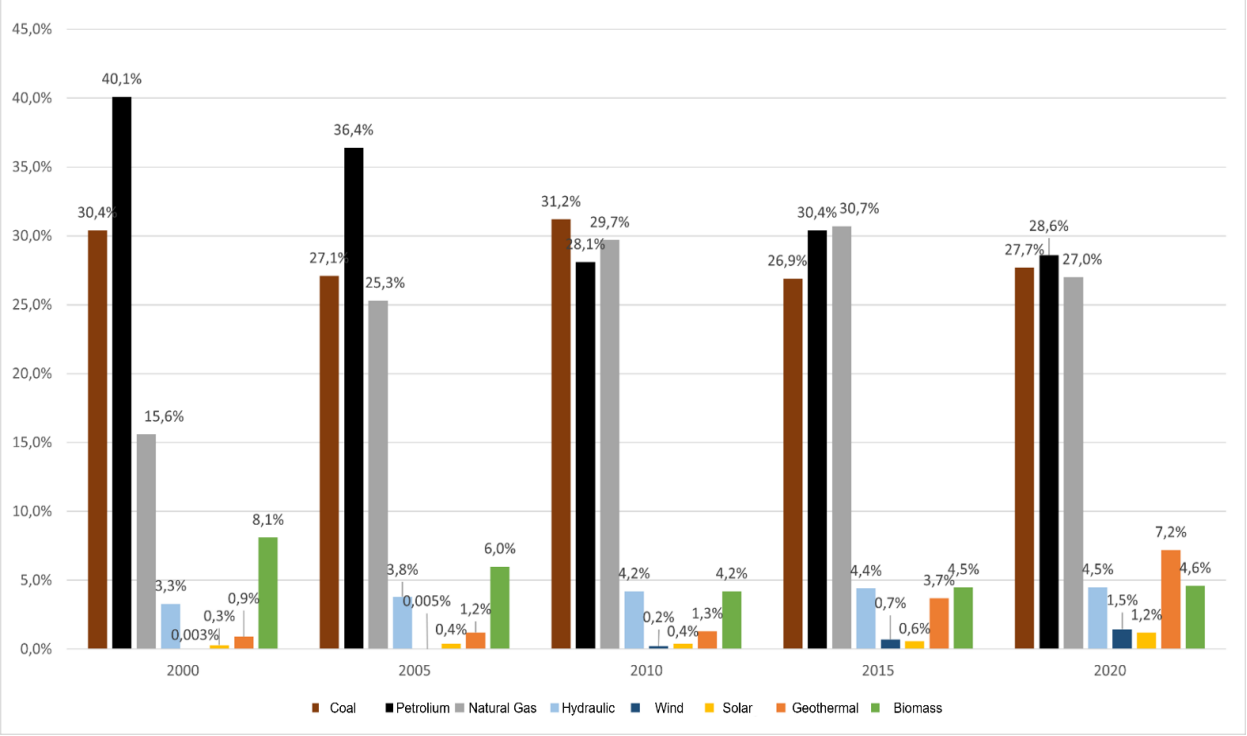

Figure 2. 3. Share of Energy Resources in Türkiye's Primary Energy Supply (Source: Ministry of Energy and Natural Resources)

While the total energy production in Türkiye, was 26.46 MTEP in 2000, it increased by only 17.67 MTEP (66.9%) in 20 years. While Türkiye's total primary energy production has risen by 17.67 MTEP in 20 years, 7.9 MTEP of this increase has been realized in the last five years, of which solar, wind, and geothermal energy production. On the other hand, in the 20 years between 2000 and 2020, total energy production increased by 66.9%, while energy supply increased by 85.3%. As a result, the total primary energy supply increased from 79,428 thousand TEP to 147,168 thousand TEP. (MMO, 2022).

Considering the ratio of total energy production to cover the total energy supply, it is seen that it has decreased from 33% to 29.8% in the last 20 years. The rate of foreign dependence on energy, which was 67% in 2000, increased to 76% in 2015. With the increase in the tendency to use renewable energy sources after 2015, national production increased, and thus, the dependence rate on energy decreased to 70% in 2020. (Ministry of Energy and Natural Resources , 2022), (MMO, 2022)

2.1. Main Indicators of NUTS 1 Regions in Türkiye

The classification of regional statistical units emerges as a criterion Türkiye must fulfill in the European Union membership process. The application aims to determine the regional policy framework, the socioeconomic analysis of the regions, and the production of regional statistical data comparable at the European Level (Council of Ministers, 2002). While creating the three-stage regional system, 81 provinces were defined as Level 3, and "Neighboring provinces that are similar in economic, social and geographical terms, taking into account their regional development plans and population sizes" were determined as Level 2 (26 units) and Level 1 (12 units). (Sadıoğlu, Dede, & Goçoğlu, 2020)

Within the scope of this study, first, the population of the regions and the per capita GDP values at Level 1, and then the energy consumption data of the installed power capacities were evaluated.

As seen in the literature review, the bilateral or unilateral causality relationship between countries' development levels, economic development status (which many studies have considered as GDP of countries), and energy production/consumption values has been revealed by many studies. For this reason, in this study, population size, population density, area size, and GDP per capita values, which are the main indicators for each of the NUTS 1 regions, were examined. Then, the energy data were taken into consideration, and an evaluation was made for the regions. Thus, the current situation of the regions for 2020 is presented.

In the map in Figure 3.4, the population density of 12 regions at Level 1 in Türkiye is marked with colors. TR1 Istanbul region has been the most densely populated area with 2,894 persons/km². TR1 region is followed by TR4 Region with 167 persons/km². In third place is TR3, which included İzmir and its surroundings with 118 persons/km². The population density decreases eastward in the country. 44% of the total population, almost half, live in the TR1, TR3, and TR6 regions, but these three regions only cover 21% of the country in the area.

When the GDP per capita in the regions is examined, it is seen that only TR1, TR3, and TR5 out of 12 regions have 67% of the total GDP (Table 3.1). In terms of area size, these regions have only 23% of the country. The area sizes, populations, population densities, GDP, and GDP per capita values of the regions are shown in Table 2.1.

Table 2. 1. NUTS 1 Regions Main Indicators (Source: TUIK, 2020)

	SURFACE (km²)	POPULATION 2020	POPULATION INTENSITY (Per/km²)	GDP 2020 (TL)	GDP PER CAPITA (TL)	GDP PER CAPITA ($)
TR1	5.343	15.462.452	2.894	1.517.323.616	₺97.950	$13.914
TR2	41.280	3.632.398	88	237.727.696	₺65.722	$9.336
TR3	90.456	10.689.115	118	631.233.668	₺59.250	$8.416
TR4	49.404	8.235.816	167	587.116.362	₺71.771	$10.195
TR5	73.126	8.168.261	112	607.034.808	₺74.515	$10.585
TR6	89.983	10.759.218	121	486.606.355	₺45.505	$6.464
TR7	91.709	4.088.228	45	186.752.399	₺45.750	$6.499
TR8	73.946	4.638.622	63	192.219.982	₺41.316	$5.869

TR9	37.551	2.677.584	71	111.030.662	₺41.369	$5.876
TRA	71.035	2.192.453	31	78.440.604	₺35.716	$5.073
TRB	78.458	3.951.294	50	125.260.838	₺31.785	$4.515
TRC	75.938	9.118.921	120	286.136.317	₺31.627	$4.493

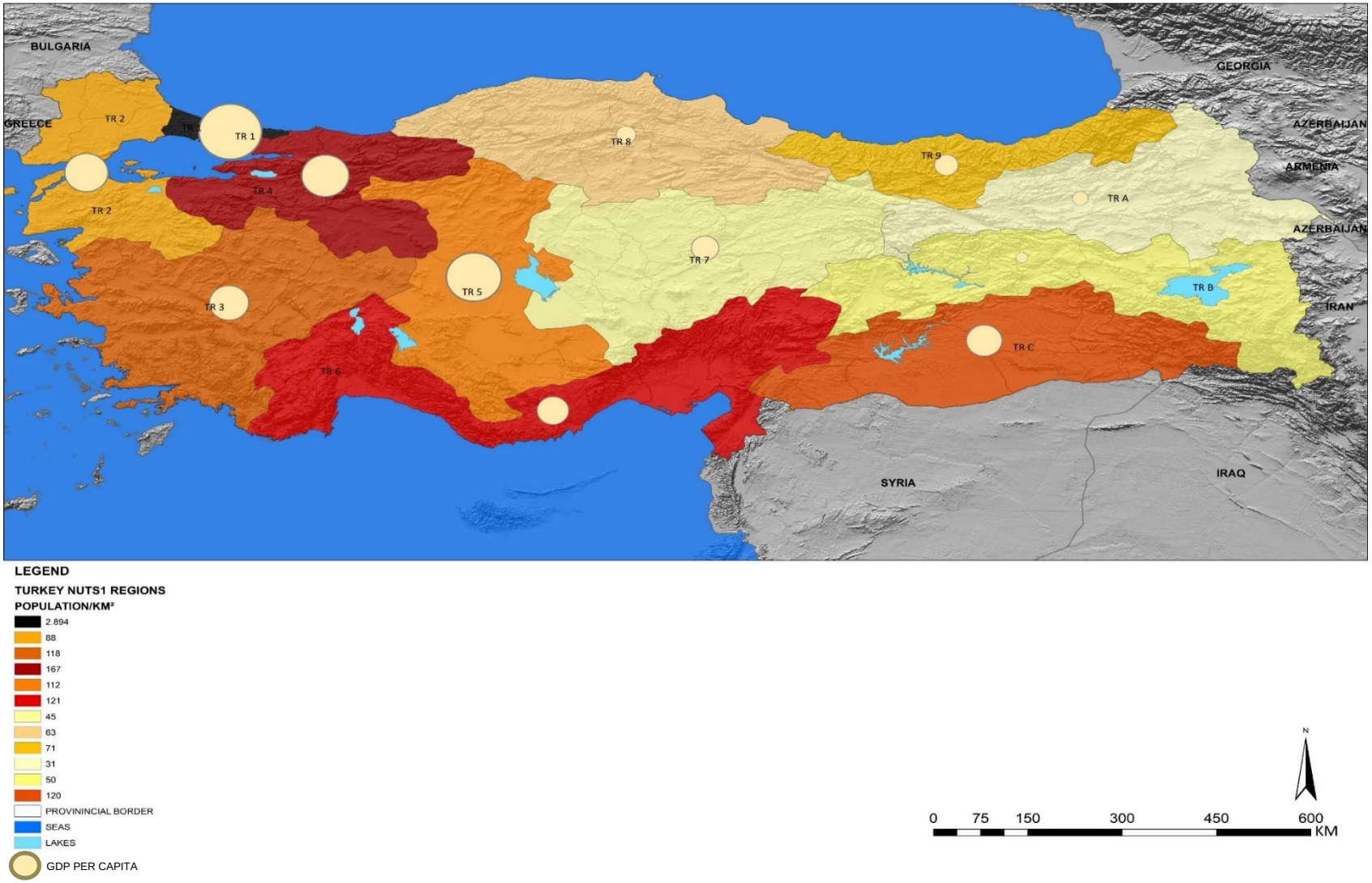

Figure 2. 4. Distribution of Türkiye's Population and GDP Values by NUTS1 Regions (It is prepared by using TUIK Data).

2.2. Türkiye NUTS 1 Regions Installed Capacity and Energy Generation/Consumption Values

Energy has taken place in the economy with ecological economics approach both as a concept and a production factor. The cycle between labour and capital, expressed as a neoclassical activity flow until the ecological economics approach, has been seen as a subsystem of the global ecosystem in ecological economics. In ecological economics, solar power is the only energy source in the global ecosystem (Usta, 2016).

Energy, an input in production and a cost element in consumption, has become an economic value. Therefore, energy is an essential factor in the level of development and development of countries. For this reason, in the context of regional development, the energy consumption amounts of the regions and installed capacities are examined at the NUTS1 level.

When looking at the order of usage areas of energy consumption from Türkiye national energy balance tables, it is seen that the order is in the form of industry, transportation, residential, services sector, commercial and agricultural. The fact that the industrial sector is in the first place can mean that the most energy use is in the industrial field and that as production increases, energy consumption also increases. The increase in production brings with it economic growth. (Ministry of Energy and Natural Resources, 2022).

A comparison was made by examining the energy consumption and installed power data at the NUTS 1 level. On the map in Figure 3.5, the colours represent the energy consumption of the regions. The enormous energy consumption amount belongs to TR1 Istanbul, with a share of 16.13%. Istanbul is Türkiye's commercial, tourism, investment, and financial centre, and approximately 20% of Türkiye's population lives here. The fact that Istanbul ranks first in energy consumption is an expected situation under these conditions. The TR6 region ranks second in energy consumption and in third place is the TR3 region. The energy consumed in TR1, TR6, and TR3 regions correspond to 45.62% of all consumption. Half of the energy consumption takes place in the area covering 23% of the country's surface area. If we look at Istanbul specifically, 16% of energy consumption is realized in 0.7% of the country's territory. Detailed energy consumption, installed capacity, and energy production/consumption rates of the regions are given in Table 2.2.

Table 2. 2. NUTS 1 Regions Fundamental Energy Datas (Source: TUIK, 2020)

NUTS 1 Regions	Energy Consumption	Installed Capacity	Generation/Consumption Rate
TR 1	16,13%	3,44%	22,00%
TR 2	7,05%	11,25%	251,58%
TR 3	14,69%	16,65%	329%
TR 4	14,51%	9,80%	70,47%
TR 5	9,14%	5,43%	49,59%
TR 6	14,80%	16,80%	103,26%
TR 7	4,29%	5,10%	128,35%
TR 8	4,28%	9,24%	229,99%
TR 9	2,07%	4,96%	126,23%

TR A	1,12%	1,93%	87,65%
TR B	2,28%	5,18%	137%
TR C	9,64%	10,19%	64,72%

The installed capacity is demonstrated with the point representation on the map. Installed power is the maximum capacity a power plant can supply, an installation system can handle, and an electrical network can carry. Installed capacity, also known as connection power, is vital in ensuring electricity continuity (Maabir, 2022).

TR6 is the region with the highest installed capacity in Türkiye. 16.8% of the total installed power in the country is in this region. In second place is TR3, with a rate of 16.65%, and in third place is the TR2 region, with an installed power rate of 11.25%. TR2, TR3, and TR6 regions have 44.7% of the total installed capacity. In table 3.2, it is seen that there is a production and consumption balance in the TR6 region. In TR2, TR3, and TR8 regions, it is noteworthy that the production is much higher than the energy consumed (Table 2.2). Although Istanbul is the highest region in terms of energy consumed, the amount of energy produced in the region is only 22% of its consumption.

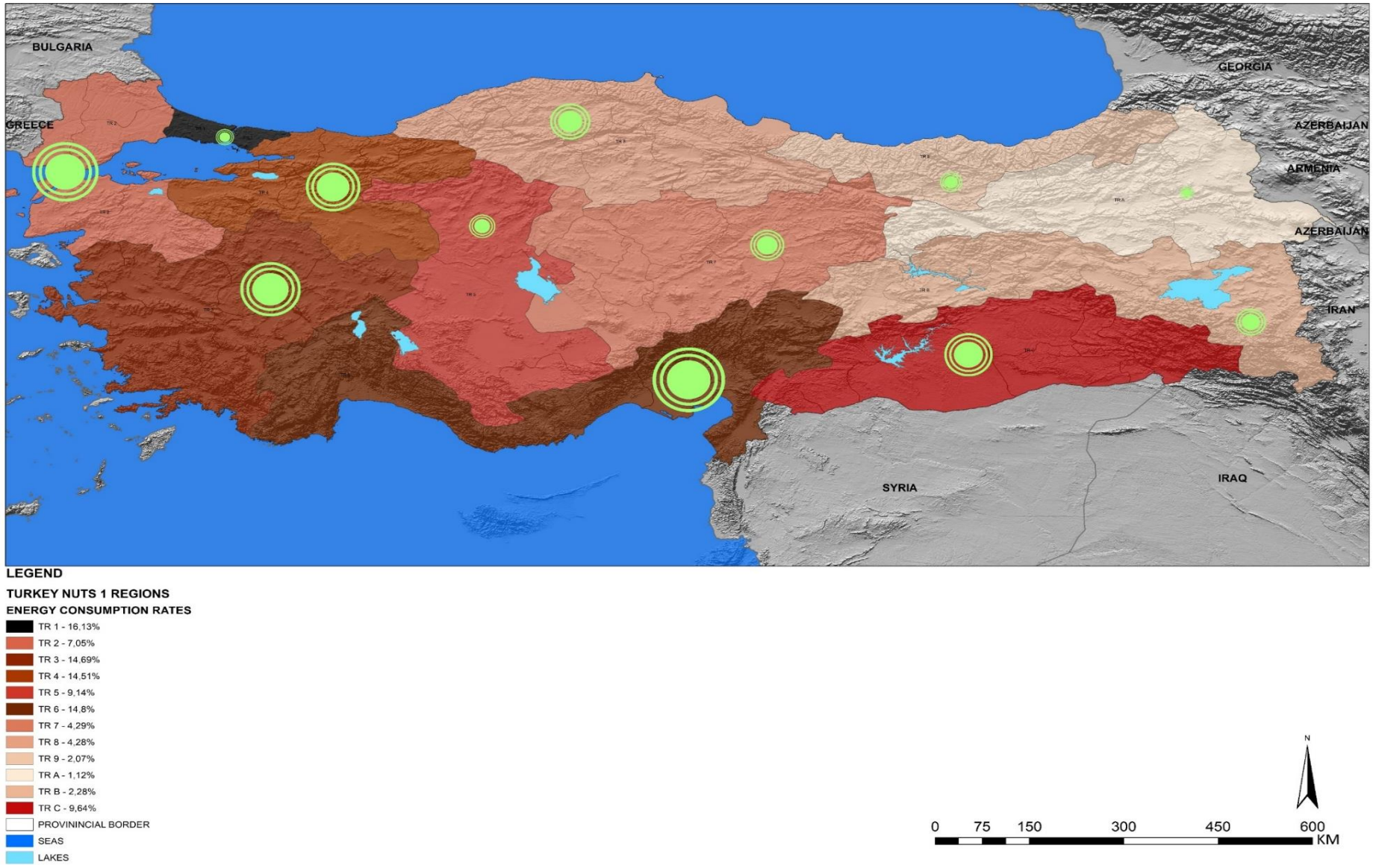

Figure 2 5. Türkiye NUTS1 Regions Energy Consumption and Installed Capacity Map (Source: TUIK 2020)

2.3. Installed Capacities of Regions in terms of Energy Sources

Considering which energy types are found more in which areas of the installed power; wind power plants on the Aegean coast and the east of the Mediterranean, hydroelectric power plants in the Euphrates-Tigris basin and Çoruh basin, domestic coal plants in regions with coal mines, imported coal plants in coastal cities, natural gas plants in regions with high electricity consumption; additionally, it is observed that solar power plants, which have just started to be established in our country, are concentrated in the southern half of Türkiye.

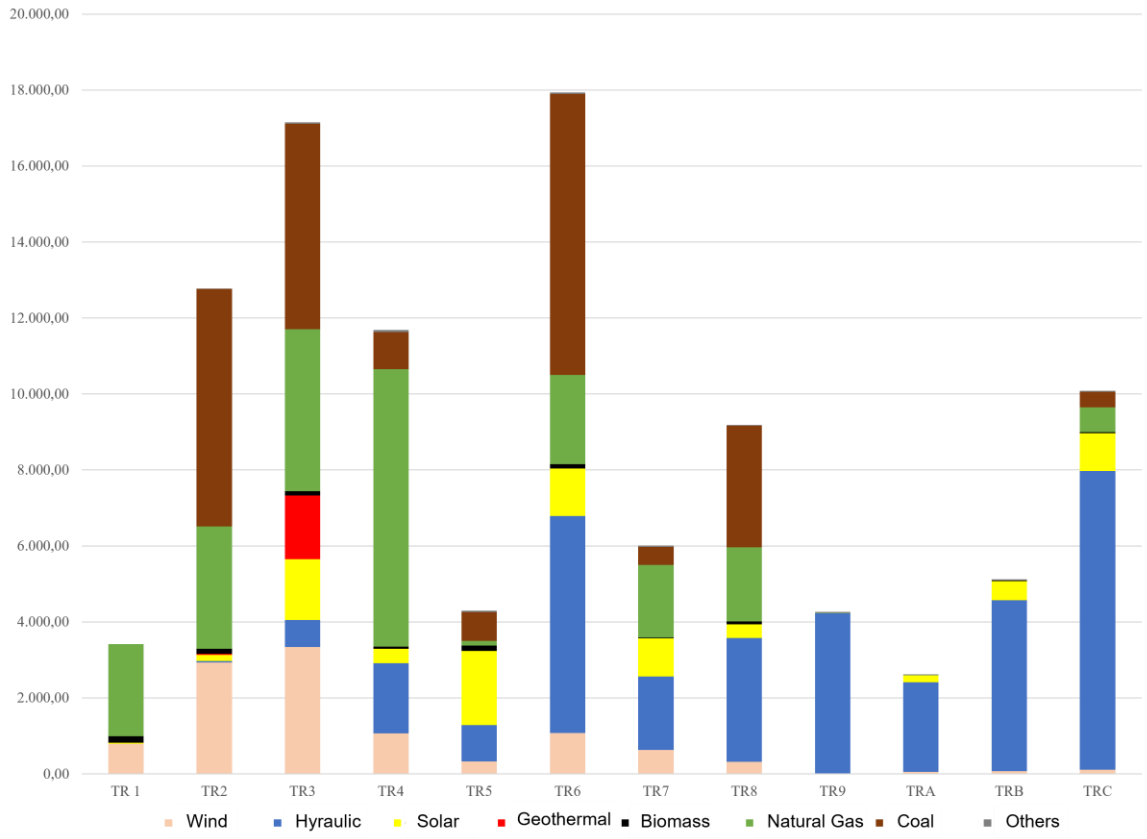

Figure 2. 6. Türkiye NUTS 1 Regions Installed Capacity Distribution in terms of Energy Resources (Source: www.enerjiatlasi.com/sehir/)

Considering the installed power in NUTS 1 regions according to sources, Figure 3.6 shows which type of installed power is concentrated in which region.

- As evaluated in terms of renewable energy, 54.08% of the total installed hydraulic power is in the TRC, TR6, and TRB regions, and the TRC region has the largest share, with 23.52%.
- 58.51% of the wind energy installed capacity is located only in the TR2 and TR 3 regions, and the TR3 region has the largest share, with 31.3%.
- TR5 region has the most significant share in solar energy installed power, with 23.17%. The TR3 region follows the TR5 region with 19.02% and the TR6 region with 14.91%.
- 98.2% of the geothermal energy installed capacity is in the TR3 region; Except for the TR2 and TR3 regions, it is seen that there is no geothermal energy installed capacity in other

regions.

- It is seen that the installed capacity of biomass is mainly in the regions where big cities such as TR1, TR5, and TR2 are located.
- In terms of fossil fuels, the TR4 region has the largest share in the natural gas installed power with 30.18%; 61.08% of the total natural gas installed power is in the TR2, TR3, and TR4 regions, but the natural gas installed power is not found in the TR9 and TRB regions.
- In terms of coal, the installed power is concentrated in TR2 (32%), TR6 (38.03%), and TR8 (16.48) regions since domestic coal power plants are in regions with coal mines and imported coal power plants are in coastal cities, TR1, TR3, TR9, there is no installed power in TRA and TRB regions.
- In general, TR3 and TR6 regions have the largest share in installed power and diversity regarding resource types. In terms of production/consumption balance, the TR6 region is balanced, and the production in the TR3 region is three times more than consumption. On the other hand, the TR1 region, where the consumption is most intense, remains very low in installed power share and production.

The map in Figure 3.7 shows the regions in Türkiye at NUTS 1 level and what percentage of each energy type is produced in these regions. According to the Ministry of Energy and Natural Resources data, as of 2021, 55.56% of the installed power in Türkiye consists of renewable energy sources and 44.44% of fossil fuels. Shares of energy resources are 33.71% hydraulic, 10.72% wind, 8.5% solar, 1.73% geothermal, 0.9% biomass, 24% natural gas, % 19.62 percent is coal, and 0.82% other liquid fuels.

Considering the shares of installed power capacities in the regions, respectively,

- In TR1, 10.01% of natural gas, 7.40% of wind, 0.28 of solar energy, 19.80% of biomass,
- In TR2, 32% of coal, 27.51% of wind, 15.16% of biomass, 13.32% of natural gas, 1.84% of solar, 1.8% of geothermal, and 1.67% of other liquid fuels,
- In the TR3, 98.2% of geothermal, 31.3% of wind, 19.02% of solar, 17.58% of natural gas, 13.27% of biomass, 11.50% of other liquid fuels, and 2.15% of hydraulics,
- In the TR4, 30.18% of natural gas, 17.5% of other liquid fuels, 9.9% of wind, 6.18% of biomass, 5.5% of hydraulics, 4.99% of coal, 4.56% of sun,
- In the TR5, 23.17% of solar, 15.86% of biomass, 12.5% of other liquid fuels, 3.9% of coal, 3% of wind, 2.86% of hydraulics, 0.5% of natural gas,
- In the TR6, 38.03% of coal, 17.09% of hydraulics, 14.91% of solar, 12.21%, 11.83% of other liquid fuels, biomass, 10.50% of wind, 9.74% of natural gas,
- In the TR7, 14.18% of other liquid fuels, sun; 11.89%, 7.89% of natural gas, 5.9% of wind; 5.79% of hydraulics; 2.43% of coal; 2.4% of biomass,
- In the TR8, 16.48% of coal, 9.76% of hydraulics, 8.44% of biomass, 8.04% of natural gas, 7.2% of other liquid fuels, 4.28% of solar, and 2.81% of wind,
- In the TR9, 12.64% of hydraulics,
- In the TRA, 7.07% of hydraulics, 6.81% of other liquid fuels, 2.13% of solar,

- In the TRB, 13.47% of hydraulics, 7.01% of other liquid fuels, 5.96% of the sun, 2.37% of the biomass,
- In the TRC region, 23.52% of hydraulics, 11.8% of solar, 9.8% of other liquid fuels, 3.36% of biomass, 2.7% of natural gas, 2.08% of coal, and wind have 1% installed power capacity.
- In terms of resources, the NUTS1-level regions in the first three ranks, respectively, in installed power capacity are as follows:
- In hydraulic energy, TRC, TR6, and TRB (54.08% of total hydraulic installed capacity);
- In wind energy, TR3, TR2, TR6 (69.31% of total wind installed capacity);
- In solar energy; TR5, TR3, TR6 (57.1% of total solar installed power);
- In geothermal energy, TR3, TR2 (100% of total geothermal installed power);
- In biomass energy, TR1, TR5, TR2 (50.82% of total biomass installed capacity);
- In natural gas, TR4, TR3, and TR2 (61.08% of total natural gas installed capacity)
- In coal, TR6, TR2, and TR8 (86.51% of total coal installed power).

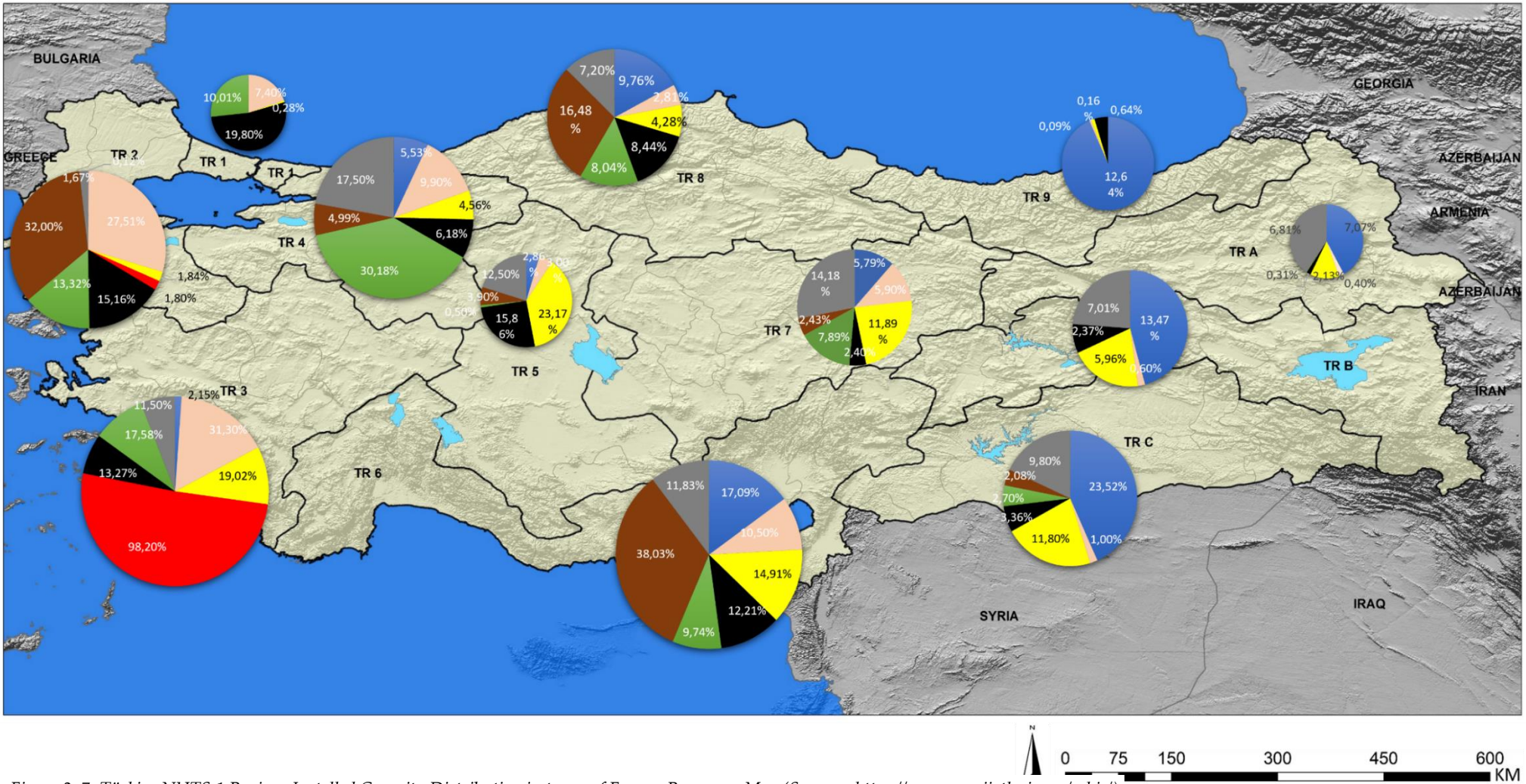

Figure 2. 7. Türkiye NUTS 1 Regions Installed Capacity Distribution in terms of Energy Resources Map (Sourcre: https://www.enerjiatlasi.com/sehir/)

CONCLUSION

Türkiye is a developing country and is directly or indirectly affected by the economic fluctuations in the world. However, it is emerged because of the literature and secondary data analysis that it has been searching for resources to provide energy supply since its establishment in 1923 and has been in the development targets for this need.

In this study, in which the change of primary energy supply in terms of quantity and type over the years and the energy policies developed from 1923 to the present are discussed in the context of development plans, it is seen that urbanization, industrialization, and development goals and energy are in a direct relationship.

It was stated that during the Early Republican Period, coal, lignite, and non-commercial energy sources were used intensively from conventional energy sources. Since the 1950s, with the increase in urbanization and industrialization, petroleum reserves were explored, and then oil imports were made. With the start of economic growth and development, there has been a period in which the energy demand has increased intensively, and the country's resources are insufficient to meet this demand. While conventional resources such as coal and oil were used until the 1980s, natural gas imports started after 1980, and thus the tendency towards oil and coal decreased a bit.

HEPPs have used intensively until 2010. Still, since 1985, targets have been set in the development plans to carry out R&D studies to increase the use of alternative, clean energy sources. After 2010 wind energy, after 2015 solar energy is included in the primary energy supply.

After 1963, first development plans developed guidelines for local resource use and self-sufficiency. However, the urban and industrial developments, with the expansion and globalization after 1980 and the understanding that the existing national resources were insufficient, increased the share of energy in imports day by day. After the significant increase in the percentage of energy in imports, it is seen that the use of alternative resources and the use of local resources gained importance in the development plan. In contrast, energy imports continued to increase in the next period. It has been observed that during periods of economic development, the need for energy increases, and the demand cannot be met locally, so the increase in imports puts a financial burden on the economy. Therefore, when the development plans are examined in the context of energy policies, it can be stated that the plans do not complement each other, the determined targets cannot be fully achieved, and there need to be consistent and sufficient policies.

When all these data and energy policies are analysed from a spatial perspective, it is understood that each region has different potentials. In terms of renewable energy sources, it can be said that solar energy in the south of the country, wind energy in the west, hydroelectric power in the east and north, and biomass installed capacity in metropolitan cities with high populations. There are thermal power plants in cities such as Zonguldak and Kahramanmaraş, where mines are located, and natural gas and oil fields are in transportation centers in terms of imports. A careful study should be made on the national energy potential, and these potentials should be used effectively. The most energy consumption is realized in the regions with population density and industrial

production. Still, the energy production-consumption balance cannot be achieved in large part of these regions. Due to the weakness in local energy production, energy imports are increasing, and the increase in imports affects national development negatively.

Current data: while arousing curiosity about Türkiye's energy potential, "Is it possible to provide spatial production/consumption balance and to produce an integrated, balanced spatial energy plan?" It also brings the question to mind.

The importance of energy policies in national development has been emphasized in many different studies for many countries. The importance of renewable energy due to sustainable development and global climate change is also known, and it is kept on the agenda by international organizations through agreements. Energy policies are vital to support sustainable development in a country like Türkiye, which has strong potential, especially in terms of renewable energy sources, and has only recently started to use this potential action for the last ten years.

Integrated spatial energy plans for the most efficient development of energy policies are a topic developed in Europe in recent years. The potentials of the regions are evaluated most effectively by carrying out feasibility studies. Not only the generation of energy but also its efficiency and storage are other prominent topics in these plans. Furthermore, considering renewable energy as a new sector, "Do renewable energy policies solve the inequality problem between regions, which is another problem in Türkiye?" answering the questions is critical for spatial energy planning and development.

While the place of energy in our lives is increasing day by day, the issue of energy policies and spatial planning should also be on Türkiye's agenda. Not only economic experts, but also city and regional planners should pay attention to this issue. Integrated spatial plans should begin to be prepared nationally and regionally. For Türkiye, which is in a relatively strong position in terms of renewable energy potential, it is necessary to focus on the regional renewable energy plan studies aiming at balanced development, together with future energy projections.

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