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Renewable and sustainable energy policies in Turkey after the Paris Agreement: economic and environmental analysis

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Abstract
The Paris Agreement established the international climate policy objectives to hold the increase in the global average temperature to well below 2°C and above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels. It achieve a balance between anthropogenic emission by sources and removals by sinks of greenhouse gases in the second half of this century. Turkey is an energy importing country with more than half of the energy requirement supplied by imports. Turkey should change its energy policy simply optimize energy consumption by supporting energy efficiency, give up on supporting environmentally hazardous energy generation such as nuclear, coal, or shale gas, and aim for 100% renewable energy. This will help relieve the economy by reducing energy importation, protect the environment by reducing carbon emissions, and provide energy independence is a national security matter. Turkey's total gross renewable energy potential is about 650 billion kWh annually while the economical potential was about 340 billion kWh/yr. Residential and commercial buildings consume a considerable amount of the energy produced in Turkey. A reduction to 25% to 50% of energy consumption is possible with only proper insulation of these buildings. In this context, buildings are efficiently designed and configured will provide energy savings. Energy efficiency in buildings in Turkey has gained prominence recently.

Keywords: renewable energy, energy efficient buildings, climate change mitigation, Turkey.

1. Introduction

The Paris Agreement requires all countries to make significant commitments to address climate change. Countries responsible for 97% of global emissions have already pledged their Nationally Determined Contributions (NDCs) for how they will address climate change. Countries revisit their current pledges by 2020 and, ideally, strengthen their emissions reduction targets for 2030 [1]. The Paris Agreement includes a stronger transparency and accountability system for all countries requiring reporting on greenhouse gas inventories and projections that are subject to a technical expert review and a multilateral examination. Countries will continue to provide climate finance to help the most vulnerable adapt to climate change and build low-carbon economies. While the Paris Agreement does not "solve" climate change, it allows us to start the next wave of global climate actions, creating a virtuous cycle for more aggressive action in the decades to come [1-3].

On the other hand, the energy world faces unprecedented uncertainty and the global economic crisis between 2010-2019 threw energy markets around the world. But it will be governments, and how they respond to the twin challenges of climate change and energy security, that will shape the future of energy in the longer term. The world primary energy demand 14 556 million tonnes of oil equivalent (Mtoe) in 2019 shown in Table 1 [1]. This compares with 2% per year over the previous 28-year period.

The majority of people without access to electricity live in rural areas and informal urban settlements in developing and emerging countries [8]. In many countries the existing grid is not adequate to meet the demand and requires technical upgrades and rapid expansion. Especially poor households and small business owners who are highly dependent on reliable and cost-effective electricity access are affected by fluctuating electricity supply and frequent blackouts [6, 7, 8].

The 'Renewables 2019 Global Status Report' [6] estimates that there is an important potential for renewable power generation (Table 2). For more than three decades, different types of decentralized

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electricity from renewable sources have been implemented by governments, development agencies, and private-sector initiatives. Besides a few success stories and best practice examples, there have also been many failures in introducing these technologies under difficult context conditions [4]. This article will analyze Turkey's renewable and sustainable energy policies after the Paris Agreement for economic and environmental analysis. The article discusses the following topics: Turkey's energy situation, renewable energy sources, green buildings, environmental impact due to energy consumption, the climate change mitigation and energy security [1-6].

2. Energy situation in Turkey

Turkey is developing an integrated energy policy aimed at securing a reliable supply of energy, as well as achieving a low-carbon and environmentally sustainable future [11, 12]. Turkey also intends to promote employment and economic growth through its energy development [13]. With a population reaching 86 million, Turkey's energy consumption based on primary energy resources is continuing to increase and this is compounded by the rapidly growing economy [14]. Turkey's increasing energy demand is mostly met by fossil fuels, of which a large portion is imported. The total installed capacity of power is 90,516 MW and the breakdown by resource is 52% fossil fuels, 34% hydro, 8.2% wind and 5.8% other renewables [20]. Turkey pays millions of dollars for its energy imports every year. Energy security and a sustainable energy supply are among the main policy concerns of Turkey. Significant importance is placed on [15-33]:

- Encouraging energy production from renewable sources in a secure, economic and cost effective manner,
- Expanding utilization of promising renewable resources,
- Increasing diversification of energy resources,
- Taking significant steps to increase energy efficiency,
- Reducing greenhouse gas emissions,
- Making use of waste products and protecting the environment, and
- Developing related mechanical and/or electro-mechanical manufacturing sector.

As a developing country an in conjunction with its fast growing economy and population Turkey's energy consumption has increased rapidly. For example, while total primary energy consumption in 2009 was 106 Mtoe in 2013 it raised 120 Mtoe and total energy production in 2009 was 28 and 31 Mtoe in 2013. Turkey is an energy importing country and dependent on the imported energy sources (Table 3) [17, 18]. Although it has a wide variety of energy sources, the quality and quantity of most of the sources are not sufficient to produce energy. Energy sources in Turkey are coal/lignite, oil, natural gas, hydropower, geothermal, wood, animal and plant wastes, solar and wind energy [15-17]. The proven reserves of lignite, the most abundant domestic energy source, is 7300 million ton and found in almost all of the country's regions. Lignite has the largest percentage in total energy production with its 43% share. After lignite, wood has the greatest share in total energy production with its 20% and oil accounts for 13%, 12.4% hydro and the final 15% includes animal wastes, solar, hard coal, natural gas, geothermal electricity and geothermal heat [14-18].

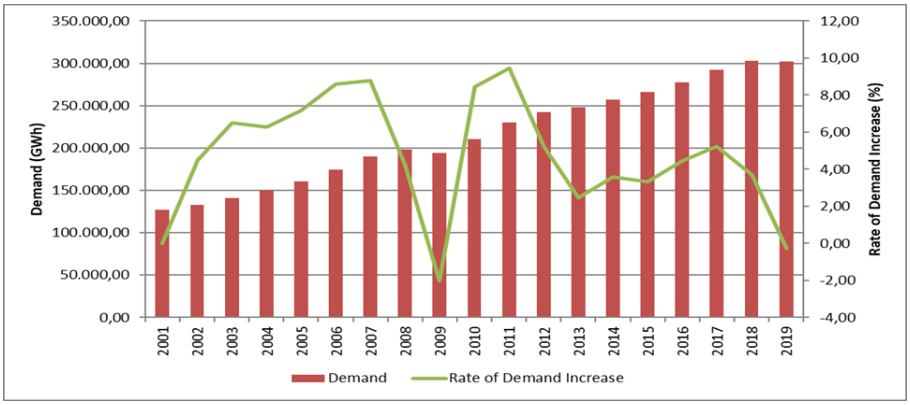

Figure 1. Turkey's electric energy demand and rate of increase (GWh-%).

3. The role of renewable energy for energy security in Turkey

3.1 Introduction

Turkey has become one of the fastest growing energy markets among the OECD countries in the world, in parallel to its economic growth registered over the last ten years. Turkey's energy policies and strategies are based on energy supply security, alternative energy resources, diversity of energy resources, utilization of domestic energy resources to create additional value to economy, liberalization of energy markets, and energy efficiency [10]. Due to this perspective, special emphasis has been made to maximum utilization of local and renewable energy resources as highest priority [14-20] (see Figs. 1-9).

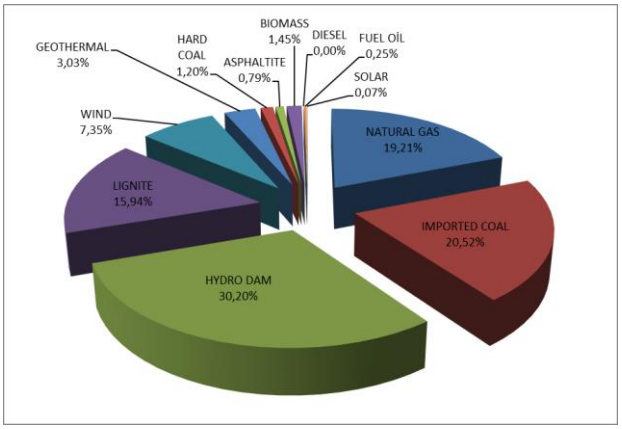

Figure 2. Turkey's distribution of electricity generation by sources in 2019 (%).

The rapid pace of urbanization, the positive demographic trends, the economic expansion and rising per capita income are the main drivers of the energy demand. It is estimated that the energy demand to increase around 4-6% per year until 2030 [16, 18]. The Turkish government has made it a priority to increase the share of renewable sources in the country's total installed power to 30% by 2030 [19]. Renewable energy has been one of the important topics on Turkey's energy agenda. The Turkish government has made the last decade significant energy reforms. The significant progress that has been made in the field of renewable energy started after the enactment of the Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electrical Energy (Renewable Energy Law, REL) in 2005 [9, 14]. After 2005, the Turkish government kept producing, updating and implementing several laws and regulations. Due to this, Turkey's energy sector turned it into one of the most attractive investment destinations in the world [9, 10, 14, 16, 18, 19, 21].

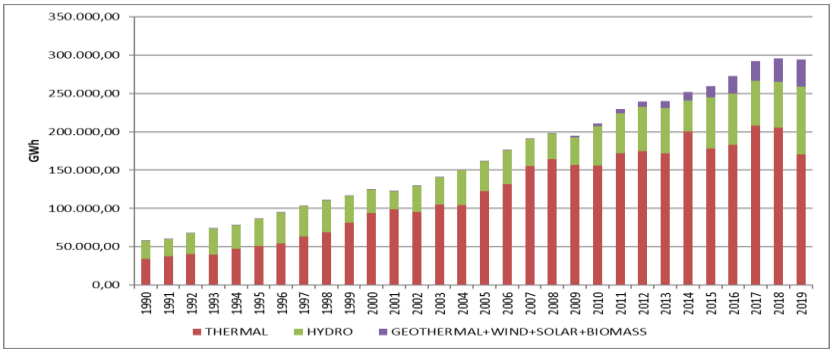

Figure 3. Source-based development of licensed electricity generation (GWh).

According to the Ministry of Energy and Natural Recourses (MENR), the total amount of investments required to meet the energy demand in Turkey by 2030 is estimated to be around USD 120 billion, more than double the total amount invested in the last decade. Turkey's ambitious vision for 2030, envisages especially interesting targets for the renewable part of the energy sector. These targets include [10, 14, 16, 18, 19, 21]:

- 34,000 MW capacity of hydro power plants;
- 20,000 MW capacity of wind power plants;
- Minimum 5000 MW of solar power plants;

- Minimum 1000 MWe geothermal energy; and
- 1000 MWe installed capacity for Biomass energy.

According to MENR studies and various resources Turkey has following minimum technical renewable energy potentials [15-26];

- 160,000 GWh/year economic hydraulic capacity
- 48,000 MW wind energy capacity
- 1,500 kWh/m2-year average global solar radiation
- 31,500 MWt geothermal capacity
- 8.6 Mtoe biomass potential
- 1.5-2 Mtoe biogas potential

3.1. Hydropower

Turkey's theoretical hydroelectric potential is 1% of that of the World and 16% of Europe. The gross theoretical viable hydroelectric potential in Turkey is 433 billion kWh and the technically viable potential is 216 billion kWh [22]. The economically viable potential, however, is 140 billion kWh. Annual energy consumption per capita in Turkey has reached 2.900 kWh which is above world average of 2.500 kWh [18]. As of the end of 2014, 43% of the potential was in operation, and 29% was in the process of being built. Turkey continues to take steps towards developing the investment environment based on competition within the electricity generation sector, which has been opened up to the private sector, 600 licenses had been obtained in 2014 with a total capacity of 13,215 MW for built hydropower plant [20].

As of the end of 2014, there were 476 HES plants, with a total installed capacity of 23, 112 MW. This is the equivalent of 34,8% of the total potential. In 2014, 24,8% of our electricity output came from hydraulics. The base line feed-in tariff for hydroelectricity generation is 7.3 USD cent/kWh. If the equipment is locally manufactured, the facilities can benefit from bonuses provided for locally manufactured equipment [18]. The maximum feed in tariff price hydroelectricity generation facilities is 9.6 USD cent/kWh. Baseline feed-in tariff is 7.3 USD cent/ kWh. Bonus for locally manufactured component is an extra 2.3 USD cent/ kWh. Namely; bonus for Turbine is 1.3 USD cent/ kWh; bonus for Generator/ Power Electronics is 1 USD cent/ kWh [8-16].

Approximately 50% of the additional potential of 41 TWh realized as small hydroelectric plants (SHP), with installed capacities of less than 10 MW [22]. The share of SHP potential in the total, which is 3% at present, would be 14%. On the other hand, in accordance with the results obtained from the pre-evaluation study, about 15% of the increase in 126 TWh annually exploitable energy potential might be achieved by developing additional SHP potential [23, 24]. However, this study gives only rough results about the additional SHP potential of the country and the potential must be evaluated more precisely, with comprehensive master plan studies for each hydrological basin [9, 15, 16, 17, 18, 20, 21].

3.2. Bioenergy

In rural Turkey, biomass potential includes wood, animal, and plant wastes [24]. Among the biomass energy sources, fuelwood seems to be the most interesting because its share of the total energy production of Turkey is high at 12%. The total biomass energy potential of Turkey is about 36 Mtoe [25]. The amount of economic biomass potential is app. 16 Mtoe [26]. The electrical production from biomass has a net impact of 6.4 billion USD in personal and corporate income and represents more than 350,000 jobs [9, 10, 16, 26-33]. There is a total 4.0 million ha of degraded coppice forests for energy forestry applications in Turkey. The improvement of degraded coppice forests is a very important activity, as important as forestation. Converting coppice forests into productive energy forests in order to meet the continually-increasing fuel requirements in Turkey prevents the destruction of highly productive forests, therefore supplying more wood raw material for the forest industry, which at present operates with a low capacity. In 2018, 723.17 ha of energy forest been established [4-16].

Figure 4. Biomass energy potential map of Turkey.

In Turkey, total amount of waste from forests is 4,800,000 tons (600 MW); from agriculture 15,000,000 tons. In Turkey, 34 biodiesel facilities received processing license for biodiesel production. Total biodiesel production capacity of all these facilities is 561,217 tons. The biodiesel production is 21,876 tons in 2013. Estimation at least 1.2 million ton/year biodiesel and 0.7 million ton/year bioethanol production capacity based on 2.7 million hectare agricultural land. Turkey has also 1.5 - 2 Mtoe biogas potential. Almost 180 million m3/year biogas produced by 20 running biogas plants. Recently landfill gas extraction gained importance (total capacity 164 million m^3/year).

3.3. Geothermal energy

Turkey forecasts 6% to 8% yearly growth in energy demand until 2020 and anticipates adding 50,000 MW to the grid. Considered to be one of the ‘‘hottest’’ markets in Europe for geothermal, Turkey is the seventh most promising country in the world in terms of geothermal energy potential. Within Europe, Italy is the market leader with over 50% of the European capacity. Turkey and Iceland are currently centers of geothermal exploration and development in Europe and Germany is considered a new, but an important factor in the market [8-12].

Turkey has drilled around 1200 geothermal wells for geothermal electricity production and direct use applications in these geothermal sites since 1960. About one-third of these well-bores have been drilled since 2009. As of 2019, 159 new geothermal projects completed. With the new additions, there are more than 290 geothermal sites discovered in Turkey and approximately 95% of them are low-to-medium enthalpy sites mostly proper for direct use applications. Even though geothermal energy potential of Turkey was theoretically estimated as 31,500 MWt and recently increased to 60,000 MWt, the proved potential by drilling activities (4209 MWt) and natural discharges (600 MWt) is only 4809 MWt. As of today, 58% of the proved capacity (2705 MWt) is used for geothermal heating, consisting of residence heating (805 MWt), greenhouse heating (612 MWt), thermal facilities heating (380MWt), balneological use (870MWt) and heat pump implementations (38MWt).

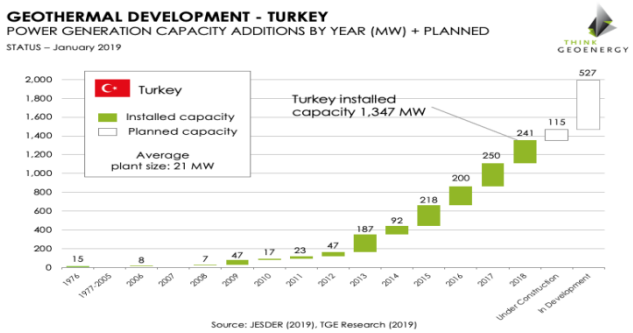

Figure 5. Geothermal development in Turkey.

The most significant change in the activities took place in the exploration of geothermal resources for electricity production. Present installed capacity is 1402.2 MWe and it isexpected to become above 1897 MWe by the end of 2023. Expanding new research activities of geothermal development

especially in the last three years resulted in a geothermal flourish in Turkey. The addition of new sites and updating the data of existing ones raised the presently determined capacity notably. With the new discoveries of 23 geothermal sites, geothermal power potential increased by 1.6 times.

3.4. Solar energy

While energy need of Turkey in 2012 was 240 billion kWh, which has produced by using of 46 700 MW power plants (coal, natural gas, fuel and hydro), the estimation for 2023 is around 350 billion kWh which is equal to 90.000 MW Power Plant. If it is considered 72% of energy demand of Turkey is provided from fossil row material and Turkey has 67% dependency to import feedstock. Because of this import row material, Turkey has paid 33 B$ at 2007. Turkey needs head towards renewable energy investments. Turkey is so lucky about solar energy potentials that it has 4.2 hours insulation time avarage per day and 1514 kWh/year.m2 solar radiation level. Only available rooftop area for PV modules is 611 km2 and energy gain from this area will be 90 BkWh/year. Apart from this area it is determined that the area which has more than 1650 kWh/m2 irradiation level is about 4600 m2 in Turkey. That means this solar energy potential equals to a natural gas plant with a power of 54,300 MW [32].

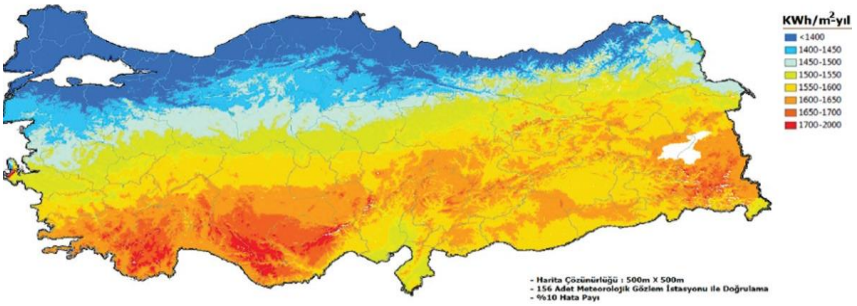

Figure 6. Solar energy potential map of Turkey.

Except some special applications PV installation is almost non existing in Turkey. However, solar energy is widely used for heating water [6]. The hot water heating system installations cover about 10 Million m2 surface. Turkey is the second big country at hot water heating systems all over the world. Apart from this, PV installations are not so much up to now because of the govermental issues [18]. While the existing feed in tariff is about 5.5 €cent/kWh, it is foreseen that it will be about 25 €cent/kWh for PV and 20 €cent/kWh for CSP in January of 2009.Moreover, there will be no licence need for systems up to 500 kW. There are some goals about PV installations in Turkey due to these regulations. It is expected that there will be 3 million installations of private homes which has totally power of 3.000 MW. In addition, the target of installed PV power plant by 2020 is 20.000 MW [32, 33].

The photovoltaic sector in Turkey is still small, providing work for only a small number of employees. The main actors consist of several companies and a number of research institutes. There are about 60 solar PV companies are operating in Turkey's PV sector. The main business types are importer, wholesale supplier, system integrator and retail sales. The companies serve in the installation, engineering and project development sectors. PV modules, battery charge controllers and inverters are mainly imported. Batteries, solar lighting systems supplied by the domestic market. Some of the domestic products exported. There is not any cell production factory in Turkey [32].

The energy policy objectives of Turkey essentially require diversifying the energy sources, to use domestic energy resources, to increase efficiency in electricity generation and consumption and to create an environment-friendly power system. It is clear that all of these objectives include increasing the share of renewable energy sources in total electricity generation [18]. Although the Turkish government and citizens have been familiar with wind energy and accepted it as renewable energy technologies in recent years, most of them don't have enough knowledge about solar electricity potentials as alternative energy sources. To improve a level of understanding and acceptance of PV systems, first, the production of PV panels and the usage of the PV power systems promoted for low cost systems. R&D studies at the universities and institutes in the PV area significantly supported.

The total established solar collector area within our country as of 2019 calculated as being close to 18.640.000 m2. The annual production of plenary

solar collectors calculated as 1.164.000 m2, while that of vacuum-tube collectors was 57.600 m2. On the other hand, 50% of the plenary collectors and all of the vacuum-tube collectors are produced are known to be used within the country. In 2019, close to 768 000 Tons Equivalent to Petrol (TEP) heat energy produced using solar collectors. The use of the heat energy produced in 2019 was calculated as 800 000 TEP in homes and 468 000 TEP for industrial purposes. On the other hand, ith a total new installation of about 1,865,100 m2 of flat plate collectors and 938,300 m2 of vacuum tube solar collectors in 2019, Turkey has again been the second largest solar thermal market after China.

The Renewable Energy Resources Legislation numbered 5346, which is necessary in order for the use of photovoltaic systems to become more widespread revised on 29.12.2010, and the studies concerning the Legislation completed in 2013. The technical evaluations of the applications made to EMRA for the licensed generation of electricity in 2013 currently carried out, and photovoltaic plant licenses given to 600 MW of installed capacity at this first stage. This capacity increased in stages in the coming years, with the target of our Ministry being a minimum of 3000 MW installed capacity of license PV plants in 2030.

3.5. Wind power

Turkey has the serious wind energy potential. Turkey has 11GW stock of the current Project and the capacity of 20 GW for the national goal in 2023 in terms of wind Energy, therefore, Turkey plays a vital role in the European market. In the future Turkey will probably play an important role in shaping the investment opportunities. On the other hand, surrounded by the Black Sea to the north, the Marmara and the Aegean Sea to the west and the Mediterranean Sea to the south, Turkey has huge potential for wind power generation.

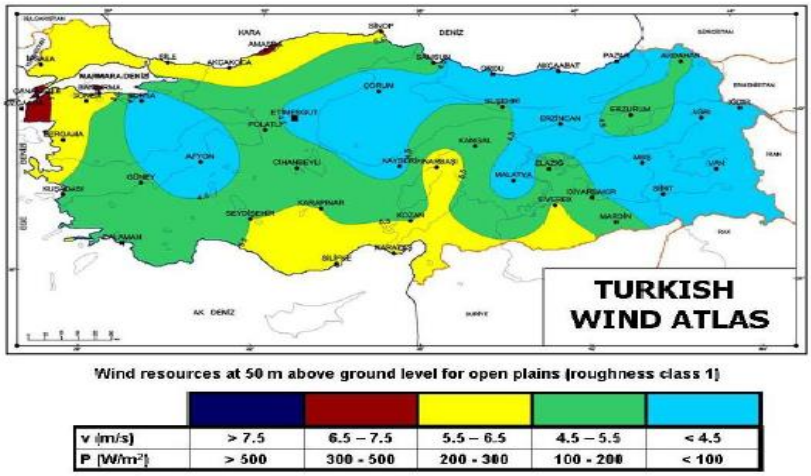

Figure 7. Wind energy potential map of Turkey.

It is shown that Turkey has plenty of renewable energy resources which are still not utilized [6]. This paper proves that wind energy is one of those alternative renewable energy resources which help Turkish economy and development in the following years. Since wind energy is not a stable electricity source, it requires other sources of electricity production investments to different energy resources. In addition to that, the demand of Turkish Republic is much more than the amount that can be produced by wind energy [18].

It is a free energy resource once all the investments are completed. Price of wind does not fluctuate and by the technological advancements in wind power engineering, repair costs, and efficiency levels and it is a great way of producing energy. As a result, it was possible to produce annual energy of 22,807GW/year from a total wind power plant area of 629 km2 which corresponds to a 35.26 GW/year per 1.0 km2. Considering the fact that it is possible to produce such energy for at least 30-40 years with today's technological achievements, it is certain that wind power plants pay back every penny that is spent to build them [38, 39].

Turkey added 1304 MW of new wind power in 2019 for a total installed capacity of 3,763 MW. Turkey's installed capacity has grown at over 500 MW per year since 2010 and Turkey's National Transmission

Company expects annual installations to reach 1,000 MW per year from 2015 onwards. On the other hand, Turkey's best wind resources are located in the provinces of Çanakkale, Izmir, Balıkesir, Hatay and Istanbul. As of the end of 2019, the Aegean region had the highest installed wind capacity with a total of 1,686 MW, followed by Marmara region with 1,359 MW and the Mediterranean region with 543 MW.
The Turkish wind market is mostly dominated by local developers: the 1,210 MW currently under construction is divided between the Borusan-EnBw Partnership, Güriş and Bereket Enerji. The leading players in the Turkish wind market are Polat Energy (457 MW), Demirer Holding (331 MW) and Bilgin Energy (295 MW), followed by Aksa Energy (237 MW) and Eksim (235 MW). The Turkish Wind Energy Association (TUREB) expects Turkey to reach an installed capacity of 5,000 MW by the end of 2015 and 6,200 MW by 2016. To ensure that these targets met, the transmission system operator has announced investments in grid reinforcements for the period from 2015 to 2020. Presently, Turkey is one of the biggest on-shore wind markets in Europe with an 11 GW pipeline of wind power projects.

4. Climate change mitiation by using renewable electricity

4.1. CO_2 emissions in Turkey

Under the Paris Agreement, governments have committed to limiting temperature increase to well below 2°C above pre-industrial levels and pursuing efforts to limit it to 1.5°C. Current efforts are insufficient: aggregate mitigation targets for 2030, according to Climate Action Tracker (CAT) estimates, result in global warming of about 3.0°C by 2100. Implementation of the targets is falling short, with greenhouse gas (GHG) emissions under implemented policies leading to an estimated warming of around 3.3°C.

To stay below the globally agreed limit, the IPCC Special Report on 1.5°C finds that an increase in efforts is required to peak global GHG emissions as soon as possible, reduce them by 45% compared to 2010 by 2030, and reduce CO_2 emissions to net-zero around 2050 and total GHG emissions by around 2070. We no longer live in a world where climate change mitigation is a burden per se, but where it increasingly becomes the most feasible option when considering all socio-economic aspects. For cost-efficient global mitigation, it will be essential to make those mitigation actions accessible to, and overcome remaining barriers in, all countries.

In recent years, measures to reduce GHG emissions have become more attractive globally to policy makers and private investors, both because of falling technology costs, as well as increased awareness of the negative impacts avoided and other positive benefits of mitigation measures such as air quality improvement and job creation from zero-carbon technology and infrastructure development. The qualitative analysis of policy activity and ambition of this analysis for Turkey results in a rating of each sector. The rating aims to reflect the sector's current transition state towards 1.5°C Paris Agreement compatibility. For this purpose, the rating accounts for existing sectoral long-term strategies and/or policies, their status of implementation, as well as the general state of transition of the sector under analysis.

In 2017, the electricity and heat sector accounted for approximately 28% of the total national GHG emissions. Between 2010 and 2017 Turkey's electricity consumption increased by 41% to 297 TWh in 2017. It is expected that the electricity demand will double between 2019 and 2030, as the electricity consumption will reach 453 TWh in the low-demand scenario or 515 TWh in the high-demand scenario in 2030. Between 2002 and 2018, there were gross investments in "electricity, gas, steam and air conditioning production and distribution" of nearly 110 billion USD in Turkey. In addition, 10 billion USD invested for improving energy efficiency. For the period from 2019 to 2030, it is expect that an average annual investment of 5.3-7.0 billion USD is required. In 2018, 37% of electricity generation was from coal, followed by natural gas (30%) and hydro (20%). Liquid fuel, waste, wind and geothermal contribute the remaining 13%. Turkey's electricity sector heavily relies on natural gas, mostly imported from Russia. To reduce dependency and meet the increasing power demand, the Turkish Government aims to increase the share of electricity generation based on domestic lignite and renewables. Compared to 2017 data on electricity generation, 2018 shows a decline of natural gas by 7%points, an increase of coal by 5%points and an increase of others by 2%points (see Table 4-6).

Turkey, as an Annex I party to the United Nations Framework Convention on Climate Change (UNFCCC), reports annually on greenhouse gas (GHG) inventories. The latest GHG inventory submission contains national GHG emission/removal

estimates for the period of 1990-2016. A complete description of the factors underlying the Turkish emission trends, the rationale for the choice of methodologies, the emission factors and parameters used to estimate emissions for the relevant sectors. According to the latest GHG inventory of Turkey, total GHG emissions were 496.1 Mt of CO_2 equivalents (Mt CO2 eq.) and represents 134% increase as compared to 1990 level (see Figure 8) [8, 9].

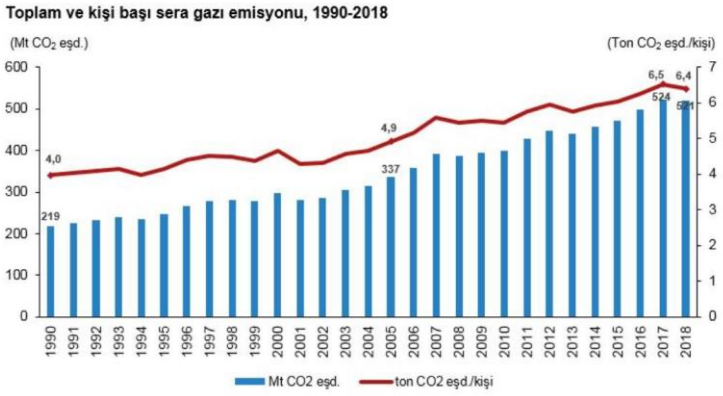

Figure 8. Total Greenhouse Gas Emission per capita, 1990-2018 in Turkey

4.2. Renewable electricity

Renewable energy sources offer a unique opportunity to achieve the transformation needed to ensure energy supply security and effective climate change mitigation. However, like all energy projects, renewable energy projects also have some negative environmental impacts. Environmental and social risks arising from the implementation of renewable energy projects, especially hydroelectric power plants well known by most stakeholders. In order to eliminate the risks, these projects should follow strict environmental criteria from the planning stage to the operation stage and be subject to strategic environmental impact assessment processes. Necessary to avoids, mitigate and compensate negative environmental and social impacts of renewable energy projects taken [8-16].

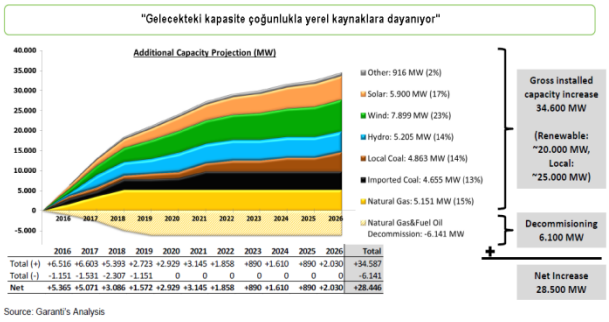

Figure 9. Present and future renewable electricity capacity in Turkey.

4.2.1. Hydropower

Hydropower currently accounts for 16% of global power generation. It generates 80% of the total electricity production from renewables. Hydroelectric dams can generate uninterrupted power, and pumped hydropower plants can provide energy storage. Despite these advantages, hydroelectric power plants, no matter what size or type, have serious environmental and social drawbacks. The MENR advocates that during hydropower generation, the health of rivers and biodiversity protected and sustainability of ecosystem services that rivers provide maintained. In this respect, internationally accepted sustainability principles such as Hydropower Sustainability Assessment Protocol given consideration. In addition, a set of requirements met in hydropower development processes:

- Conservation of legally protected areas and species conservation priority ensured. Dams constructed on rivers that are good representatives of free-flowing rivers bearing their natural structures.
- Credible information made publicly available to demonstrate that a dam is the best

available option, and the best possible locations, designs and operating rules chosen.
- The benefits of the planned dam acknowledged by all stakeholders, including downstream communities.
- Environmental and socio-economic risks and impacts emanating from the project avoided or minimized.

processes. If necessary, "no-go" areas identified by taking into account relevant environmental and socio-economic criteria.
- Environmental impact assessment processes should be transparent, and all stakeholders should be involved. Measures, identified for mitigation and compensation of environmental and social impacts implemented.

4.2.2. Wind Energy

While the global wind power installed capacity has increased eight-fold over the last decade, wind power capacity in Turkey has increased from 20 MW to 3,000 MW. A target of 20,000 MW of installed wind capacity in 2023 has been set. In terms of carbon lifecycle emissions (cradle to grave), wind power is 40 times cleaner than natural gas and 80 times cleaner than coal. Wind will play a key role in power generation in the rest of the 21st century.

Environmental and social impacts of wind power plants are also becoming a topical issue. The environmental value of wind energy projects questioned because of aesthetic concerns about wind turbines and landscape, agriculture and other types of land use. It should emphasized that the environmental impacts of wind power considered negligible when compared to those of other alternatives such as fossil fuels and nuclear energy. Various policy tools and measures are available to prevent, mitigate and compensate for environmental and social impacts of wind power development projects:

- Wind power plants should undergo appropriate planning and siting processes in order to minimize their negative impacts on ecosystems as well as local communities.
- Wind power plants should be included in strategic environmental impact assessment

4.2.3. Solar Energy

Solar energy installed capacity appeared in the Turkish Electricity Transmission Company's statistics only in 2014. By the end of July 2014, installed solar capacity of Turkey was 14 MW. The official target for 2023, on the other hand, stands at 3,000 MW. The most important environmental concern regarding the proliferation of solar power is the potential impact on land use – in particular on valuable agricultural land. According to the Solar Atlas, in theory, a total of 790 km² of solar panels would generate enough electricity to meet Turkey's current total power demand. 790 km² is equal to 0.1 % of Turkey's total surface area or the total lake area of Atatürk Dam.

In the near future, Turkey will not be meeting its power demand solely from solar energy. Even in a 100% renewable energy system, other sources such as wind, geothermal, hydropower and biomass will have signifi cant shares. It just needs to be underlined that nature conservation and renewable energy development can coexist and develop in parallel, without undermining each other. As the global climate change takes its toll on people and the environment, the importance of properly-sited renewable power plants that meet the criteria of sustainability becomes even more apparent.

5.Conclusions

Turkey should change its energy policy to simply optimize energy consumption by supporting energy efficiency, give up on supporting environmentally hazardous energy generation such as nuclear, coal, or shale gas, and aim for 100% renewable energy. This will help relieve the economy by reducing energy importation, protect the environment by reducing carbon emissions, and provide energy independence which is a national security matter. Turkey can set a great example in the global energy industry, leading the way for many countries to transit to carbon-free economies (see Table 3-6 and Figs. 1-9).

Turkey's energy demand is increasing consistently. The country's energy policy focuses on increasing the supply of energy to fuel its economic growth. As a result of this energy supply policy, import of oil and gas has increased, negatively affecting the current account deficit, and more power plants have been built. To mitigate the risks of energy dependence and the negative consequences of energy importation, the current policy is to support nuclear, coal (lignite), and shale gas opportunities in the country. However, this comes with a serious

environmental cost. This article aims to explain why Turkey should take an alternative path and head straight to 100 percent renewable energy.

In a sun-rich country like Turkey, whether via centralized systems such as solar power plants or via decentralized systems for houses, hotels, shopping malls, hospitals, factories etc., solar energy can meet most of the energy demand. The country's other renewable energy resources, i.e. the wind, geothermal, biofuels, hydro, wave, hydrogen, also have huge potential. Contrary to the arguments claiming that renewable energy cannot provide baseload power; one can rely 100 percent on renewable energy sources to generate power 24 hours a day by simply installing storage technologies such as heat storage or power storage systems, or by utilizing geothermal systems and biofuels to back up your solar or wind systems. Furthermore, biofuels have the potential to replace fossil fuels in Turkey, as they can be grown by humans en masse.

Turkey should change its energy policy to simply optimize energy consumption by supporting energy efficiency, give up on supporting environmentally hazardous energy generation such as nuclear, coal, or shale gas and aim for 100 percent renewable energy. This will help relieve the economy by reducing energy importation, protect the environment by reducing carbon emission, and provide energy independence which is a national security matter. This will also put Turkey at the leading edge of the curve in the global energy industry, where even developed countries will have to follow Turkey once it proves that 100% renewable energy is not just a dream, but a reality. The time has come for the inevitable transition to renewable energy and carbon-free economies.

Considering the fact that Turkey is rich in renewable energy resources together with the aim of diversifying energy supply, the maximum level for domestic, renewable resources in the production of electricity has been targeted within the framework of the national energy policy. Turkey, being the 17th largest economy in the world and 6th largest in Europe, is experiencing a steep increase in its demand for energy. Therefore, Turkey has initiated a forward-looking and innovative energy policy in which renewable energy plays a significant role. On one hand, by 2023 Turkey plans to have an electricity generation mix in which the share of renewable energy accounts for 30% of overall need as well as having 10% of the requirements of the transportation sector met by renewable energy. There is also a commitment to reduce by at least 20% the amount of energy consumed per unit GDP in the year 2023.

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