This project is co-funded by the European Union
and the Republic of Turkey.

Climate Change Training Module Series 6

iklimIN

CLIMATE CHANGE AND ENERGY POLICY

QR Code for Modules
Electronic Version

QR Code for Energy
Module Electronic Version

CFCU
CENTRAL FINANCE & CONTRACTS UNIT

WEglobal

CLIMATE CHANGE AND ENERGY POLICY

Prepared by:
M. Tülin Keskin
2019, Ankara

The original content of this publication has been prepared in Turkish.
In case of discrepancies with the English translation, the Turkish version is valid.

CLIMATE CHANGE AND ENERGY POLICY

CONTENT

ABBREVIATIONS....2
EXECUTIVE SUMMARY....3
1. ENERGY APPEARANCE OF TURKEY AND IMPACT ON CLIMATE CHANGE....6
1.1.Primary Energy Sources and Electric Energy....6
1.2. Renewable Energy Sources....8
1.2.1. Hydrualic Energy....11
1.2.2. Wind Energy....12
1.2.3. Solar Energy....15
1.2.4. Geothermal Energy....16
1.2.5. Biomass Energy....17
1.2.6. Biodiesel and Bioethanol as Alternatives of Oil....18
1.3. Nuclear Energy....19
1.4. Turkey's Energy Potential and Its 2023 Targets, Energy Projections....19
1.5. Turkish Energy Sector and Its Impact on Greenhouse Gases....23
2. SECTORAL ENERGY EFFICIENCY POTENTIAL IN TURKEY: CURRENT TARGETS, BEST PRACTICES, IMPORTANT DEVELOPMENTS, OPPORTUNITIES AND CHALLENGES....25
2.1. Sectoral Energy Consumption....25
2.2. Energy Efficiency Indicators and Sectoral Energy Efficiency Works....26
2.2.1. Energy Efficiency in Industry Sector....30
2.2.2. Energy Efficiency in the House and Services Sector....34
2.2.3. Energy Efficiency in Transportation Sector....37
3. FINANCIAL ANALYSIS OF FOSSIL RENEWABLE NERY SOURCES AND FOSSIL ENERGY SOURCES AT GLOBAL SCALE....42
4. ENERGY EFFICIENCY AND IMPORTANCE OF RENEWABLE ENERGY ORIENTED ENERGY POLICIES IN STRUGGLING AGAINST CLIMATE CHANGE....48
5. TURKEY'S ENERGY SECTOR COMMITMENTS IN STRUGGLING AGAINST CLIMATE CHANGE AT GLOBAL/ REGIONAL LEVEL 55
6. EU ENERGY POLICIES AND POSITION OF TURKEY IN STRUGGLING AGAINST CLIMATE CHANGE....61
6.1. EU Energy- Climate Policies....61
6.2. Turkey's Energy Politics and Relationship with EU....64
7. TURKEY'S ENERGY EFFICIENCY AND RENEWABLE ENERGY POLICIES....65
7.1. Legal Framework in Energy Efficiency....65
7.2. Legal Framework in Renewable Energy....70
8. AN ASSESSMENT ON BOTH DOMESTIC AND RENEWABLE ELECTRICITY GENERATION OPPORTUNITIES AND CHALLENGES IN DEVELOPING RENEWABLE ENERGY TECHNOLOGIES IN TURKEY....74
9. REVIEW OF CLIMATE FRIENDLY FINANCIAL OPPORTUNITIES IN THE ENERGY SECTOR IN TURKEY....79
9.1. Public Support in Energy Efficiency....79
9.2. Public Supports in Renewable Energy Sector....80
9.2.1. Renewable Energy Resource Area (YEKA) Tenders for Strengthening Regulatory Framework That Supports Energy Transformation....85
9.2.2. Wind Energy Plant (YEKA-RES) Tender....87
9.2.3. Renewable Energy Resource Area Solar Energy Plant (YEKA-GES) Tender....87
10. RENEWABLE ENERGY PRACTICES IN VARIOUS SECTORS OF TURKEY....87
11. SOCIAL DIMENSION OF ENERGY AND ENERGY PREFERENCES OF TURKISH PEOPLE (see Ediger et al., 2019)....92
12. EVALUATION OF RENEWABLE ENERGY SECTOR FROM THE PERSPECTIVE OF ENERGY COOPERATIVES....97
12.1. Creating Solidarity Economies in Renewable Energy Sector:....97
12.1.1 Renewable Energy Cooperatives....97
12.2. Renewable Energy Cooperatives in Turkey....100
12.3. Renewable Energy Cooperatives in Turkey -Process of Establishment....102
REFERENCES....107

ABBREVIATIONS

EU	European Union
LULUCF	Land Use, Land-Use Change and Forestry(LULUCF)
CSP	Concentrated Solar Power
EPDK	Energy Market Regulatory Board
EPİAŞ	Energy Markets Operating Inc.
EV	Energy Efficiency
GEPA	Solar Energy Potential Atlas
GDP	Gross Domestic Product
Gton	Giga tons
IPPU	Industrial Processes and Product Use
IEA/UEA	International Energy Agency
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
LCOE	Levelized Cost of Energy
MTOE	Million Tons Oil Equivalent
ÖTV	Special Consumption Tax
RİTM	Wind Energy Monitoring and Estimation System
TURSEFF	Turkish Sustainable Energy Financing Program
TWh	Terawatt hours
UNFCCC	United Nations Framework Convention on Climate Change
YE	Renewable Energy
YEKA	Renewable Energy Resource Area
YEKDEM	Renewable Energy Support Mechanism

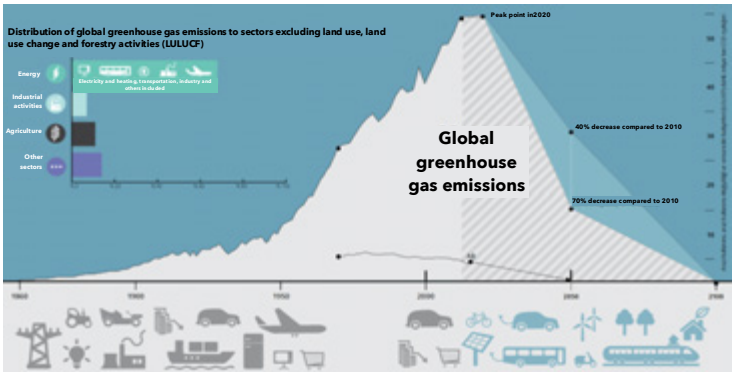
EXECUTIVE SUMMARY

Globally energy use has the biggest share among greenhouse gas emissions released from human activities and almost two third of the global greenhouse gas emissions are related to the energy we use for heating, electricity, transportation – delivery and industrial production (Figure 1).

The fact that greenhouse gas emissions have demonstrated significant increase since 1990 and the greenhouse gases and in particular CO_2 have the biggest share in emissions lead to the focus being put on the "Energy Sector" so as that the climate policies progress on a desired path overall the world. Processes that involve energy consumption are responsible from around 70% of total emissions in the European Union (EU) for instance. For that reason, energy consumption is closely monitored as the biggest source of greenhouse gas emission in the EU and the strongest commitments are given in this field. Even though the energy consumption is still a big problem, it progresses on the way of decrease in amount thanks to the policy measures implemented on this issue. For example, the amount of CO_2 equivalent emission which arises only from energy consumption was 1.8 million kilotons in 1990, which decreased to 1.3 million kilotons in 2015.[1]

[1] CO_2 equivalent

Figure 1: *Distribution to Sectors and Development of Global Greenhouse Gas Emissions (European Environment Agency, 2017). 28-29)*



Both the speed of increase in energy consumption and the consumption composition of energy resources have made the cooperation between energy sector and climate change policies obligatory, putting the World on a path whereas less energy as possible is consumed and this consumption is cleared off the fossil fuels. This important transformation process is the start of a silent renaissance in the energy sector. For that reason, when we speak of the "Climate Change", we should better understand and analyze the energy sector and dynamics and take the most efficient measures in this field.

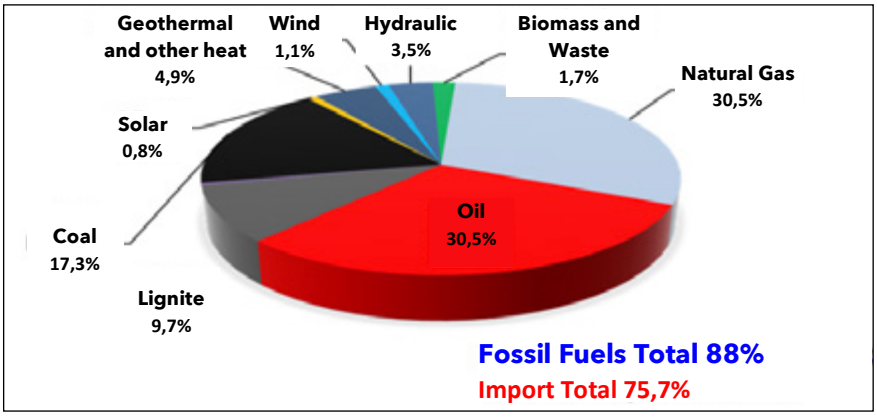
This report aims at better understanding how the impacts of energy sector on climate in Turkey and in the World could change with energy efficiency and renewable energy policies and where the policy of our country in these fields stands in the climate change with its current status and opportunities.

1. ENERGY APPEARANCE OF TURKEY AND IMPACT ON CLIMATE CHANGE

1.1. Primary Energy Sources and Electric Energy

The primary energy supply of Turkey, which was 136.2 TOE in 2016, increased to 145.3 million TOE in 2017. In the distribution of this supply to resources, the first tank is occupied by natural gas and oil with a share of 30.5%. These are followed by coal with a share of 27% (mineral coal and lignite). Finally, the fossil fuels received a share of 88% from the primary consumption of Turkey (Figure 2).

Figure 2: *Share of Sources in the Primary Energy Supply of Turkey for 2017 (ETKB-EIGM, 2018)*



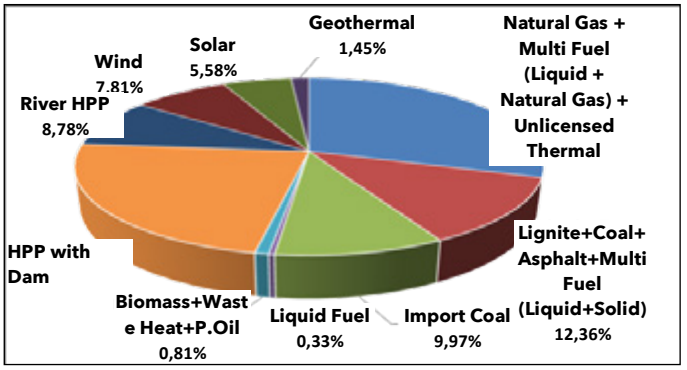
When the Primary Energy Demand increase is considered, the demand which was 52.7 in 1990, reached to 145.3 million in 2017 with an increase of 176%. A high portion of this demand was met with fossil import fuels (75.7% as of 2017). Whereas this situation weakens our hand in the issued of climate change, it also stands as an area of potential problem in ensuring uninterrupted, cheap and sage provision of energy supply in our country. In particular, foreign-dependency of around 98% in natural gas and 91% in oil among the primary energy sources constitutes an important supply safety risk. Moreover, the fact that energy import is one of the most important import items in foreign trade deficit (energy import cost is 37 billion USD in 2017), has made the energy sector a sector which creates pressure on economy.

On the other hand, whereas the primary energy supply per person in Turkey is 1.69 TOE, the average of UEA members is 4.5 TOE per person. In other words, it is three folds of Turkey. When the "Per Capita Electricity Consumption" which is accepted as a wealth indicator is considered, it is foreseen that the consumption which is 3690 kWh in 2017, will be increased over 8000 kWh in 2040 in the Ministry (ETKB) projections (average of UEA member since 2016 is 9.900 kWh). When compared to the current

per capital consumption values of Turkey and UEA members, it seems inevitable that, with the increase of wealth, Turkey's energy consumption will increase soon. The important thing is how much of this growth will be accomplished carbon-free within the context of climate.

In recent years, the electric energy installed power in our country has been demonstrating a rapid growth in favour of renewable energy, in particular wind, geothermal and solar energy in line with the incentives given and the technology becoming cheaper. Whereas there was an increase of 3.2 GW in the renewable resource capacity in 2017, the added capacity in fossil fuels was 1.5 GW, namely the half of it (TEIAS, 2017a). Whereas the total installed power reached to 88.177,7 MW as of the end of 2018 October, the share of installed power based on renewable energy is 45.8% and the share of thermal is 54.2% (Figure 3).

Figure 3: *Distribution of Installed Power to Resources as of 2018 October end (88.177 MW) (TEİAŞ, 2018)*



As in the case of installed power, the share of energy resources in the production started to increase since 2009, and in 2017, the share of renewable energy reached to around 30% in the electricity production, which was 95.511 GWh in 2017 (Figure 4 and 5).

Figure 4: *Development of Contribution of Renewable Energy in GWh (TEIAS, 2017a)*

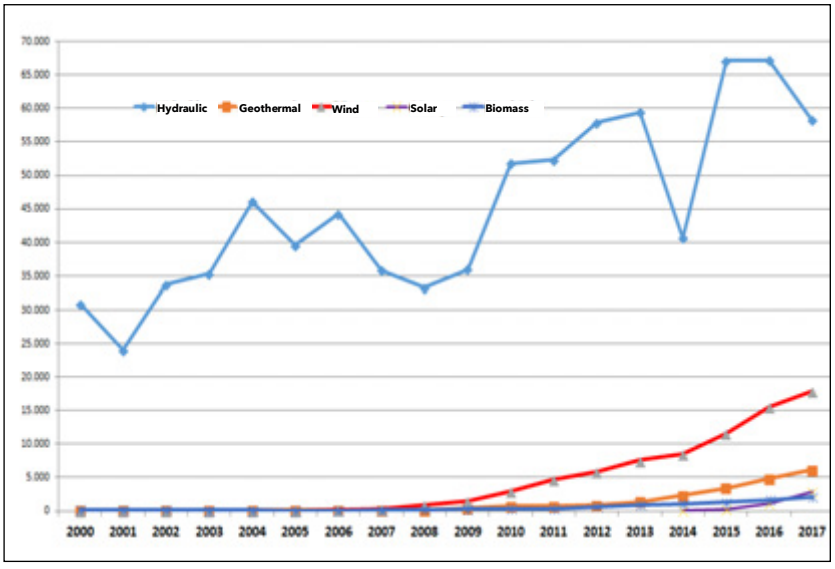
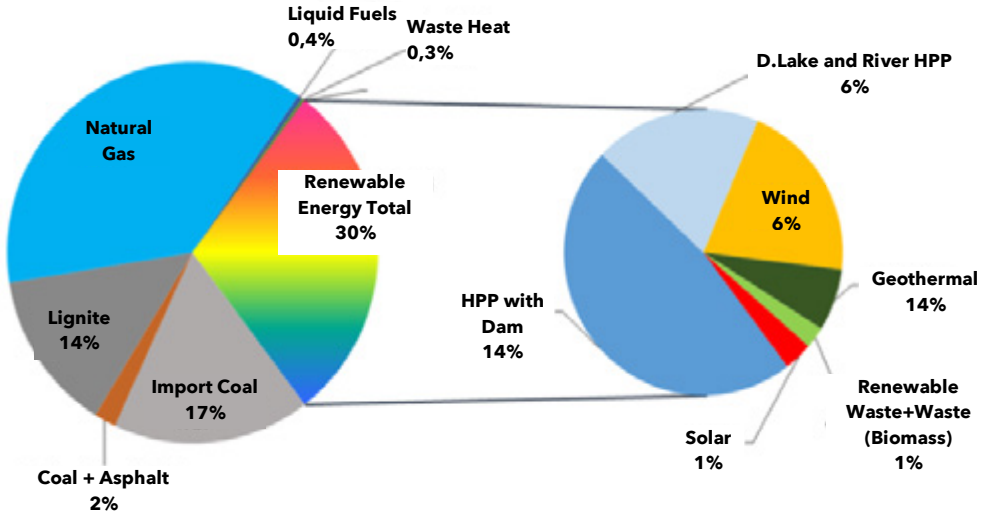


Figure 5: *Share of Sources in Turkey Electricity Energy Production in 2017 (TEIAS, 2017b)*



295.511 GWh electricity produced in our country is consumed as 295.515 GWh as a result of various losses and a small amount of export. The biggest part in consumption is taken by industry with 47%, which is followed by 26% by Commercial and Public and 22% by residential units.

1.2. Renewable Energy Sources[2]

Renewable energy sources have become an important competitor of fossil fuels overall the world with the technological developments in recent years. Besides, the fact that these sources could be used in every region of the world opens the way for energy independence, making energy consumption possible in every region of the world. On the other hand, the fact that renewable energy technology is held by a couple of countries appears as a new foreign dependence as it is transformed from import energy dependence to technology dependence. Countries which make investment in the recent past in order to develop technology will transform this situation into opportunity and enable a superiority of competition in global economy. As a result, countries which will produce renewable energy resources by using their own energy resources are among the countries which are the candidates for being the leading economies of the coming period. For that reason, countries which have renewable energy potential and technology, develop and implement long term smart policies will have very important opportunities.

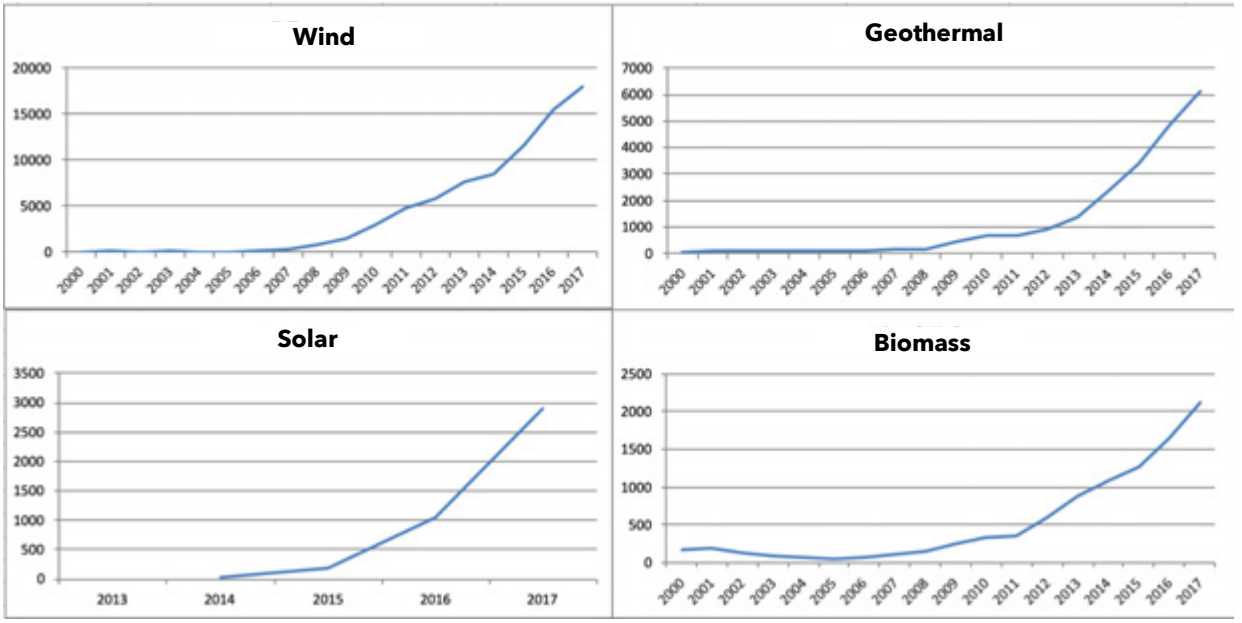
In our country, ***hydroelectric power, wind, geothermal solar energy and biomass, which covers all wastes that could be converted into energy***, and ***wave energy*** for which currently no project has been developed, are accepted and being used as renewable energy sources

Turkey is lucky in terms of renewable energy sources due to its geographical conditions and location. It has not yet converted its position into advantage other than HPPs since it does not have the required

[2] Information given in this section mainly rely on 11th Development Plan Energy Supply Safety and Efficiency OIK, Local and Renewable Energy Sub Group Draft Report 30.01.2018. Installed power information is regulated with data taken from: https://www.teias.gov.tr/sites/default/files/2018-11/kurulu_guc_ekim_2018.pdf

technologies and the installation cost of these sources is high. However, the contribution of these resources in the production rapidly increases as potential area works are being carried out in this field for the last 10 years, the costs are lowered, legal regulations are made and new incentives are brought (Figure 6). It is indicated by ETKB that our installed power in renewable energy has increased by 245% in the last 16 years and capacity increase records are broken in solar, wind, hydroelectric, biogas, geothermal.

Figure 6: *Change in electricity production from wind, geothermal solar energy and biomass resources in GWh over years (TEIAS, 2017c).*



Despite the fact that the rate of renewable energy installed power in the total installed power is around 45%, its contribution in the energy production is less. The most important reason of this situation that arises from the nature of renewable sources is that the annual benefitting periods from these sources is lower compared to fossil fuels. With the existing economic technologies, it is not possible to ensure the supply safety only with renewable sources since the production of renewable sources such as wind and solar, which have high potential in our country, depends on natural factors such as blowing of the wind, appearance of the sun, sunset at nighttime and the level of precipitation. This issue is one of the important obstacles encountered in developing renewable energy projects.

Works are being carried out overall the world on such new areas as storage technologies and smart networks overall the world in order to overcome the problem of energy variability. If the shares of wind and solar energy in the total electric production with our current network structure increase above the level of 10%, the new investments should absolutely be made in a manner to develop supply flexibility of the system and it will be necessary to use electric storage technologies in order to ensure energy supply safety. However, the new EU strategy

foresees to make planning in order to increase this value to 15% in 2030. There are examples wherein this value is increased to 25% at the global scale.

The "Long Term Electric Market Outlook Report" of Turkey, which was prepared by SHURA Energy Transformation Center and Bloomberg New Energy Finance (BNEF), includes the results of a model study that demonstrates that 50% of the electricity produced in Turkey could be provided from wind, solar and other renewable energy sources. This report includes many promising findings concerning the future of renewable energy in Turkey. The main emphasis in the report is given below;

- *Turkey's electricity demand will increase 126% between 2017 – 2050 depending on the economic growth and the increasing population, reaching to 653 TWh annually by 2050.*
- *The electricity intensity in Turkish economy will enter into a decline trend after 2023 and the electricity sector emissions will start to decrease despite the increasing demand.*
- *The corrected electric production costs of wind and large scale solar energy plants will remain at the same level with coal in 2023. These sources are currently behind the natural gas plants.*
- *Costs which were at the level of 67 USD / Megawatt-hour (MWh) in 2018 for wind energy, will decrease back to the level of 29 USD / MWh in 2050.*
- *The adjusted electric production costs for solar energy investments in Turkey is at the level of 79 USD/ MWh. This makes Turkey the second most expensive country after England in Europe, Middle East and Africa region. Together with this, these costs will decline at a rate of 77% in 2050.*
- *The current adjusted electric production cost of natural gas plants, which is currently 94 USD/ MWh, will continue to rise with the effect of the increasing fuel prices and after year 2023, operating the existing natural gas plants will be more costly than constructing new large scale solar plants and performing production.*
- *Natural gas prices will be 7 USD/ MMBtu in 2024 – 27 period, and decline back to 6 USD / MMBtu level in 2050.*
- *Coal is the source of electricity production with the lowest adjusted cost of production with a rate of 44 USD / MWh. Together with this, wind and solar will catch coal after 2023.*
- *The electricity production capacity of Turkey, which was 88.5 GW as of 2018, will increase to 261 GW in 2050. The share of coal at this capacity will decrease to 5% and the photovoltaic systems will have the highest share in the capacity with 26 %. The share of wind plants will reach to 24%.*
- *Thanks to the contribution of storage units to grid flexibility, 88% of the electricity production capacity of Turkey in 2050 will be covered from electric production plants which do not lead to carbon emission.*
- *Emissions arising from electric production sector will increase by 17% in 2023 compared to 2017 and reach to the peak point with 206 megatons (Mt). Afterwards, a decline period will follow with the effect of the shares of decreasing fossil fuels in electricity production.*

The most important factor for the increase of the share of renewable energy sources in our country is the support system which is being implemented in electricity production. This support is applied in the form of price and purchase guarantee. The supports are provided within the scope of Regulation on Certification and Supporting Renewable Energy Sources (YEKDEM) (EPDK, 2019). The incentive purchase price of electricity to be produced from Renewable Energy Sources is indicated for each source in Schedule 1 of the regulation in USD cents

per kilowatt hour. The tariff validity period shall be 10 years provided that it shall be commissioned from 1.1.2016 to the end of year 2020[3] . Besides, for the purposes of encouraging local technology production, additional price as indicated in Schedule 2 is applied for a period of 5 years for the electricity energy to be generated if minimum part of the mechanical and/or electro-mechanical equipment used in the licensed facilities as defined in the relevant regulation is of domestic production.[4] Detailed information will be given on this issue in the following sections.

Significant studies have been conducted on the potential towards using renewable energy in an efficient and effective way and using the same in energy production. The Ministry of Energy and Natural Resources has prepared REPA (Turkish Wind Energy Potential Atlas), GEPA (Turkish Solar Energy Potential Atlas), BEPA (Turkish Biomass Energy Potential Atlas). Besides, in order to use the wind energy potential of our country to a maximum extent, "Wind Monitoring Estimation and Management Center" (RITM) has been established for Electric Power Generated from Wind in order to ensure more wind plants to be integrated in the electric system and estimating the electric power to be produced from wind beforehand.

1.2.1. Hydraulic Energy

It is assumed that hydroelectric plants are one of the energy production methods with minimum damage on the environment when correctly designed and operated in accordance with EIA reports. No hazardous waste occurs at the stage of operation and in this way it has a greenhouse gas emission amount (carbon dioxide CO_2) which is quite lower compared to energy plants using fossil fuel in energy production.

Hydroelectric is product of a developed and evidenced technology with a more than hundred years of experience. Today's plants provide the highest energy transformation at a rate of around 90-95 %. Hydroelectric has the lowest operating cost and longest operating life compared to other large scale energy production options. The fact that hydroelectric power plants could be commissioned within short period provides a significant advantage and strategic benefit compared to other renewable sources in terms of being easily commissioned and covering the sudden demands for electric energy instantaneously. In particular, HPPs with storage facilities could be activated and deactivated within maximum 3-5 minutes. These also abolish the disadvantage of continuing with the production using the source at times where there is no need for energy. In many countries, the pumping units and HPPs are also used for storage purposes in order to cover the deficit when other renewable energy sources do not perform production. These plants supply water from the reservoir at lower level to the reservoir at upper level at times when electricity is abundant and cheap in the system, closing the system gaps by turning the stored water into electricity. HPPs also have important tasks for covering the peak energy demand by hydroelectric power plants.

[3] Cabinet Decree No. 2013/5625 (OG dated 5 December 2013) – Decree for Putting into Practice the Decision on Prices and Periods to be Applied for Facilities Making Production Based on Renewable Energy Sources and the Domestic Additive Addition

[4] Regulation on supporting the domestic equipment used in facilities producing electricity energy from renewable energy sources (OG dated 24 June 2016) – Official Gazette No: 29752.

Hydroelectric power plants, which have the share of 20% as of 2017 in the electricity supply (its share was around 30% in periods when water incomes were higher in previous years), are the most important renewable energy sources of Turkey.

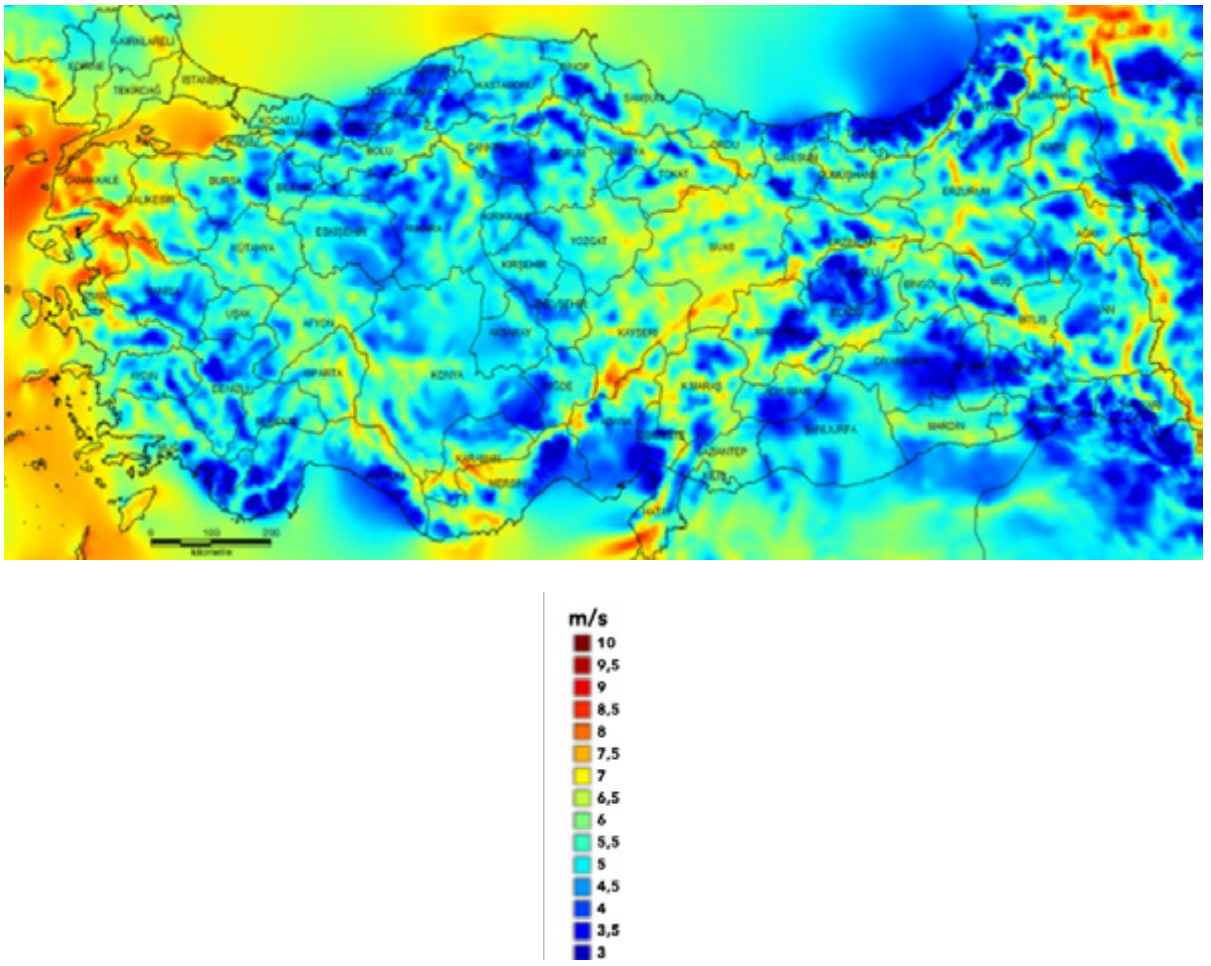
Our countries theoretical hydroelectric potential is 433 billion kWh, its usable potential is 216 billion kWh and economic hydroelectric energy potential is 10 billion kWh/ year. Hydroelectric installed power as of the end of October 2018 reached to 28.248 MW, comprising 20503,5 MW (117 plants) dam type, 7.737 MW river type (523 units) and 7,4 MW(10) unlicensed.[5] Within the scope of using the hydroelectric energy potential, there is project stock at various stages such as licensed and pre-licensed around 10.000 MW in addition to HPPs which are commissioned.

1.2.2. Wind Energy

According to Turkey Wind Energy Potential Atlas (REPA) the strongest annual average wind speeds in the vicinity of open areas are through the west coasts of Turkey, around Marmara Sea and around Antakya (Figure 7). Wide areas with a wind speed of medium magnitude and wind power intensity also exist alongside the central parts of Turkey. According to REPA, Turkey's wind energy potential is determined as 48 thousand MW between good and extraordinary and the total area corresponding to this potential corresponds to 1.3% of Turkey's surface area.

[5] Unlicensed Production Facility: This defines the production facilities which could be installed with exception from the obligation to establish company and receive pre-license and license. These are the production facilities based on renewable energy sources with installed power of one megawatt and below. Besides, cogeneration facilities, micro cogeneration facilities, solid waste facilities of municipalities and the production facilities established to be used in the disposal of treatment plan sludges, which are in the category that meet the productivity value to be determined by the Ministry, are included in this category. All these issues have been regulated with a regulation.

Figure 7: *Wind Energy Potential – Wind Speed at a height of 50 m (m/sec) (REPA) Map (YEGM, t.y.a)*



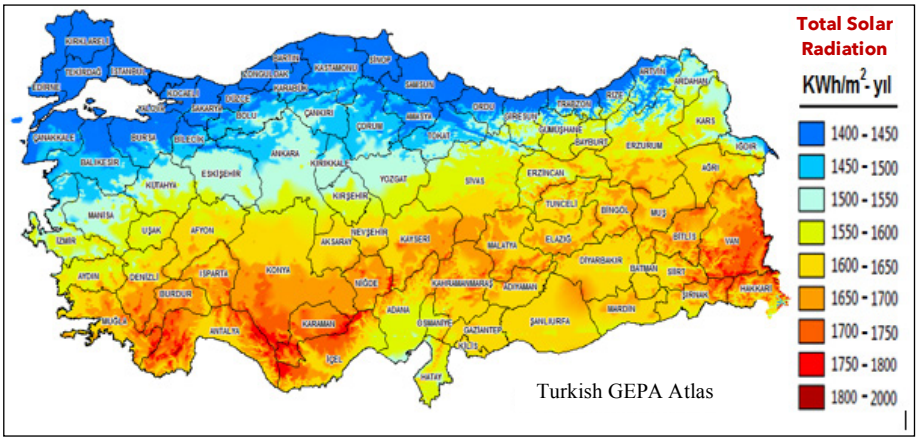
The licensed wind electricity installed power in Turkey connected to the grid has reached 174 licensed and 69 unlicensed wind plants as of October end, 2018, amounting 6.883 MW (around 8% of the total installed power of Turkey). The energy generated from these plants was 6% of the total energy production in Turkey in 2017.

Plants over 10 MW with a total installed power of 6624,8 MW are connected as of February 2019 to the Wind Energy Monitoring and Estimation System (RITM) which was established with a regulation enacted in 2013 in order to estimate the electric energy produced from wind. Thus, the electricity production of RES that are under operation could be instantaneously watched and the production could be estimated 48 hours in advance. Studies conducted in order to mitigate estimation error rate are ongoing.

1.2.3. Solar Energy

According to Turkey's Solar Energy Potential Atlas (GEPA), it was determined that the total annual insolation time is 2.727 hours (daily total 7.5 hours), annual total derived solar energy is 1.527 kWh/m2 (daily total 4.2 kWh/m2). Using this data, the theoretical solar energy potential for our country was calculated as 380 billion kWh/year.

Figure 8: *Solar Energy Potential (GEPA) Atlas (YEGM, t.y. b)*



Whereas Aegean region receives radiation at medium level, Central Anatolia, East Anatolia, Mediterranean and South East Anatolia are high level radiation zones (Figure 8).

In our country, solar energy had been used only for obtaining hot water, drying etc. in houses and in the industry, at places such as observation stations which are away from the grid, and for minor electricity energy needs such as illumination of parks and gardens until 2014. After that year, the use of solar energy has changed dimension and plants were started to be established for electricity energy production. With the decrease of cost experienced in solar panels and increase of panel efficiency, the solar energy electricity production which was only 40 MW in 2014, reached to 81.7 MW as installed power of 9 licensed solar plants as of end October, 2018.

As a result of the regulations made, the unlicensed solar energy which covered installations below 1 MW and exempted from many permits, reached to 4842 MW in total with 5689 plants (5.5% of the total installed power). Whereas the development of solar energy has been ongoing without any slowdown, a licensed installed power of 100 MW and unlicensed installed power of above 5.000 MW have been reached today for solar energy together with the plants that are about to be completed. The electricity production of licensed electricity production facilities based on sun has reached to 122 million 72 thousand kilowatt hours (kWh) in 2018, with a 11-folds increase compared to the previous year.

In this way, Turkey has become 7th among European Countries and 13th in the world in terms of solar energy by the end of 2017. (Elektrik Haber, 2018).

Feed-in tariff is applied for solar electric, as in the case of all renewable energy sources. There is incentive purchase warranty of $13.3 cents by 2020 per kilowatt-hour produced from solar energy.

1.2.4. Geothermal Energy

Geothermal energy plants are costly and risky as the heat, which is stored inside the rocks deep under the ground, appear as the reservoir they are stored is discovered and taken to earth surface and turned into processable condition. Geothermal source explorations start with geothermal mapping which takes a lot of time, and continue with drilling following geophysics data collection methods that have high costs. Resource discovery rate is a very risky one such as 60% (an exploration well of 3.000 m is 4.5 million USD). Together with this, these plants have the characteristics of base load plan, which is an advantage compared to solar and wind[6]. Besides, these could be rapidly installed, operated and easily maintained, leased and sold. However, when the geothermal source, which is drilled out and heat of which is used, is not reinjected to the well and released to nature, it creates important problems for the environment due to the mineral and salts in its content.

Overall the world, the top five countries for electricity generation from geothermal energy are the USA, Philippines, Indonesia, Turkey and New Zealand. The potential of geothermal energy which is highly important as one of the local energy resources due to the tectonic structure of Turkey, is 31.500 MW. 12% of this potential is theoretically considered to be suitable for electric production. 10% of geothermal energy sources, of which 78% are in West Anatolia, 9% in Central Anatolia, 7 % in Marmara Region, 5% in East Anatolia and the remaining 1% in other regions, is suitable for electricity production.

The geothermal power production of Turkey, which started in Denizli Kizildere with a capacity of 15 MWe in 1984, has reached to 1.282,9 MW with 48 plants as of the end of 2018 October, with a growth rate of 80% after a period of around 30 years. In 2018, the amount of electricity generated from geothermal resources in Turkey reached to 6.9 billion kWh with an increase of 30% compared to previous year, and the share of geothermal electric plansin total electricity production increased from 1.82% to 2.35%. Despite the cost of 4.2 million USD / MW and all searching risks, geothermal plants play an important rule with the legal regulations for the investors and the government incentive and purchase warranty provided to them.

Geothermal energy is also used for the heating of regions and buildings as well as in greenhouses as heat energy in addition to its contribution in electricity production. Currently, it is used for the heating of 120.000 house equivalent areas in 19 residential units. In addition to electricity production potential of 3 thousand MW in West regions, it is indicated that new geothermal sources of 30 thousand MW were discovered for heating - drying purposes and that this potential corresponds to a natural gas of 9 billion cubic meters and a gas replacement of 2.2 billion USD at current rates (Yilmaz, 2019).

In regions with agricultural livelihoods that are rich in geothermal sources (in particular Aydın, Manisa, Denizli, Çanakkale), high-technology greenhouses with CO_2 cooling and heating using geothermal fluid before reinjection are named as secondary geothermal investments. Taking into account the fact that technological greenhouse activities are 7-folds more efficient, it could be understood that facilitating long term credits for investment and supporting the same with tax incentives would be profitable. Geothermal

[6]Base load plant: Plants that operate continuously for meeting energy need or plants that are activated rapidly when there is a need, which cover the need for power, reaching the full power in short period (activation of geothermal power plants takes a time of less than 1 hour).

energy target was indicated as 3000 MW for 2023 in the 10th plan. The following table summarizes the current status as of 2017, as well as 2023 targets.

Table 1: *Current Status in Turkey and 2023 Targets (11th Development Plan: Energy Supply Safety and ficiency)*[7]

Type of Application	2017	2023 Targets
Electricity Production	1100 MWe	3000MWe
Heating (Houses, Hotels, Thermal resort etc.)	120.000 DE	1.000.000DE
Greenhouse Heating	3.931 Decare	50.000 Decare
Drying etc.	5.000 ton/year	20.000 Ton/Year
Thermal Tourism	450MWt	900MWt
Cooling		300MWt
Fishery and Other		400MWt
Thermal Direct Use		10.000MWt

DE: Dewelling Equivalent

1.2.5. Biomass Energy

Biomass energy is potentially one of the most important renewable energy sources for our country. The geographical structure of our country, our territories being suitable for the production of biomass, our people living together with agricultural activities and the increasing demand towards biomass energy including the rural areas carry our country to top in terms of biomass energy.

According to Biomass Atlas prepared by Renewable Energy General Directorate, there are 97 million tons of vegetative wastes with an energy equivalent of 40 million TOE/year, 163 million tons of animal wastes with an energy equivalent of 1 million TOE/year, 31 million tons of urban organic waste with an energy equivalent of 2 million TOE and forest wastes with an annual energy of around 1 million TOE. The total energy equivalent of wastes in Turkey is 44 million TOE/ year. Turkey has a significant potential in energy forestry in addition to a large waste potential.

As the modern biofuels; biogas, bioethanol, biodiesel, gas obtained from gasification process, biomethanol, biohydrogen and other various fuel types. In order for the modern biomass energy technology to be implemented, it is necessary to think the waste/wastes that could be used for energy production, energy plant cultivation, energy planning and production planning in rural regions all together.

In recent years, electricity production from biomass energy has increased. Biomass is also supported as in the case of other sources under the scope of YEKDEM, and 13.3 Cent/ kWh purchase guarantee is given to electricity production from biomass. A significant amount of investment was started to be made in this field.

The project named "Developing and Disseminating Rural Area Biogas Technologies", which is supported by State Planning Organization (or the Ministry of Development with its new name) and carried out by Aegean University Solar Energy Institute towards the use in rural areas, has been completed in 2012. Within the scope of the project,

[7] See. Republic of Turkey Presidency Strategy and Budget Department 11th *Development Plan: Energy Supply Safety and Efficiency*. Specialty Commission Report 28.02.2018

rural biogas systems were established in 11 villages selected in Izmir. Thus the end users could use the biogas produced in volume heating, cooking and electricity generation and apply the fermented fertilized in the agricultural activities.

In addition to these actions, our country has biogas systems which are installed under waste water treatment plants as well as gas production systems from garbage.

In Turkey, enterprises such as İzaydaş İzmit, Sütaş Çiftliği, İlci Tarım İşletmeleri, Devsüt, Afyon Enerji and Gübre Üretim, ISIT Biyokütle, TİGEM Işletmeleri, Cargill Tarım, Sütaş/Enfaş establish and operate biogas systems. The enterprise sizes change between 0.05 – 5 MW.

According to October 2018 data, the number of biomass plants that hold production license increased to 127 with an installed power of 717.3 MW. According to the data of Energy Market Regulatory Board (EPD), production license has been given to 35 biomass plants with a total installed power of 215.2 MW in the year 2018 and the number of biomass plant projects that hold pre-license increased to 62 with 514.3 MW.

1.2.6. Biodiesel and Bioethanol as Alternatives of Oil

Another use of agricultural products is the production of fuels as an alternative to oil products. In the past years, more than 200 biodiesel facilities were established in Turkey, of which 56 hold license, with a total capacity of 1.5 million tons, in spite of which many facilities were shut down due to lack of local raw materials (such as oily seeds) and the high prices. Studies are being carried out in our country, as in the case of the whole world, for biodiesel production from algae, which has attracted great interest.

Of the biodiesel which is produced in our country with local raw materials, 2% blended with diesel is exempted from Special Consumption Tax (OTV). EPDK has brought the obligation of adding local additives in oil and diesel by increasing every year after 2013 with a regulation it has enacted in relation to agricultural product additives to fuel oil in order to decrease current deficit and encourage the production of local biofuels. However, this decision has been abolished on 26 June 2013 due to raw material and other problems experienced in the sector. Following the agricultural regulations, within the scope of the "Circular on Blending of Biodiesel to Diesel Types" published by EPDK on 01.06.2017, there is the expression which states "it is an obligation that the holders of distribution license shall blend biodiesel, which is produced from domestic agricultural products and/or vegetative waste oils, at a minimum rate of 0.5% (V/V), to the total of diesel obtained from the refinery, excluding the imported and land tanker filling units, in one calendar year." **After 1 January 2018, the obligation to blend 0.5 % (V/V) biodiesel to the volume of diesel has started.**

Since bioethanol is a clean source of energy that could be used by blending with oil at certain rates, it is a globally accepted type of biofuel on which numerous studies have been carried out. In our country, biofuel is produced from the fermentation of sugar beet, molasses, wheat and corn.

Whereas there are 8 factories in our country which have bioethanol production capacity, active production is performed only in three of these. Among these companies, the one which has the highest capacity is Cumra Sugar and Alcohol Factory which operates under Konya Sugar Factory. Its annual bioethanol production capacity is 84 million liters.

For bioethanol which is legal to be used in vehicles by mixing with the oil at a rate of 5%, OTV is not imposed only for the additions of 2%. Within the framework of "Circular on Blending of Ethanol to Oil Types" which was published in the Official Gazette dated 07.07.2012 No. 28346, the obligation to blend ethanol produced from local agricultural products to oil types was started on 1 January 2013.

According to this regulation, **it has become necessary to blend bioethanol, which is produced from domestic sources, to oil at a rate** of 2% on 1 January 2013, 3% on 1 January 2014, and **4% on 1 January 2015**. Today oil distribution companies such as Opet, Petrol Ofisi, Tupras, Damla Petrol and Aytemiz are blending bioethanol with oil and present to sell.

In addition to the social and economic impact which the use of bioethanol, for which the obligation of blending has started in 2014, created in Turkish economy, this leads to a raw oil replacement of 330 thousand m3 (2.1 million barrels) with the blending of 54 million lt bioethanol with oil, leading to a raw oil import saving of 203.4 million USD.

1.3. Nuclear Energy

The Law on Establishment and Operation of Nuclear Power Plants in Turkey was published in the Official Gazette dated 21 December 2007 No. 26707. With the regulations published afterwards, legal infrastructure was prepared and the agreement was signed with Russia Federation for the construction of Akkuyu Nuclear Power Plant (NGS) with a power of 4.800 MW (4x1200 MW) in 2013.

The foundations of Akkuyu NGS was built on 3 April 2018 and it is planned that the first unit will be commissioned in 2023. It is projected that other units will be commissioned until 2026 with an interval of one year each.

For the second nuclear power plant with a capacity of 4480 (1120x4) MW to be constructed in Sinop, is under consideration and negotiations are going on with the possible investor countries.

1.4. Turkey's Energy Potential and Its 2023 Targets, Energy Projections

The most important equity of Turkey is lignite and hydraulic energy (Table 2). Whereas in the 2009 targets in the "Electricity Energy Market and Supply Safety Strategy Document" of ETKB it was foreseen that the electricity energy demand of Turkey for the year 2023 would be 500 billion kWh, it could be seen that in the new scenario studies of ETKB, this value is postponed to post-2030.

Electricity demand increase rate, which was 7-8% on average annually in the previous periods, has been gradually decreasing as a result of efficiency increases in the infrastructure and technology improvements. In the new scenario studies, the annual average electricity demand for the coming 20-year period has been calculated as 2.90% for Scenario 1 (low), 3.36% for Scenario 2 (reference) and 3.84 % for Scenario 3 (high). According to this, it is foreseen that an electricity energy demand is foreseen as 375.8 in reference scenario and 385.2 TWh in high scenario for year 2023; and 481.7 for reference scenario and 515.4 TWh for high scenario for year 2030 (ETKB, t.y).

In order to reach the strategy targets, it is targeted that the share of renewable energy sources in electricity production will be minimum 30%, all hydraulic potential will be used for electricity generation, that the electric installed power of geothermal energy will reach to 1000 MWe and an installed wind energy power of 14000 MW shall be provided. On the other hand, a minimum biomass energy of 5000 MWe is targeted for solar energy,

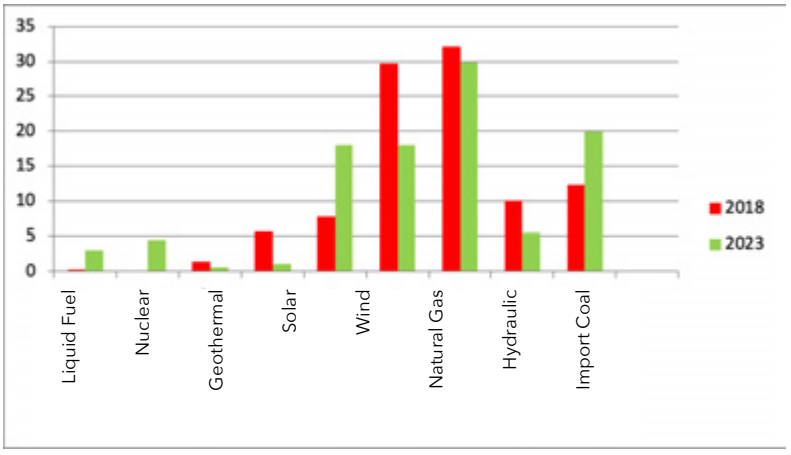
where a minimum biomass energy of 1000 MWe is targeted for biomass energy. Within this scope, Turkey aims at increasing the share of renewable resources to 30% in electric production, decrease the share of natural gas to 30% and provide 30% thereof from coal, by the year 2023. In Table 2, numbers related to the potential of Turkey on the basis of resources, current installed power and the target numbers in the strategies are given for comparison purposes.

Table 2: *Turkey Energy Resources Potential and Targets (Electric Energy Market and Supply SafetyStrategy Document Published in 2009).*

Source:	Potential	Targets* (2023)
Lignite	1 7,5 billion tones	Using all of our known lignite and coal sources for electricity production Increasing the amount of electric energy produced from domestic coal to 60 billion kW (≈10.000 MW).
Hard coal	1.5 billion tons	
The total capacity that could be established based on local coal is approximately 28.125 MW (currently operated around 10.800 MW)		
Asphaltite	82 million tons	
In 2023, share of renewable energy sources in electricity generation shall be minimum 30%.		
Hydraulic	Theoretical hydraulic potential 433 billion kWh, Economic Potential 140 billion kWh/year (36. 000MW) (currently installed around 29.000 MW)	All of the technical and economic potential
Wind	Very Efficient: 8.000 MW, Medium Efficient: 48.000 MW (currently installed around 7000 MW)	20,000 MW
Geothermal	31.500 MWt (1000 MW available for electric generation) (currently installed around 1300 MW)	Minimum 1.000 MW electricity
Biomass	44 MTOE (currently installed around 750 MW)	Minimum 1.000 MW electricity
Solar Energy	80 MTOE- Contribution in Electricity Production depending on Technical and Economic Developments (currently installed around 5000 MW)	5.000 MW electricity

When the Table 2 and Figure 8 is analyzed, the future planning followed roughly could be interpreted as follows: whereas the share of import coal and natural gas decreases, there will be an increase in the share of local coal, however intensive increases in carbon will be in decline trend proportionally with the important impact of nuclear and wind energy, and therefore it will be expected that carbon intensity will be reduced in energy production from the point of carbon intensity.

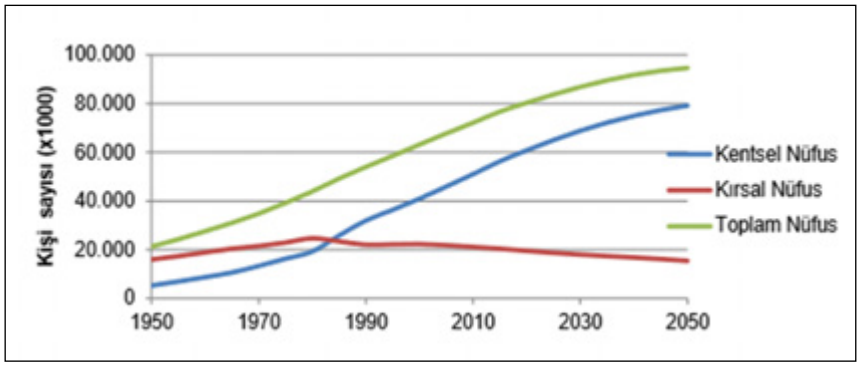
Figure 9: *Proportional Comparison of Current Status and 2023 Targets from the point of Installed Power (%) (TEIAS, 2018)*



Note: 2023 values are the values calculated by Budak Dilli according to Electric Strategy Document. This is not an exact value, it is approximate. Values for year 2018 are the October 2018 rates on the page of TEIAS.

On the other hand, it is foreseen in the projections that the increases in energy demand will continue without reducing speed. According to Turkey Electric Energy Demand Projection Report, which covers the coming twenty years to be prepared by ETKB, based on the Reference Scenario, it is estimated that the production which is accepted to be 290.2 TWh in 2017, will increase to 481.7 TWh in 2030 (ETKB, t.y).

Figure 10: *Expectation in Urban and Rural Population Change Overall Turkey by Years (Republic of Turkey, Ministry of Environment and Urbanisation, 2016).*



The increase of urban population, which had a share of 87.9% in the total population in 2016, in the medium term (Figure 10) will bring to the agenda both the new transportation need and the new settlement areas that were lost from agricultural lands. It will be necessary to access these settlement areas by means of smart transportation systems and to create new settlements with solutions developed to be self-sufficient in terms of energy and water. The agricultural and animal production which will be sufficient for the increasing population will cause us to need more energy as the agriculture will become more mechanized. Considering the fact that increasing temperatures and negative climate events are added to these as a result of the impacts of climate change, we could say that a harder and more costly period is on the way for our children.

The most important development of the coming period will be that the digital technology will totally control our lives. In our daily lives, using the technologies such as robots, automation systems and 3D printers in the agricultural fields, smart cities and house concept, buildings, energy consumption and production, the concept of "Internet of Things" which is considered to be used in such areas as finance (crypto moneys), logistics, safety and health, will bring changes in the order in which we currently live and ensure that we use our time and energy in a more efficient manner. However, this will have a correspondent as electric energy. It is also said that data mining where the Big Data collected from the machines and internet, with which we are in continued communication, has started to create a hidden energy demand overall the world. As the devices, which make human life easier and put the industry production into a new form, talk with each other, new demand increased will be seen despite the increase of consumption efficiency for the electricity energy as a result of the phenomenon called the internet of things, and Turkey, which has limited opportunities in terms of energy, will be required to be ready for this and manage demand increases so as to be carbon-free.

1.5. Turkish Energy Sector and Its Impact on Greenhouse Gases

Energy sector is the main source of human oriented greenhouse gas emission in our country as well as overall the world in relation to electricity and other purposes. Meanwhile, it follows an increasing trend due to economic growth and population increase (Figure 11).

According to the date of 2017, the greenhouse gas emission that arises from the energy sector, which is calculated as 367 Mt CO_2ton, has the highest share in terms of CO_2 equivalent with 72% within total greenhouse gas emission (AKAKDO – Land Use, Land Use Change and Forestry excluded), and it has increased by 177% compared to 1990. Due to their big share in direct CO_2 emissions which take the biggest share in greenhouse gases and which are released as a result of the burning of fossil fuels to a large extent (at a rate of 99%), fossil fuels are the main determinants of the emissions of our country as in the case of the whole world.

In the year 2017, energy sector is the most important component with a share of 42% in the CO_2 emissions as part of energy industry wherein the fuels are burn to be converted into secondary energy such as electricity, oil refinery. This is followed by transportation with 22.6%, production industry and construction with %163. House, trade, agriculture, forestry and fishery sector has constituted 19.1% of the CO_2 emissions in total.

Whereas the greenhouse gas emissions arising from energy industry was 37 Mt CO_2 equivalent in 1990, it increased to 144.6 Mt CO_2 equivalent in 2016. Within the energy industry emissions, electricity and heat production has the highest share with 94% and this is followed by oil refinery with 4% and solid fuel production with 1%.

The transportation sector emissions which are considered within the energy sector increased 203% in 2016 (highway 205%) Compared to 1990 (54.9 Mt CO_2 equivalent). Whereas diesel motor vehicle fleet which constitutes 49.5% of the highway vehicles that are responsible from 92.4 % of transportation sector emissions, constitutes 77.4% of the emission, LPG assembled vehicles, which constitute 21.5% of the vehicle fleet, caused 13.1% of the emission.

Domestic airway transportation emission increased by 364% and domestic maritime transportation emissions increased by 91%. Emissions arising from railway transportation decreased by 48% between 1990 and 2016.

The total illegal emissions for 2016 has 8.3 Mt CO_2 equivalent representing 1.67% of total greenhouse gas emissions (excluding AKAKDO), and the energy sector is responsible from all of these emissions. Whereas oil and natural gas systems constitute 32.5% of the illegal emissions, solid fuels contribution to illegal emissions at a rate of 67.5 % (Republic of Turkey, Ministry of Environment and Urbanisation, 2018).

It is necessary to concentrate on energy consumption in every sector as it takes the greatest share in greenhouse gases and in particular in CO_2 emissions and that there is a significant increase in the greenhouse gas emissions since 1990 (Figure 11).

For that reason, with the "Technical Assistance Project for Developing Solution Based Strategy and Action for Low Carbon Development", which has been carried out under the scope of Instrument of Pre-Accession Financial Assistance of the European Union by the Ministry of Environment and Urbanisation (UIDEP), actions are being carried out in order to prepare middle and long term low carbon development targets for our country in waste, building, transportation and agriculture sectors. Both the speed of increase in our energy consumption and the consumption composition of energy resources have made it necessary for the energy sector to cooperate with climate change policies. Broader evaluations in this issue will be handled in the next section of the report.

2. SECTORAL ENERGY EFFICIENCY POTENTIAL IN TURKEY: CURRENT TARGETS, BEST PRACTICES, IMPORTANT DEVELOPMENTS, OPPORTUNITIES AND CHALLENGES

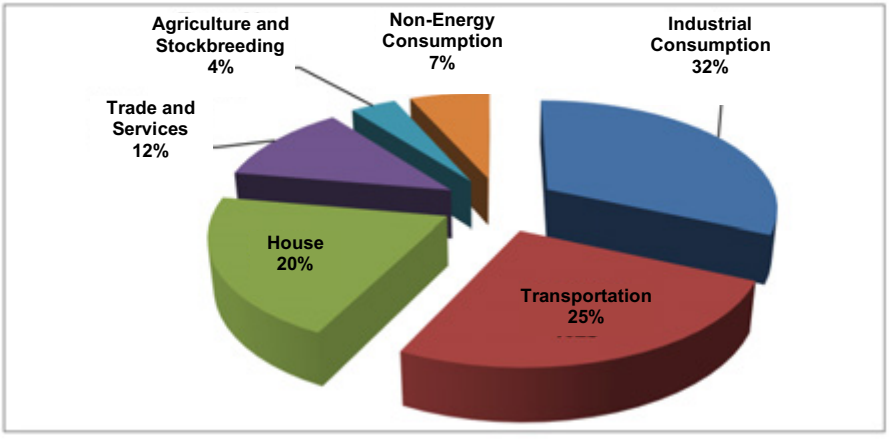
2.1. Sectoral Energy Consumption

Of the Primary Energy Consumption of Turkey for 2017, which is 145.3 MTOE, 33.5 MTOE was spent in the Cycling Sector (electric and heat production, refineries, coke production etc.), and 111.8 MTOE thereof took place as the Energy Consumption of the Final Sectors. Due to the fact that energy intensity is high, industry sector (production sector) has been holding a significant place in the total energy use for long years in Turkey.

Whereas in 2017 the Industry sector got the biggest share in this consumption with 32%, the transportation sector, energy consumption of which has increased in recent years with the increase of city population and wealth, followed this sector with 25%.

The energy consumption in Housing (20%), Commerce and Services (12%) sectors points out the energy consumption in the buildings. In this way, the total energy for heating, cooling, illumination of buildings, operation of elevators, pumps and similar systems, house and office devices reached to the same level with the industry sector (Figure 11). Of the energy consumption in buildings in 2017, 33% is covered from natural gas, 26% from electricity, 11% from coal, 19% from renewable energy sources comprising solar, geothermal energy, wood, plant – animal wastes.

Figure 11: *Turkey's Final Sectors Energy Consumption Distribution (111,8 MTOE, %)-2017 (ETKB-EİGM, ty.)*[8]



[8] ETKB 2017 National Energy Balance Table

2.2. Energy Efficiency Indicators and Sectoral Energy Efficiency Works[9]

Works related to energy efficiency has been launched by Electric Affairs Survey Administration General Directorate (EIE) at the beginning of 80s. Afterwards EIE was closed and the Renewable Energy General Directorate (YEGM), which was established with the Decree Law No. 662 On 2 November 2011, has undertaken the process and recently the unit was restructured in the form of Energy Efficiency and Environment Department under the Ministry of Energy and Natural Resources (Presidential Decree No. 27 – 10 January 2019), which is currently carrying out energy efficiency works.

In these units in question, various survey, awareness rising projects have been carried out in addition to international technical assistance programs. Heat insulation standard (TSE 825), which limits energy consumption in buildings according to regions, labels on electric house appliances, training and assignment of energy managers in industrial organizations and other various practices that found their place in our lives are among the actions taken since 1995. These practices have been strengthened by creating a regulatory framework with various regulations towards various sectors starting from the Energy Efficiency Law that was enacted in 2007.

Thus, certified training activities (Survey Project Certificate) which were organized for the authorized technical services in order to carry out energy efficiency survey in industries and buildings as well as Energy Managers for industries and buildings, have been disseminated to TMMOB Chamber of Mechanical Engineers and Universities for which training infrastructure was created for applied trainings.

With the Energy Efficiency Consultancy companies (EVD), it was encouraged to create Ministry certified consultancy market which serves to the building and industry sector with survey and trainings. Energy Identity Certificate (EKB) practice, which classifies the annual energy consumption and carbon footprint for our buildings, made it necessary to share the heating energy in the buildings according to real consumption and apply A and above energy labels in the electric house appliances.

The efficiency classes of electric motors were harmonized with the international standards. ISO 50001 Energy Management Standard has become a certification that is sought in the industry sector since it become a precondition for incentives. Grant programs were launched for SMEs and side industries and green loans that relied on international financing were started to be given by our banks. Numerous regulations have been enacted for these regulations and strategy-action plans and targets with actions were determined.
Despite these developments, the energy policy of the country was building on meeting the energy need with new energy supply as priority as in the case in many countries since the earnings obtained and to be obtained by energy efficiency could not be dimensioned completely in the energy plannings.

It has been accepted for long years that the rapidly growing energy demand is a natural result of economic growth and the energy policies were developed in this direction considering that new natural gas and oil lines as well as plants relying on

[9] For the data and energy intensity assessments in this section, National Action Plan was taken as resource, data which could be updated were replaced with the new ones.

fossil and import resources are absolutely necessary.

Due to this mind-set and the fact that direct accountability of energy efficiency is possible only with detailed sectoral analysis works, the energy efficiency potential could not be evaluated as a source at hand until recently.

Developed countries have supported comprehensive energy efficiency programs which they have carried out for the last 40 years starting from the oil crisis and also supported energy efficiency technologies, reaching to conclusions that will break the correlation between increase in energy demand and the economic growth. The process of climate change has lead the plans and policies towards replacing this energy demand with efficiency increases to a large extent, to become efficient. The results have been reflected to energy intensity indicators in digital terms.

Energy intensity indicators is one of the basic data used for comparing energy efficiency overall the world, though it has some weaknesses. Not only the decline in energy consumption, but also the increase or decrease of Gross Domestic Product or Value Added are evaluated to see how the energy consumption affects economic development.

For example, whereas the total energy consumption of OECD countries, which mainly comprise developed countries, did not increase, it reversed back in 2015 to be same with 2002. In the same period, Gross Domestic Product increased by 23%.

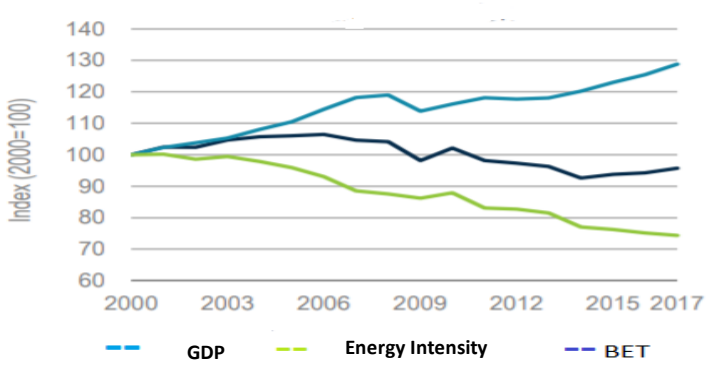
A similar development in the EU could be seen as 30% increase in GDP in 2017 and 25 % decrease in energy consumption based on the 100 index in year 2000[10] (Figure 13).

Box 1 : Concepts in Energy Efficiency

- ***Energy Efficiency*** is the decrease in the amount of energy spent for a certain service (heating, cooling etc.) or production, using technologic practices or non-technical measures (better organization and management, behavioral changes etc.).
- ***Energy Saving*** is the `+` energy recycled with efficiency. Sometimes saving could be provided by not using the energy where it is not required by increasing efficiency.
- ***Energy Intensity:*** Amount of Energy Consumed for Producing a Unit Economic Value (Gross Domestic Product or Added Value) E/GDP. Decreasing the energy intensity is the decrease of energy consumer for each unit of return or added value created (E= million TEP Primary Energy Consumption, GDP: Gross Domestic Product (1 million Turkish Lira or 1000 USD or Euro)

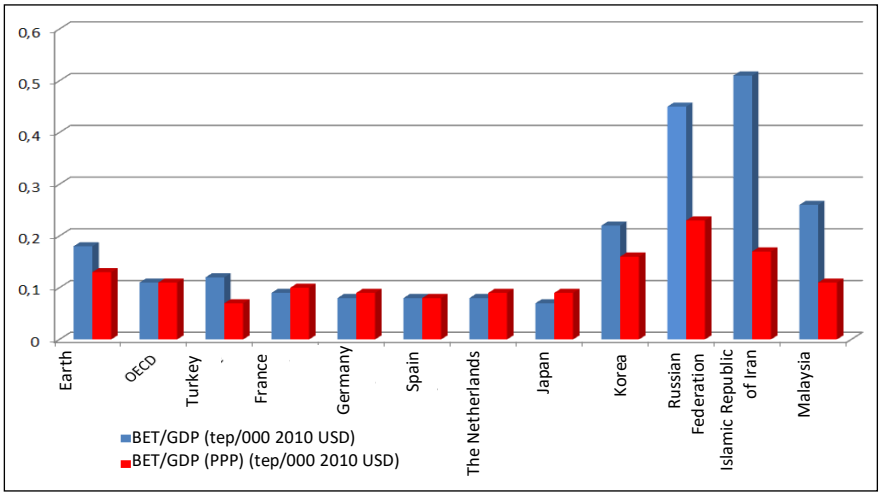
[10] Index: Indicator when annual developments are compared taking year 2000 as 100.

Figure 12: *Primary Energy Demand in OECD Countries Between 2000 – 16, GDP and Energy Intensity Development (IEA, 2017b)*



Energy intensity values of Turkey is above OECD average and developed countries as could be seen below. However, taking into account the purchasing power parity, Turkey's energy intensity is at the same level currently with other developed countries, and under many developing countries and world average (Figure 14).

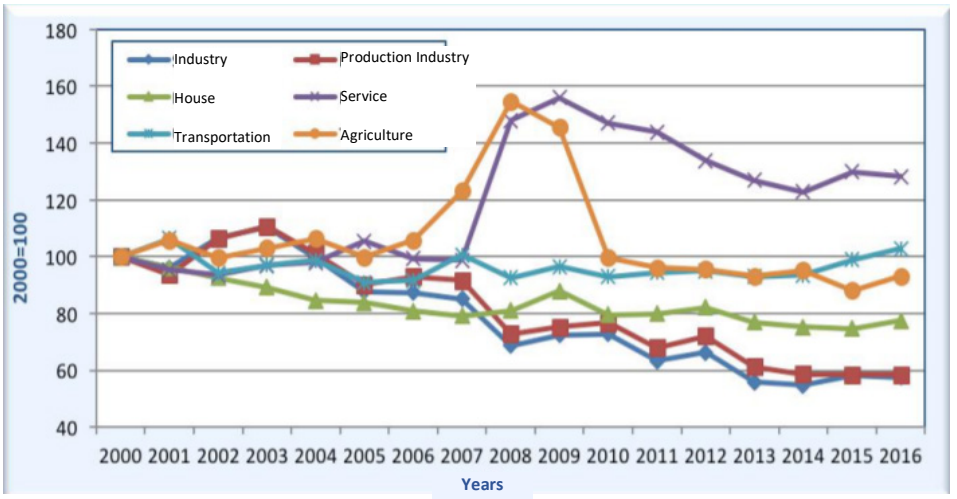
Figure 13: *Energy Intensity Comparison in Certain Selected Countries, 2016 (IEA, 2018a)*[11]



According to the sectoral energy intensity assessments made by MENR, generally improvements are observed in the energy intensity in Turkey in 2000- 2016 period.

[11] Drawn with numbers from Key Word Energy Statistics 2018 – Selected indicators for 2016

Figure 14: *Energy Intensity Index Development on Sectoral Basis (YEGM, 2017)*



According to MENR-GDRE Analysis, when considered on sectoral basis, the sector which demonstrates the most improvement is the industry sector with an improvement rate of 42.5%. The improvement rate on annual basis in the energy intensity of the industry sector was 3.4%. It is considered that the increase in the share of construction sector, which creates high added value despite low energy consumption, from 19% in 2000 to 25% in 2016, has had an effect in the improvement in question (GDRE, 2018).

Energy efficiency index is an important indicator in terms of demonstrating the contribution provided to country economy with the improvement of energy efficiency and energy saving provided in the primary and final energy consumption in housing and transportation sectors. According to this index, there has been an improvement of 1.8% annually in the production industry in 2000 – 2016 period, 1.1% in building sector and 2.4% in the transportation sector. In total, an improvement of 2.1% has been provided on annual basis in the energy efficiency (EYODER, 2017).

It was calculated that, with the energy efficiency precautions taken, a saving of 9.8 mtoe in construction sector, 7.7 MTOE in housing sector and 24.9 MTOE in transportation sector, and 42.5 MTOE in total has been ensured on cumulative basis in 2000 – 2016 period.

2.2.1. Energy Efficiency in Industry Sector

Industry sector, which has a share of 26% in our GDP, has continued a continuous trend of growth, and has been the locomotive sector of growth in our country as in the case of many other countries. Turkish economy where 32 % of final energy consumption in 2017 and 46% of the net electric consumption took place in the industry sector, is one of the "energy intense" economies compared to developed countries.

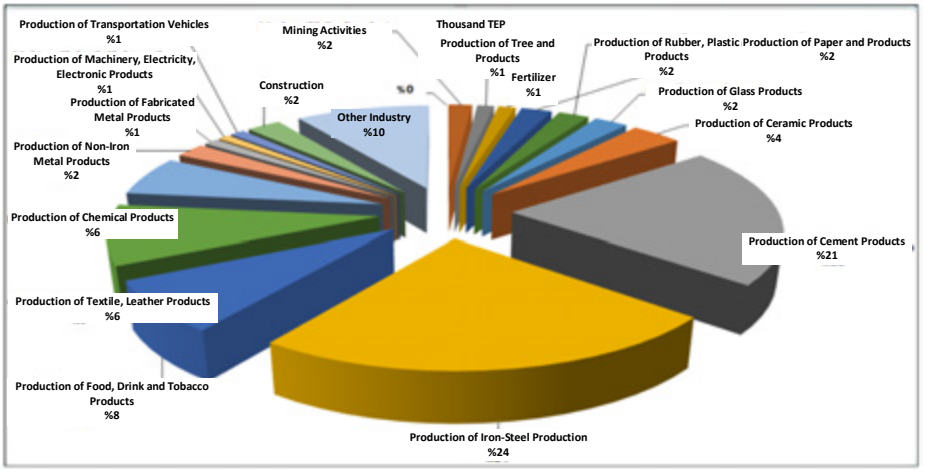
53% of the energy consumed in the production sector in 2017 has arisen from sectors with high energy intensity such as metal, cement, glass and ceramic (Figure 16).

Structural changes in the last 8 years has been effective significantly in the improvement on the annual basis in the energy intensity of industry sector.

The fact that the energy costs are one of the biggest burdens on the enterprises in particular in energy intensive sectors (enterprises where energy costs in production costs are above 15%), has made energy efficiency an area of priority and significant results have been obtained on this issue with the studies conducted. The most important improvement in energy efficiency in 2000 – 2016 period was in the iron steel sector with 3% on annual basis. This is followed by the glass sector with 2%.

On the other hand, SMEs where the cost of energy consumption is around 2-15 on average among the total costs, constitute 99% of the enterprises in Turkey in numeric terms, 46% of the employment and 35% of the total added value, around 400 thousand enterprises at SME size which operate in the manufacturing sector are expected to be more efficient in terms of energy consumption.

Figure 15: *Distribution of Energy Consumption to Sub-Sectors in Industry (MENR GDEA, t.y)*



Improvements that could be made in the field of energy efficiency in the industry sector provide important opportunities for process efficiency, enhancing technologic development level and mitigating greenhouse gas emissions in addition to the mitigation of energy consumption. In order to improve energy efficiency: Around 250 areas which have energy saving potential have been defined in the industrial facilities in ancillary units (boilers, pressurized air systems, electric systems etc.) and production equipment (weaving machine, dying, drying units, press, tempering furnace etc.). Many of these could be adapted to industrial facilities at every dimension with small adaptations to all sectors and from SME scale to large sized industrial plants. Some of these are (Keskin, t.y):

- Implementing ISO 50001 Energy Management standard and monitoring energy consumption together with such parameters as production, outside temperature etc. and increasing awareness about losses.
- By repairing all the leakages and preventing the loss of production flows obtained by spending energy such as fuel, gas, water, pressurized air, steam, condensate and hot fluid, cold air.
- Ensuring and maintaining suitable burning efficiency by adjusting the non-adjusted boilers;
- Surface insulation of hot and cold pipes and equipment,
- Maintenance and repair of steam traps, reducing steam condensate losses;
- Maintenance of worn belt pulley systems, dirty and unmaintained motors, dirty lamps;
- Changes in process operating characteristics; reducing the temperature of dye tank (e.g. from 90 °C to 80 °C, adjusting the pressurized air pressure, producing air with a maximum height of 2 bar when machines are used), isolating the unused production equipment from the system (separating the spare boiler which is not operated from the system);
- Performing recycling from the waste heat of processes with equipment such as Heat Exchangers, Economizer, Recuperator (from water, chimney gas etc. heat wastes) and reuse of the heat, therefore of the energy
- Saving in steam systems with the replacement of condensate cycling systems and steam traps;
- Replacement of pressurized air system and equipment;
- Adjustment of power factor;

- Automatic combustion control systems;
- High efficiency illumination systems;
- High efficiency engines, fan operating at low capacity with variable speed drivers, pump, electric saving in systems such as compressor;
- Efficiency increasing practices in electricity systems and soft starter and process automation systems.

In the industrial facilities, there is always an energy saving potential that could be recycled. These could most of the time be recycled with known measures and practices. There are various studies and supportive structures within the scope of strategies and regulation in order to restore this potential.

With Energy Efficiency Law, industrial organizations which have an annual energy consumption of 5000 TOE and above are granted with the obligation to perform energy efficiency surveys and those with energy consumption of 1000 TOE and above to create energy management.

Besides, various support mechanisms have also started to be implemented towards encouraging energy efficiency such as Efficiency Increasing Projects (VAP) and Voluntary Agreements. Energy efficiency projects, which will be conducted in manufacturing facilities with a minimum annual energy consumption of 1000 TOE, are designed to provide a minimum energy saving of 20% compared to the current status, with simple repayment period of 5 years and less and price of which does not exceed 5 million TL, are supported at a rate reaching 30% (1.5 million TL). Industrial organizations which undertake to reduce energy intensity at a rate of 10% on 3-year average use energy support at an amount of 30% (maximum 300.000TL) of the energy expense of the year when the agreement is concluded within the scope of Voluntary Agreement and industry and commercial enterprises above 500 TOETOE and make energy efficiency investment could benefit from incentives provided to investments to be made in the fifth region.

With the "Energy Efficiency Strategy Document" it was targeted to reduce the energy intensities in each industry sub-sector so as not to be less than 10% at rates to be determined in sectoral collaborations. In order to reach this objectives, various actions have been defined such as encouraging investments that ensure increasing energy efficiency, and determining measures to be implemented in energy efficiency with saving potentials in industry sub-sectors.

Within the scope of "Energy Efficiency Development Program" under the Tenth Development Plan, actions were defined such as replacing low efficiency AC electric motors with those with higher efficiency, improving the mechanisms for supporting the training, survey and consultancy services of SMEs concerning energy efficiency and disseminating the technologies and best practices in the field of energy efficiency among SMEs.

Within the scope of "Energy Efficiency Action Plan" which was recently published in 2018, 7 actions were defined in line with the strategic objectives defined above such as increasing energy efficiency in the industry and technology sector and thus carrying out support activities for this purpose, preparing energy saving potential map in the industry, increasing project variety, defining new support mechanism, disseminating cogeneration systems in big facilities that use heat, and implementing environmentally sensitive design and labelling system in the devices.

2.2.2. Energy Efficiency in the House and Services Sector

Turkey is the country with the most rapidly growing building stock in the European continent with a new building rate of more than 4%. When compared with the growth rate of the EU (less than 1%), this rate is more than 4 folds. This situation leads the construction sector to become one of the most important locomotives of Turkish economy with a real GDP contribution of 6.6%. It is expected that this percentage will increase further in the future due to new construction activities. It is expected that the building stock which is currently 2.400 million m^2 will grow more than 50% and reach to almost 4.000 million m^2 by the year 2050.[12]

This clearly demonstrates that one of the most important basis towards accomplishing climate protection targets of Turkey as defined in the Intended National Declared Contribution of Turkey which is presented to United Nations Climate Change Framework Convention Secretariat in 2015 (INDC) is the building sector in Turkey.[13]

According to the data of Turkish Statistics Institution (TUIK), there are 9.1 million buildings in Turkey as of 2017 and around 87% of this amount comprises the buildings with housing character. Number of houses is more than 22 million[14]. According to building utilization permit statistics, more than 100.000 new buildings are added every year to the building stock of Turkey. As it could be seen from the statistics in question, Turkey has a rapidly growing and transforming building stock. In this scope, it is possible to provide significant amount of energy saving by making the buildings to be newly built efficient and improving the existing buildings.

Besides, buildings and services sector has a significant potential in relation to the use of renewable energy sources and on site production.

Of the 36 million TOE energy consumed in 2017 in the buildings, 64% is in the buildings with housing nature. Energy consumption structure of House and Service buildings is very different in terms of electricity consumption. The electricity energy consumption rate of trade service buildings is 42%. In houses, natural gas is consumed with a weight of 44%.

When the energy consumption in housing sector is controlled by adjusting from the climate effect, it could be seen that this increased by 41% in 2016 compared to the year 2000. Energy consumption in the houses is directed more to natural gas, and the rates of oil, wood and coal in the consumption decreased and the solar energy and electricity consumption increased significantly (annually 3% increase per house). Despite the important efficiency increases in electric house appliances and illumination devices, electricity consumption has increased in the houses together with the increase in wealth and urbanisation.

The energy consumed for heating up to area per m^2 in houses (60% of the energy consumed in houses) decreased by 1.7% as adjusted for climate impact on annual basis. The most important reason for this is that the heating systems that shifted to natural has are more efficient, that the heat insulation is improved by almost two folds with the heat insulation in buildings regulation, and that the efficiency of stoves that burn coal and wood has increased.

[12] Turkey Building Sector Energy Efficiency Technology Atlas Executive Summary, March 2018, GIZ

[13] Implementation of comparative methodology towards cost efficiency under the scope of "U-Value Maps for Turkey, Energy Performance in Buildings Regulation (EPBD)"- Ecofys 2016.

[14] TUIK building counting statistics and annual building utilization permit statistics for year 2000 were used.

Service sector covers sectors which do not have any production/ operation action such as retail, tourism, food services, banking, computer services, and its share in energy consumption and employment has been rapidly increasing.

The energy consumption of this sector which mainly consumes electricity increased by 170% in 2016 compared to year 2000. The electricity consumption which has a share of 41% in this sector demonstrates an annual increase of 7%. The electricity intensity of this sector, which is one of the most negative sectors in terms of efficiency, has increased by 44.4%. The increase in the energy intensity per working person is worse. One of the most important reasons for the negative position of this sector in energy efficiency, is the shopping centers that have excessively heated and cooled areas as well as the business plaza investments that have high need for high pump, air conditions and motor, which are the most important components of retail sector.

Currently there are 412 Shopping Centers currently operating in Turkey. The total investment amount of these is around 53 billion USD level. Besides, the construction of 10-12 Shopping Malls is ongoing in 2019. Whereas the total turnover of Shopping Centers was 130 billion TL in 2018, it is foreseen that the turnover will reach to 160 billion TL in 2019 (Diken 2019). However, fast increase of e-trade creates commercial risks on the profitability of Shopping Centers. For example, this situation constitutes a great hardness for the Shopping Centers in the USA. With the increase of e-trade, shops turn into stacks of concrete and become dead investments. As a consequence, the shops are closed and their operating costs increase. In a projectable near future, this trend will rapidly continue. A similar development is also possible for Turkey and the most important measure is to increase energy efficiency in order to decrease operating costs.

Building sector is responsible from 16% of total greenhouse gas emissions in 2016. The energy consumption of the buildings has increased by a rate of 4% yearly since 1990. Whereas the speed of energy consumption increase has a decline trend as a result of energy efficiency activities, the speed of building stock increase is one of the potential risks in terms of increase of greenhouse gas emissions.

TS 825 Standard has become an obligatory standard after being published as "Obligatory Standard Communique" under "Regulation on Heat Insulation In Buildings" after 2000 and has been put into force in order to define the procedures of calculation heat energy demand of buildings to be newly constructed and to also define various threshold values.

Thereafter, Regulation on Energy Performance in Buildings, was published in order to reach the targets defined under Energy Efficiency Law and ensure compliance with similar directives of the EU. Within this framework, energy efficiency works are being carried out in both public and private sector buildings overall the country. It is required that the new buildings shall have minimum Class C Energy ID Document according to the Regulation. Whereas it is necessary for the existing buildings to have energy ID document, the obligation to have energy ID documents in sales and leasing processes was postponed to year 2020. Energy ID Document software was developed in BEP-TR 2011 and recorded in the EKB documents of the buildings since 2012. The class certificate of around 800.000 buildings (October 2018 – TC CBS) at level C and above has been prepared by around 5500 EKB experts and recorded by the Ministry of Environment and Urbanisation.

Green buildings and settlements; Buildings with almost "0" energy have become more in the agenda now. Currently many buildings in the World have

new building certificate system. Among the leading of these is the one emerged in the UK in 1990, BREEAM (Building Research Establishment Environmental Assessment Method), the one emerged in the USA in 1998, LEED (Leadership in Energy and Environmental Design), IISBE (International Initiative for Sustainable Built Environment) which was established in 1998 by developed countries coming together, Greenstar which was created in Australia after adaptation from BREEAM in 2003, CASBEE (Comprehensive Assessment for Building Environmental Efficiency) which appeared in Japan in 2004 and DGNB (Deutsche Gesellschaft fur Nachhaltiges Bauen) which appeared in Germany in 2009. Buildings are also constructed in Turkey in accordance with these certifications wherein conformity with such criteria as Integrated Green Project Management, Land Use, Water Use, Energy Use, Health and Comfort, Material and Resource Use, Life in House, Operating and Maintenance and Innovation is evaluated. For example, number of buildings that have the widely used LEED Certification is 830.[15]

New regulations are issued by the Ministry of Environment and Urbanisation on this issue. The "Green Certificate for Buildings and Settlements Regulation" which was issued for creating evaluation and certification (green certificate) systems in order to decrease the negative impact on environment using by enabling buildings and settlements to use natural resources and energy in an efficient way taking into account the technical specifications and requirements of the existing and new buildings and settlements, and determining their tasks, characteristics and responsibilities of those who will take role in evaluation and certification process, has come into force on 23 December 2017.

Within the framework of Regulation on Increasing Efficiency in the Use of Energy Sources and Energy, energy efficiency surveys are conducted in the public buildings and studies are being carried out in order to implement the potential determined. It is foreseen that the annual energy consumption of public buildings will decrease by 20% by 2023.

Various strategies have been defined in Turkey towards increasing the energy efficiency in buildings and decreasing energy consumptions arising from buildings, and studies are being carried out towards implementing the tasks determined. Within the scope of Climate Change Action Plan 2011- 2023, various objectives have been defined towards increasing the share of renewable energy in electricity production and the energy efficiency.
Under the strategic purpose titled "decreasing the energy demands and carbon emissions of buildings; and under the strategic purpose titled "disseminating sustainable environment friendly buildings that use renewable energy sources", actions have been defined towards "bringing maximum energy requirement and maximum emission limitation to buildings" and "imposing administrative sanctions on those which are above the minimum value defined in the regulations in relation to Carbondioxide emission amounts". Besides, the same document includes actions towards "requiring sustainability in licensing the buildings" and "disseminating the on site production practices in the mass houses" under the strategic purpose titled "at least one fourth (1/4) of the building stock in the year 2010 will be turned into sustainable structures by the year 2023" in the same document.

Under the scope of Energy Efficiency Development Program Action Plan under Tenth Development

[15] See https://www.usgbc.org/projects

Plan, a component titled "Improving Energy Efficiency in Buildings" is defined and under the component in question, actions have been defined for developing financial mechanisms and improving the regulations for the purpose of increasing energy efficiency in buildings.

12 actions have been defined under the scope of Energy Efficiency Action plan for the purposes of increasing energy efficiency in the building and services sector in line with the strategic targets defined above. The actions in question cover such issues as improving the efficiency classes of the buildings to be newly constructed and the existing ones, putting into life the saving potential in the public sector, disseminating the on site production and renewable energy use in the buildings, performing a comprehensive building inventory study and carrying out awareness studies that address all segments.

2.2.3. Energy Efficiency in Transportation Sector

Together with a fast period of integration in the world, innovations reached in technology, intensification of the population in cities and the economic development, the demand towards quality, safe and comfortable transportation services has increased and as a result of this the transportation sector has become a rapidly growing dynamic sector. The fact that this development in the transportation sector continued on the axis of highway transportation that depends on oil brought together many problems such as ensuring energy supply safety, environment, air and noise pollution, distortion of the natural areas and health problems, making it necessary to use energy effectively and efficiently in the transportation sector.

In 2017, around 25% of the total final energy consumption of Turkey took place in the transportation sector. This sector is a sector that is in the trend of having increased energy consumption and energy share. It has increased at a rate of 5.1% on average annually in the last 16-year period. This rate is only 0.3% in EU28. The sector which perform transportation services at the highway at a rate of 92% is based on oil at a rate of 99% (ETK- EIGM ty).

Together with this, the energy intensity in transportation did not increase due to the replacement of vehicle fleet with new and efficient vehicles, but on the contrary decreased in some years.

The number of vehicles has been continuously increasing since 1990. The total number of vehicles registered in the traffic was 3.8 million in 1990, and this number reached to 22.9 million as of the end of 2018 December. Of these vehicles, 54.2% are automobiles, 16.4% are trucks. Of 12.4 million automobiles registered in the traffic, 37.9% are LPG fueled, 36.8% are diesel fueled and 24.9% are oil fueled.

The average age of motor land vehicle fleet in Turkey is determined as 13.4%. Whereas the average age is 12.6 in automobiles, the tractors that constitute 8.3% of the vehicle fleet is the group with the highest average age, which is 23.2 years (TUIK, 2019a). With the increase in the number of LPG vehicles, which have the lowest carbon intensity, there was an effect of decrease in the greenhouse gas emission in highway transportation despite the increase of the number of vehicles.

In our country, it is possible to increase energy efficiency in the transportation sector with the measures to be taken and thus decrease the foreign dependency of the country in oil.

In order to ensure a balanced distribution among the modes in the transportation sector, it is important to develop combined/ intermodal/ multimodal transportation practices in the transportation of passengers and goods, increase the shares of railway and maritime transportation and shift to corridor approach in transportation planning. In this direction, there is the target of increasing the share of Turkey in railway goods transportation by 15% and share of passenger transportation by 10% under "Turkey Transportation and Communication Strategy Target 2023". By this means, it is planned that the share of highway load transportation will reach to 60% and the share of passenger transportation will reach to 72% by the end of 2023. Railway load and passenger transportation has grown more than 10% between 2017 and 2018.

Table 3: *Comparison of Modal Distribution of Turkey and EU Sub Sectors 2018 (%)*

Load (tonnes-km)				
	Highway	**Railway**	**Maritime and Inland Waters**	**Highway**
EU-28	76,4	17,4	6,2(1)	
Turkey	89,2	3,9	6,9(2)	
Passenger (passenger -km)				
EU-28	82,2	6,7	0,4	10,7
Turkey	89,3	1	0,3	9,4

Source: Year 2019 Presidency budget Table II: 51; EU Transportation statistics 2019 and Ministry of Infrastructure, TCDD

- Maritime and coast transportation is not included for EU 28 countries, and includes only inland water transportation data.
- This is the Coasting transportation data for Turkey
- Excludes in-city transportations.

The fact that the average age of around 23 million moto vehicles, which is 12.4, is high constitutes a negative condition both for the fuel economy and for the environment. For that reason, certain regulations and incentives are implemented in our country in some periods towards removing the vehicles with old model age to scrap.

Within the framework of tax incentives, around 400.000 vehicles aged over 20 have been removed from the market between 2013 and 2014 and this had been effective on mitigating the emission. From time to time, tax discounts are applied for scraping the old vehicles in order to increase efficiency in fuel consumption and to provide incentive to the automotive sector when there is a shrinkage in the sector.

A regulation was recently made with the Motor Vehicle Tax General Communique with Serial No. 48 published in the July of 2017, and incentive was provided for scraping the motor vehicles which are registered recorded in the traffic registry and model years of which are 1997 and older (whereas it was applicable by the end of 2018, it was extended to the end of 2019 with the communique No. 50).

Besides, the Ministry of Treasury and Finance has launched a regulation for decreasing the tax in electric motor vehicles in February 2011 in order to encourage the use of electric motor vehicles. Together with this, in the automobile market which is more expensive compared to normal vehicles, there was no additional increase in the number of electric and hybrid vehicles that are more efficient that internal combustion motor vehicles, and this segment vehicle fleet did not reach to a size that could cause a change in the sector both in numerical terms and in terms of the number of charging stations.

155 electric vehicles and 3.899 hybrid vehicles have been sold in 2018. The number of electric vehicles sold in Turkish automobile market since 2012 as of February 2019 is 669, and the number of hybrid vehicles sold was 10.133.

When the sales of electric vehicles overall the world is considered, the market increased by 40% in 2016 due to the expansion in production capacity, a wider model range and the developed vehicle performance. Together with this, lower oil prices caused the increase of sports vehicle sales, which decreased the global improvement rate in the fuel efficiency of large vehicles, in particular the automobiles, which are less efficient.

Although such type of vehicles provide important contribution to the air and noise pollution in the cities, since the electric vehicles are charged with the electricity provided from the interconnected grid, this has a negative impact in terms of emission at the end of the day. For that reason, dissemination of stations that provide charging with renewable resources should be developed in parallel to supporting electric vehicles.

In order to create a sustainable transportation system in our country, it is highly important to plan and operate the transportation infrastructure in an integrated manner, ensure integration of transportation modes with each other, decrease the unit fuel consumptions of vehicles and develop policies and strategies which will minimize the danger on environment. In this regard, with the Energy Efficiency Strategy Document, which is one of the main documents that handle the issue of energy efficiency in transportation in our country, it was targeted to decrease unit fossil fuel consumption of motor vehicles, increase the share of railways in load and passenger transportation and public transportation within the cities, prevent the unnecessary fuel waste in in-city transportation and decrease emissions that are hazardous to the environment.

With the Climate Change Action Plan 2011 – 2023, it is aimed at balanced use of transportation types in load and passenger transportation, restructuring the urban transportation in line with sustainable transportation principles, disseminating the use of alternative fuel and clean vehicle technologies and increasing the efficiency in the energy consumption of the sector. Besides, there are measures towards transportation sector in the National Smart Transportation Systems Strategy Document (2014 - 2023) and Action Plan prepared by the Ministry of Transportation, Maritime and Communication, which aims at adapting the information and communication technologies to the transportation sector.

In addition to the documents in question, the municipalities also demonstrate their local targets and objectives with their transportation expertise plans which they have published and their activities are being carried out in this direction. The issue of energy efficiency in transportation is being handled in policy documents produced by different organizations and institutions similar to these.

In the Energy Efficiency Action Plan, which handles the issue of energy efficiency in transportation that is clearly seen to have a significant place in the policies and strategies of our country, there are 9 actions towards the transportation sector in order to encourage energy efficiency and provide sustainability. Priority action areas are indicated as encouraging energy efficient vehicles, developing comparative works related to alternative fuels and new technologies, developing and improving bicycle and pedestrian access, mitigating the use of automobile use for the purposes of alleviating the traffic intensity in cities, dissemination of public transportation, developing and implementing corporate restructuring for urban transportation, strengthening maritime transportation, enhancing railway transportation and data collection towards transportation.

3. FINANCIAL ANALYSIS OF FOSSIL RENEWABLE ENERGY SOURCES AND FOSSIL ENERGY SOURCES AT GLOBAL SCALE

The global energy investments in 2016 continued to decrease (12%) and it was 1.7 trillion USD which is equivalent to 2.2% of global GDP overall the whole energy sector from oil and gas explorations to energy efficiency.

Box 2: Adjusted Electric Generation Cost Analysis

For the calculation of lifelong cost of electric production facility, not only the initial cost but many other costs as indicated below are taken into account.

- ***Fixed operation and maintenance*** – annual costs independent of production.
- ***Variable operation and maintenance*** – Changing depending on the amount of electricity produced
- ***Fuel cost*** – Fuel cost foreseen in IEA World Energy Outlook
- ***Heat income*** – Earnings obtained from the sales of heat (valid only for combined heat and energy plants)
- ***System costs***
  - *Balancing costs* – Costs of overcoming the deviations from the planned production
  - *Profile costs* – Value of the electric production compared to average electric production price in the market
  - *Network costs* – Costs for expanding and adapting to electric distribution transmission infrastructure
- ***Climate***
  - *CO_2 emission costs – Price foreseen by IEA or international organizations for the future.*
  - *CH_4 emissions CO_2 equivalent cost*
  - *N_2O emissions, CO_2 equivalent cost*
- ***Air Pollution***
  - *Socio-economic cost of SO_2 - SO_2 emissions*
  - *Socio-economic cost of NO_X - NO_X emissions*
  - *Socio-economic cost of PM2.5 - PM2.5 emissions*
- ***Other costs***
  - *Radioactivity – Socio-economic value of radioactivity*
  - *Other costs defined by the user specific to the condition*

Around 42 % of all investments have been made for the supply of oil, gas and coal and mainly for the extraction and transportation of these resources. These investments, namely the investments made to fossil fuels decrease by 25% compared to the previous year, and the total investments to energy efficiency increased by 9% in 2016, reaching 47% of the total energy investment made in the same year. This demonstrates us that the world has refrained from the habits of meeting its energy need from new energy supply resources, and started to invest in efficiency in order to better evaluate the existing resources (IEA,2017b).

Expenditures that support energy efficiency have intensified on building heat insulation, and changing the heating system and electrical house appliances. Efficiency increases in transportation took place with the expenditures made with electric vehicles.

On the other hand, whereas the monetary size of global renewable electric energy investments seems to have decreased by 3% more compared to 5 years ago, the added capacity 50% and the expected production amount is 35% more. The most important reason for this is that the solar PV and wind investment costs have rapidly decreased with the technologic developments. On the other hand, the increase of competition in the market due to the increasing number of equipment producers and the growth of active and experienced project developers at the international arena, as well as the increase of experienced in the realization of projects cause these investments to increase and unit costs to fall. Thus, renewable energy has started to be an important alternative for fossil fuels.

As the renewable energy costs decrease, the renewable sources become more competitive in meeting the need for electriciy production. Costs

have started to fall for the projects which have been commissioned in 2017 and the production cost of most of the projects has come back to the fossil fuel costs interval.

In 2017, the cheapest current electricity source in the USA has been the renewable energy sources without subventions due to rapid cost decreases. It was revealed that in many regions of the USA constructing new wind plant is cheaper than operating the existing coal plants and the wind plants, nuclear and natural gas have a head to head value. As the renewable energy costs continue to fall rapidly, the fossil fuels in the USA continue to force more in profitability and it could be seen that all closed plants and fossil fuel plants.

The contests/ tenders that have taken place in recent period confirm that the renewable costs will continue to fall after 2020.

IRENA has prepared a new database which brings together the results of around 7000 contests in addition to "Renewable Costs Database". Although it is not possible to directly compare the figures included in these databases, analysis give important results in relation to the development of renewable costs.

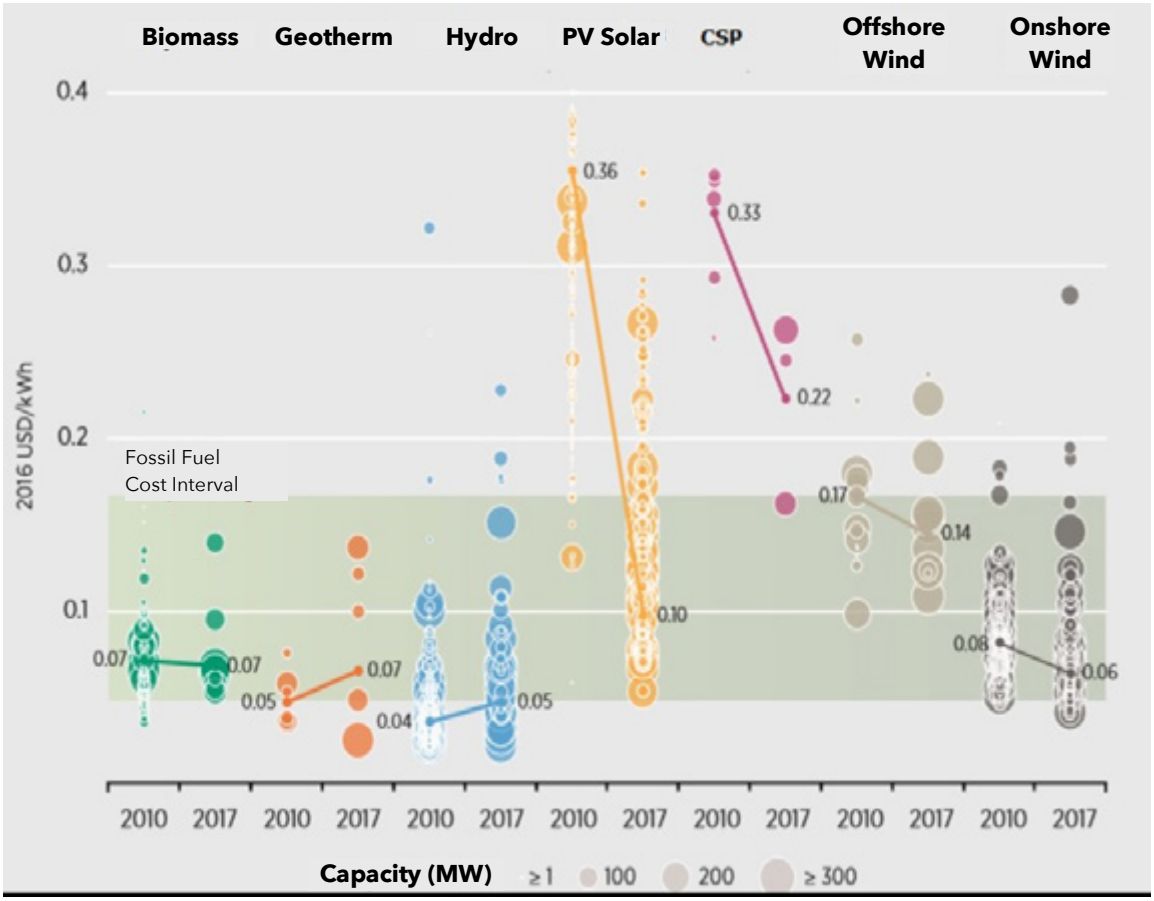
Levelized Costs of Electricity (LCOE) is an indicator that is used for comparing the economy of different electricity production technologies in a correct way by taking into account the initial investment cost of the plant as well as the operating cost during and presumed life. Among the main costs that are taken into account in the calculation of LCOE are capital costs, fuel costs, fixed and floating operating and maintenance costs (O&M), financing costs as well as the presumed utilization rate for each type of project (Box 2) (EIA, 2019).

In the last 30 years when environmental sensitivity has increased much, life cycle analysis' are performed for many productions and these are also applied for the energy sector where the greenhouse gas emission is produced the most. By this means, many energy facilities that are different from one another are evaluated under a common unit roof and damage on the environment could be compared.

Below Figure 19 is the Adjusted Electric Energy Market comparison work performed by Lazard. As it could be seen from here, the dissemination of renewable energy production technologies continued and accelerated in the year 2017 and reached to a level to compete with fossil resources.

Data collected by International Renewable Energy Agency (IRENA) demonstrate that although the cost of hydroelectric, biomass, geothermal energy and land wind projects change for some amount depending on the project size and the resource potential of the project region, it is in the same interval to a large extent with fossil energy costs (0,07) and it was demonstrated that the corrected electric cost (LCOE) was between 0,05 – 0,07 USD per Kilowat-hour (kWh) approximately.

Figure 16: *"Adjusted Electricity Costs" comparison which occurred in the practices of renewable energy production technologies in energy service companies and change between 2010 – 2017 (IRENA, 2017: 17)*



NOTE: *The diameter of the circles demonstrates the size of the project. The center of the circle shows price on y-axis and the year in which the contest takes place on x-axis. The thick lines mainly give the LCOE average or the results of contest/ tender. The green area shows the fossil fuel costs interval.*

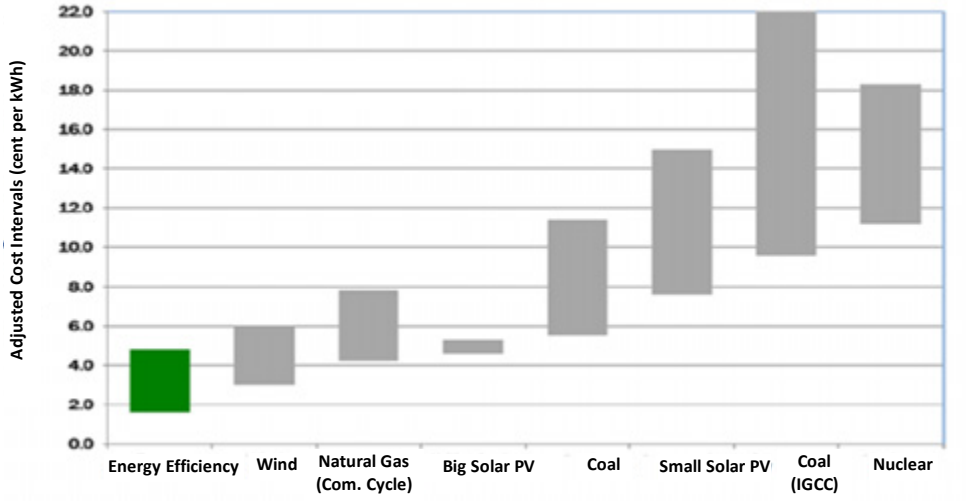
It could be seen that the cost of solar PV per kWh decreased from 0.36 USD in 2010 to 0.10 USD in 2017, that the cost for a project sized 100 MW in Concentrated Solar Plant (CSP) decreased to 0.17 USD and the cost for offshore wind project with of 2000 MW decreased to 0.14 USD level (IRENA, 2018).

On the other hand, investments made to energy efficiency which have a dimension closer to renewable energy investments continued to increase despite the low energy prices in 2016 and reached to 231 billion USD. Whereas Europe was the region which had the highest investment to energy efficiency, China which has strengthened its policies in addition to structural changes accomplished to ensure the highest energy efficiency in 2016 and decreased the energy intensity of its economy.

Globally, a major part of energy efficiency investments – 133 billion USD – was invested to the building sector that constituted one third of the total energy demand. The growth in energy efficiency investments in the USA demonstrated a striking increase in the role of energy efficiency in the electric sector. Today energy efficiency is the 3rd biggest electric production source in the electric system of the USA and provides contribution to the system more than the nuclear power (Gilleo, 2017).

In the study of Lazard related to the adjusted costs of electricity supplied to the market in November 201, it was demonstrated that electric companies assisted their customers to purchase house appliances, insulate their houses and workplace buildings and improve operating and maintenance applications, and that they invested in the lowest cost energy source.

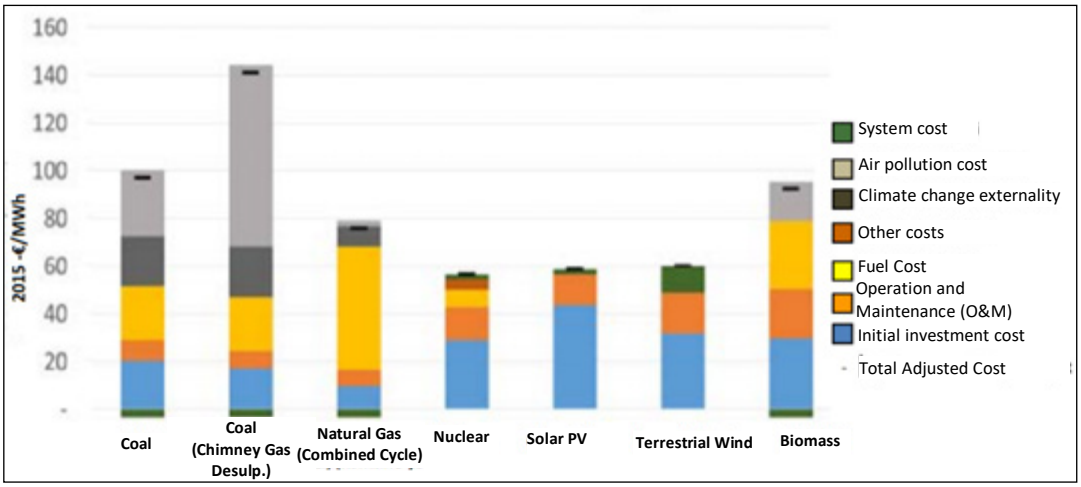
Figure 17: *Energy Efficiency and "Adjusted Electricity Costs" comparison in USD cent per kWh of various energy production technologies (ibid)*



As it could be seen from Figure 17, it has the most advantageous position in energy efficiency compared to all energy production technologies in terms of cost. The most important reason for this is that the energy saved has no fuel, maintenance and repair cost and the investment cost is lower (since there is no need for big financing loans). Energy efficiency investments enable the electric companies to decrease their energy losses with two to five cent costs (on average three cents) per kWh. On the other hand, production of electricity at the same amount from the sources such as fossil fuels, is 2-3 folds more expensive.

As a result of the analysis of the data received from 5.400 program executed by the electric companies between 2009 – 2013 by Lawrence Berkeley National Laboratory; it was calculated that each kWh cost saved was around 0.028 USD/kWh for a period of five years (ibid). It was thus revealed that energy efficiency was the source with the lowest cost in electricity production.

Figure 18: *"Adjusted Electricity Costs" of Eight Energy Production Technologies (Danish Energy Agency, 2018)*



Assumptions :

Technology data has been received from "Designed electric generation cost 2015" (IEA, 2015). However, for PV and wind, financial (CAPEX and OPEX) data was received from Denmark Technology Catalogue.

Annual full load times for coal, gas and biomass technologies: 5.000, nuclear power: 7,000, wind energy from land: 3,150, offshore wind energy 4,500, solar PV: 1,700.

Discount rate: %4 real.

Projection prices for fuel and CO_2 were received from IEA New Policy Scenario 2015, World Energy Outlook 2015.

FGD: Chimney gas Sulphur removal.

It could be seen with the comparison of energy production technology with various cost components taken into account in the calculation of adjusted electric costs under Figure 21 that nuclear energy has a cost which was close to solar and wind energy with today's technology and that the coal has lost its cost advantage against renewable resources.

4. ENERGY EFFICIENCY AND IMPORTANCE OF RENEWABLE ENERGY ORIENTED ENERGY POLICIES IN STRUGGLING AGAINST CLIMATE CHANGE

Energy and development policies have a double-direction cause and effect relationship with each other. In other words, energy is the pushing power of development; production is the most important requirement for development wealth, and energy for the production. However, this production and therefore the energy consumption has an environmental cost.

In the post-second world war period, industrialized countries focused on growth disregarding the ecologic balances as though tomorrow would not come. Countries used the abundant resources and assets for growth no matter what is costs and thus they borrowed the resources and wealth of today from that day. This unconscious consumption has lead the effect of consumption and in particular of energy consumption to become to an undeniable degree as a result of the reaction by nature with climate change facts.

In industrialized countries, together with the global agreement processes on climate change, economic growth, energy consumption and greenhouse gas emission indexes were started to be questioned together, and targets were started to be determined and followed However, climate change has not yet been involved in the environment or economic policy agenda of the developing countries. Unfortunately, these countries where the population is the most vulnerable and lack the sufficient resources to easily adapt to the effects of climate change, experienced the most negative effects of climate change and became the "disadvantageous" part of the world in this field where the development of the countries would be effected to a high extent.

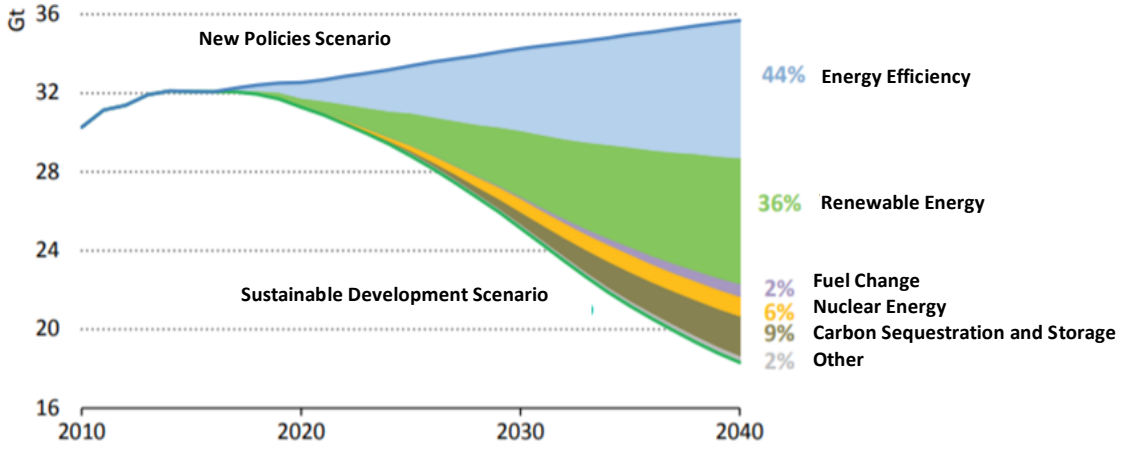
Even though the developing countries say "We have not caused the climate distortion, we are not responsible", it is too late to claim this. Since the earth approaches to the limit of the tolerance which it could show towards climate change, everyone is in need of the steps to be taken within its context. Global emission increase is calculated as 40 Gton annually (37 Gton in 2017). Scientific studies demonstrate that the amount of emission that the world could bear before passing to critical climate change stage is maximum around 800 Gton. When we rake the value for 2016 as the highest value, it could be thought that we have a period of 25 years left and it could be said that the straight progress that the emission increase followed is not sufficient against a growth of 2-3% as in the case of the past couple of years. Besides that, it could not be guaranteed that the emissions would decrease as a result of energy consumption in the coming years. For example, an increase of 2% was seen in 2017 in the global emission parallel to the increase of energy consumption due to the economic growth and changes in consumer behaviors (IEA, 2018b). In order to escape from this situation which constitutes a danger for our world, it is necessary to plan the progress of emission increase graphic in a downwards direction an even towards carbon-free economic policies in 2050 and to guarantee this. Currently many countries and international organizations are preparing roadmaps for this purpose, however the desired result has not yet been obtained.

In order to be less affected from the economic and social hazards of climate change, developed and developing countries are required to be in a total fight against this all together. On the other hand, energy efficiency, renewable energy, sustainable

transportation and land use practices, which are the basic elements of Sustainable Development Policies, and the climate change policies serve to the same end. At the end of the day, although the climate change Is not the final target, efficient use of energy and more use of renewable energy have become an obligatory route for a sustainable development.

In the climate change policies, for now the improvement of energy efficiency and increasing the share of renewable energy are the policy tools with the biggest emission potential. In the "New Policies" and "Sustainable Development Scenarios" Global CO_2 Emission Mitigation and Resource Comparison work which was published by the International Energy Agency, energy efficiency appears as the most important precaution with an emission mitigation potential of 44%. This if followed by renewable energy with a rate of 36% (Figure 22). Other climate struggle instruments with low effect are the fuel change, namely the transformation from high emission electricity production to low emission fuels (For example from coal to natural gas) with 2%, Nuclear Energy for which opposition has increased overall the World with 6%, and carbon storage technology for retaining the carbon which arises as a result of burning of fossil fuels, for which technology has not yet become commercial.

Figure 19: *UEA New Policies Scenario Global CO_2 Emission Mitigation and Resources Comparison in the Sustainable Development Scenarios (IEA, 2018b)*



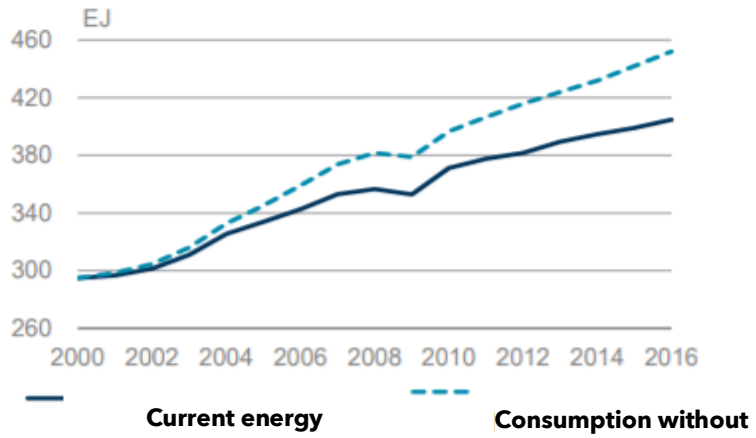
Climate change policies, which rely on mitigation of energy consumption with energy efficiency involve also many "win – win" opportunities. For the last 10 years, climate change policies have been closely following up the energy sector and more importance is attached than ever on energy efficiency in order to accomplish a series of policy targets, including energy supply safety, economic growth and environmental sustainability. Ensuring significant progress in energy efficiency despite the decrease trend in recent years in the energy prices, points out that the effect of prices on the preferences has started to decrease. With the triggering effect created by efficient energy use techniques, the production could be increased, and it can be ensured that other resources such as water and raw material could be used in a more efficient manner. Thus the energy efficiency also supports development and wealth increase and increases energy safety. It decreases energy demand and provides the opportunity to control energy prices, paving the way for opening new employment areas.

The contribution provides by increasing energy efficiency to the problem of energy safety, which the countries overall the world face with at least to the extent of climate change, appears as creating an additional source without making bi infrastructure investments through more efficient use of the existing sources and without waiting for the period required for the realization of these investments. For example, when 1 million bulbs are replaced with the efficient one, there will be no need for 25 MW installed power, when 1 million inefficient refrigerators are replaced, a saving of 500 million kWh, and when efficiency application is made for operating the industry motors not selected at correct capacity, 400 million kWh saving will be ensured. These savings could be realized within maximum 1 month and the cost will be very low since these are distributed to millions of micro investors.

In fact, energy efficiency is the most important energy equity of any country in its hands. With the improvement in energy intensity at global level in 2015, 70% of the new energy demand was covered. As a conclusion, the global primary energy demand increased only by 0.8% in 2015 (final consumption 1%). An improvement of 13% was recorded in energy efficiency between 2000 and 2016.
Efficiency gains in the housing sector in UEA member countries between 2000 and 2016 demonstrated a total increase of 22%. In these countries, energy efficiency improvements totally compensated for the increase effect of the demand for energy, leading to a net decrease of 7% in the final energy use. In particular, more efficient area heating in Europe had a significant contribution in this efficiency increase: Heating intensity (energy use per building area), has improved by 45% in Germany and 36% in France since the year 2000.

Without the improvements provided in energy intensities, it was expected that the global final energy use would be 12% higher in 2016 (Figure 23). This corresponds to annual final energy use of the European Union. The energy saving obtained from the efficiency improvements only in the International Energy Agency member countries constitutes almost half of the global total and this is the equivalent of the total energy use of Germany, France and the UK for the time being. The developing economies constitute around 40% of this data (IEA, 2017b)

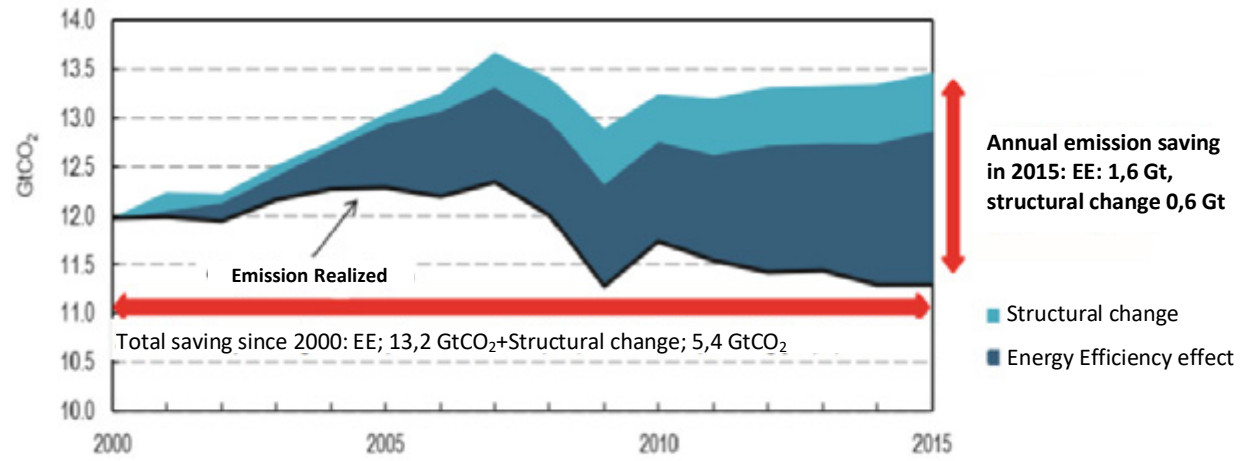
Figure 20: *Energy Efficiency (EV) and Energy Consumption Development Between 2000 and 2016 (IEA, 2018b).*



The value of saving from cumulative energy expenditures in UEA countries between 2000 – 2015 is more than 4 trillion USD. Since 2000, there was no need for 578 GW new plant investments which would have a value of 1.2 trillion USD. In Germany and England, which are the biggest gas markets of the Europe, total gas need of the Europe for 2015 decreased by 30% as a result of energy efficiency improvements since 2000. Germany, which has been following energy efficiency targets very closely and covers 70% of its energy need from import, plans to reduce this import by 6% in 2020 with an ambitious energy efficiency strategy and to make a saving of 4.3 billion Euros from the import invoice. In addition to the decrease in the saved electric and greenhouse gas emissions, it is foreseen that the electricity prices will also fall. With this projection, it is estimated that the electricity demand will decrease by 10-35% in 2035 and the electricity consumption cost will decrease by 10- 20 billion Euro (IEA,2014).

Greenhouse gas savings which are provided by energy efficiency and other factors that reduce energy consumption, are determined analyzed with studies. The energy efficiency and structural changes between 2000- 2015 in UEA member countries (changing the buildings, vehicles and the industry with new infrastructures that consume less energy, shifting of value added production to such sectors as digital technology, banking, tourism) lead to a total energy efficiency of 13.2 $GtCO_2$ in final sector emissions and 5.4 $GtCO_2$ from structure changes, making a total emission reduction of 18.6 $GtCO_2$ (Figure 21) (IEA, 2016).

Figure 21: *Emission saving in UEA member countries that occurred with Energy Efficiency (EV) and structural changes between 2000 – 2015 (ibid)*



Source: Adapted from IEA (2016c), Energy Efficiency Market Report 2016, based on the IEA Energy Efficiency Indicators database (2016 edition).

The global energy saving that has arisen from efficiency increases since 2000 caused the Greenhouse Gas emissions to fall at a rate that is equal to 4 billion tons of carbon dioxide ($GtCO_2$-equivalent) in 2016. Without this efficiency increase, emissions in 2016 would have been 12.5 % higher.

The energy intensity which has been in regular fall trend between 2014 and 2016 lead to the greenhouse gas emissions arising from global energy consumption to follow a straight course and this compensated three fourths of the effect of GDP growth.

Despite these developments provided in energy intensities overall the world, there is still an important energy saving potential in many areas such as electrical devices, buildings, industry sector, electricity generation and transportation and corresponding emission saving possibility and this is at an unignorable level.

With the energy efficiency precautions to be taken in the buildings, energy saving of 3700 TWh could be ensured, and with the precautions in the industry, a saving of 700 billion USD could be ensured, which corresponds to an emission saving of 65000 Mton CO_2. The following Figure 26 demonstrates the expected effect of various energy efficiency precautions on energy consumption and therefore on greenhouse gas emissions (IPEEC, 2018)

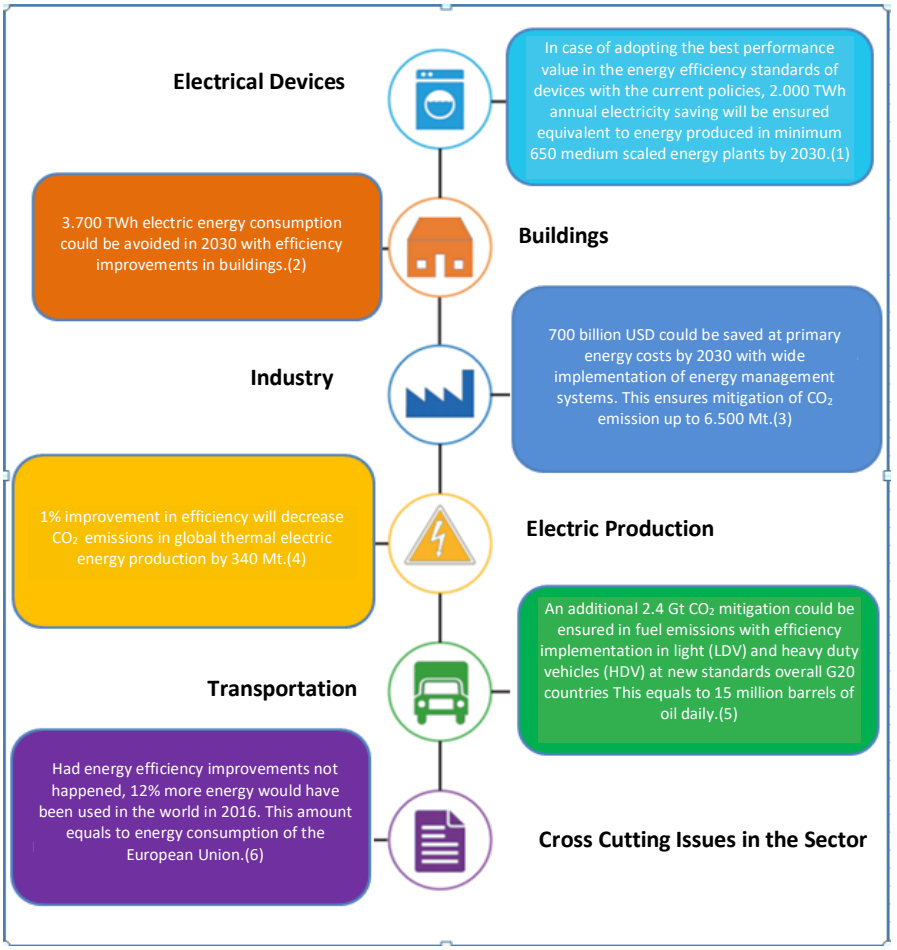


Figure 22: *Energy Efficiency Precautions and Their Results (IPEEC, 2018).*

These evaluations demonstrate how energy efficiency has been effective on emissions. International Energy Agency (UEA) makes assessments by performing various analysis on this issue. UEA Director Dr. Fatih Birol says: "In recent years, energy efficiency is required to be at the center of energy policies. While the world is transforming to clean energy, it ensures that this transformation is cheaper, faster and takes place to the multifaceted benefits of all sectors of the

economy. There is no reality of an energy strategy which does not involve energy efficiency and this shall not provide energy supply that could be purchasable by all", by which words he confirms the foregoing assessments once again.

The second measure that follows energy efficiency in energy and climate scenarios and the most valuable resource in energy supply is energy. Electricity generation arising from renewable energy has a great potential as an alternative to fossil fuel in mitigating greenhouse gas emissions. When compared throughout the life cycle, electricity generation arising from fossil fuel is important in terms of the greenhouse gas emission of renewable energy.

In the analysis of lifecycle of energy production facilities, many processes are taken into account such as exploration and processing of the source, construction of the facility, its operation, decommissioning and waste management. For the sake of comparing the result, the unit of life cycle analysis is taken as "gram equivalent of carbon dioxide released to the environment for producing an electricity of 1 kilowatt hour" (g CO_2-equi/kwh It is not only the carbon dioxide that is released in energy production. However, since carbon dioxide takes the biggest percentage in the greenhouse gases, emissions such as Sulphur, ozone etc. are converted into carbon dioxide equivalent and included in the calculation (Hidrokarbon Adam, 2016).

Table 4: *Lifecycle Emissions of Electricity Generation Technologies ((g CO_2-equi / kWh) (Hidrokarbon Adam, 2016)*

Technology	Low	Average	High
Coal	740	820	910
Natural Gas	410	490	650
Sun – Big scale PV	18	48	180
Sun – Rooftop PV	26	41	60
Geothermal	6	38	79
CSP	8,8	27	63
Hydroelectricity	1	24	2200
Wind (land)	7	11	56
Wind (offshore)	8	12	35
Nuclear	3,7	12	110

Despite the fact that the stage with highest release for a coal plant is the burning process of the coal, the construction stage has the highest percentage when the wind plant is examined. Since the analysis conducted involves many contents such as the region where the plan is located, its vicinity to the source, type of the facility, technology used, operating form and destruction of the fuels, no single type result could be reached, but a general judgment could be made on which stage has the most damage on the environment. Table 4 demonstrates the greenhouse gas emission value of the electricity produced from different resources in (g CO_2-equi/kwh)

As could be seen from there, electricity generation with fossil fuels and in particular with coal has a significantly negative effect on the climate change compared to renewable sources. Even the natural gas which is the most innocent source, creates 10 folds more emission when compared to solar PV systems. For mitigating the effects of climate change, energy efficiency in final sectors on the side of demand and energy efficiency and renewable energy in electricity generation and renewable energy on the side of supply will continue to be the most important policies of the future for that reason.

5. TURKEY'S ENERGY SECTOR COMMITMENTS IN STRUGGLING AGAINST CLIMATE CHANGE AT GLOBAL/ REGIONAL LEVEL

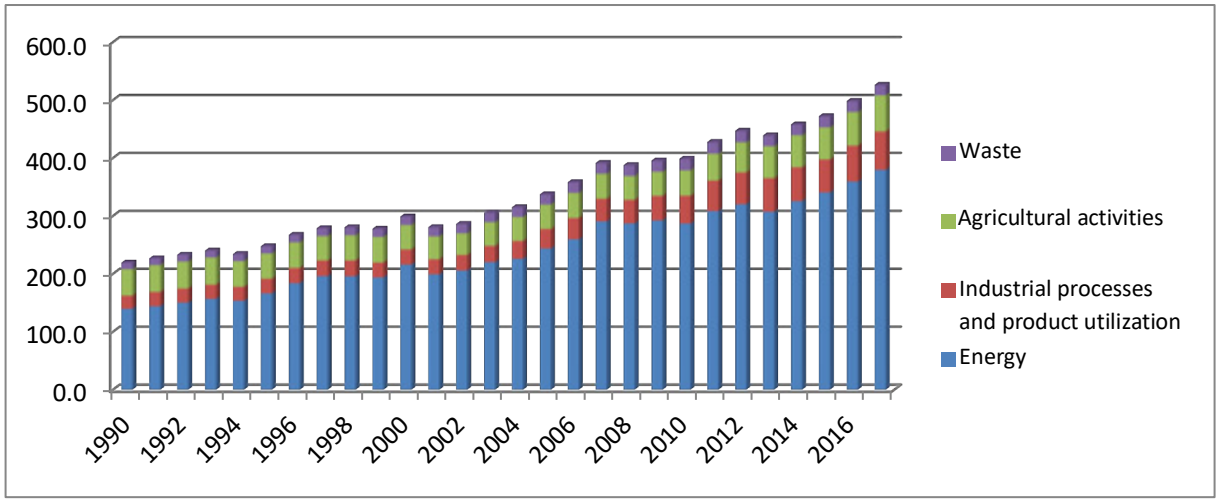
5.1. Greenhouse Gas Emissions Mitigation Policies and Energy Consumption in Turkey

Turkey has become a part to UNCCFC in 2004 and ratified the Kyoto Protocol in 2009. Despite the fact that Turkey does not have emission mitigation targets within the scope of Kyoto Protocol, national communications are submitted to UNCCFC by the government after becoming a partner. Within this framework, Turkey Climate Change 6th National Communication was submitted in 2016 and 7th National Communication was submitted in 2019. Turkey has been performing intense studies on such issues as increasing new and renewable energy, accelerating the investments towards public transportation that has less carbon emission, increasing energy efficiency in order to mitigate greenhouse emissions and struggling against climate change and demonstrates efforts for developing voluntary carbon market and integration to obligatory markets.

Turkey presents to UNCCFC the greenhouse inventory report every year as the Annex I country of United Nations Climate Change Framework Convention (UNCCFC). The most up to date greenhouse gas emission submitted to the Secretariat involves national greenhouse gas emission/ carbon remedial estimations for 1990 – 2017 period.

According to the latest greenhouse gas inventory of Turkey (TUIK, 2019b) the total greenhouse gas emission was **526,3Mt CO_2 equivalent (CO_2-equi)** in 2017 excluding emissions due to the land use, land use change and forestry and the swallows **(AKAKDO) sector**. This situation demonstrates an increase of **140.1 % compared to 1990 level**.

Figure 23: *Distribution of Total Greenhouse Gas Emissions by Sectors in Turkey mton CO_2, 1990-2017 (TÜİK, ibid)*

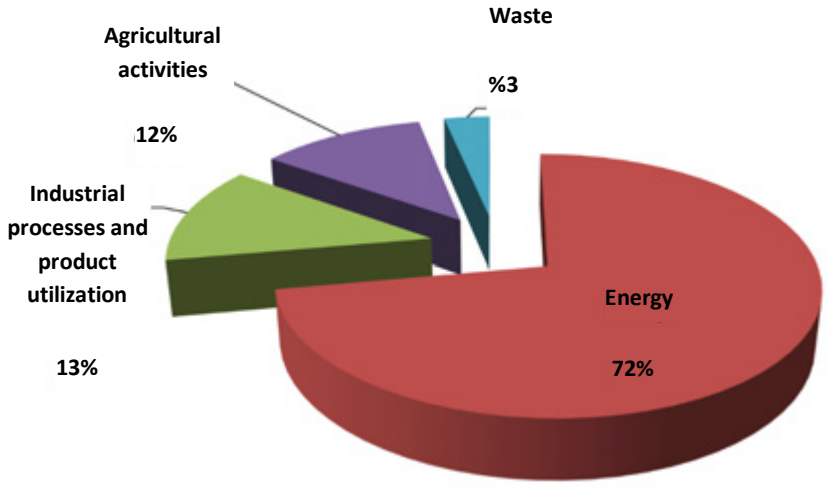


Growing economy, population increase and urbanisation are the basic factors of greenhouse gas emission in Turkey. Turkey is among the most important energy consumers of the world with its developing economy (one of the top 25 countries among UEA countries). In the primary energy supply of Turkey in 2017, which is 145.3 Mtoe, oil and natural gas has a share of 30.5% and coal as 27%. The share of renewable energy resources was 12%.

As of the end of 2017, the installed power of Turkey reached to the level of 85 bin MW (88,5 MW in 2018) Around half (45%) of the installed power of which more than two thirds belongs to the private sector comprises the plants based on renewable energy sources, around one third (31%) comprises of natural gas plants and around one fourth (24%) comprises of coal and other fueled thermal plants. Important incentives are being implemented for increasing the renewable energy installed power and production. However, replacement of fossil energy with renewable energy is a long and costly process.

The energy sector has the highest share with a rate of 72% in 2017 greenhouse gas emissions, excluding AKAKDO. Emissions arising from fuel combustion is the main source of greenhouse emissions arising from human beings in Turkey. In the emission profile, the biggest reason or Carbondioxide emissions (CO_2) is the energy oriented CO_2 emissions. According to TUIK data, in year 2017, 34% of CO_2 emissions arising from energy was a result of electricity and heat production, 86.3% from energy, 13.4% from industrial processes and product use and 0.3% from agricultural activities and waste. There was an increase of 172% compared to 1990 in emissions arising from energy sector, and 191% in CO_2 emissions arising from industrial processes and product use.

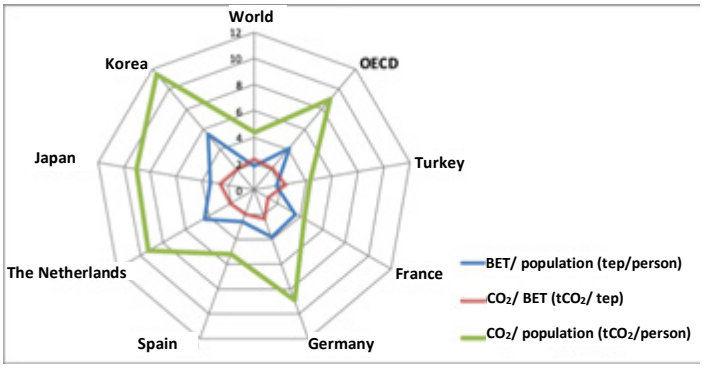
Figure 24: *Share of Sectors in Turkey's Greenhouse Gas Emission, 2017 (excluding AKAKDO) (ibid)*



Energy sector was followed by industrial processes and product use sector with 13% (IPPU), agriculture with 12% and waste sector with 3%. An increase trend is seen in emissions in all sectors between 1990- 2017.

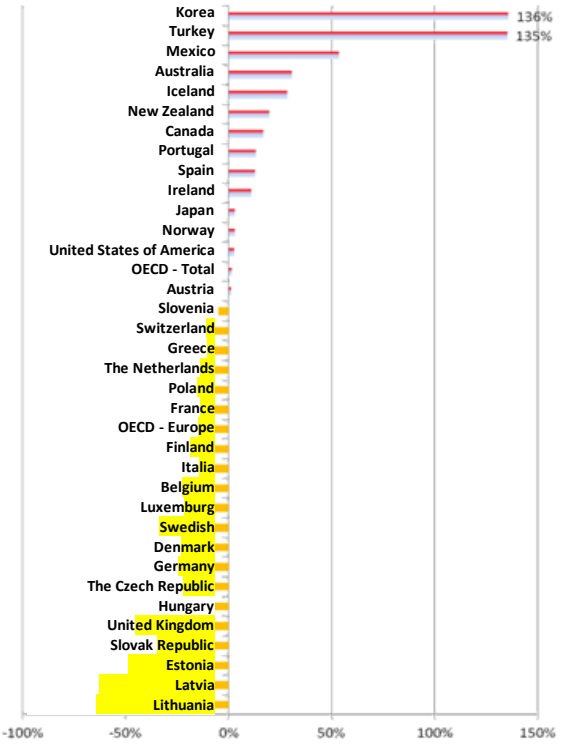
Greenhouse gas emissions per person demonstrate a similar increase trend with total greenhouse gas emission. The equivalent CO_2 emission per person has increased to 6.6 CO_2equi in 2017 from 3.88 in 1990. When per capita greenhouse gas emission is compared to world and OECD averages, Turkish emissions are relatively low. In the following Figure 25, Turkey's status is compared to some selected countries.

Figure 25: *Comparison of Turkey's Per Capital Primary Energy Consumption and CO_2 and CO_2 intensity Per Primary Energy Consumption (IEA,2018a).*



As it is show in Figure 26, Turkey's CO_2equi emission demonstrated a cumulative increase of 135.4 % in 2015 compared to year 1990. This situation demonstrates that Turkey will demonstrate a different trend from most of the emerging market economies and global average during the coming decade. Turkey is among top five countries with the rate of increase in CO_2equi emissions. Turkey listed the 2nd among OECD countries (after Korea) in the rate of greenhouse gas emission increase between 1990- 2016 (Figure 26). In the same period, almost half of the OECD economies demonstrated a decrease in their emission rates (OECD, 2019).

Figure 26: *Rates of Change in Total Greenhouse Gas Emissions for OECD Countries (%), 1990–2016 (ibid).*



The "Paris Agreement" accepted by the parties in 2015 is characterized as a historical agreement and has the results which will fundamentally affect the local, national, regional and global economies, societies and the environment.

The basis of this global agreement, which was adopted by 195 countries and to which 185 countries are parties as of February 2019, is to keep the warming of earth, which reached to 1 °C from the industrial revolution up to now, to keep under 2 °C, and around 1.5 °C if possible. With the entering into force of the agreement in November 2016, it is required that countries which sign the agreement which has legal binding in international terms and ratify the agreement according to their national legal systems, are required to put into practice their plans to mitigate their greenhouse gas emissions and to keep global temperature increase below 2 °C by the year 2020.[16]

Turkey has presented its Intend of National Direct Contribution voluntarily to the United Nations Climate Change Framework Convention (UNCCFC) Secretariat on 30 September 2015 within the context of struggling against climate change. This Declaration confirms a mitigation that reaches to 21% in greenhouse gas emissions by the year 2030 (around 246 million tons of CO_2 equi) and covers the following articles that target at efficient and low carbon intensive use of energy consumption:

[16] Turkey has not yet been a party to Paris Agreement For the list of countries which are parties, see: https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-d&chapter=27&clang=_en

In the energy sector

- Having the solar power plants reach 10 GW and wind power plant 16 GW by the year 2030
- Using all hydroeectric potential
- Commissioning a nuclear power plant by the year 2030;
- Reducing transmission and distribution losses to 15% by the year 2030;
- Rehabilitation of electric production plants owned by the public, putting into life the cogeneration, micro-generation and on-site generation facilities;
- Using solid and liquid wastes in recycling and energy generation

In the industry sector:

- Mitigating greenhouse gas emissions by implementing National Energy Efficiency Strategy Plan and Action Plan
- Increasing energy efficiency practices and supporting energy efficiency projects;
- Performing studies to increase wastes and alternative fuels in the suitable industrial sectors

Transportation sector;

- Balanced use of transportation modalities for passenger and load transportation, decreasing the share of highway transportation in this direction and increasing the shares of railway transportation
- Strengthening combined transportation
- Implementing "sustainable transportation" approach in the cities
- Encouraging the use of alternative fuels and "clean" vehicles;
- Mitigating fuel consumption and affiliated emissions in highway transportation in line with National Smart Transportation Systems Strategy Document (2014 -2023) and Action Plan (2014 – 2016)
- Realizing high speed railway projects
- Disseminating the urban rail systems
- Providing fuel saving with tunnel projects;
- Withdrawing the old vehicles from traffic
- Implementing green port and airport projects in order to ensure energy efficiency;
- Putting special consumption tax exemption for maritime transportation

Buildings and Urban Transformation Sector:

- Building the new houses and service sector buildings with energy efficiency in accordance with "Energy Performance in Buildings Regulation".
- Controlling the energy consumption and greenhouse gas emissions by preparing Energy Performance Certificates for the New and Existing Buildings, and mitigating the energy consumption per meter square
- Mitigating primary energy source consumption through practices that encourage the use renewable energy and design, technologic equipment and construction materials in the New and Existing buildings (loans, tax reduction etc.)
- Disseminating green buildings, passive energy and zero energy house designs in order to minimize energy demand and ensure on site energy generation

Turkey is a country that increases CO2 emissions due to per capital energy consumption and its consumption structure and accordingly it has set a target that reduces the speed of increase, rather than decreases, the emissions when compared to the European Union. Although this situation arises from the special conditions of Turkey, it is difficult to walk on a different roadmap in this process where the World is under pressure and the countries follow one another. A low carbon and climate-resistance development model is a necessity for Turkey. In fact it has the sufficient opportunities for this issue. Its strong policy and regulation infrastructure, renewable energy sources that take a share of 30% in electricity production, energy efficiency potential that exists in every sector create great advantages for Turkey. It is necessary not only for the public institutions but also the relevant Civil Society Organizations and the media to create awareness and sensitivity among all segments of society on the issue of "climate change" and include energy efficiency effectively within this framework.

6. EU ENERGY POLICIES AND POSITION OF TURKEY IN STRUGGLING AGAINST CLIMATE CHANGE

6.1. EU Energy- Climate Policies

EU has significantly reduced its greenhouse gas emission with energy efficiency, fuel replacement policies and use of renewable resources following the summit in 1979. As a conclusion, between 1990 and 2016, the energy use decreased by almost 2% and greenhouse gas emissions by 22%, the GDP has grown by 54%. EU has accomplished this with uninterrupted policies with continuously growing targets.

EU Climate Change and Energy Policy relies on a three stage long term strategy (European Commission, 2019):

- 2020 Climate and Energy Package
- 2030 Climate and Energy Framework
- 2050 Low Carbon Roadmap

2020 Climate and Energy Package (20/20/20) is a strategy that relies on a binding regulation which helps EU reach its 2020 climate and energy targets This strategy was adopted in 2009 and has three main objectives:

- 20% mitigation in greenhouse gas emission (from 1990 level)
- Providing 20% of EU energy from renewable energy
- 20% increase in energy efficiency

Among the main actions in the implementation of this package are annual binding targets within the scope of EU Emission Trade System (ETS) "Effort Sharing Decision" and Renewable Energy Directive, measures for improving energy efficiency within the framework of Energy Efficiency Plan and Energy Efficiency Directive and research and innovation programs that support low carbon technologies. With ETS, it is aimed at covering 45% of EU greenhouse gas emission.

Energy Efficiency Directive has come into force in 2012 in order to help realization of energy saving target in EU regulations and other two targets in EU Climate and Energy Package. 2012 Energy Efficiency Directive foresees a series of binding measures that will help EU reach its 20% energy efficiency by the year 2020. According to the directive, all EU countries will use the energy more efficiently at all stages of the energy from production to the final consumption.

For this purpose, sectoral policies of the EU are handled as a whole and targets are identified clearly. With the projections made in 2007, it was calculated that the primary energy consumption in 2020 would be 1840 Mtoe. A reduction of 20% will decrease this consumption to 1483 Mtoe in 2020 and will ensure a decrease of 368 Mtoe when compared to the projection.[17] This target is equivalent to the closure of 400 energy plants. The primary energy consumption in the EU has decreased by a rate of 12 % in 2014 from 1712 Mtoe to 1507 Mtoe, and this consumption level is currently a bit higher than the 2020 primary energy consumption target.

The directive in question foresees measures and obligations towards every sector in order to increase energy efficiency. In particular, concrete digital obligations in the field of public, building, energy service is to be highlighted. For example:

- Energy distribution companies and retail energy sales companies provide an energy saving of 1.5% annually by implementing energy efficiency measures.
- EU countries should implement such measures as increasing the efficiency of heating systems, double-glass windows or heat-isolated roofs in order to ensure the saving foreseen.
- The public sector in EU Countries should prefer energy efficient buildings, products and services in the procurements.
- Governments in the EU countries should renew the areas of public buildings they own and use so as to ensure energy efficiency at minimum 3% of the area every year.
- Energy consumers should be encouraged so as to better manage their consumptions. For that purpose, the consumers shall be enabled to access individual energy consumption data easily and freely.
- The SMEs should be enabled to benefit from national incentives for the energy surveys.
- Big companies should prepare energy surveys to help determine the ways to mitigate energy consumptions.
- Efficiency levels of new electric production facilities should be monitored.

2030 Climate and Energy Framework was adopted in 2014 with the Clean Energy for All Europeans Program and the targets for 2030 were increased compared to the year 2020 and three new objectives were determined:

- At least 40% mitigation in greenhouse gas emissions (from 1990 level)
- Share of renewable energy at least 27%
- Minimum 27% improvement in energy efficiency

In order to ensure 2030 targets, it was foreseen to create individual binding targets which ensure that, by the year 2023, 10% renewable energy share target is reached at the grid connection, energy internal market regulations are completed for increasing this share to 15% by the year 2030, emission trade system within EU is improved and emission for member states are reduced by 30% (compared to 2005) and in this manner a binding target has been set to decrease the emissions within the EU to minimum 40% below 1990 level by the year 2030 (43% mitigation in emissions compared to year 2005).

The Commission also foresees that EU shall not only lead the transition to clean energy, but also that the country comply with this. For that purpose, while EU increased employment with economic growth, it has

[17] Directive 2012/27/EU of the European Parliament and Council of Europe, October 2012.

undertaken to mitigate CO^2 emissions at least by 40%. Three priorities have been foreseen for the transformation recommended:

- Putting energy efficiency to the first priority;
- Reaching the global leadership in renewable energy
- Protecting the consumers

In November 2016, the European Commission has explained 8 new regulation recommendations of "Clean Energy Package for All Europeans" which included eight proposals that will facilitate the transition of EU to clean energy. The Package includes recommendations related to the updating of Energy Efficiency Directive (EED) and Energy Performance of Buildings Directive (EPBD) and some other measures. In June 2018, EU members countries and the European Parliament have agreed on a non-binding target in order to increase energy efficiency by 32.5% until 2030. It was resolved to review this target in 2023.

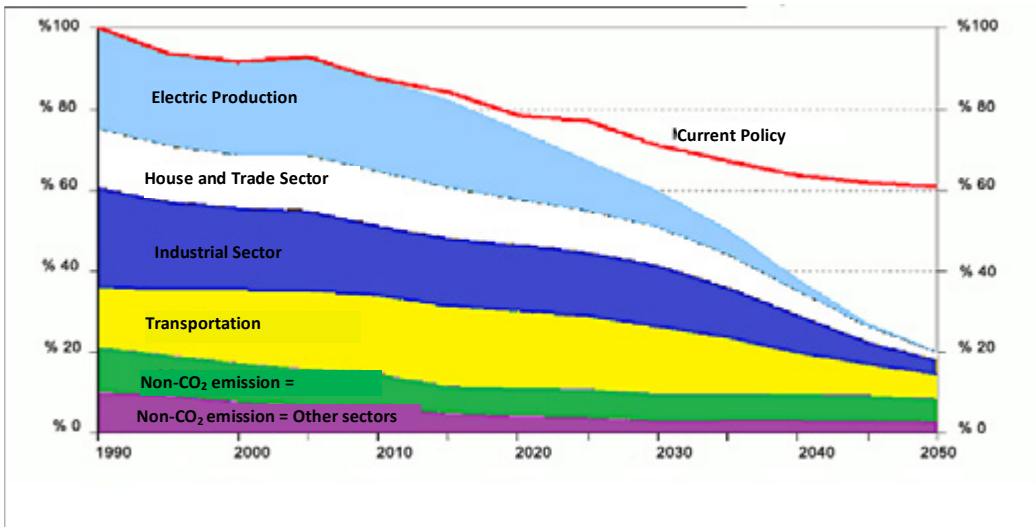
In this scope, the reviewed EPBD was adopted in May 2018 and came into force in 9 July 2018 (EU 2018/844). The member countries are asked to create long term strategies for complete removal of carbon from the energy use of all house and non-house building stocks and reducing the same at a significant level, with the support of finance mechanisms. This means that all EU buildings shall reach near zero energy performance level by the year 2050.

This new regulation also includes in addition to other measures the "smart preparation" obligations which require the member states to provide at least one electric vehicle recharging point in all non-house buildings that have minimum ten parking areas. The energy performances of equipment using energy in the building will be tightened more at the product standards in EU Eco-Design Directive.

EU 2050 low carbon economy roadmap includes the following projections by continuing the previous targets:

- Reducing the greenhouse gas emissions to 80% of 1990 levels (in order to accomplish this, the milestones in the emission mitigation are 40% by 2030 and 60% by 2040).
- Ensuring that all these sectors contribute in these targets

Figure 27: *Transition Towards a Low Carbon Energy System by 2050: What Role for the EU? (Meeus et al., 2011: 2)*



The roadmap includes that transition to low carbon economy is possible and at low cost. Besides, innovations and significant investments are required in the process. It is emphasized that the EU should make an additional investment of 270 billion Euro (1.5% of the annual GDP on average) by the year 2050. Within this scope, expected mitigations rates are determined with the roadmaps for the main sectors that are in charge of emissions. The energy sector roadmap which has the biggest emission mitigation potential includes the replacement of fossil fuel production capacity with other low carbon sources such as renewable sources like wind, sun, hydro and biomass or fossil fuel energy plants that have carbon catching and storage technology or nuclear energy plants, and implementing measures towards completely abolishing CO_2 emission by the year 2050. In order to implement this, it is necessary to make strong investments towards developing smart networks in order to disseminate the renewable energy in particular.

Emissions arising from transportation could be mitigated by 60% compared to 1990 level by means of developing the fuel efficiency of oil and diesel motors more in the short and middle term and shifting to hybrid and electrical vehicles by the year 2050.

Emissions arising from houses and office buildings could be mitigated at a significant rate such as 90 % by the year 2050. Implementing passive house technology in new buildings, renewing the old buildings in order to increase energy efficiency, using renewable energy or electric energy in place of heating, cooling and cooking will enable a strong improvement in the energy performance.

Energy-intensive industry could mitigate its emissions at a rate of more than 80% by the year 2050 with cleaner and more energy efficient production technologies. Despite the global increase expected in food demand, it should not be forgotten that emissions arising from fertilizer, farm fertilized and stockbreeding will decrease in the field of agriculture and this situation will contribute CO_2 storage on earth and forestry areas. It is considered that healthy nutrition that involves more vegetables and less meat will also reduce the emissions.

Turkey as a EU member country, aims at harmonization with EU climate policy and regulations (EU climate acquis) and developing significant measures related to climate in greenhouse gas emission intensive sectors. Whereas the regulations made in the field of energy market, energy efficiency and renewable energy are in compliance with EU policies, there are some lacking points in particular related to compliance with Energy Efficiency Directive. Besides, it is necessary to demonstrate more efforts towards implementing the harmonized policies and regulations in accordance with EU legal documents, and following the results of implementation in digital form.

6.2. Turkey's Energy Politics and Relationship with EU

Energy constitutes one of the most important issues of Turkey – EU relationships. Turkey, which is at a significant position for ensuring the energy safety of Europe, was involved as an observer to the Energy Community in 2006 as an indicator of the importance given to regional energy cooperation (Energy Community is an international organization established in 2005 which aims at establishing an integrated energy market to encourage competition between EU member countries and South East Europe and other neighboring countries which are not member of the EU)

Within the scope of EU participation negotiations, the screening process of the "Energy Chapter" was completed in 2007. Energy Chapter Post Screening

Report updating works are currently being carried out by the EU.

In the 15th Chapter Energy Section of Turkey 2018 Report which is prepared by the European Union (EU), the following issues are emphasized.

"Progress has been recorded at good level in the field of renewable energy which is a key element of the National Energy Strategy. Whereas the total installed power capacity provided with the renewable energy corresponds to a rate of 44%, of which 34% is hydroelectric, the electric production rate reached to 33% in2 016. A good level of progress has been recorded in the area of energy efficiency. National Energy Efficiency Action Plan, which aims at mitigating the primary energy consumption by 14% until 2023, was adopted in January 2018. Authorization and awareness rising activities have continued towards energy efficiency services. Small and medium scaled enterprises were supported with efficiency increasing projects and voluntary agreements. There is no time schedule in the buildings towards full compliance with Energy Performance Directive or Energy Efficiency Directive. Turkey is in an urgent need of strengthening the corporate structure for establishing an efficient institution towards the purpose of developing the coordination between different ministries in relation to the implementation of energy efficiency as in the case of many of EU member countries" (EU, 2018).

7. TURKEY'S ENERGY EFFICIENCY AND RENEWABLE ENERGY POLICIES

Energy efficiency is the most important energy equity of our country, as in the case of other countries. On the other hand, all regions of our country have a rich potential specific to the region in terms of renewable energy. For that reason, the renewable energy in energy policy is supported with renewable energy and energy efficiency, development plans, strategy documents and special laws and regulations related to renewable energy. The basic energy policy and strategies of Turkey are listed below:

- Electric Market and Supply Safety Strategy Document (2009).
- Ministry of Energy and Natural Resources 2015 - 2019 Strategic Plan (2014)
- Energy Efficiency Development Action Plan and Energy Production Based on Local Resources Action Plan (2014) under 10th Development Plan (2014 – 2018).
- Energy Efficiency Strategy Document (2012 – 2023)
- Renewable Energy Action Plan (2013- 2023)
- Climate Change Strategy (2010- 2023)
- Climate Change Action Plan (2011- 2023)
- Energy Efficiency Action Plan (2017- 2023)

7.1. Legal Framework in Energy Efficiency

The regulation infrastructure and policy strategies required for developing energy efficiency in Turkey have been defined by target year and actions that are different from each other on various days since 2007.

National Climate Change Strategy Document covering years between 2010 – 2023 and 2010 – 2023 National Climate Change Action Plan, Energy Efficiency Strategy Document covering years 2012 – 2023, Tenth Development Plan covering 2014 – 2018 period, Energy Efficiency Development Program No. (1.14), Ministry of Energy and Natural Resources 2015 – 2019 Strategy Plan, National Energy Efficiency Action Plan (2017 – 2019) are among these strategies. To what extent these strategies are implemented could be determined by establishing an efficient monitoring system. Certain actions have been handled in National Energy

Efficiency Action Plan in order to remedy this problem.

On the other hand, the targets of National Energy Efficiency Action Plan, which is connected with the regulation mentioned above, are also included within the scope of National Energy and Mine Policy which was prepared by the Ministry of Energy and Natural Resources in 2017. **However, the National Energy Efficiency Action Plan 2018 January (2017 -2023) which came into force lastly in 2018 is given as the only road map on this issue.**

Within the scope of 2012/27/EU Directive on energy efficiency published by European Parliament and European Council on 25 October 2012, the member countries are obliged to prepare national energy efficiency action plans which provide methods towards a joint structural framework and implementation on member countries energy efficiency. Implementation of the National Energy Efficiency Action Plan of our Country is a significant step in terms of adaptation with the directive in question.

The most comprehensive legal framework in Turkey in the field of energy efficiency relies on the Energy Efficiency Law. With this law, a new transformation process has started in the energy policies of our country. In general the law includes various sections including the formation of administrative structure on effective execution, monitoring and coordination of energy efficiency activities, authorizations to be made for carrying out energy efficiency services, task responsibilities, education of and awareness rising in the society, supports provided for encouraging energy efficiency, and penalties to be implemented for problems and hinderances in the implementation that aims at disseminating the use of renewable energy resources. These penalty amounts are increased every year with communique. Secondary regulations have been published comprising numerous regulations and communiques in order to regulate the issues specifies in the law and explain the procedures to be implemented with details.

Energy Efficiency Strategy Document (2012 – 2023)

Energy Policy targets related to energy efficiency is included in 2012 – 2023 Energy Efficiency Strategy Document. This document aims at decreasing the amount of energy spent per GDP of Turkey at least by 20% as of year 2023. The Strategy Document has determined 7 Strategic Areas that are required for reaching this target.

1. **Mitigating energy intensity and energy losses in the industry and services sector**
   Within 10 years as of the date of publication of the document, the reduced energy intensities in each industry sub-sector will be decreased at rates to be determined with sectoral collaborations, which shall not be less than 10 % for each subsector.

2. **Mitigating the energy demands and carbon emissions of the buildings; disseminating sustainable environmentally friendly buildings that use renewable energy sources**
   At least one fourth (1/4) of the building structure in the year 2010 will become sustainable structures by the year 2023.

3. **Ensuring transformation of energy efficient products to the market**
   The market transformation of lamps, refrigerators and electric motors above the minimum energy efficiency class will be completed by the end of 20212, and the market transformation of heating/ cooling systems and

other energy efficient products will be completed in line with EU practices.

4. **Increasing efficiency in electric generation, transmission and distribution; mitigating energy losses and hazardous environment emissions.**
   By the year 2023, the average total cycle efficiencies of coal thermal plants overall the country, including the waste heat recycling, shall be increased above 45%.

5. **Mitigating the unit fossil fuel consumption of motor vehicles, increasing the share of railways for load and passenger transportation and public transportation within the city and prevent unnecessary fuel consumption for in-city transportation and mitigate emissions that are hazardous to the environment.**
   Small vehicles that carry load or passenger (M1/N1 categories) will meet the secondary regulation conditions that will be issued in line with EU directives in relation to CO_2 emission, prepare transportation specialist plans in big cities and put them into implementation.

6. **Using energy efficiency and effectively in public institutions**
   The annual energy consumption of buildings and facilities of public institutions will decrease by 10% until 2015 and 20% until 2023.

7. **Strengthening corporate structures, capacities and collaborations, increasing advance technology use and awareness activities and creating financing environments outside the public.**
   By the end of year 2012, collaborations between corporate structures, capacities of implementing agencies and the cooperation between them will be improved.

National Energy Efficiency Action Plan 2018 January (2017- 2023)

In the National Energy Efficiency Action Plan, energy supply safety, decreasing energy costs, reducing the emission values arising from energy use, decreasing foreign dependency in energy and the contribution in the macro economy have been prioritized. With the Action Plan, it is foreseen to implement and monitor 55 actions defined under 6 categories (services, energy, transportation, industry, building and technology, agriculture and general) in an effective way.

With the Action Plan, it is targeted to decrease the primary energy consumption of Turkey by 14% compared to the base scenario by the year 2023 (the continuity of the current status). It is foreseen that by the year 2023 (within the coming 5 years), a cumulative energy saving of 23.9 Mtoe is foreseen and the monetary corresponding of this saving is calculated as 8.4 billion USD. In order to provide for such amount of a saving, it is estimated that 10.9 billion USD will be invested. The saving which is accumulated as 86.4 Mtoeby the year 2033, is projected to be 30.2 billion USD as of 2017 prices. It is also foreseen that the impacts of the Action Plan will continue until 2040.

Whereas the National Energy Efficiency Action Plan demonstrates the implementation steps, basic performance indicators of the actions, how they will be implemented, the outputs and possible impacts, the fact that energy efficiency is a multi-disciplinary issue that is related to many sectors and stakeholders and its monitoring made it a challenging process. It is necessary to establish a close collaboration between the institutions and organizations which are responsible from the implementation of the below actions and evaluating their results, and to ensure coordination. The Energy Efficiency and Environment Department, which was

established in January 2019 within the body of the Ministry of Energy and Natural Resources, will carry out the processes of ensuring coordination and collaboration, monitoring, reporting and approving the validity of the Action Plan.

Actions related to horizontal issues and the sectoral actions as of 2017 – 2023 are indicated below:

Cross-Cutting Actions

- Y1- Establishing Energy Management Systems and Increasing Their Effectiveness
- Y2 – Developing National Energy Efficiency Financing Mechanism
- Y3 – Supporting Energy Efficiency Projects with Energy Efficiency Contests
- Y4- Creating Subheadings Such as Guides, Standard Contracts etc. That Include Technical, Legal and Financial Issues in Energy Efficiency Projects
- Y5 – Developing Registration, Database and Reporting Systems in Energy Efficiency Activities
- Y6 – Increasing the International Energy Efficiency Financing Opportunities and Effectiveness, Their Coordination and Control
- Y7 – Strengthening the Administrative and Corporate Structuring
- Y8- Carrying out Information, Training and Awareness Raising Activities
- Y9- Energy Efficiency Surveys
- Y10 – Adopting Sustainable Operating and Purchasing Approaches in the Public
- Y11 – Energy Efficiency Obligation Program Towards Energy Distribution or Retail Companies

Building and Services Sector

- B1 - Determination and Sharing of Best Practices Related to Materials and Technology used in the Construction Sector
- B2 – Creating A Database That Includes Energy Consumption Data for the Buildings
- B3 – Defining Energy Saving Target for Public Buildings
- B4 – Energy in Municipality Services
- Increasing Efficiency
- B5 – Rehabilitation of the Existing Buildings and Developing Energy Efficiency
- B6 – Encouraging the Use of Central and Regional Heating/ Cooling Systems
- B7 – Increasing the Rate of Having Energy ID Certificate for the Existing Buildings
- B8 – Encouraging Certification of Sustainable Green Buildings and Settlements
- B9 – Encouraging Energy Efficiency in New Buildings
- B10 – Improving Energy Performance in the Existing Public Buildings
- B11 – Disseminating the Use of Renewable Energy and Cogeneration Systems in Buildings
- B12 – Resource Allocation for Energy Efficiency Survey Programs and Surveys for Buildings with SME Nature

Industry and Technology Sector

- S1 – Dissemination of Cogeneration Systems in Big Industrial Facilities Using Heat
- S2 – Providing Support for Increasing Energy Efficiency Projects and Diversity in the Industry
- S3 – Increasing Efficiency in the Industry Sector
- S4 – Implementing Energy Efficiency Performance Standards and Environmentally Sensitive Design, Production, Labeling System
- S5 – Supporting Efficiency Increasing Projects in the Industry Sector
- S6 – Preparing Energy Saving Potential Map in the Industry
- S7 – Improving Voluntary Agreements

Energy Sector

- E1 - Determining the Potential of Cogeneration and Regional Heating –

Cooling Systems and Preparing the Roadmap
- E2 – Implementing Efficiency Standards for Natural Gas Infrastructure
- E3 – Creating Energy Data Platform for Smart Management of Measurement Information and Presenting a Comparable and More Detailed Invoice Information to the Consumer
- E4 – Harmonizing the Regulatory Framework Related to Reading of Meters with the Main Principles Determined with European Union Acquis (Dissemination of
- Smart Meters)
- E5 – Implementing Minimum Performance Standards in Transformers
- E6 – Managing Point Load Arising from Heating and Cooling
- E7- Increasing Energy Efficiency in General Illumination
- E8 – Developing Electricity Transmission and Distribution Activities Efficiency Increase
- E9- Increasing Efficiency in the Existing Electricity Production Plants
- E10 – Creating Market Infrastructure for Demand Side Response Practice

Transportation Sector

- U1- Encouraging Energy Efficiency Tools
- U2 – Developing Comparative Study Related to Alternative Fuels and New Technologies
- U3 – Development and Improvement of Bicycle and Pedestrian Transportation
- U4 – Mitigating Traffic Jam in the Cities
- : Reducing Automobile
- Use :
- U5- Dissemination of Public Transportation
- U6 - Developing and Implementing Corporate Restructuring for Urban Transportation
- U7 – Strengthening Maritime Transportation
- U9 – Data Collection for Transportation

Agricultural Sector

- T1- Encouraging Renewal of Tractors and Harvesters with Energy Efficient Ones
- T2 – Shifting to Energy Efficient Irrigating Methods
- T3 – Supporting Energy Efficiency Projects in the Agricultural Sector
- T4 – Encouraging Renewable Energy Sources in Agricultural Production
- T5 – Determining and Encouraging the Use of Agriculture Side Products and Waste Potential in Order to Obtain Biomass
- T6 – Supporting Energy Efficiency in Water Products Sector

Whereas the programs and strategy documents related to energy efficiency and renewable energy are parallel with those of other countries, problems are encountered in meeting the strategy targets due to such obstacles as problems in financing, implementation of policies and implementation of the regulations. Although these actions have many shortcomings, these support the EU Energy Efficiency Directive and Energy Performance in Buildings Directive. There are developments in relation to the actions in this action plan, of which the starting year is 2017, and some new projects are being carried out.

7.2. Legal Framework in Renewable Energy

There are 2 legal regulations which are the basis for the regulation related to supporting and developing renewable energy resources. One of these is the "*Law Related to Use of Renewable Energy Sources for the Purposes of Producing Electric Energy*" No. 5346. This law includes dissemination of using renewable energy sources for the purposes of electricity energy generation, providing these sources to the economy in a reliable, economic and quality manner, increasing resource diversity, mitigating greenhouse gas emissions, evaluating the wastes, protecting the environment and protecting the

manufacturing sector needed for realizing these purposes. The law defined the renewable energy sources, indicated that the sales price of the electricity to be produced from these sources will be between 5-5.5 Euro and encouraged the production of electricity from renewable energy with such supports as land use change etc.

The second is the "*Law on Amendment of Law for The Use of Renewable Energy Sources for Electric Energy Production Purposes*" No. 6094, which came into force on 8 January 2011 as a result of the process that started in 2005. The law was reshaped with this law and the incentive mechanism under the scope of the law was improved and support tariffs were leveraged by bringing important changes towards encouraging renewable energy investment opportunities.

Within the scope of the Law No. 6094, depending on the type of the facility based on the source of renewable energy, a price support of 7.3 cent/ kWh for generation facility based on wind energy for hydroelectric generation facility; 10.5 cent/ kWh for generation facility based on geothermal energy, 13.3 cent/ kWh for generation facility based on biomass (including garbage gas) has been provided.

Law On Geothermal Resources and Natural Mineral Waters No. 5686 includes principles and procedures related to ownership, transfer, abandonment of resources, tendering out the resource utilization, termination, inspection, protection of resources in the exploration and operating periods of geothermal and natural mineral water resources and gases of geothermal origin determined or to be determined.

Unlicensed electricity production in Turkey has been regulated under the "Regulation on Unlicensed Electricity Production in Electricity Market" which came into force after being prepared based on Article 14 of Electric Market Law No. 6446. In this way, micro renewable energy investments are supported.

Besides, *Renewable Energy Resource Area (YEKA) Regulation* has been *issued on 9 October 2016* in relation to the technical evaluation of practices based on solar energy and installation of large scaled renewable energy resource areas. Turkey has launched two major solar and wind energy tenders (auction) which were designed based on fixed rate warranty and each with a total installed capacity of 1.000 megawatt, which will secure the R&D investments for a period of 10 years and are sourced domestically for R&D and production at a rate of 80%.

In the "Strategic Plan" of ETKB involving the period 2015-2019, there are targets which are in compliance with other strategies in relation to the evaluation of domestic and renewable energy sources.

According to Renewable Energy Action Plan, it is projected that 34 thousand MW hydroelectric, 20 thousand MW wind energy, 5 thousand MW solar energy, one thousand MW geothermal energy and one thousand MW biomass installed power is foreseen to be reached within the scope of 2023 targets. In line with these targets, it is planned that minimum 30% of the demand of Turkey towards electric energy in year 2023 (including hydroelectric) will be provided by renewable energy sources. As of 2017, this target is met with rapid progress in solar, geothermal and wind energy. It was calculated that an investment of 60 billion USD will be required to be made to renewable energy sources in order to realize these targets.

Within the scope of these targets, the electricity generation for year 2023 is estimated to be 91

thousand 800 GWh in hydroelectric, 50 thousand GWh in wind energy, 8 thousand GWh in solar energy, 5 thousand 100 GWh in geothermal energy and 4 thousand 500 GWh in biomass energy. In other words, it is planned that a gross electric generation of 159 thousand GWh will be obtained from renewable energy sources. This amount constitutes 32% of the total gross electric consumption amount (around 500 thousand GWh) calculated for 2023. In short, it is foreseen that around one third (1/3) of the total electricity consumed in Turkey in 2023 will be acquired from the renewable energy resources. In order to keep these targets, a high importance is attached to electricity generation with wind and solar energy.

8. AN ASSESSMENT ON BOTH DOMESTIC AND RENEWABLE ELECTRICITY GENERATION OPPORTUNITIES AND CHALLENGE SIN DEVELOPING RENEWABLE ENERGY TECHNOLOGIES IN TURKEY[18]

Clean energy industry in the developed countries is accepted as priority areas for investment both for environmental and economic reasons in recent years. Energy which is supplied using clean energy technologies produced domestically provides for more energy independence and safety. Clean technology equipment produced domestically triggers clean energy use, providing significant environmental benefits in mitigating CO_2 emissions. It is considered that economic crisis experienced in the world in the last decade and the economic stagnation that lead to double digit unemployment in many countries could be overcome with innovation in clean energy technologies and new technologies could play a role a sa new power in economic growth. For example, in 2009, the United States of America has allocated a resource of 775 billion USD within the framework of "Economy Revitalization Program" by foreseeing investment and support program in many field, including energy, in order to get out of the crisis. As a result of green energy investments and energy efficiency supports, it was seen that jobs were created for a total of 459.000 by the energy sector as of the last quarter of year 2010 (Romer and Bernstein, 2009).

The issue of Domestic Production of Energy Machinery and Equipment is an issue which has been discussed in Turkey for years and it defines the domestic production of machinery, equipment and ancillary materials used in the production, transmission, distribution and storage of energy, equipment used in the generation facilities, and performing any type of project design, manufacturing and mounting services with local sources and labor force. This definition covers the manufacturing and mounting works that are performed according to project of foreign origin. Whereas the foreign dependence of Turkey in energy resource is around 70%, on the other hand, it is also dependent to foreign companies to the most extent from the point of energy equipment. For that reason, increases in foreign exchange rate prevent the development of renewable energy investments. Many of the investments made up to now in energy sector have been designed by foreign companies and commissioned with foreign technology. The fact that the domestic technology is included in the construction of these plants leads to the decrease in costs in the investments that depend on renewable energy potential which is high and distributed overall the country, while this will enable this sector, which will create a significant amount of employment, to become the locomotive sector in economy.

Special emphasis has been attached to produce the mechanical and/or electro-mechanical parts used in the renewable energy production facilities in recent years domestically, and regulations have been started to be made on this issue. The first meaningful regulation on this issue is made for the renewable energy resources. With the Law on Utilization of Renewable Energy Resources for the Generation of Electric Energy No. 5346, which came into force in 2005, and its revision with the Law No. 6094, has provided the first net support to domestic production in energy investments. New steps have

[18] Information related to the current status of the technology given in this section mainly relies on the report: "Energy Equipment Local Production Status Assessment and Recommendation – MMO April 2014, Ankara, Edition No: MMO/621.

been taken in the field of developing local technology supported with YEKAs. In this way, the share of domestic production increases further more every year in the existing renewable energy plants.

Important experiences have been acquired in the **Hydraulic** Plants, which are one of the oldest plant types of our country. Whereas construction works and hydro-mechanical equipment change depending on river-canal and storage hydroelectric plant types, in general the construction cost of water structures in a hydroelectric plant corresponds to around 70% of the total investment cost. With a decree published in 1960s, it became obligatory to construct any type of lids, valves, penstock pipes etc. used in the dams, hydro-mechanical equipment, control mechanisms and lifting machines such as cranes etc. domestically, and as result of this, the domestic construction rate in these equipment reached to 100%. Today, all elements of a plant, excluding the turbines and generators, can be domestically designed, produced and mounted in a safe manner. Works launched for the turbine and generator design, test and production for which we are currently dependent abroad should be supported for encouraging, development and sustainability.

Components of the **wind** plant are the tower, rotor, nacelle and electric collection systems. All production of steel and concrete towers and wings are produced domestically by creating joint venture companies between our domestic companies with international big turbine producing companies and elements. Besides, the production of wing raw materials, wing connection nuts and bolts, tower connection nuts and galvanized anchorage production, various machinery equipment such as couplings and redactors are manufactured domestically. Most of the electric materials (transformer, switch field materials, transmission and distribution system connection etc.) could be provided from Turkey. Other elements such as wind turbine, generator, hub, gearbox could be supplied directly from abroad companies. Our industry has been developing every day on domestic production of small and middle sized turbines under the scope of unlicensed production. Small wind turbines could be produced with 100% local design and 80-90 domestic materials.

Works have been carried out on National Wind Energy Systems Development and Prototype Turbine Production (MILRES), which is a R&D application project created by some universities., research institutions and private sector At the first stage, design and production of 500 kW turbine is supported and realized by TUBITAK.

While constructing the basic systems that transform **solar** energy into electric energy, there is a separation between main product production equipment and complementary product production equipment. Main products could include silicone, ingot, cell, module, glass, eva, backsheet, inverter, ribbon and connection box and complementary products could be mounting sets, cable, regulator, battery etc. Whereas around 20 companies produce panel in Turkey, the domestic contribution rate of the panels they produce is low. Only the lamination works of these panels could be performed domestically. Around 800 million Euro investment is required for a production plant with a capacity of 1.000 MW/year in the production of PV panel which we could define with the process order of polysilicon, ingot, wafer, cell and panel production. However, in addition to the investment cost, there are other important obstacles such as R&D, know-how, technology and patent requirement. Besides, there is no sufficient raw material and local capital that could cover silicon, ingot and cell production technology in our country. In case of supporting and increasing the local module producers and establishing quality

standards, it will be possible in the coming years to produce these manufactured products.

Currently there are companies that operate in the production of solar, glass, inverter and module in our country, and although Eva, backsheet, ribbon and connection box are supplied from outside, there is raw material and machinery technology suitable for production.

The solar inverters, which are required for converting the electricity, which is produced as direct current in the solar cell so as to be suitable for the grid electric, are being developed and produced within the country by companies that develop or produce uninterrupted power supplies, redressers, rectifiers or industrial type inverters, which have specialized in their fields. However, since it is necessary to import the electronic components such as semi-conductor, resistor, diode, condenser in this production, the domestic contribution share in the inverter is maximum around 78%.

Biomass resources are very suitable for both direct burning and indirect burning (gasification) cogeneration (combined heat- electricity production – CHP) and trigeneration (combines heat – cold – electric production) technology. In the bioelectric production connected to the grid, biogas plants, large scaled biomass gasifiers and burning systems are used.

In the electricity generation from biogas which is obtained through fermentation from vegetative and animal wastes, concrete reactors, vertical and horizontal mixers, liquid and gas pumps, mud pumps, chemical substance dosage systems, biogas storage balloons, biogas safety and alarm systems, biogas safety burning chimney, automation (pH, temperature, liquid and biogas level etc. controls), mud separators, gas motors, electric generators, electric transformers, electric line connection equipment and construction works are required. It is possible to make half of the investment costs of biogas facilities with local equipment. Together with this, gas motors, some control units and technology (know-how) comes from abroad.

Main equipment used in the electricity generation with geothermal energy; turbines, generators, heat exchangers, cooling tower, control valves and pumps are all imported. Among the common facility equipment which are located between the plant and the wells; gate valves, booster pumps, reinjection pumps, pressurized vessels (separator, accumulation tanks etc.), pipes, supports could be domestically produced.

The investment and operating experiences that have been increasing in recent years in our country in renewable energy, demonstrate that domestic equipment production could be easily made with our production industry and engineering level. For this, Turkey needs to direct its domestic market according to this new understanding with correct policies and adequate incentives. Besides, international companies that sell to the domestic market could shift their productions to this country and certain components of international companies could establish joint venture companies to perform local production or totally domestic design and production. This is the emergence mission of YEKAs.

It is calculated that a significant source could be created for internal stability and growth by making the existing infrastructure (such as any type of equipment and system consuming energy, production facilities etc.) and creating new areas with newer technologies (zero carbon cities, innovative, production technologies and materials, new transportation systems and vehicles etc.) For example, Solar Impulse Foundation, which is created in partnership with the European Commission, leads

the creation of efficient, cleaning, profitable technologic solutions with a long term vision for 1000 new solutions that could not be imaged today with an international platform created with the name World Alliance for Efficient Solutions.

In this way not only a solution will be created for climate change, but a new roadmap will be put for new employment areas and for a clean and rapid growth (Solar Impulse Alliance, 2019). New giant companies that are placed at the top of global economy, such as Google, Apple, Facebook, progress towards 100% renewable energy target and make investments that combine data technology and energy technology, leading the developments in this field (Moodie, 2016). This and other similar examples point out the start of a new era that relies on R&D and is based on innovation, triggered by climate change.

Energy efficiency improvements directly and indirectly affect the economic activities measured by GDP; they may have benefit for the whole economy with the impact on employment, foreign trade balance and energy prices. Whereas the analysis of GDP changes depend on the economic structure and the design and scale of basic policies, in general, when large scaled energy efficiency policies are implemented, it is demonstrated that an economic growth between 0.25 – 1.1 % could be ensured annually and when 1 million Euro is spent to efficiency measures, 8 to 27 full time works could be created in a year.

Clean energy technologies where energy efficiency has the highest weight, could create many local jobs in regions they are implemented and additionally, the income obtained could have significant contributions to the economy of that region, including the unemployment, as many of these jobs relate to works concerning materials supplied at local level such as construction and installation as well as support services (IEA, 2014). Taking into account the indictor numbers in Table 5 and the strategic goals of Turkey, it is estimated that 1 million employment could be created in Turkey from the production of the equipment (domestic) to its commissioning.

Table 5: *Employment Effect of 1 Million USD Green Energy Investment (Number of Jobs Created) (Pollin & Garrett-Peltier, 2009)*

Energy Source	Direct Employment – Number of Jobs	Indirect Employment – Number of Jobs	Total Employment – Number of Jobs
Energy Demand Management	9.0	5.2	14.2
Hydraulic	8.2	6	14.2
Biomass	8.4	8	16.4
Recycling of Waste Energy	8.2	7.9	16.1
Wind (Terrestrial)	7.6	8.2	15.8
Solar	8.2	7.6	15.8
Smart Grid	7	7.1	14.1

As a conclusion, in addition to being the most effective measure in mitigating the effects of climate change, energy efficiency and renewable energy are one of the most important remedies in mitigating the possible social and economic losses (arising from such measures as closure of coal plants, narrowing down of energy intense industry) that arise together with struggle.

9. REVIEW OF CLIMATE FRIENDLY FINANCIAL OPPORTUNITIES IN THE ENERGY SECTOR IN TURKEY

In addition to public supports in energy and resource efficiency, renewable energy, clean production in Turkey, the World Bank, European Investment Bank (EIB), German Development Bank (KfW), German International Collaboration Organization (GIZ), French Development Agency (AFD), European Bank for Reconstruction and Development, Japan Bank for International Cooperation (JBIC), United Nations Development Program (UNDP) and many other foreign finance institutions and international funds provide some grant programs and provide long term low interest loans to entrepreneurs which will produce environmentally friendly energy through Turkish banks. One of the organizations that provide the most foreign resource in the field of renewable energy is the Turkish Sustainable Energy Financing Program (TURSEFF). TURSEFF provide financing with interest rates starting from 1% monthly up to a maturity of 60 months.

Renewable energy loans, which could be provided at very appropriate interest rates compared to many commercial loans, are being provided by many banks in Turkey. Besides, Clean Technology Fund and GEF Foundation Fund, which are managed by the World Bank, provide loans over banks and carry out technical assistance programs in the public sector.

9.1. Public Support in Energy Efficiency

The Ministry of Energy and Natural Resources provide supports within the scope of Efficiency Enhancing Project (VAP), Voluntary Research programs.

Efficiency Enhancing Project (VAP): Application is required in the January of every year for industrial enterprises which have an annual energy consumption of ≥1000. With the decision which was published on 14 March 2019, the support amount of the efficiency increasing projects has been increased and projects with a project investment price of ≤5 million TL, with a repayment period of less than 5 years could apply for support. The amount of support, which is grant, is 30% of the highest project price. The candidate projects are evaluated with the formulae specified and support amount is calculated according to the ranking. It is required that the project will be implemented within 2 years. Application is made in the January of every year.

Voluntary Agreements: Industrial enterprises with an annual energy consumption of ≥1000 toe, may apply in the October of every year with the commitment to decrease the energy intensity by 10% on average within three years. Applications made for GA support are evaluated with the formulae determined and put into order according to the total scores. 30% of the energy costs pertinent to year of the agreement (maximum 300.000TL) shall be paid to industrial organizations which fulfill the commitment of decreasing the energy intensity by making a voluntary agreement.

KOSGEB EE supports: The KOSGEB energy efficiency support updated in September 2018, could be provided up to **35.000 TL** within the scope of Enterprise Development Support Program. Depending on the annual energy consumption intervals of SMEs, support upper limits for energy efficiency are as follows:

- Support upper limits for preliminary survey are 2.500 (two thousand five hundred) TL for 20-200 toe, and 5.000 (five thousand) TL for toe over 200.

- Support upper limits for detailed survey are 10.000 (ten thousand) TL for 20-200 toe, and 20.000 (twenty thousand) TL for toe over 200. In order for the enterprise to benefit from the support for detailed survey services, it must have received preliminary survey service. In order to make support payment for detailed survey services; it is required that detailed survey report should be approved by detailed survey evaluation commission.
- The support upper limit for VAP consultancy to be received after detailed survey is 10.000 (ten thousand) TL.
- The support upper limit for energy manager trainings is 5.000 (five thousand) TL. Several staff of the enterprise could participate in energy manager training within support upper limit.

The enterprise could benefit from each of the preliminary survey, detailed survey and VAP consultancy support during the program period. In order to receive support, these services should be received from organizations and companies authorized within the scope of Energy Efficiency Law. SME which intends to benefit from the support shall print out the application form that is filled out in the electronic media from the web page of KOSGEB and apply to relevant application unit of KOSGEB.[19]

Vth Region Incentives: Investments for energy efficiency which will be made in the existing production industry facilities with a minimum annual energy consumption of 500 toe (tone equivalent oil), will ensure energy saving of minimum 20% per unit product and which have an investment return period of maximum five years, could benefit from the incentives provided to investments to be made to 5th Region. 5. Regional incentives include supports such as VAT and customs tax exemption, tax deduction, social security premium supports, interest support and site allocation.

Duty, paper and stamp duty exemption for processes related to direct writing off of the expenditures towards ensuring heat insulation and energy saving, ensuring heat insulation and energy saving:[20] With the "Law on Amending Some Laws f or the Purpose of Improving the Investment environment" No. 6728, companies and taxpayers who have commercial earnings that could be taxable according to real procedures, could not capitalize their expenditures towards heat insulation and energy saving, which increase the economic value of their real estates included in the enterprise, and could directly write these off. With this law, duty exemption has been put for the transactions that are directed towards ensuring heat insulation and energy saving. Besides, the contracts concluded for ensuring heat insulation and energy saving to the buildings are exempt from any type of paper and stamp duty.

9.2. Public Supports in Renewable Energy Sector

Electric energy production from renewable energy sources in Turkey is supported by "Electric Market Law No. 6446" and the secondary regulation, "Law On Use of Renewable Energy Sources for The Purpose of Energy Generation No. 5346" (YEK-e Law).

Under "Renewable Energy Resources Support Mechanism", of Turkey, which is the guaranteed purchase from fixed price tariff, tariff levels are identified for each renewable energy technology. In this way, projects at grid scale could benefit from the purchase guarantee determined in YEKDEM (***Feed-in tariff support)*** for a period of 10 years from the moment of start. Purchase guarantee support is provided within the scope of Regulation on

[19] www.kosgeb.gov.tr - Enterprise Development Support Program

[20] Official Gazette dated 9 August 2016.

Certification and Supporting Renewable Energy Sources (YEKDEM) (EPDK, 2019).

Projects which have capacity above 1 MW are subject to licensed energy generation regulations and the investors of these projects are obliged to apply for preliminary license for the connection capacity. If there is a demand for capacity connection above the capacity and more than once in the transformers which the project will connect for the transfer of energy, preliminary license tenders are held in order to manage the connection capacity. Preliminary license is given for a total capacity of 2.122 MW for the projects in year 2011. In 2017, preliminary license tender has taken place for 3.000 MW for the wind energy and in 2015, preliminary license has taken place for 600 MW connection capacity for solar energy. For the wind energy, an additional 2.000 MW connection capacity is disclosed and it is planned to perform preliminary license tender in the April of 2020.

From 1 January 2016 to the end of 2020, for the purposes of encouraging local technology production, additional price as indicated in Schedule 2 is applied for a period of 5 years for the electricity energy to be generated if minimum part of the mechanical and/or electro-mechanical equipment used in the licensed facilities as defined in the relevant regulation is of domestic production.[21] The domestic part ratio for any mechanism used in any unit of the facility is required to be the same for all units used in the facility. In case that the rate of the integrating part in the mechanisms is not the same, domestic contribution additional price is calculated taking into account the lowest domestic part ratio in the units.

[21] Regulation on Production of Parts Used in Facilities Generating Electric Energy from Renewable Energy Resources in Domestic Production

Table 6: *YEKDEM Feed-inTariffs – Chart No. I (Provision dated 29/12/2010 No 6094)*

Type of Production Facility Based on Renewable Energy Resource	Applicable Prices (USD cent/kWh)
▪ Hydroelectric production facility	7,3
▪ Generation plants based on wind energy	7,3
▪ Generation plants based on geothermal energy	10,5
▪ Generation plants based on biomass (including garbage gas)	13,3
▪ Generation plants based on solar energy	13,3

Table 7: *YEK Support Tariffs – Chart No II – Domestic Production Contribution (Provision dated 29/12/2010 No 6094)*

Type of Facility	Production Within the Country	Domestic Additive Addition (USD cent/kWh)
Hydroelectric production facility	1- Turbine	1,3
	2-Generator and power electronic	1,0
Generation plants based on wind energy	1-Wing	0,8
	2-Generator and power electronic	1,0
	3-Turbine tower	0,6
	4-All of the mechanical parts in rotor and nacelle groups (Excluding payments made for wing group and generator and power electronic)	1,3
Generation plants based on photovoltaic solar energy	1-PV panel integration and solar structural mechanic production	0,8
	2-PV modules	1,3
	3-Cells constituting the PV module	3,5
	4-Invertor	0,6
	5-Material focusing solar light on PV module	0,5
Generation plants based on condensed solar energy	1-Radiation collection type	2,4
	2-Reflective surface plate	0,6
	3-Solar follow-up system	0,6
	4-Mechanic parts of heat energy storage system	1,3
	5- Mechanical parts of steam production system by collecting solar light at the tower	2,4
	6- Stirling motor	1,3
	7-Panel integration and solar panel structural mechanic	0,6
Generation plants based on biomass energy	1-Fluid bed steam boiler	0,8
	2-Liquid or gas fueled steam boiler	0,4
	3-Gasification and gas cleaning group	0,6
	4-Steam or gas turbine	2,0
	5-Internal combustion motor or stirling motor	0,9

Type of Facility	Production Within the Country	Domestic Additive Addition (USD cent/kWh)
	6-Generator and power electronic	0,5
	7-Cogeneration system	0,4
Generation plants based on geothermal energy	1-Steam or gas turbine	1,3
	2-Generator and power electronic	0,7
	3-Steam injector or vacuum compressor	0,7

Besides, according to Article 8 of the Law on Using Renewable Energy Resources for the Purpose of Electric Energy Generation, the following shall be applicable for legal persons who hold production license which will be operational as the first time by December 31, 2020: [22]

- In production facilities that are based on renewable energy sources within the scope of the Law, a discount of 85% shall be applied to the permit, lease, usufruct right and utilization permit costs for the investment and operating periods from energy transportation lines, including which will be transferred to TEIAS and distribution companies, on access roads and up to the connection point to the system as specified in their licenses. Forest Villagers Development Income, Afforestation and Erosion Control Income shall not be taken.
- A discount of 50% shall be applied over the transmission system utilization fees for a period of 5 years from the date of operationalization of production facilities.
- In the investment period of production facilities, processes performed in relation to production facilities shall be exempted from duty and the papers issued from stamp duty.

The issue of whether YEKDEM will be continued to be implemented after 2020 is uncertain. However, it is the expectation of the market that it will continue. If continued, the support amounts could be updated or indexed to YEKA tender cost trends (to lower support price).

According to Article 17 of the Communique No. 2012/1 on the Decision on State Aids in Investments No. 2012/3305[23], investments related to the production of certain parts of the facilities for the production of renewable energy shall be counted among the priority investment issues. According to this, supports will be provided to the investors in the investments to be made from VAT exemption to customs tax exemption, from corporate tax discount to insurance premium employer share support, from investment site allocation to the interest support.

Significant success has been obtained within the scope of YEKDEM system, and the increase in the targeted installed power will continue until the end of year 2020. Terrestrial wind energy capacity of around 7.000 MW has been established with YEKDEM system until the end of 2018, and in addition to this, 5.000 MW solar energy capacity has been reached (together with unlicensed ones), and the 2023 target in solar energy has been met by now.

[22] Cabinet Decision No. 2015/8317, Official Gazette dated 24.12.2015

[23] Official Gazette dated 19/11/2015 No. 29537

Unlicensed Production

Law No. 6446 has brought significant innovations and incentives to the existing electric market system. With an exemption of acquiring license and company obligation, the installed power of production facility based on renewable energy sources was increased from 500 kW to 1 MW, and also the installed power of generation facility based on renewable energy resources from the point of developing competition and ensuring supply safety was resolved by the Cabinet to be increased up to 5 folds (5 MW).

The real and legal persons who produce within the scope of unlicensed production shall benefit from YEKDEM through the supply companies who are in charge in their regions for a period of ten years from the date of full or partial commissioning of the generation facilities for electric energy in excess of need. Unlicensed electricity generators may not benefit from domestic contribution rate.

Within the framework of Communique amendment made by the Ministry of Economy[24] *, unlicensed electric production investments, sector for which incentive document could be prepared by local units and investment issues were taken under the scope*. With the amendment of the regulation "unlicensed electric generation investments were also added to the list prepared for investments which are included under the scope of general and regional incentive practices and of which fixed investment amount does not exceed 10 million TL". Thus, it will be possible to apply for incentive certificate to local units at places where this investment will be made, depending on the preference of the company. Previously the incentive documents were given by the Ministry of Economy.

According to the Biomass Atlas, which is prepared by YEGM, there is vegetative waste of 97 million tons, animal waste of 163 million tons, 31 million tons of urban organic waste and forest wastes, with an energy equivalent of 40 million toe/year. The total energy equivalent of wastes in Turkey is 44 million toe/ year. Since CO_2 is used during the production of biomass sources, carbon is not accepted as a neutral fuel.

For that reason, it is within the scope of Communique On Supporting Agriculture Based Investments[25] ;

- In order to be used in the existing modern greenhouses registered in the undercover registration system, provided that these shall not be smaller than three decares, construction of facilities that generate heat and/ or electric energy from geothermal and biogas among renewable energy resources as well as that produce electricity from solar and wind energy, shall be evaluated within the scope of grant support.
- The amount of project on which the grant is based under the investment issues specified, cannot exceed 2.000.000 Turkish Lira in the applications for new facilities, 1.500.000 Turkish Lira for applications of technology renewal and / or capacity increase, and 1.750.000 Turkish Lira for completion applications.
- 50% of the project amount on which the grant is based shall be supported with grant. The

[24] Communique on Amendment of Communique (Communique No. 2012/1) Related to the Implementation of Decision on State Aids in Investments (Communique 2017/1), Official Gazette dated 26 July 2017 No. 30135.

[25] Communique No 2017/22 Official Gazette dated 13 September 2017 No. 30179).

remaining 50% is required to be provided by the applicants.

- In relation to all investment issues which will use geothermal, biogas, solar and wind energy as renewable energy, the grant support shall be facilitated if the production of renewable energy will meet minimum 51% maximum 110% of the annual energy need calculated over the installed power of the facility that exists or to be established within the scope of this Communique.
- It is a condition that the energy shall be connected to the national network in all investment issues which will generate electricity using biogas, solar and wind energy as renewable energy.

The date of completion of investment projects physically is 1 October 2018 (extended until 1 August 2019 with the Communique dated 30 March 2019).

9.2.1. Renewable Energy Resource Area (YEKA) Tenders for Strengthening Regulatory Framework That Supports Energy Transformation

These are the "Renewable Energy Resources Support Mechanism" (YEKDEM) tender and "Renewable Energy Resource Area (YEKA)" tender, which is the newest policy mechanism that has started to be implemented in Turkey towards performing energy sector investments with more cost-based following preliminary license tender model, which have been implemented since 2005 and 2011 respectively. In the YEKA tender model, which Turkey has been implementing, local equipment production capacity development and technology transfer are highlighted, meanwhile it is targeted at creating a domestic market that generates electricity in a competitive manner with low cost from renewable energy resources.

In 2016, "Renewable Energy Resource Areas Regulation" was published[26]. First YEKA tenders were held in the year 2017. The new YEKA tender (Renewable Energy Auctions), which was announced in 2018 for wind energy and planned to take place in 2019 but was postponed, the solar YEKA tender which was announced to take place in January 2019 but was recently cancelled, and the offshore wind YEKA tender which was postponed to 2019 as the earliest, are among the main planned programs within the scope of YEKA. Two tenders for wind and solar energy, each with an installed power of 1.000 megawatt (MW), were awarded to two separate consortiums comprising national and international partners. In the YEKA tenders in question, final prices received were under the global average due to the fact that the costs of renewable energy technologies in Turkey were significantly lower as in the case in other regions of the world.

- In onshore wind tender, 3,48 US$ ct/kWh
- In solar energy tender, 6,99 US$ ct/kWh

Compared to YEKA tenders which target at developing a single and major object installed power in 2017, new tenders were designed to develop four plants each with a size of 250 MW for onshore wind, and three plants with installed powers of 500 MW, 300 MW and 200 MW in three separate regions for solar energy.

According to the explanations of the Ministry of Energy and Natural Resources (ETKB), Turkey plans to establish additional 10.000 MW solar and 10.000 MW wind capacity in the next ten years. In the implementation of these installed powers, it is foreseen that YEKA tenders will play an important role.

[26] Renewable Energy Resource Areas Regulation, Official Gazette dated 9.10.2016 No. 29852.

9.2.2. Wind Energy Plant (YEKA-RES) Tender

In 2016 Renewable Energy Resource Areas Regulation[27] was published. Thus, wind sector will have a new investment model with mega projects. Within the scope of RES 1 tender(auction), in regions where there is a permit to install 1700 megawatts plant in total (Kayseri-Niğde, Sivas, Ankara-Edirne-Tekirdağ, Ankara-Çankırı-Kırıkkale, Bilecik-Kütahya-Eskişehir), areas will be selected where turbines could be established so as to create a capacity of one thousand megawatt. A wind facility investment above 1 billion USD will be made and a wind turbine factory will be installed with an investment cost of over 100 million USD, where the condition of domestic contribution will be 65%. RES-2 tender was postponed.

9.2.3. Renewable Energy Resource Area Solar Energy Plant (YEKA-GES) Tenders

An electricity energy generation plant based on solar energy with a capacity of 1.000 MWe will be installed on 19.2 km^2 part of the area sized 27.2 km^2 in total which was announced (auction) as YEKA-GES-1 on the area characterized as Energy Specialized Industrial Zones in Konya Karapinar.

In addition to installing the electric energy generation facility within the scope of Karapinar YEKA-1, Research and Development center and photovoltaic (PV) solar module factory of domestic production will also be installed. The commissioning of the PV solar module factory to be installed will take place within 18 months following the date of signing of the contract, and the domestic product solar module factory will have an annual minimum capacity of 500 MWp/Year.

The solar energy plant will have an installed power of 1.000 MWe. The total domestic contribution rate of PV solar modules shall be minimum 60% for the first 500 MWp product, and minimum 70% for the remaining production.
There is a requirement to have local employment in minimum 80% of the R&D center to be installed within the scope of the project, and minimum 90% for the installation and operation of YEKA GES-1. The YEKA-GES-2 tender, which would be held on 31 January 2018, was cancelled. Besides, the foreign partner of the first tender announced that it will transfer its shares to the domestic partner and leave the partnership.

10. RENEWABLE ENERGY PRACTICES IN VARIOUS SECTORS OF TURKEY

Renewable energy practices have various different applications both from the point of technology and place of use. Renewable energy resources have become systems which the final consumer could benefit with the development of technology. Thus, the final consumer could produce his own electricity and ensure saving.

In particular, the solar energy has a great diversity from this aspect and our country is a very advantageous region in terms of resources. Solar energy is a type of energy which could be used in different areas and almost in every sector. It is a method of generating energy on which numerous studies have been conducted together with the developing technology.

Solar energy systems are in fact now a new form of energy for our country. Sun is the first energy that has been used in the south regions of the country for long years for the production of hot water. Electricity

[27] ibid

application has entered into our life long years ago on watches, lanterns and calculators. Nowadays, its place of use has extended even to the energy source of satellites. In our country, electricity generated from sun is a source which is not included in our energy balance sheet much, however the widespread areas of use of solar energy include the traffic lamps, road, park, garden illumination and signboards, as well as various stations that are remote from the network (phone transfer station, forest observation, lighthouse, agricultural water pump etc.).

In today's world where renewable energy source has a great importance, the installation of solar energy plants has become widespread. The roofs of factories, industrial areas and cold air depots have become the systems preferred by the enterprises as solar energy systems installation areas. In addition to this, there is an increasing interest towards roof type solar energy systems in meeting the electricity requirement of the houses due to such reasons as the costs becoming cheaper and easiness of selling to the network when not used.

Rooftop solar energy plant practices provide advantageous areas of use for companies and houses by using the unused areas. With GES roof application designs, higher efficiency is obtained compared to standard field designs and these could be realized within shorter period as there is not much bureaucratic process. Rooftop GES projects have a wide field of application from industrial areas, namely Organized Industrial Zones, to small craftsmen sites, storage, agricultural and stockbreeding facilities; house and major commercial structures, namely shopping centers, sports centers, hotels, hospitals, fuel oil stations etc. In rooftop GES projects, straight roofs have less cost compared to sloped roofs and the ability to locate the panels with suitable angles in order to receive the light in the best way leads to the best result as the straight roofs do not require any additional cost.

Due to the fact that solar energy data relies on global meteorological resources, the production values and the values after the completion of the project coincide one to one and thus the production is guaranteed.

Illumination of Alaşehir District Public Hospital with Solar Energy

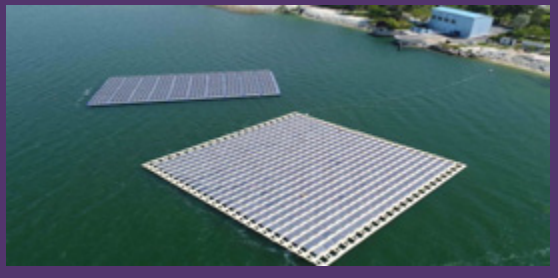
With the support of Zafer Development Agency (412.5 thousand TL, which is 70% of the total cost of project, namely 540 thousand TL) 50 solar panels have been placed on the Public Hospital in Alaşehir district of Manisa for illumination with solar energy. In order to disseminate the concept of electric energy efficiency in the hospital as well as the use of renewable energy sources, the existing illumination elements were converted into LED technology. The illumination lamps in the yard of the Hospital have been replaced with photovoltaic park lamps. Solar energy illumination system has provided approximate saving of 50% in the electric illumination costs of the hospital which correspond to around 200.000 TL annually.

Erzurum Metropolitan Municipality Solar Energy Plant

2 GES' are being constructed for the City to generate its own electricity in Erzurum, which, despite being a cold area, receives sun in most of the year. Construction of GESs with a total power of 4.9 MW is ongoing, comprising 2.4 MW in the Dağlar area of Aziziye district, and 2.5 MW in Susuzlar site of Yerlisu Neighborhood of Yakutiye District.

When in operation, these plants will be able to generate electricity from 5.88 MW peak solar energy, which is the maximum power when the solar lights come to solar panels at correct angle and density, and cover the own energy need of the Municipality.

By establishing 960 floating solar energy plants on Büyükçekmece Lake in Istanbul, energy is provided to 260 houses.



The first Floating Solar Energy Plant of Turkey (GES), which comprises 960 units of 260 Watt solar panel on Büyükçekmece Lake, has reached the capacity to meet the energy need for 260 households on a daily basis. It is calculated that 164 tons of carbon dioxide emission will be saved annually with the production of the plant (Solarist, 2018).

Istanbul energy, which is a company of Istanbul Metropolitan Municipality (IBB), and ISKI, which is its affiliate, have commissioned the first Floating Solar Energy Plant (GES) of Turkey.

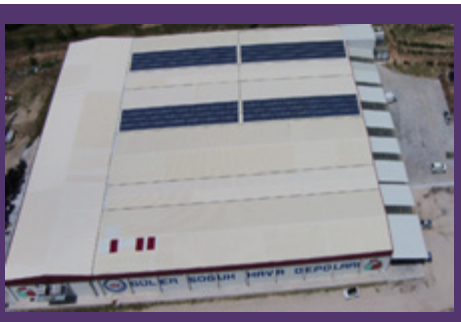
The plant which is established on Büyükçekmece Lake, which is one of the resources that provide clean water to Istanbul, is characterized to be a system which is applied as the first time in Turkey, and it is indicated that this plant is 10% more efficient compared to the practices on the land. In order for the system to be long life, a special material is used which is resistant against corrosion.

Cold air depot operation with solar energy

Güler Cold Air GES, is one of the reference Solar Energy plants of the region which operates with self-consumption model, with a power of 144 kWp, located at the roof of cold air depot in Isparta province.

In the plant that comprises 576 panels, a total of 193.225 kWh electricity is generated annually.

It was calculated that this plant prevented the release of 118 tons of CO_2 on average annually. The project was commissioned in March 2014.



Irrigation System with Solar Energy

This has become widely used for the irrigation of agricultural lands that are remote from the electricity network. The system capacity changes according to the well depth and the amount of irrigation water needed on a daily basis. For example, for a field that has a water need of 10 tons/ day, there is a need for a system that has a power of 1000 wp in order to extract water with submerged pump from a depth of 50 meters. The system has a cost of around 5.000 Euro.

Samples from Biomass Plants:

SÜTAŞ Biomass Plants

There are biogas facilities with an electricity generation capacity of 4 MW in Karacabey and 6.4 MW in Aksaray. The animal and vegetative wastes of SÜTAŞ farms are used as raw materials.

GÖNEN ALTACA Biogas Plant

The plant which was installed in Gönen in 2014, comprises biogas and integrated organic fertilizer facilities with a capacity of 3.7 MWe. The raw materials used are chicken farm wastes, bovine wastes, rice husk and rice stems, caustic milk factory wastes, slaughterhouse wastes, yeast factory yeasts and other organic industrial wastes.

Polres Biogas Plant

The plant which is established in Polatli has started production with 400 – 600 kW, and has an electricity generation capacity of 1.4 MW. As raw materials, solid and liquid bovine fertilized is used. The plant has a waste processing capacity of 240 m3/day.

Pakmil Biomass Plant

It is the biomass incineration plant established in 2015 integrated to the cotton oil factory that is being operated in Adana. It has a capacity of 1,763 MW_e. Main raw materials used include cotton stem, corn stem, stub and soya wastes. 18.000 tons of waste are processed annually.

Water pumping with Wind Energy

Wind energy has been used since ancient ages in places where there is a need for mechanical energy using the shaft power of the turbine for water pumping, cereal grinding, cutting, compacting and oil extracting.

In addition to generation of electricity at high capacity directly, it could also be used in water pumping in an efficient and economical way.

Systems used in water pumping are the systems which operate in connection with water pump, that have multi-wings and could provide high moment at low wind speed. They are used for small scale irrigation and irrigated agriculture where pump depth is small in remote areas. It is sufficient to have small amount of wind in order for the system to operate. In slight winds, **10- 15 tons of water could be extracted by a wind pump with a size of 10 meters**. This number reaches to around 25 -30 tones when the wind is powerful. Users may provide pumps with different dimensions as needed.

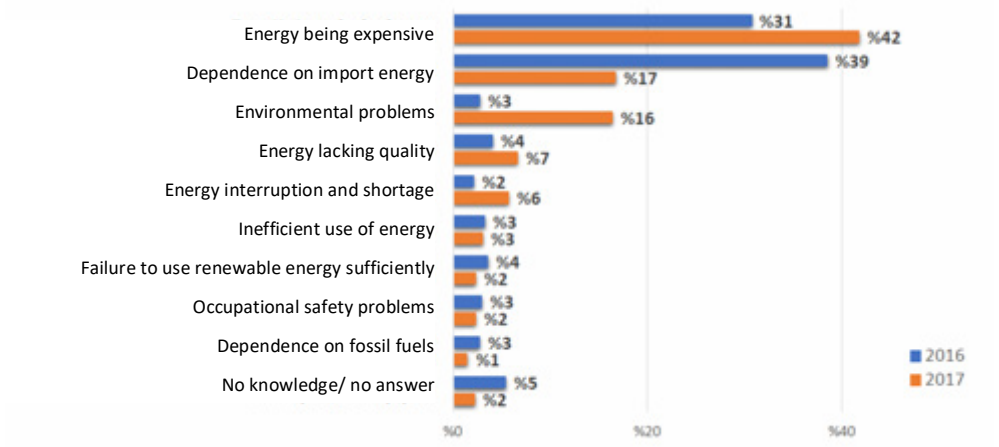
11. SOCIAL DIMENSION OF ENERGY AND ENERGY PREFERENCES OF TURKISH PEOPLE (see Ediger et al., 2019)

Energy is a must for human beings and societies for heating, illumination, operation of devices/ equipment, transportation and production. The preferences of public in energy consumption in terms of resource and among are shaped according to the regional and cultural habits and climate conditions, level of education and knowledge, accessible resources and related technology options and most importantly the income level and the fact that the energy source is at a purchasable level compared to that level. Urbanisation is also one of the factors that change the energy consumption preferences of the public.

In order to reveal the energy preferences of the public in our country, Kadir Has University Center of Energy and Sustainable Development Implementation and Research Center (CESD) has been carrying out "Research on Energy Preferences of Turkish Society" for the last two years and monitoring the results in a comparative way (years 2016 and 2017) (Kadir Has University, 2017). In this study, analyzes related to energy preferences that rely on responses given to questions are given, taking into account the regional and social differences.

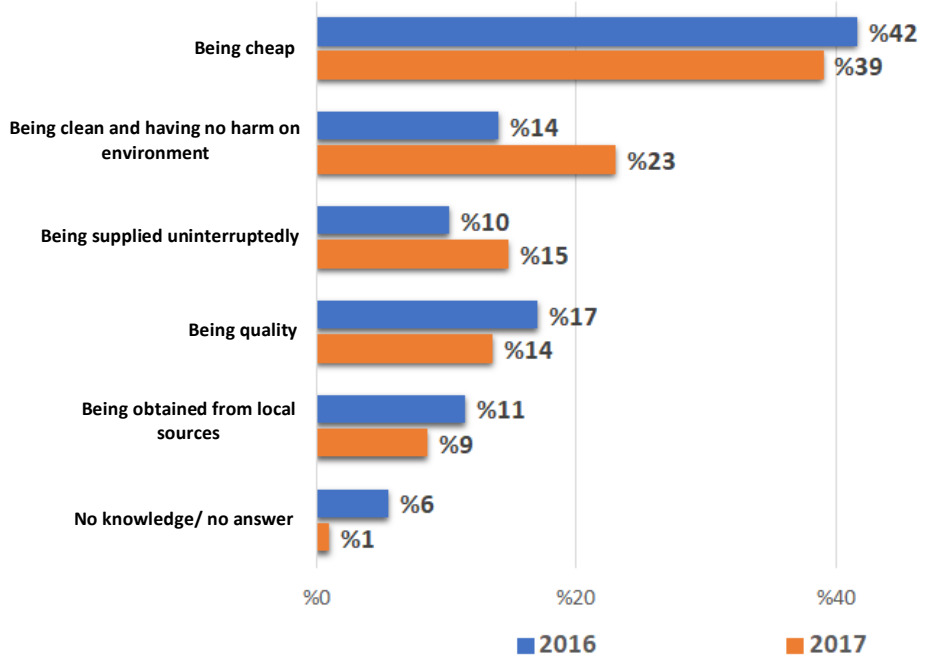
The question "What is the most important problem of energy system in Turkey", which was asked to the participants of the survey, was responded as "**the energy being expensive**" by 42%, which was followed by "dependence on import energy" with a rate of 17% as the second important problem of Turkish energy system. The most important third problem of the energy system was indicated to be environmental problems with a rate of 16%.

Figure 28: *Responses Given to the Question "What is the Most Important Problem" of Turkish Energy System (As Specified in the First Row) (ibid)*



Similarly, it could be seen that the issue which affects the energy use preference of the public the most was the energy price with a rate of 40%. Whereas the priority of environment issue is the preference that comes after price, an increase of sensitivity is observed on this issue in the last two years.

Figure 29: *The Order of Importance of Issues Which are Important In The Preference of Public in Energy Consumption (ibid)*



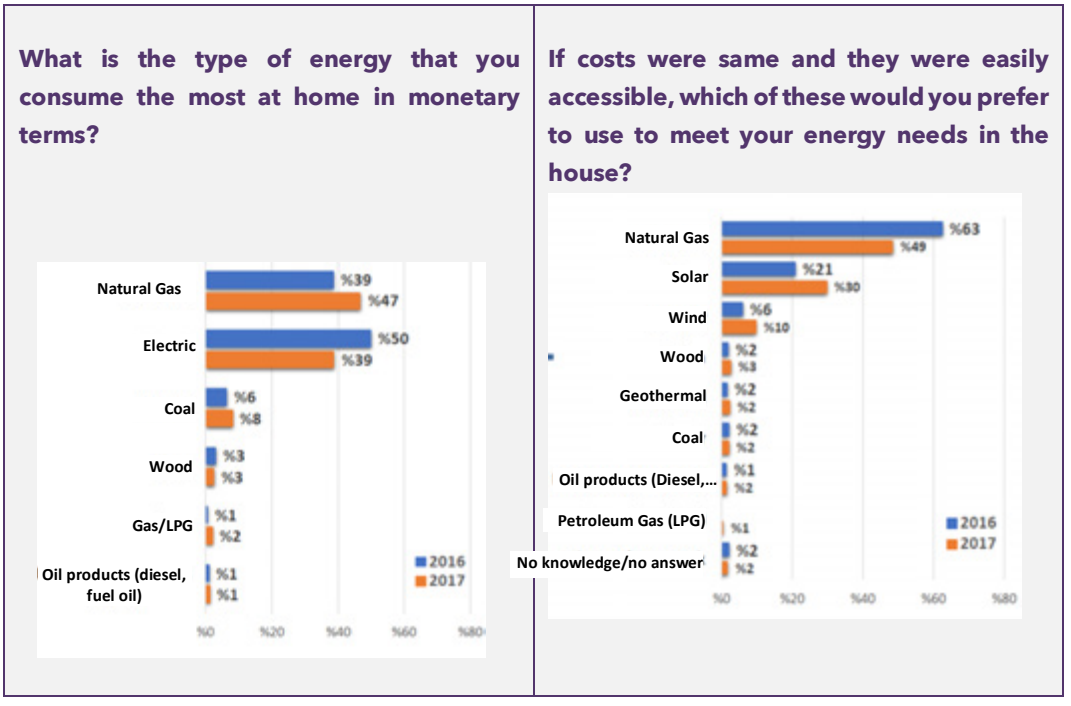
According to this evaluation, the energy preference of the public is heavily determined by the price, or to put it better, the affordability. As a matter of fact, the participants answered the question of "How do you find the prices of electricity and other energies" as "high and very high" at a rate of 80% and above.

It could be seen that those who participated in the survey indicated their energy use preference on the side of natural gas (since the heating energy gets a share of 52% in energy consumption). However, the fact that natural gas prices is high for the consumers in the poor section of cities whose purchasing power has decreased over the recent years, leads to consumption of cheap and poor quality cool for heating purposes. As a result of this, air pollution occurs. It is observed that the consumers are aware of this.

On the other hand, the people have started to show interest in the solar energy. In particular, due to being perceived as "free energy" for heating water in the south regions, as the solar energy became advantageous in terms of cost and accessibility, it could be seen from the answers to the survey that the second most important energy preference following natural gas could be solar energy (30%).

As of today, it could be seen that the solar energy, which is used for hot w aster on the south zone of our country, is used at a rate of 11% for water heating overall the country. In fact, it is known that solar energy is used more efficiently in North European countries where the radiation magnitude is much lower compared to Turkey. In our country, natural gas (51%) and electricity (27%) are mainly used for heating hot water.

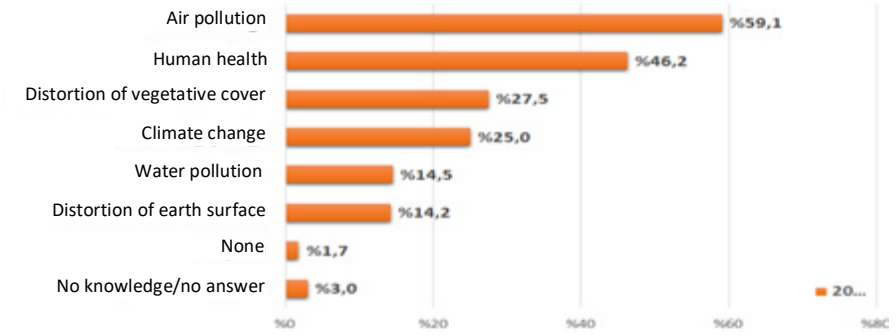
Figure 30: *Current Energy Consumption Profile of Households and Their Conditioned Preference (ibid)*



When the energy consumption profile in the houses is examined according to 2017 energy data, it could be seen that the natural gas has the biggest energy consumption share with a rate of 44%. The share of wood and vegetable wastes, which were heavily used in the final consumption 20 years ago, has

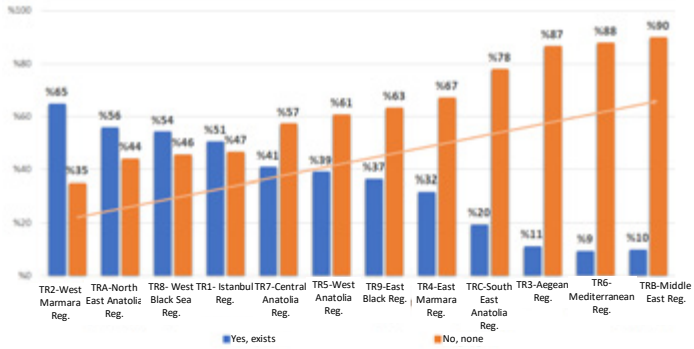
decreased with the shift to natural gas. The most important reason or this is that natural gas pipe distribution network has spread to all provinces and some major district, and heating systems such as combined heater, natural gas stove are sold at affordable prices with installments. Migration from rural areas to big cities also lead to the less use of wood.

Figure 31: *Responses to the Question "What is the Most Important Environmental Problem Arising from Energy in Turkey" (ibid)*



According to the response given by survey participants, it was determined that the most important environmental problem arising from energy was air pollution with a rate of 59%. Human health was the second with 46%, climate change was 26% and the most important fourth environmental problem arising from energy was climate change with a rate of 26%. On the other hand, to the question "Do you believe in climate change", the responses were "Yes" with a rate of 87%. With these responses, it is thought that the level of awareness on global climate change has significantly increased among our public, but there has not yet been established a conscious correlation between the climate changes such as sudden showers and floods, summer temperatures which boosted the AC sales almost everywhere in the country, and the measures required for mitigating this.Those who participated in the survey indicated that they had the highest spending for energy purposes and according to income roups, they do not have heat insulation in their houses with a rate of 50% and above. In the survey conducted by the Ministry of Energy and Natural Resources Renewable Energy General Directorate in 2010, it was observed that the rate of houses which have heat insulation was 17.3%. According to this result, whereas it is possible to state that the rate of heat insulation found in the houses improved for some amount in the last 7 years, the most important factor here is the dissemination of construction of mass houses and the increase of improving rate in building stock with the urban transformation.

Figure 32: *Responses Given to the Question "Do You Have Heat Insulation in Your Home" By IBBS Region Code (ibid)*



As a conclusion, whereas Turkish people prefer natural has as energy, they also tend to use new energy sources. Whereas social behavior believes in climate change, it is not effective in increasing energy efficiency and decreasing fossil fuel consumption.

12. EVALUATION OF RENEWABLE ENERGY SECTOR FROM THE PERSPECTIVE OF ENERGY COOPERATIVES

12.1. Creating Solidarity Economies in Renewable Energy Sector:

12.1.1 Renewable Energy Cooperatives

Local organizations could create rapid solutions by combining the powers in remedying a shortcoming in an area where there is need. In some countries of the world, it was seen that, through local initiatives, people living in a region could meet their energy needs by themselves without government contribution according to their own requirements by also getting the support of the local administration. Denmark, Belgium, Holland and Germany (in particular north regions), which have abundant wind, have met the electricity need by establishing Wind Power Plants by means of cooperatives. Regions where stockbreeding or agriculture is widespread, have developed heat and electricity production with biomass cooperatives. Southern regions established solar cooperatives and directed towards providing hot water and electricity, and thus the cooperatives have arisen.

For this reason, these cooperatives have a significant role in the leading countries in energy (such as Germany, USA and Denmark and many other countries of the world).

The Renewable Energy Cooperatives in the European Union have come together under the roof of REScoop.eu (European Renewable Energy Cooperatives Federation). 1250 cooperative enterprises, which have around 1 million members, are the member of this federation. According to 2015 data, the cooperatives in question have over 1000 employees, with an annual turnover reaching around 980 million Euro (Cooperatives Europe, 2016).

70% of the facilities in Germany, which has 40 GW GES potential, are owned by the cooperatives and there are 812 renewable energy cooperatives. Whereas electricity is provided over 42 million

consumers in the USA in 47 states, the number of cooperatives in Denmark reached to 2000.

Energy cooperatives in Turkey have a very long history. Some of successful cooperative examples are listed below:

Denmark: Middelgrunden Energy Cooperatives have been established with 50/50 municipality partners in 1997 as Wind Energy Cooperatives. With the wind turbine with a capacity of 40.000 kW, electricity need of around 50.000 houses are covered.

Samso Energy Cooperatives were established in 1997. There are 11 coast turbines of 1000 kW, and 10 sea turbine of 2.300 kW.

Germany; with Großbardorf Solar Energy Roof Project, solar panel with a capacity of 96 kW was located in 2011 with a cot of 190.000 Euro to the roof of the facility where agricultural and animal wastes are stored as required for the biogas. The energy produced could cover the electricity requirement of the facility.

United States of America: Roosevelt has published the New Deal program which supported cooperative movements in the field of energy following the Great Depression. Rural Electrification Center was established within the scope of the program which was published between 1933 – 1936. 417 electricity cooperatives which are established with the help of REA, provided electricity to 288 thousand houses. 900 rural electricity cooperatives provide electricity service in 47 states to more than 42 million electricity consumers. Cooperatives provide 12% of the total electricity production in the country and they have 42% of the country electricity distribution lines.

Licking Rural Electrification Cooperative; it is established in 1936 and provides electricity distribution to 25.000 consumers. It has 32 miles of transmission, and 3.072 miles of distribution lines. Thus, it is aimed at bringing the citizens together under the roof of cooperative with their own opportunities and to cover their energy requirements from renewable sources at local level.

12.2. Renewable Energy Cooperatives in Turkey

Despite the fact that Turkey has a good potential in terms of various resources, and in particular solar energy, compared to the regions, it cannot fully use these resources. The most important reason for this is that big resources are needed for investment, that there is foreign dependency at technological level and the bureaucratic long processes. Despite the fact the Germany, which is one of the countries that hold the best position in the world in terms of technology, has a lower potential compared to Turkey in terms of solar energy potential, it has an installed power of over 40.000 MW.

Whereas major scale solar projects are being spoken of in Turkey recently, it has become a model that is in the agenda recently to establish energy cooperatives in small industrial sites, workplaces, irrigation cooperatives, forestry villages and even schools within the scope of unlicensed production activity. Within this scope, the target is that a production model which will personally include the citizens will increase the use of local and renewable resources and contribute in ensuring the mitigation of energy gap of the country.

The cooperative is a model of partnership with variable partners and variable capitals established by minimum 7 real and legal persons for the purposes of meeting the needs of partners and protecting their interests by mutual assistance, solidarity and guarantee. According to Article 124 of Turkish Trade Code[28] cooperatives are commercial companies and they aim at earning profit in their investments. The point which distinguishes cooperatives from other company models is the principle of social responsibility they have. This principle is an important factor for the cooperatives to be include in the energy sector.

"Renewable Energy Production Cooperatives" installation works have been launched as a result of the expression included in Turkey Cooperatives Strategy and Action Plan (TUKOSEP), which states "new areas with high cooperative potential will be determined and encouraging works will be carried out towards establishing and developing cooperatives in these areas" and the recommendations towards establishing energy cooperatives in Turkey in order to produce energy from renewable resources in the "Turkey National Renewable Energy Action"

These two fundamental texts and the "Regulation on Unlicensed Electric Generation" which was

[28] See http://www.ticaretkanunu.net/ttk-madde-124/

published in 2013, enabled the individual consumers to combine and generate electricity. With the amendment made in the same regulation in the year 2016, renewable energy cooperatives were included in the legal regulations as the first time in Turkish Law. Thus, it has become possible to provide electric production service to the local and in particular to real consumers by means of the cooperatives.

Renewable energy cooperatives were encouraged by the Ministry of Customs and Trade, Cooperatives General Directorate and in 2016, citizens who combine their consumptions under renewable energy cooperatives were provided with the opportunity to apply for 1 MW on the basis of all renewable sources and for 5 MW in GES roof and front applications.
With these cooperatives the following are ensured:

- On Site Evaluation of Local and Renewable Resources and mitigating the loss rates in the energy system;
- Realization of local and sustainable development, creating regional value added and contributing in the employment
- Having the citizen own his own energy, being more independent on determining the energy price;
- Small Capitals coming together to realize bigger investments, creating alternative investment model in the sector
- With the correct determination of energy need and resources in the region, making rational investments, enabling the regional public to support investment.[29]

More attractive opportunities are developed every day in order to ensure that renewable energy cooperatives have a wider area of effect in Turkey and the interest among society on this issue is gradually increasing with the awareness rising and training works. GUNDER, which is one of the important associations of the sector, has paved a positive way with the actions of bringing the sector representatives in this area together and in particular encouraging the individual / cooperative institutions. A project has been carried out in Bodrum on this issue and local information is provided to the effect that roofs should be used for solar energy in the sites.

28 renewable energy cooperatives have been established in Turkey as of March 2019. Many new formations are on the way in such provinces as Aydın, İzmir, Van.

Aegean Electricity Energy Generation Cooperative, which was established in 2014 as the first renewable energy cooperative in our country, was founded in Tavas/ Denizli. At the first stage, cooperative which is established by 7 founders acquire new partners. It has found land and is at the stage of application for connection agreement.

The first objective of the cooperative, which was first established by 7 people who were engaged in production and trade operation in Karaman province, was determined to meet the electricity needs of the artisans at local level. Karaman Artisans and Artists Electricity Generation Production Cooperative was the second energy cooperative that was established.

Renewable energy cooperative was established in Çorum, which engaged in generation with two solar energy units, one with 600 kW and the other 500 kW, and Çorum Renewable Energy Cooperative is one of the cooperatives established in the year 2016. The cooperative which was initially established by 7

[29] Republic of Turkey Ministry of Customs and Trade, General Directorate of Cooperatives Brochure

founder partners, made application agreement for connection agreement.

Çorum Municipality Egg Producers Cooperative prepares for producing energy from animal fertilized by establishing Çorum Biogas Electric Generation Inc. It is planned that the biogas energy plant, which will be established next to the Organized Industrial Zone, will start operations by the end of the year. The company, which has completed its licensing procedures, is planned to generate electric energy of 1.2 MW with an investment price of 15 million TL. When the plant reaches to full capacity, 6 MW energy generation will take place with an investment cost of 60 million.

The cooperative established by Small Industrial Site in Kayseri was established on roof as 5 MW GES and was connected to the grid.

Amasya Renewable Energy Cooperative was established by 7 founder partners in 2016 and launched its operations. The connection agreement is at the final stage.

12.3. Renewable Energy Cooperatives in Turkey -Process of Establishment

Establishment of renewable energy cooperatives in Turkey has become possible with the Article 5 of "Regulation on Unlicensed Electricity Generation in Electricity Market", which was published in the Official Gazette dated 2 October 2013 No. 28783. In order for renewable energy cooperative to be established;

- The consumptions are required to be combined;
- There is a condition to be in the same distribution region;
- No condition of common connection point shall be sought;
- It may be established by minimum (7) same type subscribers
- With the addition that was made to the Regulation on 23 March 2016, cooperatives which have up to 100 partners are entitled to establish plant to produce up to 1MW, those with 101 to 500 partners up to 2 MW, those with 501 to 1000 partners up to 3 MW, and those with more than 1000 partners up to maximum 5 MW.

Step;	Remarks
Establishing Partnership	The cooperative could be established with minimum 7 persons. Whereas the partners could be private persons, they could also comprise legal persons. The issue to be stressed is the same subscriber type of the partners. The cooperative could only comprise house subscribers or only commercial subscribers. All of the partners of the cooperative are required to be the electric subscribers in the same distribution region. The "share" determined for the partnership is the minimum price that everyone who wants to be a partner to the cooperative should deposit. The amount of a share is determined by the Cabinet of Ministers. The figure determined for the year 2017 is minimum 100 TL. However, the cooperative may write in its status to determine the maximum and minimum shares to become a partner. Thus, the cooperative could meet its establishment costs by creating an equity with its own partners.

Step;	Remarks
Preparing Cooperative Status Draft	The cooperative partners come together to prepare "Cooperative Articles of Incorporation". This draft shall include the following: a. Name of the cooperative b. Where the center of the cooperative would be c. Why type of energy resource will the production take place d. Minimum amount of capital to be contributed; e. Conditions of partnership f. Those who will take office in the Management and Audit Board. The first board of directors is determined and the signature circulars is received from each member of Board. Chamber of Commerce registration form is filled out. Registration is made to the MERSIS system and relevant documents are added. The articles of association are signed before notary together with all founding partners.
Approval	The articles of association are sent to Cooperatives General Directorate for Ministerial approval. (The energy cooperatives are required to deliver the articles of association no through the Provincial Trade Directorates in the provinces, but directly to the general directorate located in Ankara) With the receipt of approval letter, application is made for registration to the Trade Registry Directorate of the province where the cooperative is located.
The land or area where the plant will be established is determined	Cooperative partners determine where they will generate electricity with the renewable energy source they prefer. If it is desired to construct solar energy plant, attention should be paid to ensure that the land has an average slope of 10%, there is no tree/ structure at a size to prevent the sun on the east and west parts, that it is close to the transmission and transformer line and that there is no agricultural land. The land determined is purchased or a minimum two-year lease contract is prepared. These documents should be approved.
Land class determination	After the cooperative partners purchase or lease the land they determined, they need to apply to the Provincial Directorate of the Ministry of Food, Agriculture and Stockbreeding of the land where the cooperative will establish the plant. With the application, marginal agricultural land letter is demanded. The provincial directorate asks for approval from Provincial Special Administration and State Water Affairs in accordance with the characteristics of the land and prepares this letter. Cooperatives which will perform roof application are exempted from this stage.
Environmental Impact Assessment Decision	Application is made to the Ministry of Environment and Urbanisation Provincial Directorate for "EIA Not Required" for the electricity generation plant (solar or wind) to be established on the land. This document shall also not be required for root application.
Application to distribution company	Different distribution companies provide service to regions in Turkey. The region is required to make an application to the distribution company for letter of invitation. For the letter of invitation, the title deed (or lease contract), Marginal Agricultural Field letter, EIA exemption letter, Cooperative Trade Registry Document are delivered to the relevant institution (EDAS) with a cover letter.

Step;	Remarks
Project Approval	Cooperative to which letter of invitation is sent for the connection agreement given to the distribution company, shall deliver the project which is drawn for the generation plant and connection line, if any, to TEDAS within 90 days following the date of notification of the letter. The application of the cooperative which does not apply within this period shall be deemed invalid.
Zoning Permit	Upon the approval of the project, zoning permit is received for the establishment of the plant from the municipality to which the region in which the cooperative plant will be established is connected. The zoning permit means that the plant which will be established in the region has passed through all approval stages and there is no obstacle for establishment.
Installation	Connection agreement is made with the distribution companies. After all permits are received, the project is drawn beforehand. Proposals are received from the companies to perform installation in order to put the plant into life. The plant is installed on the land determined by the company which will undertake the construction work accordingly.

The following documents are required for the establishment of the cooperative:

- 2 notary-attested articles of association and 4 photocopies reproduced from the notary-attested articles of association (6 articles of association in total)
- Incorporation Information Form
- Receipt showing that the cooperative capital is deposited to the account opened in the name of the cooperative.
- Statement by the members of board of directors and audit that they are not relatives in blood or in laws up to and including 2nd degree.
- Criminal records of the members of board of directors and audit
- For each partner, document demonstrating that it is electricity consumption subscriber in the same tariff group (subscriber contract or invoice)

Although the issue of cooperative seems to be an ideal solution, it should be taken into account that there are certain problems that a wait for solution in this field.

- First there is a need for capital in order to put into life the renewable energy cooperatives within the scope of unlicensed electricity generation activity. Since the cooperatives are not companies, they will have problems in reaching the financing.
- Besides, the fact that the loan interest rates towards renewable energy investments are high, problems experienced in showing mortgage and failure of banks such as the Development Bank to provide sufficient opportunities for the cooperatives, lead to delays for these cooperative to pass to the incorporation stage.

Additional costs could arise for constructions in Organized Industrial Zones, Small Industrial Sites and even bigger house sites since the solar panels are not mounted in a way to be suitably integrated. For that reason, designing the new projects in this way will provide great facility for the cooperatives to be established in the future.

REFERENCES

- AB, (2018). *Komisyon Çalışma Dokümanı – 2018 Türkiye Raporu*. Avrupa Komisyonu.
- Avrupa Çevre Ajansı, (2017). *Avrupa'da enerjinin geleceğini şekillendirmek: Temiz, Akıllı ve Yenilenebilir*. accessed at: https://www.eea.europa.eu/tr/publications/aca-isaretler-2017-avrupa2019da-enerjinin .
- Danish Energy Agency, (2018). *Finding Your Cheapest Way to a Low Carbon Future: Danish Levelized Cost of Energy Calculator*. https://ens.dk/sites/ens.dk/files/Globalcooperation/vejledning_lcoe_calculator.pdf .
- Diken, (Mart 5, 2019). AYD Başkanı Uyardı: Kur Sıçrarsa 15 Milyar Dolar Problemle Karşı Karşıyayız. http://www.diken.com.tr/ayd-baskani-uyardi-kur-sicrarsa-15-milyar-dolar-problemle-karsi-karsiyayiz/
- Ediger, V.Ş., Kirkil, G., Çelebi, E., Ucal, M.Ş. ve Kentmen, C. (2019). Türkiye Toplumunun Enerji Tercihleri–3: Turkish Public Preferences for Energy (2018-BAP-06). http://www.khas.edu.tr/uploads/kiletisim/cesd-enerji-anketi-3-19032019.pdf
- EIA, (2019). Levelized Cost and Levelized Avoided Cost of New Generation Resources in the *Annual Energy Outlook 2019*. https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf .
- Elektrik Haber, (Haziran 12, 2018). Türkiye Güneş Enerjisi Üretiminde Dünyada 13. Sıraya Yükseldi. http://elektrikhaber.com/2018/06/12/turkiye-gunes-enerjisi-uretiminde-dunyada-13-siraya-yukseldi/ .
- Enerji ve Çevre, (Ocak 25, 2019). Jeotermal Enerjide Avrupa'da Birinci Sıradayız. 147. Sayı (Ocak-Şubat), http://www.enerji-dunyasi.com/yayin/841/-jeotermal-enerjide-avrupa-da-birinci-siradayiz-_24518.html#.XL77uC2B3BK
- EPDK, (2019). *Yenilenebilir Enerji Kaynaklarının Belgelendirilmesi ve Desteklenmesine İlişkin Yönetmelik*. http://www.epdk.org.tr/Detay/Icerik/3-6736/yenilenebilir-enerji-kaynaklarinin-belgelendirilm .
- ETKB-EİGM, (2018). *2017 Yılı Türkiye Birincil Enerji Arzında Kaynakların Payı*.
- ETKB-EİGM, (t.y.). *Denge Tablosu 2017*. accessed at: https://www.eigm.gov.tr/tr-TR/Denge-Tablolari/Denge-Tablolari .
- ETKB, (t.y.). *Türkiye Elektrik Enerjisi Talep Projeksiyonu Raporu*. https://www.enerji.gov.tr/File/?path=ROOT%2f1%2fDocuments%2fEİGM%20Ana%20Rapor%2fTürkiye%20Elektrik%20Enerjisi%20Talep%20Projeksiyonu%20Raporu.pdf .
- European Commission, (2019). *Climate Strategies & Targets*. https://ec.europa.eu/clima/policies/strategies_en .
- EYODER, (2017). *Ulusal Enerji Verimliliği Eylem Planı 2017-2023*. http://www.eyoder.org.tr/UlusalEVEP.pdf .
- Gilleo, A. (Aralık 1, 2017). New Data, Same Results – Saving Energy is Still Cheaper than Making Energy. *ACEEE*. https://aceee.org/blog/2017/12/new-data-same-results-saving-energy
- Godron, P., Cebeci, M.E., Tör, O.B. ve Saygin, D. (2018). Türkiye'nin Enerji Sisteminde Yenilenebilir Kaynakların Payı: İletimde Genişleme ve Esneklik Seçenekleri. *SHURA Enerji Dönüşümü Merkezi*. Sabancı Üniversitesi.
- GÜNDER, (2018). İstanbul Büyükçekmece Gölü'ndeki Yüzer Güneş Enerji Santrali Günde 260 Eve Enerji Veriliyor. *Solarist*. https://www.solar.ist/istanbul-buyukcekmece-golundeki-yuzer-gunes-enerji-santrali-gunde-260-eve-enerji-veriliyor/
- Hidrokarbon Adam, (Mayıs 5, 2016). *Fosil Yakıtlar ve Yenilenebilir Enerji Kaynaklarının Yaşam Döngüsü Analizi*. http://www.hidrokarbonadam.com/alternatif-enerji-kaynaklari/__trashed-2/

- IEA, (2014). *Capturing the Multiple Benefits of Energy Efficiency, IEA*. https://www.iea.org/Textbase/npsum/MultipleBenefits2014SUM.pdf .
- IEA, (2016). *IEA-Energy, Climate Change and Environment: 2016 Insights*. https://www.iea.org/publications/freepublications/publication/ECCE2016.pdf
- IEA, (2017a). *IEA World Energy Investment 2017*. https://www.iea.org/publications/wei2017/ .
- IEA, (2017b). *Energy Efficiency 2017*. https://www.iea.org/efficiency2017/
- IEA, (2018a). *Key World Energy Statistics 2018*. Accessed at: https://webstore.iea.org/key-world-energy-statistics-2018 .
- IEA, (2018b). *Market Report Series: Energy Efficiency 2018*. https://webstore.iea.org/market-report-series-energy-efficiency-2018 .
- IPEEC, (2018). *Annual Report 2017*. https://ipeec.org/publications/reports.html .
- IRENA, (2018). *Renewable Power Generation Costs in 2017*. https://www.irena.org/publications/2018/Jan/Renewable-power-generation-costs-in-2017 .
- İklim Haber, (2019). *Türkiye'de Toplam Seragazı Salımlarının Sektörlere Göre Kırılımı 1990-2016 (Veri: TÜİK)*. https://plot.ly/create/?fid=iklimhaber:7#/ .
- Kadir Has Üniversitesi, (Şubat 9, 2017). Khas Türkiye Toplumunun Enerji Tercihleri Araştırması Sonuçları Açıklandı. http://www.khas.edu.tr/news/1511 .
- Keskin, M.T. (t.y.). *Enerji Verimliliği*. OSTİM ve Enterprise Euro Network Ortak Raporu.
- Meeus, L., Hafner, M., Azevedo, I., Marcantonini, C. ve Glachant, J-M. (2011). Transition Towards a Low Carbon Energy System by 2050: What Role for the EU? *European University Institute*, accessed at: https://www.eui.eu/Projects/THINK/Documents/THINK2050Report.pdf.
- Moodie, A. (Aralık 6, 2016). Google, Apple, Facebook race towards 100% renewable energy target. *The Guardian*. https://www.theguardian.com/sustainable-business/2016/dec/06/google-renewable-energy-target-solar-wind-power
- OECD, (2019). *Greenhouse Gas Emissions*. https://stats.oecd.org/Index.aspx?DataSetCode=AIR_GHG .
- Pollin, R. & Garrett-Peltier, H. (2009). *Building a green economy: Employment effects of green energy investments for Ontario* . Political Economy Research Institute, University of Massachusetts at Amherst.
- Romer, C. & Bernstein, C. (2009). *The Job Impact of the Amerikan Recovery and Reinvestment Plan*. https://www.economy.com/markzandi/documents/The_Job_Impact_of_the_American_Recovery_and_Reinvestment_Plan.pdf
- Solar Impulse Foundation, (2019). *The World Alliance in Efficient Solutions in 90 Seconds*. [Video] https://solarimpulse.com/world-alliance .
- T.C. Çevre ve Şehircilik Bakanlığı, (2016). *Türkiye İklim Değişikliği 6. Bildirimi*. accessed at: https://webdosya.csb.gov.tr/db/destek/editordosya/Turkiye_Iklim_Degisikligi_Altinci_Ulusal_Bildirimi.pdf
- T.C. Çevre ve Şehircilik Bakanlığı, (2018). *Seventh National Communication of Turkey Under The UNFCCC*. accessed at: https://unfccc.int/sites/default/files/resource/496715_Turkey-NC7-1-7th%20National%20Communication%20of%20Turkey.pdf .
- TEİAŞ, (2017a). *Türkiye Elektrik Üretim-İletim 2017 Yılı İstatistikleri*. https://www.teias.gov.tr/tr/turkiye-elektrik-uretim-iletim-2017-yili-istatistikleri .
- TEİAŞ, (2017b). *Türkiye Elektrik Enerjisi Üretiminin Birincil Enerji Kaynaklarına Göre Yıllar İtibariyle Gelişimi (2000-2016)*. http://www.teias.gov.tr/sites/default/files/2017-10/59%282000-2016%29.xls

- TEİAŞ, (2017C). *III – Elektrik Enerjisi Üretimi – Tüketimi – Kayıplar*. accessed at: https://www.teias.gov.tr/tr/iii-elektrik-enerjisi-uretimi-tuketimi-kayiplar .
- TEİAŞ, (2018). *Türkiye Elektrik Sistemi Kuruluş ve Kaynaklara Göre Kurulu Güç*. https://www.teias.gov.tr/sites/default/files/2018-11/kurulu_guc_ekim_2018.pdf
- TÜİK, (2017). *Sera Gazı Emisyon İstatistikleri, 1990-2017*. http://tuik.gov.tr/PreTabloArama.do?metod=search&araType=hb_x.
- TÜİK, (2018). *Seragazı Emisyon İstatistikleri, 2016*. TUİK Bülteni Sayı: 27675 - 13 Nisan 2018. http://www.tuik.gov.tr/PreTabloArama.do?metod=search&araType=hb_x .
- TÜİK, (2019a). TÜİK Haber Bülteni Sayı: 30629 - 05 Şubat 2019 – Motorlu Kara Taşıtları, Aralık 2018. http://www.tuik.gov.tr/PreTabloArama.do?metod=search&araType=hb_x .
- TÜİK, (2019b). TÜİK Haber Bülteni Sayı: 30627- 11 Nisan 2019 – Seragazı Emisyon İstatistikleri, 1990-2017. http://www.tuik.gov.tr/PreHaberBultenleri.do?id=30627.
- YEGM, (2018). *Türkiye Enerji Verimliliği Gelişim Raporu 2018*. http://www.yegm.gov.tr/document/enver_gelisim_rapor_2018.pdf .
- YEGM, (t.y. a). *Türkiye Rüzgar Enerjisi Potansiyel Atlası*. http://www.yegm.gov.tr/YEKrepa/REPA-duyuru_01.html .
- YEGM, (t.y. b). *Güneş Enerjisi Potansiyel Atlası (GEPA)*. http://www.yegm.gov.tr/MyCalculator/
- Yılmaz, Ö.B. (Ocak 30, 2019). Jeotermalde Hedef 2 Bin Megawat. *Ekonomist Online*, https://www.ekonomist.com.tr/enerji/jeotermalde-hedef-2-bin-megawat.html .

Republic of Turkey
Ministry of Environment and Urbanisation,
General Directorate of Environmental Management

Mustafa Kemal Mah. Eskişehir Devlet Yolu
(Dumlupınar Bulvarı) 9. Km No:278 Çankaya / Ankara
Tel: +90 (312) 410 10 00

This publication was produced with the financial support of the European Union. Its contents are the sole responsibility of the consortium lead by WEglobal Consultancy Inc. and do not necessarily reflect the views of the European Union.


iklimin.org


facebook.com/iklimin


twitter.com/iklimin


iklimIN Projesi


instagram.com/ikliminprojesi