T.C.
ANKARA YILDIRIM BEYAZIT UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES

THE ROLE OF FISCAL INCENTIVES ON RENEWABLE ENERGY: COMPARISON OF TURKEY IN INTERNATIONAL CONTEXT

MASTER THESIS

Emrah KESKİN

THE DEPARTMENT OF PUBLIC FINANCE

ANKARA, 2020

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ASST. PROF. DR. ASUMAN ÇUKUR ADVISOR

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APPROVAL PAGE

The thesis, prepared by EMRAH KESKİN and titled "The Role of Fiscal Incentives on Renewable Energy: Comparison of Turkey in International Context" is accepted as a master thesis at Ankara Yıldırım Beyazıt University, Institute of Social Sciences, Department of Public Finance by unanimous vote.

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PLAGIARISM

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work. (21/09/2020)

Emrah KESKİN

To My Family…

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ÖZET

Yenilenebilir Enerjide Mali Teşviklerin Rolü: Türkiye'nin Uluslararası Bağlamda Karşılaştırması

Enerji kaynaklarını ve doğal kaynakları verimli ve çevreye duyarlı bir şekilde kullanarak ülke refahına en yüksek katkıyı sağlamak bugün birçok ülkenin en önemli misyonlarından biridir. Bu bağlamda ülkelerin artan enerji ihtiyaçlarını dışarıya bağımlı olmadan karşılayarak enerjide güvenli bir gelecek yaratmak için yoğun çaba sarf ettikleri görülmektedir. Halihazırda kıt olan fosil enerji kaynaklarının uzak olmayan bir gelecekte tükeneceği düşünülürse, enerjinin dünya çapında uluslararası savaşlar da dahil olmak üzere birçok çatışmaya neden olduğu ve olacağı aşikardır. Yakın geçmişte ivme kazanan yenilenebilir enerji kaynaklarına yönelim, bu kaynakların fosil kaynaklara göre sağladığı avantajlarla ulusal ve küresel düzeyde dünya çapında birçok ülkenin önceliği haline gelmiştir. Devletin yenilenebilir enerji yatırımlarına sağladığı mali teşvikler, ülkelerin bu alanda kaydettiği ilerlemenin ana aktörlerinden biri haline geldi. Son yıllarda Almanya, ABD, Japonya, Çin gibi birçok ülkede ve Avrupa Birliği üyelerinin çoğunda yenilenebilir enerji üretiminin artırılması konusunda önemli gelişmeler oldu. Bu tez, Türkiye'nin yenileneblir enerji alanındaki mali teşviklerini uluslararası bağlamda (Amerika Birleşik Devletleri, Çin, Japonya, Almanya, İspanya ve Avrupa Birliği) analiz etmekte ve karşılaştırmaktadır. Yenilenebilir enerji kavramı ve türleri, avantajları ve dezavantajları ile ayrıntılı olarak ele alınmaktadır. Yenilenebilir enerjide ülkemizin geçmişi ve mevcut durumu yasal düzenlemeler ve performans ekseninde incelenmektedir. Yenilenebilir enerji alanındaki mali teşvikler uluslararası bağlamda incelenerek Türkiye ile karşılaştırılmaktadır. Son olarak tez, hükümetin yenilenebilir enerji sektöründeki önemli rolünü teyit etmekte ve sonuçları politika çıkarımlarıyla tartışmaktadır.

Anahtar Kelimeler: Devlet, Enerji Politikaları, Mali Teşvikler, Yenilenebilir Enerji.

ABSTRACT

The Role of Fiscal Incentives on Renewable Energy: Comparison of Turkey in International Context

It is one of the most important missions of many countries today to make the highest contribution to the welfare of the country by using energy resources and natural resources in an efficient and environmentally sensitive manner. In this context, it is seen that countries are making intense efforts to create a secure future in energy by meeting their increasing energy needs without being dependent on the outside. Considering that fossil energy resources will be depleted in the coming future, it is obvious that energy causes many conflicts around the world, including international wars. The tendency towards renewable energy resources, which has gained momentum in the recent past, has become the priority of many countries around the world with the advantages of these resources relative to fossil resources at the national and global level. The fiscal incentives provided by the state to renewable energy investments have become one of the main actors of the progress made by countries in this area. In recent years, there have been significant developments in increasing renewable energy production in many countries such as Germany, the USA, Japan, Spain, China, and most of the members of the European Union. This thesis analyzes and compares the fiscal incentives of Turkey in an international context. The concept and types of renewable energy are addressed in detail with its advantages and disadvantages. The history and current situation of our country in renewable energy is examined in the axis of legal regulations, and performance. The fiscal incentives in the field of renewable energy is investigated in an international context and compared with Turkey. Finally the thesis confirms the important role of government in the renewable energy sector and discusses the results with policy implications.

Keywords: Energy Policies, Fiscal Incentive, Government, Renewable Energy.

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LIST OF ABBREVIATIONS

CSP : Concentrated Solar Power

EIA : US Energy Information Administration

EİGM : General Directorate of Energy Affairs

EPDK : Energy Market Regulatory Authority

EU : European Union

EÜAŞ : State Electricity Generating Company

FIT : Feed in Tariff

GDP : Gross Domestic Product

Gw : Gigawatt

HEPP : Hydroelectric Power Plant

IRENA : International Renewable Energy Agency

ITC : Investment Tax Credit

kW : Kilo watt

Kwh : kilowatt hour

LNG : Liquified Natural Gas
MENR : Ministry of Energy and Natural

Resources mtoe : Million Tonnes of Oil

Equivalent mW : Mega watt

Mwh : Megawatt hour

OECD : Organization of Economic Cooperation and Development
OPEC : Organization of Petroleum Exporting Countries

PTC : Production Tax Credit

PV : Photovoltaics

R&D : Research and Development

RES : Renewable Energy Resources
RPS : Renewable Portfolio Standard

TG : Tariff Guarantee

TJ : Terajoule

USA : United States of America

USA : United States of America

VAT : Value Added Tax

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1. INTRODUCTION

After the Industrial Revolution energy became essential to sustain production. At first, coal was used as the main energy source and then after World War I, it was replaced by oil. As technology advanced, the use of natural gas in energy sources had increased. The oil crisis in 1973, showed countries how their economy dependent was on energy resources. After that, many countries in the world, no matter an energy supplier or energy importer, try to maintain their own energy security. Today energy is the key factor of sustainable economic growth and social welfare.

The purpose of this thesis to discuss the role of fiscal incentives with examples in an international context and to contribute to our energy policy by comparing them with fiscal incentives in Turkey. In addition, the importance of renewable energy types was discussed in order to understand better the role and importance of renewable energy in the energy sector. After all, fiscal support mechanisms applied for renewable energy sources (RES) will be analyzed in international context and some inferences will be made for Turkey. Countries have implemented various fiscal, monetary, credit and foreign trade policies within their economic systems in order to ensure their social and economic development and increase their competitiveness in the international arena. Incentives within these policies are used at various levels in all countries as a tool of policy (Giray et al. 1998). In this context, incentives are applied over public expenditures and public revenues, which are the instruments of fiscal policy, consistent with its aims, such as accelerating development and realizing full employment (Pınar, 2010). Incentives are defined as fiscal and/or non-fiscal support or assistance provided by the state through various methods to ensure that a particular sector and / or region develops rapidly than others (Selen, 2011). Incentive tools basically have two purposes. First, to increase the funds to be invested by the private sector by reducing the costs; and the second, to canalize resources to areas that are considered to be beneficial for the country's economy in order to increase efficient economic activities. (Güzel, 2015). However, it should be emphasized here that; whether or not incentives will increase the private sector investment volume depends on the extent to which entrepreneurs will direct their savings to investments (Şen and Sağbaş, 2015). In this context, the main renewable energy incentives are; fixed price guarantee, premium guarantee, mandatory quota and green

certificate applications, various tax incentives and investment loans. Among these incentives, fixed price guarantee and premium guarantee are applied over public expenditures, while tax incentives are applied over public revenues. Mandatory quota and green certificate applications are regulatory policies (Şen, 2019). Therefore incentives provided by the state for renewable energy may be categorized as fiscal policy tools and this brings to the agenda that the government's role on renewable energy is of critical importance. In this context, the aim of this study is to highlight the importance of the government's role on the renewable energy performance of the country by handling the issue in terms of countries making significant progress in increasing renewable energy production such as Germany, USA, China, Japan, Spain and EU in general.

Throughout modern times, the pushing force of most of the battles generally involves sharing natural resources. Since energy security is so important, conflicts on this issue have been inevitable today. In addition, one of the possible reasons for the third World War might be the sharing of energy resources. Furthermore, most of you can say that wars are already on energy sources at present, as clearly can be seen in the Middle East and the so-called war between China and the United States of America (USA). At the backstage, these conflicts might be based on sharing energy sources. Super-powers of the world are quarrelling with each other over energy sources in the Middle East, even though none of them have a border in the region. The relationship between natural resources and civil wars is strong everywhere. "W*ars are often over resources*" (Galtung, 1982:99). The literature has many examples (Lodgaard, 1992), just like civil wars and oils are linked (Ross, 2004).

Energy is associated with literally everything, naturally, as long as civilizations need to survive, energy remains the indispensable component of life, and the lack of sufficient energy sources will certainly be the cause of many conflicts around the world as it is today. But there is not a sole winner in this game. Therefore countries of many levels of development are trying to find alternative ways to get through the problem about economy, national security, healthy environment and politics. Unfortunately, the options are limited. Energy resources are classified according to their use and convertibility. Energy sources are divided into two as primary and secondary energy according to their convertibility. Primary energy sources are oil, coal, natural gas, nuclear, hydraulic, biomass, tidal wave, sun, and wind. After primary energy conversion the energy obtained is known as secondary energy. Electricity, gasoline, diesel oil, air-gas and liquefied petroleum etc. are included in this type

of energy (Koç and Kaya, 2015). Another common classification is according to their use. Here, energy sources are divided into two as renewable and non-renewable. This classification is used in this study. Non-renewable energy resources constitute fossil fuels and nuclear energy (Acaroğlu, 2003).

As a result of the continuously rising world energy demand, fossil fuel reserves are rapidly declining, especially oil and natural gas reserves are approaching the critical levels. Generally, in the literature taking the total proven oil, natural gas, and coal reserves into consideration, they account for 40, 62, and 216 years of consumption, respectively (Ürün and Soyu, 2016). Without change, we are on the way to an era of energy shortage. In the near future, tomorrows' conventional sources will be on the verge of exhaustion and fossil fuel-rich countries will use that innate opportunity as an economic weapon in foreign policy as in the oil crisis broke out in the twentieth century. At this juncture, another gift of God for humanity pops up; non-conventional energy sources, in other words Renewable Energy Sources, which are infinite and self-replicating, unlike fossil fuels. Deployment of this green and clean technology depends on the costs of different types of renewable sources and support schemes characterized by public policy authorities in the national or local level or on the governance structures in a country. The high cost of renewable energy investments significantly increases the role of government in this area. The fact that new-born, so costly renewable energy technologies restrict private sector activities to invest in and maintain investments and yet governments have to be the most critical actor in the stage. However, governments should keep in mind that; since government supports have to be met through the public budget, it is important to gradually reduce the support as the industry matures, so that the burden on the public budget is not met by society in the medium-long term.

Subjects related to the development of renewable energy alternatives like increasing energy efficiency and thus reducing the effects of energy consumption on climate change and also increasing the energy supply security as well as its positive impact on employment have drawn the academic attention of many studies in recent years. Environmental, energy efficiency, and renewable energy investments around the world create thousands of business opportunities. Environmental awareness, Kyoto protocol, carbon tax, renewable energy investments and energy security, international agreements and cooperation in energy trade; many of these enable the emergence of new employment areas defined as green jobs. Based on earlier studies, renewable energy is heavily discussed in the context of technical features, advantages, disadvantages, and incentive mechanisms. According to the common insight in

the literature, the increase in the production and use of renewable energy can reduce the import costs arising from oil and natural gas, in direct proportion to this increase, prevent the instability problems that may arise as a result of energy dependence and it can provide additional added value from energy production. In addition, it is frequently stated in the literature that with the support given to the renewable energy market, the production volume in this area will expand, and with this expansion, a significant amount of income can be obtained from exports in the future. (Karaca and Erdoğdu, 2012).

Turkey depends heavily on foreign resources to meet its energy demand. Being a foreign-dependent country in terms of fossil fuel resources in energy, Turkey, despite its advantageous position in terms of renewable resources, does not benefit from these resources sufficiently. When we examine the electricity production of Turkey as of 2018, oil has a share of %0.1, and natural gas has a share of %30 in total. Considering the fact that Turkey imports most of the natural gas demand causes a huge burden on the budget. As of 2019, it is seen that the share of natural gas in total electricity production decreased to %18. In this period, Turkey was able to increase the share of renewable energy sources in total electricity production from %32.5 to %44.6. This growth comes, particularly from hydroelectricity. As of 2019, the share of hydroelectricity in total electricity generation increased from %20 to %30, while the share of other renewable energy sources increased from %12.5 to %14.6. The country imports most of the natural gas, and that constitutes a significant share of country's energy need. As of 2019, Turkey consumed 43.2 billion cubic meters (bcm) natural gas. 31.3 bcm of this was met through pipelines and the rest by Liquified Natural Gas (LNG). Natural gas has been imported mainly from the Russian Federation as 14.6 bcm through pipelines. Russia is followed by Azerbaijan with 9.2 bcm, and Iran ranks third with 7.4 bcm. As of LNG, Algeria ranks first with 5.8 bcm, followed by Qatar and Nigeria with 2.5 bcm (BP Statistical Review, 2020). Common thought since the 1980s has been to increase domestic energy production in Turkey. There have been major changes in Turkey regarding the renewable energy sector in which the state is an engine and in cooperation with the private sector. In Turkey, it would not be wrong to say that the renewable energy sector has revived significantly since 2010. Since the revision of fixed-price guarantees in 2010, it would not be wrong to say renewable energy investments have been attracted both national and international investors.

1.1. Nature and Scope of the Problem

Being a foreign-dependent country in terms of fossil resources in energy Turkey; although its advantageous position in terms of renewable resources do not benefit from these resources sufficiently. The aim of this study is to point out background of selected countries' renewable energy fiscal incentive policies and to make some inferences for Turkey. By this way trying to make a contribution to this area by first presenting a well-rounded study on renewable energy sources in a general manner, then advancing our knowledge about fiscal incentives by comparing policies being implemented in Turkey and some practices in the world currently take the advantage of fiscal drivers.

1.2. Questions of the Study

Fiscal incentives for Renewable Energy have been used around the world as a supplementary policy tool. Comparing fiscal policy tools among Turkey and in International Context will give a brief conclusion on policies implemented by government to stimulate investors in the field of Renewable Energy. Within the scope of the study, answers to the following questions were sought:

- What is renewable energy?
- What are the advantages and disadvantages of renewable energy in a general manner?
- What sorts of renewable energy are there in the world and which of them have been utilized in Turkey?
- Which type of support mechanisms have been applied in Turkey to drive renewable energy in the context of legal regulations and renewable energy performance of Turkey?
- Comparing fiscal incentive policies of Turkey in International Context; what kind of fiscal incentive policies applied in the selected countries?
- What is the role of government in policies that intend to attract renewable energy investors in terms of fiscal incentive policies?

1.3. Purpose of the Study

The purpose of this thesis to discuss the role of fiscal incentives with examples in international context and to contribute to our energy policy by comparing them with fiscal incentives in our country. In addition, the importance of renewable energy types was discussed in order to better understand the role and importance of renewable energy in the energy sector. By this way trying to make a contribution to this area by first presenting a well-rounded study on RES in a general manner, then advancing our knowledge about fiscal incentives by comparing policies being implemented in Turkey and some practices in the world.

1.4. Research Method

The method applied in the research is data analysis and evaluation, which is one of the qualitative research methods. This method is based on the collection, analysis and inference of the texts. Although the information collected varies in qualitative research, generally written and visual materials are the basic materials used in this research method. A systematic perspective and approach is required to interpret the different types of data collected. In this framework, firstly, written sources, primary sources and investigative works covered in the study will be examined, and evaluations have been made as a result of the data obtained from these works.

1.5. Literature Review

Different studies have been carried out in the context of renewable energy. Based on earlier studies renewable energy discussed in terms of incentive policies applied by governments. In this thesis on renewable energy sources in general the sources examined are; *Alternatif Enerji Kaynakları* written by Acaroğlu (2003), *Renewable Energy Handbook* belongs to Kemp (2009), Maczulak (2010); *Renewable Energy: Sources and Methods,* Ragheb (2011)*; Solar Thermal Power and Energy Storage; Historical Perspective,* Rathore and Panwar (2007); *Renewable Energy Sources for Sustainable Development,* Tester et al. (2005); *Sustainable Energy: Choosing among Options,* Jones (2017*); Renewable Energy Integration, Economic and Reliability Benefits of Solar Plants* generally examines the renewable energy and resources. In addition agencies related to renewable energy such as International Renewable Energy Agency, International Energy Agency, US Energy Information Administration have been utilized to contribute descriptions and pros and cons

of renewable energy. To relate renewable energy with social problems studies belonging to Galtung (1982); *Environment, Development and Military Activity. Towards Alternative Security Doctrines,* and Ross (2004); *What Do We Know about Natural Resources and Civil War*, Lodgaard (1992); *Environmental Security, World Order, and Environmental Conflict Resolution* are taken as the most outstanding examples on the issue. To discuss the current and historical situation of renewable energy in Turkey sources utilized are generally from Ministry of Energy and Natural Resources, World Bank. The articles related to subject are belonging to Arık (2016); *Yenilenebilir Enerji Politikalarının Sürdürülebilirliği: AB Ülkeleri ve Türkiye Açısından Bir Değerlendirme*, Gözen (2014); *Renewable Energy Support Mechanism in Turkey: Financial Analysis and Recommendations to Policymakers,* Kaya et al. (2017); *Renewable Energy in Turkey: Potential, Current Status and Future Aspects.* To discuss fiscal incentives for renewable energy in intenational context and in Turkey articles written by: Mingyuan (2005); *Government Incentives to Promote Renewable Energy in The United States*, Nixon (2007); *Renewable Energy Tax Credits,* Şen (2019); *Incentives as a Fiscal Policy Tool in Renewable Energy Production: Experiences of a Number of Selected European Countries and Turkey,* Şimşek (2013); *Recent Incentives for Renewable Energy in Turkey*.

1.6. Boundaries of the Research

In this thesis renewable energy sources around the world categorized in six sub- titles. However, in Turkey apart from ocean energy other resources are utilized to generate electricity in some degree. In this context renewable energy generally mentioned in terms of generating electricity. The period of Turkey starts especially in 2005, as regulations related to renewables began to gain momentum since then. About pre-2005 period a brief historical background is given to show the status of the country.

1.7. Organization of Chapters

The outline of the thesis is as follows: Chapter 2 starts with the definition of Renewable Energy by explaining the importance as well as advantages and disadvantages and tries to explain different sources of renewable energy. Chapter 3 generally describes renewable energy in Turkey mentioning the potential and actual situation of each source followed by current national policies and support mechanisms as well as renewable energy performance of the country. Chapter 4 focuses on fiscal incentive practices for renewable energy in

international context such as countries; the USA, Germany, Japan, China, Spain, EU in general and Turkey. Subsequently in the last Chapter tries to highlight the role of the state on renewable energy investments in the light of fiscal policy tools.

2. RENEWABLE ENERGY and RESOURCES

2.1.RENEWABLE ENERGY

Energy resources are classified according to their use and convertibility. Energy sources are divided into two as primary and secondary energy according to their convertibility. Primary energy sources are oil, coal, natural gas, nuclear, hydraulic, biomass, tidal wave, sun, and wind. After primary energy conversion, the energy obtained is known as secondary energy. Electricity, gasoline, diesel oil, air-gas, and liquefied petroleum, etc. are included in this type of energy. Another common classification is according to their use. Here, energy sources are divided into two as renewable and non-renewable. This classification is used in this study. Non-renewable energy resources constitute fossil fuels and nuclear energy. The gap between energy production and consumption is growing rapidly. In addition, it is an undeniable fact that fossil fuels will be exhausted after a while. Also, traditional energy production methods are one of the important causes of environmental pollution today. At this point, an alternative way is available; Renewable Energy Sources.

By the start of the new century, most people had developed a fresh outlook on the environment, although it is difficult to identify a defining moment that turned the tide toward less-polluting energy sources (Maczulak, 2010). Even though mankind had necessarily been relying mostly on renewable energy since the early ages due to unawareness of the huge reservoirs of fossil fuels and the lack of ability to extract them, the first considerable movement to shift from fossil fuels to renewable energy sources occurred in the early 1970s when the world had experienced its first “oil shock” in 1973. In the fall of 1973, the Organization of Petroleum Exporting Countries (OPEC) countries cut oil exports, causing the first global oil crisis. The oil embargo is a reaction to the “Yom Kippur war.” On October 6, the highest Israeli holiday “Yom Kippur”, Israel was surprisingly attacked by Syria and Egypt. Despite severe losses, Israel was able to conquer and occupy parts of the Syrian Golan Heights. The OPEC countries then use the oil embargo as a political weapon to demonstrate their anger at the Israeli-friendly stance of the West. This issue has been caused two problems; global warming and sustainable development. Thus, sustainability, climate, and energy are the major social challenges of the present and the future. OPEC countries affected the global economy since an increase in the price of crude oil brought about an increase in the cost of production of everything else. At that time, the world seriously began to be aware of environmental pollution and particularly the usage of a vast amount of unclean fossil fuels.

The second oil shock came in 1979, also brought by the OPEC group as a rise in oil prices. Subsequently, in 1980 the war between two oil-rich countries Iran and Iraq on oil refineries not only fueled the oil crisis but also emerged as a new issue that is "energy security". From then onwards, the world realized that having limited fossil fuels and being dependent on fossil fuel-rich countries increased many risks like supply being reduced, cut, or made costlier. As a result of these happenings, the world started to consider that conventional energy sources not only affect the environment adversely but also our pockets, energy security, and consequently, national and economic security as well. Our production methods and our consumption behavior should become more resource-friendly, environmentally friendly, socially compatible, and thus more sustainable. Research for sustainable development and an environmentally and socially responsible energy supply will enable innovative solutions and create the basis for decisions for future-oriented action in accordance with our responsibility for the present and future generations. Therefore increasing renewable energy sources, their usage, as well as public policies have become crucial. In line with these happenings, the world began to look for alternative ways to meet their energy needs; as a result, renewable sources of energy were taken to the stage.

In the literature, renewable energy has been described in the context of three main characteristics; less pollutant than conventional energy, naturally replenishing, neverending, and in five main forms; wind, solar, hydro, geothermal, and biomass. The renewables are the primary, domestic, cleaner than fossil fuels and inexhaustible energy resources (Dincer, 2001) which can be used to produce energy again and again, e.g., solar energy, wind energy, biomass energy, geothermal energy, etc. and are also often called alternative sources of energy (Rathore and Panwar, 2007). U.S. Energy Information Administration (EIA) defines renewable energy as clean energy sources that exist in nature and continue their permanency by renewing themselves, and can be obtained as long as the world exists. The main ones are wind, solar, geothermal, biomass, and hydraulic (EIA, 2019a). Accordingly, European Union states wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogases as renewable non-fossil energy sources in Directive 2003/54/EC. Tester defines renewable energy as "*a dynamic harmony between the equitable availability of energy-intensive goods and services to all people and preservation of the earth for future generations*" (Tester et al., 2005). In quantitative terms, according to the Organization of Economic Cooperation and Development (OECD); renewable energy is defined as the contribution of renewables to the total primary energy supply, which means a

country's total amount of energy not being exposed to any processes harvested directly from natural resources (coal, natural gas, wind, tide, etc.) and equivalent to energy production plus energy imports, minus energy exports, minus international bunkers, then plus or minus stock changes and renewables include the primary energy equivalent of hydro (excluding pumped storage), geothermal, solar, wind, tide and wave sources (OECD, 2018). In table 1.1 below is given renewable energy sources and their use in general.

Table 2.1. : Renewable Energy Sources and Their Use.

Energy sources	**Energy conversion and usage options**
Hydropower	Power generation
Modern biomass	Pyrolysis, gasification, heat and power generation, digestion
Geothermal	Hydrothermal, power generation, hot dry rock, urban heating,
Solar	Solar dryers, solar home systems, solar cookers
Direct solar	Thermal power generation, photovoltaic, water heaters
Wind	Windmills, wind generators, water pump, power generation
Wave and tide	Barrage, numerous design, tidal stream

Source: (Panwar et al. 2011)

2.2. Advantages and Disadvantages of Renewable Energy

Today, we meet a high proportion of our energy needs from fossil sources. But it may not be valid for the future due to the lackness of fossil fules. In a close future, accessible and large amounts of energy may only be possible by using renewable energy resources. But can we say mankind allways reach to fruitness with renewable energy? This makes us wonder about the positive and negative sides of renewable resources in general? Examining the general advantages of renewable energy we could make significant inferences. After renewable energy is used, it can be replenished naturally, and used again. It would not be wrong to say renewable sources are not limited like fossil resources. Therefore, renewable sources can be used almost unlimitedly, and assumed as a free fuel as they are not under the control of oil cartels or multinational corporations. During energy production, it is generally environmentally friendly, and does not cause pollution. Also contributes to reduce emissions. A significant proportion of the technology required to obtain energy from renewable sources is available today. As long as sufficient investments are made, costs will decrease and energy production will be provided more easily. Some of the renewable energy technologies are more successfully competitive than traditional sources. Solar heating and cooling, which are more common in rural areas may have relatively low costs compared to conventional sources. In addition, most of the renewable energy sources are not decentralized. That means, it is usually controlled by small companies. That's why they may not exposed to threats such as sabotage. Due to the stated advantages and many more, it is necessary to make maximum use of renewable energy sources.

We can generally state the disadvantages of renewable energy sources as follows. Although it is a clean energy, may cause damage at reasonable levels during production and installation. However, this could be ignored when compared to fossil-fuel sources of energy. When we look at the financial side of renewable energy investments, there is a common insight that infrastructure investments for renewable energy required to meet large amounts of energy demand are quite expensive. Especially in sort of energy such as hydroelectric, and wave energy. However, due to advanced technologies, the common insight that "renewable technologies are expensive" has begun to alleviate. Investments in renewable energy sector are capital-intensive but have low operating costs in the long run. On the other hand, the specialization required for the production and use of renewable sources is not at an

adequate level. Therefore, there are potential problems regarding to durability, feasibility, storage, and emissions reduction. To overcome these problems, required technology may be expensive. Hence, we can say that renewable sources are not at a level to compete with conventional fuels. Adequate support may not be obtained for the development of renewable resources under the influence of fossil-based industries. This makes the transition to renewable energy difficult. On the other hand, some renewable energy sources are not available at all hours of the day. It can be given examples of solar, and wind energy. Generally because of disadvantages like these, renewable- based energy have a small share in the availability of existing production, and consumption potential. However, energy companies, institutions and organizations in both national and international arena, are trying to expand utilization of renewable energy sources.

2.3.Sources of Renewable Energy

2.3.1. Solar Energy

Solar energy describes the energy of solar radiation that can be used technically by humans. It can be used in the form of electrical current, as heat, but also as chemical energy. Humans can use it technically in various areas of energy supply. These technologies are technically well-proven with various systems installed around the world over the last few decades. Mankind has been using solar energy for thousands of years. In order to benefit from solar energy, people's studies are based on ancient history. Archimedes (250 BC) burned the ships surrounding Syracuse by focusing the sun-beam with concave mirrors (Simms, 1977). Studies have improved in the 1600s with Galile finding the lens. French scientist Mohuchok worked on a small steam engine in 1860 with the help of parabolic adjusters, focusing the solar radiation, and experimenting on solar pumps and solar cookers (Ragheb, 2011). If you pay attention to the old palaces, you will see a lot of mirrors, and it is a good example of the use of solar energy. (Byrne at al. 2010).

In general solar power is generated by Photovoltaics (PV) and Concentrated Solar Power (CSP). Photovoltaics can be described as a system that converts solar cells (photons) directly into direct current electric energy when it reaches solar cells and contains semiconductor materials such as Silicon, Gallium, Arsenite, Cadmium Telluride, or Copper Indium Diselenide (Miles et al. 2005). The first use of photovoltaic modules is provided for satellites. Since the conventional batteries, fuel cells, and nuclear energy do not meet the

conditions of the period, the stored energy started to be used shortly. As technology and conditions evolve, high-efficiency silicon solar cells were discovered, and photovoltaic energy started to become widespread. In common insight, access to electricity means access to everything else, especially in solar energy-rich developing countries. The best way to provide electricity for people living far from transmission lines, is to use solar PV to power mini-grids. In the early periods of solar technology, the cost of fabricating solar panels was relatively high so constructing a solar farm was both expensive and unaffordable for most. Along with technological progress in the field and awareness of clean sources, there has been a remarkable reduction in the costs making solar PV not only more affordable but also the cheapest form of electricity. Contingent on the sort of material used in manufacturing, various types of solar panels have a lifetime of 30 years more or less (Jones, 2017).

The system of CSP focuses the large radiated sun rays into a single small spot through mirrors and solar monitoring systems connected to these mirrors. It is based on the principle that sunlight is collected in the water transmitted in the tube, passing through the focus of the mirrors and provides direct steam production (Toygar et al., 2018). In the system, water and steam pass through the units connected to each other by heating. When the desired pressure and temperature reaches the desired value, the generated steam is sent directly to the steam turbine, and electrical energy is generated without creating carbon emissions. Concentrated solar energy technologies have come to life with examples such as solar energy tower, and solar chimney. Each focusing method provides high temperatures and, in parallel, high thermodynamic efficiency (IRENA, 2019a). According to 2018 data, China is the country that ranks first in terms of utilizing solar power. The country generated 177.5 terawatt-hours of energy, from this source. This amount makes the country first ranking in the world with a share of 30.3%. After China, the United States of America (USA) has the second place. The USA generated 97.1 terawatt-hours of energy from solar power, and this amount corresponds to 16.6% of the world use. Japan ranks third with 71.7 terawatt-hour generated energy, which corresponds 12.2%. When we look at this issue again in the context of Turkey as of 2019, Turkey generated 7.9 terawatt-hours of energy from solar sources, which corresponds to 1.3% of total World generation and 5.6% of total Europe generation. This amount also corresponds to 20.9% of its total energy generation by RES (BP, 2019).

2.3.2. Wind Energy

Wind motion in the air includes kinetic energy. This form of energy can be altered to mechanical energy. In general, throughout the world, a great portion of this source of energy is used for electrical power generation by wind turbines or wind energy conversion systems. The common method to generate electricity from wind is exploiting wind turbines. In a simple prescription, how a wind turbine works: at the first stage, wind hits a turbine's blades. This movement caused a rotation in the blades and then wheels the turbine attached to them. By running a shaft connected to a generator, this process converts the kinetic energy to mechanical energy. At last electrical energy emerges through electromagnetism (Schubel and Crossley, 2012). Since wind as a finite and ubiquitous source of energy like other renewables, countries worldwide utilize wind energy both in onshore and offshore wind turbines. Although in the world there are many places with strong wind speeds, locations providing maximum effort are generally remote ones as well as offshore styles with extremely large potential. The wind energy source is free and unlimited. Wind turbines use this "raw material." Because more and more energy in the form of fuels must be used in the operation than you get from useful energy. In addition, the use of wind energy offers the most economical expansion among renewable energies in short to medium term. Electricity generation from wind turbines, plays an important role in the energy transition.

The history of using wind energy goes back to very old times. In the old days, it was a matter of course. As late as 1882, according to statistics from the German Reich, 18,901 windmills turned and emitted the authority of peaceful country life, immortalized on romantic oil paintings. The impressive number marks the historical maximum. The construction and operation of the mills had long been under the regulatory supervision of the sovereigns and church rulers, but in the 19th century, the need for flour required the regulations to be relaxed for the rapidly growing population. The number of windmills climbed to record levels - until the steam engine propped their wings. In June 1887, Scottish academician Professor James Blyth started wind power experiments and patented in England in 1891 by making a wind-powered battery charger. In 1887-88, in the USA, Charles Francis Brush produced electricity using a wind power machine (Dang, 2009).

In the pursuit of ever lower electricity production costs, the wind turbines gradually grew in size in the course of development. The average nominal output of the new wind turbines installed in Germany was 164 kilowatt (kW) in 1990, over 1 megawatt (MW) for

the first time in 2000, and over 2 MW for the first time in 2009. In 2011 it was over 2.2 MW, with systems with an installed capacity of 2.1 to 2.9 MW dominating with a share of 54%. A further increase in the average nominal output is foreseeable: the 3 MW class will be introduced for onshore wind turbines, while the increasingly built offshore wind farms will mainly be used to build large turbines with a capacity of 3.6 to 6 MW (IRENA, 2019b). In 2018 according to the data of the production of energy from wind power, like solar sources, China ranked first in utilizing wind power. The country generated 366 terawatt-hours of energy from this source. This amount makes the country first rank in the World with a share of 28.8%. After China, the USA has the second place. The USA generated 277.7 terawatthours of energy from solar power, and this amount corresponds to 21.8% of the World use. Germany ranks third place with 111.6 terawatt-hour generated energy which corresponds to 8.7%. When it comes to Turkey, as of 2018, the country generated 19.8 terawatt-hours of energy from wind sources which corresponds to 1.5% of total World generation and 4.8% of total European generation (BP, 2019).

2.3.3. Geothermal Energy

Heat derived from the sub-surface of the earth is called "Geothermal energy." This sort of energy is being transferred to the Earth's surface by water and/or steam and can be used for bathing, heating buildings, or generating electricity resting on its characteristics. Even so, to generate electricity, geothermal resources must have a high or medium temperature. There are three main types of geothermal energy systems (EIA, 2019b):

"Direct use and district heating systems; From the geothermal sources used only for health purposes from the early ages to the recent past, today; it is used directly in heating or by converting it into other types of energy. Geothermal electricity generation; Electricity is produced from geothermal fluid with a chamber temperature of 200 ° C and more. However, according to new technologies developing day by day, electricity can also be produced from a fluid with a low chamber output up to 150 ° C. With a system developed in recent years and called binary cycle, 70 ° C using low gases (freon, isobutane etc.) with low evaporation points. Geothermal heat pumps; For most people, the heat pump is a new term. However, in our homes, devices such as refrigerators, air conditioners and deep freezers, which are products of the same logic as the principle of heat pump operation, are used. Heat pump is a machine that draws heat from a low temperature environment (air, soil or water) and gives it to a high temperature environment. The purpose of the cooling machine is to cool a room;

The purpose of the heat pump is to heat a room." With an installed capacity of 3.639MW in 2018, the USA is the leading producer of geothermal energy across the world, producing 16.7 billion kilowatt-hours (kWh) of geothermal energy throughout the year. Indonesia followed with 1.948 MW recorded capacity of geothermal in 2018, making it the world's second-biggest producers of the energy source. Philippines comes third with an installed capacity of 1,868 MW. When it comes to Turkey, with an installed capacity of 1.347MW in 2018, the country ranks fourth in the list of top geothermal power-producing countries (ThinkGeoEnergy, 2019).

2.3.4. Hydropower

Using water for driving turbines is the main principle of hydropower, and thus the source of hydroelectric power is flowing water. People have a long history of using the force of water running in streams and rivers to produce mechanical energy. For instance, in Norway, 99% of electricity comes from hydropower (IRENA, 2019c). Hydropower was used to drive mills, sawmills, and hammer mills in pre-industrial times. The kinetic and potential energy of water flow is converted via a turbine wheel into mechanical rotational energy that can be used to drive machines or generators. This is a mature technology that generates the largest share of renewable energy worldwide.

The basic determinants of the amount of available energy in flowing water are the volume of the running water and the change in altitude (or fall) from one point to another. Because the volume of the running water depends on the water cycle on earth (solar heating, evaporation, and precipitation), seasonal fluctuations in precipitation and long-term changes in precipitation composition, such as lack of rain, have a big impact on hydropower production. Different types of hydropower plants differ not only in various technical details but also in the type of use. Hydroelectric power plant (HEPP) is characterized by large amounts of water and a small difference in height. It is important that no water is stored here; the amount of water flowing in must be used immediately. This gives an around-the-clock power generation that is suitable for covering the base load. The amount of energy generated daily can be subject to certain seasonal fluctuations; due to the melt water, it can be significantly higher in spring than in winter. Most hydropower plants use water turbines, the design of which is adapted to the amount of water and the gradient of use (and thus the water pressure). For example, Kaplan turbines and flow-through turbines are suitable for run-

ofriver power plants with a small height difference (low-pressure power plants). Francis turbines and especially Pelton turbines are more suitable for medium to high-pressure levels, for example in storage and pumped storage power plants (Hemant and Jasvir, 2013). There are some significant advantages to using hydropower as an energy source (USGS, 2020): obtaining energy from water, which is a renewable resource, the most important thing is that; unlike fossil fuels, water is a practically inexhaustible raw material, (unlike coal or oil, for example) there are no harmful emissions, hydroelectric power plants (HEPP) are not as high a risk as nuclear power plants, low operating maintenance costs, an extremely cheap method of energy production, although the construction of a hydropower plant involves high investment costs, the plants are very durable and the raw material water is also available free of charge. The 2018 hydroelectricity consumption data shows us that in this category, China has the first place in the World. China's hydroelectricity energy production is 272.1 million tonnes oil equivalent (mtoe), which corresponds to 28.6% of total World production. After China, Brazil has the second and Canada has the third place. Both countries have a share of 9.2% with the energy production of Brazil's 87 mtoe, and Canada's 87.6 mtoe. In this category Turkey's energy production is 13.5 mtoe, and this figure corresponds to 1.4% of total global production, and 9.2% of total Europeean production (BP, 2019).

2.3.5. Bioenergy

The source of bioenergy is biomass. Biomass is a natural material that derives from plants and animals, and thus a renewable source of energy. The process of bioenergy starts with biomass. This source contains stored energy from the sun. Plants absorb the energy from the sun in a process called photosynthesis. When biomass is burned, the chemical energy in biomass emerges as heat. Biomass can be burned directly or converted to liquid biofuels or biogas that can be burned as fuels (EIA, 2019c). Bioenergy is a type of energy that has a wide production potential and diversity among the RES, which has been used for a long time in human history (Hall and Scrase, 1998). There are many reasons for us to use biofuels such as to reduce the damage of fossil fuels to the environment, to reduce the harm of exhaust emissions to human health and the environment, to reduce dependence on foreign energy. According to the industry where biomass energy is used, it is divided into two main groups as traditional and modern forms. Traditional biomass is produced from animal and agricultural wastes used for heating and cooking, often in developing countries and rural homes, and a direct energy-burning method is used. Modern biomass, on the other hand,

creates biofuels such as bioethanol, biodiesel, landfill gas, synthetic oil, and biogas, which are produced by advanced chemical conversion techniques and used for electricity production and fuel oil. The 2018 biofuels production data shows us that the USA is the leading country in this area. It produced 38.088 mtoe biofuels which corresponds 39.9% of total global production in that year. After the USA, Brazil follows that country. Brazil produced 21.375 mtoe biofuels which corresponds to 22.4% of total World production. Indonesia got the third place with 4.849 mtoe biofuels, which corresponds to 5% of total global production (BP, 2019).

2.3.6. Ocean Energy

The ocean energy sector includes a number of different technologies, namely tidal energy, wave energy, ocean thermal energy conversion, and salinity gradient, designed to harness power contained in our seas and oceans and convert it to renewable low-carbon electricity (Magagna and Uihlein, 2015). Each of these ocean energy types has different origins and requires different technologies for conversion. According to the International Renewable Energy Agency (IRENA) classification promising renewable energy Technologies to include (IRENA, 2019e):

"a- Wave energy is defined as a type of energy derived from the wave movements created by the winds on the surface of the ocean and seas. The movement created by the waves under the water surface is accumulated by converting it into electricity by means of a wave energy converter consisting of special turbines. Electric energy produced by wave energy can be used directly or it can be used for different purposes such as heat generation and water treatment.

b- Tidal energy, In connection with the idea 'energy from the sea' the tidal power is mostly mentioned in the first place. The so-called 'Great Breath of the Sea' is a self-renewing energy with an output of 2.7 · 1012 watt (W), but the potential that can be used by it is estimated at only about 0.03 · 1012 W. In principle, the tide is a confluence and damming of the water and not an uplift or a reflow, as was long assumed. There are still remnants of medieval flour mills that received their grinding water with the tidal range. Leonardo da Vinci also demonstrably worked on this technique. Around 1130, a tidal watermill was built in the Adour estuary in France, and a century later several tidal mills even worked near Venice.

c- Salinity gradient energy, The system is based on the difference in salt concentration between the two water sources. This difference in salt concentration has the potential to produce enough energy to meet 40% of global electricity demands. Although there are many methods to obtain this energy, the two most successful methods are; pressure delayed osmosis and reverse electrodialysis.

d- Ocean thermal energy conversion takes advantage of the mobility created by the temperature difference between warm tropical surface waters and deep cold ocean water. In this process, the temperature difference is used to generate energy."

In 2018, European tidal stream installations reached 26.8MW, and wave energy installations 11.3MW. Since 2013, 34 gigawatt-hours of electricity have been produced by tidal streams in Europe. This is enough to power more than 9,000 homes over the same period. Europe remains the world leader in wave energy installations, but the rest of the world not to be ignored. Tidal power installations outside Europe increased from zero in 2015 to a total of 6.7MW between 2016 and 2018 (Ocean Energy Europe, 2018).

As seen in descriptions, although renewable energy resources have a chance to replenish, in categorization they are limited like fossil fuels. Today, energy demand is met by both fossil and alternative energy sources, and sustaining economic activities depends on meeting the energy demand. Most of the energy demand comes from fossil sources. Fossil resources, on the other hand, are rapidly depleting, creating great damage to the environment and causing significant economic and social problems. Especially in countries with insufficient fossil resources, the economic costs arising from dependence on imports become critical. Renewable resources, on the other hand, are environmentally friendly, local, clean, and inexhaustible energy resources that can be an alternative to fossil resources in solving these problems. The use of renewable energy resources in energy production requires high initial investment costs due to the underdevelopment of technologies in this area. In addition, it is also difficult to compete with fossil resources used for many years. At this point, the aforementioned disadvantages of renewable resources can be eliminated with correct and appropriate incentive policies that can be applied as a fiscal policy tool (Şen, 2019). Moreover, *"if renewable energy technologies are produced with domestic equipment, the economic advantages to be gained in terms of employment, growth, and balance of payments may increase"* (Yılmaz, 2014:79).

Factors such as being environmentally friendly, contributing to the country's economy, creating new employment areas, being a local resource, and keeping the capital in the country are of great importance in the adoption of renewable energies more and more. However, we can not ignore the challenges that renewable energy has to handle. Briefly, the high cost of renewable energy investments, new technologies in this field, competing fairly with fossil fuels, increase the role of the government in this area. Therefore supporting renewable energy investments by the government is of critical importance and this study aims to highlight the role of the state on renewable energy.

3. RENEWABLE ENERGY STATUS AND POLICIES IN TURKEY

This section includes four subsections that briefly explain the history of renewable energy, renewable energy potential, renewable energy laws and targets, and renewable energy performance of Turkey, respectively. In the renewable energy history subsection, some historical background will be given until the beginning of the development of renewable capacity. It is worth noting here that high costs of renewable energy investments, new technologies in this field, competing fairly with fossil fuels, increase the role of the government in this area. Therefore supporting renewable energy investments by the government is of critical importance. It is an undoubted fact that investment projects will accelerate in the coming years, thanks to incentives offered by the government. When the government is on the stage for renewable energy, fiscal incentives offered by the state are the most critical point that this study aims to highlight.

3.1.Historical Background

We could say that except for hydroelectric sources, the use of "renewables for electricity generation" was not on the agenda in Turkey until the mid-1980s. Studies regarding the development of hydroelectric sources had, however, begun as early as 1935, after the establishment of General Directorate of Electrical Power Resources Survey and Development Administration, which was authorized to study the country's hydroelectric potential and develop projects. After the establishment of the State Hydraulic Works in 1954, the pace of hydroelectric development increased. The first geothermal power plant was commissioned in 1984 (17.5 MW) and General Directorate of electrical Power Resources Survey and Development Administration began studying wind energy in the mid-1980s. However, there was no distinct framework for renewable energy until 2005. Although there were some attempts to develop small hydro and wind projects under the BOT model, only 18.9 MW in wind plant capacity and 220 MW in small hydro capacity had been developed by 2001. Following the enactment of the Electricity Market Law (EML) in March 2001, the development of renewable capacity began, and the process gained pace, after the enactment of a renewable energy law no. 5346 Utilizing Renewable Energy Sources for the Purpose of Generating Electricity in 2005; this is discussed in the following sections (World Bank, 2015).

3.2. Renewable Energy Potential of Turkey

Before giving information about the renewable energy potential of Turkey, be aware that in this subsection, renewable energy sources are those that have been utilized in the country according to the data derived from MENR. That is to say, except tidal or, in other words, wave energy and off-shore wind energy, Turkey has experience in taking advantage of wind, solar, biomass, geothermal and hydraulic potential of the country until recently. Below find the snapshot of the up to date picture of the potential and installed capacity of these resources according to the latest datum as of the end of June 2018 organized by MENR.

Wind energy is the most developed and most commercially available type of renewable energy in the world. In parallel with this development, the installed power, which is connected to wind energy, reached 282.577 MW at the end of 2012 in a very short time. While China ranks first with the development it has shown in recent years in the production of electricity from wind power, the USA, Germany, and Spain follow (Dawn et al., 2019). Turkey is a country with 784.347 km² of land area, and large areas with significant wind climate due to its own peculiarities are potential hosts. Wind energy potential in Turkey, depending on the wind speed and the continuity of the wind, varies on the scale of the regions. EIEI by Turkey's wind to determine the potential for the purpose of studies in light of electricity produced could wind energy potential in Turkey wind speed of 7.0 meters when calculated according to the higher value of 10.463 MW sea, 37.386 MW of land totaling 47.849 MW was identified (MENR, 2019a).

Solar energy, which is the origin of many natural energy sources, is used for purposes such as heating and obtaining electricity. Since solar energy is an environmentally friendly and clean energy source, it is seen as an alternative to fossil energy sources. It should position where Turkey is in a quite good condition in terms of solar energy potential. In terms of monthly average sunbathing times, it is seen that they have high potential in July (365 hours), August (343 hours), and June (325 hours). There is a similar situation in terms of monthly average radiation values. In Turkey, about 56.000 MW of thermal power plant capacity case in which the equivalent solar energy potential and the exploitation of this potential has been calculated annual average of 380 billion kilowatt-hour (kWh) of electricity can be produced (MENR, 2019b).

When we translate the word "geothermal energy," we can do that as follows: "geo" means "earth," "thermal" means heat. So geothermal energy is the same as geothermal heat.

The earth is piping hot inside. This heat can come up through geysers, volcanoes and hot springs. In some places in the world, earth's costs are very thin, and the earth is already very warm at a few 100 meters deep in the soil. Although these rocks do not contain any fluids, they are hot dry rocks in the depths of the ground, whose heat is used by some technical methods. In the broadest sense, the thermal energy stored in the earth's crust constitutes geothermal energy. Turkey due to tectonic and volcanic features, is located on the world geothermal generation. The tectonic depression areas of the Aegean region, the North Anatolian earthquake zone, and our other volcanic regions constitute the main potential areas in terms of geothermal resources and fluids. 95% of Turkey's known geothermal heating and hot springs in use while the other is suitable for the production of electricity. The first research related to geothermal waters in Turkey was initiated by General Directorate of Mineral Research and Exploration (MTA) in 1962. According to the statistics obtained since then, our country's geothermal electric power potential is approximately 4.500 MW, while its geothermal heating potential is 31.500 MW. Today geothermal plants with around 13 gigawatts of electrical power are installed worldwide. This corresponds to the output of around 50 medium-sized coal-fired power plants or 30,000 wind turbines. The countless smaller geothermal plants that supply heat and energy for individual buildings are not included. The leading countries are the USA, the Philippines, Indonesia, Mexico, Turkey, and Iceland (MENR, 2019c).

Biomass energy is mostly used in under-developed parts of Turkey for house heating with classical methods. Studies about energy production with modern biomass plants are very limited in Turkey (Kaya et al., 2017). As of 2017, biogas plants in Turkey constituted an installed capacity of 378 MW, and the country has a target of 1.000 MW for 2023 (Koç et al., 2018).

HEPP in Turkey has begun on a small scale production of electricity from water. 60 kW HEPP held in Tarsus in 1902, is the first HEPP in Turkey. It has an installed power of about 30000 KW. In the 1950s, the total power plant was 408 MW, of which only 4.4 (18MW Installed Capacity) hydroelectric energy. With 562 HEPPs commissioned as of 2015, approximately 40 million tons of carbon dioxide emission per year has been prevented. With the %75 capacity utilization rate, as of 2015, 26% of our energy production is met by HEPP (MENR, 2019d).

Table 3.1. : National Renewable Energy Balance Sheet (2016)

Energy Supply Distribution	Biofuels and Waste Energy (T. Tonne*)	Hydraulic Energy (Gwh)	Wind Energy (Gwh)	Geothermal Heat and Other Heat (T.Toe**)	Solar Energy (T.Toe)
Indigenious Production	10.319	67.231	15.517	6.034	917
Transformation and Energy Sector	-1.576	67.231	15.517	-2.934	-90
Total Final Energy Consumption	8.744	0	0	3.100	827
Industry Consumption	0	0	0	1.209	288
Transport	135	0	0	0	0
Other Sectors	8.608	0	0	352	539
Non Energy Use	0	0	0	0	0
Electricity Generation (Gwh)	2.372	67.231	15.57	4.819	1.043
Installed Power Capacity (MW)	496	26.681	15.751	821	833
Basis for Energy Consumption	10.319	67.231	15.517	6.034	917

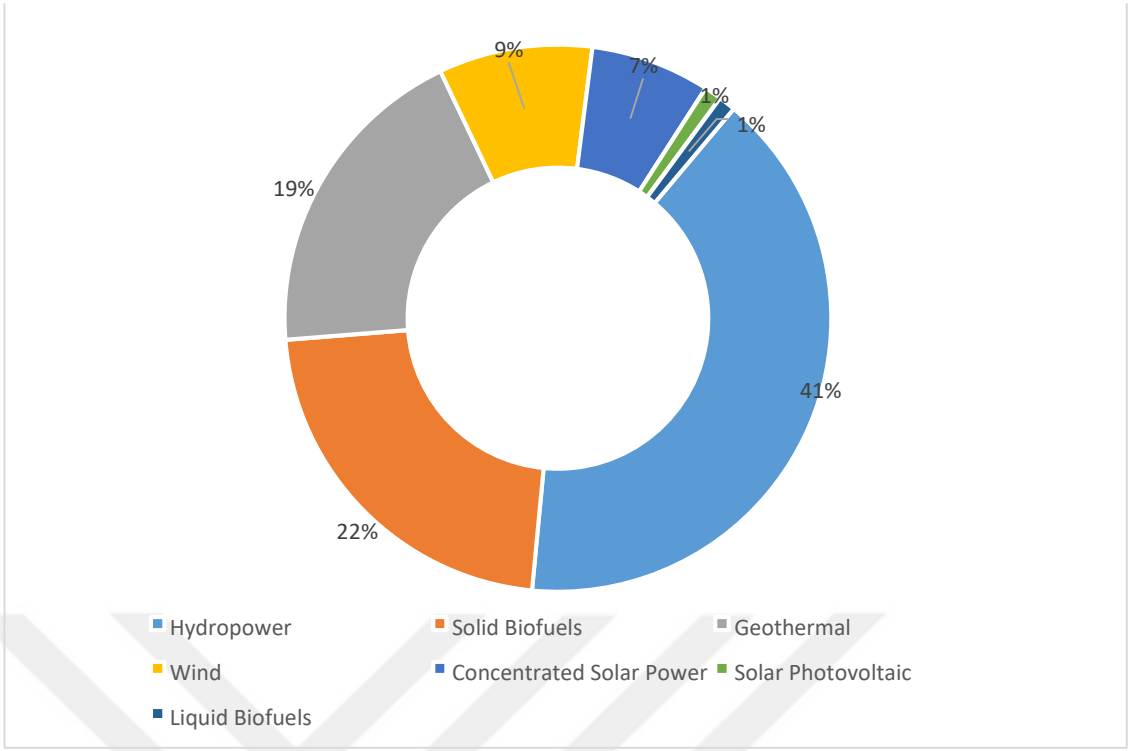
*Thousand tonnes;**Thousand of oil equivalent; *Source: EİGM, 2016.*

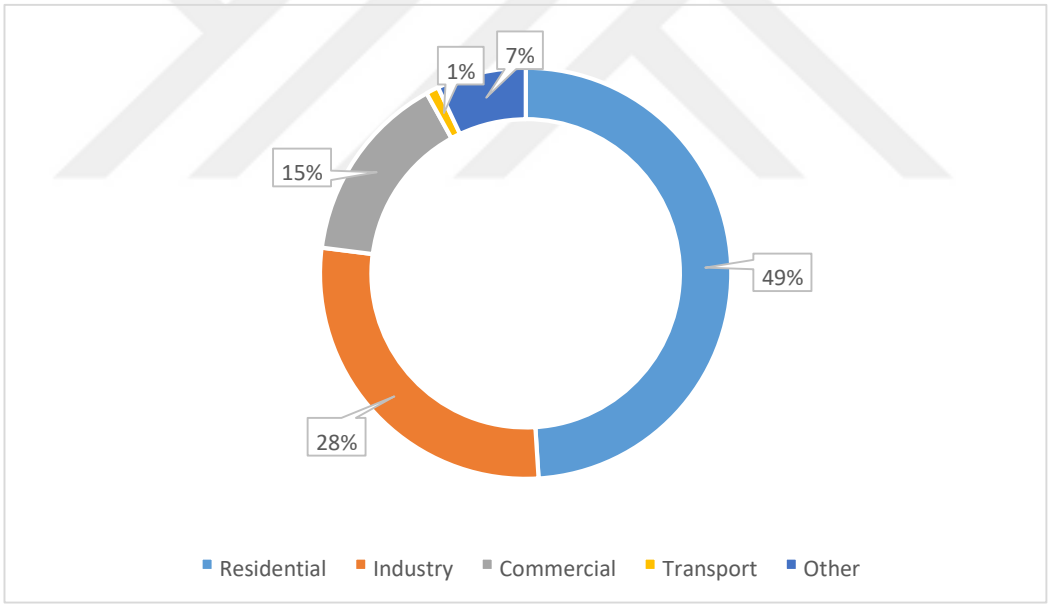
Renewable energy could be used in different sectors, from industry to transportation and heat generation to electricity production worldwide. However, in Turkey, there is general concern about in which sectors renewable energy is utilised and how much.

Therefore bringing the data together for the year 2016 above in table 2.1 that derived from the General Directorate of Energy Affairs (EİGM) might be leastwise helpful to satisfy the curiosities on the matter. Titles within the table 2.1 are Transformation and Energy Sector: electricity and heat production, coke oven, blast furnace, petroleum refinery, own use and

losses. Industry Consumption: manufacture of food beverage and tobacco products, manufacture of textile and leather products, manufacture of wood and products, manufacture of paper and products, manufacture of chemical-petrochemical products, manufacture of non-metallic mineral products, basic metal industry, manufacture of machine-electricalelectronic products, production of transportation equipment, furniture and other manufacturing, construction and other industry, Transport: rail, domestic navigation, domestic aviation, pipeline transportation and road, Other sectors: residential, commercial and public services and agriculture and farming. Non- energy use: petrochemical feedstock.

It would not be wrong to make the following inferences in the light of the table above and the figure 3.1, below showing final renewable energy concumption by techonology and sector as of 2016. Renewable energy supply in our country is dominated mainly by hydropower, except tidal energy the other forms of RES are at the least used in different sectors especially in producing electricity, all the energy that derived from hydraulic and wind and was converted into electrical energy whereas just a smallportion of other types of RES was converted into electricity, the big share goes to residential use in biofuels and waste, geothermal and solar energy, in transportation only renewable source that can be utilized from is biofuels used only in roads as a fuel for vehicles, transportation got the minor share from renewable energy consumption cake as being at the last place in the ranking of the sectors that utilized from renewable energy, residential use of renewable energy is the most popular sort of use, total renewable energy consumption as of 2016 was 499.770 terajoule (TJ) and this would be equal to around 138 GW based on the calculation as in the conversion unit table. This means that the total annual electricity consumption of 30.000 people is taking the annual electricity consumption per person approximately about 4.500 kW.





Source: IRENA, 2016.

Figure 3.1.: Renewable Energy Consumption by Technology and Sector (2016)

3.3. LEGISLATIVE REGULATIONS FOR DEPLOYMENT OF RENEWABLE ENERGY

Before 2005 there was no separate law to define the sources and to promote renewable energy deployment in Turkey. The only law relevant to renewable energy was the Electricity Market Law no. 4628 in 2001. This law covers electricity generation, transmission, distribution, wholesale or retail sale, import and export, market operation, and the rights and obligations of all real and legal persons related to these activities. It was decided to establish an electricity market institution in the first version of this law. This institution is authorized to take necessary measures in order to encourage the use of renewable energy sources and domestic energy resources due to environmental impacts in electrical energy production and to take initiatives in the presence of relevant institutions and organizations for incentives in this regard. The former Electricity Market Law no. 4628 had been in effect until 2013 and then named as "Law On the Organization and Duties of the Energy Market Regulatory Authority (EPDK)." Since this amendment in the law no. 4628, the former Electricity Market Law continues to exist by law no. 6446 with the same name in a separate statute. This new Electricity Market Law includes support schemes for renewable sources that will be mentioned in the next section. Energy Efficiency Law (No. 5627) was published in the Official Gazette with the number of 26510 dated 02.05.2007. It offers a 10-year transition period. Especially in the buildings to be constructed after the Law was published, implementation is mandatory. And, it ensures the efficient use of energy and energy resources in buildings, to prevent waste of energy, to reduce energy costs, and to protect the environment. The official documents (such as Energy Efficiency Strategy Paper 2012-23, MENR Strategic Plans for the periods 2010-14) mainly aimed to reduce import dependence, minimize the adverse environmental effects of activities in the sector of energy and natural resources. The goal of the government for 2023 is to provide a minimum %30 of electricity from RES.

3.3.1. Support Schemes in the former and present Electricity Market Laws (no.4628 and no. 6446)

In Turkey, the first law encouraging electricity generation from renewable energy sources was the Electricity Market Law (No. 4628) enacted in March 2001. It was decided to establish an electricity market institution in the first version of this law. This institution is authorized to take necessary measures in order to encourage the use of renewable energy

sources and domestic energy resources due to environmental impacts in electrical energy production and to take initiatives in the presence of relevant institutions and organizations for incentives in this regard. Later on, with amendments in this law, two policies related to renewables were put forward. First, renewable energy facilities would be required to pay 1% of the total license fee or the license for construction and be exempted from license fees for the first eight years following the completion date. Second, the Turkish Electricity Transmission Company (TEİAŞ) and distribution companies would be required to give priority status to renewable facilities. In this law, with these objectives, the legal framework for promoting electricity generation from renewable sources was set, and incentives such as, priority connection to the grid, reduced license fees, exemptions from license obligation for small-scale generators, reduced fees for project preparation and land acquisition were mentioned (Şimşek, 2013).

Besides, according to the law, individual and corporate entities that built electricity generation facilities from RES having a maximum installed capacity of 500 kW were exempted from licensing obligations and setting up a company (Kucukali and Baris, 2011). Also, in this law, the EPDK was authorised to take the necessary measures to promote the utilization of renewable energy resources (Gaupp, 2007). The Electricity Market Law (4628) was amended with law 6446 in 2013. The law no. 4628 then became an organizational law of EMRA named as Law on the Organization and Duties of the Energy Market Regulatory Authority. In order to encourage investments in Turkey and renewable energy resources within the framework of the Law No. 6446 and the related secondary legislation, electricity generation plants based on renewables are supported by the following mechanisms (Tükenmez & Demireli, 2012: 7; Topkaya, 2012: 3758-3759): *"Payment of only 10% of the total licensing fee: According to By-Law on Electricity Market Licensing, legal entities applying for pre-licences and generation licenses for construction of facilities based on renewables are required to pay only 10% of the total licensing fee, exemption from payment of annual license fees for the first 8 years of operation: Generation facilities based on renewables are exempted from paying annual license fees for the first 8 years following the facility completion date inserted in their respective licenses, priority for system connection: Priority shall be given to renewable energy resources based power plants by EPDK when forming the connection opinion, exemption from being a balancing mechanism unit: Article 18 of By Law on Electricity Market Balancing and Settlement says that generation facilities listed below are exempted from the liability of being a balancing mechanism entity, but can*

be registered as a balancing mechanism entity, if requested by the market participant and agreed by National Load Dispatch Centre within TEIAS that the generation facility or unit can participate in the balancing mechanism:canal or river type hydroelectric generation facilities, wind power plants, solar power plants, power plants based on wave and tidal energy, cogeneration facilities, generation facilities based on fluidized bed technology, purchasing electricity option: All legal entities engaged in generation activity may purchase electricity from the market up to 40% of the annual average generation amounts indicated in their licenses in a calendar year in order to meet their contractual obligations, exemption from licensing and establishing company: In addition, power plants based on renewables with a maximum capacity of 1 MW are exempted from establishing a legal entity and obtaining the related license from EPDK to enter the electricity market."

3.3.2. Support Schemes in the Renewable Energy Laws (5346 and 6094)

According to Law No. 5346, RES based generators were not required to participate in the support scheme. They were free to sell their energy in the market through bilateral contracts. Suppliers were obliged to purchase renewable generation in the market. The purchase obligation ratio equaled, at least, the market share of each supplier for the previous year. In addition, this market share could not be less than 8% if there was enough energy in the market. The price for the renewable energy resources certified electricity within each calendar year was formulated as the average wholesale electricity price in the previous year determined by EPDK. This price would be valid for the electricity produced from RES based power plants, commissioned before 2011, and for power plants with less than 10 years of operation. After a maximum of 10 years of support, the price for RES based power plants would be formed through bilateral agreements in the electricity market, but the purchase obligation of the suppliers would continue. There was a price band for the support price applied, which was between 50 and 55 euro/MWh to protect losses from the currency exchange rate. That means that the support price is not allowed to be lower than the TL (Turkish Liras) equivalent of 50 euro/MWh and higher than the TL equivalent of 55 euro/MWh. The same feed-in tariff (FIT) applied for all kinds of renewables. (Gözen, 2014).

Renewable energy investors were not satisfied with the 2005 Law on the Utilisation of Renewable Energy Resources for the Purpose of Generating Electrical Energy (No. 5346). Therefore in 2011, Law No. 5346 was amended by Law No. 6094. A new support mechanism

was introduced with this amendment, and stakeholders in the field of renewable energy get the opportunity of a new support scheme. As stated above, the FITs were all the same for each renewable source and based on Euro, but differently in the new feed-in system, there exists different FIT for different renewables, and fixed price guarantees have been based on US dollars and not been subjected to any escalation. These comparable price mechanisms can be seen in table 2.2 in two periods; after 2011 and 2005-2011.

Table 3.2.: Renewable Energy Support Mechanism Prices by Type of Production

Type of Production Facility (Renewable Energy Based Resources)	Prices Applicable After 2011 (US Dollar cent/kWh)	Prices Applicable between 2005-2011 (Euro/kWh)
a. Hydroelectric production facility	7.3	5-5.5
b. Wind power-based production facility	7.3	5-5.5
c. Geothermal power-based production facility	10.5	5-5.5
d. Biomass-based production facility (including landfill gas)	13.3	5-5.5
e. Solar power-based production facility	13.3	5-5.5

Source: Law No. 5346 and 6094

Furthermore, a new extra chance emerged with the amendment law 6094 in 2011. The main objective of this new support type is to motivate producing domestic equipment and to encourage investors. That is to say, using domestically produced equipment in renewable energy generators provides a chance for extra support in addition to government purchasing guarantee prices. In the law, there exist specific premiums to different types of equipment. A licensed company has a right to receive domestic product incentive only if local content is over 55%. Domestic product incentives are given in table 2.3 in terms of RES.

Table 3.3.: Domestic Product Incentives

Facility Type	Domestically Manufactured Parts	Additional Domestic Incentive (USD Cent/KWh)
Hydroelectric production facility	Turbine	1.3
	Generator and Power Electricity	1.0
Production based on wind energy facility	Wing	0.8
	Generator and Power Electricity	1.0
	Turbine Tower	0.6
	Rotor and Nacelle Groups All Mechanical Parts (Wing With Generator and Power Payments For Electronics Excluding)	1.3
Production based on photovoltaic energy facility	PV panel integration and solar structural mechanics fabrication	0.8
	PV modules	1.3
	Cells that make up the PV modüle	3.5
	Inventors	0.6
	Solar beam on PV module focusing material	0.5
Concentrated solar energy-based production facility	Radiation collection tube	2.4
	Reflective surface plate	0.6
	Solar tracking system	0.6
	Heat energy storage system mechanical parts	1.3
	Collecting the sunbeam in the tower mechanical steam generation system parts	2.4
	Stirling engine	1.3
	Panel integration and sun panel structural mechanics	0.6
Biomass energy-based production facility	Fluidized bed steam boiler	0.8
	Liquid or gas-fired steam boiler	0.4
	Gasification and gas cleaning group	0.6
	Steam or gas turbine	0.2
	Internal combustion engine or Stirling engine	0.9
	Generator and power electronics	0.5
	Cogeneration system	0.4
Production based on geothermal energy facility	Steam and gas turbine	1.3
	Generator and power electronics	0.7
	Steam injector or vacuum compressor	0.7

Source: Law no. 5346 and 6094.

The support mechanism is run on a calendar year basis. Participation in the mechanism is voluntary. When a RES power plant participates in the mechanism, it must remain in the mechanism during the calendar year. It is important to note that the participating power plant is not allowed to sell its energy on a bilateral market or in any other mechanism. All RES power plants constructed or to be constructed between May 18, 2005, and December 31, 2015, may participate in the support mechanism. However, the power plants can only benefit from the mechanism during their first 10 years of operation. The interested power plants will apply to EPDK by October 31 to join the support mechanism in the next calendar year. All generation from participating power plants is considered in the mechanism. In the case of hybrid plants, only the generation from renewables is subject to the support (Gözen, 2014). There is a change related to licences. During previous legislation, apart from retail sale licences, no other licenses were required to purchase renewable energy. So, retail sale licence owners had to purchase renewable under the previous legislation. However, in the new support scheme, sharing renewable generation costs is obligatory. Being in the support mechanism or selling energy in the market is under the initiative of the companies. The amendment law also includes a %85 discount on rent, easement and permission costs for generation facilities based on renewable energy sources for the first ten years of investment and operation periods.

Another significant step taken by the government related with renewable energy projects is Renewable Energy Resources Areas (Yenilenebilir Enerji Kaynak AlanlarıYEKA) projects. It was implemented in 2017 to increase electricity generation from renewable sources. In this context, the tender for a solar-based power plant with a capacity of 1,000 MW has been completed in Karapınar YEKA project. The electricity to be produced in the power plant has been guaranteed for 15 years at a price of 6.99 US dollars-cents per kWh, and a production facility, and R&D center with a domestic production capacity of at least 500 MW per year will be established to cover all components of solar modules. In addition, 1,000 MW capacity has been allocated for wind energy YEKA projects, and a production and R&D center will be established to manufacture wind turbines with an annual production capacity of 400 MW and a domestic rate of 65 percent. Electricity to be produced from wind power plants will be purchased at a price of 3.48 US dollars-cents per kWh for 15 years (11^{th} Development Plan, 2018).

As a result, when compared to the period 2005-2010, it can be said that the renewable energy sector has revived significantly since 2010. In particular, after the revision of fixed-price guarantees, renewable energy investments attracted the attention of both national and international investors. The critical point on government support for RES is to gradually decrease the level of support as the industry matures because all kinds of fiscal tools are a burden on the public budget. If done like this, the burden of public budget on the society will decrease in the medium-long term. This not only affects the public budget in a positive manner, but also contributes to social wealth in total as well.

3.4. Renewable Energy Performance of Turkey

Turkey has few conventional resources, such as oil and natural gas. This is a well-known matter of fact due to the country's geographic location. However, the lack of conventional resources could be a stimulating factor to take advantage of alternative sources of energy and a chance to protect the environment through no carbon footprint energy. But did we do this? This is the question we will try to find an answer in this sub-section. As mentioned above, Turkey's fossil fuel energy resources are limited, and this makes the country energy-dependent relying significantly on foreign resources thus on other countries, to meet its energy demand. A great portion of natural gas and oil are imported from Russia, Iran, the Middle East, and a few other sources. Imports have a great portion of the current energy consumption of our country. Today most of the natural gas and oil demand of Turkey are imported, and it is estimated that the foreign dependency rates will continue in the coming years if no possible reserves are found and not move towards renewable energy.

In 2019 Turkey exported approximately 8.5 billion and imported 41.7 billion dollars on energy as it is seen from table 2.4. As a result of this, the foreign trade balance had a surplus of 3.7 billion dollars. Apart from energy expenditures, the foreign trade balance had a deficit of 29.5 billion dollars due to energy expenditures. At the same time, Turkey's net energy imports were approximately 33.2 billion dollars. Considering that Turkey's gross domestic product (GDP) of 2019 was 754 billion dollars, it is seen that the country spent 4.4 % of its GDP on energy imports. For this reason, increasing renewable energy resources is of great importance in ensuring foreign trade balance by reducing the country's energy expenditure. A fresh outlook is given below:

Table 3.4. : Foreign Trade Developments in Energy Sector

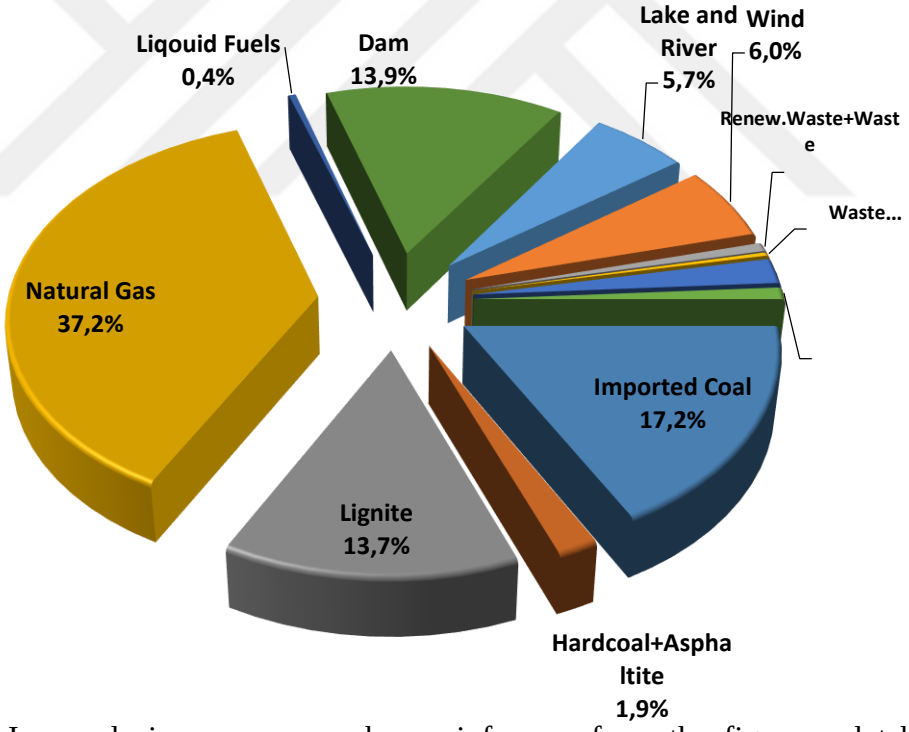
FOREIGN TRADE DEVELOPMENTS IN ENERGY SECTOR - Annual — $ Million

	2013	2014	2015	2016	2017	2018	2019	% Change
TOTAL EXPORTS	**161.481**	**166.505**	**150.982**	**149.247**	**164.495**	**177.169**	**180.833**	**2,1**
TOTAL IMPORTS	**260.823**	**251.142**	**213.619**	**202.189**	**238.715**	**231.152**	**210.345**	**-9,0**
FT volume	422.304	417.647	364.601	351.436	403.210	408.321	391.178	-4,2
FT balance	-99.342	-84.638	-62.637	-52.942	-74.221	-53.984	-29.512	-45,3
Export/Import	61,9	66,3	70,7	73,8	68,9	76,6	86,0	-
Energy exports	**10.118**	**7.500**	**5.148**	**3.380**	**4.799**	**5.810**	**8.447**	**45,4**
Energy imports	**57.753**	**56.176**	**38.652**	**27.465**	**37.655**	**43.613**	**41.731**	**-4,3**
Energy foreign trade volume	67.870	63.676	43.800	30.845	42.454	49.423	50.179	1,5
Energy foreign trade balance	-47.635	-48.675	-33.503	-24.085	-32.856	-37.804	-33.284	-12,0
Exports/Imports(%)	17,5	13,4	13,3	12,3	12,7	13,3	20,2	-
Energy Exports share	6,3	4,5	3,4	2,3	2,9	3,3	4,7	-
Energy Imports share	22,1	22,4	18,1	13,6	15,8	18,9	19,8	-
Exports excluding energy	**151.363**	**159.005**	**145.834**	**145.867**	**159.695**	**171.359**	**172.385**	**0,6**
Imports excluding energy	**203.070**	**194.967**	**174.968**	**174.724**	**201.060**	**187.539**	**168.614**	**-10,1**
Ft volume excluding energy	354.433	353.971	320.801	320.591	360.756	358.898	340.999	-5,0
Ft balance excluding energy	-51.707	-35.962	-29.134	-28.858	-41.365	-16.180	3.771	-123,3
Exports/Imports(%)	74,5	81,6	83,3	83,5	79,4	91,4	102,2	-
Export share excluding energy (%)	93,7	96,1	96,9	97,7	97,2	96,7	95,3	-
Import share excluding energy (%)	77,9	77,6	81,9	86,4	84,2	81,1	80,2	-

Source: Ministry of Trade, 2020.

Here it is important to say that; being significantly dependent on foreign countries in terms of energy resources caused economic burdens such as high current account deficit and exchange risks because the price of fossil fuels are generally based on the euro or US dollar, and this makes the Turkish lira sensitive to the foreign market. This dependency also causes political pressures arising from fossil fuel-rich countries making the dependent country voiceless in the international arena. In Turkey, a few renewable energy sources have been utilized for direct usage. For instance, geothermal and solar energy are kinds of renewable sources which the country utilizes for the output of minerals, thermal tourism and heating, etc. These are indirect applications. Therefore, we can make concrete inferences on the utilization of renewable sources from the data of electricity generation. As it is a well-known matter of fact that renewable energy sources are primary energy sources are found in nature and have not been converted or transformed. Due to the fact that the direct usage areas of renewable energy in Turkey are limited, a great amount of energy derived from renewables has been transformed into electrical energy. Support schemes for renewable energy like the targets, output, incentives, etc. are all on the generation of electricity rather than on heat or other purposes. Therefore, to get a better understanding of the renewable energy performance of Turkey. Principally, we should look at the development and status of our country's production of electricity by renewable energy resources.

Figure 3.2 below shows the production of electricity by all energy sources utilized in Turkey as of 2017. As it is seen from the figure 2.2, natural gas takes the lead by a share of 37.2%. It is important to note that Turkey depends heavily on foreign resources to meet its energy demand. Just like oil, all natural gas that is used to produce electricity and for other purposes like heating is imported. The other commonly used source is that of imported coal by a share of 17.2%. The source leading the way in renewable energy is hydraulic energy. This kind consists of two sources: dam, lake, and river (without dam). As seen in the figure and table, hydraulic sources with an important share of 19.6% (lake and river 5.7% + dam 13.9%) rank third in the list. The country has great amounts of lignite reserves as a natural inheritance. Turning this natural inheritance to an advantage, the country utilizes this source fairly good, and thus, lignite takes the fourth place as commonly used reserve to generate electricity by a share of 13.7%. Other sources drawing up the list are hard_coal and asphaltite, waste and renewable waste, heat, and liquid fuels. These sources contribute to the production of electricity on a small scale with a share of 1.9%, 0.7%, 0.3% and 0.4%,



respectively. In conclusion, we can make an inference from the figure and table that renewable energy has a considerable amount of contribution in the total generation of electricity by a share of roughly 30%, including hydraulic energy.

0,7%

Geothermal
2,1%

Source: TEİAŞ, 2017:30

Figure 3.2.: Production of Electricity by Resources as of 2017

As it is seen from table 3.5, the total production of electricity as of 2017 was 297,277.5 Gwh. When we examine the shares of energy resources in this total production rate; natural gas has a share of approximately 110.490 Mw and leading the way, imported coal has a share of 51.118 and takes the second place in the list, lignite has a share of 40.694 Mw and takes the third place in the list. In brief, we could say that RES, apart from hydroelectric energy and wind energy, do not contribute to the total energy production remarkably as other resources.

Table 3.5.: Production of Electricity By Resources as of 2017

RESOURCE	PRODUCTION (GWh)	SHARE (%)
Imported Coal	51,118.1	17.20
Hardcoal + Asphaltite	5,663.8	1.91
Lignite	40,694.4	13.69

Natural Gas	110,490.0	37.17
Liquid Fuels	1,199.9	0.40
Dam	41,312.6	13.90
Lake and River	16,905.9	5.69
Wind	17,903.8	6.02
Renewable Waste+Waste	2,124.0	0.71
Waste Heat	848.3	0.29
Geothermal	6,127.5	2.06
Solar	2,889.3	0.97
TOTAL	**297,277.5**	**100,00**

Source: TEİAŞ, 2017:30

After analysing the recent situation of renewable energy for electricity generation, table 3.6. below shows the annual development of renewable electricity generation share in Turkey's total electricity generation between 2005 and 2017. It can clearly be seen in table 3.6. that there has been a great bounce in the usage of all kinds of renewable resources for electricity generation but in total, when compared with each source separately whole renewable share in the country's total electricity generation increased slightly. In the last 12 years period between 2005-2017, it can clearly be seen that only a five percent increase had been made. The share of renewables 24.6% in 2005 and increased only to 29.6% in 2017. What does it mean? The answer refers to the heavy dependence of the country on foreign resources provided essentially by imports such as natural gas, oil, and coal to meet its increasing electricity demand as a result of being in the league of developing countries. Remember that in electricity production, the first two mostly used sources were imported natural gas and coal have a share of 37.17% and 17.2%, respectively as of 2017. The scheme

is the same as it used to be. We can describe this as an energy dependence meaning that more than half of the electricity production in Turkey comes from other countries, so the electricity demand is satisfied mainly with foreign resources. As energy is an indispensable component of life, this dependency on foreign resources is of crucial importance. It does not only affect the costs of energy but also the national security, budget deficit, and eventually the whole economy, all sectors, and life, as well. However, considering the weak statue of Turkey in the area of renewable energy before 2005, we can not ignore the country's significant steps in that challenging and long way in recent years. Furthermore, it would not be wrong to say that "the year 2005 is a milestone for renewable energy in Turkey". In addition to concrete steps taken in recent years, the country has set a renewable energy target to reach at least 30% coverage ratio of the electricity demand of the country and meet at least 10% of transportation sector needs, which was 1% as of 2016, by renewable energy by 2023.

Table 3.6. : Annual Development of Renewable Electricity Generation Share in Turkey's Total Electricity Generation (2005-2017) **Unit:MW**

Years	Hydro	Geothermal	Wind	Solar	Renew Wastes+Waste Heat	Renewable Generation	Total Generation	Renew. Share %
2005	39,560.5	94.4	59.0		122.4	39,836.3	161,956.2	24.6
2006	44,244.2	94.0	126.5		154.0	44,618.7	176,299.8	25.3
2007	35,850.8	156.0	355.1		213.7	36,575.6	191,558.1	19.1
2008	33,269.8	162.4	846.5		219.9	34,498.6	198,418.0	17.4
2009	35,958.4	435.7	1,495.3		340.1	38,229.5	194,812.9	19.6
2010	51,795.5	668.2	2,916.4		457.5	55,837.6	211,207.7	26.4
2011	52,338.6	694.4	4,723.9		469.2	58,226.1	229,395.1	25.4
2012	57,865.0	899.3	5,860.8		720.7	65,345.8	239,496.8	27.3
2013	59,420.5	1,363.5	7,557.5		1,171.2	69,512.7	240,154.0	28.9
2014	40,644.7	2,36	8,520.1	17.4	1,432.6	52,978.8	251,962.8	21.0
2015	67,145.8	3,424.5	11,652.5	194.1	1,758.2	84,175.1	261,783.3	32.2
2016	67,230.9	4,818.5	15,517.1	1,043.1	2,371.6	90,981.3	274,407.7	33.2
2017	58,218.5	6,127.5	17,903.8	2,889.3	2,972.3	88,111.4	297,277.5	29.6

Source: TEİAŞ, 2017.

Today generation of sufficient electricity from RES and promoting energy efficiency measures are the two priorities of Turkey's energy policy. These priorities also help to develop a sustainable industry. The most important indicators of this are the Renewable Energy Action Plan and the National Energy Efficiency Action Plan (NREAP). As mentioned above, the 2023 target of at least 30% share of renewables in electricity generation takes place in NREAP. The main aim of NREAP is to increase the share of renewable energy to 20% in general energy consumption by 2023. In this context, Turkey intends to utilize (NREAP, 2014): a hydroelectric based potential of 34.000 MW, a windbased installed capacity of 20.000 MW, all geothermal potential by 2023, and a biomass- based installed capacity of 1.000 MW. Also it is targeted to generalize the use of solar energy for generating energy, ensuring maximum utilization of country potential. MENR is targeting 3.000 MW in 2019 and at least 5.000 MW in 2023.

4. FISCAL INCENTIVES FOR RENEWABLE ENERGY SOURCES IN LIGHT OF SELECTED COUNTRY EXAMPLES

The policies and regulations put forward for energy resources in a country are a part and reflection of the current socio-economic and political structure of that country. In this framework, the unique constraints of each country, as well as the wealth and possibilities, can play an important role in shaping energy policies. Long-term contracts and investments, which are carried out in line with the existing policies and approaches, may also be an obstacle to sudden changes in energy policies and, in a sense, constitute a constraint in the formulation of energy policies (Yılmaz and Hotunluoğlu, 2015).

In this context, countries have implemented various fiscal, monetary, credit, and foreign trade policies within their economic systems in order to ensure their social and economic development and increase their competitiveness in the international arena. Incentives within these policies are used at various levels in all countries as a tool of policy (Giray et al. 1998). In this context, incentives are applied over public expenditures and public revenues, which are the instruments of fiscal policy, consistent with its aims, such as accelerating development and realizing full employment (Pınar, 2010). Incentives are defined as fiscal and/or non-fiscal support or assistance provided by the state through various methods to ensure that a particular sector and / or region develops more and rapidly than others (Selen, 2011).

Incentive tools basically have two purposes. First, to increase the funds to be invested by the private sector by reducing the costs; and the second, to canalize resources to areas that are considered to be beneficial for the country's economy in order to increase efficient economic activities (Güzel, 2015). However, it should be emphasized here that whether or not incentives will increase the private sector investment volume depends on the extent to which entrepreneurs will direct their savings to investments (Şen and Sağbaş, 2015). In this context, the main renewable energy incentives are; fixed price guarantee, premium guarantee, mandatory quota and green certificate applications, various tax incentives, and investment loans. Among these incentives, fixed price guarantee and premium guarantee are applied over public expenditures, while tax incentives are applied over public revenues. Mandatory quota and green certificate applications are regulatory policies (Şen, 2019).

Fixed price guarantee is an incentive mechanism that aims to increase renewable energy investments. Although the first place of this mechanism is the USA, it is applied in

many countries today (Aslani, Naaranoja and Wong, 2013). Fixed price guarantee has two main functions. First, energy from renewable sources is guaranteed a purchase. Second, a long-term price guarantee is provided, usually ranging from 10 to 30 years. Thus, for the investor, sales and price risks are eliminated (Brown, 2013). The premium guarantee, on the other hand, is similar to the fixed price guarantee and brings a purchase guarantee to the energy produced by the renewable energy producer, but instead of the fixed price guarantee, it involves adding some premium to the market price (Deloitte, 2010).

In renewable energy production, tax incentives are used in order to increase the profitability of investments by reducing the costs of producers. Tax incentives are one of the most common types of incentives reducing/eliminating the tax burden in certain sectors of the economy (Giray, 2016). Major tax incentives; exemptions, discounts, depreciation regime, forward and backward deduction of losses, tax breaks and tax deferral (Şen and Sağbaş, 2015). In addition, taxation of fossil fuels at higher rates or with additional taxes such as carbon tax can be included among taxation measures (Aslani, Naaranoja and Wong, 2013). In this way, energy consumption is directed in favor of renewable resources.

With the mandatory quota application, energy producers are obliged to meet a certain amount of energy from renewable sources. Those who produce more than the quota amount from these resources, with the green certificates designed, can sell the energy to other producers who cannot meet the quota amount. Green certificates show that energy production is met from renewable sources. The ability to buy and sell certificates enables parties that do not fill their quota to reach their quotas by purchasing certificates, and those who produce above their quota can earn additional income by selling the certificates. The value of green certificates is generally determined according to supply and demand in market conditions (Brown, 2013).

Another significant fiscal tool for renewable energy is Environmentally Friendly Budgeting System. It is an environmental management system and budgeting technique developed considering the needs of local governments. This system has an important place in terms of ensuring the quality or standard of life for citizens while managing limited natural resources in the context of sustainability principles. The system is also known as green budget system, ecological budget system, environmental budget system (Kılıçer, 2016). This system has been created especially for local administrations to protect the environment and

manage natural resources, and uses the same methods as the known annual financial budgeting technique. Like the fiscal budget, the environmentally sensitive budget also implements the annual budget cycle that allows local governments' traditional budgeting procedures and approved by the city council (EcoBudget Ratification Report, 2003). However, while the financial budget system focuses on economic efficiency; environmentally friendly budgeting system focuses on sustainable efficiency, that is, providing maximum human benefit with minimum ecological cost (European Circular, 2003). Environmentally friendly budgeting does not attempt to express the effects on the environment as a monetary value. Rather, this system uses physical descriptions or values for the use and consumption of natural resources. In this context, it deals with the management of natural resources, and provides local environmental targets using physical or numerical indicators and makes it possible to monitor the state of the environment in relation to these targets (Burzacchini and Erdmenger, 1999).

All these incentive mechanisms provided by the state for renewable energy may be categorized as fiscal policy tools, and this brings to the agenda that the government’s role on renewable energy is of critical importance. In this context, the aim of this study is to highlight the importance of the government’s role on the renewable energy performance of the country by handling the issue in terms of countries making significant progress in increasing renewable energy production such as Germany, the USA, China, Japan, Spain and EU in general.

In terms of renewable power generation, as seen in table 4.1. from BP Statistical Review of World Energy (2020), apart from Turkey, selected countries have generated more renewable power than Turkey since 2010. In this context, the role of incentives as instruments of fiscal policy in increasing renewable energy production is examined, and the incentives applied to renewable energy in Turkey are compared with those in the USA, Spain, Japan, Germany, China, and EU in general.

Table 4.1.: Renewable Power Generation*

Terawatt-hours	2010	2011	2012	2013	2014	2015	2016	2017	2018	Growth rate per annum 2019 2019	2008-18		Share 2019
USA	173.7	201.9	228.3	266.2	28	315.8	367.4	417.7	451.6	489.8	8.5%	13.2%	17.5%
Germany	84.2	106.4	121.3	129.3	142.9	169.8	1691	196.2	206.8	224.1	8.4%	11.0%	8.0%
Turkey	3.9	5.8	7.4	9.8	12.0	16.5	23.0	29.0	37.8	45.3	19.8%	41.8%	1.6%
Spain	54.6	55.6	66.4	74.2	71.1	68.9	68.2	69.5	69.8	77.5	11%	6.1%	2.8%
China	75.0	104.3	136.8	183.8	2295	279.1	369.5	502.0	636.	732.3	15.1%	36.6%	26.1%
Japan	29.7	31.0	34.2	41.2	52.2	68.2	68.1	81.9	96.8	121.2	25.2%	13.7%	4.3%
Total Europe	313.6	379.5	448.7	506.8	547.2	625.3	638.4	716.7	756.3	836.6	10.6%	12.2%	29.8%
Total World	760.1	904.5	1062.4	1238.9	1405.2	1626.7	1839.9	2170.8	2468.0	2805.5	13.7%	16.2%	100.0%
EU	302.3	365.5	431.5	485.8	522.9	596.1	602.8	673.1	700.9	768.2	9.6%	11.8%	27.4%

Source: BP, 2020:54

* Renewable power is based on gross generation from renewable sources including wind, geothermal, solar, biomass and waste, and not accounting for cross-border electricity supply.

4.1. Fiscal Incentives for Renewable Energy in Germany

Germany is a role model for many countries in the production of energy from renewable sources. Since the 1970s, when the oil crisis was experienced, Germany has made significant attempts to diversify its energy resources. After the oil crisis, in the period of 1974-1982, R&D studies for energy generation from renewables were seriously supported by the government. Germany, which is trying to maintain its role in the EU and in the world, has published laws, regulations, and directives in the field of renewable energy before most countries (Bayraktar and Kaya, 2016).

In Germany, which is regarded as one of the leading companies in the world, in the field of Renewable Energy, the "Renewable Energy Resources Law" came into force in 2000. The law supports the type of the power plant established in the context of electricity production from wind, hydraulic, solar, biomass, waste-water, and geothermal sources in accordance with a purchase-guaranteed tariff determined by the installed power and commissioning date (Uluatam, 2010). It is stated that Germany is the country with the best renewable energy legislation and incentive system in the world, and it is stated that the administrative processes in this country is very clear, easy-for-investor, and a system of uncertainties (Arık, 2016).

Fiscal support instruments applied for renewable energy sources in Germany are listed as; subsidy, tariff guarantee, premium tariff guarantee, loans, tax regulations, and quota system (Selvi, 2015). Renewable energy incentives implemented in Germany can be summarized as follows; support programs are carried out by the German Development Bank Kfw Bankengruppe (KfW Renewable Energy Program, KfW Open Sea Wind Energy Program, KfW Energy Efficiency Program and KfW Energy Efficiency Financing Initiative Program) and the Federal Ministry of Environment, Nature Conservation, Construction and Nuclear Safety. Apart from this, other subsidies are applied in the form of operational subsidies, mandatory direct marketing (power plants with 100 kW and above as of 1 January 2017), market premium, and technology-specific corridors, and payments. In addition, heavily subsidized loans are provided through the Deutsche Ausgleichsbank Environment and Energy Efficiency Program. Tariff and purchase guarantee in 2017 can be summarized as (KPMG 2017: 30-33): *"Hydroelectric Power Plants: 3,50 – 12,52 cent/kWh, biomass: 5,85 - 23,73 cent/kWh, landfill Gas: 3,80 – 8,42 cent/kWh, geothermal: annually 25,20 cent/kWh, Wind: 4,95 – 19,40 cent/kWh, solar: 9,23 – 13,50 cent/kWh."* This, unlike many

models, is a fairly high amount of guarantee, making renewable energy investments attractive. Since 2000, investors are provided with a purchase guarantee for a very long period of 20 years. The implementation of fixed price guarantee being implemented until 2010 has a similar structure to feed-in tariff mechanism in Turkey. The aforementioned practice imposes mandatory renewable energy-based electricity purchases for supply companies, but it is not clearly predicted how much the supply companies receive from this electricity and therefore how much they will have to pay, but this can only be seen when the invoice is sent to them. This has become an important uncertainty for supply companies to manage. Small scale suppliers, in particular, are struggling due to this uncertainty. Since the beginning of 2010, the application has been revised. In the new application, the System Operator estimates the quantity of electrical energy that will be produced based on renewable sources and purchases it. Then the system operator sells it to the Day Ahead Market with a price-independent offer. This situation eliminated the uncertainty over the supply companies.

The country enacted the renewable heat law on January 1, 2009. With this law, Germany has brought the obligation to all building owners that they will provide a certain amount of building heat from renewable sources. Fiscal support is also provided for the use of these technologies. In addition, the combined heat and power law provides a purchase guarantee and fiscal support to facility operators for full working capacity in certain conditions (Uluatam, 2010).

Electricity tax has been applied in Germany since 1999. The amount of tax is determined as 0.06125 Euro / liter in gasoline and 0.55 Euro / kWh in gas. However, electricity generated from RES is excluded from this tax. As a measure to encourage the use of renewable electricity, the country has included an exemption on the payments of excise duties for electricity from renewable energy sources (Clement et al. 2005; Cansino et al. 2010; OECD, 2012). *"Extremely well-prepared administrative procedure and legislation system, satisfactory support rates, up to 20 years of support guarantee period, serious supports and investments in renewable energy technology, no fossil fuel power plant planned in 2020 target show that a very serious politic will is formed on renewable energy in Germany"* (Arık, 2016:71).

4.2. Fiscal Incentives for Renewable Energy in the USA

Nuclear energy was given weight in the USA rather than Renewable Energy in the 1961-1973 period. During this period, 70% of federal research and development (R&D) expenditure was reserved for nuclear, and other energy expenditures were very limited. When the oil embargo crisis broke out in 1973, the radical national changes have been made in energy research. Thus, renewable energy investments rose from 32 million dollars to 1.36 billion dollars in the 1974-79 period. More than 2 billion dollars were invested in large scale solar and wind energy programs between 1978-1982. In 1977 with the establishment of the Ministry of Energy, there was a fundamental transformation in R&D expenditure and the government decided to support renewable energy (TR 83, 2011). With the Clean Energy Law, which came into force in 2009, incentives were increased, and carbon quotas were introduced. However, renewable energy systems still have difficulties in competition with cheaper technologies (such as coal) (Walsh, 2013; Mingyuan, 2005; Nixon, 2007).

Currently, the energy need is one of the most important issues in the USA, which has the most developed industry and the largest economy in the world. Because of this importance and also being the second country with the highest energy consumption in the world, the USA follows policies to ensure energy supply security and reduce oil dependence. As a result, the USA's basic energy policy is listed as targets that will enable cheap supply, energy security, and the development of clean energy technologies. In this context, the USA is the third country after China and Germany, which invest the most in clean energy resources (Batı, 2013, Çepik, 2015). It is stated that tax deductions have been provided for solar, wind, and geothermal energy installations since 1978 within the scope of the national energy law in the USA (Uluatam, 2010). With the Law of 1978, it is stated that the government provided tax credits to homeowners investing in solar panels, and it was requested by public institutions to purchase electricity from renewable sources for the first time (Scott, 2014).

In the study dealt with by Bailie et al. (2016), where the USA's recent energy policies are evaluated, the electricity sector in the USA is moving from coal to RES, so the USA energy sector is in the middle of a major transition period and at a higher level. It is stated that policies that support renewable energy and energy efficiency investments have accelerated this transition period. One of the types of energy used to switch from coal to cleaner energy sources is shale gas. Shale gas production started in the USA in 2000. It is expected that with the increase in shale gas production in the USA, greenhouse gas emission

will decrease, and foreign dependency in natural gas will decrease (Batı, 2013). In terms of RES, it can be stated that legal regulations and regulations related to the subject are mostly formed at the state level in the USA. Many states have set goals that they will generate certain percentages of their total electricity generation from RES over a period of time. ITC (Investment Tax Credit) plays an important role in the expansion of solar energy projects in the USA. ITC is an arrangement that enables individuals or companies investing in solar energy systems to take back as a discount from federal taxes, where they will pay 30% of the cost of the system. Another fiscal incentive for renewable energy sources is the discount on property tax. In this context, it can be stated that tax exemption or reduction is applied in 38 states. In addition, sales tax on sales to end-users is applied in 29 states in RES, either fully or partially, at a discount (Anna, 2010).

It is stated that thanks to renewable energy targets, accurate legislative regulations, federal and state incentives, innovative programs, and wide financing opportunities, the USA solar market is one of the world's leading energy markets (Anna, 2010). Similarly, also Crago and Chernyakhovskiy (2014) stated that in the last few years, there had been a significant increase in government policy-based incentives for solar power in the past few years, and empirical findings, tax incentives, discounts, solar energy orders, and loan programs are important factors affecting the development of solar energy in residential buildings. It has been stated that the renewable portfolio standard from regulatory policies has been applied to 55% of USA retail electricity sales; since 2000, it has been associated with renewable portfolio production (60%), and more than half of the capacity increase (57%). It is also stated that in renewable energy portfolio standard, wind energy took the first place (64%), but in 2015, solar energy came to the fore (69%) (Galen, 2016).

It can be stated that there are many tax incentives related to RES for both consumers and businesses across the USA at the federal and the state level. In the Energy Improvement Act, which was adopted by Congress in 2008 and called the fiscal recovery, an 18 billion dollars tax incentive was provided for wind, solar, and geothermal energy resources, and 30% tax credit for residential, commercial, and industrial products related to solar energy systems for eight years (Hausking, 2017). Tax incentives applied to RES in the USA consists of; income tax, corporate tax, sales tax, property tax and tax return, and tax incentives include tax returns for personal or corporate income tax expenses, property or sales tax exemptions,

and tax returns for renewable energy generation or renewable energy systems production (Vasseur, 2016).

Renewable energy incentives applied in the USA consist of the PTC, ITC, grant, and business subsidies (KPMG, 2016a). In this context, firstly, with the Energy Tax Law of 1978, a 10% ITC was introduced for renewable energy investments. However, it was repealed in 1985. Therefore, when solar investments came to a halt, it was put into effect again in 2005. Accordingly, businesses optionally can benefit from ITC (excluding tax-exempt organizations such as schools, municipalities, governments, or foundations) at the rate of 30% of the project cost (10% from 2017). For this, the enterprise has to be held for 6 years. Otherwise, some of the ITC will be returned. The main problem with ITC is that if the period expires before the project puts in operation, it will not be able to take full advantage of the discount. For this reason, it is recommended to extend the period. Another problem is that the number of investors to benefit from the discount is limited. In order to ensure that investors who cannot find enough funds can enter the market, the expansion of the investor pool that will benefit from the discount is discussed (US Energy, 2020).

With the Energy Policy Law, as of 24.10.1992, besides ITC, the application of PTC has been started as an optional right. When the application period ended in 1999, in the 200003 period, PTC was re-enacted, especially since wind installations decreased by 93%, 73%, and 77% respectively. Except for solar, all renewable energy sources can benefit from PTC. In 2005, the utilization period was increased from 5 to 10 years. This is based on the date when the project was put into operation. It is applied in certain areas. The amount of PTC for wind, biomass, and geothermal is 2.3 cents/kWh and half of it for other technologies. PTC amounts are updated according to inflation. If the market price of electricity exceeds a certain threshold (12.27 cents for 2015), the amount gradually decreases (Aldy, 2012). National Tax Committee estimated the cost of PTC to the budget as 16.4 billion dollars (13.8 billion dollars of which is wind) for the period of 2014-18. However, given the environmental and energy policy objectives, there are pressures to limit the duration of utilization indefinitely (Sherlock, 2015). Along with the American Investment Law, a cash payment program (1063 Grant Scheme) was initiated, which corresponds to 30% of the project cost of renewable energy facilities, which started operation or started to be built in 2009-10. In this context, one-off payments are exempt from tax, provided that they are limited to the amount of funds. The aim of this program, which provides an advantage

equivalent to ITC, is to meet the needs of small investors affected by the crisis. For this, the construction has started before 2011 and must be completed by 2016. Also, within this scope, under the 1705 guarantee program for the 4 major wind, 12 major solar, and some other project types, the construction of which started before October 1, 2011, low-interest loan guarantee was introduced (Tang et al., 2012). There is a 5-year accelerated cost improvement for renewable energy facilities. In this way, wind projects with an average life span of 20 years are amortized in 5 years (IEA, 2016).

4.3. Fiscal Incentives for Renewable Energy in China

The GDP of China, the most populous country in the world, has increased more than many countries worlwide annually in the last 30 years. This has significantly increased the energy demand of the country. China, which currently meets a great portion of its electricity needs from coal, has recently set important renewable energy targets for potential environmental pollution, and supply security reasons. In China, which has significant coal reserves, 67% of primary energy consumption, and 73% of electricity production, are covered by coal. Considering that 27.7% of the primary energy consumption is covered by coal worldwide, China's coal consumption at this level brings environmental pollution and makes the country the largest greenhouse gas, sulfur dioxide, nitrogen oxide, and particulate emitter. In order to deal with these problems and ensure energy security, China has made rapid progress after 2000 by making intense efforts to develop renewable energy resources (Yang et al., 2016).

Climate change experienced around the world in recent years is an important reason why China is turning to renewable energy sources. China is one of the countries with the highest carbon emissions in the world due to its high coal usage rates. This situation causes air, water, and soil pollution, and threatens water, and food security. In addition, it reduces the quality of life by causing a negative effect on human life in the general society, especially in less developed regions. It is possible to talk about the existence of a significant international pressure on China due to the commissions, and protocols regarding to climate change. China has made significant breakthroughs in terms of industry, and when the existing technology is combined with cheap labor, it has gained a significant competitive advantage. The Chinese private sector is investing substantially in the production of photovoltaic batteries for wind turbines, and solar energy. By this way the country both meets

its domestic demand, and increases its market share in this field by exporting these equipment worldwide. In addition, as a result of the investment made in these sectors, employment areas called green business resources are emerged.

In addition to European countries, China, which has started to make progress in clean energy in the world, focuses on the promotion of renewable energy resources. From 2009 renewable energy has come a long way with fiscal incentives. The country ranked first in the world in the field of wind energy installed power, leaving the USA behind with a growth of 73.3% in 2010 (TR 83, 2011). It is stated that China, which is the world's largest energy consumer, renewable energy and clean energy technology investments exceeded the total investment of the EU and the USA, that China will continue to make up about 40% of the world's renewable energy capacity by 2020. It is estimated that the energy investments will be 145 billion dollars annually until 2030, or 2.2 trillion dollars in total (China Institute, 2016). With the industry developing on the basis of export, a part of the rapidly increasing electricity demand is tried to be met with renewable energy investments in line with the production targets based on ambitious renewable resources. The most important support for renewable energy investments to reach these ambitious targets is the high loan amount in the country.

It is stated that renewable energy policies of China are addressed in five main points: energy supply security, climate change, economic competition, pollution, and quality of life (Lo, 2014, Bayraktar and Kaya, 2016). It is stated that the Renewable Energy Law, which came into force on January 1, 2006, provided significant increases in the use of wind and solar energy. As a result of these regulations and practices, China became the first in the world with installed wind power capacity (33% share in world wind power installed power with 2015 data) and among the leading countries in solar energy. The study undertaken by Lo (2014), where the main policy elements behind this success are listed as renewable portfolio standards, tariff guarantees, and direct subsidies, include the following issues related to direct subsidies: in order for China’s solar industry to compete with EU and USA, the Ministry of Finance launched two subsidy programs in 2009 to support domestic demand developments in this area. The first one is the Solar Roofs program, which supports distributed photovoltaic projects, including roof systems and building integrated photovoltaic systems, and provides a subsidy of 50% of the program investment amount. The second is the Golden Sun Demonstration project, which supports larger photovoltaic

energy projects than the Solar Roofs program, including building integrated photovoltaic systems, rural electrification projects, and large-scale photovoltaic energy projects. The program provides 50% of the total cost in grid systems and 70% for non-grid systems in rural areas (Lo, 2014).

Renewable energy incentives applied in China are corporate tax reduction, valueadded tax (VAT) refund, vehicle purchase tax exemption, energy performance contracting, tariff guarantee incentives, fiscal funds and fiscal subsidies to develop renewable energy (KPMG, 2016b). In this context, corporate tax is an application that provides 15% reduced corporate tax opportunity to innovative and technology producing enterprises in solar, wind, biothermal and geothermal energy fields. After a three-year corporate tax exemption for the income generated in some projects, a 50% reduction from the standard corporate tax rate is applied for another three years. In addition VAT refund and vehicle purchase tax discount are other forms of tax regulations for renewable energy. Other than these, tariff guarantee incentives offered for energy performance contracting projects (entitlement to tax exemption for the first three years starting from the tax year of the first day from which the project is earned, a tax reduction of 50% for following three years), can be stated as other incentives for renewable energy sources in China, for renewable energy development.

4.4. Fiscal Incentives for Renewable Energy in Spain

Spain is among the best practices in renewable energy production. While the share of fossil fuels in electricity generation decreased in the country during 2004-2014, thanks to strong government support, the share of renewable energy increased rapidly. Thus, in the last decade, the share of renewable energy resources in primary energy supply has increased from 7% to 14.9%. Spain has the highest share of solar energy and is the third country in the share of wind energy among IEA members in primary energy supply. In the country where almost half of the electricity is supplied from renewable energy sources, 40.4% of the electricity produced in 2014 was met from these sources. There is a special unit called Renewable Energy Control Center for electricity generation from renewable energy resources in the country (IEA, 2015).

The background of Spain's becoming one of the main renewable energy producers is the support given to renewable energy since 1997. This has a great impact. With the

Electricity Sector Law dated 1997, which ensures the privatization of the electricity market, it is aimed to provide 10% of the total energy demand by 2010 and 20% by 2020 from renewable energy sources. For this, the feed-in tariff model, which has been updated four times a year according to inflation, has been implemented since 2008. There is an investment discount for renewable energy up to 40%. A reduced rate of 12% VAT is applied for the purchase of renewable energy machinery and equipment. There are depreciation rates ranging from 5-10% for solar power-based installations, and 4-8% for wind power-based installations. In order to get out of the crisis, amortization liberty was applied in the period of 2009-2012. 25% of R&D expenses can be deducted from the tax base. Since 2008, vehicle registration tax has been determined according to emission. Within the framework of the 2015 comprehensive green financial reform, a "carbon tax" was introduced to the nontradable sector (Marata et al., 2010; TR 83, 2011).

Real estate tax privileges that vary by state by municipality is implemented. Real estate tax rates between 0.4% and 1.10% in cities and between 0.3% and 0.9% in other places are applied at a discount of 15% to 50% in buildings with renewable energy system. For example, the discount rate; in Seville it is 50%, 40% in Madrid, 15% in Malaga. If the property is equipped with a solar system; construction, installation and labor tax is reduced up to 95%. Renewable energy businesses can benefit from business tax reductions up to 50% of the quota. There is a requirement for solar panels in new buildings. 30-70% of the hot water need is provided by solar energy (Shazmin et al., 2016; KPMG, 2015).

4.5. Fiscal Incentives for Renewable Energy in Japan

After two major oil crises of the 1970s, the Japanese government tried to diversify oil supply countries. Although Japan tries to diversify its oil supply countries and primary energy source, it provides a great portion of its oil supply from the Middle East. Countries such as Syria, Iraq, Qatar, and the United Arab Emirates, which are among their suppliers, are observed to be at high risk considering the geopolitical situations. In order to reduce this risk, oil exports from Asian countries such as China, and India are decreasing due to the increasing energy demands of these developing countries. This will make it difficult for Japan to get imported fuel cheaply in the future. Considering all these, it is critical for Japan to produce energy from local sources and reduce dependence on imported energy in order to ensure its own energy security. Nuclear energy comes to the fore in Japan's energy policies

in order to reduce dependence on fossil fuels. In the face of Japan's increasing energy needs, many nuclear power plants were opened in the country, which made it difficult to comply with the commitments of the Kyoto Convention, to which Japan is also a party. However, after the Fukushima nuclear accident, safety issues and sensitivity in nuclear power generation negatively affected the policies in this area. As a result, only three of the 42 nuclear power plants in the country were active in 2018. In line with all these developments, renewable energy has come to the fore as an alternative in the national energy supply. In addition, the fact that renewable energy is an alternative in solving environmental problems such as climate change and air pollution has made this energy gain importance in the national energy supply. Although Japan developed many national policies to spread renewable energy after the oil crises, it could not achieve the targeted level of success. Except for largescale hydropower generation, renewable energy accounts for only a small percentage of the total primary energy supply.

Following the Fukushima disaster (March 2011), Japan has prepared a concrete incentive program to meet its energy needs from renewable sources. In this context, the price of the tariff guarantee given for solar energy for electricity production is determined as 42 Yen (20 years for electricity produced by renewable energy facilities established in 2013). Renewable energy incentives implemented in Japan are outlined as tariff guarantee and green ITC (KPMG, 2016c). The tariff guarantee came into effect in July 2012 and was applied as 29.16 Japanese Yen / kW for the period between 1 July 2015 and 31 March 2016. Green investment tax incentive, on the other hand, is an incentive program offered for taxpayers who received approval for tariff guarantee and then supplied solar or wind power generation equipment and put them into operation within 1 year from the date of procurement. The taxpayer has the right to choose one of the following incentive mechanisms provided that the equipment is put into operation by the specified date: in addition to the normal depreciation rate, 30% special depreciation application, in the first year, 100% depreciation application for equipment used in wind energy production, and tax reduction that is implemented as 7% of equipment expenses for small and medium enterprises.

4.6. Fiscal Incentives for Renewable Energy in EU in General

The foundations of the European Union were laid in 1951 with the European Coal and

Steel Community, which was established between Belgium, Holland, Luxembourg, Germany, France and Italy to develop the coal and steel industry. The union, which was named the European Economic Community in 1957, took its present name in 1992 and became an economic and political organization. The European Union countries, whose capital is Brussels, use the common currency, the euro, except for a few members. The union, which has been expanding since its establishment, has finally become a large free movement zone with 27 members. The total population of 28 EU member countries, which was 513.5 million at the beginning of 2019, declined with the departure of the UK in 2020. The total population of the 27 EU member countries decreased to 447.7 million in 2020. The aim of the European Union is to create common policies not only in economic terms but also in the fields of agriculture, transportation, industry, military, political, and energy.

The EU has an important place in the world energy market. The EU, with member countries, ranks first in the world in energy imports and second in its consumption. Having to supply half of its primary energy consumption externally, the EU develops a common energy policy to ensure energy supply security. In this context, the European Coal Steel Community (1951) and the European Atomic Energy Community (1958) contracts can be evaluated to show that EU cooperation is directly related to energy. Following the 1970 oil crisis, changes in EU energy policies became inevitable, and the preparation of the "New Energy Policy Strategy" program emerged in this process. In the new process, the concerns and forecasts of reducing energy dependency, ensuring resource security, preventing climate change caused by energy production, and consumption and coping with the threat of abduction of the global technology market have been effective in the formation of both general and local renewable energy policies. In this process, the EU adopted the Community Strategy and Action Plan, called the "White Paper (Book)" in December 1997, and set concrete targets to promote renewable energy development. Three years later, in 2000, the EU adopted the European Strategy Plan for Energy Resource Security called "Green Paper (Book)." With this Plan, it is aimed to find solutions to the concern that the dependence on energy, which is around 50%, will reach 70% in the next 20-30 years if no action is taken (Altuntaşoğlu, 2005).

The basic renewable energy incentive policy of the EU is the Tariff Guarantee (TG) application, which differs considerably by country. TG, which has a wide range of applications in the EU, is seen by the EU Commission as the most effective and lowest cost

incentive mechanism (Connor et al. 2013). In TG application, electricity produced from renewable sources is guaranteed for a very long period (15-25 years) at a fixed price. The price is determined according to the kilowatt-hour of the electricity produced and generally differs according to the type of technology. In this sense, technologies with high investment and maintenance costs, such as solar, take a much higher guarantee compared to the wind. In successful TG models such as Germany, Spain, Denmark, the price is determined as close as possible to the production cost. In this way, investors are guaranteed against price fluctuations and purchase guarantee based on real project costs. As well as the "fixed model" that does not depend on market price, TG also has a "premium model" dependent on market price. The most preferred of these is the fixed price model and is actually used in many union member countries (such as Germany, Lithuania, Hungary, Bulgaria). The second option, the premium model, is usually implemented in two different ways. In Denmark, Spain, Estonia, and Slovenia, a fixed premium guarantee is provided, while in the Czech Republic, a premium guarantee is provided according to the project. In Spain, premiums vary by hourly market. According to the results of a study conducted by the European Wind Energy Association, the first option (fixed price guarantee) was much more effective in the EU-27 (TR 83, 2011).

Another incentive policy of the EU is the Renewable Portfolio Standard (RPS). "Today, there is a general consensus that RPS will be effective especially in attracting large pollutants to the renewable energy sector if it is applied together with other incentive policies" (Aguirre and Ibikunle, 2014:375). There is no Portfolio Standard in the EU yet. Despite initially being heavily supported by the EU Commission, German and Spanish experiences have prevented RPS from being dominantly implemented in Europe. The first country to adopt RPS within the Union was the Netherlands in 1998. In addition, it is seen that in some other countries (such as England, Belgium, and Poland), RPS is used as the main option (Berry and Jaccard, 2011). RPS is a quantity-based incentive policy. It obliges a certain percentage of energy to be produced from RES. In the RPS application, the price determination by the market causes uncertainty about future electricity prices for the producers. Therefore, in practice, lower and upper limits are placed on prices to compensate for losses generally caused by market mobility. Another negative aspect of RPS is that it does not allow price discrimination for different renewable energy technologies. While this encourages low-cost renewable energy technologies, it prevents the development

(commercialization) of high-cost technologies that are still in its early stages. In contrast, the most important feature of RPS is that it is simple to implement. Namely, certain targets/quotas are set for producers to generate a certain percentage of energy from RES. For that reason, there are renewable energy certificates. Since these certificates are also possible to trade, it is considered a kind of environmental loan (Tang et al. 2012). A certificate must be obtained for every unit of electricity produced from renewable energy sources. Manufacturers who fail to meet the renewable energy target have the opportunity to obtain a renewable energy certificate from other businesses. This application also provides an additional income to renewable energy producers (Pegels, 2010; Artigues and Rio, 2014; Carley, 2009; Abolhosseini and Heshmati, 2014).

The tender system used as an incentive mechanism for renewable energy is no longer preferred as the main policy instrument in any country in the EU. This application, which aims to increase the competitiveness of renewable energy, is especially suitable for largescale projects. In this way, the "National Electricity Administration" is committed to purchasing electricity for a certain period of time (10-25 years) from the winner of the tender. Since the tender awarded to the lowest bidder, this theoretically reduces the cost of the investment to society. However, in practice, very low bids for profitable power plants makes it difficult to run projects. Although the UK was the first country to implement the tender system under the Non-Fossil Fuel Necessity Program in 1991, it began to implement "quota requirement" in 2003 due to a large number of incomplete projects. Similarly, France gave up the tender system (excluding biomass) in 2000. A recent similar step was taken by Ireland. On the other hand, this method is still used in some countries to promote specific technologies (such as wind in Denmark and the Netherlands) (COM, 2005; Rio and Gual, 2004).

"Tax incentives (such as exemptions, discounts, low rates) have also been widely used across the EU, especially since the 2000s. The European Parliament is of the opinion that tax incentives are the most effective way of developing renewable energy" (Cansino et al. 2010: 6001). However, tax incentives are still used as a complementary policy tool across the Union. Attractive loans also play an important role in promoting renewable energy throughout the EU. This application, which contributes to the solution of the high capital cost problem, has been used effectively in Germany since the 1990s. Due to its advantages, such as minimizing the burden on the public budget and spreading the cost over time, it is

noted that although it is politically feasible, it has some undesirable consequences in combating with credit defaulters (Connor et al. 2013).

In the study by the EU Commission in 2013 regarding tax regulations as a tool of renewable energy incentives, the following topics are included related to tax exemption. Tax exemptions and reductions are used extensively in the energy sector. Tax incentives are often used to encourage household investments (e.g. roof systems) at the industry level and at the household level to promote biofuel production in the renewable energy industry. Tax exemptions are indirectly financed by all taxpayers due to reduced public revenues. Therefore, such arrangements are generally subject to the political and economic approaches that form the fiscal policy. In accordance with Directive 2003/96 / EC17, renewable energy tax incentives subject to state aid control are provided under certain conditions. In this framework, the directive enables tax exemption or reduction for biofuels as well as electricity generated from solar, wind, tidal, geothermal, and hydraulic sources. In some countries, the sector is also encouraged with reduced taxes on electric and hybrid vehicles (EC, 2013). Various tax incentives are applied in all member states. In this sense, the most common tax incentives are; reduced income and corporate tax, accelerated depreciation, R&D discount, application of reduced VAT rate, and property tax exemption. In addition, in some countries, renewable energy wastes are encouraged by exempting from the energy/carbon tax. This idea was first developed by Alfred Marshall (1890), Pigou (1932), and Tullock (1967). “Finally, it was proposed by Pearce in 1991 to collect the type of tax proposed by Pigou to eliminate market failures caused by negative externalities, in other words, to reduce the negative costs of environmental pollution and taxation” (Cansino et al. 2010, 6005). In this context, some member countries of the Union levy energy tax on fossil fuel energy consumption. However, by excluding RES from this tax, the consumption of renewables is tried to be encouraged.

4.7. Fiscal Incentives for Renewable Energy in Turkey

Any developments in the field of energy inevitably makes it necessary to assess the situation in Turkey. The main reason for this is Turkey's dependence on foreign sources of energy up to 72%. In other words, about three quarters of the energy used belongs to other countries. As a result, every possible problematic situation that may occur outside brings into question the status of our current domestic resources, to what extent they are properly evaluated and to what extent they are prepared for possible troubled times (Yazar, 2010). Here, it would not be wrong to say that the dependency of Turkey on foreign energy

resources can be expressed as the biggest constraint in arranging the energy policies of the country. For that reason, Turkey, to get rid of dependence on foreign resources in energy consumption, must develop a concrete, specific renewable energy policy. Because the increase in the prices of foreign resources and the fluctuations in exchange rates are generally against the economy of the country, and as a general rule, the result is boom in foreign trade deficit. To overcome problems like these and so forth, it is inevitable for Turkey to turn the tide towards RES. In addition, due to the advantages like reducing the negative environmental impacts, contributing to employment opportunities, etc. Turkey should take advantage of RES to a great extent (Gurbuz, 2009).

In order to encourage the use of renewable energy sources, Turkey continues to make arrangements. The law No. 5346 "Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electrical Energy" in 2005 was the first legislation on the subject in Turkey. In order to increase the share of renewable energy resources in energy consumption, Turkey is also implementing various incentives and fiscal support tools in line with world practice. The most important main incentive provided to renewable energy producers in our country is FIT. According to Law No. 6094, the said fixed prices depend on the type of source. These fixed-price guarantees may increase if renewable energy technologies are produced domestically. Apart from FIT, incentives for renewable energy in Turkey have less impact on renewable energy investments

It would not be wrong to say that fiscal incentives for renewable energy in Turkey are new in terms of historical processes and types of incentives. “Accompanied by the idea that Turkey cannot differentiate tax incentives for renewable energy resources sufficiently, stamp duty exemption was the only type of tax incentive applied in this area until 2012” (Sezer, 2012: 52). Similarly, it can be said that Turkey cannot create a tax incentive mechanism including property tax, special consumption tax, energy tax as in EU countries to increase the demand for RES (Eser and Polat, 2015).

Apart from FIT, fiscal incentives to promote renewable energy in general in Turkey as a whole can be summarized as follows (KPMG, 2016d: 68); *“Under the general investment incentive regime, exemption of value added tax for the purchase of investment equipment at home or abroad, ensuring customs duty exemption in importing investment equipment, exemption of other funds and additional charges (85% discount for power plants, which will be operational until 31.12.2020, for lease, easement and use for 10 years, including*

investment and operation periods), providing 50% discount to the transmission system usage fee, valid for 5 years from the operation date, exempting documents and transactions related to electrical power plants concluded during the investment period from stamp duty and other legal dues, to operate renewable energy-based electrical power plants and other similar investments in the specified capacity without any generation license."

On the other hand, a recent regulation on renewable sources-based electricity generation is related to generation of electricity of houses. In accordance with the Law No. 7103 "Amending Tax Laws and Certain Laws and Decree Laws", electricity generation based on renewable energy sources on the roofs and / or facades of houses is encouraged. According to the article 3 of this Law, those who sell the surplus of electricity that installed on the roofs and/or facades of the houses they own or rented up to a maximum of 10 Kw (including 10 kW) (including those established by the flat owners to meet the common electrical energy need of the main real estate) produced only from a generation facility, to the last source supplier company, have been exempted from income tax since 28/03/2018. In addition, with the provisional article 4/1-b of the Law No. 6446, the transactions regarding the generation facilities during the investment period of the electricity generation facilities that will be commissioned for the first time until the date of 31.12.2020 are exempted from the fee, and the issued papers are exempted from stamp duty tax. In accordance with the Stamp Duty Law General Communiqué (Serial No. 62), in 2018, 9.48 per thousand stamp tax is levied on wholesale and retail sales contracts in the electricity and natural gas sector.

5. CONCLUSION AND ASSESSMENT

Energy resources are classified according to their use and convertibility. They are divided into two as primary and secondary energy according to their convertibility. Primary energy sources are oil, coal, natural gas, nuclear, hydraulic, biomass, tidal wave, sun, and wind. After primary energy conversion, the energy obtained is known as secondary energy. Electricity, gasoline, diesel oil, air-gas, and liquefied petroleum, etc. are included in this type of energy. Another common classification is according to their use. Here, energy sources are divided into two as renewable and non-renewable. This classification is used in this study. Non-renewable energy resources constitute fossil fuels and nuclear energy. Non-renewable energy resources still remain as an essential energy source all around the world. Since the oil crisis, the problem of supply security in energy has become one of the priority policy issues of all countries. "Considering the ever-increasing global energy demand, meeting the energy needs safely remains critical importance for all countries. 78.4% of global energy consumption is covered by fossil fuels, 2.3% comes from nuclear energy, and 19.3% comes from renewable energy sources" (REN 21-Renewables, 2017: 30). It is not sustainable to meet the increasing energy demand from imported fossil fuels. Also being dependent on fossil fuels is not only fiscally costly but also has serious environmental consequences.

The problem of fossil reserves being exhausted in a certain future, as well as environmental problems that occur during the production-consumption stages, make it imperative for societies to focus on cleaner, natural, and sustainable energy resources. When meeting the increasing energy need, it becomes critical to save the environment where the energy needs can be met in a livable world for future generations. To this end, RES becomes inevitable within the framework of alternative energy policies that have been brought to the agenda worldwide. "In 2008, the European Union announced 20% renewable energy target for 2020, and then rose the target to 100% renewable energy for the year 2050 at the Copenhagen Climate Conference in 2009, these happenings also lead renewable energy to attract the attention of the whole world" (Zhang et al., 2012:241; Schleicher, 2012:64-65). At this point, the share of renewable energy is constantly increasing in world energy production. Renewable Energy's contribution to global final energy production increased from 8.5% in 2013 to 19.1% in 2014. This also means saving 1.3 gigatons of carbon dioxide (BNEF, 2015).

It is a fact that as the use of renewable energy becomes widespread, the import of energy from fossil fuel producers that are still dominant in the world will decrease. This means a significant amount of foreign exchange savings for all energy-dependent countries. Therefore, as renewable energy becomes widespread, the current account deficit, which is the problem of energy-dependent foreign countries will decrease. On the other hand, environmental scientists are in full agreement that fossil fuel use causes climate change and must be reduced. Also, as known, the proliferation of renewable energy reduces the harmful effects of fossil fuels on the climate. Fossil fuel use also threatens energy supply security. Therefore, in order to combat climate change and ensure supply security, the use of renewable resources is inevitable. For this purpose, policies towards increasing the use of renewable energy resources have accelerated all over the world (Belhamadia et al. 2014; Linscott, 2011; Sherlock, 2014). "Despite all these economic and environmental advantages, renewable energy share in primary energy supply still remains low. Subsidies to pollutant fossil fuels are in great demand almost all around the world due to renewable energy still maintains its disadvantageous status against fossil fuels" (Holburn, 2012:654; Dong, 2012:476). In such an environment, renewable energy needs serious public support in order to increase its competitiveness against fossil fuel resources. In the first phase of energy production from renewable sources, the cost can be high due to the new technologies in this field. Depending on the cost structure, renewable energy must be supported by some incentives to compete with energy production from non-renewable sources.

Countries have implemented various fiscal, monetary, credit, and foreign trade policies within their economic systems in order to ensure their social and economic development and increase their competitiveness in the international arena. Incentives within these policies are used at various levels in all countries as a tool of policy. In this context, incentives are applied over public expenditures and public revenues, which are the instruments of fiscal policy, consistent with its aims, such as accelerating development and realizing full employment. Incentives are defined as fiscal and/or non-fiscal support or assistance provided by the state through various methods to ensure that a particular sector and / or region develop more and more rapidly than others. Incentive tools basically have two purposes. First, to increase the funds to be invested by the private sector by reducing the costs; and the second, to canalize resources to areas that are considered to be beneficial for the country's economy in order to increase efficient economic activities. However, it should be emphasized here that; whether or not incentives will increase the private sector investment volume depends on the extent to

which entrepreneurs will direct their savings to investments. In this context, the main renewable energy incentives are; fixed price guarantee, premium guarantee, mandatory quota and green certificate applications, various tax incentives, and investment loans. Among these incentives, fixed price guarantee and premium guarantee are applied over public expenditures, while tax incentives are applied over public revenues. Mandatory quota and green certificate applications are regulatory policies. Therefore incentives provided by the state for renewable energy may be categorized as fiscal policy tools and this brings to the agenda that the government's role on renewable energy is of critical importance. In this context, the aim of this study is to highlight the importance of government's role on renewable energy performance of the country by handling the issue in terms of countries making significant progress in increasing renewable energy production such as Germany, USA, China, Japan, Spain and EU in general.

Fiscal incentives can have some positive effects on economic development, national income, social welfare, and the environment, albeit in different qualities. In this context, it is stated that "the growth in renewable energy in recent years has been achieved through government-sponsored programs through subsidies, tax credits and other incentives" (Bhattacharya et al. 2016: 734). The number of countries that support renewable energy investments is increasing rapidly. While the number of countries promoting renewable energy in various ways was 15 in 2005, this number increased by 9 times in 2015 and reached 145. (Johnstone et al. 2008; Aguirre and Ibikunle, 2014). In order to ensure the sustainability and security of energy policies, various incentives and supports in different dimensions are provided by the countries for the production of energy from renewable sources. These incentives and supports can be summarized as follows (Steenblik, 2007: 24; Çelebi & Uğur, 2015: 27); *"Supporting products used in renewable energy production, encouraging labor, capital and natural resources in terms of production factors, support of manufactured products with tax deductions or tax exemptions, supporting the produced products with market prices, supporting the produced products within the scope of storage and distribution infrastructures, supporting the stage of consuming products, providing incentives for vehicles using products."*

On the one hand, these incentives play an important role in directing energy investments on the basis of resources, and on the other hand, financing opportunities of companies are also determinant in this regard. In this study, fiscal incentives applied to

renewable energy investments are presented in light of sample country practices. Many studies show that fiscal incentives are very effective in lowering the initial costs of renewable energy technologies and accelerating access to the energy market (Kemp, 2009; Zhao et al., 2013). Fiscal incentives are accepted as a supplementary policy tool in the literature which are highly effective. Therefore, fiscal incentives are very important in the initial phase of the renewable energy sector. However, since fiscal incentives are financed from the public budget, it is beneficial to gradually reduce them as the industry matures so that the burden is not met by the society in the medium-long term (Clement et al. 2005).

In light of sample country practices, it would not be wrong to say that governments are trying to encourage renewable energy production and use through mechanisms such as feed-in tariff mechanism, renewable portfolio standards, mandatory quotas, energy taxes, environmental, real estate, and value-added tax exemptions and accelerated depreciation practices in addition to carbon tax implementations. Apart from other incentive mechanisms, carbon tax implementation has a distinct characteristic that provides governments not only to support renewable energy but also to deter from fossil fuel consumption and production. Therefore implementations like carbon tax can be used as a dissuasive policy tool. In addition, tax advantages provided for hybrid vehicles and tools consuming less energy can be categorized as tax incentives, so fiscal incentives for renewable energy. As can be seen from the sample countries discussed, renewable energy incentives can be applied in various ways and areas that can be versatile and target different audiences. In this context, as a different way of application, it is possible for businesses in the USA to use tax credits they earn from renewable energy investments as well as to sell them to other businesses. In Europe, renewable energy is mostly encouraged by long-term and low-cost loans. In China, which has made the most investments in this field in recent years, as mentioned earlier, renewable energy is promoted by tax incentives such as corporate tax, VAT refund, and vehicle purchase tax, and projects related to energy efficiency are supported by the government.

Turkey is not rich in terms of fossil energy reserves. The country is highly dependent on foreign energy and has to meet three quarters of its energy needs through imports. The increase in energy consumption with each passing day increases the country's foreign dependency through imports. Almost all of the imported energy is oil, natural gas and coal, which are primary energy sources. These resources are imported from many countries. These

import dependence structure makes Turkey's current account deficit problem chronic. Energy imports have a determining role in the formation of the current account deficit. In addition to energy resources, we are also dependent on foreign sources in terms of equipment used in energy production. The country mostly produces and exports low technology products and imports medium and high technology products. Generating energy through domestic resources and domestic equipment will reduce the pressure on the current account deficit and benefit the country's economy. There are limited options for controlling import dependency in energy in the context of our country. One option is mainly supply opportunity focused on the functionalization of renewable energy sources and efficient energy use. Resource diversification can be provided by giving priority to renewable resources and domestic equipments produced and used with environmentally friendly and efficient technologies.

Turkey has a high potential for renewable energy resources, notably in solar, wind, and geothermal. Despite its good solar, and wind potential, the country's total installed solar and wind capacities are small to date, but generation is growing. This means the country, especially in solar and wind energy has been able to canalize a relatively low amount of renewable energy potential to production. This is well below the high renewable energy potential of the country. In Turkey, canalizing renewable energy resources to energy production is supported under the Electricity Market Law No. 6446, Law No. 5346, the Use of Renewable Energy Resources for the Purpose of Generating Electricity, and the General Investment Incentive Regime. The first regulation in renewable energy incentives was made within the framework of the Electricity Market Law No:4628 dated 20.02.2001. With this law, natural and legal persons having micro-cogeneration facilities based on renewable energy sources and on a non-discriminatory basis facilities with a maximum power of five hundred kilowatts are exempted from obligations to obtain licenses and establish companies. Moreover, with the arrangements made in this regard, TEİAŞ obliges to give priority to renewable energy plants to connect to the grid. Then on 10.05.2005, within the scope of the Law No. 5346, the Use of Renewable Energy Sources for the Purpose of Generating Electricity, tariff guarantee was provided for the generation of renewable energy.

The most important and attractive guarantee provided to promote renewable energy in Turkey is feed-in tariff mechanism. "Tariff guarantee mechanism has a wide range of applications in the EU and is accepted by the EU Commission as the most effective and low-

cost incentive" (Connor et al., 2013: 8). In Turkey up to 2010, feed-in tariff rates were relatively low, and the same for each kind of source. The tariffs updated in 2010 were differentiated according to the renewable energy type, and additional incentives were introduced for production using domestic technology. Tariff guarantees are paid for the first 10 years of projects, additional premium payments for domestic technologies are paid only for the first 5 years of the project. As mentioned earlier, the machinery and equipment used for energy production in Turkey are imported to a great extent. Within the framework of the tariff guarantee provided for renewable energy, it is aimed to develop domestic technologies with additional premium payments. However, since these incentives are given in a shorter period and at a lower rate than other applications abroad, it will decrease the attractiveness of the investments, causing to increase utilization period and rate. Introducing additional mechanisms such as tax grants will provide a more suitable basis for investments. For this purpose, after 2010, when tariff amounts were increased, renewable energy investments started to attract more attention from both national and international investors. Although the FIT mechanism can be assessed as an attractive policy tool, it can not be sufficient to reach the target based on increasing the share of renewable energy in total energy supply by itself. At this point, subsidiary fiscal support mechanisms like green certificates, renewable portfolio standards, carbon tax, tax credits, etc. play a critical role.

There is not a distinct tax incentive policy relevant to renewable energy in Turkey. A special regulation for renewable energy is to exclude 2% of biodiesel/bioethanol mixed with gasoline/diesel from special consumption tax. Other fiscal incentives seen in the countries compared (investment / production tax incentives, sales / energy / CO2 / VAT, and other taxes reduction and energy production payment) have not been implemented in Turkey yet. Although there is not a specific tax incentive policy applied in the field of renewable energy in Turkey, renewable energy investments, like other investments, can take advantage of general/regional tax incentives and, as mentioned above to exclude %2 of biodiesel/bioethanol mixed with gasoline/diesel from special consumption tax. Within the scope of the "General Investment Incentive Regime," supports are also provided to RES such as VAT exemption in purchasing (or importing) investment equipment, customs exemption in importing investment equipment, exemption from income tax withholding and other funds and additional fees. However, regardless of the renewable energy potential of the region, the incentives given within this framework is limited to the regions defined in the legislation.

Providing tax advantages specific to renewable energy will reduce the high initial cost of renewable energy investments. Given that a significant portion of the electricity produced in Turkey is met by imported sources, the contribution of tax advantages of renewable energy to the economy may be many times more than tax loss (tax expenditure). On the other hand, compared to fossil fuel sources, the positive effect of renewable energy on the climate and nature is priceless. Absolutely it should not be forgotten that the continuity of RES depends on the behavior of mankind and is not unlimited and endless. Increasing energy demand in recent years, dependency on foreign resources, and the fragility require Turkey to focus especially on the design of an energy policy based on domestic and renewable energy sources. As mentioned above, Turkey's import-dependent energy structure leads to higher deficit rates in the energy component of the current account deficit. Taking altogether high current account deficit due to energy imports with high dependency ratios of energy imports from Russia, Iraq, and Iran brought energy management to the agenda as a critical policy priority. The relationship between energy imports, energy deficit, and current account deficit has revealed the need to encourage domestic and renewable energy investments within the framework of its diversification and security as main objectives. There is a big role for the Turkish goverment in utilizing the RES in Turkey. In this context, the utilization period of feed-in tariff mechanism may be extended as in sample countries covering 15-20 years period, and bringing to the agenda of fiscal incentives as investment and production tax credit, and other tax credits applied in sample countries may be useful in Turkey in the field of renewable energy. For instance, carbon tax or carbon market implementation may be a disadvantage for fossil fuels, but at the same time provides an advantage for energy efficiency and renewable energy sources. In addition, special regulations are not included in the Corporate Tax Law regarding companies operating in the electricity market. In this context, there are no special regulations such as corporate tax exemption, or a specific exception regarding to earnings provided to legal entities operating in the electricity sector. The earnings of the companies operating in the electricity sector are subject to Corporate Tax at a general rate. In this context, providing specific tax incentive regarding to Corporate Tax for renewable energy may have a positive effect on decreasing the energy generation from renewable sources-based generation facilities.

In essence; considering the supports applied in the field of renewable energy in Turkey, the Ministry of Economy provides general incentives for all kinds of electricity generation investments only during the investment period. In this framework, renewable energy and

old-dated natural gas cycle power plant investments are supported within the scope of the general incentive system. The support consists of VAT exemption, customs duty exemption, income tax withholding, and stamp duty exemption. During the operational period, renewable energy investments are supported through purchase guarantees and tariffs. Although these incentive mechanisms have a positive affect to drive renewable energy investments, more fiscal tools can be used in the operational period of renewable energy investments. Here it is important to say that, when regulating fiscal supports to be given to energy production from renewables, the potential of the regions in terms of renewable energy resources should not be ignored. Considering the renewable energy potential of regions may be useful to decrease the burden of supports on the public budget. Also, it should be borne in mind that, implementing fiscal incentive mechanisms, the tool distrupting the market structure the least should be chosen as a fiscal policy mechanism. Although, in common the most attractive fiscal policy for encouaring renewable energy investments is feed-in tariff mechanism, other fiscal support mechanisms will have a positive affect on renewable energy so the nature, energy supply security as well.

REFERENCES

- Abolhosseini S, Heshmati A. (2014). The Main Support Mechanisms to Finance Renewable Energy Development, *IZA Discussion Paper No. 8182*, May.

- Acaroğlu M. (2003). Alternatif Enerji Kaynakları, Atlas Yayın Dağıtım, İstanbul.
- Aguirre M, Ibikunle G. (2014). Determinants of Renewable Energy Growth: A Global Sample Analysis. *Energy Policy*, 69, 374-384.
- Aldy JE. (2012). A Preliminary Review of the American Recovery and Reinvestment Act's Clean Energy Package, *Discussion Paper*, January.
- Altuntaşoğlu ZT. (2005). Yenilenebilir Enerji Avrupa Birliği ve Türkiye Müktesebatı. *TBMM Türkiye 5. Enerji Sempozyumu*, Ankara, 249-261.
- Anna P. (2010). Renewable Energy in South Africa: Potentials, Barriers and Options for Support, *Energy Policy*, 38: 4945–4954.
- Arık A. (2016). Yenilenebilir Enerji Politikalarının Sürdürülebilirliği: AB Ülkeleri ve Türkiye Açısından Bir Değerlendirme. Unpublished Dissertation Thesis. Ordu University. Institute of Science. Ordu.
- Artigues P, Pablo DR. (2014). Combining Tariffs, Investment Subsidies and Soft Loans in Arenewable Electricity Deployment Policy, *Energy Policy*, 69, 430–442.
- Aslani A, Naaranoja M, Wong KV. (2013). Strategic Analysis of Diffusion of Renewable Energy in the Nordic Countries, *Renewable and Sustainable Energy Reviews*, No.22.
- Bailie A, Deyette J, Clemmer S, Cleetus R, Sattler S. (2016). Capitalizing on the Clean Power Plan and renewable energy tax credits. *The Electricity Journal*, 29(6), 15–21. Retrieved from https://doi.org/10.1016/j.tej.2016.07.001.
- Baños R, Manzano AF, Montoya F, Gil C, Alcayde A, Gómez J. (2011). Optimization methods applied to renewable and sustainable energy: A review. *Renewable and Sustainable Energy Reviews, 15*, 1753–1766.
- Batı O. (2013). Türkiye'de Sürdürülebilir Kalkınma ve Yenilenebilir Enerji Kaynakları. Unpublished Doctoral Dissertation. Marmara University. Institute of Social Sciences. Department of Economics. International Economics. İstanbul.
- Bayraktar Y, Kaya Hİ. (2016). Yenilenebilir enerji politikaları ve rüzgâr enerjisi açısından bir karşılaştırma: Çin, Almanya ve Türkiye Örneği. *Journal of International Economic Researches*. 2 (4), 1-18.

Belhamadia A, Muhamad M, Mahmoud AY. (2014). A Study on Wind and Solar Energy Potentials in Malaysia. *International Journal of Renewable Energy Research*, 4 (4): 1042-1048.

Berry T, Jaccard M. (2011). The Renewable Portfolio Standard: Design Considerations and an Implementation Survey. *Energy Policy*, 29: 263277.

- Bhattacharya M, Paramati SR, Ozturk I, Bhattacharya S. (2016). The effect of renewable energy consumption on economic growth: Evidence from top 38 countries. *Applied Energy*, 162, 733–741. Retrieved from https://doi.org/10.1016/j.apenergy.2015.10.104. 14 May 2018.
- Bloomberg New Energy Finace (BNEF). (2015). *Global Trends in Renewable Energy Investment 2015*, http://www.fs-unep-centre.org. 14 May 2018.
- BP Statistical Review of World Energy (2019). https://www.bp.com/en/global/corporate/energy-economics/statistical-review-ofworld-energy.html. 13 September 2019.
- BP Statistical Review of World Energy (2020). https://www.bp.com/en/global/corporate/news-and-insights/press-releases/bpstatistical-review-of-world-energy-2020-published.html. 25 August 2020. 13 Sep 2020.
- Brown P. (2013). European Union Wind and Solar Electricity Policies: Overview and Considerations, CRS Report for Congress, https://www.fas.org/sgp/crs/row/R43176.pdf. 08 Sep 2016.
- Burzacchini A, Erdmenger C. (1999). The Environmental Management System ecoBudget - A model of environmental budgeting, Local loops How environmental management cycles contribute to local sustainability, Editted by: Erdmenger et al., Freiburg.
- Byrne J, Kurdgelashvili L, Mathai MV, Kumar A, Yu J, Zhang X, Tian J, Rickerson W, Gowinda RT. (2010). *World Solar Energy Review: Technology, Markets and Policies.* Technical Report.

- Cansino JM, Pablo RM, Rocı´o R, Rocı´o Y. (2010). Tax Incentives to Promote Green Electricity: An Overview of EU-27 Countries, *Energy Policy* 38: 6000–6008.
- Carley S. (2009). State Renewable Energy Electricity Policies: An Empirical Evaluation of Effectiveness, *Energy Policy*, 37: 3071–3081.

  Çelebi AK, Uğur A. (2015). Biyoyakıtlara yönelik mali teşvikler: Türkiye açısından bir değerlendirme. *Hacettepe Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 33* (2), 25-45.

  Çelikkaya A. (2017). Avrupa Birliği Üyesi Ülkelerde Yenilenebilir Enerjiye Sağlanan Teşvikler Üzerine Bir İnceleme. *Sayıştay Dergisi, 104, Ocak-Mart/2017*.
- Çepik B. (2015). Sürdürülebilir Kalkınma Çerçevesinde Türkiye'de Yenilenebilir Enerji Politikaları, Unpublished Doctoral Thesis, Maltepe University, Institute of Social Sciences, Department of Economics, İstanbul.
- China Institute, (2016). *China's renewable energy & Clean-Tech Market*, Summary Report, (March), University of Alberta, Retrieved from www.china.alberta.ca. 08 May 2016.
- Clement D, Lehman M, Hamrin J, Wiser R. (2005). International Tax Incentives for Renewable Energy: Lessons for Public Policy, Draft Report, Center for Resource Solutions, San Francisco, California, June 17.
- Commission of the European Communities (COM) (2005). The Support of Electricity from Renewable Energy Sources, Brussels.
- Connor P, Luuk B, Karin E, Christiane E. (2013). Devising Renewable Heat Policy: Overview of Support Options, *Energy Policy*, 59: 3-16.
- Crago CL, Chernyakhovskiy I. (2014). Solar PV Technology Adoption in the United States: An empirical investigation of state policy efectiveness. Agricultural & Applied Economics Association's, *2014 AAEA Annual Meeting*, Minneapolis, MN, (July 27-29).
- Dang T. (2009). Introduction, History and Theory of Wind Power, *41st North American Power Symposium*, Stockville, 1-6.
- Dawn S, Tiwari KP, Goswari AK, Singh AK, Panda R. (2019). Wind Power: Existing

Status, Achievements and Government's Inititative towards Renewable Power Dominating India, *Energy Strategy Reviews*, 23, 178-199.

- Deloitte, (2010). New Life for Renewable Energy Resources: Renewable Energy Policies and Expectations, The Energy and Natural Resources Industry.
- Demirdizen H. (2013). Market Development of Renewable Energy in Turkey, Graduate School of Natural and Applied Sciences, Department of Civil Engineering, Dissertation Thesis, Ankara: METU.
- Dincer I. (2001). Environmental Issues: II- Potential Solutions. *Energy Sources*. 23(1):83–92.

Directive 2003/54/EC of the European Council (EC) (2003). https://eurlex.europa.eu/legal content/EN/TXT/HTML/?uri=CELEX:32003L0054&from=EN. 23 Aug 2019.

Dong CG. (2012). Feed-in Tariffs, Renewable Portfolio Standard: An Empirical test of their Relative Effectiveness in Promoting Wind Capacity Development. *Energy Policy*, 42, 476-485.

- EcoBudget Ratification Report (2003). Budget Balance Booklet, Director of Planning & Environmental Services, Lewes District Council.
- Edenhofer O. (2012). Policy Financing and Implementation. In: O. Edenhofer, RP. Madruga, Y. Sokona, K. Seyboth, P. Matschoss, S. Kadner, T. Zwickel, P. Eickemeier, G. Hansen, S. Schlömer, C. Stechov (eds). *Renewable Energy Sources and Climate Change Mitigation.* 1st edition. Cambridge, Cambridge University Press, 865-950.
- Elektrik Üretim Anonim Şirketi (EÜAŞ). (2018). Annual Report. https://www.euas.gov.tr/tr-TR/yillik-raporlar. 24 August 2020.
- Eser LY, Polat S. (2015). Elektrik Üretiminde Yenilenebilir Enerji Kaynaklarının Kullanımına Yönelik Teşvikler: Türkiye ve İskandinav Ülkeleri Uygulamaları. *Gümüşhane Üniversitesi Sosyal Bilimler Elektronik Dergisi,* 12, 201-225.
- European Circular (2003). Newsletter for ICLEI members, partners and friends, Issue 18, autumn 2003, http://www.iclei-

europe.org/fileadmin/templates/icleieurope/files/content/ICLEI_IS/Circular/EC_18.pdf . 01 Sep 2015.

- European Comission (2013). Comission Staff Working Document European Commission Guidance For The Design Of Renewables Support Schemes, Retrieved from https://ec.europa.eu/energy/sites /ener/files/documents/com_2013_public_intervention_swd04_en.pdf-18.02.2017.
- Eurostat, (2017). Renewable Energy in the EU, http://ec.europa.eu/eurostat. 14 March 2017.
- EÜAŞ (2018). Annual Report, Retrieved from https://www.euas.gov.tr/tr-TR/yillikraporlar, 09 Dec 2019.
- Galen B. (2016). U.S. Renewables Portfolio Standards 2016 Annual Status Report, by the National Electricity Delivery Division of the Office of Electricity Delivery and Energy Reliability of the U.S. Department of Energy.

Galtung J. (1982). *Environment, Development and Military Activity. Towards Alternative Security Doctrines.* 1st ed. Norwegian University Press, 99.

- Gaupp D. (2007). Turkey's New Law on Renewable Energy Sources within the Context of the Accession Negotiations with the EU. *German Law Journal*, 8, 413–416.
- General Directorate of Energy Affairs (EİGM). Retrieved from http://www.eigm.gov.tr/tr-TR/Denge-Tablolari/Denge-Tablolari. 30 Oct 2019.
- General Directorate of Petroleum Affairs (2017). Orta Dönemli Petrol ve Doğal Gaz Arz-Talep Projeksiyonu, Retrieved from http://www.mapeg.gov.tr/petrol/orta%20d%C3%B6nemli%20arz%20talep%20projeksiyon/Orta_Donemli_Petrol_ve_Gaz_Arz-Talep_Projeksiyonu.pdf. 14 Nov 2019.
- Giray F, Koban E, Gerçek A. (1998). *Avrupa Birliği ve Türkiye'de Yatırımlara ve İhracata Yönelik Vergi Teşvikleri ve Karşılaştırmalı Değerlendirilmesi*, Minerva Ofset, Bursa.
- Giray F. (2016). *Vergi Teşvik Sistemi ve Uygulamaları*, Yenilenmiş 3. Baskı, Ekin Yayınevi, Bursa.
- Gözen M. (2014). Renewable Energy Support Mechanism in Turkey: Financial Analysis and Recommendations to Policymakers, *International Journal of Energy Economics and Policy*, 4: 274-287.
- Güzel S. (2015). Avrupa Birliği ve Türkiye'de Kobilere Yönelik Ar-Ge Teşvikleri: Bursa Uygulaması, Unpublished Doctoral Thesis, Uludağ Üniversitesi Sosyal Bilimler Enstitüsü, Bursa.
- Hall DO, Scrase JI. (1998). Will Biomass be the Environmentally Friendly Fuel of the Future? *Biomass Bioenergy,* 1998;15 (4/5):357–67.
- Hausking. (2017). Tax Incentives For Cleantech Businesses. www.hausking.com. 24 March 2017.
- Hemant S, Jasvir S. (2013). Run off River Plant: Status and Prospects, *International Journal of Innovative Techonology and Exploring Engineering*, 3, 2278-3075.
- Holburn GL. (2012). Assessing and Managing Regulatory Risk in Renewable Energy: Contrasts Between Canada and the United States. *Energy Policy*, 45, 654-665.
- International Energy Agency (IEA). (2015). Energy Policies of IEA Countries, Spain, 2015 Review, http://www.iea.org/t&c. 25 April 2016.

- International Energy Agency (IEA). (2016). Renewable Energy Medium Term Market Report. https://www.iea.org/reports/medium-term-renewable-energy-market-report2016. 03 May 2018.

  International Energy Agency (IEA). (2019). https://webstore.iea.org/energy-policies-ofiea-countries-united-kingdom-2019-review. 24 Aug 2020.
- International Renewable Energy Agency (IRENA), (2016). https://www.irena.org/publications/2016/Jul/Renewable-Energy-Statistics-2016. 01 Jan 2018.
- International Renewable Energy Agency (IRENA),(2019a). Retrieved from http://www.irena.org/solar. 28 Aug 2019.
- International Renewable Energy Agency (IRENA),(2019b). Retrieved from http://www.irena.org/wind 04 Sep 2019.
- International Renewable Energy Agency (IRENA),(2019c). Retrieved from https://www.irena.org/hydropower. 19 Sep 2019
- International Renewable Energy Agency (IRENA),(2019d). Retrieved from http://www.irena.org/bioenergy. 21 Sep 2019
- International Renewable Energy Agency (IRENA), (2019e). Retrieved from http://www.irena.org/ocean. 22 Sep 2019
- Johnstone N, Ivan H, David P. (2008). Renewable Energy Policies and Technological Innovation: Evidence Based on Patent Counts, National Bureau of Economic Research, Working Paper 13760, http://www.nber.org/papers/w13760. 26 June 2020.
- Jones EL. (2017). Renewable Energy Integration, Economic and Reliability Benefits of Solar Plants. 2nd edition, 351-372.
- Karaca C, Erdoğdu M. (2012). Türkiye'de Rüzgâr Çiftliklerinden Elektrik Üretilmesiyle Sağlanabilecek Çevresel ve Ekonomik Kazançlar. *Akdeniz İ.İ.B.F. Dergisi*, 12(23), 156188.
- Kaya MN, Aksoy MH, Köse F. (2017). Renewable Energy in Turkey: Potential, Current Status and Future Aspects. *International Journal of Engineering*, 1: 65-69.
- Kemp WH. (2009). *The Renewable Energy Handbook*. Aztext Press, Kanada.
- Kılıçer E. (2016). "Çevreye Duyarlı Bütçeleme", *Electronic Journal of Vocational Colleges*, 6 (2), 37-53.
- Koç A, Yağlı H, Koç Y, Uğurlu İ. (2018). Dünyada ve Türkiye'de Enerji Görünümünün Genel Değerlendirilmesi, *Engineer and Machinery*, 59, 692, 84-112.

- Koç E, Kaya K. (2015). “Enerji Kaynakları-Yenilenebilir Enerji Durumu”, *Engineer and Machinery*, 56(668), 36-47.

  KPMG (2017). Green Tax Index. https://kpmg-univ.adobecqms.net/content/dam/tax/en/pdfs/2017/2017-green-tax-index.pdf. 25 Aug 2020.
- KPMG. (2016a). Yenilenebilir Enerji: Dünya ve Türkiye Uygulamalarına Bakış. www.kpmg.com/tr/tr/sayfalar/kpmgyenilenebilir-enerji-vergi-tevsikarastirmasi.aspx. 03 May 2017.
- KPMG. (2016b). Yenilenebilir Enerjiye Yönelik Vergi Teşvikleri. https://home.kpmg/tr/tr/home/gorusler/2016/03/yenilenebilir-enerjiye-yonelik-vergive-tesvikler.html. 19 January 2019.
- KPMG. (2016c). Yenilenebilir Enerjiye Yönelik Vergi Teşvikleri. https://home.kpmg/tr/tr/home/gorusler/2016/03/yenilenebilir-enerjiye-yonelik-vergive-tesvikler.html. 19 January 2019.
- KPMG. 2016d. Yenilenebilir Enerjiye Yönelik Vergi Teşvikleri. https://home.kpmg/tr/tr/home/gorusler/2016/03/yenilenebilir-enerjiye-yonelik-vergive-tesvikler.html. 19 January 2019.
- Küçükali S, Baris K. (2011). Renewable Energy Policy in Turkey, *World Renewable Energy Congress*, Sweden.
- Linscott B. (2011). *Renewable Energy, A Common Sense Energy Plan*, Tate Publishing, USA.
- Lo K. (2014). A Critical Review of China’s Rapidly Developing Renewable Energy and Energy Efficiency Policies. *Renewable and Sustainable Energy Reviews,* 29, 508-516.
- Lodgaard S. (1992). Environmental Security, World Order, and Environmental Conflict Resolution. In: NP Gleditsch (ed). *Conflict and the Environment.* 1st ed. Dordrecht, Springer Publishing, 115-136.
- Maczulak AE. (2010). *Renewable Energy: Sources and Methods.* 1st ed. New York: Facts On File Publishing, 14.
- Magagna D, Uihlein A. (2015). Ocean Energy Development in Europe: Current Status and Future Perspectives. *International Journal of Marine Energy*, 11: 84-104.

- Gerard M, Soldevila OF, Dorrill J, Watkins EL. (2010). Renewable Energy Incentives in the United States and Spain: Different Paths –Same Destination?, *Journal of Energy & Natural Resources Law*, 28(4): 481-502.
- Maruyama Y, Nishikido M, Iida T. (2007). The Rise of Community Wind Power in Japan: Enhanced Acceptance through Social Innovation. *Energy Policy*, 35(5), 2761–2769. Retrieved from https://doi.org/10.1016/j.enpol.2006.12.010.

  Miles RW, Hynes KM, Forbes I. (2005). Photovoltaic Solar Cells: An Overview of State of the Art-Cell Development and Environmental Issues. *Progress in Crystal Growth and Characterization of Materials*, 51, 1-3.
- Mingyuan W. (2005). Government Incentives to Promote Renewable Energy in The United States. *Temple Journal Of SCI. Tech. & Envtl. Law*, XXIV, 355-366.
- Ministry of Energy and Natural Resources. (2019a). Wind. Retrieved from https://www.enerji.gov.tr/en-US/Pages/Wind. 23 Oct 2019.
- Ministry of Energy and Natural Resources. (2019b). Solar. Retrieved from https://www.enerji.gov.tr/en-US/Pages/Solar. 27 Oct 2019.
- Ministry of Energy and Natural Resources. (2019c). Geothermal. Retrieved from https://www.enerji.gov.tr/en-US/Pages/Geothermal. 27 Oct 2019.
- Ministry of Energy and Natural Resources. (2019d). Hydraulics. Retrieved from https://www.enerji.gov.tr/en-US/Pages/Hydraulics. 27 Oct 2019.
- Ministry of Energy and Natural Resources. Strategic Plan. www.enerji.gov.tr/trTR/Stratejik-Plan. 13 November 2018.
- National Renewable Energy Action Plan (NREAP). (2014). https://eigm.gov.tr/File/?path=ROOT%2F4%2FDocuments%2FEnerji%20Politikas%C4%B1%2FTurkiye_Ulusal_Yenilenebilir_Enerji_Eylem_Plani.pdf. 27 Nov 2019.
- Nixon P. (2007). Renewable Energy Tax Credits. www.nixonpeabody.com. 10 Sep 2013.
- Ocean Energy Europe. (2018). https://www.oceanenergy-europe.eu/wpcontent/uploads/2019/04/Ocean-Energy-Europe-Key-trends-and-statistics2018_web.pdf. 24 Aug 2020.
- Organization for Economic Cooperation and Develeopment (OECD). (2018). Renewable Energy. https://data.oecd.org/energy/renewable-energy.htm. 08 May 2018.
- Organization for Economic Cooperation and Development (OECD). (2012).

Environmental Performance Review of Germany www.oecd.org/env/countryreviews/germany. 10 June 2018.

- Panwar NR, Kaushik SC, Kothari S. (2011). Role of Renewable Energy Sources in Environmental Protection: a Review. *Renewable and Sustainable Energy Reviews*, 15, 1513–1524.
- Pegels A. (2010). Renewable Energy in South Africa: Potentials, Barriers and Options for Support, *Energy Policy*, 38: 4945–4954.

Pınar A. (2010). *Maliye Politikası*, 3. Baskı, Naturel Yayınları, Ankara.

- Ragheb M. (2011). Solar Thermal Power and Energy Storage; Historical Perspective. University of Illinois.
- Rathore NS, Panwar NL. (2007). *Renewable Energy Sources for Sustainable Development*. 1st ed. New India Publishing, 3.
- Renewable Energy Policy Network for the 21st Century (REN21) (2017). *Renewables 2017 Global Status Report*.
- Rio P, Miguel G. (2004). The Promotion of Green Electricity in Europe: Present and Future, *European Environment Eur. Env*, 14: 219–234.
- Ross ML. (2004). What Do We Know about Natural Resources and Civil War?, *Journal of Peace Research*, 41: 337–356.
- Shazmin SAA, Sipan I, Sapri M. (2016). Property Tax Assessment Incentives for Green Building: A Review, *Renewable and Sustainable Energy Reviews*, 60: 536-548.
- Schleicher TR. (2012). How Renewables will Change Electricity Markets in the next Five Years, *Energy Policy*, 48, 64-75.
- Scott SZ. (2014). Subsidizing Solar: The Case For An Environmental Goods and Services Carve-Out From the Global Subsidies. *UCLA Journal of Environmental Law and Policy*, 32(2), 422-484.
- Schubel PJ, Crossley RJ. (2012). Wind Turbine Blade Design, *Energies*, 5, 3425-3449.
- Selen U. (2011). *Maliye Politikası Aracı Olarak Teşvik Uygulamaları*, Ekin Yayınevi, Bursa.
- Selvi Ç. (2015). AB 2020 Stratejisi ve 2050 Vizyonu Bağlamında Belirlenen Yenilenebilir Enerji Hedeflerine Ulaşılabilirliğin Mali Açıdan Analiz Edilmesi. Unpublished Doctoral Thesis, Dokuz Eylül University, Institute of Social Sciences, Departmen of EU, İzmir.

- Sezer Y. (2012). Enerjide Yatırımcı ve Tüketici Fiyatlarının Vergi Boyutu. *14. Uluslararası Enerji Arenası,* 24-25 Eylül 2012, 1-62.
- Sherlock MF. (2015). The Renewable Electricity Production Tax Credit: In Brief, Congressional Research Service, www.crs.gov. 25 December 2017.
- Sherlock MF. (2011). Energy Tax Incentives: Measuring Value Across Different Types of Energy Resources, *Congressional Research Service*.
- Simms, D. (1977). Archimedes and the Burning Mirrors of Syracuse. *Techonology and Culture*, 18, (1), 1-24.

  Steenblik R. (2007). Subsidies: The distorted economics of biofuels. Joint Transport Research Centre, OECD, Discussion Paper No. 2007-3.
- Şen H, Sağbaş İ. (2015). *Vergi Teorisi ve Politikası*, Kalkan Offset, Ankara.
- Şen S. (2019). Incentives as a Fiscal Policy Tool in Renewable Energy Production: Experiences of a Number of Selected European Countries And Turkey. *Journal of Life Economics*, 4 (1), 59-76.
- Şimşek HA, Şimşek N. (2013). Recent Incentives for Renewable Energy in Turkey. *Energy Policy*, 63, 521-230. https://doi.org/10.1016/j.enpol.2013.08.036.
- Tang A, Nicolachiara JT. (2012). Financing Renewable Energy Infrastructure: Formulation, Pricing and Impact of A Carbon Revenue Bond, *Energy Policy*, 45, 691–703.
- T.C. Cumhurbaşkanlığı Strateji ve Bütçe Başkanlığı, (2019). Eleventh Development Plan (2019-2023).
- T.C. Ticaret Bakanlığı (Ministry of Trade). Ekonomik Görünüm 2020. https://ticaret.gov.tr/data/5e18288613b8761dccd355ce/Ekonomik%20G%C3%B6r%C3%BCn%C3%BCm%20Haziran%202020.pdf. 24 Aug 2020.
- Türkiye Elektrik İletim Anonim Şirketi (TEİAŞ). (2017). Annual Report. https://www.teias.gov.tr/tr-TR/faaliyet-raporlari. 24 August 2020.
- Tester JW, Elisabeth MD, Michael JD, Michael WG, William AP (2005). *Sustainable Energy: Choosing among Options.* 2nd ed. MIT Press.
- ThinkGeoEnergy. (2019). https://www.thinkgeoenergy.com/the-top-10-geothermalcountries-2018-based-on-installed-generation-capacity-mwe/. 24 August 2020.

- Topkaya SO. (2012), A Discussion on Recent Developments in Turkey's Emerging Solar Power Market, *Renewable and Sustainable Energy Reviews*, 16: 3754-3765.
- Toygar EM, İncesu Ö, Toygar A. (2018). New Design of Solarux CSP Greenhouse, Produces and Dries Agricultural Products in addition to Electricity Generation, *International Journal of Engineering Science and Application*,2 (1), 12-17.
- TR 83 Bölgesi Yenilenebilir Enerji Raporu (2011). http://www.ctso.org.tr/depodosya/b91e6d2481b7f475c6e80c3016e38ca5--bd-.pdf. 02 June 2018.
- Tükenmez M, Demireli E. (2012). Renewable Energy Policy in Turkey with the New Legal Regulations, *Renewable Energy*, 39: 1-9.

  Uluatam, E. (2010). Yenilenebilir Enerji Teşvikleri, *Ekonomik Forum*, http://www.tobb.org.tr/AvrupaBirligiDairesi/Dokumanlar/Raporlar/YenilenebilirEnerjiTesvikleri.pdf. 15 Sep 2016.
- Ulusoy A, Bayraktar Daştan C. (2018). Yenilenebilir Enerji Kaynaklarına Yönelik Vergisel Teşviklerin Değerlendirilmesi. *HAK-İŞ Uluslararası Emek ve Toplum Dergisi* Cilt: 7 Yıl: 7 Sayı:17 (2018/1).

  Retrieved from https://dergipark.org.tr/tr/download/article-file/458256
- US Department of Energy. Guide to the Federal ITC for Commercial Solar PV. https://www.energy.gov/sites/prod/files/2020/01/f70/Guide%20to%20the%20Federal%20Investment%20Tax%20Credit%20for%20Commercial%20Solar%20PV.pdf. 15 Sep 2017.
- US Energy Information Administration, (EIA). (2019a). Retrieved from https://www.eia.gov/energyexplained/?page=renewable_home. 23 Aug 2019.
- US Energy Information Administration, (EIA). (2019b). Retrieved from https://www.eia.gov/energyexplained/geothermal/use-of-geothermal-energy.php.

  19.09.2019.
- US Energy Information Administration (EIA). (2019c). Retrieved from https://www.eia.gov/energyexplained/biomass/ 21 Sep 2019.
- https://www.usgs.gov/.

- US Geological Survey. Hydroelectric Power Water Use. https://www.usgs.gov/specialtopic/water-science-school/science/hydroelectric-power-water-use?qtscience_center_objects=0#qt-science_center_objects. 25 August 2020.
- Ürün E, Soyu E. (2016). Türkiye' nin Enerji Üretiminde Yenilenebilir Enerji Kaynakları Üzerine Bir Değerlendirme. *Dumlupınar Üniversitesi Sosyal Bilimler Dergisi*, 31-45. Retrieved from https://dergipark.org.tr/tr/pub/dpusbe/issue/31354/345354.
- Vasseur M. (2016). Incentives or mandates? Determinants of the renewable energy policies of U.S. States, 1970-2012. *Social Problems*, 63, 284-301.
- Walsh KM. (2013). Renewable Energy Financial Incentives: Focusing On Federal Tax Credits and The Section 1603 Cash Grant: Barriers To Development, http://environs.law.ucdavis.edu/issues/36/2/walsh.pdf. 07 March 2014.
- World Bank. (2015). Turkey's Energy Transition; Milestones and Challenges. Retrieved from

http://documents.worldbank.org/curated/en/249831468189270397/pdf/ACS14951REVISED-Box393232B-PUBLIC-EnergyVeryFinalEN.pdf. 21 Oct 2019.

- Yang XJ, Hu H, Tan T, Li J. (2016). China's Renewable Energy Goals by 2050. *Environmental Development.* 20, 83–90. https://doi.org/10.1016/j.envdev.2016.10.001.
- Yazar Y. (2010). Türkiye'nin Enerjideki Durumu ve Geleceği, *SETA Analiz*, (31), ss.1-24.
- Yenilenebilir Enerji Kaynaklarının Elektrik Enerjisi Üretimi Amaçlı Kullanımına İlişkin Kanun (5346) (The Law on Using Renewable Energy Resources fort the Purpose of Generating Electricity). Official Gazette of the Republic of Turkey. No:25819, 18 May 2005.
- Yenilenebilir Enerji Kaynaklarının Elektrik Enerjisi Üretimi Amaçlı Kullanımına İlişkin Kanunda Değişiklik Yapılmasına Dair Kanun (6094). (The Amendment Law of The Law on Using Renewable Energy Resources fort the Purpose of Generating Electricity). Official Gazette of the Republic of Turkey. No:27809, 08 January 2011.
- Yılmaz O, Hotunluoğlu H. (2015). Yenilenebilir Enerjiye Yönelik Teşvikler ve Türkiye. *Adnan Menderes Üniversitesi, Sosyal Bilimler Enstitüsü Dergisi, 2*(2), 74-97.
- Yılmaz SA. (2014). Yeşil İşler ve Türkiye'nin Yenilenebilir Enerji Alanındaki Potansiyeli. *T.C. Kalkınma Bakanlığı Yayını*, Ankara, 2014.
- Zhao X, Luo D. (2017). Driving Force of Rising Renewable Energy in China: Environment, Regulation and Employment. *Renewable and Sustainable Energy Reviews*, 68, 48-56.
- Zhao Y, KamKi T, Lili W. (2013). Do Renewable Electricity Policies Promote Renewable Electricity Generation? Evidence From Panel Data. *Energy Policy*, 62, 887897.
- Zhang X, Liyin S. Sum YC. (2012). The Diffusion of Solar Energy Use in HK: What are the Barriers?, *Energy Policy*, 41, 241-249.