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EFFECTIVENESS OF INCENTIVE POLICIES IN RENEWABLE ENERGY: EU AND TURKISH CASE

Yenilenebilir Enerjide Teşvik Politikalarının Etkinliği: AB ve Türkiye Örneği

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ABSTRACT

Increasing industrialization, technological developments and urbanization, which are the most important drivers of economic growth require much more energy utilization. In order to ensure energy supply security and to mitigate the Greenhouse Gas (GHG) emissions, there has been a trend towards renewable energy sources in the world. Hence, many incentive instruments and subsidies are being started to be ensured by the states for the promotion of renewable energy, which is an important factor in terms of sustainable development and environmental transformation. European Union (EU) countries have so far consumed 80 % of the total amount of fossil fuel and have emitted 67.5 % of the total CO2 emissions globally. For this reason, EU countries have very ambitious renewable energy policies, since they want to be at the leading position in research, development, and consumption of renewables in the world. Turkey, which has a high dependence on imported energy sources, aims to increase the share of renewable sources in electricity generation to at least 30 % by 2023. In this study, based on the literature survey, the effectiveness of the incentive policies such as feed-in tariff, grants and subsidies, loans, taxes etc. in renewable energy deployment in EU and Turkey is examined. Among the others FITs, tax incentives, tradable green certificates, strategic planning, and R&D incentives are the most effective RE deployment mechanisms in RE sector. On the contrary, loans, subsidies, public policy supports, and quota found to be ineffective in stimulating the RE capacity.

Keywords: Bioenergy, Renewable Energy Policies in EU, Renewable Energy Policies in Turkey, Renewable Energy incentives.

ÖZET

Ekonomik büyümenin en önemli itici güçleri olan artan sanayileşme, teknolojik gelişmeler ve kentleşme çok daha fazla enerji kullanımına yol açmaktadır. Enerji arz güvenliğini sağlamak ve sera gazı emisyonlarını azaltmak için dünyada yenilenebilir enerji kaynaklarına doğru bir eğilim olmuştur. Bundan dolayı, sürdürülebilir kalkınma ve çevresel dönüşüm açısından önemli bir faktör olan yenilenebilir enerjinin teşviki için devletler tarafından birçok teşvik aracı ve sübvansiyon sağlanmaya başlanmıştır. Avrupa Birliği (AB) ülkeleri küresel düzeyde toplam fosil yakıtların %80'ini tüketmekte ve CO2 emisyonlarının %67,5'ini ise atmosfere salmaktadır. Bu bağlamda, AB ülkeleri yenilenebilir enerji araştırma, geliştirme ve tüketiminde dünya lideri olmak istemekte ve bunu gerçekleştirmek için oldukça iddialı politikalar uygulamaktadır. Enerjide dışa bağımlılık oranı çok yüksek olan Türkiye ise, 2023 yılına kadar elektrik üretiminde yenilenebilir kaynakların payını en az yüzde 30'a çıkarmayı hedeflemektedir. Bu çalışmada, AB ve Türkiye'de uygulanan sabit fiyat garantisi, hibeler ve sübvansiyonlar, krediler, vergi vb. yenilenebilir enerji politikalarının etkililiği literatür taramasına dayalı olarak araştırılmaktadır. Yenilenebilir enerjinin geliştirilmesinde, uygulanan teşvikler arasında sabit fiyat garantisi, hibe, vergi teşvikleri, ticarete konu olan yeşil sertifikalar, stratejik planlama ve AR&GE teşviklerinin en etkili teşvik mekanizmaları olarak öne çıkmaktadır. Ancak krediler, sübvansiyonlar, kamu politikası destekleri ve kotaların yenilenebilir enerji kapasitesini teşvik etmede etkisiz oldukları bulunmuştur.

Anahtar Kelimeler: Biyoenerji, AB'de Yenilenebilir Enerji Politikaları, Türkiye'de Yenilenebilir Enerji Politikaları, Yenilenebilir Enerji teşvikleri.

1. INTRODUCTION

Energy has vital role in economic development and demand for energy sources are continuously increasing in the world. According to 1990-2008 IEA data, the world population increased by 27%, while average energy usage per capita increased by 10%. Regional energy utilization rate also grew: Middle East 170%, United States 20%, Africa 70%, Latin America% 66, China 146%, India 91%, EU-27 bloc increased 7% and World overall grew 39%. In this projection, meeting the energy demand has become a key security issue in the world due to two reasons. First, because of scarcity of fossil fuel resources and the fluctuation of the prices that causes hitches in short-term and medium-term production and budget plans; second, environmental problems that increase in the long term due to the consumption of fossil fuels and its relative return to diseconomies. Due to energy security problems, limits of world's fossil energy reserves, catastrophic nuclear power accidents and increasing Greenhouse Gas (GHG) emissions, renewable energy (hereafter RE) has become alternative to replace conventional fossil energy systems in the world. RE sources are considered alternative to mitigate environmental degradation and to ensure sustainable economic development. In this context, many countries designed policies to promote RE in their energy mix. REN21 (2020) reports that, more than 160 countries have important RE targets and new RE investment is around 301,7 billion USD by 2020. As a result of RE incentive policies, the share of RE in word energy supply increased significantly in the world. The International Renewable Energy Agency (2020) [1] has revealed that renewables will provide the majority of global energy at an impressive 86% by 2050 from 24% in 2016.

RE is strategically important for both the EU and Turkey as well. While the EU is the largest energy importer in the world and the second largest energy consumer after the USA, Turkey is a country whose energy consumption is increasing with its growing and developing industry day by day. Although the EU and Turkey are among the regions with the highest energy consumption in the world, they are dependent on foreign sources due to insufficient energy resources. While Europe imports 54% of the energy it consumes, this figure is around 75% in Turkey, and this dependency increases with each passing year due to the increasing demand for energy. Foreign dependency in energy consumption has increased the importance given to the issue of energy supply security and has made it necessary to formulate energy supply strategies and to be implemented by supporting them with energy policies. After the European Union entered into an economic downturn with the OPEC crisis in 1973, it would have reinforced its importance that the dependency rate, which was 62% in 1973, decreased to around 40% with the policies implemented in the 1980s, but it was 54% in 2015 with the waves of expansion (Bayraç & Çildir, 2017). Similarly, the rapid increase in energy prices in Turkey, especially with the 2018 currency crisis, put the domestic industry into a bottleneck in the short and medium term. In addition to the increase in the prices of consumed energy products based on imports (oil, natural gas), the increase in the exchange rates used in the payment for these products is against Turkey, thus causing the foreign trade deficit to grow (Ulusoy & Daştan, 2018, p.149). Hence, 80% of Turkey's current account deficit in the last five years consists of energy imports. Throughout the EU, dependency on petroleum is approximately 90%, dependence on natural gas is 66%, dependency on solid fuels is 42% and dependence on nuclear energy is at the level of 40% (Belet, 2016, p.191). It is inevitable for both the EU and Turkey to turn to RE sources in order to find solutions to these and similar problems.

Initiatives were observed in recent decades in EU and Turkey. In fact, EU wants to be leader in RE in the world. For this purpose, the share of RE in energy consumption increased continuously between 2004 and 2017, from 8.5 % to 17.5 %. The Europe 2020 target is 20 % by 2020, and the Europe 2030 target is 32 % by 2030. Turkey on the other hand, in the 11. Development plan set a goal of increasing the share of RE sources in electricity generation is planned to reach at least 40 percent until 2023.

Although the countries adopting RE incentive schemes are increasing day by day, there are important discussions about the effectiveness of RE policies in the world. It is debated that whether RE sources should financially be supported and if yes with which incentive tools. In literature, empirical studies revealed mixed results. IEA (2020) reported that RE investments decreased significantly due to Covid 19 Pandemic in 2020. Hence, to evaluate the effectiveness of RE incentive policies has become key to achieve environmental targets and to ensure sustainable economic development in the world.

[1] https://www.smart-energy.com/tag/irena/ retrieved in 10.04.2021

In this context, this paper discusses the effectiveness of RE incentive policies (i.e. feed-in tariff, grants and subsidies, loans, taxes etc.) with a focus on their relevance and compatibility of EU and Turkey RE sector. Our study specifically focuses on RE sources such as wind, solar and bioenergy etc. and benefits from the literature review. Our results will provide important information to design effective energy policies to ensure sustainable economic development in EU and Turkey as well.

The rest of the paper is organized as following. In second section, importance of the RE sources and developments in RE sector are presented. In the third section, RE policies in EU and Turkey are examined in detail. In fourth section, results of empirical studies that focusing on the RE incentives are evaluated. Last section presents the important findings and some policy recommendations.

2. RENEWABLE ENERGY: DEFINITION, DRIVERS, AND IMPORTANCE

It is estimated that by 2050 the total population will reach 9 billion in the world. With the increasing population consumption rate per capita also increases. Within the scope of sustainable development, states are moving to more efficient economic models such as cyclical economics. Cyclical economic model, unlike linear economic model has a circular flowing material balance that ensures less use of environment and minimizing the use of ample resources for economic activities. Thereby, a strong relationship emerges between cyclical economy and RE sources. Both cyclical economies and renewable energy's essence lie on these three basic principles: Reduce, Reuse and Recovery. Reduce is to minimize consumption of raw materials and energy for decreasing environmental pollution. Reuse is to provide the reusability of a product in another economic activity after the first cycle life of the product is over. Recovery is to recycle and usability of a product in its primary state for different economic activities. These three principles are the golden rules to achieve sustainable economic development in a society (Zhijun &Nailing, 2007).

Energy resources produced by using resources that can renew themselves in nature are called RE resources. For this reason, it has a sustainability feature. RE plays an important role in reducing the dependence of countries on primary energy sources if they meet their energy needs from domestic sources. On the other hand, because of the diversification of RE resources, countries help to reduce the damage given to the environment as a result of increase in the production and consumption of sustainable and environmentally friendly energy.

RE types can be examined under five headings such as solar energy, wind energy, hydraulic energy, geothermal energy, and bioenergy. RE gets more and more attention by the world as the environmental concerns increase. In this context, depending on the endowment advantage and advantage coming from its geographic location, states aim to maximize the profitability of natural resources such as wind power, solar power, hydraulic power, geothermal power or bio-energic power. At global level, energy supply is divided into continental regions and Asia's share of global renewable production was accounted 40 percent in 2018, Europe and North America 20 percent each, South America 12 percent, and Euroasia 5 percent [2]. The main reason behind Asia to rank top one continent is its large-scale energy demand in growing economies such as China, India, Indonesia, Pakistan etc. these countries have rapidly growing industries and high population. Asia has the leading position in growth of wind and solar power generation. Wind, biomass, and solar energy technologies are the most supported systems in Europe (Selvi, 2015, p.348), while hydraulic, wind and solar are the energy technologies preferred in Turkey (IRENA, 2020). However, World Biofuels Association (WBA, 2018)[3] reveals that in terms of share of renewables, African continent is the leading continent in the world. In Africa, almost 50 percent of the energy supply is renewables.

Despite all these efforts, the GHG reduction rate is far behind the targets. According to global emission data, the total greenhouse gas emission in 2016 was accounted 46 141 Mt CO_2 equivalent. The 10 countries with the highest greenhouse gas emissions generated 62.6% of global emissions. Among these countries, China ranked first with 25.8% emissions, the USA was second with 12.8% and India was third with 6.7%. According to the results of the greenhouse gas emission inventory, the total greenhouse gas emission for 2018 was calculated as 520.9 million tons (Mt) CO_2 equivalent, decreasing by 0.5% compared to the previous year. As for Turkey, energy-related emissions have the largest share with 71.6%, followed by industrial processes and product use with 12.5%, agricultural activities with 12.5% and waste with 3.4% in 1190-2019 period (TÜİK, 2021).

[2] IRENA "Yenilenebilir Enerji İstatistikleri 2020"raporunu yayımladı - Temiz Enerji, retrieved in 12.05.2021

[3] www.worldbioenergy.org/uploads/181017 WBA GBS 2018_Summary_hq.pdf

Therefore, RE sources (such as wind, solar and bioenergy etc) play a crucial role in reduction of GHGs and in achieving sustainable economic development. For example bioenergy has low production cost, it is an environmentally friendly technology that enhance provision of clean energy from organic waste furthermore recycles even the waste at second stage obtained after production of bioenergy to the economy as fertilizer, in that aspect it also reduces the cost of controlling weeds in agricultural land by eliminating weed seeds in animal manure, increases water quality by reducing the mixing of pathogens from animal manure into the water (Şenol *et al*., 2017; Yılmaz & Hotunoğlu, 2015).

The essential difference between bioenergy as a RE resource and the other RE resources lies on the major source's bioenergy is derived from. There are four major sources of bioenergy. These are herbal bioenergy resources, forest and forest products, animal bioenergy resources and bioenergy resources obtained from organic wastes, urban and industrial wastes. The range of RE sources other than bioenergy are developed depending on factors such as geographical location, requirements for use and even the time of the year (especially solar and wind power). However, bioenergy has an advantage of sustaining energy with its wide range of sources throughout a year (Deloitte, 2014). It is estimated that world population will exceed nine billion by 2050. UN Food and Agriculture Organization estimates that the population growth will boost demand for food by roughly 50 percent compared to today. Unfortunately, beside of the waste of these sources which are no more infinite, organic waste results in decomposition without accepting oxygen and creates methane, which is 23 times more deadly than carbon dioxide. In that sense, bioenergy is a contributor to human health and hygiene with solid waste management and organic waste management, and even to food security (De Clercq *et al*., 2018). Unlike other RE industries on an industrial basis, bioenergy includes a wide range of "different businesses. The bioenergy supply chain is more complex than other types of RE. That's why the bioenergy sector is developing a little slower (Deloitte, 2014).

According to the REN21 (2020) Report, the total share of RE in electricity generation was 24.4 percent in 2017. This value rose to 24.9 percent with an increase of 0.5 in 2018. Biomass energy in electricity generation ranks second among RE sources after wind, while solar energy-based production ranks third. Brazil has the leading position in usage of biomass for industrial heat in the world **(**REN 21, 2020). Bioenergy's total share increases in the RE market. The Global biodiesel production in 2019 witnessed an increase and accounted 47.4 billion liters – a 13% annual increase overall (Wind Europe, 2019).

Nearly all member countries in the EU, the most numerous and detailed regulations belong to the electricity sector. Wind, biomass, and solar energy technologies are the most supported systems (Selvi, 2015, 348). In the EU, bio-power capacity and generation continued to rise to meet the national targets for 2020 under the new Renewable Energy Directive. Bio-power capacity grew around 4% in 2019 to 44 GW, and generation increased 5% to 200 TWh (REN 21, 2020). On the other hand, despite the slow development of bioenergy sector in Turkey, Energy and natural resources ministry of Turkey estimates that Turkey's biomass waste potential is approximately 8.6 million tons of equivalent oil (MTEP) and the amount of biogas that can be produced is 1.5-2 MTEP per year. Based on the projections by the IEA (2021), it is predicted that bioenergy production will triple the current production in 2050. In this context, it is estimated that biomass energy may have the potential to meet 7.5 percent of the world's electricity production or 27 percent of the fuel used in transportation. From this point of view, it is seen that incentive schemes are very important in terms of developing renewable energy sources in energy supply mix.

3. RENEWABLE ENERGY POLICIES IN EU AND TURKEY

Renewables are being promoted around the world. The total number of countries that make investment on RE increased to 172 in the year of 2019 (REN21, 2020). There is a significant increase in the installation capacity of renewables in the world. However, with the 2019 pandemic, a drawback occurred in these investments. An axis shift from RE investment to fossil fuels occurred especially with the sharp decrease in fossil fuel prices. This raised importance of an important question: "*Should states give incentives to RE investments*?", furthermore "*If states should support the Re capacity installation, what kind of incentive mechanisms should they do it with*?".

Incentives are broadly divided into economic and political. Economic instruments are the main support mechanisms while the political instruments are used to ease the bureaucratic path in front of RE investments. Other than the economic and political instruments, R&D incentive is an effective tool for raiding RE capacities' high deployment and generation. Moreover, R&D serves to increase RE's competitiveness against fossil fuels and nuclear power by lowering the cost.

Table 1: Classification of policy incentive schemes on renewable energy

Economic Instruments-1	Economic Instruments-2	Economic Instruments-3	Policy Supports/ Regulatory Instruments	R&D
Fiscal and Financial Incentives	Market-based instruments	Direct Investments		
- Feed-in tariff/premiums -Grants and subsidies -Loans -Taxes -Tax reductions -Depreciation incentives	-Green certificates -GHG emissions allowances	-Funds to subnational governments -Infrastructure Investments	-Institutional creation -Strategic planning -RPS&Codes and standards -Obligation Themes -Mandatory requirements -Net metering -Tendering	- R&D deployment

Source: Polzin et.al., 2015; REN21, 2020.

Among the others, the main economic instrument is feed-in tariff (FIT). There are two different applications of the feed in tariff as a fixed price guarantee that is not dependent on the market price and a market price dependent premium guarantee. Fixed price guarantee is a long-term purchase agreement used to accelerate RE investments. With this method, governments guarantee annual energy purchases from producers who produce their energy needs using RE sources at a price above the market price. The amount of energy to be taken depends on the type of resource and its economic viability. In addition, by providing a long-term price guarantee for a period ranging from 10 to 30 years, sales and price risks for investors are eliminated (Brown, 2013, 3). In premium guarantee application, unlike a fixed price guarantee, the producer is paid a premium above the market price instead of a fixed price. If the market price exceeds the specified minimum price, no premium payment is made (Delolite, 2011, 4).

Investment loans are loans for long-term and low interest rates per installed kWh or a certain percentage of total costs for the development of RE investments.

Subsidies, refer to grants made by the state to individuals or institutions in the form of goods, money, or services. In this context, the state finances a certain percentage of the investment cost as a grant to support RE generation.

Depreciation incentive provides an opportunity for accelerated depreciation in RE investments. While power plants are generally depreciated for a long period of 20-30 years, this period can be reduced to 15 years with accelerated depreciation. R&D expenditures for RE technologies can be deducted from the income tax base. In addition, there are three different real estate tax incentives for renewable energy: exemption, discount, and refund. EU countries prefer more exceptions or discounts (Bayraç & Çildir, 2017).

One of the main support tools used in the promotion of RE is the application of the Renewable Portfolio Standard. The renewable portfolio standard (RPS) is a quantity-based incentive tool. To generate a certain percentage of energy from renewable sources, mandatory targets or quotas are set for producers. RE certificates are issued for this. RE loan, green certificate, green label or RE certificate etc. It is possible to evaluate these certificates as a kind of environmental credit since they are also possible to be traded. RPS policies express great political feasibility, they are presented as cost-effective opinions to support RE sector grow and help new renewable technologies become cost-competitive with conventional sources of fossil fuel energy (Rabe, 2008). Bayraç& Çildir (2017) state that the main disadvantage of RPS; it causes uncertainty about future electricity prices for producers as the price is determined by the market. In order to prevent this, lower and upper limits are usually set on prices to compensate for losses caused by market fluctuations. Another disadvantage is that it does not allow price discrimination for different RE sources technologies. While this situation encourages low-cost RE technologies, it prevents the development of high-cost technologies that are still in their early stages. The first country in the EU to adopt the RPS was the Netherlands in 1998. In addition, it is seen that it is used in a small number of countries.

In the tendering processes, the providers with the lowest costs contract to produce power. The purpose of the "tendering system" is to increase the competitiveness of RE. In this method, which is used especially for large-scale projects, the electricity administration undertakes to purchase electricity at a price above the market price (10-25 years) in accordance with the agreement made with the winner of the tender. Tendering for capacity systems is a quantity-driven mechanism. A fixed amount of capacity to be installed is auctioned and contracts are agreed to ensure the capacity is built (Klessman *et al.*, 2011). The tendering process has advantages for encouraging competition between RE technologies without governments having to speculate which providers will be the most cost effective. However, it has also some disadvantages such as moral hazard an adverse selection. The limited effectiveness of this system is a major disadvantage. In practice, projects are difficult to run as RE producers offer very low prices to operate profitable power plants. One reason behind the RE to develop slow is the strong lobbies behind traditional energy suppliers. Hence tendering may cause similar sort of problem and diseconomies if the control mechanism is not strong enough and the expertise on the cost-calculations isn't provided (Bayraç & Çildir, 2017)

In another method, net metering/billing method; consumers are offered the opportunity to generate their own electricity from renewable sources and sell the surplus to the national grid at a high tariff. In this model, which is one of the oldest policy tools, it is to equip homes, schools, or commercial buildings with RE and to obtain a loan that can be used at another time from the grid for the surplus electricity. It is argued that its effectiveness is relatively low due to the focus on small-scale applications. In addition, it is stated that investment security is at a rather low level due to the fluctuation in the purchase price of the excess electricity generated. It is generally used in solar and wind power.

While more technological R&D policies were focused on promoting RE sources in the 1970s, it has been replaced by a RPS since the 2000s. Today, it is thought that it will be effective in attracting large pollutants to the RE sector by applying it together with other incentive policies (Aguirre &Ibikunle, 2014, p.375).

All incentives (See Table 2) are being used as a tool to stimulate renewables in EU countries. However, some incentives are not being given in some countries in EU. For example, FITs are not ensured in Belgium, Spain, Sweden and United Kingdom. Indeed, Sweden and UK removed the FITs since they did not create the desired effect in RE deployment. In Turkey, FITs, net metering (in 2019), mandatory obligations (i.e.biofuels), heat obligations, public grants, loans and subsides are commonly used incentive schemes.

Table 2: RE Incentive Mechanisms Used in EU-27, UK and Turkey

	Feed-in tariff/ premium payment	Electric utility quota obligation/ RPS	Net metering/ billing	Biofuel blend, renewable transport obligation/ mandate	Renewable heat obligation/mandate, heat feed-in tariff, fossil	Tradable REC	Tendering	Reductions in sales, energy, CO2, VAT or other taxes	Investment or production tax credits	Energy production payment	Public investment, loans, grants, capital subsidies or rebates
Austria	exist		exist	exist		exist		new	exist		exist
Belgium		exist	exist	exist		exist	exist	exist	exist		exist
Bulgaria	exist			exist							exist
Croatia	exist			exist							exist
Cyprus	exist		exist	exist			exist				exist
Czech	exist			exist		exist		exist	exist		exist
Denmark	exist		exist	exist	exist	exist	exist	exist	exist		exist
Estonia	exist			exist						exist	exist
Finland	exist			exist	new	exist	exist	exist		exist	exist
France	exist			exist	exist	exist	exist	exist	exist		exist
Germany	exist			exist	exist	exist	exist	exist	exist		exist
Greece	exist	exist	exist	exist	exist	exist	exist	exist	exist		exist
Hungary	exist		exist	exist			exist	exist			exist
Ireland	exist			new	exist	exist	exist	exist			new
Italy	exist		exist	exist			exist	exist	exist		exist
Latvia	exist		exist	exist			exist	exist			
Lithuania	exist	exist	exist	exist	exist		exist	exist			exist
Luxem-bourg	new			exist							exist
Malta	exist		exist	exist			exist	exist			exist
Netherland	exist		exist	exist	exist	exist	exist	exist	exist	exist	new
Poland	exist	exist		exist		exist	exist	exist			exist
Portugal	exist	exist		exist	exist	exist	exist	exist			exist
Romania		exist	exist	exist		exist					exist
Slovakia	exist			exist		exist		exist			exist
Slovenia	exist		exist	exist		exist	exist	exist	exist		exist
Spain			new	exist	exist		exist	exist	exist	exist	exist
Sweden	removed	exist		exist		exist		exist	exist		exist
UK	removed	exist		new	exist	exist	exist	exist		exist	exist
Turkey	exist		exist	exist	exist		exist				exist

Source: Authors compiled from REN 21 (2020) report.

3.1. RE Policies in EU

While the EU is implementing a policy in the field of energy; it aims to provide safe, cheap, clean, and safe energy in terms of human health and environment without interruption, and at the same time to develop new energy systems and to complete the energy internal market. EU Energy Policy can be summarized as; to provide energy supply in a sustainable, reliable, and competitive environment, to reduce GHG emissions by combating climate change, to contribute to the competitiveness of the economy, to offer energy resources to consumers in a reliable and economical way, and to switch to a low carbon economy by reducing dependence on imported oil, natural gas and coal. RE sources pose key role to achieve these goals (Aytüre, 2013, pp.37-39).

With the "Green Energy Report" published on November 26, 1997, it was recommended that the members increase their share of RE from 6% to 12% until 2010. Later, in 2007, within the scope of the EU Energy and Climate Change Package, it has determined three important targets until 2020 and has taken important steps towards achieving these targets since 2007. These three important goals are as follows: To reduce greenhouse gas rates by at least 20% by 2020 compared to 1990, to increase the share of RE in energy supply to 20% by 2020, and to at least 10% of gasoline and diesel fuels used in transportation. The availability of biofuel has been determined as saving 20% in primary energy consumption until 2020 (Aytüre, 2013, p.39). With the RE resources directive dated June 2009 (2009/28 / EC), it has become a common policy for all EU countries. The European Council later revised this target to 27% for 2030 in October 2014. In December 2020, the European Commission met again on the issue of RE and reached a joint agreement in its decision to increase the share of RE in total energy to 55% by 2030, based on the past 13 years of success (EC, 2020).

According to the data shared by Eurostat (2021), the share of energy distribution in total energy consumption in EU-27, in 2018 calculated as 15.2 percent from solid fossil fuels, 35.9 percent from petroleum products, 21.3 percent from natural gas, 12.9 percent from nuclear energy, 14.6 percent RE resources and 0.1 percent from other sources.

The European Environment Agency also confirms that the highest level of gas emission is generated by energy industries with 30%, road transportation with 18%, and households and services with 14%.[4] Based on the projections, it is concluded that bioenergy offers an opportunity to decrease the GHG emissions caused by road transport as well. One of EU's targets in coping with GHG is to raise biofuel production and consumption rate. EU sets an at least 30% biofuel, biodiesel overall the total EU-27 transport fuel by 2030.

Wind, biomass, and solar energy technologies are the most supported systems in EU countries. In order to achieve the target depicted by European Commission, many countries have been implementing important incentive policies, especially since the 2000s. Thus, the share of RE resources in energy consumption reached 16.7% as of 2015 throughout the union. The highest rate was in Sweden with 53.9%. This country was followed by Finland with 39.3%, Latvia with 37.6% and Austria with 33%. The countries with the least RE consumption are Malta and Luxembourg with 5%. These are followed by the Netherlands with 5.8%, Belgium with 7.9%, England with 8.2% and Southern Cyprus with 9.4% (Selvi, 2015, p.348; Eurostat, 2021).

Sustainable development policies implemented by the EU in the 1990s with environmental priorities changed shape through the policies of reducing GHG emissions due to climate change, ensuring energy security due to instability in energy prices, and increasing technological innovation and competitiveness and transformed into a green growth model. In existing policy documents of the EU, it is seen that the elements related to green economy such as environmental protection, resource efficiency, social integration and creating new business areas are integrated into EU policies at different levels (Yılmaz, 2014, p.73).

With the 96/92 / EC Directive, cost-effectiveness in energy consumption, low consumer prices and environmental protection have become the main targets in the EU energy markets. This development positively affected the competitiveness of RE in EU (Klessmann *et al.*, 2011, p.7638).

Main incentives for RE production in EU are fixed price guarantee, premium system, mandatory quota and green certificate applications, tax incentives and investment loans. Among these incentives, tariff

[4] https://www.eea.europa.eu/data-and-maps/figures/total-greenhouse-gas-emissions-by-sector-in-eu-1

guarantees, including fixed price and premium guarantee, investment loans and subsidies, public expenditures, tax incentives are based on public revenues, mandatory quota and green certificate applications are a regulatory policy. FIT application, which is the main incentive policy of the EU and differs by each country in application, is accepted by the Commission as the most effective and minimum cost incentive mechanism. Since the initial setup costs are high in the use of RES, fixed price guarantee is generally given when the production facilities start their first operation Fixed price guarantee is used in many EU member countries such as Germany, Lithuania, Hungary, and Bulgaria (See Table 2) (Delolite, 2011, p.3).

Tax incentives (exception, discount, low rate, etc.) have been used as a complementary policy throughout the EU since the 2000s. Among the main tax incentives used are exemptions, discounts, depreciation regime, forward and backward deduction of losses, tax breaks and tax deferral. In addition, taxation of fossil fuels with higher rates or additional taxes such as carbon tax constitutes tax measures (Aslani *et.al*., 2013, p.503).

RE capital expenditures (machinery, equipment, land and fixtures, etc.) can still be deducted from the income and corporation tax base, with 40% of RE installation costs in Belgium and 50% of RE equipment costs in France. In order to qualify for the investment allowance in Ireland, you must make a minimum and maximum investment. To get the discount in some countries, you'll need a security or performance certificate (Artigues & Rio, 2014, p.433). Instead of deductions for investment or production, some countries apply direct income tax exemptions. In the Czech Republic, earnings from the sale of energy to the grid are exempt from 5-year income tax. Electricity sales from low-capacity solar panels in Luxembourg are exempted from income tax.

3.2. RE in TURKEY: Turkey's RE Strategy Map

Turkey targets to increase the use of renewable resources primarily to generate electrical energy in the conjuncture it targets for future energy demand and supply. For this purpose, country aims to support RE with safe, economical, and effective incentive mechanisms, thus increasing the diversity of energy sources. As a result of the measures to be taken for the use of domestic and RE resources, it is targeted to reduce the share of natural gas in electricity generation to less than 30% (Aşker, 2013, p.2) In this context, using waste products and protecting the environment is of particular importance.

Electricity consumption is expected to reach 375.8 TWh in 2023[5], with an annual average increase of 4.8% compared to the baseline scenario. The highest share of total energy consumption attributes to electricity. According to the data shared by the ministry of Energy and natural resources of Turkey, electric energy consumption in Turkey increased by 2.2% to 304.2 billion kWh in 2018 compared to the previous year, and electricity generation increased by 2.2% compared to the previous year and reached 304.8 billion kWh. In 2018, 37.3% of electricity generation was from coal, 29.8% from natural gas, 19.8% from hydraulic energy, 6.6% from wind, 2.6% from the sun, 2%, 5 from geothermal energy and 1.4% from other sources (TEİAŞ, 2020)

The total share of RE used for electricity generation increased throughout the past ten years. However, there is a significant increase in share of primary energy sources such as coal and natural gas since late 2019-beginning 2020. The increase in usage of primary energy resources in Turkey, is due to the sharp decrease in the global market price of petroleum and natural gas after the pandemic. However, one can argue that despite this increasing trend in coal and natural gas consumption in electricity generation, the total share of RE resources has increased by 2.20% (except hydraulic energy resources). In 2019, 19.87% of the total electricity was produced from coal, 18.85% from natural gas, 29.23% from hydraulic energy, 7.15% from wind, 3.04% from the sun, 2.95% from geothermal. By end of 2020, Turkey's total share of energy sources by consumption rate has changes as: 20.37% coal, 22.69% natural gas, 25.59% hydraulic energy, 8.11% wind power, 3.82% sun, 3.06% geothermal energy. Overall, biomass has the smallest share of RE resources used in Turkey for production of electricity (TEİAŞ, 2019).

According to the data provided by IRENA, while the total RE generation capacity in Turkey was 17 thousand 369 MW in 2010, this value increased to 44 thousand 587 MW in 2019. The statistics suggests that there is a great capacity in RE in Turkey. According to municipal waste statistics, a total of 25.28

[5] https://www.teias.gov.tr/tr-TR/aylik-elektrik-uretim-tuketim-raporlari

million tons of municipal waste was collected in 2010, while more than half (54.4%) of the collected waste was taken to regular collection areas, 43.5% was taken to municipal dumpsites. The total amount of waste that can be obtained from these forests in Turkey, whose coastal areas are rich in forests, is approximately 4.8 million tons, or 1.5 MTEP. In addition, the total amount of usable waste in the fields and gardens is 15.3 million tons and the calorific value of this amount is 303.2 PJ. It is equal to 7.24 MTEP. According to 2010 data retrieved from Energy and Natural Resources Ministry of Turkey website, there are 52 landfills in Turkey. The capacity of these areas is 423 million tons and a total of 14,376,674 tons of waste came to these facilities in 2010. More than 95% of the waste brought to solid waste storage facilities is municipal waste, and 4% includes waste brought by other sectors and waste brought from incineration and compost facilities. In 2010, 14,309,356 tons of waste was disposed of in solid waste storage facilities, and 67,318 tons were sold or donated. These numbers show that Turkey has an extraordinary biomass potential. However, it has been observed that despite the big capacity bioenergy has a lower growing share in Turkey, biomass energy production using modern techniques is in the development stage in Turkey, not much progress has been made in this area.

The use of biomass energy, which has been increasing day by day in Turkey, generally consists of traditional techniques such as heating and cooking. Biomass energy, which has a high potential throughout the country, is more in the background in terms of usage compared to other RE types. As of the end of 2016, Turkey's biomass energy installed power is around 467 MW (Karagül & Kavaz, 2017). In this direction, incentive mechanisms to reach the biomass-based energy production amount determined as 2 thousand MW in the 2023 targets should be handled again and necessary measures should be taken into effect.

Until 2005, no serious steps were taken by the government regarding renewable energy. In the sixth and eighth development plans, the necessity of using renewable resources due to reasons such as being indigenous, not harming the environment, and lack of supply security of fossil-based fuels were emphasized, but serious investments were not made, and incentives were not given.

As of the end of 2006, the share of RE sources in total energy consumption was less than 1%, except for biomass resources used for hydroelectric and fuel purposes, which are among the RE sources in Turkey.

The most important development regarding RE has been with the enactment of the Law on the Use of RE Resources for the Purpose of Electric Energy Production (YEK), dated 10.05.2005 and numbered 5346. With this law, what are the RE sources are defined and some incentives have been brought to these sources. With the enactment of RE Law (YEK) in 2005, a momentum has been achieved in the field of RE sector. However, because of the absence of secondary legislation and relatively low fixed price guarantee levels, investment in RE sources between 2005 and 2010 was limited. Due to the changing conditions over time, some regulations were made in the RES law on 29.12.2010 and a new era started in Turkey in terms of renewable energy. With this change, government incentives have been diversified on the basis of resource types. Incentives have also been given to support the development of domestic technology in resource use. The Electricity Market Law No. 4628 was enacted to create a competitive, strong, and stable market for the use of electricity in a sufficient, high-quality, continuous, low-cost, and environmentally friendly manner (Yılmaz & Hotunoğlu, 2015). With the New Electricity Market Law No. 6446, some radical innovations and incentives in the electricity market system were made to eliminate the difficulties in front of the producers. The Law No. 5346 on the Use of RE Resources for the Purpose of Generating Electrical Energy was enacted to encourage the use of RE for electricity generation, based on the purchase and price guarantees that are based on loan agreements with banks at the point of obtaining the required amount for investments. In addition, fixed price guarantees that require differentiation according to source diversity, equal price for all renewable resources are determined as 5 - 5.5 Euro. In Law No. 6094, fixed price guarantee tariffs, which are equal for all renewable resources in the current RE Law, have been updated and rearranged according to the facility installation and operating costs of the resource type. With this law, the incentive mechanism has become even more attractive. While the support mechanism within the scope of the law was initially processed only for the facilities that were put into operation before 31.12.2015, it was extended until 31.12.2020 with the decision of the Council of Ministers issued in December 2013 (YEGM, 2014, p.12). Especially after the revision of fixed price guarantees, the interest of domestic and foreign investors in environmentally friendly energy resources has increased considerably (YEGM, 2014, p.11). The Energy Efficiency Law No. 5627 has determined the procedures and principles for increasing and supporting energy efficiency in the production, transmission, distribution and consumption stages of energy, industrial enterprises, buildings, electrical energy production facilities, transmission and distribution networks and transportation, and raising energy awareness throughout the society. With the update of the Environment Law No. 2872 in 2006, incentive systems were introduced into the Environmental Law. There is a discount of up to 50% of the electricity tariff used in the treatment facilities of the organizations that establish and operate the treatment plant and fulfill the obligations specified in the regulations, and the energy tariff used in the industrial facilities. The main purpose of this is to protect the environment, which is the common asset of all living things, in line with the principles of sustainable environment and sustainable development.

The incentive instruments adopted to boost the RE in Turkey are Feed-in tariff/ premium payment, net metering/billing, biofuel blend, renewable transport obligation/mandate, renewable heat obligation/mandate, heat feed-in tariff, fossil, tendering and public investments (See Table 2) (REN 21, 2020).

FITs given in Turkey:

According to the law numbered 6094, a fixed price guarantee of 13.3 cents is applied for biomass-based production. If the mechanical or electro-mechanical parts used in the production facilities that entered into operation before 31.12.2020 of the licensed real and legal persons are produced domestically, for the electrical energy obtained from these facilities and sent to the transmission and distribution system, the prices presented in the Table 3. Addition of local additives is added. Biomass investments are supported with the highest fixed price purchase guarantee level of 13.3 USD cents / kWh, together with the secondary legislation of the Regulation on Domestic Production of Components Used in Plants Producing Electrical Energy from RE Sources, in case of domestic equipment use, additional with the incentive, this price reaches up to 18.1 US $ cent / kWh. The incentives defined in the law cover the facilities that have been or will be activated in the period until December 31, 2020. The fixed price purchase guarantee defined in Schedule I, annex of the Law, is valid for 10 years from the start of the facility, and domestic contribution additions specified in Schedule II are valid for 5 years (Deloitte, 2014).

Table 3: Biomass Energy Technology Basis Fixed Purchase Price Guarantee and Domestic Contribution in Turkey

Biomass energy-based production facility Domestic Contribution (US dollar cent / kWh)	
1) Fluidized bed steam boiler	0.8
2) Liquid or gas bed steam boiler	0.4
3) Gasification and gas cleaning group	0,6
4) Steam or gas turbine	2,0
5) Internal combustion engine or Stirling engine	0,9
6) Generator and power electronics	0,5
7) Cogeneration system	0,4

Source: RE Law-YEK No.5346.

Afterwards, with Presential Decision (No:3453) published in Turkey’s Official Gazette, FITs have been started to be given in TL basis as of June 30, 2021. Accordingly, the tariff rates will be updated quarterly based on the inflation and exchange rates. However, there are concerns that this practice will negatively affect the renewable energy investments in Turkey (EÜD, 2021).

Other subsidies which are being given to RE in Turkey can be summarized as follows:

• The installed power of a renewable energy-based generation facility was increased by the Council of Ministers from 500 kW to 1 MW, exempt from licensing and company liability, and the installed power of a renewable energy-based generation facility in terms of competition development and supply security is up to 5 times (5 MW).

• RE facilities consisting of more than one building can be considered as a single generation facility if they are connected to the system from the same point (YEGM, 2014, p.12).

• Up to 20% of the application projects submitted to the General Directorate by industrial firms are accepted by the Board with the General Directorate's permission, with a maximum payback time of five years and a maximum sum of 500,000 Turkish Liras in the project.

• The energy produced in facilities that convert wastes into heat and electrical energy using contemporary combustion techniques, in cogeneration facilities produced domestically, or in facilities that use biomass resources is not included in the energy density calculation. (Ylmaz & Hotunoğlu, 2015).

Tax Incentives given in Turkey:

• The revenues originating from the transfer, merger, division, and partial division transactions to be carried out until 31.12.2023 are free from Corporate Tax in the context of privatization of energy distribution firms and power producing facilities.

• VAT is also not charged on deliveries and services that are within the scope of tax legislation.

• To meet the short-term need for supply capacity, transmission system use costs will be discounted by 50% for the next five years, from the start of operations through December 31, 2015, while transactions linked to generation facilities will be free during the investment period. Stamp duty was waived, as well.

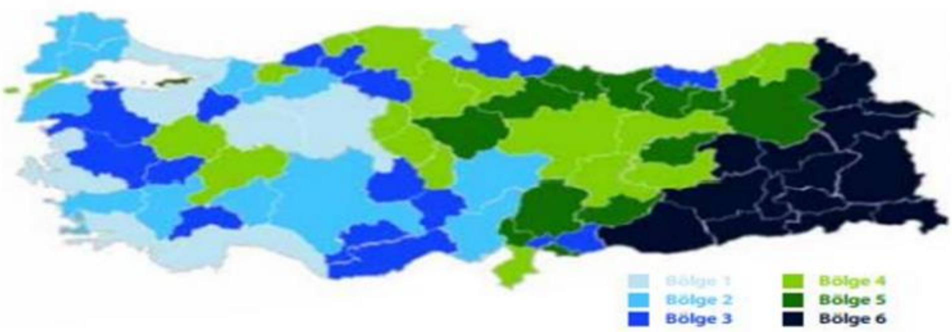
Investment Credits given in Turkey:

• The repayment of loans given by the Fund, which are planned to be repaid to the Fund by giving more resources to the enterprises by reflecting on the firms' sales tariffs, is exempt from interest under Law No. 3096.

• In the first 10 years of investment and operation periods from production facilities based on RE resources, an 85 percent reduction is given to the expenses of permission, rent, easement right, and use permit until 2020.

• The agreement on water usage rights and operation principles issued by DSI is free from stamp tax and levies.

The supports provided by the new investment incentive program, which was introduced in April 2012 and is in force since January 1, 2012, consist of 4 main components (Yılmaz & Hotunoğlu 2015; 90-91).



Source: YEGM, 2014, p. 30.
Figure 1: Regions of Turkey, according to the incentive plan.

According to this:

1- General Investments: In the general investments to be made, VAT exemption, customs tax exemption; 6. In a general investment to be made in the region, additional income tax withholding support will be provided.

2- Regional Investments: In regional investments to be made, VAT exemption, customs tax exemption, tax reduction, land allocation, interest support, insurance premium employer's share support. Moreover, additional income tax withholding support and insurance premium worker share support will be provided under the “regional investments” plans. The main purpose of regional incentive applications is to minimize the level of interregional development. Minimum investment amounts have been determined for different investments, the minimum investment amounts are 1 million TL for the 1st and 2nd regions, and 500,000 TL for the 3rd, 4th, 5th, and 6th regions. In addition, an additional 38% labor cost reduction is applied only for the 6th Region (YEGM, 2014, p. 30).

3- Large-Scale Investments: In large-scale investments to be made, VAT exemption, Customs tax exemption, tax reduction, land allocation, insurance premium employer's share support. Moreover, income tax withholding support and insurance premium worker share support will be provided for large-scale investments in the region. The main purpose of promoting large-scale investments has been determined as increasing the current capacity of Turkey in terms of R&D and technology and ensuring international competitiveness (AKİB, 2015, p.8).

4- Strategic Investments: In strategic investments to be made, VAT exemption, Customs tax exemption, tax reduction, land allocation, interest support, VAT refund, insurance premium employer's share support. Moreover, additional income tax withholding support and insurance premium worker share support will be provided for the "strategic investments". The main purpose in promoting strategic investments is to popularize the production of intermediate goods or products, especially where the domestic production capacity is less than the foreign purchase. Investments with a fixed investment amount of a minimum of 50 million TL can benefit from this application (AKİB, 2015, p.10).

4.EFFECTIVENESS OF RE IN RENEWABLE ENERGY: A LITERATURE SURVEY

Many empirical studies focused on the effectiveness of RE incentive policies, but it is seen that these research papers reveal different results. The effectiveness differs based on the type of RE policy instruments and the type of the renewable energy. Most studies investigating the effectiveness of RE policies have relied on exploratory analyses and case studies at the individual state or country level. Although some studies suggest positive relationships between RE policy instruments and RE deployment, others have found no relationship or a negative one. This is most likely due to individual studies having a narrow geographic focus, using methods appropriate for a focused approach, and examining a wide existence of variables.

Many studies investigating the effectiveness of quantity based RE policies by using data panel analysis for deployment in the case of US states have found that quotas in general has no positive effect. For example, Shrimali et al. (2012) based on their investigation concluded that RPS has no effect on RE deployment. Income also negatively impacts RE deployment. As the growth model suggest, as the GDP per capita in a country increases and consumption per capita and the energy demand in that country increases. That's why primary energy sources are still more attractive than RE sources. However, Menz & Vachon (2006) analyzed 39 countries using data set covering the 1998-2003 period and came across a positive correlation between RPS and wind installed capacity. Delmas *et.al* (2007) state that quota (RPS) doesn't have a positive impact on RE generation while three other studies focused on the US (Neuhoff *et. al*., 2008; Smith & Urpelainen, 2014; Yin &Powers, 2010) found positive and significant relationships between quotas and the capacity of RE deployment.

Carley (2009) evaluated the effectiveness of state energy programs with an empirical investigation of the linkage between state RPS policy implementation and the percentage of RE electricity generation across states in the US, and, found that RPS implementation is not a significant predictor of the percentage of RE generation in the total generation mix but increases the total amount of RE generation. Based on findings of study, researchers set forward to question whether the effectiveness of RE policies is conditional on the social, natural, and institutional environment. For instance, Delmas and Montes-Sancho (2011) argued that a large presence of non-governmental organizations, democratic representatives, and green residential customers facilitate the transmission of RE policies in the US.

On the other hand, studies that analyze the effectiveness of RE policies at country groups such as Johnson et al (2009). Using panel data set for 25 OECD countries for the period of 1978 and 2003, Johnstone et.al. (2009) suggested that public policy plays a significant role in different renewable technological innovation. There are other authors that studied the impact of public policies on RE and added that although there is a positive effect that is traced on RE promotion, the effect mainly depends on which kind of RE source it is and the suitability of the kind of RE with the country conditions (Frondel *et.al.*, 2010). Likewise, Zhao *et.al*. (2013) investigated the specific effect of renewable electricity policies on renewable electricity generation with panel data analysis method on range of 122 countries with an existing range of development level during the period of 1980 and 2010. The results support the findings of the previous study and suggest that renewable electricity policies have a significant role in promotion of renewable electricity generation. However, their marginal effect is subject to diminishing rule of marginal effect as number of policies increase.

Dong (2005), in his study focused on the effectiveness of FIT and RPS on promotion of wind capacity development by using dataset covering 53 countries. According to the findings he achieved fiscal and financial incentive policy instruments have a positive effect on development of RE projects (De Jager & M. Rathmann, 2008; Bird et al., 2005). He also found that quota displays a positive role on RE application in the US (Menz & Vachon, 2006). Dong (2012) in another study he compared three European countries using FIT policy with three European countries using Quota policy. He found that FIT promoting countries (Denmark, Germany, and Spain) increased total wind energy production better than those countries promoting Quota (United Kingdom, Ireland, and France). In the feed-in tariff model, which has been successfully implemented in Germany, Spain and Denmark, the price is determined at a very close level to the production cost, and in this way, investors are given high assurance against price fluctuations and a purchase guarantee in line with real project costs (Bayraç & Çildir, 2017). Sawin (2004) worked on FIT effectiveness across Italy and Spain, and he demonstrated that FIT policies performed a positive effect on RE promotion while it had no success in Italy. Sawin (2004) says that FIT encountered problems such as lack of confidence in permanency of the policy due to financial interruption.

Carley (2009), out of her insight observation on effectiveness of RE policies focused only on 48 US states between the years of 1998 and 2006 stated that quota implementation is insignificant on RE electricity generation. Overall, some scholars are in the same view that financial incentives and renewable portfolio standards have an important influence in deploying wind power in the US. (Verbruggen 2009; Bird *et. al*., 2005)

Most of the RE studies generally focuses on the US. Upon the last 10 years with the increasing importance of RE markets and with EU countries to emphasize more attention on RE promotion, the pivot of the empirical studies has enlarged and contain now a broader range of countries. However, at first sight, one can observe that Germany has much of the attention when it comes to empirical policy affect studies on Europe. Mitchell *et. al*., (2006) itemized his comparative approach of RE policy tool effectiveness by analyzing Germany's FIT policies with renewable obligation mechanism used in the UK. He found that FIT is more effective than tradable green certificates as FIT is less risky and more effective for generation of RE. Another author that studied on Germany is Jacobsson & Lauber (2009). They found that beside the incentive policies, the available political environment to embrace new emerging system has crucial importance on the wind tribunes and solar cells to be invested in at high rate in Germany as explanatory variable. Toke et al. (2008) come up with similar sort of finding out of the six European countries they analyzed (Denmark, Germany, The Netherlands, Spain, the United Kingdom before Brexit) suggesting that financial support systems are influential for the deployment and generation of renewable energy. Hence the political bodies to be supportive is positively correlated with financial support system. So, one can suggest that political environment is an explanatory variable of financial support on the dependent variable of electricity from RE with robust consistency in Denmark, Germany and Spain. Another study of Lipp (2008) observed Denmark, Germany, and the United Kingdom and compared the effectiveness of FIT and tradable green certificates as policy instruments in developing RE installed capacity and found that FIT is more effective than tradable green certificates in those countries. On contrary of Toke et al.(2008) and Lipp (2008), Hughes (2010) found FITs to be inefficient in Britain, and he rationalize this inefficiency due to the fact that FITs discourage local promotion of RE capacity. Likewise, Frondel *et.al.* (2010) claim that public policy mechanism cause inefficiency and further claim that the system causes a high societal cost and against the long odds pushes the country more to use of imported gas, because the incentives disincentivize the competition among producers. RE requires a new different technology. That's why Frondel *et. al*. (2010) suggest that the incentive policies should promote innovation and improvision of technology through R&D if it is aimed to decrease dependency on existing technology of first-generation energy production.

Kilinc Ata (2016) states that price-based incentives such as FIT and tax incentives are more effective because price-based policies guarantee purchase by the utility services such as electric utility services in the long run. On the other hand, we can describe quotas and tenders as quantity-based incentive instruments. Tenders are investment policy instrument and quotas are generation policy instruments. Author found in her study that those policies in the long run do not boost RE deployment because these quantity-based policies set some the supplier's barrier to meet a targeted capacity of RE generation. Using panel data set of 27 EU countries, Kilinc Ata (2016) reveals that FITS, tenders, and tax incentives are effective mechanisms for stimulating deployment capacity of RE sources for electricity, while the other commonly used policy instrument -quota is not.

Haas *et.al.* (2011) review RES-E promotion strategies in the EU through the discussion of several case studies and conclude that technology specific financial support measures generally were more efficient and effective. According to Kanes &Wohlgemuth (2008), a tax decrease on fossil fuels is more efficient and helpful than a subsidy and tax reduction on RE, which may be necessary to support efficient investment decisions. Controlling for existence of political concerns such as energy security, ratification of the Kyoto Protocol, and socioeconomic challenges (e.g. prices for fossil-fuels, welfare). Aguirre & Ibikunle (2014) concluded that policies had no substantial beneficial impact on RE growth, but that fiscal and financial incentives had a detrimental impact (i.e. taxes).

As seen in Table 3, empirical results regarding to effectiveness of RE incentives schemes are mixed and controversial for some incentives. However, majority of studies confirms that, among the others, FITs, tax incentives, tradable green certificates, strategic planning, and R&D incentives are the most effective RE deployment mechanisms in RE sector. On the contrary, loans, subsidies, public policy supports, and quota found to be ineffective in stimulating the RE capacity in these countries.

Table 4: Empirical studies on effectiveness of RE incentives in EU and Turkey

Author/s	**Data period**	**Countries analyzed**	**Methodology**	**Results**
Nicolini and Tavoni, 2017	2000-2010	5 largest European countries (France, Germany, Italy, Spain and UK)	Panel data analysis	Efficient Incentives: FITs (+), Tradeable Green Certificates (+)
Bolkesjo et.al., 2014	1990-2012	5 largest European countries (France, Germany, Italy, Spain and UK).	Panel data analysis	Efficient Incentives: FITs (+), RPS (+) R&D (+).
Liu et.al., 2019	2000-2015	29 countries (including 15 EU countries and Turkey)	Panel data analysis	Efficient Incentives: FITs (+), Grants and subsidies (+), R&D (+) İneffective incentives: Green certificates, GHG allowances, policy support and regulatory investments.
Jenner et.al., 2013	1992-2013	26 EU countries	Panel data analysis	Efficient Incentives: FITs (+)
Kilinc-Ata, 2016	1990-2008	27 EU countries and USA	Panel data analysis	Efficient Incentives: FITS (+), Tenders (+), Tax incentive (+) Ineffective incentives: Quota
Marques and Fuinhas, 2012	1990-2007	22 European countries and Turkey	Panel data analysis	Efficient Incentives: FITS (+), Subsidies (+), Strategic Planning (+) Ineffective incentives: R&D, Tradeable Certificates, Public policy supports.
Kaya H.İ., 2017	2000-2015	27 EU countries and Turkey (solar energy)	Dynamic panel data analysis	Efficient Incentives: FITs (+), Tax (+) Green Certificates (+) Ineffective incentives: Loans, Subsidies

Source: Author's elaboration.

5.CONCLUSION

Different policies for environmental protection and sustainable economic development are implemented such as incentives and regulations in the world. Since RE sources has become key to achieve these goals, many countries adopted incentive tools to accelerate the development of RE projects. EU countries have ambitious targets to encourage the development of RE sources. Due to implemented incentive policies, the share of RE use increasing rapidly in both EU and world. It seems that, RE will play key role in the future as well.

In this study, the effectiveness of RE incentive policies has been evaluated for EU countries and Turkey. Among the others, FIT is the most implemented policy instrument EU and worldwide. However, it cannot be claimed that FIT will bring efficiency on RE promotion by itself. Results of empirical studies that focusing on the effectiveness of RE policies are mixed and controversial for some incentives.

However, majority of studies confirms that, among the others FITs, tax incentives, tradable green certificates, strategic planning, and R&D incentives are the most effective RE deployment mechanisms in RE sector. On the contrary, loans, subsidies, public policy supports, and quota found to be ineffective in stimulating the RE capacity in these countries. Moreover, FIT has been found insignificant for biomass energy in EU countries. In contrast to FIT policies, tax reductions, grants and subsidies, funds to subnational governments and institutional creation are suitable to encourage biomass energy. Since R&D instruments are found to be important in order to reduce the cost of RE and enable its competitiveness against fossil fuels, it is necessary to establish a budget for R&D programs.

As a result of implemented incentive schemes in RE in last two decades, there has been important progress in RE installed capacity in Turkey. However, Turkey still can not fully utilize its RE potential. Therefore, Turkey should adopt more efficient incentive schemes such Renewable Portfolio Standard, tax reductions etc. Thus, Turkey will contribute to the harmonization in the field of energy on the way to EU membership and sustainable economic development.

Based on the empirical literature, results regarding to effectiveness of RE incentives schemes are mixed and controversial for some incentives. Therefore, it is vital to assess RE type specific empirical studies on the effectiveness of the incentive instruments. Further empirical studies are needed to better understand the effectiveness of RE policies.

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