Turkey's Renewable Energy Sources and Govermental Incentives

Evren Kaydul[1(✉)], Zafer Demir[2], and Nesrin Çolak[3]

[1] Anadolu University, Fen Bil. Ens., Eskisehir, Turkey
evrenkaydul@icloud.com
[2] Anadolu University, Porsuk MYO, Eskisehir, Turkey
zaferdemir@anadolu.edu.tr
[3] Anadolu University, Ulaştırma MYO, Eskisehir, Turkey
nesrincolak@anadolu.edu.tr

Abstract. One of most crucial problems the world is facing today is the decrease in available fossil fuels. This decrease is, however, also increasing the value of renewable energy resources. According to International Renewable Energy Agency (IRENA) data, power generation from renewable energy sources increased 100% between the years spanning 2000–2013 and 14% between 2013 and 2015. In the years ahead, this rise is expected to increase exponentially. In light of these changes Turkey has set a target to increase its renewable energy ratio in the energy sources to 81% during the years 2015–2019. In this study, Turkey's renewable energy sources—wind, solar, hydraulic, biomass, and geothermal—along with its potentials for wave energy and this potential's effect on Turkey's installed power will be examined in detail. Governmental incentives that are provided for renewable energy sources and the results these EPDK study will also present suggestions related to power generation from renewable energy sources and incentive process.

Keywords: Turkey renewable energy sources · Incentives
Power generation

1 Introduction

Modern renewable energy can put the world back on track to limiting global warming to 2 °C by the end of this century, the target agreed by all countries at the COP21. Finally, the RE map analysis shows how we can operationalise the United Nations' Sustainable Development Goal call on Energy of "ensuring access to affordable, reliable, sustainable and modern energy for all" [1].

1.1 Renewable Energy Resources

Renewable energy is energy that is derived from natural processes (e.g. sunlight and wind) that are replenished at a higher rate than they are consumed. Solar, wind, geothermal, hydropower, bioenergy and ocean power are sources of renewable energy. The role of renewables continues to increase in the electricity, heating and cooling and transport sectors [2].

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This work uses 5-year segments to investigate the share of renewable energy resources among total resources. It is noted that there has been a world-wide increase in the use of renewable energy sources [3] (Table 1).

Table 1. Share of renewable energy in electricity production

Region	Share of renewable energy in electricity production (%) in 2005	Share of renewable energy in electricity production (%) in 2010	Share of renewable energy in electricity production (%) in 2015
Africa	16.9	17.4	18.9
Asia	13.9	16.1	20.3
CIS	18	16.7	16.1
Europe	20.1	25.7	34.2
Latin America	59.3	57.7	52.4
Middle East	4.3	2.0	2.2
North America	24	25.8	27.7
Pacific	17.9	18.6	25.0

Source World energy resources (2016, p. 9)

2 Renewable Energy Sources in Turkey

2.1 Renewable Energy Sources

On 31 November 2016, renewable energy sources claimed a 43.2% share in Turkey's total installed power capacity of 78,591.8 MW. The utilizations of the sub-categories of renewable energy sources include: wind (5387 with 6 MW at 6.86%); geothermal (775 with 1 MW at 0.99%); biomass (464, with 8 MW at 0.59%); hydroelectricity (26,515 at 9 MW with 33.74%); and solar (792 at 8 MW with 1.01%) [4] (Table 2).

Table 2. Annual changes to renewable energy sources in installed power capacities of renewable energy resources

Source	2013	2014	2015	2016
Wind	2759.6	3629.7	4503.2	5387.6
Geo	310.8	404.9	623.9	775.1
Biomass	236.9	288.1	344.7	464.8
Hydro	22289.1	23643.2	25867.8	26515.9
Solar	0	40.2	248.8	792.8
Other	38447.6	41513.6	41558.3	44655.6
Summary	64044.0	69519.7	73146.7	78591.8

Sources TEİAŞ installed power capacity

An investigation of Turkey's potentials for renewable energy sources demonstrates that Turkey has a wind energy potential of 48,000 MW. This potential equals 1.30% of Turkey's total surface land mass [5].

Turkey ranks fifth in the world and first in Europe with its approximate 31,500 MTt of geothermal energy potential. A 6 TWh portion of this energy can be used for the generation of electricity, while a 19 TWh portion can be used as a direct energy resource [6].

It is predicted that Turkey's animal waste potential is equivalent to a volume of biogas that is roughly equal to 1.5–2 million tons of petroleum (MTEP) [7]. This in turn is equivalent to an energy potential of approximately 17–23 TWh.

Turkey has an annual hydroelectric energy potential of 433 TWh, which that will provide technological utilization of 216 Twh per year, and an annual economic based hydroelectric energy potential of 144 TWh [8].

It has been demonstrated that Turkey's solar energy potential is based on an average annual total sunlight period of 2640 h (or 7.2 h per day) and an average solar radiation intensity value of 1311 kWh/m^2-per year (daily total of 3.6 kWh/m^2) [9].

3 Laws Governing Renewable Energy Sources Renewable Energy Resources

The legal structure that began in 2001 with the establishment of the Energy Marketing Regulatory Authority has resulted in a number of modifications to current laws and the passing and publication of new legislation, guidelines, and by-laws aimed at regulating Turkey's electricity markets. This Authority has been significantly instrumental in meeting the needs of the energy market and in the provision of legislation that has especially streamlined and updated the electricity markets. These legislative efforts have also played an important role in increasing the share of renewable energy resources in Turkey's overall energy consumption markets.

Listed below are the names and descriptions of these legislations and a brief summary of the innovations they have brought to the sector.

3.1 2001—Law no. 4628: Law Governing the Electricity Market

Law 4628 Governing the Electricity Market, which was passed in 2001 and aimed at encouraging the use of renewable energy and domestic energy resources includes the provision of oversight to the Energy Marketing Regulatory Authority (EPDK). This law, which references renewable energy resources in Turkey, is comprised of two legal texts. The law also limits the non-licensed generation of electricity to 500 kW Renewable Energy Resources [10].

3.2 2002—Guidelines Governing the Licensed Electricity Market

Law Number 4628 Governing the Electricity Market lays out the legal procedures and principles of licensing those legal entities that are determined to have the qualifications

of competing in a financially sound, stable, and transparent electricity market. As a means of predicting or eliminating problems that could arise in the post-licensing period, amendments made to the law in 2013 established a pre-licensing, probational period in which those license applicant companies can be monitored prior to approval or denial of license [11].

3.3 2003—Guidelines Governing the Legal Procedures and Principles of Water Utilization Agreements for Operations on the Electricity Market

These guidelines have been prepared exclusively for private sector entities investing in energy producing facilities using state-owned hydraulic resources [12].

3.4 2005—Law Number 5346 Governing the Utilizations of Renewable Energy Resources in the Generation of Electric Power Renewable Energy Resources Renewable Energy Resources

Proposals call for the establishment of a fixed price for purchasing of electricity generated at YEK facilities. This Turkish Lira price should not be less than the equivalent of 5 Euro cents/kWh and should not be more than the Turkish Lira equivalence of 5.5 Euro cents/kWh. There is no distinction in prices for parts and equipment that are either domestically manufactured or imported [13].

An amendment made in 2010 determines a different unit price for each kind of renewable energy resource utilized and also authorizes additional incentives for the use of domestic parts and equipment. The amendment also specifies that these incentives will be valid for a period of 10 years and will include all energy generating facilities, including the YEKDEM plants, [14].

3.5 2013—Law Number 6446 Governing the Electricity Market

This law modifies the exemption on obtaining a license for the generation of electricity from renewable energy resources by raising the generated energy derived from renewable energy resources to 1 MW. The law also proposes the organization of a competition for the licensing of wind and solar generating stations [15].

3.6 2013—Guidelines for the Certification and Support Regarding Renewable Energy Resources

These guidelines comprise the principles and methods and monitoring to be utilized in the determination of source of renewable energy resources in the purchasing of the electricity generated by the license holder of the YEK Certificate (Renewable Energy Resource Certificate) issued by the EPDK [16].

3.7 Guidelines Legislating the Competition Organized for Pre-licensing Applications for the Establishing of a Wind and/or Solar Energy Generating Plant

These guidelines establish the competitive method to be employed by Turkish Electricity Transmission Council (TEIAS) if there are more than one applications from any one region. The guidelines have also been designed to determine the details of the Wind and Solar Energy Based Electricity Generation Station Contribution Margins [17].

3.8 2013—Guidelines Relative to the Non-licensed Electricity Market

These guidelines refer to the principles and methods to be employed in the generation of electricity by those legal individuals and entities that are exempted from the requirement to obtain a license [18].

The following guidelines are to be used for the transmission of extra electricity to the system by those legal individuals and entities that are generating less than <1 MW of electricity.

An amendment made to the law in October of 2016 eliminates Article 21 of the law relative to the support of domestically manufactured parts and equipment [19].

3.9 Bulletin Related to the Implementation of the Guidelines Legislating the Non-licensed Generation of Electricity in the Electricity Market

This bulletin has been prepared for the purpose of explaining and implementing the regulations outlined in the Guidelines Relative to the Non-Licensed Generation of Electricity [20].

3.10 2014—Guidelines to the Electricity Marketing Grid

These guidelines delineate the standards to be utilized in ensuring the kind of effective planning, operating, decision making implementations that will lead to a safe and low-cost electricity transmission system. The guidelines also outline the conditions to be established so as to provide consumers with high quality and adequate supplies of electricity [21].

3.11 2015—Guidelines to the Monitoring of Wind Power Capacities of Wind Energy Generating Stations and the Connecting of These Stations to the Forecasting Center

These guidelines explain the legalities involved in attaching wind power generating stations to the Wind Power Monitoring and Forecasting Center (RITM). By law, all stations licensed to generate 10 MW or more of wind energy must be connected to this center [22].

3.12 2016—Guidelines Relative to Renewable Energy Resources Fields/Farms

These guidelines have been published to establish extensive renewable energy generation areas (YEKA). A tender system is used to provide investors with advanced technology areas to be used in the domestic generation of electricity or for the procurement or transfer of know-how within the country [23].

The guidelines call for the generation of 1.7 billion kWh of energy at the station to be established following the tender.

4 Incentive Mechanisms

4.1 State Sponsored Investment Support

Turkey's policies relative to energy investments include the provisions of incentives as per Law Number 3305 published in 2012: Decision Relative to Governmental Investment İncentives. This law delineates the implementation of investment provisions by dividing the country into six regions based on the socio-economic development levels of the provinces included in these regions.

The incentive system includes the provision of various support mechanisms based on the categories of: general, regional, large scale, and strategic investments. Those generating stations benefiting from these support systems are exempted from various customs taxations, the paying of VAT, other taxation deductions, and the employer's share of social security benefit payments. The investor also receives interest payment supports, VAT redemptions, and support for social security [26].

A later Bulletin has removed the purchasing of imported solar panels from the list of incentive supports [27]. This amendment serves to benefit the transfer of currency out of the country and to support domestic manufacture of such panels. The purpose of the latter is to modify Turkey's position from technology consumption to technology production.

From January through August of 2016 a total of 23 foreign investment entities and 1270 domestic capital companies were granted incentive certification for energy sector investments [28].

For the first time in the history of the Turkish Republic, the Mid-Term Plan for the years 2017–2019 prepared through the coordination of the Ministry of Development has included the terms "wind", "solar", and "hydroelectric".

Predictions call for energy imports to total 32 billion dollars in 2017. By the end of 2017 it is expected that energy importation will maintain its nominal increase and will reach a total of 41.3 billion dollars. In order to achieve security in the field of energy, efforts will be expended towards domestic and renewable energy resources, while investments in nuclear technologies will also continue. Efforts directed towards the acquisition of machinery and equipment used in the establishment and operations of such alternative energy resources as wind, solar, and hydroelectric power will also continue [29].

4.2 Renewable Energy Resources Support Mechanism

An amendment to Law 5346 published in 2010 has determined the provision of 7.3 (US dollar) cents/kWh for the generation of electricity through solar and wind power. Other incentives are directed towards the use of domestically manufactured parts and equipment in the establishment of such generating plants. A purchasing price of 11 (USD) cents/kWh has been determined for wind generated energy.

The kWh incentive figures are given in Table 3 [14].

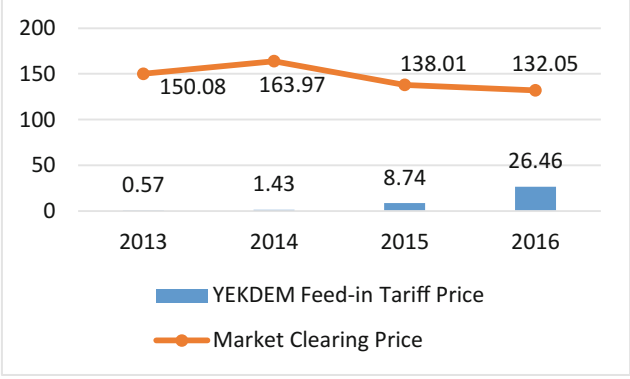
Table 3. Incentives for support mechanism

Production type based on renewable energy source	Prices to be applied (U.S.D. cent/kWh)	Maximum prices can be applied with the addition of local content (U.S.D. cent/kWh)
Hydroelectric energy based production power plant	7.3	7.3 + 2.3 = 9.6
Wind energy based production power plant	7.3	7.3 + 3.7 = 11.0
Geothermal energy based production power plant	10.5	10.5 = 2.7 = 13.2
Biomass energy based production power plant	13.3	13.3 + 5.6 = 18.9
Solar energy based production power plant (PV)	13.3	13.3 + 6.7 = 20.0
Solar energy based production power plant (concentrator)	13.3	13.3 + 9.2 = 22.5

Sources Law Number 5346, p. 9, 10

Table 4 (which shows both the Yekdem Feed-in Tariff Price per MWh and the Market Clearing Price used as a reference), demonstrates that those years with high Market Clearing Price have low Yekdem tariff prices, while, correspondingly, when the Market Clearing Price is high, the Yekdem tariffs drop [30].

Table 4. YEKDEM feed-in tariff price—Market Clearing Price



Sources EPİAŞ transparency

The influence of the Renewable Energy Resources Council has strengthened with the provision of incentives, resulting in a relative rise in the retail prices of electricity on the Electricity Market. Commercial electricity is being calculated according to the unit sales price Market Clearing Price (MCP) + Yekdem Feed-In Tariff Price.

The Guidelines to the Certification and Support of Renewable Energy Resources was amended on 29 April 2016 [31] so as to assume the responsibility for the state of unbalance in costs between renewable energy resources and generating plants.

These new guidelines, which provide YEKDEM generating plants with a 2% disparity right, have catalyzed major debate due to the fact that this rate varies according to the kind of resource being utilized, especially so the disparity related wind turbine fields, which is higher than that of other energy resources.

Turkey's Union of Wind Energy Generators have reported that this new tolerance rate has resulted in a 15% decrease in income [32].

During the period spanning January to October 2016 total incentives totaling 381.982.841,17 TL have been paid as LÜYTOB (YEKDEM Non-Licensed Production Feed-In Cost) and 9019, 617,679. 94 of YEKBED (YEKDEM Licensed Production Feed-In Cost) as compensation for the generation of 39,132,779.35 MWh of energy, for a total of 9,401,600,521.11 TL YEKTOB (YEKDEM Total Incentives) [33].

In 2017 there are also other renewable energy resource-based electricity generation plants that are not being supported by incentives and that are producing an annual 17,399.94 MW of electricity. Forecasts call for these plants to generate a total of 47,448.19 GWh of energy [34].

Table 5 shows the installed power of YEKDEM plants by years and by resources utilized.

Table 5. Changes by years to the established power of YEKDEM participating energy generating plants by resources utilized

Sources	2014	2015	2016	2017
Wind	826.4	2732.1	4319.8	5238.7
Solar	0	0	0	12.9
Geo	227.8	389.9	599.2	752.1
Biomass	136.3	185.2	203.7	300.0
Hydro	608.4	2116.3	9960.0	11096.3
Sum	1798.9	5423.5	15082.7	17399.9

Sources EPDK YEKDEM reports

5 Conclusions and Proposals

Table 6 provides Turkey's installed power during the years spanning 2013–2016. While it shows that the potentials of wind power have not transformed into investments up to 2016, it also shows that there has been a 95% increase in Licensed Wind Established Power.

Table 6. Turkey's installed power capacity (MW)

Sources	2013	2014	2015	2016
Fuel-oil + naphta + diesel	708.3	659.8	851.0	368.7
Local coal (hard coal + lignite + asphalt)	8515.2	8573.4	9013.4	9842.4
Imported coal	3912.6	6062.6	6064.2	7473.9
Natural gas + LNG	20269.9	21476.1	21222.1	22502.4
Biomass	236.9	288.1	344.7	464.8
Multi fueled solid + liquid	675.8	667.8	667.1	667.1
Multi fueled liquid + natural gas	4365.8	4074.0	3684.0	3719.0
Geothermal	310.8	404.9	623.9	775.1
Hydro (dammed)	16142.5	16606.9	19077.2	19408.5
Hydro (run of the river)	6146.6	7036.3	6790.6	7107.4
Wind	2759.6	3629.7	4498.4	5376.1
Solar	0	0	0	12.9
Thermic (non-licensed)	0	0	56.5	82.1
Wind (non-licensed)	0	0	4.8	11.5
Solar (non-licensed)	0	40.2	248.8	779.9
Summary	64,044	69,519	73,146	78,591

Sources TEİAŞ installed power capacity

Turkey's solar energy installed power has increased by 519%, leading it from an earlier position of 13th in Europe to current 7th place [35].

As of 31 November 2016, Turkey's total installed power of 78.591.8 MW has been made up of: Solar (12.9 MW licensed at 0.02%, and 779.9 MW non-licensed at 0.99%); hydroelectric (19,408.5 MW from dams at 24.7% and 7107.4 MW from running water at 904%); biomass (464.8 MW with 0.59%); wind (5376.1 MW licensed 6.84%, and 11.5 MW non-licensed at 0.01%); geothermal (775.1 MW with a contribution of 0.99%) [4].

Table 6 shows that in 2016 solar energy had a break-through year with licensed solar energy generating plants taking the lead. Energy generated from geothermal and biomass resources also increased during this same time period. Most likely the reason for the increase in biomass generated energy was due to the addition of this energy source to the national development plan, which transferred the management of waste to the municipalities, which in turn have developed their own ways to benefit from this resource. Thus we can see that Turkey's utilization of renewable energy resources has been making positive strides.

However, in November of 2016 the rapid rise in foreign exchange rates opened a debate on the payment of incentives. Three separate arguments have been placed on the table: (1) these incentives need to be lowered if the US dollar continues to be used as a basis; (2) if the dollar continues to be used as the basis for tariffs, its exchange rate should be stabilized and not allowed to flux; or (3) the incentives should be paid on a Turkish Lira basis. The competition scheduled to be held as per the Guidelines Governing Renewable Energy Resources Fields was postponed until 14 February, 2017, thus allowing a period of time for the continuation of discussions relative to the YEKDEM tariffs.

The Guidelines Governing the Certification and Support of Renewable Energy Resources includes the provision of 10-year guarantees. This implementation poses a risk for current investments after the expiration of the 10-year period and a risk for future investments as well. This cloud of uncertainty needs to be cleared so that long-term plans can be made.

In 2016 Turkey should modify its energy policy paradigms to direct the policy towards investments in electricity transmission infrastructures. Rather than focusing on non-licensed generation of less than 1 MW, attention should be turned towards renewable energy resource-based generation plants with high installed power rates. The Guidelines Governing Fields of Renewable Energy Resources should be modified to include those licensed solar energy and other resources generating plants with high installed power generating operations into competitions that should be held in 2017.

New alternative models should be established for YEKDEM and these models should use investment financing funds to assist investors in turning profits on their efforts.

To this end, those funds that are currently not being used and whose rates of profit are low, especially the unemployment insurance fund, which in 2015 reached a total of 94,117,471.1 TL [36] and the individual retirement insurance fund with its total of 51,996,814,532 TL [37] should be used to finance those plants that are generating electricity from renewable energy resources.

Internet-based public funding tools could also be utilized to support such plants. This is one of the new model proposals raised by this work.

All legal obstacles to the development and installation of rooftop electricity generating systems should be eliminated and the roofs of public buildings should be used as models in the advancement of such systems.

The Law on the Regeneration of Areas under Disaster Risk, which is popularly referred to as the Law on Urban Renewal, should be amended with articles [38] that provide incentives or other encouragements to the establishment of roof top energy systems.

The atlases on solar energy and wind energy potentials both need to be updated. A solar energy forecasting and monitoring center needs to be established.

Turkey's energy policy paradigms should be modified to encourage both the establishment of high installed energy capacity generating plants and the transfer of technologies and know-how. Adding requirements that companies entering licensing competitions must establish Turkish factories to manufacture the parts and equipment to be used in the energy generating plants to be set up will bring the future into clearer focus.

Separate incentive mechanisms and relative policies must be devised for systems based on non-licensed plants and solar rooftop generators that are directed to the use of immediate consumers.

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