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Review Paper

Impact of Financial Support Mechanisms on Renewable Energy Deployment: Turkey as a Case Study

Gamze Tanil*

Department of International Relations, Faculty of Administrative, Economic and Social Sciences, Nişantaşı University, Sarıyer, Istanbul, Türkiye

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Abstract: In this study, the link between state financial support mechanisms for renewable energy sources (RES) and renewable energy deployment success in Turkey is inquired. The study particularly focused on the electricity sector. Deployment success for renewable energies is defined using several indicators: number of new participants to the RES financial support scheme, their installed capacity, their electricity generation, the amount of RES payments in the given year, the increase in overall renewable energy capacity, and the increase in the share of renewable energies within overall electricity generation of the country. The study starts by reviewing state regulations and financial incentives that promote renewable energy investments in Turkey. The effectiveness of this policy is tested by using yearly renewable energy statistics for the period 2014-2020. Methodologically, correlation analysis is applied to test the research hypotheses. The research results showed significantly positive correlation coefficients between the tested variables within the study period, and therefore, validated the positive impact of the use of state financial incentives on the promotion of renewable energy capacity, and thereby, on the increase in the share of renewable energies in the overall electricity mix in Turkey.

Keywords: *Renewable energy, financial incentives, investments, feed-in tariff, Turkey*

Introduction

In the post-Covid 19 pandemic period, in the global scale, states and societies increasingly faced with energy supply insecurity and price volatility problems. The conventional energy sources also bring about environmental pollution and warming problems. To prevent these negative effects on environment, economy, and society, the governments focus on the ways of reducing fossil fuel use and increasing the share of renewable and environmentally friendly energy sources. The renewable energy sources have many advantages over the conventional energy sources. They have less environmental impact, they are infinite and flexible, and they have decentralization possibility. They also contribute to other sectoral goals such as reducing greenhouse gas emissions, developing the related manufacturing sector, and creating new jobs for the society. The overall positive impacts of the renewable energies would be a significant contribution to the sustainable development goals of the countries. There are many studies in the academic literature that confirm these positive impacts. For instance, Dincer provided that sustainable development requires a sustainable supply of energy resources, and in this context, renewable energies are sustainably available at reasonable cost (Dincer, 2000). To encounter the negative consequences of the fossil fuel use and of the dependence on energy imports, many states focus on policies to increase the share of renewables in their energy generation and benefit from these resources in a secure, economic, and sustainable way in the longer term.

However, many developing countries encounter problems of finding efficient and sustainable ways of abandoning fossil fuels and investing in renewable energies. Especially for those countries that are traditionally dependent on conventional energy sources, energy transition is a complicated process implying major changes in the existing energy structures. Turkey is one of such examples with its dependence on imported fossil-fuel based energy sources. A quick analysis of national statistical data shows that conventional energy sources dominate the energy mix of Turkey in electricity generation. IEA database shows that fossil fuels dominate the total primary energy supply (TPES) in Turkey as their share has been stable at around 90% since 2000 (IEA, 2021). In 2019, the share of fossil fuels in TPES was 83%, which ranked the ninth-highest ratio among IEA member countries. In terms of electricity generation in 2019, coal constituted the biggest share (34.5%), followed by hydro energy (25.4%), natural gas (22.5%), and wind energy (8.03%). Even though Turkey has a growing production capacity

*Corresponding: E-Mail: gamzetanil@yahoo.com; Phone: +902122101010

in RES, the choice of electricity production remains heavily on the side of the conventional energy sources due to their being considered as a reliable power supply. This situation not only limits the country's options in economic development and foreign policy, but also exacerbates its environmental problems.

Turkey recognized the need to promote the production and use of renewable energies, and thereby, to change its energy mix. The Eleventh Development Plan of Turkey (2019-2023) set forth national energy targets with a target of 38.8% share of renewable energy sources in electricity production in 2023. It is obvious that this political target can be achieved through effective government policies that would provide supportive legal and financial framework for the new renewable energy investments. In many developing countries, a big obstacle to renewable energy deployment is its high upfront capital costs because the renewable energy projects require high initial investment before the start of production and this investment cost is generally borne by investors. For this reason, many states try to promote the deployment of renewable energies with enabling policy frameworks including different financial support measures.

Therefore, this article inquires the implementation of renewable energy deployment in Turkey through enabling financial measures. The focus is on the relationship between state's various financial incentives and the increase in renewable energy investments, and the resulting increase in the share of renewable energies in the overall energy generation. Most of the existing literature on the subject have affirmed the triggering effect of state financing mechanisms on the new renewable energy investments. In the same vein, this article inquires the role and efficiency of state financial incentives for renewable energies in Turkey on deployment success.

In this article, state's financial incentives are defined as allocation of financial resources in the energy sector with an aim to guide the capital flow into renewable energy investments. In the global context, the impacts of financial incentives on renewable energy investment efficiency have been empirically analyzed by several academic studies. As an example, scholars studied the intermediary effect of bank loans, short-term loans, and long-term loans in China and found that short-term loans have few intermediate effects on investment efficiency, while long-term loans have no intermediary effect (He et.al., 2019). These authors suggested that the government should construct the green financial system through appropriate policies and regulations (He et.al., 2019).

There are several studies on the impact of financial mechanisms for an effective utilization of renewable energy sources in Turkey. In 2017, scholars analyzed the renewable energy utilization in Turkey and concluded that although electricity was mainly generated by using fossil energy resources, renewable energies showed a significant increase as well (Ugurlu and Gokcol, 2017). The authors attributed this increase to the renewable energy law in 2005 which regulated the sector and provided financial incentives for the new renewable energy investments. To achieve full utilization of the renewable energy potential of the country, they suggested to remove the barriers to new investments via laws, regulations, and financial incentives (Ugurlu and Gokcol, 2017).

A number of studies focused on the role of enabling government policies and financial support mechanisms in triggering the deployment of renewable energies (Haas 2011). In this context, several scholars underlined the need for government financial incentives for the deployment of renewable energies in Turkey. This need mainly arises from the fact that renewable energy technologies have high initial capital costs. Particularly, this holds true for the solar PV electricity, hydropower, and wind energy. Due to high investment costs, poor people or communities may find it difficult to afford investments without government's financial support (Kaygusuz, 2011). For this reason, the high initial costs of investing in renewable energies should be overcome by state mechanisms via financial, technical, and organizational intermediation (Kaygusuz, 2011).

Similarly, other scholars analyzed government policies in Turkey for the promotion of renewable energy investments and argued that the introduction of the Renewable Energy Law of May 2005 boosted the new renewable energy investments via the introduction of tariff support for renewable electricity (Benli, 2013). The amendments of this law in May 2007 and in 2010 increased the level of the support, however, the author considered this support low in comparison to other European countries (Benli, 2013).

In the literature, energy policy legislative framework and financial incentives in Turkey were also analyzed to find out the institutional barriers for the development of renewable energies. This research depicted these barriers as high taxes, inadequate market conditions and private sector participation, and risks and costs associated with the renewable energy investments (Simsek and Simsek, 2013). The authors concluded that implementation of a successful renewable energy policy should be the priority

of Turkey's energy policy, and it should be facilitated by an intense collaboration between government agencies, the private sector, and the consumers via appropriate financial incentive mechanisms (Simsek & Simsek, 2013).

Researchers also showed a correlation between the development level of financial markets and new renewable energy investments. It was found that the renewable energy sectors grow disproportionately faster in countries with developed financial markets. Since renewable energies are highly dependent on external financing, they demonstrate a higher deployment level in more developed financial markets (Kim and Park, 2016).

The financing methods of renewable energies were also analyzed in developing countries to find out the ultimate method of achieving sustainable development. The researchers have shown that in Africa, governments promote renewable energies to foster economic development and they implement various financing mechanisms to achieve anticipated level of deployment of renewable energies. These governments mostly focus on end-user finance for individual households, business finance for small and medium enterprises (SMEs), and small-scale project finance for energy communities (Oji et.al., 2016). However, in Africa, the problem associated with the support for large projects is that although they provide an increase in electricity production, they do not provide an increased energy access for the whole society. Therefore, the authors suggested that it is better for the governments to support individual households and SMEs in terms of new renewable energy investments, if they seek to achieve energy transition and sustainable development (Oji *et.al*., 2016).

Several policy experts and scholars share the argument that feed-in tariffs are the most convenient and efficient financial support mechanism to reach wider sections of society. In a comparative analysis among several countries, researchers analyzed the impact of feed-in tariffs (FIT) for the deployment of renewable energies in China, India, and South Africa, particularly for the solar PV sector (Becker and Fischer, 2013). The authors argued that FITs provide investment security by increasing investor's ability to plan the future of the business, and by this way, accelerate deployment of the targeted renewable energies, whereas low tariffs and competitive auctions limit the deployment of solar PV projects (Becker and Fischer, 2013).

As a conclusion, government financial mechanisms are inevitable for the increase in renewable energy investments in all countries, although the mix of financial measures might vary depending on different political, economic, and social contexts.

Policy Analysis

In this study, it is argued that the energy transition process begins with supportive governmental policies such as creating a sound regulatory framework and employing financial mechanisms. These policies are implemented by many countries with an aim to create enabling conditions for new renewable energy investments and promote the use of renewable energies by individuals, energy communities, and the private sector. The outcome of such policies reduces business risks and increases the confidence of investors and markets. Turkey combines different forms of financial support measures for the renewable energy investments. This section provides an overview of these financial support mechanisms. This analysis serves as the validation of a determined governmental policy for the promotion and the use of renewable energies.

In Turkey, Renewable Energy Support Mechanism (YEKDEM) regulates the feed-in tariffs (FITs) for renewable energy facilities since 2011. The terms and conditions to receive FITs are firstly specified in 2005 with Law No:5346. An amendment to this law was provided in 2011 with Law No:6094 on the utilization of renewable energy sources in electricity generation. This law regulated the incentives to renewable energy sources according to source type and locality rate and determined the details of the Renewable Energy Resources Support Mechanism. According to this law, the legal entities who wish to apply for support mechanism must hold a valid license for renewable electricity generation and obtain a RES certificate. For this purpose, they must apply to the Energy Market Regulatory Authority (EPDK). The FIT support is given in Turkey for the first ten years of operation starting from the commissioning date of the facility. Law No.5346 provided a fixed FIT support for all renewable energies, but later, Law No.6094 differentiated the FIT support for each renewable energy sector (See Table 1).

Law No. 5346 also provided local content support for domestically manufactured equipment used in the renewable energy generation facility. This type of support is an extra bonus that is added to the FIT price. The basic requirement is that at least 55% local content ratio must be met to receive the incentive. The law stated that the amount of this support would be between 0.4 USD and 3,5 USD per kWh depending on the types of local components and machinery (See Table 1). This support is provided

for five years from the starting date of operation of the renewable energy facility.

There is another financial support mechanism, that is termed as land usage fee incentive. This mechanism was designated for the land that is privately owned by the Treasury or placed under state disposal to be utilized for renewable energy generation. The renewable energy projects that are granted this incentive are entitled to a discount of 85% for permission, lease, easement rights, and servitude right fees for the first ten years of operation.

Renewable energy facilities in Turkey can also benefit from a reduction in license and system usage fees. The system usage fees are reduced by 50% for the renewable electricity generation facilities for the first five years of their operation, while the annual license fees are annulled for the first eight years of operation.

Pursuant to the Council of Ministers' Decision No. 2012/3305 on the "State Aids for Investments" the renewable energy generation facilities can benefit from the General, Regional, and Strategic Investment Incentive Schemes. These schemes include different incentives, such as VAT exemption, customs duties exemption, corporate tax reduction, social security premium support, and interest rate support. These support schemes have been successful in driving sizeable new investments in renewables within the period of their implementation.

Table 1. Feed-in tariff and local content support provided for renewable energies in Turkey

Renewable energy sector	Feed-in-tariff (US Dollar cent/kWh	Local content support (US Dollar/kWh)
Hydro energy	7.3	1.0 – 1.3
Wind energy	7.3	0.6 – 1.3
Solar PV energy	13.3	0.5 – 3.5
Geothermal energy	10.5	0.7 – 1.3
Biomass	13.3	0.4 – 2.0

The literature on the analysis of the deployment of renewable energies in various countries affirmed that effective design as well as transparent and extensive use of state financial support schemes result in a successful energy transition. Upon a closer investigation, the brief analysis here demonstrated that Turkey carefully designed and adjusted financial support mechanisms to ensure investor interest in renewable energy projects and provided a positive climate for new investments. These financial support mechanisms are important to attract new actors to the market and stimulate new investments in renewable energies. Only through implementing such measures states can acquire a growth in renewable energy installation and generation.

Materials and Methods

Methodology

The aim of this analysis is to find out the impact of the financial support mechanisms on the renewable energy deployment success in Turkey in the examined time period (2014 – 2020). The selected time series starts with 2014 due to data availability because statistical data regarding YEKDEM mechanism has been provided constantly since 2014.

Regarding the renewable energy investments, particular attention is given to six variables: number of new participants to the RES support scheme, their installed capacity, their electricity generation, the amount of RES payments to these participants, overall renewable electricity capacity in the country, and the share of renewable energies in the country's electricity mix. These aspects are called together as "deployment success". Detailed descriptions of all variables are provided in Table 3. The statistical data for these variables are acquired from the annual reports of Energy Market Regulatory Authority (EPDK) and Energy Markets Operation Company (EPİAŞ) of Turkey. This data is tested, when applicable, using the annual statistical reports of the International Energy Agency (IEA).

A correlation analysis is applied for these hypotheses. The statistical expectation is that if the correlation coefficient is closer to +1, it indicates a positive (+1) correlation between the variables. If the correlation coefficient is closer to -1, it indicates a negative (-1) correlation between the variables. Positive correlation means that when the values of one variable is increasing, the values of other variable increase as well. Negative correlation means that when the values of one variable is decreasing, the values of other variable decrease as well. If the correlation coefficient is closer to 0, it indicates no or weak correlation. The results of empirical analysis are given in the next section.

Table 2. Description of variables

Symbol	Definition	Unit
PART	New participants to YEKDEM scheme in a given year	Number
INST	New installed renewable electricity power in the context of YEKDEM in a given year	MW
GEN	Generation of renewable electricity power in the context of YEKDEM in a given year	MWh
PAYM	Annual YEKDEM payments each year	TL
YEAR	Year	Time
CAP	Overall renewable energy capacity in the country	MW
SHARE	Share of renewable energies to the overall energy capacity in the country	Percent

The hypotheses in this study are:

H1 = New participants in RES support scheme (PART) positively impacted on the increase in the installed capacity in renewable electricity (INST)

H2 = New participants in RES support scheme (PART) positively impacted on the increase in renewable electricity generation (GEN)

H3 = New renewable electricity installations (INST) in the context of RES support scheme positively impacted on the increase in overall renewable electricity capacity (CAP)

H4 = RES incentives (PAYM) positively impacted on the overall renewable energy capacity (CAP)

H5 = New participants in RES support scheme (PART) positively impacted on an increase in the share of renewable energy capacity in the country (SHARE)

Empirical Analysis and Discussion

A data set from 2014 to 2020 is used to examine the relationship between financial incentives and renewable energy growth (See Table 3). The preliminary argument is that the growth in the share of renewable energies in a country is highly reliant on supportive government policy; this argument is tested by using a correlation analysis. There are several ways to measure renewable energy's development in the literature, such as through installed capacity and electricity generation. The capacity increase is used to examine the links between available financial incentives and the actors' decision to invest in renewable energy installations. To the extent that the state financial support is an effective policy for promoting renewable energy growth in a country, annual financial payments to renewable energy investments is used to capture the link between the policy dependence and growth in renewable energy deployment.

Table 3. Data set for the variables

YEAR	PART	INST	GEN	PAYM*	CAP	SHARE
2014	93	1798.0	5874.769	1207044	27945.0	40.2
2015	234	5423.6	17944.514	4045866	31520.8	43.1
2016	556	15082.7	45830.502	11015263	34449.6	43.9
2017	647	17399.9	50496.769	13869442	38751.1	45.5
2018	708	19266.3	62505.431	21945656	42264.0	47.7
2019	777	20921.5	76668.087	37996703	44395.5	48.6
2020	821	21146.1	73482.227	46323195	49202.2	51.3

* Data for 2014, 2015, 2016 are taken from EPİAŞ online information platform (Exist). Data for 2017, 2018, 2019, 2020 are taken from EPDK annual reports.

Table 4. Hypothesis testing: correlation coefficient between the selected variables

Hypothesis	Variable 1	Variable 2	Correlation coefficient
1	PART	INST	0.998286
2	PART	GEN	0.98797
3	INST	CAP	0.921618
4	PAYM	CAP	0.959867
5	PART	SHARE	0.924408

** significant at alpha = 0.05

As can be seen from Table 4:

H1: The impact of new participants in RES support scheme on the installed capacity in renewable electricity is significant (0.998286), thus the correlation between these variables is tenable.

H2: The direct effect of new participants in RES support scheme on the renewable electricity generation is significant, and the coefficient is 0.98797, which shows that increasing number of participants in the RES support scheme increases the renewable electricity generation.

H3: The effect of new renewable electricity installations in the context of RES support scheme on overall

renewable electricity capacity is significant (0.921618); this shows that a contributing effect of supported renewable energy facilities on the overall energy capacity exists.

H4: The impact of RES incentives on the overall renewable energy capacity is significant (0.959867), thus the correlation between these variables is tenable.

H5: The direct effect of new participants in RES support scheme on the share of renewable energy capacity in the country is significant, and the coefficient is 0.924408, which shows that increasing number of participants in the RES support scheme increases the share of renewable energy in the country.

The results show that within the study period (2014-2020), state financial support for the renewable energies increased the renewable energy capacity and generation in Turkey. In practice, this capacity and production increase within the RES schema improved the share of renewable energies in the overall energy mix and brought a positive development on the way of energy transition. To maintain this positive trend in renewable energy deployment, government, financial institutions, and private enterprises must continue coordinating with each other in this policy framework.

Conclusion

In this article, the use of financial incentives and the deployment success in renewable energies in Turkey is analyzed, and a positive correlation is found between the financial incentives and the renewable energy capacity increase.

The preliminary assumption of this research is that effective governmental policies for the promotion of renewable energies positively impact on new renewable energy investments, and thereby, they trigger energy transition from conventional energy sources to renewable energy sources. The conclusion of data analysis showed that in Turkey, supportive financial incentives for renewable energies provided an effective method to maintain new investments and contributed to the increase in the share of renewable energies in the overall energy capacity. Therefore, supportive financial incentives provided a useful mechanism for the achievement of Turkey's renewable energy targets.

There is still a high potential for renewable energy resources in Turkey, so, an economic growth opportunity can be triggered by greater investments in the renewable energy sectors. These investments are expected to provide positive socio-economic consequences as well. Although dominant policy objective for the promotion of the renewable energies is mainly the reduction of import dependency on oil and gas, a sustainable economic growth opportunity is also significant for Turkey. The achievement of both goals of energy transition and sustainable economic growth would be in line with the EU's policy goals and objectives. These achievements would be a decisive move for this EU candidate country to associate itself more closely with the EU member states.

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