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Renewable Energy Contributions to Turkey's Economic Framework

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ABSTRACT

This article offers an overview of the policies implemented by the Turkish government in the renewable energy sector, and how investments in this realm can affect the economic growth of the country. In the last fifteen years, the renewable energy sector has gained more importance and has witnessed many improvements mainly as the focus of most countries in the world has shifted from non-renewable and fossil fuel energy to green and eco-friendly solutions. Turkey's dedication to enhancing its renewable energy portfolio and the government's initiatives and investments in this field like reforming the energy market, diversifying the country's energy mix and implementing supportive policies for investments in the renewable energy sector, all that have contributed to making the country one of the leading countries in the sustainable energy realm. This article will help researchers and policymakers use Turkey as a source of inspiration when it comes to implementing eco-friendly regulations and help them see how investment decisions in this field can boost economic growth. The article mainly gives an overview of the effectiveness and the design of the Turkish government's renewable energy strategies and policies. The study also gives an updated image of the renewable energy sector production in Turkey with also some recommendations in order to overcome some challenges the country still faces in this field.

Keywords: Policy, Renewable Energy, Turkey, Investment

JEL Code: E22, Q28, Q29

1. Introduction

Our lives and eventually our economic activities have a great dependence on climate stability. Sectors like tourism, construction, and agriculture, which are in most cases the backbone of some countries' economies, are closely related to weather change. With climate-related risks growing daily, the seriousness of its effect on the economy grows paralytically. As an effective risk management strategy, growing the use of renewable energy can contribute to minimizing the related risks.

Turkey is considered one of the countries that have a big advantage in the energy sector. With its unique geographical location, the abundance of its natural resources, and the efforts that the Turkish government has put into the energy sector, Turkey has great potential to grow its wind, geothermal, and solar energy and minimize its energy imports which will boost its economic stability and eventually its energy security.

The policies made by the government play a major role in shaping the renewable energy sector inside the country. This is one of the reasons that make analyzing and studying the policies made by the government crucial and important. Turkey has worked throughout the years on improving the renewable energy sector by implementing and updating a set of policies and incentives like Renewable Energy Support Mechanism (YEKDEM), and domestic renewable energy production incentives. The efforts made by the Turkish government in the renewable energy sector reflect the country’s commitment to its climate goals in accordance with the Paris Agreement.

This article gives an overview of the policies implemented by the Turkish government in the renewable energy field. First general information about the energy sector situation in Turkey is given. Then, policies implemented by the Turkish government in the renewable energy sector are listed. In the end some recommendations for some challenges faced by Turkey are given.

2. Literature Review

Many studies have been conducted in the renewable energy sector in order to study its contribution to the economic situation of the country. The studies analyzed are listed below:

Bezdek (2009)'s research aimed to analyze the impacts of renewable and energy efficiency industries in the U.S on the employment rate and the country's overall GDP. According to the findings, the macroeconomic impacts are the creation of 504,000 new job in the renewable sector and 8,586,000 new job in the energy efficiency sector.

Alvarez et al.(2009) performed a research that examined the impact of the use of renewable energy sources on the macroeconomic situation in Spain. The analysis examined the new employment rates after the implementation of wind , mini-hydro and solar energy. It reveals negative net employment effects for all 3 RES (-4.27 jobs/MW for wind, -5.05 jobs/MW for mini-hydro and -12.7 jobs/MW for solar).

Yıldırım (2019) explored how government incentives influence the economic performance of renewable energy investments in Turkey. By employing techniques like Net Present Value (NPV) and Payback Period (PBP) analysis, the research concentrated on a wind energy project in Balıkesir. The results indicate that higher incentives improve profitability and shorten the payback peri underscores od for investments, whereas lower incentives lead to the opposite outcome. The study highlights the critical role of ongoing government support in advancing renewable energy initiatives and recommends that incentive structures be aligned with local manufacturing to enhance both economic and environmental advantages.

Akusta and Cergibozan (2020) explored how renewable energy usage relates to economic growth and environmental impacts in Turkey, analyzing data from 1972 to 2015. They utilized Johansen and ARDL co-integration tests, along with variance decomposition analysis, to examine the interactions among variables like real GDP per capita, trade openness, financial development, and the proportion of renewable energy in total energy consumption. Their findings revealed that

increases in GDP and trade openness tend to have a positive effect on environmental damage, whereas a higher reliance on renewable energy sources helps to alleviate this damage. The study emphasized the importance of renewable energy in reducing Turkey's dependence on fossil fuels and promoting sustainable environmental and economic results.

Demirgil and Birol (2020) conducted a study in which they examined the impact of renewable energy consumption on economic growth in Turkey for the period 1980-2018. ARDL test was used in the article to study the cointegration relationship between the variables. Then a Toda-Yamamoto causality test was conducted. ARDL test showed a cointegration relationship between the variables, as for the Toda-Yamamoto test an unidirectional causality relationship from renewable energy consumption to economic growth was proved. The findings reached demonstrated that increases in renewable energy consumption in Turkey contribute to economic growth.

In Markaki et al.(2020) two techniques were used to determine the macroeconomic effects of renewable energy investments , the first being the input-output model and the second being the analytic process models based on the generation of employment coefficients , such as jobs per unit of production. According to the findings, the green investments in question result in an annual increase ranging from 8.3 billion euros to11.3 billion euros between 2010 and 2020, which corresponds to 3,8-5 percent of the county's GDP.

Livingston(2018)'s work investigates the different aspects of renewable energy investments in Turkey. It explores solar and geothermal opportunities as well as large scale and wind projects and the role of these renewable energy options in the maintaining of growth amid the challenging conditions suc as the value los of the Turkish Lira. The research concludes by stating that the Limitations experienced by the renewable energy investments is due to the country's regulations as well as the limitations of the macroeconomic environment.

Zhang et al.(2020)'s research assessed the renewable energy investment risk factors for sustainable development through applying a 3 step analysis . The first being using the Delphi method to identify the risk factors of renewable energy investments, the second being using the AHP method to assess the identified Risk factor factors and the third being the evaluation and prioritization of strategies to overcome risk factors of REI projects by using the FWASPAS[Fuzzy Weighted Aggregated Sum Product Assessment]. The findings of this research revealed 6 majors risks factors as well as 23 sub-factors, economic and business risk being a mojo risk factor. It also gave a detailed explanation a to why the RET choices are the most suitable out of the6 main strategy to deal with the risks related to the sustainable development in Turkey.

Fırat, Hoca, and Bozkurt (2021) explored the growth of renewable energy in Turkey in the context of European Union (EU) energy policies. Their study points out Turkey's heavy dependence on imported fossil fuels and the related environmental and economic issues. It also examines how EU directives influence Turkey's renewable energy regulations as it seeks EU membership. By looking at both EU policies and Turkey's national legal framework, the research highlights the critical role of renewable energy in promoting sustainability and decreasing reliance on external energy sources. The results stress the need for Turkey to align its energy policies with EU standards to ensure energy security and meet environmental objectives.

Orun and Demirgil (2021) conducted a study in order to highlight the importance of renewable energy sources by examining the incentives provided to the sector in Turkey, the potential of renewable energy in the country, and the economic outcomes derived from renewable energy sources. This analysis made in the article was about the possibilities of how to increase the energy generated from renewable sources.

Orun and Demirgil (2021), under the guidance of Associate Professor Bünyamin Demirgil, examined the motivations behind renewable energy investments in Turkey and their economic effects. The study used a descriptive approach to investigate the potential of renewable energy and its economic consequences, especially in light of Turkey's heavy dependence on imported energy, which stands at around 70%. It pointed out important government support measures, including

tariff guarantees and subsidies for domestic equipment, as vital for encouraging investment in renewable energy. The results underscored that harnessing renewable energy sources is essential for enhancing economic stability and achieving energy independence in Turkey.

Batu Ağırkaya (2022) carried out an in-depth analysis of Turkey's renewable energy strategies, examining their economic and environmental effects. The study employed a long-term data framework (2000–2050) from Enerdata to assess global and regional energy scenarios, with a particular focus on Turkey's path. The findings indicated that although fossil fuels such as oil and natural gas currently dominate the energy supply, the share of renewable energy in electricity production and primary consumption is expected to grow significantly, driven by technological advancements and supportive policies. The research highlighted the importance of increased investments in renewable energy infrastructure for achieving sustainable development, energy independence, and job creation, while also addressing environmental challenges and economic opportunities.

Şencan (2022) evaluated the latest developments in the rapidly growing renewable energy sector in Turkey and worldwide. In this context, sustainable, energy-efficient, and environmentally friendly renewable energy systems were discussed, and their recent advancements in Turkey and globally were analyzed. Subsequently, the tax and other incentives currently applied to renewable energy systems in Turkey are examined were also examined in detail.

Şencan (2022) examined Turkey's role in the global renewable energy landscape and assessed the effectiveness of the incentives in place. The study underscores the vital role of renewable energy in minimizing environmental impact and reducing reliance on energy imports. By looking at global trends alongside Turkey's specific practices such as tax exemptions, feed-in tariffs, and support for local production the research illustrates how these incentives have significantly boosted renewable energy capacity. The findings advocate for the enhancement of incentive mechanisms to promote further adoption of renewable energy, ensuring both long-term sustainability and economic advantages.

Aslan and Yavuz (2023) conducted a study in which they studied the relationships between renewable energy, financial development, and economic growth in BRICS and MINT countries from 2001 to 2019 through empirical analyses. Panel data analysis techniques were employed for the empirical tests. cross-sectional dependence, homogeneity and cointegration tests were used in the study. The article showed the existence of a cointegration relationship between renewable energy, financial development, and economic growth.

Aghaei, Gholizadeh, and Abdi (2023) carried out an in-depth study examining how financial and technological development influences the growth of renewable energy in different countries. They employed panel Tobit regression models to analyze data from 2002 to 2015, focusing on renewable energy sources like biomass, solar, wind, and hydropower. The results highlighted the crucial importance of financial and technological progress in improving renewable energy infrastructure. Importantly, the study found that the growth of financial markets has a significant effect on renewable energy capacity, especially in developed countries, while technological advancements promote sustainability in both developed and developing nations. These findings stress the need for cohesive policies that combine financial incentives with technological innovation to boost the global adoption of renewable energy

Demir (2023) conducted a study on the relationship between renewable energy consumption and economic growth in Turkey. For that, Demir gathered data from world bank database on renewable energy consumption, per capita gross domestic product, gross fixed capital formation, and total labor force for Tureky from 1990 to 2019. The result of the study indicated the positive impact of the increases in renewable energy consumption on economic growth.

Özbektaş, Şenel, and Sungur (2023) examined the current status and installation costs of renewable energy sources both globally and in Turkey, highlighting their importance for environmental sustainability and reducing reliance on fossil fuels. The research pointed out that although coal is still the most widely used energy source around the world, renewable energy now

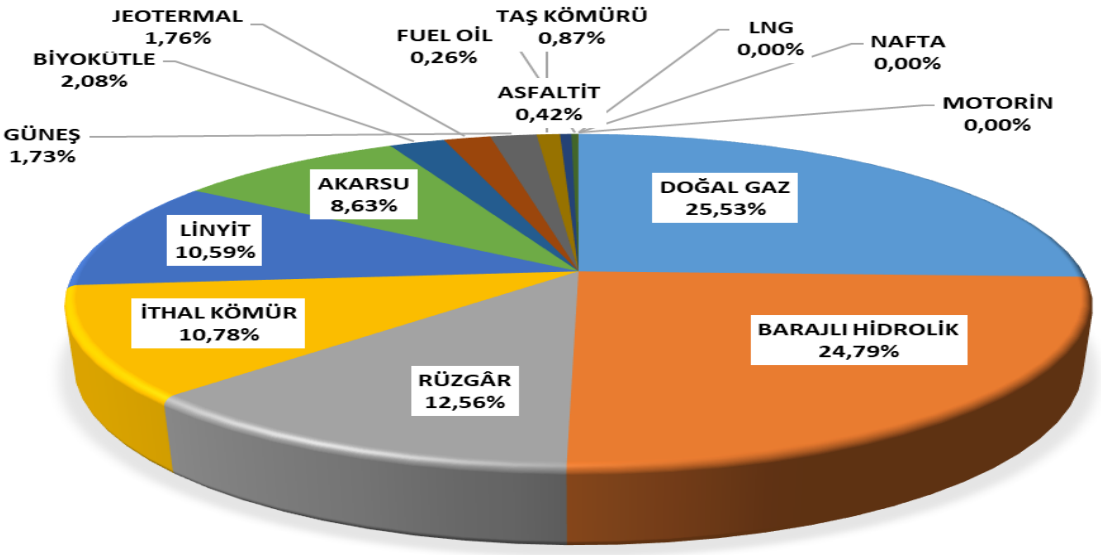
accounts for 38% of electricity generation. The results showed that hydraulic energy has the largest share of installed capacity among renewable sources, both globally and in Turkey, followed by wind and solar energy. Additionally, the study observed a decline in installation costs for solar and wind energy, encouraging greater investment in these areas to improve energy security and tackle environmental issues.

Örnek and Kabak (2023) examined the link between renewable energy consumption and economic growth in Turkey, utilizing data from 1990 to 2020 and employing the Johansen cointegration and Granger causality tests. Their results indicated a long-term balance among renewable energy use, GDP growth, and external debt, with a one-way short-term causality flowing from economic growth and external debt to renewable energy consumption. The study the essential role of renewable energy in fostering sustainable economic growth and decreasing reliance on energy imports, while also stressing the importance of policies aimed at boosting renewable energy investments and incorporating them into Turkey's overall economic framework.

Farahani, Morsali, and Mehrara (2024) carried out a study examining how investments in renewable energy affect Iran's macroeconomic variables, employing a Dynamic Stochastic General Equilibrium (DSGE) model. The research covers the period from 1991 to 2022, drawing on statistical data from the Central Bank of Iran and the Ministry of Energy. By concentrating on major economic sectors such as industry, services, agriculture, and oil and gas, the results indicate that investments in renewable energy can significantly boost economic value-added and enhance social welfare. The study suggests a four-year investment strategy aimed at increasing renewable energy infrastructure by 50%, with government policies designed to foster private sector involvement through incentives like tax breaks and guaranteed energy purchases. The results of multiple tests conducted in the study reveal a bidirectional causality relationship in the context of total energy. For non-renewable energy, a causality relationship is found from economic growth to non-renewable energy, while for renewable energy, the causality relationship is from renewable energy to economic growth.

3. Renewable energy sector in Turkey

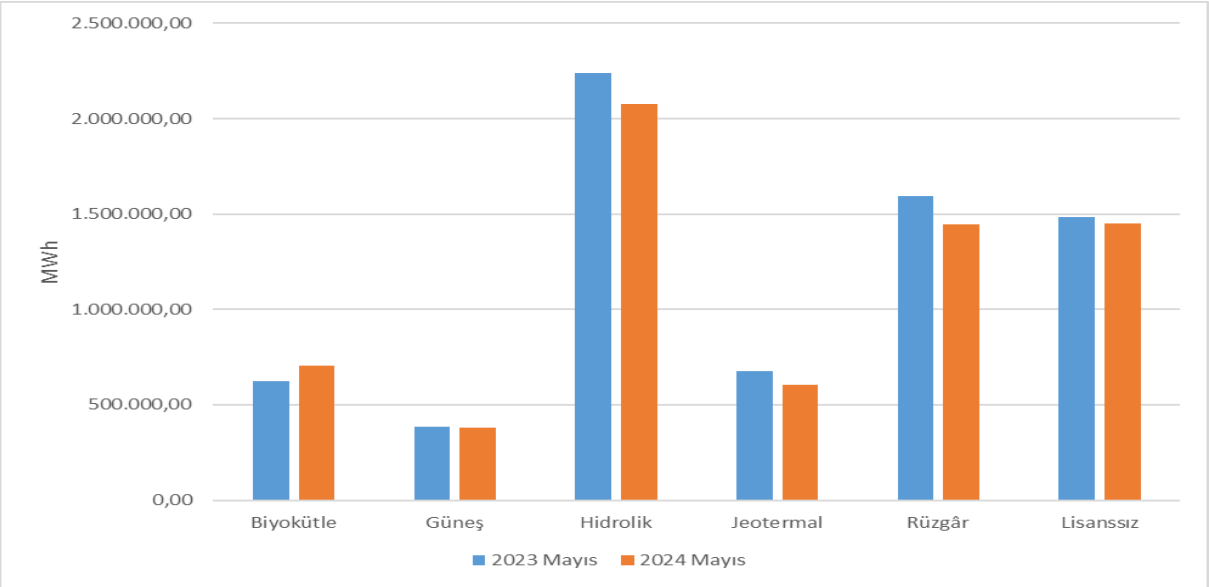
With a huge abundance of natural resources such as wind, solar and geothermal, Turkey has a big advantage compared to other countries when it comes to renewable energy.



Source: *Energy Market Regulatory Authority. (2024)*

Graph 1. *Distribution of Licensed Installed Electricity Capacity by Energy (May 2024)*

The graph illustrates the distribution of Turkey's licensed installed electricity capacity as of May 2024, highlighting the significant roles played by various energy sources. Natural gas (25.53%) and hydroelectric power (24.79%) are the leading contributors to the energy mix, while wind (12.56%), solar (1.73%), and biomass (2.08%) indicate the increasing importance of renewable energy. The consistent growth in renewable energy capacity reflects Turkey's commitment to diversifying its energy sources, decreasing reliance on fossil fuels, and aligning with global sustainability objectives.



Source: *Energy Market Regulatory Authority. (2024)*

Graph 2. *Turkey's Renewable Energy Production Comparison (May 2023 vs. May 2024) (MWh)*

The graph compares renewable energy production under Turkey's Renewable Energy Support Mechanism (YEKDEM) for May 2023 and May 2024. It reveals a 13.35% increase in biomass production, while solar energy held steady at a 5.71% share. The data highlights Turkey's initiatives to promote renewable energy production and enhance sustainability. The slight decreases in hydroelectric and wind production reflect seasonal and operational fluctuations but do not detract from the overall positive trend of clean energy growth in the country.

4. Policies Supporting Renewable Energy

Turkey's history in renewable energy is not very old. In 2003, the Energy Market Control Board (EPDK) was established, and the liberalization movement in the energy sector began. After the establishment of the Energy Market Control Board, private and public investments were taken under control in line with growth targets (Yıldırım ,2019). Turkey has created different funds, programs and institutions that aim to support the renewable energy sector from which we can mention:

- TurSEFF (Turkey Sustainable Energy Financing Program) is a program established to provide financing for Resource Efficiency and Sustainable Energy investments to be implemented by the private and public sectors.
- The Turkish Technology Development Fund (TTGV) also provides support in the field of solar energy. There is a support fund whose main purpose is to eliminate financial investment-based barriers in order to increase energy efficiency. The Turkish Technology Development Foundation aims to identify ecosystem needs and common problems, provide solutions, and think and work together to enrich through common benefit.
- Tarım ve Kırsal Kalkınmayı Destekleme Kurumu (TKDK) in English Agricultural and Rural Development Support Institution support and incentives focus on solar energy, renewable energy and energy efficiency in agricultural enterprises

The policies used by the Turkish government in order to encourage investments in the renewable sector are listed below:

In renewable energy production, facilities that were in operation before 31.12.2015, an extra incentive of between 0.4 cent and 3.5 cent per kWh will be provided on average for the mechanical and auto-mechanical equipment used, provided that they are manufactured in Turkey, within a 5-year period.

New Electricity Market Law No. 6446 has brought significant innovations and incentives to the current electricity market system:

• The installed capacity of production facilities based on renewable energy resources, exempt from licensing and company obligations, has been increased from 500 kW to 1 MW, and in order to develop competition and ensure supply security, the installed capacity of production facilities based on renewable energy resources has been decided to be increased by up to 5 times (5 MW) by the Council of Ministers.

• No limit is applied to renewable energy facilities that meet their own consumption without supplying energy to the grid.

• Renewable energy facilities consisting of more than one building can be considered a single production facility if they are connected to the system from the same point (YEGM, 2014: 12).

• Papers prepared by DSI regarding agreements on water usage rights and operating principles are exempt from stamp duty and fees.

• Within the scope of privatization of electricity distribution companies and electricity generation facilities, profits arising from transfer, merger, division and partial division transactions to be carried out until 31.12.2023 are exempt from Corporate Tax.

Exemption from License Fee or Unlicensed Production Rights is among the most important incentive mechanisms that increase investors' interest in RE investments in Turkey after the fixed price guarantee (Yılmaz and Hotunluoğlu, 2015: 89). Electricity producers in Turkey pay license fees depending on the installed capacity of their production facilities. The exemption of producers from this license fee in order to encourage the use of RE is called unlicensed production right (Eser and Polat, 2015: 219). Unlicensed production right is implemented in the form of exempting RE facilities with an installed capacity of up to 1 MW from the obligation to obtain a license and establish a company (Döner, 2018: 140).

According to the law on the amendment of the law no. 6094 on the use of renewable energy sources for the purpose of generating electricity, the price supports applied by the ETKB are provided as 7.3$\cent per kWh in electricity production through wind energy and hydroelectric energy production facilities, 13.3$\cent per kWh in electricity production through biomass energy-based production facilities, 13.3$\cent per kWh in electricity production through solar energy-based production facilities, and 10.5$\cent per kWh in electricity production through geothermal energy-based production facilities. In addition to these supports, it is planned to provide additional price support of around 0.4$\cent to 3.5$\cent per kWh in case of domestic machinery and equipment using renewable energy sources in electricity production enterprises (ATIG, 2018:5).

The supports mentioned in the General Investment Incentive Regime amended in 2012 are as follow (Kaya, 2018:74):

• Granting investors Customs Duty exemption for importing investment equipment and devices from abroad,

• Granting investors Value Added Tax exemption for purchasing or importing investment equipment and devices from abroad,

• Providing exemption to the relevant investor from other funds and additional fees in question

Turkey has also implied additional duties or countervailing measures on Chinese solar solar PV, EV and batteries since 2020(the international energy agency)

5. Conclusion and recommendations

For sustainable economic growth, growing investments in the renewable energy sector have become a necessity as energy has become a referral for a country's development and welfare.

Turkey compared to the other countries has a big advantage and great potential in the renewable energy sector. Turkey has worked hard to underpin investments in the renewable energy field implementing suitable measures to encourage domestic manufacturing and reduce external dependency. According to Minister of Energy and Natural Resources Bayraktar Turkey is among the top 11 in the world in renewable energy and 5th in Europe. With the electricity it produces from renewable resources, Turkey both prevents imports and gradually approach its 2053 Net Zero Carbon target.

Despite all that, energy sector in Turkey still has some gaps that need to be eliminated, mainly because of the regulatory instabilities the country face and the heavy reliance Turkey has on other external technologies and financing that hinder further development in the renewable energy sector. Based on the experiences of other countries, possible solutions and recommendations could be extracted, such as encouraging public and private partnerships within the country and incenting and adopting green bond financing. Moreover, the country has to further work on improving its infrastructure for effective renewable energy integration. It is also worth mentioning that collaborating with advanced renewable energy markets in European countries is important as constant improvement of related policies is crucial to minimizing risks and reduce investors' uncertainty.

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