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ANALYSIS OF THE RENEWABLE ENERGY POLICY DEVELOPMENT IN TURKEY AND POLAND

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Abstract
This article seeks to explicate the link between the governmental policies for renewable energies and associated increase in the capacity and the generation of renewable energies. The contribution of this article to the existing literature is that it emphasizes the importance of an enabling state policy for developing and implementing a successful renewable energy policy. It starts by reviewing state policies that promote new renewable energy investments in Turkey and Poland. The effectiveness of this policy is tested by using sectoral renewable energy statistics. In the next step, both countries' achievement of their renewable energy targets for 2020 are investigated. This research finds that Turkey and Poland have developed an enabling policy framework for renewable energies. These policies, in the long term, will enable energy transition in both countries and lead to a more secure, sustainable, clean, and environmentally friendly energy mix.
Keywords: Energy policy, renewable energy, Turkey, Poland.

Öz
Bu makale, yenilenebilir enerjiler için yapılan hükümet politikaları ile yenilenebilir enerjilerin kapasite ve üretim artışı arasındaki bağlantıyı açıklamayı amaçlamaktadır. Bu makalenin mevcut literatüre katkısı, başarılı bir yenilenebilir enerji politikası geliştirmek ve uygulamak için etkin bir devlet politikasının önemini vurgulamasıdır. Çalışma, Türkiye ve Polonya'da yeni yenilenebilir enerji yatırımlarını teşvik eden devlet politikalarını gözden geçirerek başlar. Bu politikaların etkinliği, sektörel yenilenebilir enerji istatistikleri kullanılarak test edilmektedir. Çalışmanın bir sonraki adımında, her iki ülkenin 2020 yılı için yenilenebilir enerji hedeflerine ulaşıp ulaşmadığı araştırılmaktadır. Bu araştırma, Türkiye ve Polonya'nın yenilenebilir enerjiler için etkin politika çerçevesi geliştirdiğini ortaya koymaktadır. Bu politikalar, uzun vadede her iki ülkede de enerji geçişini sağlayacak ve daha güvenli, sürdürülebilir, temiz ve çevre dostu bir enerji karışımına yol açacaktır.
Anahtar Kelimeler: Enerji politikası, yenilenebilir enerji, Türkiye, Polonya.

Introduction

In the global scale, the term energy transition has characterized the recent discussions about a sustainable environment and better conditions for fauna, flora, and human beings. For societies, energy transition does not only have an ecological meaning, but it also implies economic and social changes. Firstly, it would help avoid the political and economic risks linked to high level of import dependency. Secondly, it would enable the

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countries to develop a sustainable energy model, which will contribute to long-term economic growth and development. Thirdly, it would help societies escape the negative impacts of the fossil fuel use on environment and human health. Finally, in economic terms, it would give consumers more energy choices and make energy market more competitive. The overall positive impacts of the renewable energies would be a significant contribution to the sustainable development goals of the countries. For these reasons, the immediate goal of the global, European, and national energy policies is to increase the share of renewables in energy production and consumption and to benefit from these resources in secure, economic, and sustainable ways.

In pursuit of these long-term goals, the European Union set its energy policy objectives as competitiveness, security of supply, and sustainable development. These policy objectives are to be achieved via the Union's 2020 energy targets: 20% of the EU's total energy consumption will come from renewable energies by 2020, there will be 20% increase in energy efficiency by 2020, and there will be 20% reduction in emissions of greenhouse gases by 2020 from 1990 levels. Through these targets, the overall goal is to prevent the socially, ecologically, and economically harmful impacts of energy production and consumption.

This article focuses on the implementation of renewable energy policy through an enabling government policy structure. Particularly in the post-Covid-19 pandemic period, many countries find themselves struggling with the emerging energy crisis, price volatility, and economic downturn. Therefore, designing and implementing a sustainable energy policy is of uttermost importance for all governments as a sustainable solution to energy and environment-related problems. Poland, as an Eastern European EU-member state, displays a similar profile with Turkey regarding its extensive use of fossil fuels (See Table 1). Therefore, this EU member state is chosen as a comparative case to assess Turkey's performance in deployment of renewable energies.

Table 1: Gross electricity production by type of fuel in Turkey and Poland (ktoe) (2015-2020)

		2015	2016	2017	2018	2019	2020
Solid fossil fuels	Poland	11222	11205	11277	11226	10158	9234
	Turkey	6377	7771	8201	9574	9559	8943
Natural Gas	Poland	549	673	862	1086	1272	1486
	Turkey	8531	7672	9500	7952	4925	6098
Renewables and biofuels	Poland	2002	2002	2114	1894	2249	2497
	Turkey	7193	7759	7500	8406	11372	11035

Source: (Eurostat, 2022)

This empirical study takes its data mainly from the Eurostat energy database, International Energy Agency (IEA) database, and International Renewable Energy Association (IRENA) database. The comparative figures are prepared based on the official statistical data with an aim to show the deployment of renewable energies in Turkey and Poland. For each country, the first indicator analysis is the year-by-year increase in renewable energy capacities. The second indicator analysis shows the annual increase in renewable

electricity production. In the final indicator analysis, both countries' accomplishment of the EU's 2020 renewable energy targets is studied in a comparative perspective. This comparative analysis of the energy transition performances of two countries reveals how far each country achieved to fulfil its policy targets. The results of this research validate the important role of governments' decisive and timely use of enabling policies to create the desired level of renewable energy investments, and therefore move their countries forward in terms of energy transition.

Literature Review

A literature review on the renewable energy potential and utilization of Turkey reveals several studies. Capik et.al. (Capik, Yılmaz, & Çavuşoğlu, 2012) revised the renewable energy potential and the energy politics of Turkey in 2012. The authors maintained that Turkey possesses a huge hydroelectric resource, an extensive geothermal resource that is utilized for heating of residences, district heating, greenhouse heating, and for spas, as well as considerable wind energy and solar energy potential due to its geographical location. Based on this analysis, they concluded that Turkey's renewable energy sources can make a huge contribution to a sustainable and independent energy mix, and thereby, help to accomplish the country's environmental goals and increase the security of energy supply by reducing the dependence on imported fuel supplies (Capik, Yılmaz, & Çavuşoğlu, 2012).

Toklu (Toklu, 2013) revised the energy use pattern in Turkey in 2013, and concluded that although Turkey's use of hydropower, geothermal and solar thermal energy has increased since 1990, fossil fuels remained to be the main source to produce electricity. The study underlined that Turkey's dependence on expensive imported energy resources place a big burden on the economy and increase air pollution which is a great environmental concern in the country. In this regard, renewable energy resources appear to be the one of the most efficient and effective solutions for clean and sustainable energy development in Turkey. The author compared production capacities and current operational amounts in various renewable energy sectors and concluded that the considerable gap between them could be attributed to the lack of financial resources and appropriate lending facilities, particularly for small-scale projects, and complex bureaucratic procedures concerning the permit application process (Toklu, 2013).

There are also academic studies that analyse the positive role of state support mechanisms in promotion and development of renewable energy investments. These studies show the role of enabling government policies and financial support mechanisms in triggering the deployment of renewable energies. In 2008, Alboyaci and Dursun (Alboyacı & Dursun, 2008) discussed the electricity restructuring in Turkey and the development of wind energy production in the energy mix. Their statistical analysis provided that the installed capacity of Turkey's wind energy increased from 9MW in 1998 to 19MW in 2001 and reached 131.35MW in 2007. The authors' conclusion was that wind energy only received sufficient attention in terms of government policy with the introduction of renewable

energy law No.5346, by which the government guaranteed to buy the generated energy from wind and planned a large increase in electric generating capacity over the next 20 years.

In 2017, Ugurlu and Gokcol (Ugurlu & Gokcol, 2017) analysed the renewable energy utilization in Turkey and concluded that as of July 2017, wind energy constituted 74% of the total renewable based installed power capacity, and it was followed by solar (16%) and geothermal energy (10%). The authors attributed this increase to the renewable energy law in 2005 which regulated the sector and provided financial incentives for the new investments by the private sector (Ugurlu & Gokcol, 2017). Their policy recommendation to achieve full utilization of the renewable energy potential of the country was to use appropriate laws and financial incentives that would remove the barriers to renewable energy investments.

In Poland, several scholars analysed the state's energy policy, strategic objectives, and tools for the development and utilization of renewable energy sources. The research that covers early 2000s, presented that the share of renewable electricity in Poland increased from 1.68% in 2000 to 2.8% in 2006. In this period, the largest share of renewable electricity came from the hydropower, and it was followed by biomass, wind, and biogas (Paska, Salek, & Surma, 2009). The authors stated that Poland's initial target for 2010 was to enable that renewable energies shall constitute 7.5% of the country's total gross electricity consumption. Based on this target, government strategies focused on the activities for promotion of the renewable energies. Economic and environmental potential of the country could offer possible growth in three renewable energies, namely biomass, wind, and hydropower. The government strategy, therefore, focused on the restructuring of the energy supply system based on efficiency, consistency, and sufficiency (Paska, Salek, & Surma, 2009).

In a later research, researchers analysed the results of adoption of the EU's Directive 2009/28/EC on the promotion of renewable energies in Poland (Paska & Surma, 2014). This study provided that in 2009 the Polish Government adopted a strategy paper 'Energy Policy of Poland until 2030' with an aim to present the energy sector development for next 20 years. This strategy paper presented the challenges for the energy policy as high energy demand, insufficient domestic fuel supply and energy generation capacity, low density of transmission and distribution infrastructure, significant import dependence for natural gas, and almost full import dependence for crude oil. Thus, the government policy focused on the development of renewable energies and provided financial incentives in the form of feed-in-tariffs and green certificates. This support scheme had positive impact on new investments, and the installed capacity of renewable energies in Poland increased from 1028 MW in 2004 to almost 6000 MW in the beginning of 2014 (Paska & Surma, 2014).

In 2020, researchers analysed the possibilities for further development of the renewable energies in Poland based on 450 expert answers to a questionnaire (Pietrzak, Iglinski,

Kujawski, & Iwanski, 2021). The survey results revealed that experts perceived potential of renewable energies in Poland as large. This result indicates actual opportunities for further development of the sector particularly in solar energy, wind power, and solid biomass. The experts pointed out the main factors that hinder the development of the renewable energies in Poland as complicated legal regulations, high investment costs, insufficient knowledge about renewable energies among society, and negative impact of the coal energy lobby (Pietrzak, Iglinski, Kujawski, & Iwanski, 2021). Therefore, government policy needs to target these hindrance factors.

Analysis of Energy Structure in Turkey and Poland

As a candidate country, Turkey aims to comply with the EU acquis in all policy areas, including the energy policy. Although the EU's renewable energy policy objectives and targets are important benchmarks for Turkey, the country's dependence on imported energy supplies limits its policy options. The dependence on imported energy sources not only limits the country's options in foreign policy and economic development, but also exacerbates environmental problems.

Table 2: Generation of electricity from primary energy sources in Turkey

	2017		2018		2019		2020	
	GWh	Percent	GWh	Percent	GWh	Percent	GWh	Percent
Conventional energy sources								
Imported coal, hard coal, lignite	97.475	32.8	113.248	37.16	112.893	37.14	105.811	34.5
Liquid fuels	1199	0.40	329	0.11	336	0.11	322	0.11
Natural gas	110.490	37.17	92.482	30.34	57.288	18.85	70.931	23.13
Renewable energy sources								
Hydro	58.217	19.59	59.938	19.66	88.822	29.22	78.093	25.47
Wind	17.903	6.02	19.949	6.54	21.730	7.15	24.828	8.10
Solar	2889	0.97	7799	2.56	9249	3.04	10.950	3.57
Geothermal	6127	2.06	7431	2.44	8951	2.95	10.027	3.27
Renewable waste and heat	2972	1.0	3622	1.19	4624	1.52	5736	1.87
TOTAL	297.277	100	304.801	100	303.897	100	306.703	100

Source: (Turkish Electricity Transmission Corporation, 2021)

A quick analysis of national statistical data shows that conventional energy sources dominate the energy mix of Turkey in electricity generation (See Table 1). In 2020, Turkey's electricity mix was dominated by fossil fuels representing 57% of the total; of this amount, coal constituted the biggest share, followed by natural gas, and oil (only a minor percentage). In 2020, the share of renewable energy sources constituted 42% of all domestic electricity production. Even though Turkey has a growing production capacity in RES, the choice of electricity production remains heavily on the side of the

conventional energy sources due to their being considered as more reliable power supply by the government. In 2017 government policies shifted from using imported natural gas to domestic coal and we can see the result of this policy in the decrease in natural gas usage from 37% in 2017 to 18% in 2019 and 23% in 2020.

For Poland, a quick analysis of national statistical data shows that conventional energy sources dominate the energy mix in electricity generation (See Table 2). Electricity is produced mainly in thermal power plants. In 2020, the production in thermal power plants accounted for 78% of the total production. Coal plays a central role in Poland's energy system and economy. In fact, the most important fuel used to generate electricity in 2020 was hard coal, with a share of 44%, and lignite with a share of 24%. The share of these fuels in electricity production has decreased since 2017. Meanwhile, electricity generation from renewable energy sources accounted for 20% in 2020 and they have constantly increased since 2017. The most important sources in this group are wind energy, biomass, and biogas. Most of the growth in the renewable energies came from increased onshore wind generation, followed by bioenergy. Solar energy has the smallest share, but it is characterized by the highest growth dynamics.

Table 3: Generation of electricity from primary energy sources in Poland

	2017		2018		2019		2020	
	GWh	Percent	GWh	Percent	GWh	Percent	GWh	Percent
Conventional energy sources								
Hard coal	79.022	46.3	81.257	47.7	76.538	46.67	69.668	44.08
Lignite	52.166	30.6	49.331	29.0	41.639	25.39	38.148	24.13
Gas fuels	10.141	5.94	12.709	7.4	15.131	9.22	16.891	10.68
Renewable energy sources								
Hydro	2560	1.50	1970	1.1	1958	1.19	2118	1.34
Wind	14.909	8.74	12.799	7.5	15.107	9.21	15.800	9.99
Solar PV	165	0.09	300	0.1	711	0.43	1958	1.23
Biomass and biogas	6416	3.76	6511	3.8	7602	4.63	8371	5.29
Other fuels	4613	2.70	4745	2.7	4597	2.80	4270	2.70
TOTAL	170.465	100	170.039	100	163.989	100	158.043	100

Source: (Statistics Poland, 2021)

Turkey's major problems in terms of energy policy are high dependence on imported energy, persistent use of coal for energy production, depletion of fossil fuel reserves, price volatility due to rising energy prices, and environmental pollution. Turkey recognizes the need to promote the production and use of renewable energies, and thereby, to change its energy mix. This political target can only be achieved through effective government policies that would provide supportive legal and financial framework for the renewable energy investments.

Poland's major problems in terms of energy policy are related to the still strong position of the coal mining sector and the significant number of employees in it (nearly 80,000 employees in 2021). The pressure of the coal lobby to maintain the status quo has been the main barrier to the energy transformation for many years. The hard coal mining sector is unprofitable and requires permanent public subsidies (in December 2021, the mining law was amended, assuming the implementation of a PLN 28.8 billion support system for hard coal mines by 2031). By the end of 2049, it is planned to close all coal mines in Poland. The commissioning of the first unit of the first nuclear power plant is scheduled for 2033, and in the coming years it is planned to commission another five such units at intervals of 2-3 years. Russia's use of limiting gas supplies to Europe at the turn of 2021/22 in connection with the conflict in Ukraine increased the pressure to diversify the sources of gas supplies. The national regulations assume that from 2023 the maximum share of natural gas imported by energy companies from a single source in a given calendar year may not exceed 33%. High energy prices translate into an increasing interest in investments in renewable energy in the enterprise sector, which is interestingly higher in public enterprises (Żuk & Żuk, 2021).

Analysis of Renewable Energy Policy in Turkey and Poland

This section includes analysis on four fields. Firstly, it investigates renewable energy policy objectives and targets in Turkey and Poland. This analysis serves as the validation of a determined governmental policy for the promotion and the use of renewable energies. The second part presents the results of the policy implementation, i.e., the renewable energy utilization, in Turkey and Poland. This part serves as the validation of the successful operationalization of the governmental support mechanisms for the new investments in renewable energies. Finally, the conclusion investigates the achievement of the EU's 2020 renewable energy targets in Turkey and Poland.

In 2009, European Commission published the Renewable Energies Directive (European Commission, 23 April 2009) with an aim to introduce a common framework for the promotion of renewable energies and to set mandatory national targets for the overall share of renewable energies in gross final energy consumption, in electricity, and in transport. To achieve their national targets, Member States are required to establish national action plans which set out their sectoral targets for the renewable energies.

In accordance with Directive 2009/28/EC, Turkey published its National Renewable Energy Action Plan (NREAP) (Ministry of Energy and Natural Resources, 2014) in 2014. The Action Plan set ambitious goals for 2020: the share of renewable energy in electricity will be 37.84%, in the heating and cooling it will be 13.71%, and in transport it will be 7.29%. The share of renewable energy in gross final energy consumption will be 19.29%. Ministry of Energy and Natural Resources, in its Strategic Plan for 2015-2019 (Ministry of Energy and Natural Resources, 2014), set out the national energy objectives as strong and reliable energy infrastructure, diversification of primary energy resources and

utilization of domestic renewable energy resources such as hydro, wind, solar, geo-thermal, biomass, wave, and tide, and thereby, reducing the risks arising from import dependency. The Plan also stated the objectives related to the improvement of financial supports for new energy investments with an aim to remove the structural constraints against investments and to enable necessary investments easily and rapidly under competitive conditions according to sustainability principles (Ministry of Energy and Natural Resources, 2014).

These policy objectives and policy targets demonstrate the existence of political will in Turkey to adapt the EU renewable energy objectives and strategic targets. This political will has been translated into action plans and strategic objectives by the relevant ministries. The overall policy goal is to achieve energy transition via increasing the renewable energy investments, and therefore, changing the energy mix of the country.

In Poland, the core of the renewable energy legislation is the Energy Law of April 10, 1997. This law obliges the energy companies that sell electricity to final consumers to obtain and submit the certificates of origin or to pay a substitution fee. On January 4, 2005, Polish Government accepted the Energy Policy of Poland until 2025. This document presented the objectives of energy policy as energy security, energy efficiency, economic competitiveness, environmental protection from the negative effects of energy-related activities. In 2009, Polish Government adopted Energy Policy of Poland until 2030. This strategy paper defined the strategic directions for the energy sector as improvement of energy efficiency, security of energy supply, diversification of electricity generation by using nuclear energy, development of renewable energies, implementation of a competitive energy market, and reduction of pollutions originating from energy sector.

In accordance with Directive 2009/28/EC, Poland prepared and submitted its National Renewable Energy Action Plan (NREAP) to the European Commission in 2010. Poland stated to increase the share of renewable energies within its gross energy consumption to 15% by 2020. The sectoral goals were defined as 19.13% of renewable energy in electricity, 17.05% of renewable energy in heating and cooling, and 10.14% of renewable energy in transport. The main goal of the plan was to outline a path of Poland to achieve its renewable energy target by 2020.

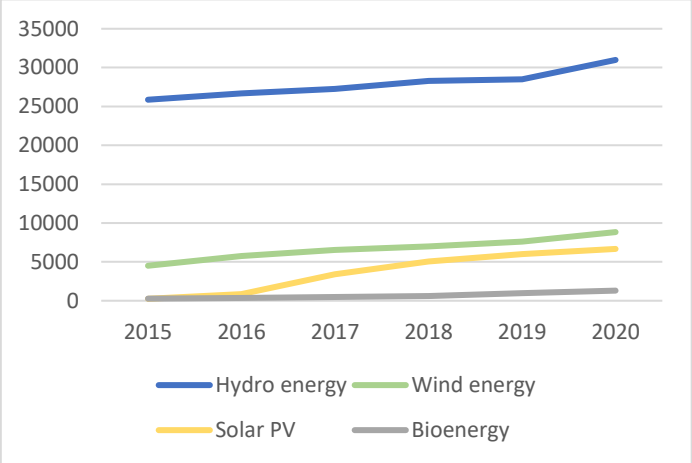
Poland's National Energy and Climate Plan for the years 2021-2030 assumed the achievement by 2030 of such goals as 7% reduction of CO_2 emissions in non ETS (Emissions Trading System) sectors (compared to 2005), 21-23% RES in gross final energy consumption and 23% increase in energy efficiency. The development of renewable energy sources in Poland is also determined by the existing problem of low emissions related to the use of coal for heating houses. Out of all 46 zones in the country, in 2018 the permissible level of PM_{10} was exceeded in the area of 39 zones, and only one city (Krakow) managed to introduce a complete ban on smoking with solid fuels from 2019 (Traczyk & Gruszecka-Kosowska, 2020).

Cilt: 4 Sayı: 1 Yıl: 2023 e-ISSN 2717-9737

The Polish government's strategy for the promotion of renewable energies was included in the document 'Poland's energy policy until 2040' and the implementation of offshore wind energy was distinguished as a strategic project.

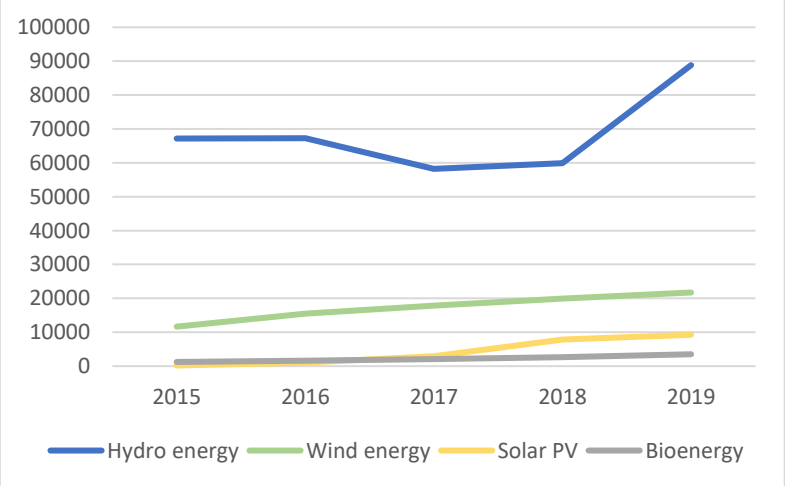
The strategic objectives and action plans in both countries provided an increase in deployment of renewable energies. Figures 1 and 2 present statistical data for Turkey's operationalization of its renewable energy strategies between 2015 and 2020.

Figure 1: Renewable energy capacity statistics in Turkey (MW)



Source: (International Renewable Energy Agency, 2021)

Figure 2: Renewable energy production statistics in Turkey (GWh)



Source: (International Renewable Energy Agency, 2021)

Turkey produced the largest quantity of renewable electricity from hydropower in 2019. It is important to note that in terms of new installed capacity in hydropower in 2020 globally, Turkey comes the second after China. In 2020, China demonstrated the biggest

Cilt: 4 Sayı: 1 Yıl: 2023 e-ISSN 2717-9737

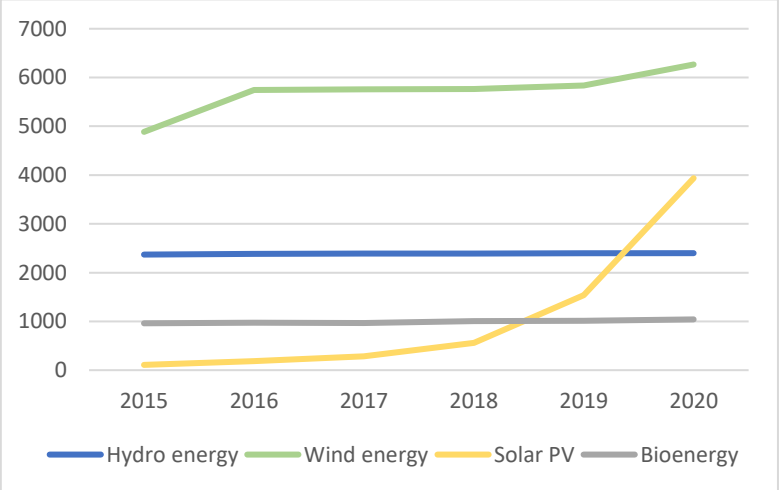
capacity increase with 13760 MW, and it was followed by Turkey with 2480 MW capacity increase (International Hydropower Association, 2021). With this increase, Turkey ranked the first among the European countries. It is only followed by Norway with 324 MW increase (International Hydropower Association, 2021). In terms of total installed hydropower capacity in Europe, with 31 GW of installed capacity, Turkey ranks the second after Norway (33 GW) in 2020 (International Hydropower Association, 2021). As of June 2020, hydroelectric energy made up majority of Turkey's renewable energy production, with 682 hydroelectric power plants in operation. However, the dependence of this capacity on the effects of climate change keeps the sustainability of hydroelectric power in doubt.

Wind energy is the second largest source of renewable energy in Turkey. Although Turkey has a significant wind energy potential, due to the technological deficiencies and financial constraints, wind energy has a low share in electricity generation. The number of wind energy installations was 2312 in 2012, which increased more than threefold to 7615 in 2019 (Turkish Wind Energy Association, 2019).

The use of solar energy in Turkey started only in 2014, and in five years period, installed capacity of solar energy power plants has reached 6667 MW in 2020. The capacity increase as well as the production increase in three renewable energy sectors are the positive outcomes of Turkey's governmental support policies for new renewable energy investments, and therefore, demonstrates an advance in step with EU regulations.

Similarly, statistical data for Poland shows an increase in the deployment of renewable energies. Figures 3 and 4 present the statistical data for Poland's operationalization of its renewable energy strategies between 2015 and 2020.

Figure 3: Renewable energy capacity statistics in Poland (MW)



Source: (International Renewable Energy Agency, 2021)

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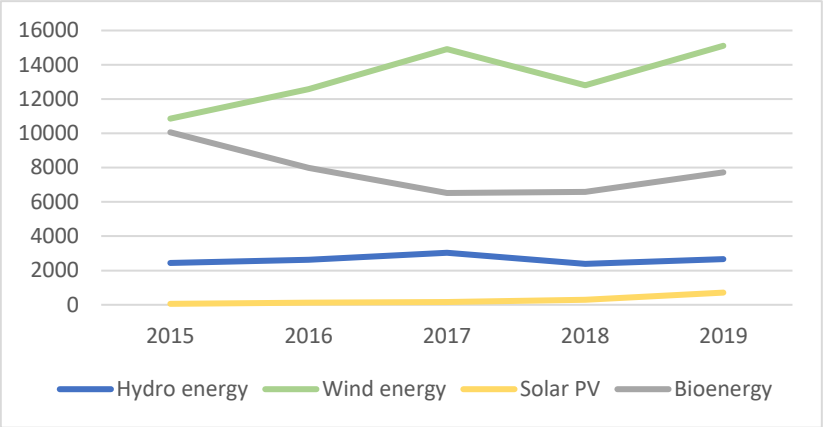
Figure 4: Renewable energy production statistics in Poland (GWh)



Source: (International Renewable Energy Agency, 2021)

Wind energy is an important source of renewable energy in Poland. The energy capacity of windmills in 2020 in Poland amounted to approximately 6.3 MW, and the production of over 15 GWh. A very weak increase in capacity in this sector results from the newly introduced legal barriers. Under the 2016 Act, a wind farm cannot be built at a distance of less than 10 times the height of the turbine from residential buildings, forms of nature protection and forest complexes. In practice, this rule, referred to as 10H, inhibited the development of onshore wind investments in Poland. Legislative work has been underway since 2021 to liberalize this rule. The second largest source of renewable energy is biomass energy, which in 2019 generated over 7.7 thousand MWh. The domestic potential in this respect is used to a minimal extent, despite the high profitability, in Poland the number of all types of biogas plants exceeds 300, while in Germany the number is around 10,000 (Mamica, Mazur-Bubak, & Wróbel-Rotter, 2022). Hydropower is in third place in terms of renewable energy production, with a stable level of generation in the range of 2.4 - 2.7 thousand GWh per year. Solar energy, although in this classification it is at the bottom in terms of annual production, in 2019 at the level of over 700 GWh, it is nevertheless the fastest growing renewable energy source in Poland. Only between 2017 and 2020, the renewable energy capacity of solar energy increased over 13 times, from nearly 300 to almost 4,000. MW.

In Green Deal, the European Commission has set out a clear vision of achieving climate neutrality by 2050. With this objective, the first step was designed by the EU Directive (Directive 2009/28/EC on the promotion of the use of energy from renewable sources, 2009) which required the member states to collectively ensure that the energy from renewable sources in the Union's gross final consumption of energy in 2020 shall be at least 20%. This overall Union target shall be met by the member states' national contributions and each member state shall introduce measures effectively designed to ensure this goal. In this context, Poland's target for the share of energy from renewable

sources in gross final consumption of energy in 2020 was defined as 15%. Turkey defined its target as 19.29% of renewable energy in its gross final consumption of energy in 2020 (See Table 4).

Table 4: Renewable energy sectoral targets for 2020 in Turkey and Poland

	2020 Targets for Renewable Energy			
	Electricity	Heating and Cooling	Transport	Gross final energy consumption
Turkey	37.84%	13.71%	7.29%	19.29%
Poland	19.13%	17.05%	10.14%	15%

Source: (Turkey's Ministry of Energy and Natural Resources, 2014; Poland's Ministry of Economy, 2010)

In Turkey, the share of renewable electricity in total electricity generation reached 44% in 2019. This placed Turkey on the higher end in comparison with the EU member states. This rate is far above the expected target in renewable electricity for the year 2020.

The residential sector in Turkey mostly uses natural gas, which covered 51% of total energy consumption in 2018. The rest was covered by electricity (23%), bioenergy (8%), coal (8%), geothermal (6%), solar (3%) and oil (1%) (International Energy Agency (IEA), March 2021). Space heating accounts for almost half of residential energy demand and the rest is used in water heating, residential appliances, and cooking. Considering the renewable energy shares in the heating and cooling sectors in 2018, the target for 2020 seems plausible to achieve.

However, oil fuels strongly dominate Turkey's domestic transport energy use. They accounted for 98% of domestic transport energy use in 2018. Only 0.7% of total energy consumed in domestic transport sector came from renewable energies in 2018. Of this amount, 0.5% came from biofuels and 0.1% came from renewable electricity (International Energy Agency (IEA), March 2021). This rate of renewable energy consumption in transport sector is one of the lowest compared to other EU member states.

Despite the growth in renewable energy, the share of renewables in total final energy consumption (TFEC) has fallen slightly due to the growth in fossil fuels. In 2018, the renewable share in TFEC was 11.9% (International Energy Agency (IEA), March 2021). This rate is far behind Turkey's 2020 target, and it places Turkey in the lower half in comparison with other EU member states.

Share of renewable energy in gross final energy consumption in Poland amounted to 16.1%, i.e. above the target set at 15%. However, the achievement of the target was possible thanks to the modification of the method of calculating the share of renewable energy sources by the Central Statistical Office. This modification concerned the estimation of a much greater use of wood in domestic boilers and fireplaces. This allowed

for the avoidance of potential penalties. Recent years have seen an unprecedented development of individual solar energy stimulated by a system of subsidies and tax reliefs. This success, due to the temporary and high loads on local power grids, resulted in the reduction of the existing incentive system. The development of wind farms in the Baltic Sea is also planned, in 2026 a wind farm with a capacity of 1 GW is to be commissioned.

Results

In its neighbourhood, Turkey and Iran are the only countries with significant coal deposits. This makes Turkey's energy system dominated by a large share of fossil fuels. In 2019, with 83% of the total primary energy supply coming from fossil fuels, Turkey ranks among the EU member states that have the highest share of fossil fuels in their energy mix. Another problem in Turkey's energy mix is the reliance on energy imports - oil and gas- for the energy supply. On the bright side, Turkey's renewable energy policy implementation has recorded a considerable success in the last decade by doubling the renewable energy production since 2009 and achieving 54% of total energy production from renewable sources in 2019. This rapid growth is mainly caused by the increase in hydro energy, wind energy, and solar energy.

Turkey's energy policy objectives have been shaped around the reduction of import dependency in oil and gas and diversification of its energy mix. Both objectives require development of renewable energies that is to be complimented by the introduction of nuclear energy. As the Turkish administration recognized the potential for renewable energy that can reduce the country's dependence on foreign oil and gas, the sector started to gain momentum. This development is expected to contribute to energy security and economic growth at the same time, both of which are political priorities for Turkey.

Poland's energy policy objectives have been shaped around two challenges, i.e., the pursuit of a low- and zero-emission transformation of the Polish economy while ensuring energy security. The strategy 'Poland's energy policy until 2040' adopted in 2021 assumes that by 2040 more than half of the installed capacity will be zero-emission sources. The new, strategic area of these changes is offshore wind energy, in which Orlen, the largest oil company in Poland, has started investing. The aforementioned strategy assumes that in 2030 the share of renewable energy sources in gross final energy consumption will be at least 23%. Polish energy policy is in line with the assumptions of the United Nations Framework Convention on Climate Change (COP21) and the European Green Deal.

Poland has experienced significant development of the RES sector in recent years, largely thanks to the use of systemic solutions stimulating investments, both addressed to larger suppliers (through RES auctions in the form of subsidies to the price of energy offered in auctions) and individual (with a good example of subsidies and concessions for the development of individual photovoltaic installations). It seems that the decision to gradually close the mines will provide an additional impulse for the development of

renewable energy sources, including through the already initiated legislative work to ease the restrictive policy in the field of installing new wind farms.

Turkey has a high potential for renewable energy resources, so, there is an economic growth opportunity only to be triggered by greater investments in the renewable energy sectors. These investments are expected to provide positive socio-economic consequences when the new employment creation effect of these sectors is considered. Although the 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 candidate country to associate itself more closely with the EU member states.

In Poland, share of renewable energy in gross final energy consumption remained at a similar level of about 11% from 2012 to 2017. A clear increase in the value of this indicator has only been observed in recent years, since 2018 it has increased from 14.9% to 16.1% in 2020, although it is partly due to the broader qualification of biomass burned in fireplaces and stoves. A barrier to the development of wind energy are the restrictive regulations on the location of windmills in relation to existing buildings and even forest complexes. Still, a large unused potential in the field of renewable energy production concerns biomass (Kampas, Rozakis, Faber, & Mamica, 2021). The decisions made in 2021 on the gradual cessation of hard coal mining by 2041 will favour the development of renewable energy in Poland. A barrier to the rapidly developing solar energy is the failure to adapt the energy transmission system to significant fluctuations related to it. Therefore, actions are required to improve this infrastructure as well as further work on technologies enabling energy storage, including particularly the production of hydrogen.

This research maintained that the deployment of renewable energies is important for maintaining environmental sustainability because of clean energy generation, reduction of CO_2 emissions, increasing air quality, and ensuring energy safety. Renewable energies also have economic importance well beyond the energy sector because of their positive impact on the generation of new jobs. The people that are directly and indirectly employed in the renewable energy technologies spend their incomes on food or consumer goods and services, and thereby, they stimulate many different industries in local and national economy. The conclusion 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 both energy transition and a sustainable economic growth. Our research data showed that in Turkey and Poland alike, supportive policies and financial incentives for the renewable energies provided an effective method to maintain new investments and fulfil these countries' international obligations in terms of renewable energies.

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