



Lessons from global experiences for accelerating energy transition in Turkey through solar and wind power

EXECUTIVE SUMMARY

About SHURA Energy Transition Center

SHURA Energy Transition Center, founded by the European Climate Foundation (ECF), Agora Energiewende and Istanbul Policy Center (IPC) at Sabancı University, contributes to decarbonisation of the energy sector via an innovative energy transition platform. It caters to the need for a sustainable and broadly recognized platform for discussions on technological, economic, and policy aspects of Turkey's energy sector. SHURA supports the debate on the transition to a low-carbon energy system through energy efficiency and renewable energy by using fact-based analysis and the best available data. Taking into account all relevant perspectives by a multitude of stakeholders, it contributes to an enhanced understanding of the economic potential, technical feasibility, and the relevant policy tools for this transition.

About Agora Energiewende

Agora Energiewende develops evidence-based and politically viable strategies for ensuring the success of the clean energy transition in Germany, Europe, and the rest of the world. As a think tank and policy laboratory, Agora aims to share knowledge with stakeholders in the worlds of politics, business, and academia while enabling a productive exchange of ideas. As a non-profit foundation primarily financed through philanthropic donations, Agora is not beholden to narrow corporate or political interests but rather to its commitment to confronting climate change.

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The global energy sector is in the midst of a profound energy transition. At the centre of this are the dual pillars of energy efficiency and renewable energy, both of which are rapidly expanding. Another key component of the energy transition is system-wide innovation, including the growing electrification of energy end uses and digitalisation.

Climate change mitigation, reducing local air pollution, improving energy security and socio-economic benefits are among the key drivers for energy transition worldwide. Many countries around the world provide clear examples of how a transition to a sustainable energy system can be achieved. Turkey has now joined in this effort by launching its own energy transition, scaling up investments both in local renewable energy sources as well as in energy efficiency. This transition is driven by Turkey's top policy priorities to reduce its current account deficit and ensure supply security to meet its rapidly growing energy demand.

Total demand for energy in Turkey is increasing by around 4% per year. In 2017, Turkey's total primary energy supply reached just below 150 million tonnes of oil equivalent (Mtoe) per year, a 50% increase compared to the level from one decade ago. Total demand for electricity is growing at an even faster pace, at around 5% per year. The projections for 2030 put the total demand between 440–550 billion kilowatt-hours (kWh) per year. In 2017, Turkey's total demand for electricity was just below 300 billion kWh per year.

Looking back at 2017, the growth of renewable energy capacity additions exceeded that of conventional fuels for a consecutive year, accounting for two-thirds of all additions. Many other promising developments have taken place in Turkey's renewable energy sector. In 2017, Turkey held its first round of capacity auctions for renewable energy¹, yielding extremely competitive prices for long-term power purchase contracts. The onshore wind auction was won with a price of 3.48 United States dollar cents (USD ct) per kWh, and solar PV auction with a price of 6.99 USD ct per kWh. Each auction had a size of 1,000 megawatt (MW). Following this success of auctions in 2017, the government of Turkey announced three new YEKA auctions in 2018. A second round of auctions for both onshore wind and solar PV technologies each with 1,000 MW, and one for offshore wind with a total capacity of 1,200 MW that will take place in 2019. Moreover, Ministry of Energy and Natural Resources (MENR) stated that Turkey plans to install an additional 10,000 MW solar PV and 10,000 MW wind capacity in the coming decade. One major factor behind Turkey's renewable energy transition is the declining costs of renewable energy technologies, particularly for wind and solar. If Turkey is to keep up this expansion of its renewable energy capacity, it has the potential to join international front-runners in the global renewable energy sector for wind and solar, following the global trends and using its own resources effectively.

The share of renewables in Turkey's electricity system is on the rise. By the end of 2017, renewables accounted for around 30% of all electricity output. This was split between 20% hydropower, 6.1% wind, 2% geothermal, 1% solar, and 1% bioenergy. Variable renewable energy sources represented only 7% of Turkey's total electricity demand. Although this share is still rather low compared to the country's significant resource potential, the recent growth in renewable energy (and variable renewables in particular) indicates that Turkey is clearly on the path toward the long-term transition of its power sector.

On 26 September 2018, Turkey's total electricity output was one of the highest throughout the year. On that same day, a new record was also made for wind power: its share in total electricity generation reached 16.8%, just below gas but surpassing resources like hydropower and lignite. This record revealed a crucial strength that Turkey possesses but does not use to its full extent: namely, the fact that its transmission and distribution grid can accommodate double-digit shares of variable renewables without experiencing disruptions in the system. This assertion is also supported by SHURA's recently released renewables grid integration study "Increasing the share of renewables in Turkey's power system". This study shows that Turkey has the potential to accommodate at least a 20% share of wind and solar power in its system by 2026 without any

¹ This auction is different from the pre-licensing auctions for grid access, which are already being implemented.

major operational issues and additional investments in grid infrastructure beyond what the Turkey's transmission system operator (TEİAŞ) has already planned.

The share of wind and solar power will increase as new capacity comes online; as a result, Turkey needs to start planning for this transformation in order to ensure the secure and reliable operation of its power system. Many countries have already achieved wind and solar shares above 15% or more without experiencing major problems. Some countries, such as Denmark, Germany, and Spain, provide close to or even more than one-quarter of all output from wind and solar power. Denmark and Germany have topped the charts for system reliability-in other words, experiencing the fewest power outages. In the process, countries have developed their own strategies to ensure a flexible power system to integrate higher shares of wind and solar. Strategies to better integrate high and growing shares of variable renewables include strong transmission grids, flexible generators, interconnector capacity that allows for electricity trade with neighbouring countries, demand-side management strategies, energy storage, and improved techniques for energy planning and forecasting. The ranking of the strategies in terms of their cost and ease of implementation will depend on country circumstances. SHURA's grid integration study outlines four flexibility strategies for Turkey: (i) locating more wind and solar capacity within proximity of load centres and strong grid areas, (ii) energy storage provided by batteries and pumped hydropower plants, (iii) demand response, and (iv) modernising thermal power plants.

To further drive energy transition regulations and market design will need to be improved, and innovative business models and financing structures will need to be developed. Achieving higher shares of wind and solar power requires current rates of technology uptake to be further increased over the coming years, combined with innovations for developing new technologies and enabling infrastructure such as energy storage, smart grids, and interconnectors. Technological efforts would need to be complemented with new approaches to ensure renewables' integration into the system. This calls for efforts extending beyond the development of new technology, notably a regulatory framework that is well adapted to rapidly evolving market developments. The goal of sound, future-oriented regulatory policy is to create a supportive environment for investments in innovation, new technologies, and new businesses.

As Turkey advances its energy transition, it can also learn from the useful lessons and experiences of other countries in order to accelerate progress in meeting its national policy goals. National energy transition narratives around the world involve both successes and failures. However, they provide firm evidence that it is possible in all countries to build a system that is cleaner, more efficient, and more reliable by harnessing the local potential of wind and solar energy.

This paper is based on the review of ten countries selected from different regions around the world. Together they represent around three-quarters of the total installed wind and solar capacity worldwide. **It identifies four key areas that are crucial for energy transition, namely: (i) long-term energy planning, (ii) regulatory framework and renewable energy generation costs, (iii) system integration measures, and (iv) innovation in finance and business models.** The objective of this paper is to provide a brief review of the selected countries against these metrics and to discuss the commonalities of countries based on their best practices and experiences.

Based on the country assessments, three priority action areas emerge for Turkey:

- **Long-term energy planning:** Turkey has developed its renewables and energy efficiency strategy until 2023. While progress has been made towards achieving these targets, now it is suggested to start planning further ahead and establish a medium- and long-term strategy toward 2030 and ultimately toward 2050. This strategy is expected to progressively increase Turkey's ambitions in meeting its energy transition targets and it is advised to include all sectors of the energy system (electricity, heating and cooling, as well as transport and industrial energy use).

- **Policy design:** Renewable energy auctions have yielded successful results that were awarded with record prices for large-scale utility projects. Turkey is suggested to continue these efforts by considering its resource potential as well as encouraging project development to ease grid integration. As the costs of renewables go down, Turkey is suggested to continue implementing market-based policy mechanisms. In order to increase competition in the medium term, it might be beneficial to develop strategies for incentivising projects of different sizes, from large to medium commercial plants, as part of defining the framework after the expiry of the current feed-in tariff (FiT) system in 2020. These strategies are also suggested to include suitable policy frameworks for distributed generation, which has significant potential in Turkey and might yield strong benefits-both when it comes to reduced losses at the distribution and transmission systems and in terms of local and regional socio-economic value creation. It is suggested to complement these policies with similar instruments and financing for energy efficiency and widespread electrification in heating, cooling and transport sectors.
- **Grid integration and innovation:** As renewables' share increases in the electricity mix, this will require more system flexibility. Providing flexibility takes time and requires significant planning. As part of its energy system planning, Turkey is suggested to carefully analyse the costs and benefits of different flexibility measures, including strategies toward energy efficiency and coupling electricity generation with those sectors that consume the electricity. Setting adequate market frameworks is suggested to be emphasised, which would incentivise investment in flexibility, be it on the generation, demand, or storage side. Transmission and distribution system planning and operation is suggested to continue its pathway toward modernisation, thus facilitating smart and efficient integration. It is suggested to complement technological efforts toward renewables' grid integration with innovative approaches for new market design as well as new business models and new approaches to financing.





About Istanbul Policy Center at the Sabanci University

Istanbul Policy Center (IPC) is a global policy research institution that specializes in key social and political issues ranging from democratization to climate change, transatlantic relations to conflict resolution and mediation. IPC organizes and conducts its research under three main clusters: The Istanbul Policy Center–Sabanci University–Stiftung Mercator Initiative, Democratization and Institutional Reform, and Conflict Resolution and Mediation. Since 2001, IPC has provided decision makers, opinion leaders, and other major stakeholders with objective analyses and innovative policy recommendations.

About European Climate Foundation

The European Climate Foundation (ECF) was established as a major philanthropic initiative to help Europe foster the development of a low-carbon society and play an even stronger international leadership role to mitigate climate change. The ECF seeks to address the “how” of the low-carbon transition in a non-ideological manner. In collaboration with its partners, the ECF contributes to the debate by highlighting key path dependencies and the implications of different options in this transition.

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