Fostering energy independence as the backbone of economic recovery

Foreword in light of the COVID-19 pandemic

At the time this report is being published, Turkey along with many economies around the world has been severely affected by the spread and impacts of the global COVID-19 pandemic. Similarly to many countries worldwide, the Turkish economy, along with thousands of businesses and workers, has been deeply affected and substantial political efforts will be needed to rebuild national and local economies and job markets. The pandemic also reminded us how public health measures are equally important as a strong and resilient health system.

This report and the related COBENEFITS study series for Turkey suggest that the new energy world of renewables and the decarbonisation of Turkey's energy sector should have a strong role in reviving the economy and health system by boosting employment, fostering energy independence as foundation of economic resilience, and — importantly — unburdening national health systems by reducing the incidence of respiratory diseases. By providing the enabling policy environment necessary for unlocking these co-benefits, the Government of Turkey can provide important stimuli to recover from the impacts of the COVID-19 pandemic and revive both the health system and the national economy.

Turkey is in the midst of an energy transition, with important social and economic implications, depending on the pathways that are chosen. Independence from energy imports; economic prosperity; business and employment opportunities as well as people's health: through its energy pathway, Turkey will define the basis for its future development. Political decisions on Turkey's energy future link the missions and mandates of many government ministries beyond energy, such as environment, industry development, economics, foreign relations, and health.

Importantly, the whole debate boils down to a single question: How can renewables improve the lives and wellbeing of the people of Turkey? Substantiated by scientific rigor and key technical data, the study at hand contributes to answering this question. It also provides guidance to government ministries and agencies on further shaping and enabling the political environment to unlock the social and economic co-benefits of the new energy world of renewables for the people of Turkey.

Under their shared responsibility, the Istanbul Policy Center (IPC) of Sabanci University (as the COBENEFITS Turkey Focal Point) and IASS Potsdam invited the ministries of Energy and Natural Resources (MoENR), Environment and Urban Affairs (MoEU), Treasury and Finance (MoTF, formerly Ministry of Economics MoE), Foreign Affairs (MoFA), and Health (MoH) to contribute to the COBENEFITS Council Turkey and to guide the COBENEFITS Assessment studies along with the COBENEFITS Training programme and *Enabling Policy* roundtables. Their contributions during the COBENEFITS Council sessions guided the project team to frame the topics of the COBENEFITS Assessment for Turkey and to ensure their direct connection to the current political deliberations and policy frameworks of their respective departments.

We are also indebted to our highly valued research and knowledge partners, for their unwavering commitment and dedicated work on the technical implementation of this study. The COBENEFITS study at hand has been facilitated through financial support from the International Climate Initiative of Germany. The Government of Turkey has emphasised climate change as one of the most significant problems facing humanity, presenting wide-ranging threats to Turkey's future

unless early response measures are taken. Within the scope of Turkey's National Climate Change Strategy, the government has laid out its vision for providing citizens with high quality of life and welfare standards, combined with low carbon intensity.

With this study, we seek to contribute to this vision by offering a scientific basis for harnessing the social and economic co-benefits of achieving a just transition to a low-carbon, climate-resilient economy and thereby also allowing Turkey to achieve a regional and international front-runner role in shaping the new low-carbon energy world of renewables, making it a success for the planet and the people of Turkey.

We wish the reader inspiration for the important debate on a just, prosperous, and sustainable energy future for Turkey!

Ümit Şahin
COBENEFITS Focal Point Turkey
Istanbul Policy Center

Sebastian Helgenberger
COBENEFITS Project Director
IASS Potsdam

Executive Summary

COBENEFITS

Increasing energy supply security and balancing Turkey's current account deficit through renewable energy

Turkey's socio-economic growth has been accompanied by increasing energy demand, thereby expanding the opportunities to enable multiple co-benefits involving both securing the country's future energy supply and utilising local and clean energy sources. The energy transition is inducing new investments in the electricity production and infrastructure sectors worldwide. By predominantly relying on fossil fuel resources to meet its increasing energy demand, Turkey faces significant risk of exacerbating the current account deficit in the energy sector's trade balance and also increasing its dependency on energy imports in the future. Electricity generation technologies that utilise local and renewable energy sources can contribute to reducing energy import dependency.

This study assesses the contribution of renewable energy sources to reducing demand for fossil fuels and thus associated fossil fuel imports. This research study has been carried out in the context of the COBENEFITS project, which assesses a range of socio-economic co-benefits[1] of renewable energy, in addition to the benefits of reducing energy sector greenhouse gas emissions, when compared to non-renewable energy systems.

The assessment consists of a series of quantitative analyses, including a renewable energy sources (RES) capacity penetration scenario analysis, a market and network simulation, and a levelised cost of energy (LCOE) analysis, based on investment and in the operation and management (O&M) cost of renewable energy under various weighted average cost of capital (WACC) assumptions.

KEY POLICY OPPORTUNITIES

- **Policy opportunity 1:** Turkey can foster its energy independence and ensure security of supply by increasing the use of its renewable energy sources. Increasing the share of renewable energy in power generation will contribute to increasing independence from fossil fuel imports and to reducing the current account deficit in the energy sector's trade balance.
- **Policy opportunity 2:** By the year 2028 Turkey can reduce its natural gas consumption by 16 % and 155 million MMBTU (million British Thermal Units) through scaling up renewable power generation without the need to increase foreseen investment in the transmission system.
- **Policy opportunity 3:** Annual economic savings on fossil fuels and fossil fuel imports can amount to USD 2.1 billion by the year 2028 by increasing the share of renewable energy in power generation and making the transmission system renewables-ready.

[1] The term 'co-benefits' refers to simultaneously meeting several interests or objectives resulting from a political intervention, private-sector investment or a mix thereof (Helgenberger et al., 2019).

FOUR POWER SYSTEM PATHWAYS FOR TURKEY

The co-benefits assessment for Turkey takes a policy-directed scenario approach, to connect with existing policy environments and learn from comparing the socioeconomic performance of various potential energy transition pathways in Turkey. In consultation with government and expert organisations, four scenarios were defined to assess the socio-economic implications of increasing the share of renewable energy in Turkey's future electricity generation mix in the year 2028 (see Figures ES.1 and ES.2 below): Building on the base year (2017) for this study, the four scenarios project an increase of total generation by one-third, from less than 300 TWh (2017) to around 400 TWh (2028).

1. **Base year (2017):** For the base year of the study the Turkish Electricity Transmission Corporation (TEİAŞ) reported 37.8 GW renewable energy installed capacity with a total generation of 85.1 TWh, accounting for 29 % of total power generation[2].

2. **Current Policy Scenario:** Based on projections by the Turkish Electricity Transmission Corporation (TEİAŞ) for 2026, proportionally adjusted for 2028. Under this scenario, in 2028 renewable energy installed capacity amounts to 61.5 GW, with a total generation of 142.0 TWh, accounting for 36 % of total power generation.

3. **New Policy Scenario:** Based on the Ministry of Energy and Natural Resources (MoENR) announcements of 1 GW annual increase in solar and wind capacity for 10 years, starting in 2018, as a part of its "National Energy and Mining Policy" (MoENR, n.d.). Under this scenario, in 2028 renewable energy installed capacity amounts to 69.5 GW, with a total generation of 167.1 TWh, accounting for 43 % of total power generation.

4. **Advanced Renewables Scenario A:** Under this scenario, in 2028 renewable energy installed capacity amounts to 77.5 GW, with a total generation of 181.5 TWh, accounting for 46 % of total power generation. This scenario is based on a report by SHURA (2018), which concluded that increasing installed wind and solar capacities to 20 GW each is feasible without any additional investment in the transmission system.

5. **Advanced Renewables Scenario B:** Under this scenario, in 2028 renewable energy installed capacity amounts to 97.5 GW, with a total generation of 217.0 TWh, accounting for 55 % of total power generation. This scenario is based on the same report by SHURA (2018), which concluded that increasing the solar and wind sector to 30 GW each is possible under the condition of a 30% increase in transmission capacity investment and 20 % increase in transformer substations investment.

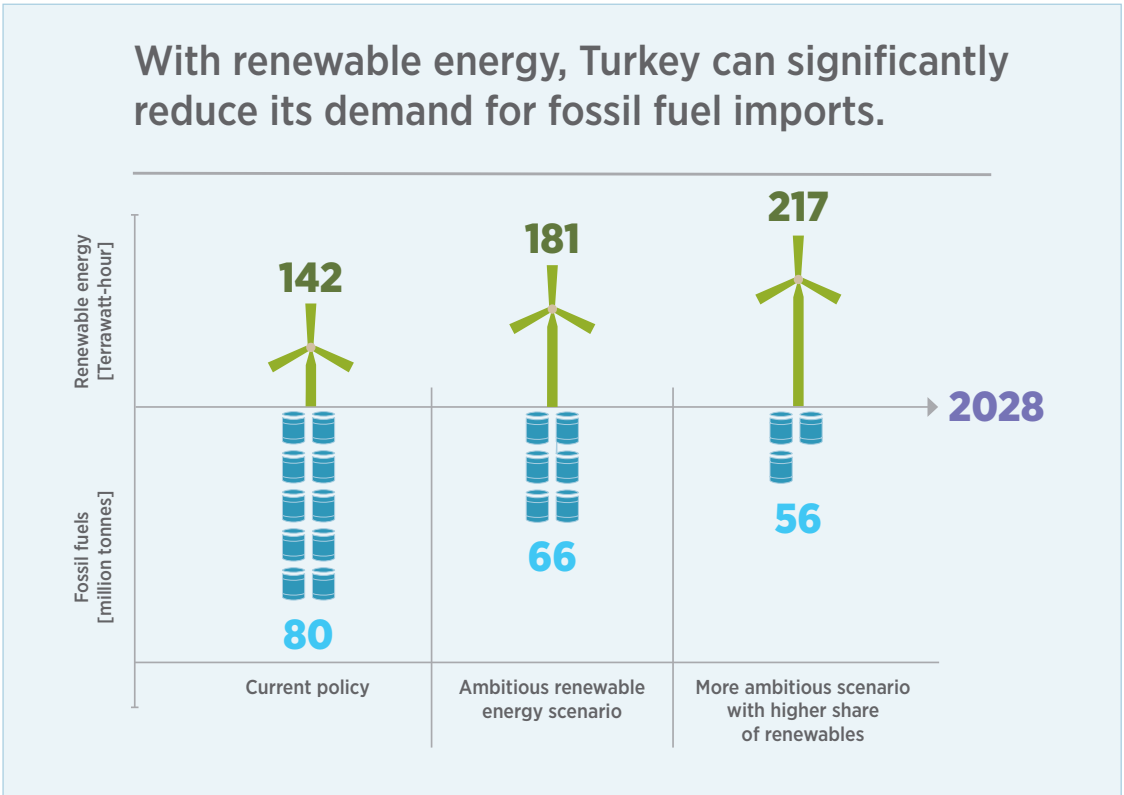
[2] The energy sources used to calculate the generation shares in this report cover 99 % of the power generated in the base year 2017. When including the remaining energy sources such as diesel or biomass, the rounded percentage of renewable energy sources (29 % for 2017) would remain unchanged. Hence, no major discrepancies are expected for the 2028 target year.

KEY FIGURES:

- Turkey is heavily reliant on fossil fuels imports: in 2017, more than 98% of the natural gas and 42% of the coal burned for electricity generation were from imported sources (EPDK, 2019).
- Turkey's coal reserves largely occur in the northwest of the country, and its natural gas resources are scarce[3]: 99% of natural gas used in the power sector was imported in the base year 2017. While lignite is available across the country, more than 90% of Turkey's domestic lignite reserves are of low calorific value with a heat rate of less than 3,000 Kcal/Kg.
- Renewable energy sources accounted for 29% of total power generation in 2017, increasing to 32% in 2018. Aside from hydro power (accounting for 20 GW), solar PV (3 GW) and wind power (6.5 GW) accounted for the highest non-fossil generation capacities. In 2018, solar PV capacities and wind power increased to 5 GW and 7 GW respectively (EPDK, 2019).
- It is feasible to more than double power generation from renewable energy sources, from 85.1 to 181.5 TWh (46% of total power generation), without any additional investment in the transmission system (own calculations; based on SHURA, 2018).
- The target for integration of renewables into the Turkish power system is 1 GW/year. However, current figures are not in line with this target (almost 0.6 GW/year in the Current Policy Scenario).

COBENEFITS
Securing Turkey's energy supply and balancing the current account deficit through renewable energy. Assessing the co-benefits of decarbonising the power sector

available on www.cobenefits.info



Key figure 1: Projected renewable energy generation and fossil fuels savings for Turkey in 2028

Source: own

[3] In 2017, the first natural gas production started in Çanakkale. In this province, the production amount was 1.48 million Sm3 in December 2017. (EPDK, 2018: 3)

KEY FINDINGS:

- Turkey can foster its energy independence and security of supply by increasing the use of its renewable energy sources: By the year 2028, Turkey can reduce its natural gas consumption by 16 % and 155 million MMBTU through scaling up renewable power generation without the need to increase foreseen investment in the transmission system (Advanced Renewables Scenario A, compared to the current policy pathway).

- By additional investment in transmission capacity (+30 % investment) and transformer substations (+20 % investment), renewable energy can allow Turkey to reduce its natural gas consumption by 38 % (300 million MMBTU) and overall fossil fuel demand in the power system by almost 30 % by the year 2028 (Advanced Renewables Scenario B, compared to the current policy pathway).

- Under the current policy pathway Turkey's power sector is expected to consume almost 80 million tonnes of fossil fuels in the year 2028. This total consumption can be reduced by 17 % (to 66 million tonnes) and even by 30 %, by following the energy transition pathways Advanced Renewables Scenarios A and B respectively (see Key figure 1)

- Under the New Policy Scenario, economic savings on fossil fuels (including imports) are estimated as USD 728 million in the year 2028. Such savings could increase to more than USD 1 billion by increasing the share of renewable energy in power generation to 46 % (Advanced Renewables Scenario A). By additional investment in the transmission grid (Advanced Renewables Scenario B), allowing a 55 % share of renewable energy in power generation and reducing the levelised cost of electricity (LCOE) for renewable energy sources, economic savings can be almost doubled to USD 2.1 billion.

Fostering energy independence and ensuring security of supply with renewables.

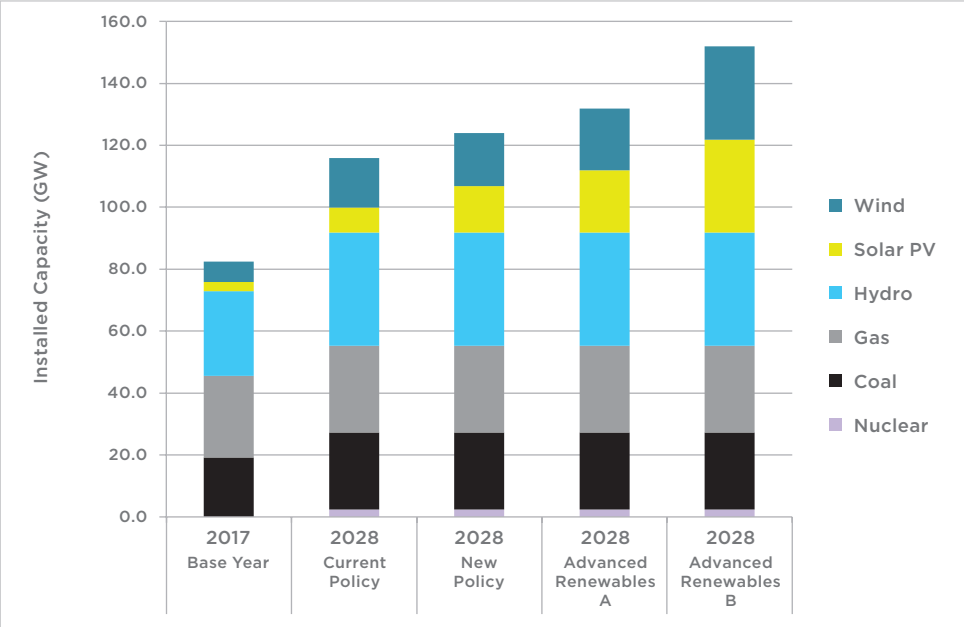


Figure ES.1: Electricity generation scenarios for different fuel types: installed capacities (GW)

Source: own, based on SHURA (2018), TEIAS (2018a), MoENR (2019)

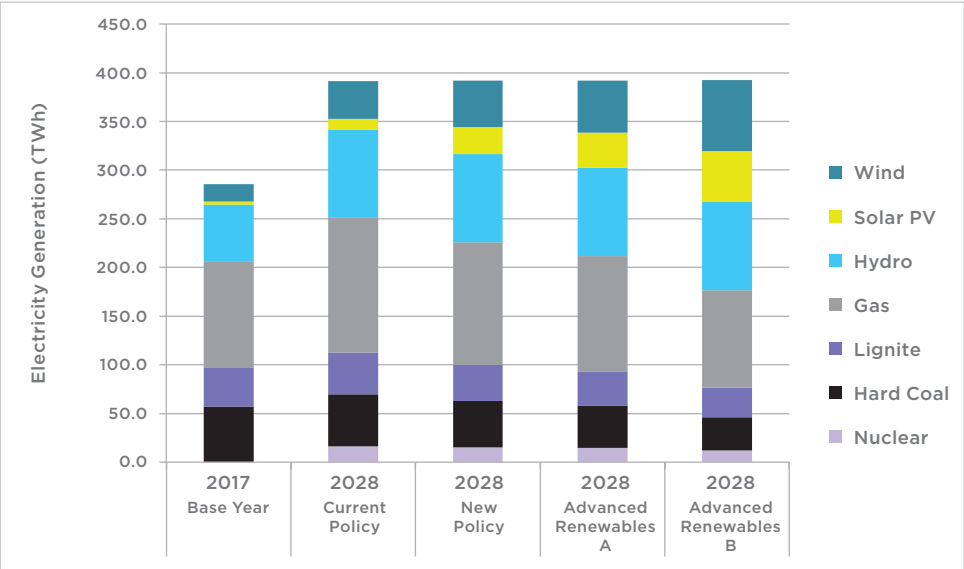


Figure ES.2: Electricity generation scenarios for different fuel types (TWh)

Source: own, based on SHURA (2018), TEIAS (2018a), MoENR (2019)