COBENEFITS STUDY

June 2020

Industrial development, trade opportunities and innovation with renewable energy in Turkey

Assessing the co-benefits of decarbonising the power sector

Executive report

İPM | IPC İSTANBUL POLİTİKALAR MERKEZİ SABANCI ÜNİVERSİTESİ ISTANBUL POLICY CENTER SABANCI UNIVERSITY

IASS POTSDAM

IET International Energy Transition

COBENEFITS

This study has been realised in the context of the project "Mobilising the Co-Benefits of Climate Change Mitigation through Capacity Building among Public Policy Institutions" (COBENEFITS).

This project is part of the International Climate Initiative (IKI). The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) supports this initiative on the basis of a decision adopted by the German Bundestag. The COBENEFITS project is coordinated by the Institute for Advanced Sustainability Studies (IASS, lead) in partnership with the Renewables Academy (RENAC), the Independent Institute for Environmental Issues (UfU), International Energy Transition GmbH (IET) and in Turkey the Sabanci University Istanbul Policy Center (IPC).

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Editors: Mara Gomez, Pinar Ertor, Sebastian Helgenberger, Laura Nagel – IASS Potsdam and Istanbul Policy Center (IPC), Sabanci University

Technical implementation: Bengisu Özenç, Efşan Nas Özen – Cobenefits Researchers at Istanbul Policy Center (IPC), Sabanci University

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INTERNATIONAL CLIMATE INITIATIVE (IKI)

COBENEFITS of the new energy world of renewables for the people of Turkey

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, industrial 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 an enabling 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 (MENR), Environment and Urban Affairs (MoEU), Treasury and Finance (MoTF, formerly Ministry of Economics MoE) Foreign Affairs (MFA) and Health (MoH) to contribute to the COBENEFITS Council Turkey in April 2018 and May 2019 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 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 frontrunner 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

COBENEFITS
Project Director
IASS Potsdam

Executive Summary

COBENEFITS

Industrial development, trade opportunities and innovation with renewable energy in Turkey

Assessing the co-benefits of decarbonising the power sector

The energy transition is inducing new investments in the electricity production and infrastructure sectors worldwide. Turkey, with its increasing energy demand met mostly by fossil fuel resources, faces significant risk of an escalation of its dependency degree on energy imports in the future. In order to address this issue, Turkey's public policy framework includes not only strategies to increase the share of renewable energy resources in its energy mix but also aims to develop a local manufacturing industry and to enable technology transfer. This study examines the co-benefits[1] to industrial development and trade of increased deployment of renewable energy in Turkey. The research is carried out in the context of the COBENEFITS project, which assesses a range of additional co-benefits of renewable energy in developing countries, besides reducing energy sector greenhouse gas (GHG) emissions, when compared to conventional energy systems. The study also provides initial insights on the regional trade opportunities available to Turkey, should technological gaps in the solar and wind sectors be narrowed.

The study methodology focused firstly on defining value chains for the solar and wind energy sectors in Turkey. This was done using licence and pre-licence information from the Energy Market Regulatory Authority and a unique administrative micro dataset (EIS) that includes all registered firms in Turkey and their domestic and export transactions. Secondly, coefficients for the value of production and trade were calculated. Finally, projections on industrial development and import–export values were estimated according to four scenarios for increased renewable energy (RE) capacity. As this study takes a static look at the scenarios, the current trade deficit resulting from low local value of production and technological gaps in the manufacture of renewable energy equipment are also observed as core issues that should be addressed by renewable energy policies.

- **Key policy message 1:** Turkey can significantly boost the value of production by increasing the share of renewables. With the decision by the Turkish Government to increase solar energy capacity by 60% and more than double the wind one over the next 10 years, the government paved the way to increase fifteenfold the value of production along the solar value chain, and over 31% along the wind value chain in the next ten years alone.
- **Key policy message 2:** There is room for more: By following more ambitious renewable pathways for Turkey, the expected increases in value of production can be more than doubled across the wind power value chain and increased eightfold along the solar value chain, pushing up the total value of production by more than 69 billion USD in the next ten years compared to 2016.
- **Key policy message 3:** Fostering competitiveness in manufacturing and closing the technology gap between imports and exports in both the solar and wind sectors is crucial to further improving the trade balance in Turkey's renewable energy sector. In solar energy, 48% of Turkey's imports are high-technology components whereas their share of exports is only 4% (in the wind sector these shares are 19% and 2% respectively). Given the increasing trade deficit and the fact that renewable energy equipment mainly comprises higher-technology components, investing in research and development (R&D) and competitiveness in those sectors, as part of a localisation policy, will increase the value-added of Turkey's industrial production.

[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). It is thus essential that the co-benefits of climate change mitigation are mobilised strategically to accelerate the low-carbon energy transition (IASS, 2017a).

KEY FIGURES:

- By 2028 it is possible for the solar energy sector to increase its value by 9.9 billion USD above the expected 1.3 billion estimated under the current policy, if more ambitious solar capacity additions are achieved.
- Likewise, the wind sector could peak to a total value of 83.5 billion USD from the expected 33.32 billion USD in the next ten years should RE capacity additions are in place.
- Across the value chains, each additional MW capacity of energy increases industrial production by around 452.5 thousand USD in the solar energy sector, and around 3.6 million USD in the wind sector, on average.
- Given Turkey's present technological imbalance between low-tech exports and high-tech imports, each additional MW increase exacerbates Turkey's trade deficit by 95 thousand USD in the solar energy value chain and by 157 thousand USD in wind energy value chain.
- 76 % of the total value of the solar supply chain concentrates in the first segment (intermediaries of good and services), only 1 % of value is added by electricity producers. Greater industrial competitiveness requires integrating at the highest possible value-added level.

COBENEFITS
Industrial development, trade opportunities and innovation with renewable energy in Turkey. Assessing the co-benefits of decarbonising the power sector

available on www.cobenefits.info

KEY FINDINGS:

- **In 2016, the total value of production within the solar energy value chain is calculated as 88 million USD; in 10 years, following the current renewable energy policy, it is possible for the solar energy sector to reach a cumulative value of 1.36 billion USD.** The value of production is expected to increase with increased solar energy deployment. Moderate additional capacity, ranging between 3 and 10 GW in the next 10 years, is expected to bring an additional industrial production between 1.3 and 4.96 billion USD in the next ten years. More ambitious capacity additions of 15 – 25 GW are expected expected to increase production by 6.8 – 11.3 billion USD.

- **The total value of production within the wind energy value chain in 2016 is calculated as 25.3 billion USD. In 10 years, following the current renewable energy policy, it is possible for the wind energy sector to reach a cumulative value of 33.32 billion USD.** The value of production is expected to increase with increased wind energy deployment. A moderate additional capacity, ranging between 9.3 and 10.3 GW in the next 10 years, is expected to bring additional industrial production of between 33.3 and 37 billion USD by 2028, and a more ambitious capacity addition of 13.3 – 23.3 GW is expected to increase production value by 47.6–83.5 billion USD.

- **Turkey has the opportunity to become the regional leader in RE equipment trade.** In the solar energy equipment sector, four of the top export destinations are in the MENA (Middle East and North Africa) region and present significant growing rates in the period 2008–2016: Turkmenistan (9.7 % share, 18.2 % growth), Iraq (6.4 % share, 3.1 % growth), Algeria (4.8 % share, 11.3 % growth) and Georgia (4.1 % share, 12.2 % growth). In the wind energy equipment sector, three out of the five top export destinations are in the MENA region and show, with one exception, strong growth during 2008 – 2016: Saudi Arabia (7.9 % share, 3.4 % growth), Iraq (7.6 % share, 3.4 % decrease) and Turkmenistan (6.6 % share, 17.5 % growth).

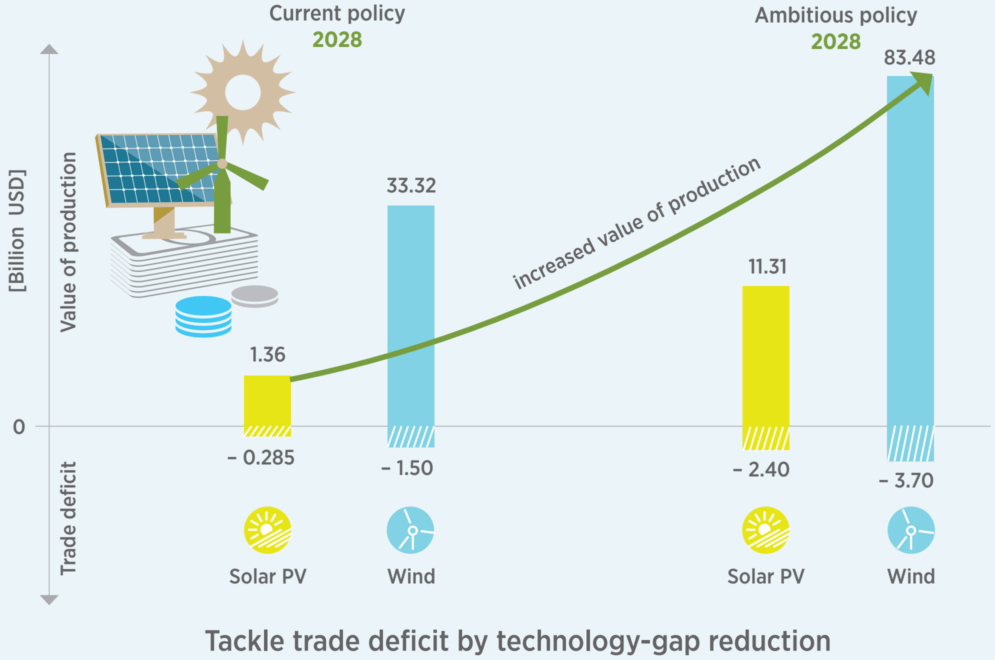
- **Although Turkey has a trade surplus in wind energy equipment, it imports high-technology equipment at a rate higher (19%) than the global average (12%).** Turkey's exports fall short regarding technology composition, where the high-technology components account for 2% whereas low-technology components are at 23%. Evidence suggests that greater industrial competitiveness tends to be integrated at higher levels within local and global value chains (UNIDO, 2012).

- **Turkey's RE equipment exports with a comparative advantage are mostly of low- or medium-technological composition.** Despite the comparative advantage of some of Turkey's exports, there is still a technological divide in the solar and wind sectors. In the solar sector, high-technology equipment comprises 48% of imports but only 4% of exports. In the wind sector, high-technology equipment comprises 19% of imports but only 2% of exports.

- **Industrial production entails a trade deficit of 19 million USD in the solar sector in 2016, which equals 21% of the total value created in this sector in the same year.** If the current industrial production structure persists over the next 10 years, this trade deficit may increase to a cumulative value of 2.4 billion USD. The solar energy value chain in Turkey exhibits both trade and technological deficits. The trade deficit was 19 million USD in 2016, whereas the technological deficit results from high-technology imports of 48% versus only 5% of exports. Unless this technological imbalance is addressed and local production capacity is built, the trade deficit is predicted to increase by a cumulative value of 285–951 million USD under a moderate scenario of 3–10 GW additions to the solar capacity in 10 years; and by 1.4–2.4 billion USD under a more ambitious scenario of 15–25 GW additional capacity.

- **Industrial production in the wind energy sector entails a trade deficit of 1.1 billion USD in 2016, which equals 4% of the total value created in this sector in the same year.** If the current industrial production structure persists over the next 10 years, this trade deficit may increase to a cumulative value of 3.6 billion USD. Similarly to solar energy, the wind energy value chain in Turkey also runs both trade and technology deficits, calculated as 1.1 million USD in 2016, with high-technology contents accounting for 19% of Turkey's imports yet only 2% of exports. Unless this technological divide is addressed and local production capacity is built, the trade deficit is predicted to increase by a cumulative value of 1.5–1.6 billion USD under a moderate scenario of 9.3–10.3 GW additions to the wind capacity in 10 years; and by 2.1–3.7 billion USD under a more ambitious scenario of 13.3–23.3 GW additional capacity.

Increased renewable energy capacity can significantly boost industrial production in Turkey by 2028.



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1. Developing industrial and trade opportunities in Turkey with renewable energy

The energy transition is inducing new investments in the electricity production and energy infrastructure sectors worldwide. The increasing pace of renewable energy investment is changing energy geopolitics, not only through changing patterns of demand for primary energy resources, but also through increased competition in the energy machinery, equipment, research and development (R&D), industry and trade (IASS, 2019; Goldthau et al., 2019).

While increasing the share of renewable energy resources in its energy mix, Turkey also aims to create a domestic manufacturing industry and to enable technology transfer, thereby profiting from the industrial development opportunities presented by the renewable energy industry. For this purpose, Turkey has implemented the Renewable Energy Resource Area (Yenilenebilir Enerji Kaynak Alanları – YEKA) scheme. In 2017, solar and wind tenders totalling 2 GW capacity (1 GW each) were completed. The selected consortiums were required to ensure that local content accounted for two-thirds of the final project value. Such a policy framework is expected to support the increase of domestic added value and employment creation in the renewable energy sector.

Notwithstanding these well-articulated policies, Turkey's growth in energy demand exceeds the global average.[2] Additionally, Turkey meets its increasing energy demand mostly through fossil fuel resources. According to 2017 data, the share of fossil fuels[2] in the global energy supply is 81% (IEA, 2019), whereas Turkey supplies 88% of its primary energy through these resources.[3] In the future, Turkey's import-dependence for primary energy sources will worsen, since fossil resources are locally scarce.[4] Therefore transitioning to a low-carbon energy system, in which Turkey deploys more renewable energy, also means improved energy trade balance for Turkey.

Against this background, the present study provides quantitative and qualitative answers to the following question:

- What industrial production and trade co-benefits are mobilised by increased renewable energy deployment in Turkey?

In terms of renewable energy sources, the study considers the wind and solar sectors due to data availability and reliability.[5] The study methodology employs the largest administrative dataset in Turkey, which spans the universe of firms all around the country, based on the Entrepreneur Information System (EIS) from the Ministry of Technology and Industry. The task involves first characterising the value chains of the renewable sectors by identifying the backward and forward linkages of each company in each sector. Once the value chains for both industries are defined, it is possible to obtain the industrial development and trade coefficients, which will be central to estimating the effects of a more ambitious renewable energy policy in Turkey under the four scenarios for increased renewable energy share.

[2] While global energy demand rose by a decade-record rate of 2.3% in 2018 (IEA, 2019), Turkey's energy demand increased well in excess of this level, at a yearly average of 6.4% between 2014 and 2018.

[3] Coal, oil and natural gas.

[4] Energy Balance Table, Directorate General for Energy Affairs, MoENR.

[5] In the long-term trend, the import share of Turkey's primary energy supply has risen from 68% in 2000 to 78% in 2017.

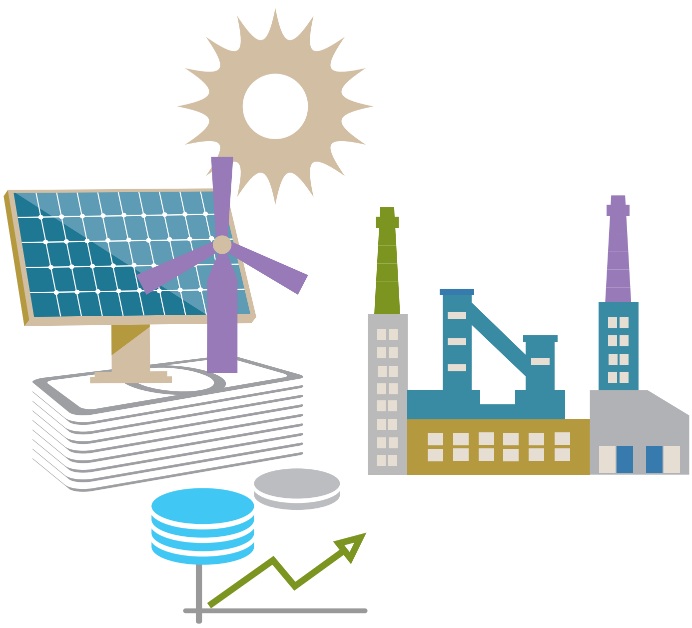
BOX 1: DEFINING THE VALUE CHAIN

The value chain, first developed by Michael Porter (1985), is an analytical model that describes the processes and actions through which businesses produce a final good or service by adding value to raw materials/intermediate inputs. An industry's value chain describes all activities, starting with the supply of raw materials, and flows through all of the value-creating activities until the marketing of the final product. The model used in the present study aims to disaggregate the solar and wind industries in Turkey into strategically relevant activities, namely: project, planning, installation and operation. By doing so, it is possible to identify the behaviour of cost at each step of the chain in order to design strategies for improving efficiency and unlocking the employment co-benefits associated with increased RE deployment in Turkey.

A standard outline of an industry value chain is shown in Figure 1.

Figure 1: Standard Industry Value Chain

Source: own



2. Measuring industrial development and trade opportunities for Turkey

The current study identifies the industrial production and international trade opportunities available to Turkey in the solar and wind energy sectors. The task involves defining the value chains of both sectors by identifying the backward and forward trade linkages among renewable energy producers. Secondly, the coefficients for the values of production and trade of each linkage are calculated. Thirdly, estimations of the value of production and trade are provided under scenarios describing increased wind and solar energy deployment.

The data source, the Entrepreneur Information System (EIS) from the Ministry of Industry and Technology, retrieves information from the entire population of the renewable energy sector in Turkey. The dataset, with companies anonymously coded, covers balance sheet information for each firm per year and provides a registry of specific items bought and sold in Turkey, as well as detailed information on imports and exports.

The sources of administrative information compiled under the EIS and relevant to this study are shown in Figure 2.

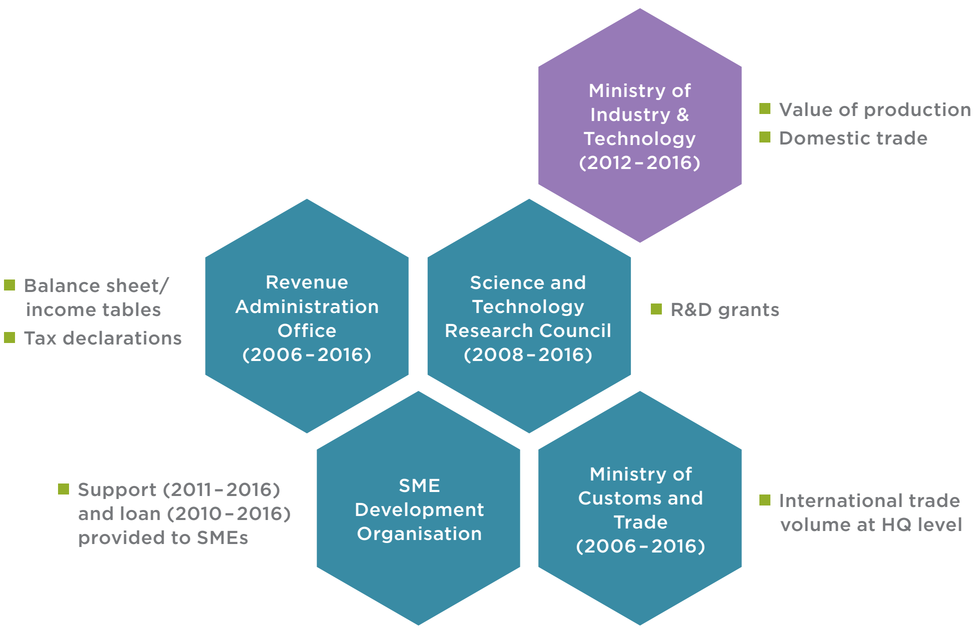


Figure 2: EIS dataset sources

Source: own

In order to map the value chain and to extract information on the companies relevant to the solar and wind sectors from the otherwise coded EIS database, firstly, those companies listed with an 'active' licence in the EPDK database were identified. The EPDK keeps track of all licencing information for electricity production plants. Information on each firm in the sector is available in the EPDK website, including tax identifications and the type of licence (pre-licence; licences: under evaluation, approved, effective, cancelled, expired, etc.). So as to match both databases, the tax IDs of the relevant companies in the EPDK database were passed to the Ministry, which matched the otherwise anonymised registries and provided the research team with a clean dataset. The process of dataset construction is shown in Figure 3.

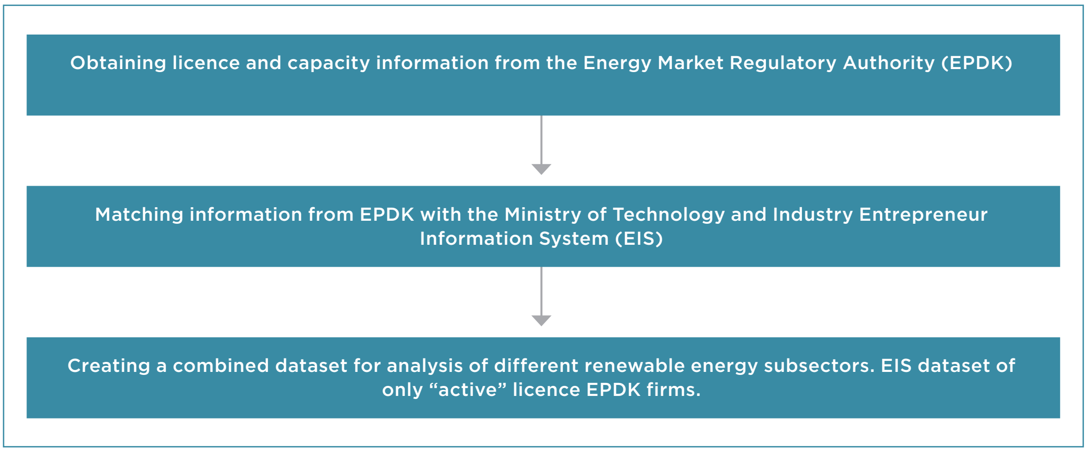


Figure 3: Construction of the dataset

Source: own

2.1 Constructing the wind and solar value chains

To calculate the value of production of each segment (Figure 4) in the solar and wind energy value chains, electricity-producing firms with an "active" licence in the EPDK database were identified. Their transactions (sales and purchases) were traced so as to establish the companies that belonged to Segments 1, 2 and 4. This information was obtained from the data declared in the EIS and refers to the purchases and sales registered in invoices between every firm.

In order to calculate the coefficients for value of production and trade (Equation 1, Figure 4), the ratio of the value of production and the total installed capacity of the electricity-producing firms (Segment 3) was employed. The total installed capacity of electricity producers was calculated with the use of EPDK electricity production licence list.

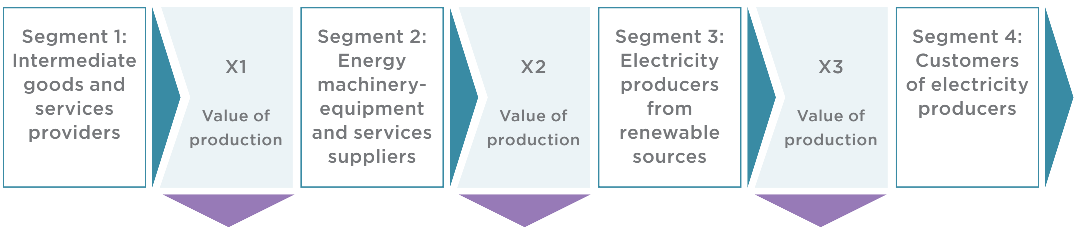


Figure 4: Construction of RE value chains

Source: own

The total sales of Segment 3 firms (electricity producers) are calculated as the core value (X3), whereas the sales induced by the purchases of Segment 3 firms from Segment 2 (electricity machinery-equipment and service providers) and the purchases of Segment 2 firms from Segment 1 (intermediate goods and services providers), weighted by the purchases of Segment 3 from Segment 2, are calculated as the indirect values (X2 and X1 respectively).

Once the value chains and coefficients for trade and value of production are calculated, the effects of solar and wind energy capacity additions in the industrial development and trade in Turkey were estimated using Equation 2 under increased RE scenarios.

BOX 2: ESTIMATING THE POTENTIAL OF RENEWABLE ENERGY — INCREASES IN PRODUCTION

1. The coefficient of production value per MW per segment in each sector (solar and wind) was calculated. Base year 2016. Eq. 1 $\delta = \left(\frac{\sum_{k=1}^{3} VP_k}{MW_{EPDK}}\right)$ VP = Value of production of a given linkage (*k* segment) in the supply chain induced by renewable energy investment and electricity production MW_{EPDK} = Installed capacity of "active" licensed electricity producers in EPDK database in base year	2. To estimate the total value of production, the capacity added per scenario (MW in Table 1) was multiplied by the coefficients. Eq. 2 $VP_{it} = \delta * \Delta MW_{it}$ Eq. 3 $\Delta MW_{it} = MW_{it} - MW_{base}$ VP = Total production increase in the sector MW = Energy capacity (MW) i = Selected scenario base = Value of Base scenario, 2018 t = Year (range 2018 to 2028)

The second part of the analysis, which identifies Turkey's trade opportunities, is assessed using two datasets. The first one utilises the classification provided by Wind (2008) for renewable energy technologies.[7] This study identifies the main components required for the installation of solar and wind energy, and matches each with the HS (Harmonized System) codes[8], which in turn enables the assessment of foreign trade trends through the use of UN Comtrade and BACI[9] databases. With this classification and datasets, it is possible to calculate the trade value of renewable energy related goods by technology, throughout the value chain. The second dataset is the EIS, which enabled the valuation of traded goods at each stage of the value chain. In order to calculate the estimated value of trade induced by electricity-producing firms (Segment 3), the share of their purchases from Segments 1 and 2 are used as coefficients. These numbers set the basis for analysis of trade scenarios, as presented in the following chapter.

Total trade of each scenario is calculated in two steps. Firstly, the net exports induced by the renewable energy investment are calculated for each segment of the value chain (Equation 4). Secondly, the weighted net exports are projected according to the scenarios and their increased RE capacity (Equation 5).

[7] A detailed list of commodity-based Wind (2008) renewable energy technology classifications is presented in Annex I.

[8] Harmonized System (HS) codes are 6-digit identification codes developed by the WCO (Wolrd Customs World Customs Organisation (WCO) which describe the types of goods entering or crossing any international borders. The codes enable tracking and statistical analysis of internationally traded commodities. The HS codes of renewable energy equipment and machinery, used in this study, are listed in Annexes I and II.

[9] BACI is developed by CEPII and is based on the UN Comtrade database. BACI harmonises the declarations of exporting and importing countries, and reports a consistent dataset.

BOX 3: ESTIMATING THE POTENTIAL OF RENEWABLE ENERGY — EFFECT ON TRADE

Eq. 4	Eq. 5
$$\overline{NX}_k = \frac{X_k * NX_k}{X_{k,total}}$$ X_k = Sales of Segment *k* to Segment 3 in base year (2016) $X_{k,total}$ = Total sales of Segment *k* in base year (2016) NX_k = Total net exports of Segment *k* in base year (2016)	$$NX_{it} = \sum_{k=1}^{3} \overline{NX}_k * \Delta MW_{it}$$ NX_{it} = Net exports of the wind/solar value chain in scenario *i* at year *t*

As part of the trade analysis, the technology components of solar and wind energy-equipment are assessed, both for global trade and for Turkey's import–export figures. This assessment provides information on the technological degree of the import and exported goods. In light of this technological assessment, Turkey's product-based revealed comparative advantage (RCA)[10] is also identified with respect to the level of technological content. Should a technological divide between Turkey's imports and exports exist, it would be identified by this analysis. This study employs static variables, which do not consider improvements in productivity due to a global or a domestic technological advance.

2.2 Scenarios and assumptions

In this study, industrial production and foreign trade opportunities associated with increased renewable energy capacity are assessed using a comparative scenario approach. The comparative approach reveals the impacts on production and trade of varying increases in Turkey's renewable energy capacity. This approach also allows the results to be directly assessed against Turkey's current and future policy options.

To this end, four scenarios were selected for analysis:

1. **Current Policy Scenario:** based on projections by the Turkish Electricity Transmission Company (TEİAŞ) for 2026, proportionally adjusted for 2027 and 2028.

2. **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.).

3. **Advanced Renewables Scenario A:** based on a SHURA (2018) study, which reported that increasing installed wind and solar capacity to 20 GW each is feasible without any additional investment in the transmission system.

4. **Advanced Renewables Scenario B:** based on a SHURA (2018) study, which reported that increases of 30 GW each in the solar and wind sectors are possible with a 30% increase in transmission capacity investment and 20% increase in transformer substations investment.

The 2018 installed capacities are taken from TEİAŞ reports. The scenario analysis takes into account the additional capacity investments for each renewable energy technology for the next years (2018–2028), to reach the expected total generation capacities by 2028.

[10] Revealed comparative advantage (RCA) is a metric that infers countries' relative differences in productivity through global trade patterns. RCA calculates the share of a country's export of a certain good in its total exports, and compare this share to its global level (share of that good's trade within total global trade). If a country has an RCA>1 in good X (i.e., good X's export from that country has a greater share of total exports than its share in global trade), then it has higher productivity in that type of good and is hence more competitive in its market.

	Total generation capacity (2018, MW)			
	Wind	Solar		
Base Scenario	6,700	5,000		
	Total generation capacity (2028, MW)		**Capacity addition (2018–2028, MW)**	
	Wind	Solar	Wind	Solar
Current Policy	16,000	8,000	9,300	3,000
New Policy	17,000	15,000	10,300	10,000
Advanced Renewables A	20,000	20,000	13,300	15,000
Advanced Renewables B	30,000	30,000	23,300	25,000

Table 1: Base and alternative scenarios for wind and solar energy capacity in Turkey by 2028

Source: own

2.3 Scope of the study and further research

Due to a lack of available data and their assumed low value of production, small-scale electricity producers (<1 MW) were omitted from the analysis. Data limitations of the EPDK dataset derive from a decree on the Regulation on Unlicensed Electricity Production in the Electricity Market, which states that every electricity producer with a maximum production capacity of 1 MW is eligible to benefit from unlicensed generation.[11] The low capacity of these unlicensed electricity producers supports the argument of them being small household systems. Nevertheless, their combined generation capacity should be included in further research efforts.

A second area for further research concerns the shadow economy in the solar and wind value chains. The EIS dataset, being a governmental dataset, can only provide information that is registered[12] by administrative agencies, and therefore does not include informal productive activities.

Thirdly, it is important to update technological developments and unusual changes in domestic production and trade. The present analysis is static and therefore cannot account for any technological advances that might lead to improvements in value added or any major changes in the share of domestic input. Over time, increases in productivity and in domestic value creation might lead to improvement of the trade and value coefficients estimated in this study.

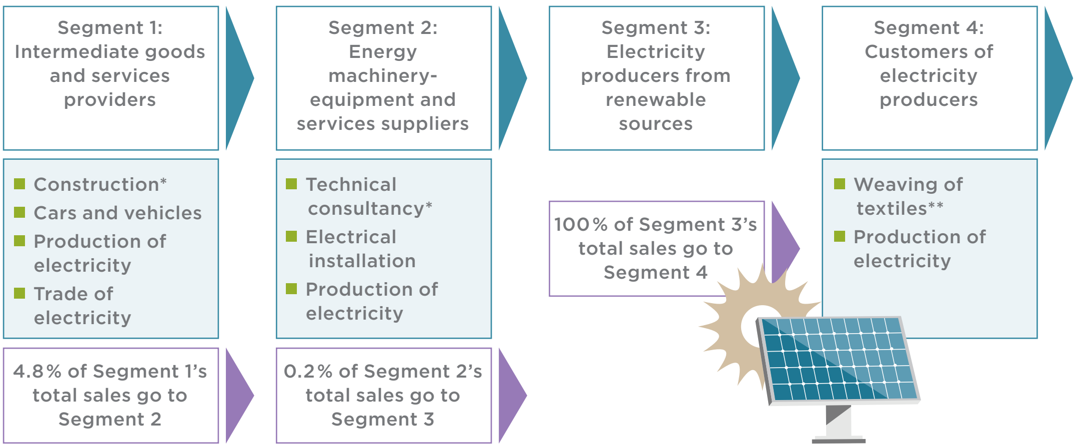
[11] This limit is raised to 5 MW in the newly updated Regulation on Unlicensed Electricity Production in Electricity Market and Presidential Decree No. 1044 (dated 10 May 2019), which came into effect after the completion of the present analysis.

[12] Although it is difficult precisely quantify the extent of informality, the IMF (Medina, 2018) estimates Turkey's shadow economy at 27% of GDP in 2017, and the OECD estimates 28% in 2015. Also, according to information from the Turkish Statistical Institute Household Labor Force Survey (2018), about 34% of total employment in Turkey is informal, i.e., not registered to the Social Security Institution. This share is significantly lower in the energy sector in general (around 2% in 2016), but it is likely to be a problem especially in small-scale plants in the solar energy sector.

3. Increased industrial development and trade opportunities

3.1 Increases in industrial production in Turkey

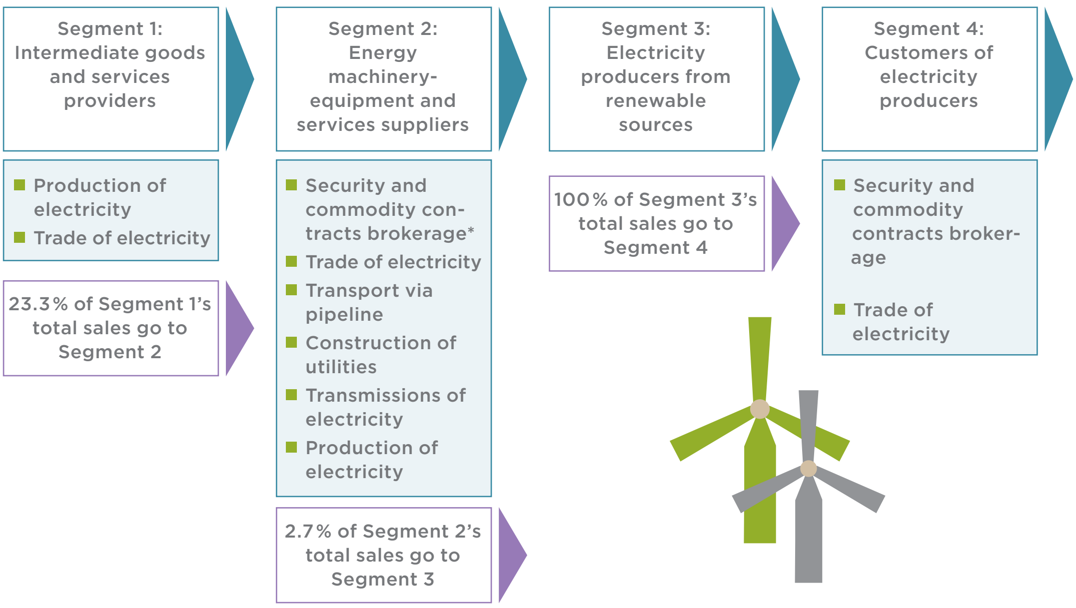
In the EPDK pre-licence and licence list, there are 28 solar energy producers and 296 from the wind sector, identified as firms with an "active" status. These firms define Segment 3 and are the basis of the analysis. Firms in Segments 1, 2 and 4 were identified according to the assessment methodology described in Section 2.1. The sales shares and main subsectors per RE sector are summarised in Figure 5 and Figure 6.



*Only the subsectors with a share of 5% or more of the purchases of their successors are listed.
** Only the subsectors with a share of 5% or more of the sales of their predecessor are listed.

Figure 5: Share of sales and main subsectors in the solar energy value chain (2016)

Source: Own calculations based on EIS



*Only the subsectors with a share of 5% or more of the purchases of their successors are listed.
** Only the subsectors with a share of 5% or more of the sales of their predecessor are listed.

Figure 6: Share of sales and main subsectors in the solar energy value chain (2016)

Source: Own calculations based on EIS

The coefficients resulting from analysing the linkages between segments (share of purchases and sales; refer to Table 2) will determine the competitiveness of each segment and will be used to determine the increases in production resulting from the RE capacity additions of the various scenarios.

Identification of the value chain is important not only for assessing how different activities of the production process are interlinked and where the real value addition is created, but also for assessing which steps of the specific production processes are integrated into the global value chains (GVC). Evidence suggests that countries with greater industrial competitiveness tend to be integrated in local and global value chains at higher segments (UNIDO, 2012). Specific emphasis should be given to seizing opportunities for upgrading domestic industries and to achieving integration into GVCs at higher value-added levels.

	Segment 1	Segment 2	Segment 3	Total
	Indirect value of production		Direct value of production	
Value of Production (USD, 2016)	67,658,901	20,219,449	804,964	88,683,315
Coefficient of VP[13] (USD/MW)	345,198	103,160	4,107	452,466
% Value of Production	76%	23%	1%	

Table 2: Value of production (industrial production) for the solar value chain

Source: own

	Segment 1	Segment 2	Segment 3	Total
	Indirect value of production		Direct value of production	
Value of Production (USD, 2016)	7,876,558,848	8,207,210,808	9,252,664,702	25,336,434,358
Coefficient of VP[14] (USD/MW)	1,113,767	1,160,152	1,308,352	3,582,641
% Value of Production	31.09%	32.39%	36.52%	

Table 3: Value of production (industrial production) for the wind value chain

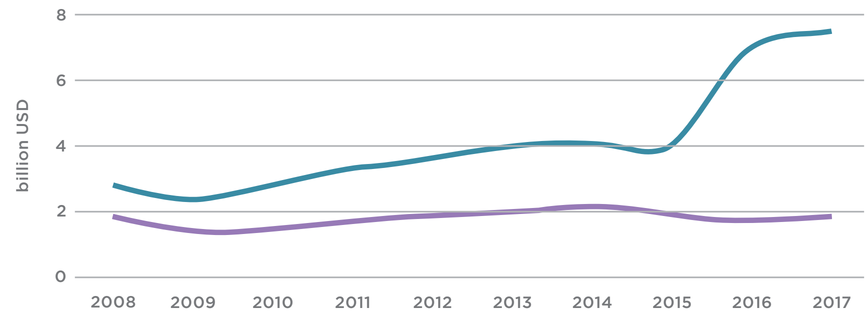
Source: own

3.2 Trade opportunities for Turkey

Turkey's solar energy equipment imports have sharply risen to 7 billion USD in 2016 (Figure 7). This increase in imports relative to steady exports (consistently around 2 billion USD) means that Turkey's trade deficit increased to 5.6 billion USD in 2017, more than doubling the 2013–2015 figure. Figures 7 and 8 regarding capacity additions in the solar sector and import of solar energy-equipment, show that Turkey's new solar power capacity is fulfilled with imported equipment, thereby exacerbating the trade deficit in this sector unless this equipment is produced domestically.

[13] As calculated with Equation 1.

[14] As calculated with Equation 1.



Share of total, %	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Exports	1.3	1.2	1.2	1.1	1.2	1.2	1.3	1.3	1.1	1.2
Imports	1.5	1.8	1.6	1.5	1.7	1.8	1.9	2.1	3.7	3.2

Figure 7: Turkey's solar energy equipment trade

Source: own calculations based on Wind (2008) and UN Comtrade

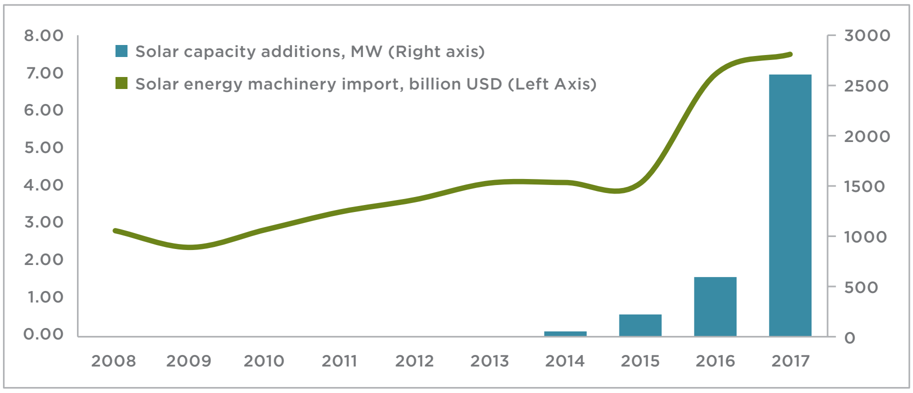


Figure 8: Turkey's solar energy equipment imports and capacity additions

Source: own calculations based on Wind (2008) and UN Comtrade

The sudden increase in import figures is also evident in the imports of solar electricity producers (Segment 3). Table 4 summarises the import and export figures for each segment of the solar energy value chain. The trend shown in the table suggests that with increasing solar energy installed capacity, electricity producers directly import relevant goods and services rather than sourcing these from domestic firms, which neither import these goods nor produce them.

	Segment 1: Intermediate goods and services providers (million USD)		Segment 2: Energy machinery-equipment and service providers (million USD)		Segment 3: Electricity producers (thousand USD)	
	Export	Import	Export	Import	Export	Import
2015	2.14	5.09	0.26	0.51	0.90	1,300
2016	2.08	4.58	0.01	0.03	1.44	16,706
Change (2015–2016)	-3%	-10%	-95%	-95%	60%	1185%

Table 4: Imports and exports of solar energy goods and services by value chain

Source: own calculations based on EIS

Turkey exports solar equipment to a diverse range of markets, with the five largest export destinations accounting for only 32% of the total exports. Of these five countries, four are located in the MENA region, suggesting a regional concentration. Three of these countries have shown strong average growth in their shares of Turkey's exports, namely, Turkmenistan (18%), Algeria (11%) and Georgia (12%). In contrast, Germany is the only trade partner with a decreasing share during 2008–2016 (average 9% contraction), but remains Turkey's second largest export market for solar equipment.

When compared to overall global trade and other renewable energy equipment, solar energy equipment has the highest share of high-technology components. Differently, most of Turkey's exports (52%) are of low-technology components. High-technology components make up 48% of Turkey's imports compared with only 5% of its exports. This disparity indicates a major technology gap in Turkey's solar energy equipment trade, which deserves urgent and appropriate policy attention in order to integrate Turkey at a higher value-added stage in the global solar energy value chain.

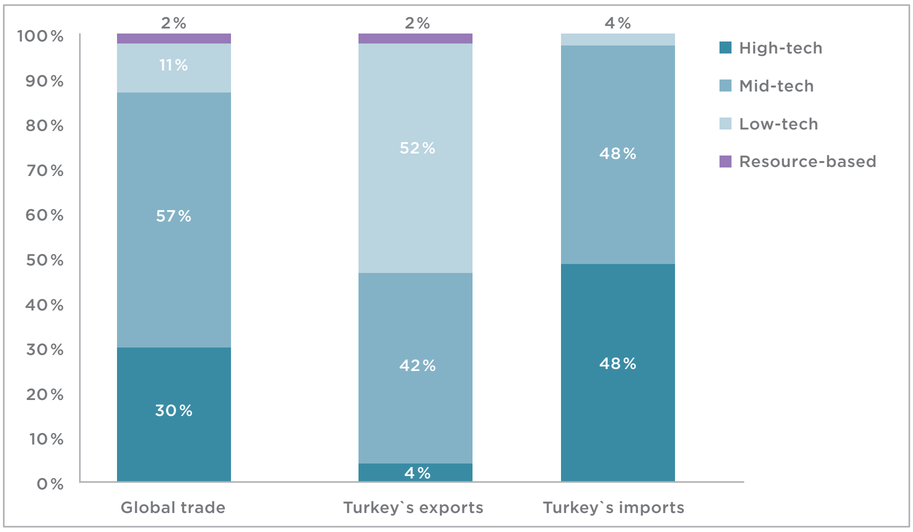


Figure 9: Technology composition of solar energy equipment (2016)

Source: own calculations based on Wind (2008) and CEPII (2018)

Product-based analysis[15] reveals that, among 39 items of solar energy equipment, Turkey has a revealed comparative advantage (RCA>1)[16] in only three of them (Figure 9). This means that, besides facing a technology divide in solar energy equipment, Turkey's productivity levels in the manufacturing of this equipment lag behind global levels and lack competitiveness. As Turkey is competitive mostly in low-technology products, they comprise most of its exports. Conversely, high-technology products, where Turkey has the lowest competitiveness, constitute most of its imports.

As shown inFigure 10, Turkey has a trade surplus in wind energy-related equipment in cumulative terms. These items account for 2.8% of Turkey's total exports on average. Imports, on the other hand, have been increasing since 2009 at an average rate of 3%.

[15] While cumulative figures give the overall picture of foreign trade flows and the technological composition of alternative energy equipment, a product-based analysis helps to pinpoint the technological level of each piece of equipment and how Turkey fares with respect to each component.

[16] For a definition of how the RCA is calculated, refer to footnote 10.

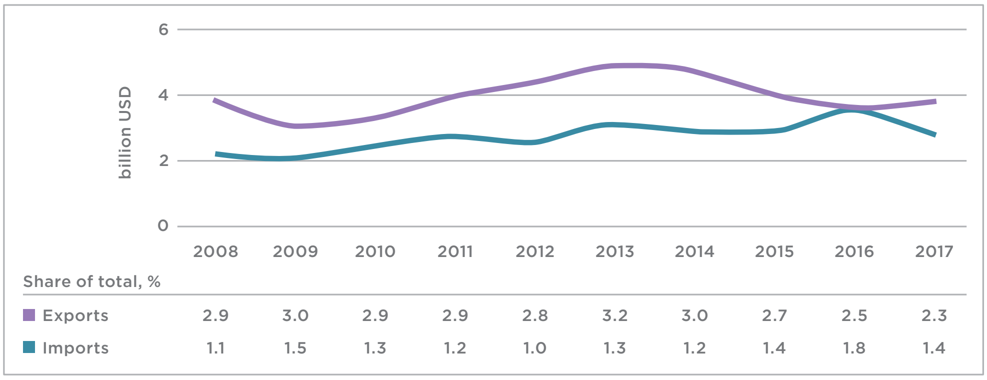


Figure 10: Turkey's wind energy equipment trade

Source: own calculations based on Wind (2008) and UN Comtrade

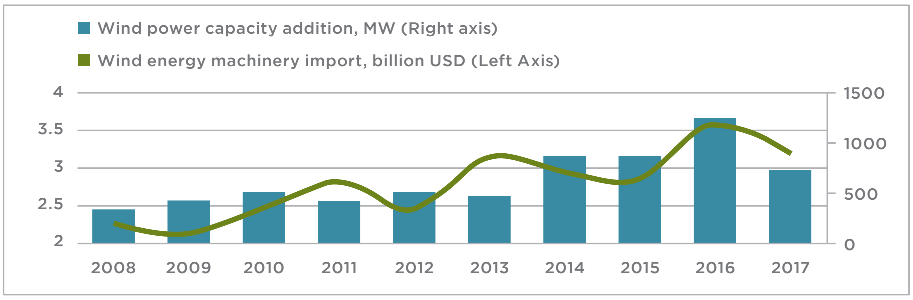


Figure 11: Turkey's wind energy equipment imports and capacity additions

Source: own calculations based on Wind (2008) and UN Comtrade

Although Turkey has a trade surplus in the wind machinery and equipment sector, analysis of the wind energy value chain firms identified through the EPDK licence database suggests an overall trade deficit for the sector in 2015 and 2016 (Table 5).

Table 5: Imports and exports of wind energy goods

Source: own calculations based on EIS

	Segment 1: Intermediate goods and services providers (million USD)		Segment 2: Energy machinery-equipment and service providers (million USD)		Segment 3: Electricity producers (million USD)	
	Export	Import	Export	Import	Export	Import
2015	236	436	261	732	474	935
2016	214	384	234	651	389	842
Change (2015–2016)	-9%	-12%	-10%	-11%	-18%	-10%

The five largest export destinations make up 41% of Turkey's total wind equipment exports. As in the solar sector, these export destinations show a degree of regional concentration. Furthermore, the growth rate of trade with neighbouring countries is positive; in the case of Turkmenistan the growth is significant (17.5%).

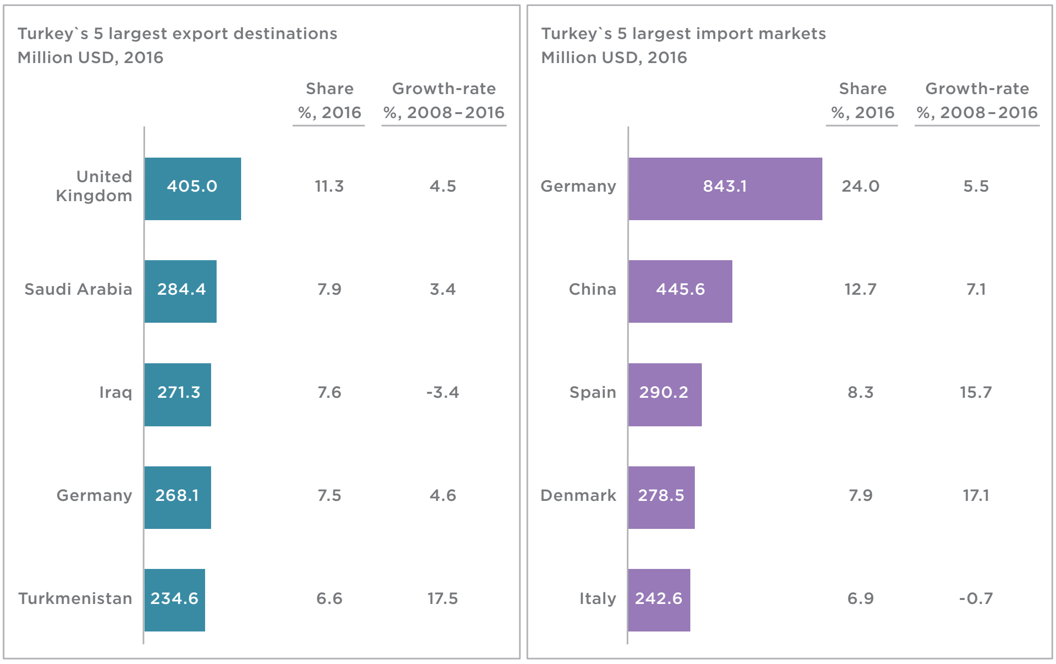


Figure 12: Turkey's largest trade partners in wind energy equipment

Source: own calculations based on Wind (2008) and CEPII (2018)

Although Turkey has a trade surplus in wind energy equipment trade, Figure 13 shows that it imports high-technology equipment (19%) at a rate higher than the global average (12%). The composition of Turkey's exports shows a technological deficit, comprising 23% low-technology components but only 2% high-technology components.

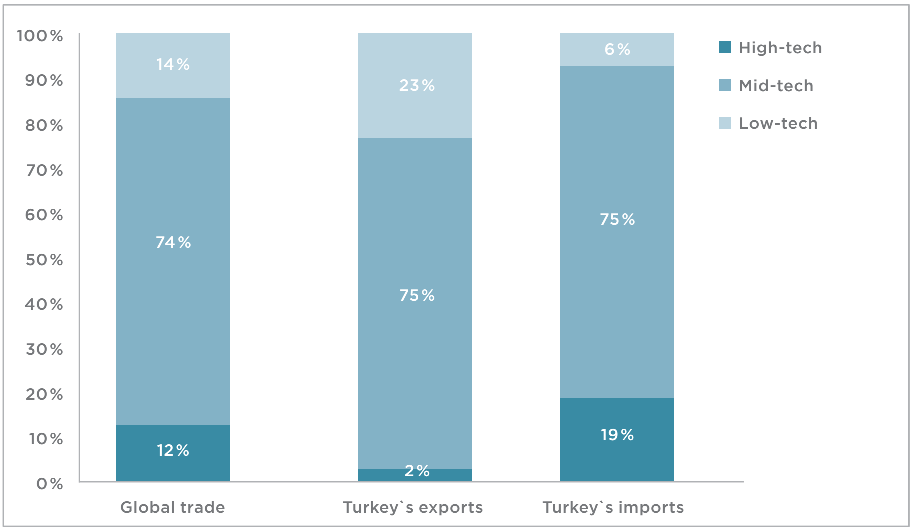


Figure 13: Technological composition of wind energy equipment (2016)

Source: own calculations based on Wind (2008) and CEPII (2018)

Although Turkey shows a comparative advantage (RCA>1)[17] for 13 of 34 items of wind energy equipment, their technological compositions suggest that none of these are high-technology components (Figure 13). Although Turkey has a comparative advantage in more items of wind energy equipment compared with equipment in the solar energy sector, a technological divide remains in the sector. This pattern indicates that, despite being a net exporter, Turkey is only able to export mostly mid- and low-tech wind equipment.

[17] For a definition of how the RCA is calculated, refer to footnote 10.

4. Industrial production and trade under different renewable energy futures in Turkey

KEY POINTS:

- **Turkey can significantly increase industrial production by increasing investment in renewable energy technologies:** Each additional MW of energy capacity increases industrial production by around 452.5 thousand USD in the solar energy sector, and around 3.6 million USD in the wind sector, on average.

- **Due to the present technological deficit in Turkey's exports versus imports,** it is calculated that, **with each additional MW increase, the trade deficit increases** by 95 thousand USD in the solar energy value chain and by 157 thousand USD in wind energy value chain.

- **In the absence of further investment in domestic value-added of solar and wind machinery and equipment production, the present trade deficit will escalate as installed energy capacity increases.** Currently, deficit in the solar value chain represents 21% of the total value of production and 4.8% in the wind value chain.

- **Despite the worldwide downturn in patents for R&D in RE, Turkey has increased its patents registry in the period 2014–2017. The renewable energy policy framework in Turkey should aim for increased installed capacity, building a domestic manufacturing industry and enabling technology transfer.** The resulting stimulus for R&D activities would also help the renewable energy sector to close the technology gap and ease the trade deficit by emphasising a shift in domestic production towards more high-tech solar and wind energy equipment that produces higher added value.

Summarising the results from Tables 2 and 3, the total value of production along the value chains in 2016 is calculated as 88.7 million USD for solar energy and 25.3 billion USD for the wind sector. It is observed that solar electricity producers (Segment 3) account only for 1% of the total value produced within the solar energy value chain, intermediate input producers (Segment 1) account for 76% and energy machinery-equipment and service providers account for 23% of the total value produced. This means that for every 1 USD produced directly in the electricity-producing segment of the value chain (Segment 3), another 109 USD are produced indirectly in other stages (Segments 1 & 2). In contrast to solar energy, the wind sector shows a more balanced distribution of value creation among different segments of the value chain. Electricity-producing firms (Segment 3) are responsible for a greater share (37%) of value production, whereas equipment and service providers (Segment 2) and intermediate input/service providers (Segment 1) account for lower shares at 32% and 31% respectively.

Under alternative scenarios, it is expected that between 3 and 25 GW of additional solar energy capacity will be added into Turkey's electricity production mix by 2028. Additionally, installed wind capacity is expected to be between 16 and 30 GW by 2028. The increases of industrial production for the solar and wind sectors under the scenarios introduced in Section 2.2 are shown in Figure 14 and Figure 15.

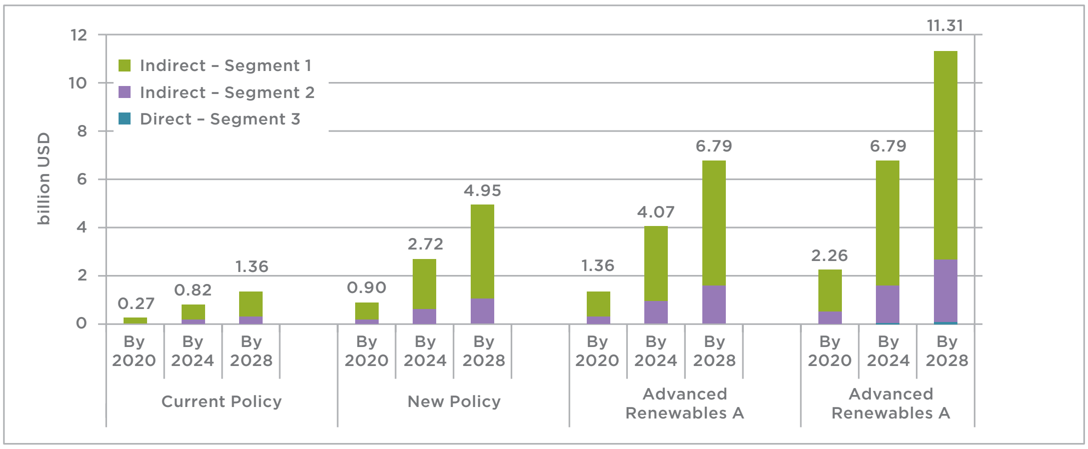


Figure 14: Increase in value of production in the solar sector (billion USD, 2020–2028)

Source: own calculations based on EIS

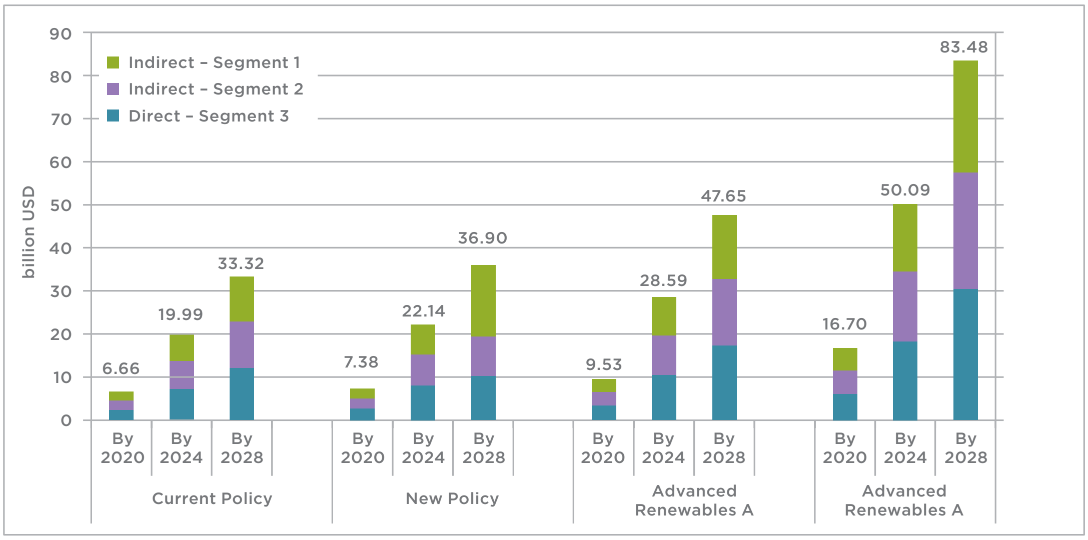


Figure 15: Increases in value production in the wind sector (billion USD, 2020–2028)

Source: own calculations based on EIS

With an additional 3 GW solar capacity addition, as indicated in the most conservative scenario, an additional value of 1,357 million USD is expected to be created by this sector. If this 3 GW is assumed to be installed in equal lots of 300 MW throughout the entire 10-year period, then the first 271 million USD of this production will be realised by 2020 and an additional 543 million will be realised by 2024. In the wind sector, even in the most conservative scenario (9.3 GW by 2028), the 10-year cumulative value creation along the value chain will be 33.3 billion USD (3.3 billion USD, annually). If this 9.3 GW is assumed to be installed in equal lots of 930 MW over 10 years, then the first 6,664 million USD of this production will be realised by 2020, followed by an additional 13,327 million USD between 2020 and 2024, reaching 33,319 million USD by 2028.

Although new capacity additions mean increased industrial production and service provision for the overall economy, under Turkey's present position as a net importer in solar energy foreign trade (Table 4), increased industrial activity is also associated with increased trade deficit. Despite being a net exporter of wind energy-related commodities in cumulative terms, the wind energy companies identified within the value chain are also associated with a trade deficit (Table 5). Thus, the foreign trade deficit in 2016 amounts to 18.5 million USD within the solar value chain (21% of the total value created) and 1.1 billion USD in the wind sector (about 4% of total production). The figures presented in Table 4 and Table 5 also indicate the distribution of imports and exports along the value chain. For the solar sector there is an uneven distribution, with 99% of imports occurring within Segment 3. Conversely, in the wind sector the import shares along the value chain constitute 43%, 36% and 21% for Segment 3, Segment 2 and Segment 1, respectively. As the scenario analysis provides a static overview of the situation, these distributions do not change throughout the projection period.

Unless there is a change in the production structure in the solar and wind value chains, trade deficits in these sectors are expected to increase proportionally to capacity additions. The trade projections are presented in Table 6 and Table 7.

Table 6: Trade projections for the solar sector (2020–2028)

Source: own calculations based on EIS

*Red numbers indicate trade deficit

		Scenario analysis (thousand USD)					
		Direct – Segment 3		Indirect – Segment 2		Indirect – Segment 1	
		Export	Import	Export	Import	Export	Import
Current Policy	By 2020	4.41	51,140.07	36.67	80.35	4,436.14	10,302.70
	By 2024	13.22	153,420.22	110.00	241.05	13,308.41	30,908.11
	By 2028	22.03	255,700.37	183.34	401.75	22,180.68	51,513.51
Net trade by 2028		255,678.34*		218.42*		29,332.83*	
New Policy	By 2020	14.69	170,466.92	122.22	267.83	14,787.12	34,342.34
	By 2024	44.06	511,400.75	366.67	803.50	44,361.36	103,027.02
	By 2028	73.43	852,334.58	611.12	1,339.17	73,935.60	171,711.70
Net trade by 2028		852,261.15*		728.05*		97,776.10*	
Advanced Renewables A	By 2020	22.03	255,700.37	183.34	401.75	22,180.68	51,513.51
	By 2024	66.09	767,101.12	550.01	1,205.25	66,542.04	154,540.53
	By 2028	110.15	1,278,501.87	916.68	2,008.76	110,903.40	257,567.55
Net trade by 2028		1,278,391.72*		1,092.08*		146,664.15*	
Advanced Renewables B	By 2020	36.72	426,167.29	305.56	669.59	36,967.80	85,855.85
	By 2024	110.15	1,278,501.87	916.68	2,008.76	110,903.40	257,567.55
	By 2028	183.59	2,130,836.45	1,527.80	3,347.93	184,839.01	429,279.26
Net trade by 2028		2,130,652.87*		1,820.13*		244,440.25*	

Table 7: Trade projections for the wind sector (2020–2028)

Source: own calculations based on EIS

*Red numbers indicate trade deficit

		Scenario analysis (thousand USD)					
		Direct – Segment 3		Indirect – Segment 2		Indirect – Segment 1	
		Export	Import	Export	Import	Export	Import
Current Policy	By 2020	102,183.64	221,358.01	61,647.61	180,929.01	53,481.38	106,955.50
	By 2024	306,550.92	664,074.03	184,942.83	542,787.04	160,444.15	320,866.51
	By 2028	510,918.20	1,106,790.04	308,238.05	904,645.06	267,406.92	534,777.52
Net trade by 2028		595,871.85*		596,407.01*		267,370.60*	
New Policy	By 2020	113,171.13	245,159.95	68,276.39	200,383.74	59,232.07	118,456.10
	By 2024	339,513.38	735,479.84	204,829.16	601,151.23	177,696.21	355,368.29
	By 2028	565,855.64	1,225,799.73	341,381.93	1.001,918.72	296,160.36	592,280.48
Net trade by 2028		659,944.09*		660,536.80*		296,120.13*	
Advanced Renewables A	By 2020	146,133.59	316,565.75	88,162.71	258,747.94	76,484.13	152,957.87
	By 2024	438,400.78	949,697.26	264,488.13	776,243.83	229,452.39	458,873.62
	By 2028	730,667.96	1,582,828.77	440,813.56	1,293,739.71	382,420.65	764,789.36
Net trade by 2028		852,160.81*		852,926.15*		382,368.71*	
Advanced Renewables B	By 2020	256,008.47	554,585.12	154,450.46	453,295.27	133,991.00	267,963.79
	By 2024	768,025.42	1,663,755.36	463,351.39	1,359,885.80	401,972.99	803,891.37
	By 2028	1,280,042.36	2,772,925.59	772,252.32	2,266,476.34	669,954.98	1,339,818.96
Net trade by 2028		1,492,883.23*		1,494,224.02*		669,863.97*	

The current study assessed the industrial production and foreign trade effects of increased renewable energy deployment in Turkey's energy production mix, using backward and forward linkages across the value chains specific to each technology. The results suggest that **Turkey can significantly increase industrial production by increasing investment in the renewable energy technologies. Across the value chains, each additional MW capacity of energy increases industrial production by around 452.5 thousand USD in the solar energy sector, and around 3.6 million USD in the wind sector, on average.**

While increased renewable energy investment induces increased industrial production, the dominance of imported solar and wind equipment means that the present trade deficits increase in **the absence of further investment in the domestic solar and wind value chains.** Under the present trade imbalance, it is estimated that each additional MW of installed capacity increase Turkey's trade deficit by 95 thousand USD in the solar energy value chain and by 157 thousand USD in the wind energy value chain.

The study found that while increasing renewable energy capacity in Turkey will stimulate industrial production and trade, it does not automatically solve the inherent issues related to Turkey's trade imbalance. The analysis shows that under current conditions, deficit in the solar value chain represents 21% of the total value of production and 4.8% in the wind value chain. However, by creating an enabling environment for increasing high-technology manufacturing, the Turkish Government has the opportunity to exploit the full economic potential of the renewable energy industry for Turkey.

5. Creating an enabling environment to boost industrial development, trade and innovation with renewables

Impulses for furthering the debate

This COBENEFITS study shows that Turkey can significantly increase its industrial production by expanding the shares of solar and wind energy in its energy mix. Across the value chains, each additional MW capacity of energy increases industrial production by 452.5 thousand USD in the solar energy sector, and around 3.6 million USD in the wind sector. In order to unlock the potential benefits of these alternative industrial development options, it is necessary to address the current trade deficit in the import and export of RE equipment. The renewable energy policy framework in Turkey should aim for increased installed capacity, building a domestic manufacturing industry and enabling technology transfer. The resulting stimulus for R&D activities would also help the renewable energy sector to close the technology gap and ease the trade deficit by emphasising the domestic production of more technologically advanced items of solar and wind energy equipment located higher up the respective value chains.

In order to drive the necessary social acceptance and also enhance local value creation and enable technology transfer, effective policies need to be developed and put in place, which combine the roles of the private and public sectors.

What can government agencies and political decision makers do to maximise the benefits of industrial development and trade based on renewable energy strategies in Turkey?

As a part of the 11th Development Plan, Turkey has once again emphasised the desire to enhance the utilisation of domestic content and to increase R&D activities in the field of renewable energy through new investment schemes, including government purchases. Although the intent of the government is to increase the installed capacity of renewables, the level of ambition also matters. As can be seen from the scenarios evaluations, it would be possible for Turkey to benefit from additional installed capacities not only in terms of reduced CO_2 emissions but also in terms of increased industrial production.

How can other stakeholders unlock the social and economic co-benefits of building a low-carbon, renewable energy system while facilitating a just energy transition?

Building on the study results and the surrounding discussions with political partners and knowledge partners, debate should be considered in the following areas, in which policies and regulations could be introduced or enforced in order to maximise the co-benefits for industrial development and trade within the shift to a less carbon-intensive power sector.

Develop local skills to address the technology gap and promote export destinations in the region

In order to provide a reassuring long-term investment environment, Turkey should not only take advantage of its domestic market but also look for opportunities to serve as an industrial hub for renewable energy within the region. However, rather than serving the assembly industry, Turkey should move up the value chain to higher value-added stages by means of active knowledge/technology development and transfer programmes. The expansion of the industrial base should also be accompanied by skills development at all stages. While higher-level education targets themes of technology development and demonstration, the increased domestic production and installation of renewable energy technologies should be complemented by training at the vocational level.

Being located at the crossroads of major RE markets, Turkey has opportunities to improve its trade position in the region by building on its domestic manufacturing capacity. In the solar energy equipment sector, four of the top export destinations are in the MENA region and have shown strong growth in their imports from Turkey during the period 2008–2016: Turkmenistan (9.7% share, 18.2% growth), Iraq (6.4% share, 3.1% growth), Algeria (4.8% share, 11.3% growth) and Georgia (4.1% share, 12.2% growth). In the wind energy equipment sector, three of the top five export destinations are in the MENA region and (with one exception) have also shown strong growth in their imports from Turkey during the period 2008–2016: Saudi Arabia (7.9% share, 3.4% growth), Iraq (7.6% share, −3.4% growth) and Turkmenistan (6.6% share, 17.5% growth). Public policy should aim to address the trade dynamics of RE machinery and equipment in the region, with Turkey as the leader in high-value manufacturing. Long-term targets should be set for renewable energy development through bi/multilateral agreements (both within Turkey and abroad), thereby providing market players with a stable trade environment for planning long-term investments.

Enable local supply/local content: Integrate renewable energy solutions into national legislation, plans and programmes as priority options to promote industrial development

Increasing renewable energy deployment holds vast advantages for industrial development in Turkey. While increasing the share of renewable energy resources in its energy mix, public policy must aim to create a domestic manufacturing industry and to enable technology transfer. There are already some efforts to reap these advantages, but these efforts should be increased in order to maximise the benefits to Turkey. An example of the strategies already implemented is the Renewable Energy Resource Area (Yenilenebilir Enerji Kaynak Alanları – YEKA) scheme. In 2017, tenders for increased solar and wind electricity generation were required to ensure that local content accounted for two-thirds of the final project value. Such a policy framework is expected to support growth in domestic value addition and employment creation in the renewable energy sector. It is clear that with the current structure, trade deficit in the solar and wind value chaind will keep growing. In order to avoid/reduce this risk, domestic production capacity should be increased and greater investment should be channelled into the area of renewable energy machinery/equipment.

The future debate must also aim to increase R&D activities in the field of renewable energy through introducing new support schemes. Increased R&D activity would also help the renewable energy sector to close the technology gap and ease the trade deficit by shifting domestic production towards more technologically advanced solar and wind energy equipment that is located higher up the respective value chains.

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List of abbreviations

BACI	International Trade Database at the Product-Level.
CEPII	from French: Center for Research and Expertise on the World Economy
EIS	Entrepreneur Information System
EPDK	from Turkish: Energy Market Regulatory Authority
GHG emissions	Greenhouse gas emissions
GVC	Global value chains
HS	Harmonized System
IASS Potsdam	Institute for Advanced Sustainability Studies Potsdam
IEA	International Energy Agency
MENA	Middle East and North Africa
MoENR	Ministry of Energy and Natural Resources
MW	Megawatt
PV	Photovoltaics
RCA	Revealed comparative advantage
RE	Renewable energy
SHURA	SHURA Energy Transition Center
TEİAŞ	Turkish Electricity Transmission Company
WCO	World Customs Organization

COBENEFITS
Connecting the social and economic opportunities of renewable energies to climate change mitigation strategies

COBENEFITS cooperates with national authorities and knowledge partners in countries across the globe such as Germany, India, South Africa, Vietnam, and Turkey to help them mobilise the co-benefits of early climate action in their countries. The project supports efforts to develop enhanced NDCs with the ambition to deliver on the Paris Agreement and the 2030 Agenda on Sustainable Development (SDGs). COBENEFITS facilitates international mutual learning and capacity building among policymakers, knowledge partners, and multipliers through a range of connected measures: country-specific co-benefits assessments, online and face-to-face trainings, and policy dialogue sessions on enabling political environments and overcoming barriers to seize the co-benefits.

Contact

COBENEFITS focal point Turkey
Pinar Ertor, Sabanci University Istanbul Policy Center
pinarertor@sabanciuniv.edu

COBENEFITS project director
Sebastian Helgenberger, Institute for Advanced Sustainability Studies (IASS)
sebastian.helgenberger@iass-potsdam.de

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www.cobenefits.info

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