COBENEFITS STUDY

November 2019

Future skills and job creation through 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 print version has been shortened and does not include annexes. The full version of this report is available upon request.

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

Supported by:
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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, 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 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), Ministry of 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 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

Future skills and job creation 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 augmenting its future dependency degree on energy imports.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 how increased deployment of renewable energy in Turkey can provide co-benefits[1] for job creation and meeting future skills requirements. 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 emissions, when compared to conventional energy systems.

The study also provides initial insights on the estimated occupational distribution, thus predicting the changes and employment opportunities available to Turkey in its solar and wind sectors.

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 employees registered with the Social Security Institution (SGK). Secondly, coefficients for the current ratio of employment per megawatt (MW) in the solar and wind sectors were calculated. Finally, projections of employment increases and skills requirements were estimated according to four scenarios for increased renewable energy (RE) capacity. The results show that increased employment is possible through renewables.

- **Key policy message 1:** Turkey can significantly boost gross employment by increasing the share of renewables. With the decision by the Turkish Government to increase solar energy capacity by 60% and more than double wind electricity capacity over the next 10 years, the government paved the way to create more than 7,400 jobs along the solar value chain and more than 59,000 jobs 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 employment effect can be doubled across the wind power value chain and increased eightfold along the solar value chain, pushing up employment by more than 200,000 jobs in the next ten years compared to the present day.
- **Key policy message 3:** While the expected growth of Turkey's wind and solar power producers will increase the demand for high-skilled jobs, middle-skilled workers are the main beneficiaries of job creation across the whole wind and solar value chains, with 55% of job additions in this labour segment.

[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:

- Up to 61,400 full-time equivalent jobs (FTE employment[2]) in the solar sector and 147,700 in the wind sector can be created nationally through the power sector transformation between 2018 and 2028.
- Over that ten-year period each additional MW in wind energy production leads to increased employment of 6.3 full-time equivalent workers across the entire value chain. Across the solar value chain each additional MW leads to an increased employment of 2.5 full-time equivalent workers.

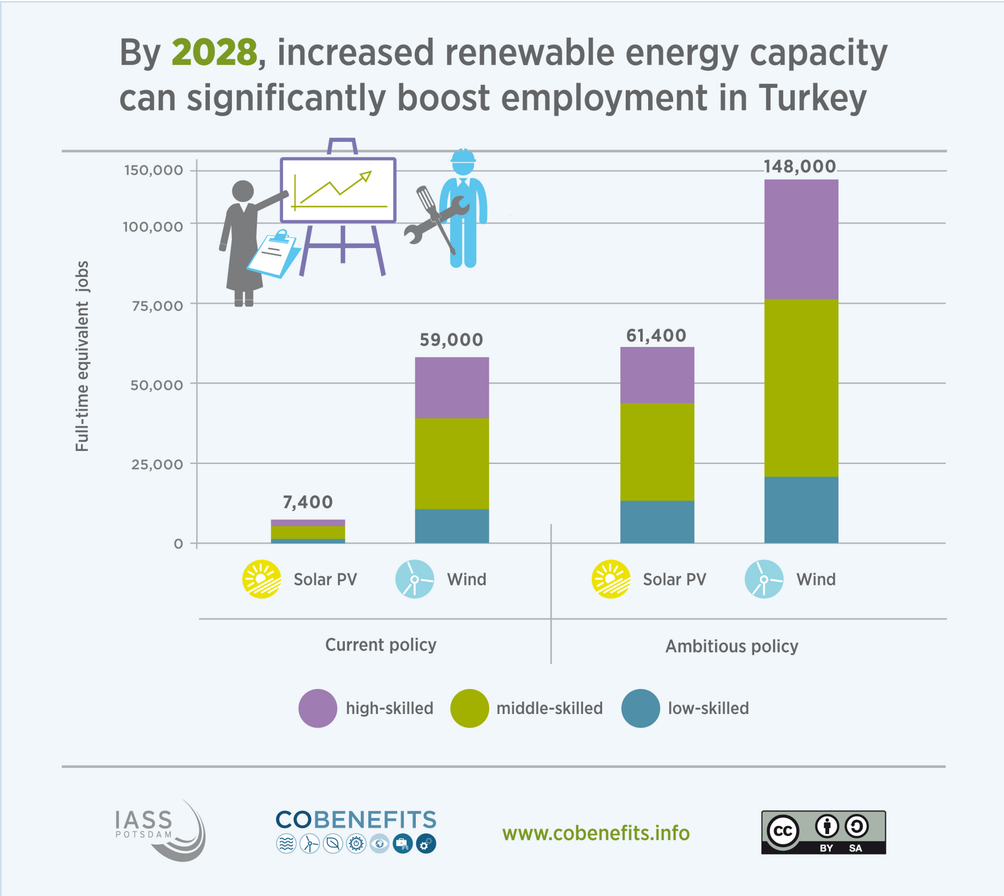
COBENEFITS
Future skills and job creation with renewable energy in Turkey. Assessing the co-benefits of decarbonising the power sector

available on www.cobenefits.info

KEY FINDINGS:

- **Turkey can significantly boost employment by increasing investment in renewable energy technologies.** On the basis of current policy, employment can already be expected to increase by an additional 7,400 FTE jobs across the solar value chain and 59,000 FTE jobs across the wind power value chain by 2028. By following SHURA's high-ambition scenario (scenario B), these numbers can be increased eightfold along the solar value chain and more than doubled in the wind power value chain, in total providing more than 200,000 additional FTE jobs in the next ten years.
- **A significant part of Turkey's workforce is already connected to renewable energy investments.** Among formally registered employees, almost 8 million are connected to the wind sector value chain, and more than 4 million to the solar sector value chain (available data as of 2016). With 16,200 FTE jobs directly in wind energy production firms and only an emerging solar energy production sector, at present this energy-producing segment only contributes a small fraction to total employment in the solar and wind value chains.
- **To date, a substantial share of the jobs created through renewable energy investment in Turkey are upstream of electricity producers.** For each job directly created among wind energy producers, 1.75 additional jobs are created indirectly in upstream segments of the value chain in the country, irrespective of the scenario assessed. Given the hitherto low numbers of licensed solar energy producers in Turkey, more than 9 out of 10 FTE jobs in the solar value chain are being created in upstream segments of the value chain, such as in manufacturing or the transport and construction sectors.
- **While large proportions of jobs created among wind and solar power producers are highly skilled, middle-skilled workers are the main beneficiaries of job creation across the whole wind and solar value chains.** Across all scenarios, 55% of the FTE jobs generated are among the middle-skilled labour group, such as machine operators or sales workers. In the solar value chain a quarter of the additional jobs created are for high-skilled professions such as managers and technicians, whereas this is slightly higher for the wind power value chain, accounting for 30% of additional FTE jobs. Among wind power producing segment this figure increases to 40%.

[2] As defined in Box 3.


By 2028, increased renewable energy capacity can significantly boost employment in Turkey
Full-time equivalent jobs
150,000
100,000
75,000
50,000
25,000
0
7,400
59,000
61,400
148,000
Solar PV
Wind
Solar PV
Wind
Current policy
Ambitious policy
high-skilled
middle-skilled
low-skilled
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1. Developing employment opportunities in Turkey with renewable energy

The energy transition is inducing new investments in the electricity production and energy infrastructure sectors worldwide. The increasing relevance of renewable energy and climate change mitigation strategies is changing energy geopolitics, not only through changing patterns of demand for primary energy resources, but also through increased competition in energy machinery, equipment, research and development (R&D), industry and trade (IASS, 2019; Goldthau et al., 2019). As the importance of renewables increases, it is crucial to identify how the sector will influence future employment and skills requirements.

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 employment opportunities presented by the renewable energy (RE) 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.

Following this framework, the present study identifies the employment creation opportunities and skills requirements, and maps the future distribution of occupations throughout the renewable energy sector in Turkey. To this end, the study evolved around the following question:

- What employment co-benefits are unlocked by increased renewable energy deployment in Turkey?

In terms of renewable energy sources, the study considers the wind and solar sectors due to good data availability and reliability.[3] The study methodology employs the largest administrative dataset in Turkey, which spans the universe of firms throughout 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 employment coefficient, which will be central to estimating the effects of a more ambitious renewable energy policy in Turkey under the four scenarios describing increased share of renewable energy generation.

[3] Refer to the Methodology section for detailed information on the data used.

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 employment in the renewable sector in Turkey

The current study identifies the employment creation opportunities and skills requirements 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 employment generation per occupation of each linkage are calculated. Thirdly, estimations of occupational and skill-level employment 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 coded anonymously) covers formal employment information for each plant, including the number of days worked in each quarter per employee, and wage information. Additionally, occupation codes (in ISCO08 4 digits), and individual characteristics such as age and gender, are also available at a micro level. Furthermore, the database contains detailed balance sheet information, including specific items bought and sold from each firm registered in Turkey, which are crucial for identification of Segments thought the value chains.

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 from their website, including tax identifications and the type of licence (pre-licence; licences: under evaluation, approved, effective, cancelled, expired, etc.). Afterwards, so as to match both databases, the tax IDs of the relevant companies in the EPDK database were passed to the Ministry, which reverted to the research team with a clean dataset. The process of dataset construction is shown in Figure 2.

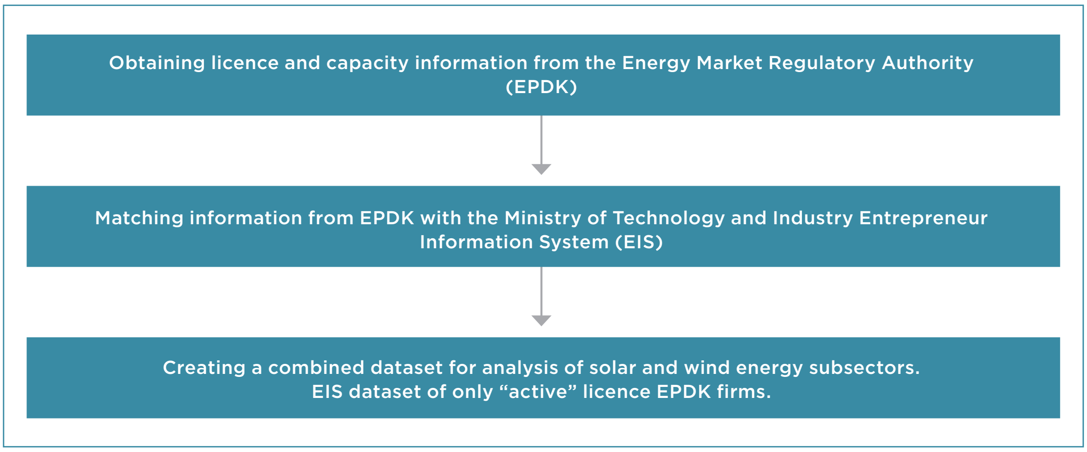


Figure 2: Construction of the dataset

Source: own

2.1 Constructing the wind and solar value chains

To define each segment (Figure) in the solar and wind energy value chains, electricity-producing firms with an 'active' licence in the EPDK database were identified and labelled as Segment 3. Their transactions (sales and purchases) were traced so as to establish which companies belonged to Segments 1, 2 and 4 (Figure 3). This information was obtained from the data declared in the EIS, and refers to the purchases and sales recorded in invoices between every firm.

The **coefficients of employment generation** (Equation 1) for the solar and wind value chains (Figure 3), were calculated from the ratio of: employment (weighted by the sales share of Segment 3 to a given Segment) and the total installed capacity of the electricity-producing firms (Segment 3). The total installed capacity of electricity producers was calculated using the EPDK list of electricity production licences.

Figure 3: Construction of RE value chains

Source: own

Once the value chain is constructed and the coefficient of employment calculated, this information is used to estimate employment growth based on the increased RE deployment scenarios. The **direct effect** is the increase in employment in Segment 3, that is, the renewable energy production sector; **indirect effects** occur among suppliers (Segment 2) and providers of intermediate goods and services (Segment 1). Employment is measured as units of full-time equivalent (FTE) employment (see Box 3).

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

1. The coefficient of employment generation per MW per segment in each sector (solar and wind) is given by Equation 1 (base year 2016).

Eq. 1

$$\delta_j^i = \frac{Employment_j^i * Sales\_share_j^i}{Installed\_capacity_i}$$

i: technology; solar or wind.

j: Segment (1 to 3)

$Employment_j^i$: is thus the registered employment in 2016 in Chain *j* in technology *i*

$Installed\_capacity_i$: installed capacity (measured in MW) among the energy producers of technology *i*, according the production licence list from the EPDK.

$Sales\_share_j^i$: sales share of Segment 3 (measured in total net sales) of Chain *j* in technology *i* during 2016, where $Sales\_share_3^i$=1 for all *i*.

These shares are shown in Table 3 and Table 4 for the solar and wind value chains respectively.

2. To estimate total employment creation, the capacity added per scenario (MW in Table 2) was multiplied by the coefficients.

Eq. 2

$$\widehat{Employment}_j^i = \delta * \Delta MW_{kt}$$

Eq. 3

$$\Delta MW_{kt} = MW_{kt} - MW_{base}$$

$\widehat{Employment}_j^i$ = estimated employment creation in technology *i* in Segment *j*

MW = Energy capacity (MW)

k = Selected scenario

base = Value of Base scenario, 2018

t = Year (range 2018 to 2028)

Box 3: Full-Time Equivalent (FTE).

The analysis uses full-time equivalent (FTE) employment, calculated as the ratio of the worked days registered by an individual during December,[4] over 31. For example, an individual that was registered for 31 days would have an FTE employment metric of 1, whereas an individual that was registered for 10 days would count as FTE employment of around ⅓, and so forth.[5] Total FTE employment figures are calculated for each MW of installed capacity in 2016 by dividing the total FTE employment in each Segment of the solar or wind value chains in 2016 by the installed capacity reported in the EPDK database. This calculation provides the basis for estimating employment creation across each step of each value chain.

The worker microdata provided in the EIS does not include the education levels of workers. However, since the dataset provides the occupations of each individual, it is possible to categorise these occupations into skill levels as provided by the International Labour Organization (ILO, 2012). The ILO (2012) classifies occupational categories (in ISCO08 1 digit) into a total of 4 skill levels based on their educational and skills requirements. Some broad occupation categories involve two different skills categories, which is why this analysis combines the top two skills categories into one category. Table 1 summarises the occupational classifications by skill level as used in this study.

[4] To avoid the effects of seasonality.

[5] Registration to the Social Security Institution is for the total number of calendar days (not working days) during the month.

Low-skilled workers	Middle-skilled workers	High-skilled workers
■ Workers in elementary occupations	■ Clerical support service and sales workers	■ Managers Professionals
	■ Skilled agricultural, forestry and fishery workers	■ Technicians and associate professionals
	■ Craft and related trade workers	
	■ Plant & machine operators, and assemblers	

Table 1: Skill and occupational classification used in the analysis

Source: own

Note that there are cases in which employees' occupations are not registered. The skill level cannot be classified in these cases, which may result in a smaller total number of skills projections compared to the total employment projections.

The EIS database, being a governmental dataset, can only provide information that is registered[6] by administrative agencies, and therefore does not include data on the shadow economy, which refer to informal employment registries. To complement the analysis, education and labour information on informal sectors was retrieved from the Household Labour Force Survey (Turkish Statistical Institute, 2018). These data were matched to the occupations obtained from the EIS database by using a broader code-number description of the occupations. The procedure for matching the information per occupation from the Labour Force Survey with the EIS dataset is described in Annex 1.

2.2 Scenarios and assumptions

In this study, employment opportunities associated with increased renewable energy capacity are assessed using a comparative scenario approach. The comparative approach reveals the impacts on employment and future skills requirements associated with Turkey's projected renewable energy capacity in each scenario. 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 substation 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 10 years (2018–2028), to reach the expected total generation capacities by 2028.

[6] Although it is difficult to precisely quantify the extent of informality, the IMF (Medina, 2018) estimated Turkey's shadow economy at 27% of GDP in 2017, and the OECD estimated 28% in 2015. Also, according to information from the Turkish Statistical Institute Household Labour 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 particular problem in small-scale plants in the solar energy sector.

	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 2: Base and alternative scenarios for wind and solar energy capacity in Turkey

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.[7] 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.

Secondly, technological developments and unusual changes in domestic production and trade should be updated in future analyses. The present analysis is static and therefore cannot account for any technological advances that might lead to major changes in employment.

It is strongly emphasised that employment numbers in different value chains cannot be added together to understand total employment in renewable energy value chains. Using the current study methodology, firms might be counted twice if they are linked to two or more different renewable energy producers; this implies that employment in the same firm might be double-counted. This issue must be given careful consideration when making inferences about the whole of the value chain.

[6] This limit is raised to 5 GW 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.

3. Status of employment in the wind and solar sectors in Turkey

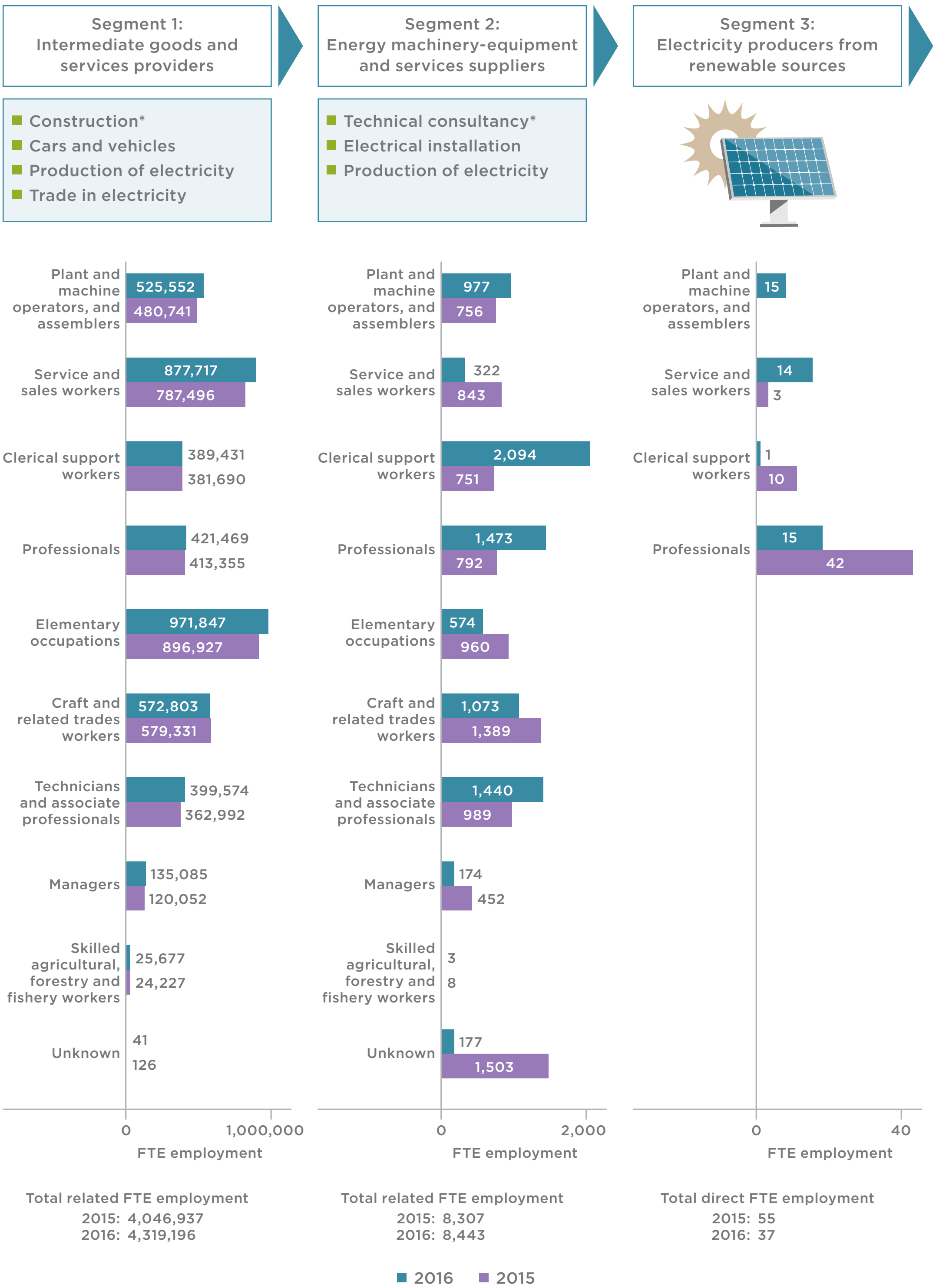


Figure 4: Main subsectors and employment in the solar energy value chain

Source: Authors' calculations based on EIS

* Only lists subsectors that account for 5% or more of purchases by their successors.

Taking into account the entire value chain, the solar energy value chain is connected to a total of 4.3 million FTE jobs. The solar energy sector itself (Segment 3) employed a total of 37 people (as full-time equivalent, formal workers) in 2016. This represents a reduction of more than 50% compared with the previous year (54 workers in 2015), stemming from a decrease in the number of professionals and clerical support workers.

Solar energy machinery-equipment and service suppliers (Segment 2) employed 8,308 FTE formal workers in 2016. The highest numbers of employees per occupation are clerical support workers. Between 2015 and 2016 there was a decrease of 136 FTE workers in the chain, due to decreases in occupations such as crafts and related trade workers, and elementary occupations.

The EPDK pre-licence and licence list comprises 28 solar energy producers with '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 Constructing the wind and solar value chains. The main subsectors and employment information[8] for solar renewable energy in Turkey are summarised in Figure 4.

The wind sector value chain was connected to a total of almost 8 million FTE formally registered employees in 2016. Of this total, 16,200 were employed in the wind energy sector itself (Segment 3). The employment size of the sector decreased by about 1,100 FTE formal workers between 2015 and 2016, resulting mainly from the loss of craft & related trade workers, and technicians & associated professionals.

Moving backwards in the value chain, wind energy machinery-equipment and services suppliers (Segment 2) employed a total of around 900,000 full-time equivalent formal workers in 2016. Service and sales workers (16%); plant & machine operators, and assemblers (14%) and elementary occupations (14%) were the main occupational categories in this chain. Under these broad categories, some occupations were more frequently observed than others. Security guards (7%) and shop sales assistants (4%) were the main occupations among service and sales workers, whereas heavy truck and lorry drivers (2%) and mechanical machinery assemblers (1%) were the main occupations among plant & machine operators, and assemblers. The size of the chain increased by about 57,000 between 2015 and 2016, stemming from increased numbers of plant & machine operators, and assemblers as well as technicians & associated professionals.

In 2016, a total of 7 million FTE formal employees worked in firms providing intermediate goods and services (Chain 1). Of these, approximately 19% were employed in elementary occupations, within which the three main occupations comprised: odd-job persons (7%); cleaners and helpers in offices, hotels and other establishments (6%); and civil engineering labourers (2%). Service and sales workers made up about 16% of these employees, with the main occupations within this broad category being shop sales assistants (6%), security guards (3%) and waiters (2%). The third-largest occupational category was plant & machine operators, and assemblers (14%), with heavy truck and lorry drivers (3%) being the most common occupation. The size of the chain increased by about 225,000 FTE formal employees between 2015 and 2016, comprising mainly managers; plant & machine operators, and assemblers.[9]

The EPDK pre-licence and licence list includes 296 wind energy producers with 'active' status. These firms define Segment 3 and are the basis for the analysis. Firms in Segments 1, 2 and 4 were identified according to the assessment methodology described in Section Constructing the wind and solar value chains. The main subsectors and employment information[10] for the wind sector are summarised in Figure 5.

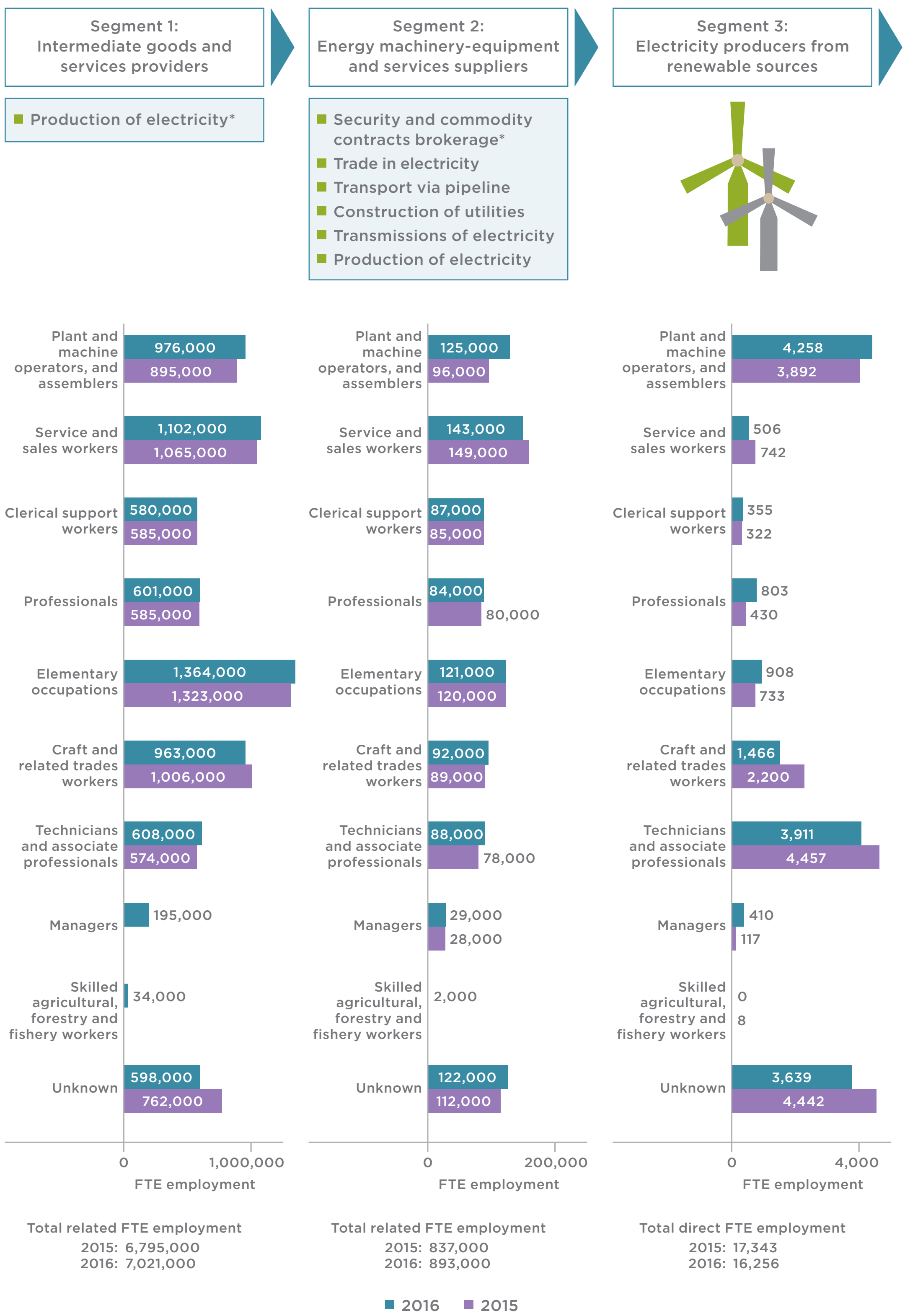
[8] Retrieved from the EIS dataset and the Household Labour Force Survey (Turkish Statistical Institute, 2018).

[9] Please note that the apparent increase in the number of managers may result from correction of occupational coding errors between 2015 and 2016, as the number of individuals with no occupation codes (termed "Unknown" in figures) declined between 2015 and 2016.

[10] Retrieved from the EIS dataset and the Household Labour Force Survey (Turkish Statistical Institute, 2018).

Figure 5: Main subsectors and employment in the wind energy value chain

Source: Authors' calculations based on EIS



* Only lists subsectors that account for 5 % or more of purchases by their successors.

4. Increased employment opportunities of renewables in Turkey

4.1 Employment opportunities under different solar renewable energy futures in Turkey

Estimations based on the scenarios show that each additional MW of solar energy production leads to an employment increase of 2.46 full-time equivalent workers. Of the FTE employment generated, 8% is directly connected to electricity producers and 92% is created indirectly along the first and second Segments of the value chain. FTE employment in the solar sector is mostly for middle-skilled workers (55%) but also for high-skilled ones (24%). Figure 6 illustrates the estimated total FTE employment per scenario, while Figure 7 shows the distributions of occupations along the scenarios in the next 10 years.

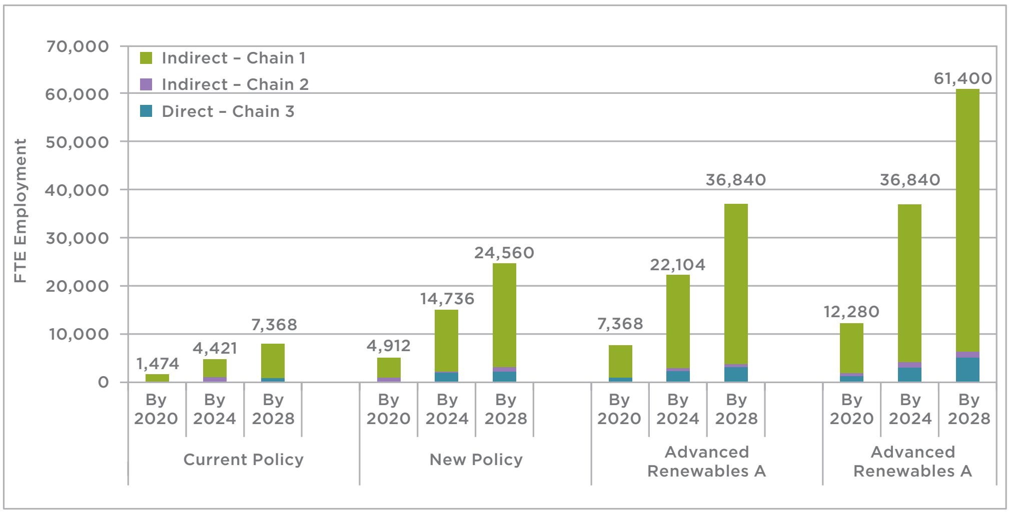


Figure 6: Development of employment in the solar value chain under alternative scenarios (2020–2028)

Source: own

In line with these changes in demand for different occupational categories, occupations with medium skill levels will be in higher demand in all scenarios, followed by an increase in the demand for high-skilled workers. The Current Policy scenario estimates a need for 4,100 more middle-skilled, around 1,800 high-skilled and 1,500 low-skilled workers. The New Policy scenario estimates an increase of almost 14,000 middle-skilled workers, around 5,900 high-skilled workers and 5,000 low-skilled workers. The Advanced Renewables A scenario predicts a need for 20,400 more middle-skilled, 8,800 high-skilled and 7,500 low-skilled workers. Finally, under the Advanced Renewables B scenario there is a need for approximately, 34,000 middle-skilled workers, 14,700 high-skilled and 12,500 low-skilled workers. The predicted occupational skill requirements are consistent between the scenarios; that is: higher-skilled workers represent 24% of total FTE employment, middle-skilled workers 55% and lower-skilled workers 21%.

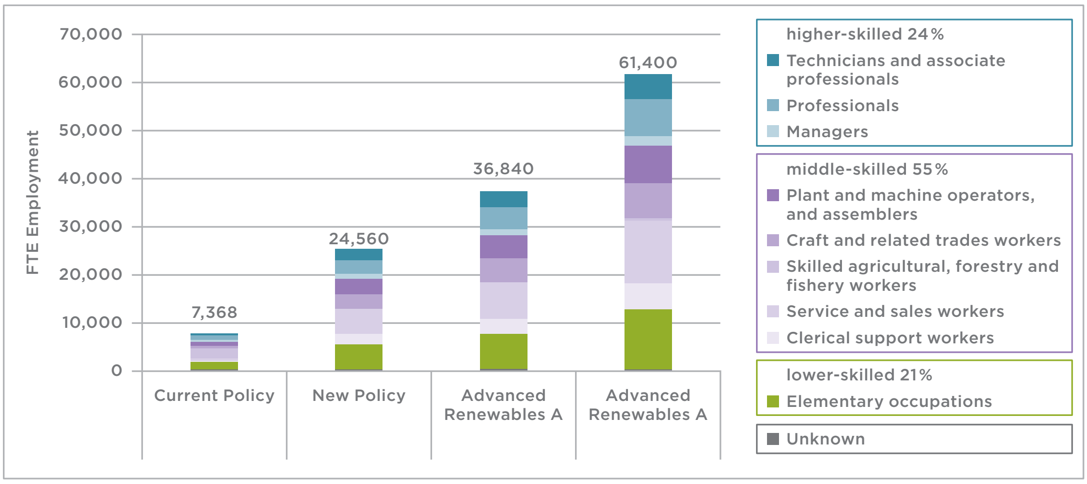


Figure 7: Estimated occupational distribution in the solar value chain per scenario, 2028

Source: own

4.2 Employment opportunities under different wind renewable energy futures in Turkey

Each MW increase in wind energy production leads to an increase of 6.34 FTE employment across the entire value chain. Of this, 36% is directly connected to electricity producers and 64% is created indirectly along the first and second Segments of the value chain. FTE employment increases in the wind sector are primarily for middle-skilled workers (56%) but also for high-skilled ones (30%). Figure 8 illustrates the total FTE employment estimated for each scenario, while Figure 9 shows the occupational distribution among the scenarios in the next ten years.

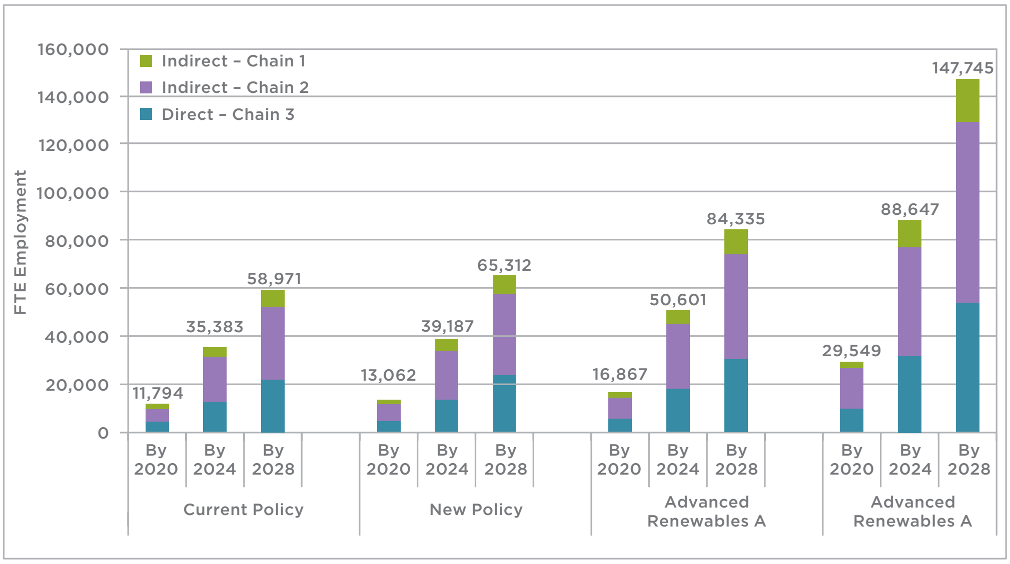


Figure 8: Development of employment in the wind value chain under various scenarios (2020–2028)

Source: own

In line with these changes in demand for different occupational categories, there will be higher demand for medium-skilled occupations under all scenarios, followed by an increase in the demand for high-skilled workers. Under the Current Policy scenario, demand will increase by approximately 28,000 for middle-skill, 15,000 high-skill and 7,000 for low-skilled workers. The New Policy scenario requires an additional 31,000 middle-skill workers, around 17,000 high-skilled workers and 7,400 low-skilled workers. The Advanced Renewables A scenario implies increased demand of 39,500 middle-skilled workers, 21,400 high-skilled workers and 9,600 low-skilled workers. Finally, the Advanced Renewables B scenario implies an increase of around 69,300 in the demand for middle-skilled workers, 37,600 for high-skilled workers and 16,800 for low-skilled workers. The share of occupational skill levels remains consistent between the various estimations; that is: higher-skilled workers represent 30% of total FTE employment, middle-skilled workers 56% and lower-skilled workers 14%.

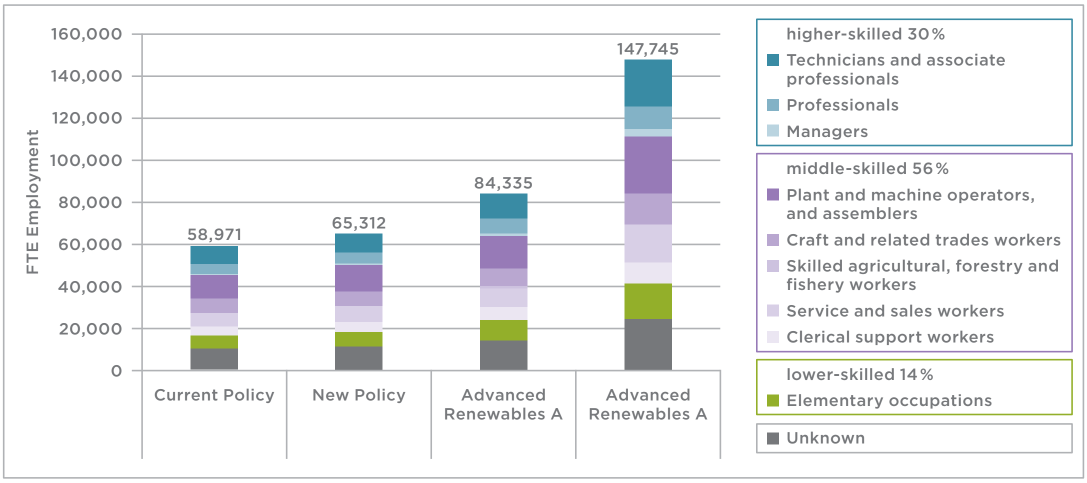


Figure 9: Estimated occupational distributions in the wind value chain per scenario, 2028

Source: own

The current study assessed the employment effects of increased energy production capacity in Turkey's renewable energy sectors based on the backward and forward linkages across the value chain specific to each technology. The results show that Turkey can significantly increase employment by increasing investment in renewable energy technologies. Across the value chains, each additional MW of RE capacity increases employment by around 2.5 FTE employment in the solar energy sector and around 6.3 in the wind sector. An increase of 7,400 FTE jobs in the next 10 years in the solar value chain is already expected with the Current Policy scenario; however, these employment gains can be increased eight-fold under SHURA's high-ambition scenario. In the wind sector, employment is estimated to peak at 59,000 FTE jobs in the next 10 years under the Current Policy scenario, but this is predicted to double if the ambition of the Current Policy is raised. Furthermore, a significant part of Turkey's workforce (formally registered employees) is already connected to renewable energy investments: almost 8 million in the wind sector and more than 4 million in the solar sector. Much of the additional demand for FTE employment is for middle-skilled workers, but expansion of RE installed capacity also creates high-skilled FTE employment. The results suggest increased demand for plant operators and assemblers, as well as service workers.

These results support the overall renewable energy policy framework in Turkey, which not only aims to increase RE installed capacity but also to build a local manufacturing industry and enable technology transfer. 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 government intends to increase installed RE capacity, the level of ambition also matters. As can be seen from the tested scenarios, it would be possible for Turkey to benefit from additional installed capacities not only in terms of reduced CO_2 emissions but also by increasing employment opportunities.

5. Creating an enabling environment to boost employment with renewables within the power sector and the wider economy

Impulses for furthering the debate

This COBENEFITS study shows that Turkey can significantly increase employment by expanding the shares of solar and wind energy in its energy mix. Across the value chains, each additional MW of installed RE capacity increases FTE employment by around 2.5 FTE employment in the solar energy sector, and around 6.3 in the wind sector. **In order to unlock the potential benefits of this additional employment, the renewable energy policy framework in Turkey should aim for higher shares of domestic inputs, building a domestic manufacturing industry that focuses on higher levels of value addition in the value chains, and enabling technology transfer.**

In order to drive the necessary social acceptance and also enhance local value creation, 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 create a suitable enabling environment to maximise employment benefits in Turkey's power sector, both in terms of job creation within the renewable energy sector, and alleviating any negative externalities or job losses resulting from shifts away from coal?

Renewable energy investments are expected to bring new employment with the increased industrial production opportunities in Turkey. Even within the current production structure, the positive effect is significant and mostly reflected in the demand for middle-skilled workers (plant operators and assemblers, as well as services workers).

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 address the following areas, in which policies and regulations could be introduced or enforced in order to maximise the co-benefits for employment within the shift to a less carbon-intensive power sector.

Develop local skills to increase the level of production and employment. Moving to higher-value added stages in the solar and wind sectors

As Turkey increases the ambition of its renewable energy targets and aims for higher shares of domestic inputs, employment opportunities would expand – not only in numbers but also in quality. Increased domestic production of RE equipment, especially of high-tech components, would require a more highly skilled workforce. Therefore, moving up the value chain to high-value added stages within the renewable energy industry will also translate into increasing demand for higher-skilled labour. To meet this demand, the expansion of the industrial base should also be matched by the development of appropriate skills at all stages. While higher-level education is targeted for technology development, increased production and installation capacities should also be complemented by vocational training.

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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
FTE	Full-time equivalent
EPDK	from Turkish: Energy Market Regulatory Authority
HS	Harmonized System
IASS Potsdam	Institute for Advanced Sustainability Studies Potsdam
IEA	International Energy Agency
ILO	International Labour Organization
IPC	Sabanci University Istanbul Policy Center
MoENR	Ministry of Energy and Natural Resources
MW	Megawatt
RE	Renewable energy
SGK	Social Security Institution (SGK)
SHURA	SHURA Energy Transition Center
TEİAŞ	Turkish Electricity Transmission Company

COBENEFITS

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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, Istanbul Policy Center Sabanci University
pinarertor@sabanciuniv.edu

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

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