Competitiveness of corporate sourcing of renewable energy

Annex D to Part 2 *of the Study on the competitiveness of the renewable energy sector*

Impact of corporate sourcing of renewable electricity on economic growth and jobs

ENER/C2/2016-501
28 June 2019

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Luxembourg: Publications Office of the European Union, 2019

ISBN: 978-92-76-09287-2
Doi: 10.2833/205100
Catalogue: MJ-02-19-629-EN-N

EUROPEAN COMMISSION

DIRECTORATE C
Renewables, Research and Innovation, Energy Efficiency

European Commission
B-1049 Brussels

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1 Introduction

Renewables have been increasingly recognized as **important contributors to economic growth both in terms of job creation and value added**. In this context, as industry and services are responsible for more than two-thirds of the European Union's (EU) final electricity consumption, corporates' decision to source renewable electricity can not only improve environmental sustainability, but also fuel economic growth, create employment opportunities and enhance welfare.

The present Annex provides an assessment of **the impact of corporate sourcing of renewable electricity on economic growth and jobs up to 2030 in ten EU Member States**: Bulgaria, France, Germany, Ireland, Italy, the Netherlands, Poland, Romania, Spain and Sweden.

The remainder is organised as follows: Section 2 briefly reviews recent studies on the socio-economic impact of RE deployment at the global and EU levels; Section 3 illustrates the methodology and data sources; Section 4 estimates total job creation and gross value added (GVA) of corporate sourcing of renewable electricity.

2 The impact of renewable energy on economic growth and jobs

In the recent past, many studies tried to **estimate and monitor the socio-economic impact of renewable energy (RE) deployment** by relying on a large variety of methodologies. Table 1Table 1Table 1 Recent studies on socio-economic impacts of RE at the global and EU level summarises the main studies on the socio-economic impact of RE at the global and EU level. Results of these studies are somehow difficult to compare, as they are based on different methodologies and focus on different timeframes. In addition, the main assumptions are frequently not made explicit, preventing an effective comparison of findings.

Since 2012, the International Renewable Energy Agency (IRENA) has been assessing RE employment at the global level on an annual basis[1]. According to the last assessment, RE direct and indirect employment reached 10.3 million jobs in 2017, up by 5.3% from the previous year.

Socio-economic benefits depend on a wide range of **technical, economic and policy-driven factors**, including costs of RE technologies, geographic shifts in the production and installation of RE equipment, corporate strategies, as well as government policies. Therefore, although RE technologies are often regarded as highly suitable for creating economic growth at the local level, employment remains highly concentrated in a few countries (China, Brazil, the United States, India, Germany and Japan).

Table 1 Recent studies on socio-economic impacts of RE at the global and EU level

Institution	RE Technologies	Socio-economic variables	Country/Region	Methodology	Years
EurObserv'ER [The State of Renewable Energies in Europe - Annual Overview]	Wind, Solar PV, Solar Thermal, CSP, Hydropower, Geothermal, Biogas, Biofuel,	Turnover, Direct and indirect employment	EU	Input-output	2012-2018

[1] IRENA (2018), Renewable Energy and Jobs. Annual Review 2018. International Energy Agency. Abu Dhabi, UAE.

Institution	RE Technologies	Socio-economic variables	Country/Region	Methodology	Years
	Municipal waste, Biomass				
IRENA [Renewable Energy and Jobs. Annual Review]	Wind, Solar PV, Solar Thermal, CSP, Hydropower, Geothermal, Biogas, Biofuel, Municipal waste, Biomass	Direct and indirect employment	Global	Various, secondary data	2014, 2015, 2016, 2017, 2018
EY/SolarPower Europe [Solar Photovoltaics. Jobs & Value Added in Europe]	Solar PV	Jobs, value added	Germany, France, Spain, Italy, Belgium, the UK, Greece. Results for other EU countries are obtained by extrapolation	Input-output	2017
Deloitte and Wind Europe [Local Impact, Global Leadership. The Impact of Wind Energy on Jobs and the EU Economy]	Wind	GDP, employment, trade, tax revenues, innovation and energy dependency	Europe	Various	2017
IRENA [Renewable Energy Benefits: Measuring the Economics]	Wind, Solar PV, Solar Thermal, CSP, Hydropower, Geothermal, Biogas, Biofuel, Municipal waste, Biomass	GDP, employment, welfare, trade	Global	Macro-econometric	2016

Source: Authors' elaboration on multiple sources.

RE employment in developed countries increased at a slower pace than Asian countries. According to IRENA, China was still the leader in terms of RE employment, with 3.9 million jobs in 2017. As for RE technologies, the photovoltaic (PV) industry was responsible for almost 3.4 million jobs in 2017, also registering the largest annual growth together with bioenergy industries (more than 3 million jobs). While the employment in geothermal energy, hydropower (small), concentrated solar power (CSP), heat pumps (ground-based), municipal and industrial waste, and ocean energy remained relatively stable, jobs in wind power (1.1 million in 2017) and in solar thermal (0.8 million in 2017) declined as a result of declining investments.

Focusing on EU, RE employment was estimated at about 1.3 million jobs (excluding large hydropower), out of which 332,000 jobs were concentrated in Germany. Estimates vary slightly between studies. The EurObserv'ER has estimated that about 1.4 million people were employed in European countries in 2016 with a reduction of about 1% compared to 2015.[2] The solid biomass industry employed about 350,000 people, directly and indirectly, in 2017. More than 300,000 people were employed in wind energy (28% of the total). The solar PV and the solar thermal industries, respectively, employed about 96,000 and 29,000 people. Further, according to EurObserv'ER, the total RE turnover in the EU28 amounted to €149.3

[2] EurObserv'ER (2018), The state of renewable energies in Europe. Edition 2017. 17th Report. Paris.

billion in 2016 with wind energy and solar PV together contributing to 42% of the total.

IRENA also provided a quantitative assessment of the macroeconomic impacts of doubling the share of renewable energy globally in 2030 compared to the 2010 level (IRENA, 2016). This change would lead to an increase between 0.6% and 1.1% in the global GDP, i.e. between $700 billion and $1.3 trillion, and would create additional direct and indirect employment for about 24 million jobs by 2030.

Deloitte and Wind Europe[3] recently focused on the economic footprint of the EU wind sector in terms of contribution to Gross Domestic Product (GDP), international trade, jobs, energy dependency and CO_2 emissions. The direct and indirect contribution of the wind energy industry was estimated at about €36.1 billion in 2016, amounting to 0.26% of the overall EU GDP. Total exports in the wind energy industry were equal to €7.8 billion in the same year, while the imports amounted to €5.4 billion. More than 262,000 people were employed by the EU wind energy industry in 2016, marking an increase of slightly more than 3,000 jobs from 2011. About 56% of the total jobs were generated by companies directly operating in the wind energy industry.

Focusing on solar PV, although the socio-economic contribution of the PV industry has been gradually declining in most European countries, EY and Solar Power Europe[4] estimated that the PV sector generated more than €4.6 billion GVA in the EU28 in 2016. The employment level in the PV sector amounted to 81,000 jobs (in terms of full-time equivalents) in the same year. A strong increase both in terms of employment (+145%) and GVA (+105%) is expected in the next few years, with estimates totalling about 175,000 and GVA of €9.5 billion by 2021.

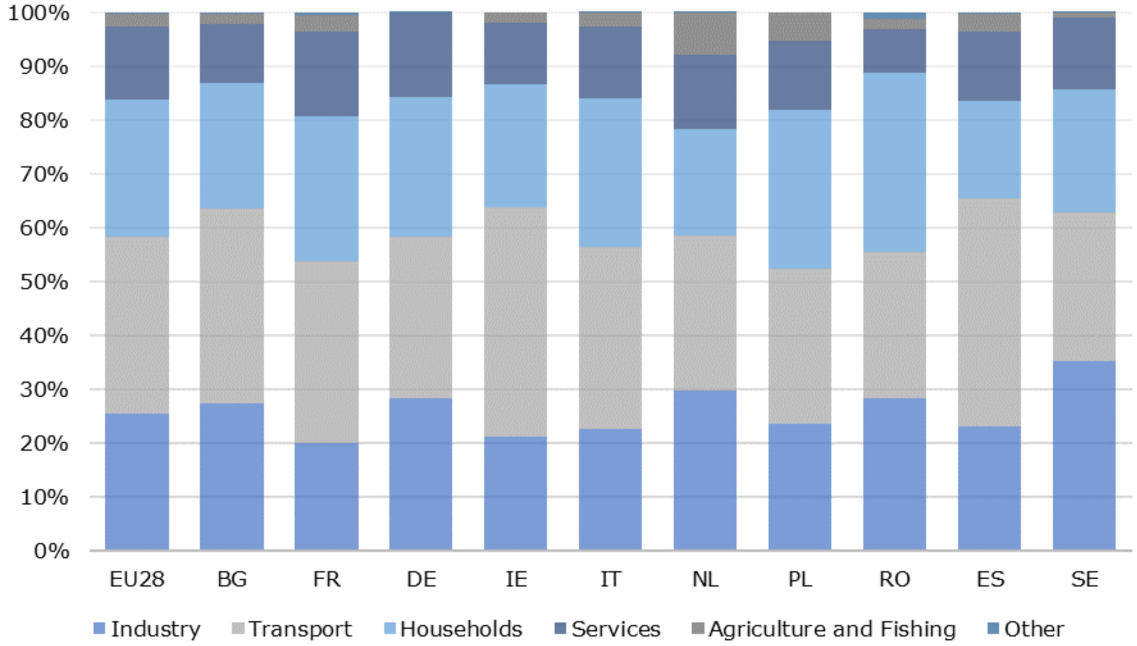
3 Corporate sourcing of renewable electricity

From a methodological standpoint, the assessment of the impact of corporate sourcing of RE on economic growth and jobs first requires addressing the so-called **'additionality'** issue. Additionality is here defined as the net incremental renewable capacity deployed or RE generated as a direct result of corporate sourcing of renewable energy beyond what would occur in its absence.

At the EU level, the share of industry and services in the final energy consumption was equal to 39% in 2016 (Figure 1). This share ranged between 32% in Ireland and 49% in Sweden. In the same year, the commercial and industrial sectors are together responsible for about 69% of the EU electricity end-use (see Figure 2). In the selected countries, this share went from about 59% in France to 73% in Germany and 75% in Poland.

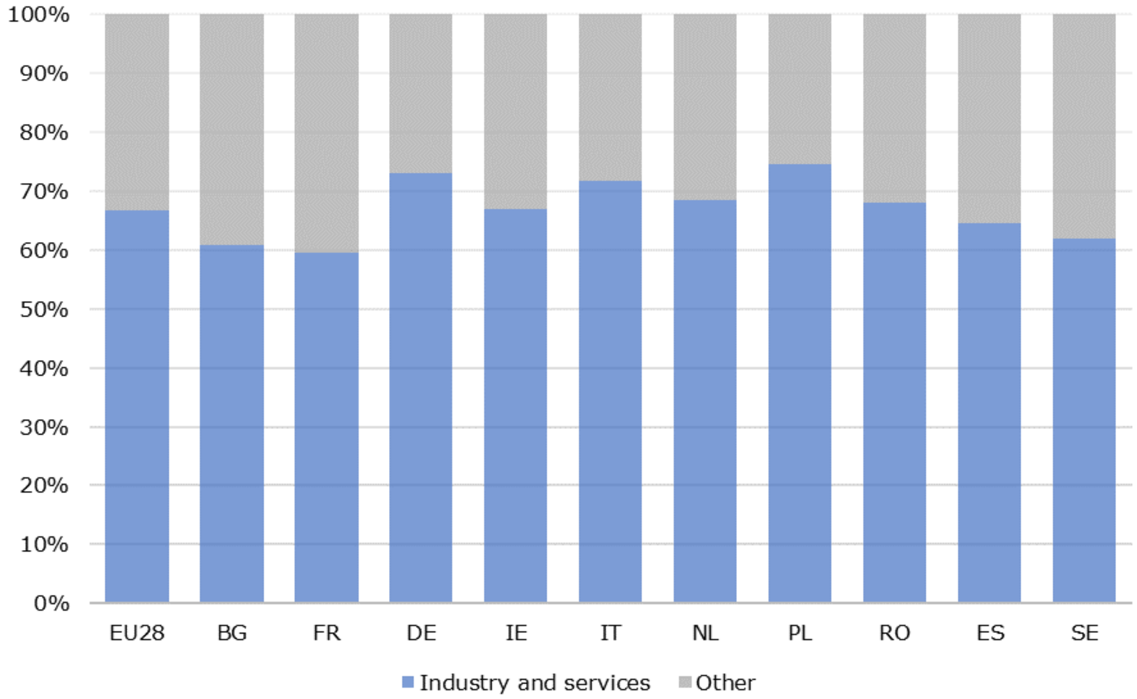
[3] Deloitte and Wind Europe (2017), Local Impact, Global Leadership. The Impact of Wind Energy on Jobs and the EU Economy. November. Brussels, Belgium.
[4] EY and Solar Power Europe (2017), Solar PV. Jobs & Value Added in Europe. November.

Figure 1 Final energy consumption by sector (%, 2016)



Source: ENERGY STATISTICS, EU Commission, DG ENER, Unit A4.

Figure 2 Share of industry and service sectors in overall final electricity consumption-Percentage (2016)



Source: Eurostat, Energy Statistics

IRENA has recently provided an overview of sectors and companies reporting renewable electricity sourcing at the global level.[5] In 2017, **the corporate renewable electricity market was estimated at 465 TWh**, representing approximately 3.5% of the total electricity demand and 18.5% of the renewable electricity demand of industry and service sectors. Out of the 941 European companies covered by the study, more than half (52%) are actively sourcing renewable electricity. There are significant differences concerning the share of companies actively sourcing renewable electricity in different countries, although the results are highly dependent on the number of companies included in the sample. **The choice to actively rely on renewable electricity depends on several factors such as**:

- The level of **maturity of climate and energy management** of a given company;
- The **cost-competitiveness** of renewables; and
- The **options available** to pursue corporate sourcing strategies.

Moreover, corporate sourcing is typically lower in small and medium-sized enterprises (SMEs), while the proportion of purchased and self-generated renewable electricity is greater in energy-intensive sectors.

Looking at different renewable technologies, **wind power and solar PV are undoubtedly becoming more appealing** for corporate sourcing, thanks to their increasing cost-competitiveness vis-à-vis 'brown' fuels. This entails a greater potential for these technologies in terms of additionality. According to IRENA[6], the costs of renewable power generation have continued to decrease in the past few years. The global weighted average of the levelized cost of electricity (LCOE) from solar PV has fallen by 69% between 2010 and 2016 and that of on-shore wind turbines by approximately 18% in the same period. As for off-shore wind, its investment costs are highly dependent on location and site conditions. At the global level, the weighted average of LCOE also decreased by 18% between 2010 and 2016, mainly because of improved capacity factors that offset the increase in total installed costs by 8% during this period. As a result, both wind and solar PV are already providing very competitive electricity.

Conversely, a more limited or no impact from the point of view of additionality can be expected at least in the next few years from hydropower, geothermal power and biomass. **Hydropower and geothermal power** are mature and predictable technologies, which have proven to be low-cost sources of electricity. However, the little room for capacity additions in the EU is limited mainly to small hydropower projects. Geothermal power generation has been deployed only in regions with high-temperature resources that are close to the Earth's surface, such as in Italy and France. Further deployment of geothermal power generation requires much less mature technologies that are still unattractive in terms of cost competitiveness. As for power generation from bioenergy, the technologies in use are very different in terms of feedstock and conversion methods. This results in a differentiated potential for cost reductions, with marginal improvements that can be expected in the short term from both mature technologies and those that are not yet widely deployed.

Against this background, this Annex focuses on additional investment in renewables stemming from corporate sourcing. Therefore, in what follows **it is assumed that the additional demand for renewable electricity by EU companies through all the various sourcing options** (self-generation, PPAs, unbundled GOs, and utility green procurement) **would be met via investments in wind power** (on-shore and off-

[5] IRENA (2018), Corporate sourcing of renewables: market and industry trend – REmade Index 2018. International Energy Agency. Abu Dhabi, UAE.
[6] IRENA (2018), Renewable Power Generation Costs in 2017. International Renewable Energy Agency, Abu Dhabi, UAE.

shore) **and solar PV**, which are likely to remain the most attractive renewable technologies in the time horizon considered in the present analysis (up to 2030).

4 Methodology

4.1 Gross input-output tables

To estimate the economic impact of corporate sourcing of renewable electricity, the present Annex applies **a gross input-output (I-O) approach**.[7] This is an analytical framework developed by Leontief in the late 1930s with the fundamental purpose of analysing the interdependence of industries in an economy[8]. More specifically, the I-O analysis aims to understand how and to what extent the activities of industries that produce goods (outputs) and consume goods from other industries (inputs) are linked in the production process of each output, thus contributing to the creation of value added as well as to meeting the final demand.[9] The scope of the original I-O analysis has been progressively broadened to account for additional issues associated with industrial production and other economic activity such as employment, international trade, energy consumption and environmental pollution.[10]

From an operational perspective, this approach relies on an **inter-industry transactions table**. This table is based on observed economic data for whole economies or for segments thereof (nation, region, etc.). Each horizontal row of the table illustrates how the total output of a given industry is used by production processes of other industries or for final consumption. Each vertical column reports the combination of inputs used by a given industry. Key data for an I-O model are monetary values of the transactions between pairs of industries (see Table 2), which allow understanding how the demand for inputs of a specific sector (e.g., sector *j*) relates to the amount of goods produced by another sector (e.g., sector *i*) in a given time period.[11]

Table 2 Input-Output table of inter-industry flows of goods

		Buying sector				
		1	..	j	..	n
Selling sector	1	z_{11}	..	z_{1j}	..	z_{1n}
	:	:		:		:
	i	z_{i1}	..	z_{ij}	..	z_{in}
	:	:		:		:
	n	z_{n1}	..	z_{nj}	..	z_{nn}

Note: z_{ij} monetary values of the transactions between the selling sector i and the buying sector j.

Source: Authors' own elaboration.

[7] For an overview of methodological approaches to assess socio-economic effects in the field of renewable electricity, please see: Breitschopf B., Nathani C., Resch G. (2011), Review of approaches for employment impact assessment of renewable energy deployment. Karlsruhe, Germany: IEA-RETD; Borbonus S. (2017), Generating socio-economic values from renewable energies. An overview of questions and assessment methods. Potsdam.

[8] Leontief, W.W. (1936), Quantitative Input and Output Relations in the Economic Systems of the United States. The Review of Economics and Statistics, 18(3), p. 105-125.

[9] Eurostat (2008), Eurostat Manual of Supply, Use and Input-Output Tables. Luxembourg: European Communities.

[10] Miller R.E., Blair P.D. (2009), Input–Output Analysis. Foundations and Extensions. Cambridge: Cambridge University Press.

[11] United Nation (2018), Handbook on Supply, Use and Input-Output. Tables with Extensions and Applications. New York: Department of Economic and Social Affairs. For a more detailed analysis of analytical models using the basic input–output data, see also Suh S. (2009), Handbook of Input-Output Economics in Industrial Ecology. Vol. 23. Amsterdam: Springer Netherlands.

For instance, the demand for electrical equipment sector from the solar PV industry depends on the amount of solar PV capacity installed, the demand for architectural and engineering activities by the wind power sector depends on the number of wind turbines being installed etc. Hence, the inter-industry transactions table describes the dependence of each industry on the products of other industries and allows to measure how changes in certain components affect the entire economy.

In principle, the assessment of the potential economic impact of corporate sourcing of renewable electricity would also require accounting for the evolution of the observed economies as well as technological progress. **A standard assumption in the gross I-O approach**, however, is to keep constant all the inter-industry transactions considering that the fundamental economic structure of a country only changes slowly. The same assumption applies to technological progress in renewable technologies so that potential changes in the quantity and type of inputs needed as well as in the ratio between investment and operation and maintenance (O&M) costs will not be considered. Therefore, the present Annex applies the *ceteris paribus* clause.

4.2 Data sources

The analysis performed in this Annex relies upon I-O tables published in the **World Input–Output Database (WIOD)**[12]. Besides providing full transparency on all the underlying data sources and methodologies, when it comes to impacts on employment the WIOD offers homogeneous and dimensionally comparable vectors of hours worked, which are less dependent on institutional arrangements, social conventions, or the length of the working day, thus allowing for a more effective comparison over time and among countries.

The analysis also draws on official energy statistics provided by **Eurostat and DG ENER, Unit A4 of the European Commission**[13], as well as on economic and technical reports from **IRENA**[14] and the **National Renewable Energy Laboratory (NREL)**[15].

Finally, data on trade flows on sold production, import and export of manufactured products contained in renewable technologies are based on **Eurostat PRODCOM** statistics[16].

4.3 Input-output vectors for renewable electricity

As mentioned, I-O tables disaggregate the economic activity in a certain geographic area into a number of industries or producing sectors. The level of disaggregation depends on the available data as well as on the aim of the analysis. When new products are invented or deployed, I-O tables need to be modified both on the **output side**, by adding an entirely new sector (or by changing the product mix in an existing sector), and on the **input side**, by replacing older inputs to the production of other sectors with the new input.

[12] The first version of the WIOD was one of the outcomes of the official WIOD Project, funded by the European Commission as part of the 7th Framework Programme, Theme 8: Socio-Economic Sciences and Humanities. The WIOD 2016 release provides I-O Tables for 43 countries, including the selected EU member states (Bulgaria, France, Germany, Ireland, Italy, the Netherlands, Poland, Romania, Spain and Sweden), and a model for the rest of the world for the period 2000-2014. The tables cover 56 sectors, classified according to the International Standard Industrial Classification revision 4 (ISIC Rev. 4). All the values are in current prices, expressed in millions of dollars, and all the transactions are registered at basic prices.
[13] For further details see: https://ec.europa.eu/energy/en/data/energy-statistical-pocketbook.
[14] For further details see: https://www.irena.org/costs.
[15] For further details see: https://www.nrel.gov/
[16] For further details see: https://ec.europa.eu/eurostat/web/prodcom

Usually available I-O tables make no explicit reference to the RE sector. This simply means that the RE industry is not included in the production sectors in which the I-O table classifies the economic activities. To overcome this problem, as done by many recent studies, **new I-O vectors need to be constructed for each source/technology**[17]. In what follows, the main steps and key assumptions on which the present analysis is based are briefly described.

- Detailed technology information on **investment costs (CAPEX**) as well as **O&M costs (OPEX)** are needed to construct I-O vectors. Data about **onshore wind, offshore wind and solar PV** were derived from IRENA Renewable Cost Database and NREL, supplemented by desk research where official statistics are not available. Country-level data were used whenever available (as in the case of Germany, Italy, France, Spain and Sweden for on-shore wind and Germany, Italy, and France for Solar PV). For other countries covered by this Study (and for off-shore wind), average values were estimated based on European data (see Box 1).

Box 1 Capital Expenditures (CAPEX) and Operational Expenditures (OPEX) of renewable technologies

There are some **differences between European countries** in terms of total installed costs reflecting the natural variation of individual renewable power projects in terms of site-specific characteristics as well as the maturity of local markets. Data available are not representative of all countries and regions, often being the result of specific subsets of projects and being dependent on the collection methodology. The variability increases for less deployed technologies, such as wind offshore.

According to IRENA, in 2016, the onshore wind total installed cost in Europe ranged from 1,485 to 2,868 USD/kW. O&M costs were estimated at about 56 USD/kW/year.

The **global weighted average of the installed costs of offshore projects** for both fixed-bottom and floating substructures varied between 2,052 and 5,991 USD/kW in 2017. As expected, due to the higher difficulty to access and to operate the marine environment, OPEX for off-shore wind farms are higher than those for onshore wind. IRENA estimates the O&M costs for Europe to be between USD 109/kW/year and USD 140/kW/year mainly depending on the distance from the maintenance facilities and the meteorological ocean climate at the site. NREL estimates the O&M expenditures to be around USD 158/kW/year for fixed-bottom substructures and USD 93/kW/year for floating substructures.

Utility-scale solar PV total installed cost at global level averaged 1,400 USD/kW in 2017. In France, Germany, and Italy utility-scale solar PV total installed costs amount to 1,070 USD/kW, 1,180 USD/kW, and 1,090 USD/kW, respectively. O&M costs are estimated to be around 18 USD/kW per year, accounting for 20‐ 25% of the LCOE.

The following tables show the **Capital Expenditures (CAPEX)** and **Operational Expenditures (OPEX)** of onshore wind, offshore wind and solar PV in the selected Member States. As mentioned, where country-level data were not available, the present analysis relies on EU average values.

[17] EurObserv'ER (2017), Renewable energy employment effects in the EU and the Member States. Methodology Report. Petten, The Netherlands: ECN, European Commission. Gestore dei Servizi Energetici (2018), Le rinnovabili nel 2017. Presentazione della Relazione sulla situazione energetica nazionale al 2017. Roma: Gestore dei Servizi Energetici. Breitschopf B., Nathani C., Resch G. (2012), Methodological guidelines for estimating the employment impacts of using renewable energies for electricity generation. Karlsruhe: Study commissioned by IEA's Implementing Agreement on Renewable Energy Technology Deployment (IEA-RETD), 2012.

Table 3 CAPEX of RE technologies (USD/kW)

	EU28	BG	FR	DE	IE	IT	NL	PL	RO	ES	SE
Wind onshore	1.690	1.690	1.677	1.833	1.690	1.694	1.690	1.690	1.690	1.546	1.697
Wind offshore	4.021	4.021	4.021	4.021	4.021	4.021	4.021	4.021	4.021	4.021	4.021
Solar PV	1.113	1.113	1.180	1.070	1.113	1.090	1.113	1.113	1.113	1.113	1.113

Source: Authors' elaboration on IRENA (2018), Renewable Power Generation Costs in 2017, International Renewable Energy Agency, Abu Dhabi.

Table 4 OPEX of RE technologies (USD/kW)

	EU28	BG	FR	DE	IE	IT	NL	PL	RO	ES	SE
Wind onshore	56	56	56	56	56	56	56	56	56	56	56
Wind offshore	153	153	153	153	153	153	153	153	153	153	153
Solar PV	18	18	18	18	18	18	18	18	18	18	18

Source: Authors' elaboration on IRENA (2018), Renewable Power Generation Costs in 2017, International Renewable Energy Agency, Abu Dhabi.

- Based on the detailed cost breakdown of single renewable technologies provided by IRENA Renewable Cost Database and NREL, **the total capital and operating expenses were broken down into the productive sectors included in the inter-industry transactions tables**. Country-specific data were used for solar PV in the case of Germany, Italy and France. Average values were estimated for other countries and other renewable technologies based on European data (see Box 2).

Box 2 Cost breakdown of onshore and offshore wind farms and solar PV power plants in Germany

By way of example, the following tables provide the cost breakdown of onshore wind farms, offshore wind farms and solar PV power plants in Germany as well as the allocation of different cost items to sectors included in I-O tables.

Table 5 Detailed cost breakdown of onshore wind farms (2016)

Cost category	Cost sub-category	Cost shares	Allocation to sectors of I-O
Construction of WPP			
Planning & miscellaneous		6.36%	M71 Architectural and engineering activities; technical testing and analysis
Wind turbines	Manufacture of WT towers	17.32%	C25 Manufacture of fabricated metal products, except machinery and equipment
	Manufacture of WT nacelles	36.10%	C28 Manufacture of machinery and equipment n.e.c.
	Manufacture of WT rotor blades	21.60%	C22 Manufacture of rubber and plastic products
Foundation		4.49%	F Construction
Development		2.75%	M71 Architectural and engineering activities; technical testing and analysis
Connection to the grid		4.89%	C27 Manufacture of electrical equipment
Other	Assembly of WPP	3.00%	C33 Repair and installation of machinery and equipment
	Construction Finance	3.50%	K64 Financial service activities, except insurance and pension funding

O&M of WPP			
Operations		29,40%	D35 Electricity, gas, steam and air conditioning supply
Land lease cost		15,67%	L68 Real estate activities
Maintenance		54,93%	C33 Repair and installation of machinery and equipment

Source: Authors' elaboration on IRENA (2018), Renewable Power Generation Costs in 2017, International Renewable Energy Agency, Abu Dhabi.

Table 6 Detailed cost breakdown of offshore wind farms (2016)

Cost category	Cost sub-category	Cost shares	Allocation to sectors of I-O
Construction of WPP			
Planning & miscellaneous		12.70%	M71 Architectural and engineering activities; technical testing and analysis
Wind turbines		23.60%	C28 Manufacture of machinery and equipment n.e.c.
Foundation		34.10%	F Construction
Development		1.00%	M71 Architectural and engineering activities; technical testing and analysis
Connection to the grid		10.90%	C27 Manufacture of electrical equipment
Other	Assembly of WPP	11.30%	C33 Repair and installation of machinery and equipment
	Construction Finance	6.40%	K64 Financial service activities, except insurance and pension funding
O&M of WPP			
Operations		29,40%	D35 Electricity, gas, steam and air conditioning supply
Land lease cost		15,67%	L68 Real estate activities
Maintenance		54,93%	C33 Repair and installation of machinery and equipment

Source: Authors' elaboration on *IRENA (2018), Renewable Power Generation Costs in 2017, International Renewable Energy Agency, Abu Dhabi; NREL, National Renewable Energy Laboratory (2017), 2016 Cost of Wind Energy Review. Denver West Parkway: National Renewable Energy Laboratory, 2017. NREL/TP-6A20-70363*

Table 7 Detailed breakdown of utility-scale solar PV costs (2016)

Category	Subcategory	Cost shares	Allocation to sectors of I-O
Construction of SPVPP			
Hardware	Module	44.6%	C27 Manufacture of electrical equipment
	Inverter	10.0%	C27 Manufacture of electrical equipment
	Cabling / wiring	3.2%	C27 Manufacture of electrical equipment
	Grid connection	6.9%	C27 Manufacture of electrical equipment
	Monitoring and control	0.3%	C27 Manufacture of electrical equipment
	Racking and mounting	8.7%	C27 Manufacture of electrical equipment
	Safety and security	1.1%	C27 Manufacture of electrical equipment
Installation	Electrical installation	2.0%	C33 Repair and installation of machinery and equipment
	Inspection	0.2%	C33 Repair and installation of machinery and equipment
	Mechanical installation	7.2%	C33 Repair and installation of machinery and equipment
Soft costs	Customer acquisition	0.6%	M71 Architectural and engineering activities; technical testing and analysis
	Financing costs	0.6%	K64 Financial service activities, except insurance and pension funding
	Incentive application	0.0%	N Administrative and support service activities
	Margin	10.0%	n.a.
	Permitting	0.4%	N Administrative and support service activities
	System design	4.2%	M71 Architectural and engineering activities; technical testing and analysis
O&M of SPVPP			
Maintenance		45.0%	C33 Repair and installation of machinery and equipment
Land lease cost		18.0%	L68 Real estate activities
Local rates/taxes		15.0%	N Administrative and support service activities
Insurance		7.0%	K65 Insurance, reinsurance and pension funding, except compulsory social security
Site security and administration costs		4.0%	R_S Other service activities
Utilities		2.0%	D35 Electricity, gas, steam and air conditioning supply
Other		9.0%	R_S Other service activities

Source: Authors' elaboration on IRENA (2018), Renewable Power Generation Costs in 2017, International Renewable Energy Agency, Abu Dhabi.

- The largest share of the total investment cost for both wind and solar PV technologies refers to the cost of equipment. In order to estimate the local or national economic impacts of the renewable electricity development in a region or country, a critical issue is whether the equipment is manufactured domestically or imported from abroad, as this has a direct impact on the total level of domestic investment. **Trade effects** were therefore taken into account for each country by relying on PRODCOM data on sold production, namely imports and exports for the main types of manufactured products contained in RE technologies[18]. Following the methodology proposed by EurObserv'ER[19], **the ratio of installed equipment that is produced in each country was computed** (see Box 3). For instance, the percentage of net import over the total consumption in Germany can be estimated to be zero for wind turbines as well as for solar PV modules. Conversely, Ireland does not actually have significant manufacturing facilities of RE technologies and, as a result, it imported most of the manufacturing equipment necessary to install onshore and offshore wind farms as well as solar PV power plants.

Box 3 Methodology to estimate domestic production of RE technologies

According to EurObserv'ER, the percentage of (net) imports from other countries over the total consumption in each country can be computed as follows:

$$RatioImport_{MS_j,t} = \left(\frac{I_{MS_j,t} - E_{MS_j,t}}{INV_{MS_j,t}}\right)$$

where $I_{MS_j,t}$ are the total imports of the j Member State of the technology t; $E_{MS_j,t}$ are the total imports of the j Member State of the technology t, and $INV_{MS_j,t}$ are the total investment of the j Member State in the installed technology t. $INV_{MS_j,t}$ is calculated as the apparent consumption of the technology t, deriving from the difference between what is produced internally ($P_{MS_j,t}$) and imported ($I_{MS_j,t}$) and the exported amount ($E_{MS_j,t}$).

- Based on the above-mentioned research steps, **six I-O vectors were devised**: i) onshore wind farm CAPEX; ii) onshore wind farm OPEX; iii) offshore wind farm CAPEX; iv) offshore wind farm OPEX; v) solar PV power plant CAPEX; and vi) solar PV power plant OPEX. The new vectors report monetary transactions reflecting the relative weight of each item in the total costs (e.g. planning, components, engineering, etc.). More specifically, they show the overall direct needs of the solar and wind power industry (which are the inputs purchased from already existing sectors in the economy) generated by one MW of new renewable electricity capacity installed in a certain year.

- The potential socio-economic impacts of corporate sourcing of renewable electricity were estimated up to 2020 and 2030, based on different scenarios. These scenarios vary in relation to the underlying assumptions about corporate sourcing strategies and the resulting share of renewable electricity over the total electricity demand of industry and service sectors. More specifically, **the following three scenarios are considered**:

[18] By way of example, for the wind power industry, the following PRODCOM codes were considered: 28112400 for the wind turbine; 279900Z1 for the wind rotor blades; 25112200 for wind towers; 26514330, 26516370, and 26518550 for grid connection equipment, 26514330, 26516370, and 26518550 for monitoring and control equipment. For the solar PV industry, the following PRODCOM codes were considered: 26112240 for solar cells and PV modules; 24333000, 24422650, 24333000, and 24422650 for PV plant structures; 27116205 for the inverters; 26516370, 26516370, 26518550 for monitoring and control equipment.

[19] EurObserv'ER (2017), Renewable energy employment effects in the EU and the Member States. Methodology Report. Petten, The Netherlands: ECN, European Commission.

1. The **Lower Bound scenario** aims to provide a conservative estimate based on the most recent data about companies' strategies of RE sourcing and the assumption that they will continue to act in the same way. It was therefore assumed that active corporate sourcing of renewable electricity will amount to 3.5% of the additional electricity demand of industry and service sectors, which is the share recently reported by IRENA at the global level.[20] This provides a benchmark (baseline scenario) against which additional impacts can be measured.
2. The **Upper Bound scenario** was built on the assumption that all the additional renewable electricity capacity required to fulfil the projections included in the EU Reference Scenario 2016 of the EU Commission[21] will be funded via corporate sourcing. This scenario would require a commitment by EU based industrial and commercial companies to source renewable electricity in order to meet about 28% of their total demand of electricity (at the end of the period) and to ensure that such commitment generates additionality, i.e. new investments in renewable electricity. Hence, this scenario considers a scale-up of corporate sourcing activities in all selected countries.
3. The **Intermediate scenario** falls in between the two previous ones and assumes that half of the total new additional renewable electricity capacity required in the EU will be funded via corporate sourcing. This is equivalent to say that about 16% of the total demand for electricity by industry and service sectors in 2030 will rely on active corporate sourcing of renewable electricity.

- The **additional generation capacity required in 2020, 2025 and 2030**, for each Member State, were estimated by relying on the projections included in the EU Reference Scenario 2016 of the EU Commission:[22]
    - In the **Lower Bound scenario**, the additional renewable electricity capacity to be installed in the 10 selected countries up to 2030 was based on the projections of the electricity demand of industry and service sectors. More specifically, the generation capacity needed to produce the additional quantity of renewable electricity demanded via active corporate sourcing (i.e. the 3.5% of the net increase in electricity demand of industry and service sectors) was estimated by considering the current generation portfolio in the 10 selected countries and employing the average capacity factor for different renewable technologies as provided by the DG ENER. It was assumed that the generation mix will not vary over the period under analysis.
    - In the **Upper Bound and Intermediate scenario**, the additional renewable generation capacity (both wind and solar PV) and the corresponding net increase in gross electricity generation was directly based on the estimates provided by the EU Reference Scenario 2016. The current generation portfolio in the 10 selected countries was then used to further identify the relative share of on-shore and off-shore wind and it was assumed that such shares will not vary over the period under analysis.

- I-O tables were then used to estimate the **socio-economic impact in terms of GVA and employment** resulting from the required additional investments in on-

[20] IRENA (2018), Corporate sourcing of renewables: market and industry trend – REmade Index 2018. International Energy Agency. Abu Dhabi, UAE.
[21] For further details, please see: https://ec.europa.eu/energy/en/data-analysis/energy-modelling
[22] Ibid.

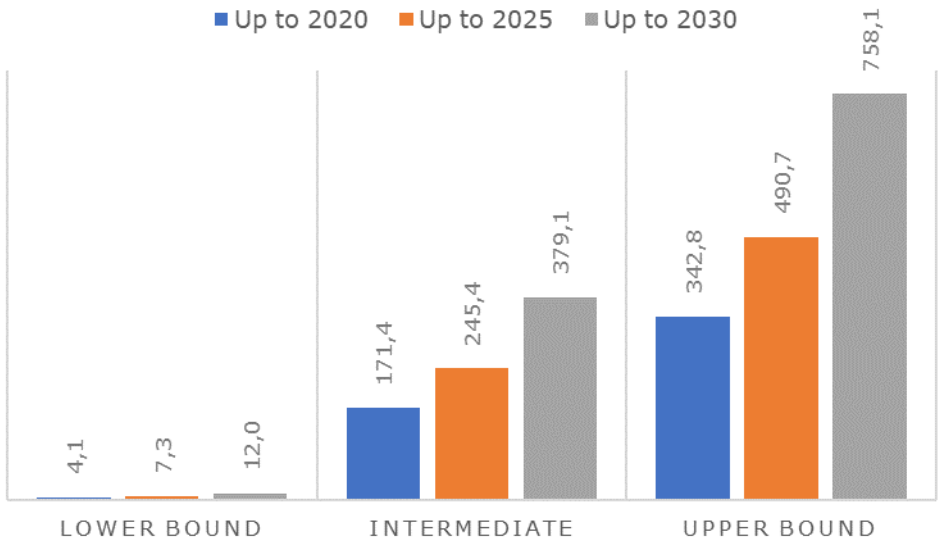
shore wind, off-shore wind and solar PV capacity. Estimates were computed in each scenario and for three different time periods: up to 2020, up to 2025 and up to 2030.

5 Total job creation and Gross Value Added from corporate sourcing of renewable electricity in 2020 and 2030

5.1 GVA of RE corporate sourcing investments

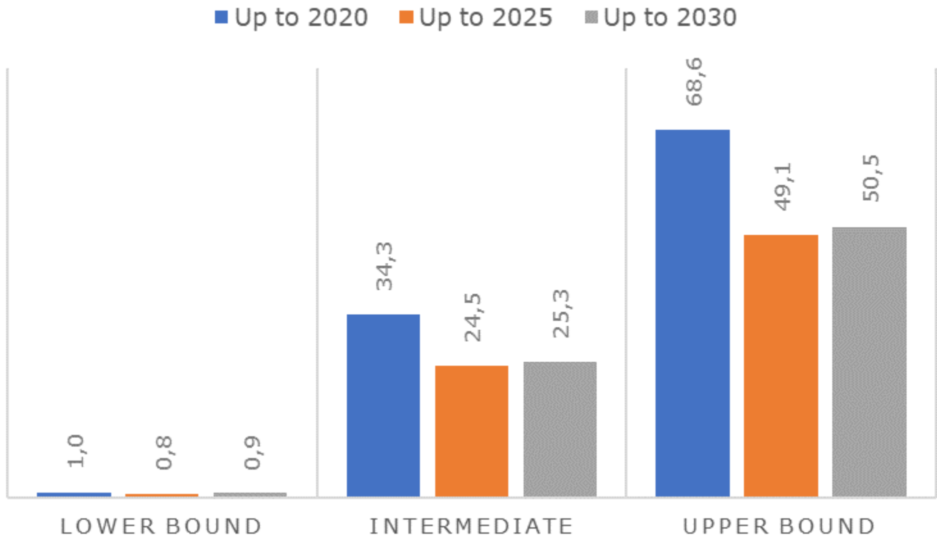
The following results are based on the gross I-O approach applied in the 10 selected countries. The cumulative GVA stemming from manufacturing, construction, O&M of renewable electricity linked to corporate sourcing was estimated to range between €12 billion (in the Lower Bound scenario) and €758 billion (in the Upper Bound scenario) by 2030. As can be seen in Figure 3, **the socio-economic impact in terms of GVA increases over time, reflecting the evolution of investments in new generation capacity**, which are mainly concentrated in the next few years. The yearly average effects in terms of GVA are estimated to range between €0.9 to €50.5 billion up to 2030, depending on the relevant scenario (see Figure 4).

Figure 3 Cumulative GVA generated by corporate sourcing of renewable electricity in 10 selected EU countries (billion euros)



Source: Authors' own elaboration.

Figure 4 GVA generated by corporate sourcing of renewable electricity in 10 selected EU countries (billion euros, yearly average)



Source: Authors' own elaboration.

More than one-third of the estimated GVA refers to activities such as manufacturing of the equipment, construction of the power plant, engineering and management, and O&M of the units, which are undertaken domestically and directly contribute to economic development as a result of corporate sourcing of renewable electricity.[23] **Indirect effects account for roughly 28% of the total GVA**; they relate to changes in GVA in sectors within the country that supply goods and services to the RE industries. Limiting to direct and indirect effects, the cumulative GVA impact varies between €6.4 billion, in the Lower Bound scenario, and more than €406 billion, in the Upper Bound scenario, by 2030. Finally, **the remaining share of the estimated overall GVA impact refers to induced effects**, which provide a measure of the economic impact stemming from the increased final consumption generated by the income earned in the RE technologies and supporting sectors.[24]

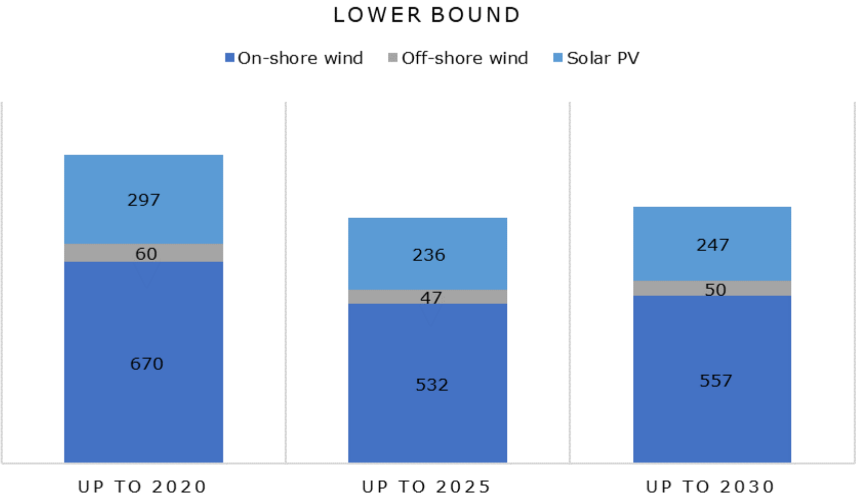
It is worth remarking that, while the economic impact of planning, engineering, investment and installation activities may be regarded as temporary, as those activities are limited in time, the socio-economic effects of O&M are permanent, at least for the economic life of RE plants. **Much of the economic impact is related to the investment and installation activities which amount, on average, to about 84% of the cumulative GVA estimated to be achieved by 2030 in the different scenarios.** Cumulative GVA generated by the O&M of wind farms and PV plants is estimated to be between €1.8 billion (Lower Bound scenario) and €129 billion (Upper Bound scenario).[25]

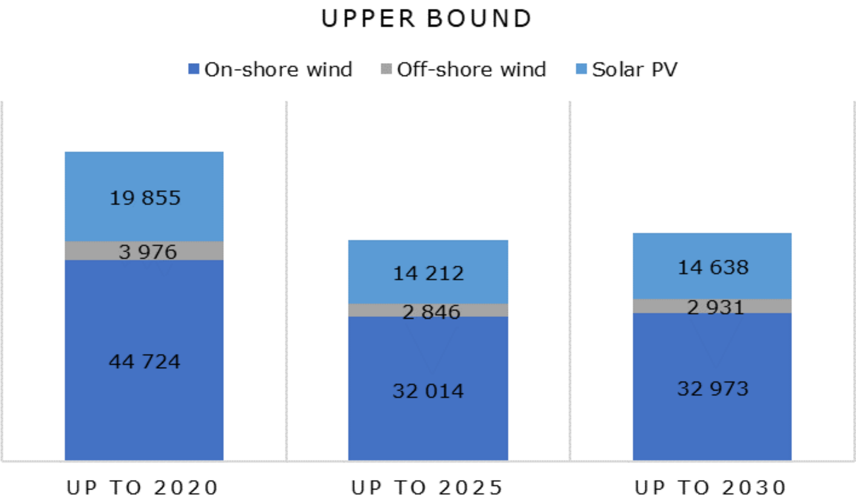
About two-thirds of the yearly average estimated GVA up to 2030 can be attributed to on-shore wind power, although the relative weight of each renewable technology is different among the selected countries. The estimated results depend on both the amount of investments made in different technologies (for instance, Northern European countries have invested sensibly more in on-shore and off-shore wind power

[23] Tourkolias C., Mirasgedis S. (2011), Quantification and monetization of employment benefits associated with renewable energy technologies in Greece. Renew Sustain Energy Rev, 15(6), p. 2876–86.
[24] Induced effects are those related to the increased consumption for purchasing goods and services by RE and supporting industries employees deriving from the growth in available income for spending.
[25] These figures do not include operational and maintenance activities for already existing plants but only account for the activities related to new plants.

in comparison to other countries) and the domestic production and trade flows of RE equipment.

Figure 5 GVA generated by corporate sourcing of renewable electricity by technology in 10 selected EU countries (million euros, yearly average)





Source: Authors' own elaboration.

Country-level data are reported in Appendix A. In terms of geographical distribution, **Germany remains the European leader representing on average about 37% of the estimated GVA.** Other than the sustained increase in industrial and commercial electricity consumption and renewable capacity additions over the entire period considered, these results can be also explained by the strong manufacturing industrial base including a flourishing domestic equipment manufacturing sectors both in the wind and solar industries.[26] France lags behind, as it was responsible both in the *Intermediate* and *Upper Bound* scenarios for another 36% of the estimated GVA on average. It is worth noting that, in the recent past, investments in new plants for the production of renewable electricity have generally decreased, especially after the downward revision of support schemes in various EU countries.[27] **A shift from large to small plants has been generally observed**, though in the wind sector there was an increase in newly created offshore capacity. The investments were concentrated in

[26] EurObserv'ER (2018), The state of renewable energies in Europe. Edition 2017. 17th Report. Paris.
[27] EurObserv'ER (2018), The state of renewable energies in Europe. Edition 2017. 17th Report. Paris.

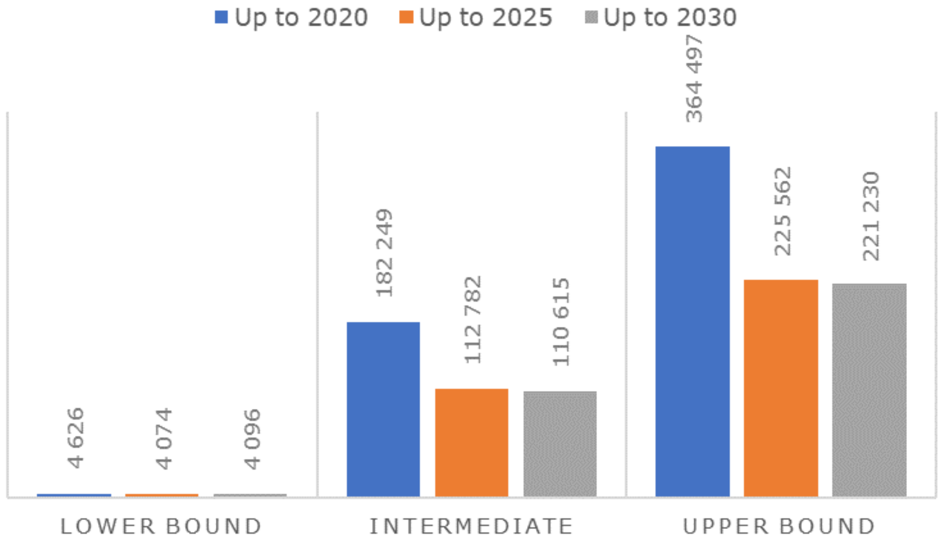
few countries, such as Germany, Ireland, Netherlands and Sweden. In these countries, the cumulative GVA was estimated to be in the range of €0.7 to more than €27.5 billion up to 2030, depending on the scenario.

Overall, the estimated figures are in line with the concentration of socio-economic impacts, which has been extensively documented in the studies presented in Table 1.

5.2 The employment effects of RE corporate sourcing

In what follows, the direct, indirect and induced employment effects associated with corporate sourcing of renewable electricity are estimated. Based on the gross I-O approach, the yearly average employment effects associated with the development and operation of solar and wind power technologies in the selected countries are estimated to range between roughly 4,630 and 221,230 jobs up to 2030 depending on the scenario (see Figure 6)[28]. **Estimated direct and indirect yearly gross employment amount to 2,520, 68,100 and 136,190 jobs in the Lower, Intermediate and Upper Bound scenario**, respectively. **Induced employment effects represent about 38% of the total additional jobs**.

Figure 6 Gross employment generated by corporate sourcing of renewable electricity in 10 selected EU countries (number of jobs, yearly average)



Source: Authors' own elaboration.

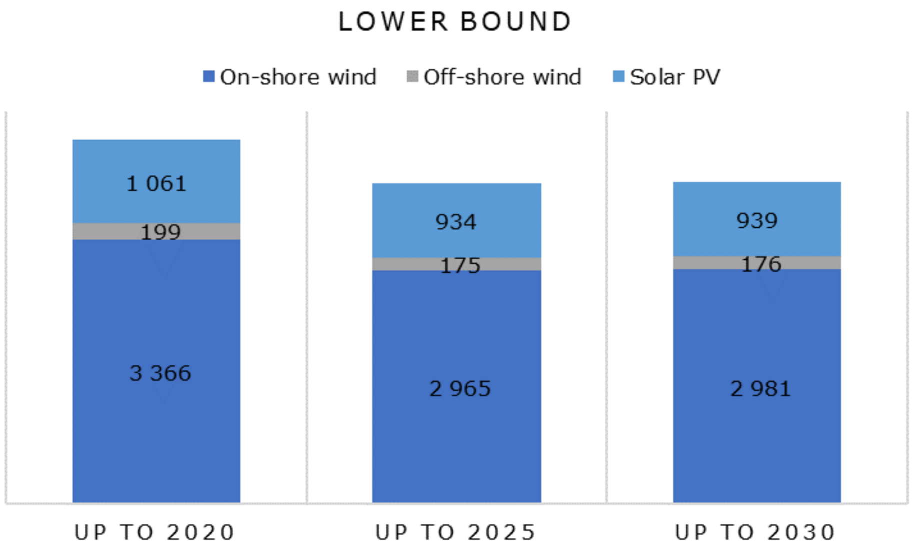
As previously noted, jobs generated by the construction and installation of RE plants should be regarded as temporary, as they depend on the amount of investments made in a given year. Conversely, jobs related to the O&M of RE are considered to be permanent over time, as they last throughout the entire economic life Figure 3of the power plant. The higher the cumulative installed RE generation capacity is, the greater the number of jobs related to the corresponding O&M activities will be.

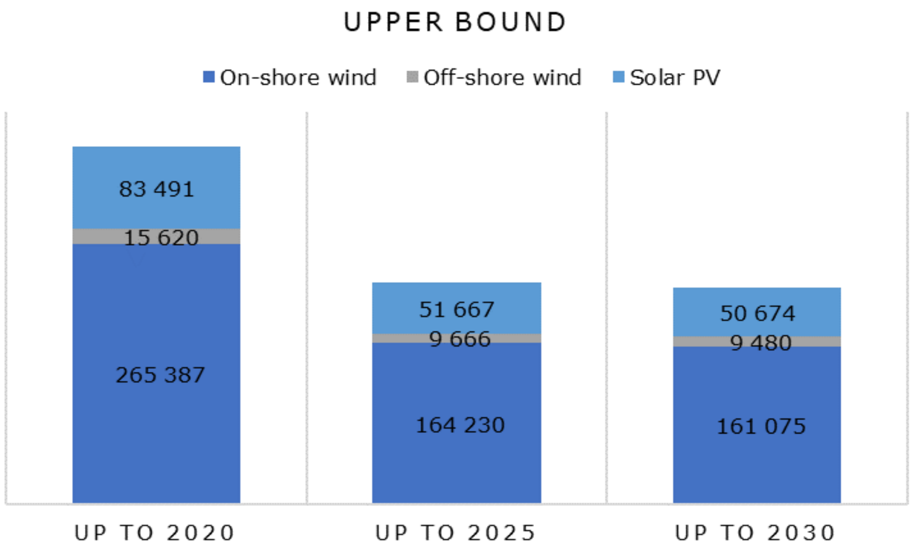
As expected, **the estimated gross employment effects are mainly related to the wind sector, particularly onshore wind** (see Figure 7). Overall, the onshore wind sector is expected to contribute about 73% of the total employment effects. Conversely, the offshore wind is expected to account for 4% of the total employment effects. Investments related to corporate sourcing of solar PV electricity will generate

[28] For an overview of sources and methods used to estimate total employment, see Gouma R., Chen W., Woltjer P, Timmer M. (2018), WIOD Socio-Economic Accounts 2016. Sources and Methods, January.

additional jobs equivalent to 23% of the total additional employment linked to corporate sourcing of renewable electricity.

Figure 7 Gross employment generated by corporate sourcing of renewable electricity in selected countries, by RE technology (number of jobs, yearly average)





Source: Authors' own elaboration.

Country-level data are reported in Appendix B. As mentioned, socio-economic impact and especially employment remains highly concentrated in a certain number of countries. When considering the **employment effects** related to corporate sourcing of renewable electricity in the 10 selected EU countries, the picture is substantially similar to GVA with regard to the geographical distribution of additional jobs: Germany, Poland, France, Italy and Spain represent on average about 87% of the generated employment. In the other countries covered by the Study, only minimum employment effects can be estimated as a result of limited corporate electricity demand, limited investments in renewable technologies, and weak RE equipment industry.

A. Appendix: Cumulative Gross Value Added by country

Table 8. GVA generated by corporate sourcing of renewable electricity by country (Lower Bound scenario, million euros, yearly average)

	2020	2025	2030
Bulgaria	3	10	12
Germany	321	315	337
Spain	-	-	-
France	197	105	213
Ireland	1	2	3
Italy	319	56	162
Netherlands	29	24	25
Poland	59	83	102
Romania	40	21	26
Sweden	58	29	43
TOTAL	1.027	646	924

Source: Authors' own elaboration.

Table 9. GVA generated by corporate sourcing of renewable electricity by country (Intermediate scenario, million euros, yearly average)

	2020	2025	2030
Bulgaria	10	493	825
Germany	16,155	2,414	8,946
Spain	1,188	1,683	3,825
France	14,319	4,955	8,104
Ireland	136	67	142
Italy	382	3,006	2,595
Netherlands	1,731	424	849
Poland	158	930	446
Romania	27	233	574
Sweden	171	590	432
TOTAL	34,277	14,795	26,740

Source: Authors' own elaboration.

Table 10. GVA generated by corporate sourcing of renewable electricity by country (Upper Bound scenario, million euros, yearly average)

	2020	2025	2030
Bulgaria	20	985	1,650
Germany	32,310	4,829	17,892
Spain	2,376	3,367	7,650
France	28,637	9,910	16,209

	2020	2025	2030
Ireland	272	135	285
Italy	765	6,012	5,191
Netherlands	3,463	849	1,697
Poland	316	1,859	892
Romania	54	466	1,149
Sweden	342	1,179	865
TOTAL	68,554	29,591	53,480

Source: Authors' own elaboration.

Table 11. On-shore wind - GVA generated by corporate sourcing of renewable electricity by country (Lower Bound scenario, million euros, yearly average)

	2020	2025	2030
Bulgaria	1	3	6
Germany	197	194	207
Spain	-	-	-
France	165	87	176
Ireland	1	2	3
Italy	137	27	75
Netherlands	8	8	10
Poland	56	80	98
Romania	10	7	12
Sweden	51	26	38
TOTAL	625	433	626

Source: Authors' own elaboration.

Table 12. On-shore wind - GVA generated by corporate sourcing of renewable electricity by country (Intermediate scenario, million euros, yearly average)

	2020	2025	2030
Bulgaria	3	296	386
Germany	10,366	920	4,830
Spain	803	415	1,993
France	10,675	3,503	6,881
Ireland	127	65	138
Italy	3	1,998	1,933
Netherlands	481	195	389
Poland	143	929	437
Romania	2	232	255
Sweden	151	524	387
TOTAL	22,752	9,077	17,630

Source: Authors' own elaboration.

Table 13. On-shore wind - GVA generated by corporate sourcing of renewable electricity by country (Upper Bound scenario, million euros, yearly average)

	2020	2025	2030
Bulgaria	6	591	773
Germany	20,732	1,840	9,661
Spain	1,606	830	3,986
France	21,349	7,006	13,761
Ireland	253	131	276
Italy	6	3,997	3,866
Netherlands	962	389	779
Poland	285	1,857	874
Romania	3	464	510
Sweden	301	1,048	775
TOTAL	45,503	18,154	35,261

Source: Authors' own elaboration.

Table 14. Off-shore wind - GVA generated by corporate sourcing of renewable electricity by country (Lower Bound scenario, million euros, yearly average)

	2020	2025	2030
Bulgaria	-	-	-
Germany	30	31	36
Spain	-	-	-
France	-	-	-
Ireland	0	0	0
Italy	-	-	-
Netherlands	15	12	11
Poland	-	-	-
Romania	-	-	-
Sweden	6	3	4
TOTAL	52	46	51

Source: Authors' own elaboration.

Table 15. Off-shore wind - GVA generated by corporate sourcing of renewable electricity by country (Intermediate scenario, million euros, yearly average)

	2020	2025	2030
Bulgaria	-	-	-
Germany	1,598	218	899
Spain	-	-	-
France	-	-	-
Ireland	8	2	4
Italy	-	-	-
Netherlands	869	154	309

	2020	2025	2030
Poland	-	-	-
Romania	-	-	-
Sweden	19	66	45
TOTAL	2,495	440	1,256

Source: Authors' own elaboration.

Table 16. Off-shore wind - GVA generated by corporate sourcing of renewable electricity by country (Upper Bound scenario, million euros, yearly average)

	2020	2025	2030
Bulgaria	-	-	-
Germany	3,197	437	1,797
Spain	-	-	-
France	-	-	-
Ireland	17	4	8
Italy	-	-	-
Netherlands	1,739	309	617
Poland	-	-	-
Romania	-	-	-
Sweden	38	131	90
TOTAL	4,990	880	2,512

Source: Authors' own elaboration.

Table 17. Solar PV - GVA generated by corporate sourcing of renewable electricity by country (Lower Bound scenario, million euros, yearly average)

	2020	2025	2030
Bulgaria	2	7	6
Germany	93	90	95
Spain	-	-	-
France	32	18	37
Ireland	0	0	0
Italy	183	29	87
Netherlands	5	4	4
Poland	3	4	4
Romania	30	13	13
Sweden	1	0	1
TOTAL	349	166	247

Source: Authors' own elaboration.

Table 18. Solar PV - GVA generated by corporate sourcing of renewable electricity by country (Intermediate scenario, million euros, yearly average)

	2020	2025	2030
Bulgaria	7	197	438
Germany	4,191	1,276	3,217
Spain	385	1,268	1,832
France	3,644	1,452	1,224
Ireland	1	0	1
Italy	379	1,007	662
Netherlands	381	75	151
Poland	15	1	9
Romania	25	1	319
Sweden	1	0	0
TOTAL	9,030	5,279	7,854

Source: Authors' own elaboration.

Table 19. Solar PV - GVA generated by corporate sourcing of renewable electricity by country (Upper Bound scenario, million euros, yearly average)

	2020	2025	2030
Bulgaria	14	394	877
Germany	8,381	2,552	6,434
Spain	770	2,537	3,664
France	7,288	2,904	2,447
Ireland	2	1	1
Italy	759	2,015	1,325
Netherlands	762	151	302
Poland	31	2	18
Romania	51	2	639
Sweden	2	0	0
TOTAL	18,060	10,557	15,707

Source: Authors' own elaboration.

B. Appendix: Gross employment by country

Table 20. Gross employment generated by corporate sourcing of renewable electricity by country (Lower Bound scenario, number of jobs, yearly average)

	2020	2025	2030
Bulgaria	4	15	21
Germany	2,869	2,726	2,717
Spain	-	-	-
France	421	235	486
Ireland	0	1	1
Italy	783	118	358
Netherlands	36	26	21
Poland	339	440	440
Romania	137	65	73
Sweden	37	16	21
TOTAL	4,626	3,641	4,136

Source: Authors' own elaboration.

Table 21. Gross employment generated by corporate sourcing of renewable electricity by country (Intermediate scenario, number of jobs, yearly average)

	2020	2025	2030
Bulgaria	14	915	1,339
Germany	147,052	11,851	63,565
Spain	2,239	2,280	7,320
France	29,140	11,981	22,280
Ireland	42	3	8
Italy	584	8,977	7,608
Netherlands	2,096	284	569
Poland	895	5,335	1,464
Romania	77	1,321	1,903
Sweden	109	367	226
TOTAL	182,249	43,314	106,282

Source: Authors' own elaboration.

Table 22. Gross employment generated by corporate sourcing of renewable electricity by country (Upper Bound scenario, number of jobs, yearly average)

	2020	2025	2030
Bulgaria	29	1,830	2,679
Germany	294,105	23,701	127,131
Spain	4,478	4,559	14,640
France	58,280	23,962	44,559

	2020	2025	2030
Ireland	85	6	15
Italy	1,168	17,955	15,216
Netherlands	4,191	569	1,138
Poland	1,790	10,671	2,927
Romania	155	2,642	3,807
Sweden	217	734	451
TOTAL	364,497	86,629	212,564

Source: Authors' own elaboration.

Table 23. On-shore wind - Gross employment generated by corporate sourcing of renewable electricity by country (Lower Bound scenario, number of jobs, yearly average)

	2020	2025	2030
Bulgaria	2	7	14
Germany	1,982	1,850	1,772
Spain	-	-	-
France	383	195	394
Ireland	0	1	0
Italy	507	57	192
Netherlands	9	6	5
Poland	328	425	425
Romania	55	29	37
Sweden	28	12	16
TOTAL	3,294	2,584	2,855

Source: Authors' own elaboration.

Table 24. On-shore wind - Gross employment generated by corporate sourcing of renewable electricity by country (Intermediate scenario, number of jobs, yearly average)

	2020	2025	2030
Bulgaria	7	709	861
Germany	104,078	2,921	35,803
Spain	1,865	791	4,219
France	24,832	7,677	14,942
Ireland	38	3	7
Italy	12	7,414	6,413
Netherlands	514	53	106
Poland	839	5,331	1,428
Romania	9	1,319	1,043
Sweden	83	283	177
TOTAL	132,279	26,501	65,000

Source: Authors' own elaboration.

Table 25. On-shore wind - Gross employment generated by corporate sourcing of renewable electricity by country (Upper Bound scenario, number of jobs, yearly average)

	2020	2025	2030
Bulgaria	15	1,418	1,722
Germany	208,157	5,843	71,606
Spain	3,730	1,582	8,439
France	49,664	15,354	29,885
Ireland	77	5	14
Italy	23	14,829	12,826
Netherlands	1,028	106	211
Poland	1,679	10,661	2,857
Romania	18	2,638	2,087
Sweden	166	565	353
TOTAL	264,557	53,002	130,001

Source: Authors' own elaboration.

Table 26. Off-shore wind - Gross employment generated by corporate sourcing of renewable electricity by country (Lower Bound scenario, number of jobs, yearly average)

	2020	2025	2030
Bulgaria	-	-	-
Germany	400	375	362
Spain	-	-	-
France	-	-	-
Ireland	0	0	0
Italy	-	-	-
Netherlands	25	17	10
Poland	-	-	-
Romania	-	-	-
Sweden	9	4	4
TOTAL	434	395	376

Source: Authors' own elaboration.

Table 27. Off-shore wind - Gross employment generated by corporate sourcing of renewable electricity by country (Intermediate scenario, number of jobs, yearly average)

	2020	2025	2030
Bulgaria	-	-	-
Germany	21,000	675	7,397
Spain	-	-	-
France	-	-	-
Ireland	4	0	0

	2020	2025	2030
Italy	-	-	-
Netherlands	1,447	42	84
Poland	-	-	-
Romania	-	-	-
Sweden	25	85	49
TOTAL	22,475	802	7,529

Source: Authors' own elaboration.

Table 28. Off-shore wind - Gross employment generated by corporate sourcing of renewable electricity by country (Upper Bound scenario, number of jobs, yearly average)

	2020	2025	2030
Bulgaria	-	-	-
Germany	42,000	1,351	14,793
Spain	-	-	-
France	-	-	-
Ireland	7	0	1
Italy	-	-	-
Netherlands	2,893	84	167
Poland	-	-	-
Romania	-	-	-
Sweden	50	169	97
TOTAL	44,951	1,604	15,059

Source: Authors' own elaboration.

Table 29. Solar PV - Gross employment generated by corporate sourcing of renewable electricity by country (Lower Bound scenario, number of jobs, yearly average)

	2020	2025	2030
Bulgaria	2	7	7
Germany	487	501	583
Spain	-	-	-
France	38	40	91
Ireland	0	0	0
Italy	276	60	166
Netherlands	2	3	7
Poland	11	14	15
Romania	82	36	36
Sweden	0	0	0
TOTAL	898	662	905

Source: Authors' own elaboration.

Table 30. Solar PV - Gross employment generated by corporate sourcing of renewable electricity by country (Intermediate scenario, number of jobs, yearly average)

	2020	2025	2030
Bulgaria	7	206	478
Germany	21,974	8,254	20,366
Spain	374	1,489	3,101
France	4,308	4,304	7,337
Ireland	0	0	0
Italy	572	1,563	1,195
Netherlands	135	190	380
Poland	56	5	35
Romania	68	2	860
Sweden	0	0	0
TOTAL	27,495	16,012	33,752

Source: Authors' own elaboration.

Table 31. Solar PV - Gross employment generated by corporate sourcing of renewable electricity by country (Upper Bound scenario, number of jobs, yearly average)

	2020	2025	2030
Bulgaria	14	411	956
Germany	43,948	16,508	40,732
Spain	748	2,977	6,202
France	8,615	8,607	14,674
Ireland	0	0	0
Italy	1,145	3,126	2,390
Netherlands	270	380	760
Poland	111	10	70
Romania	137	4	1,720
Sweden	1	0	1
TOTAL	54,989	32,024	67,505

Source: Authors' own elaboration.