Solar Photovoltaics Jobs & Value Added in Europe

November 2015
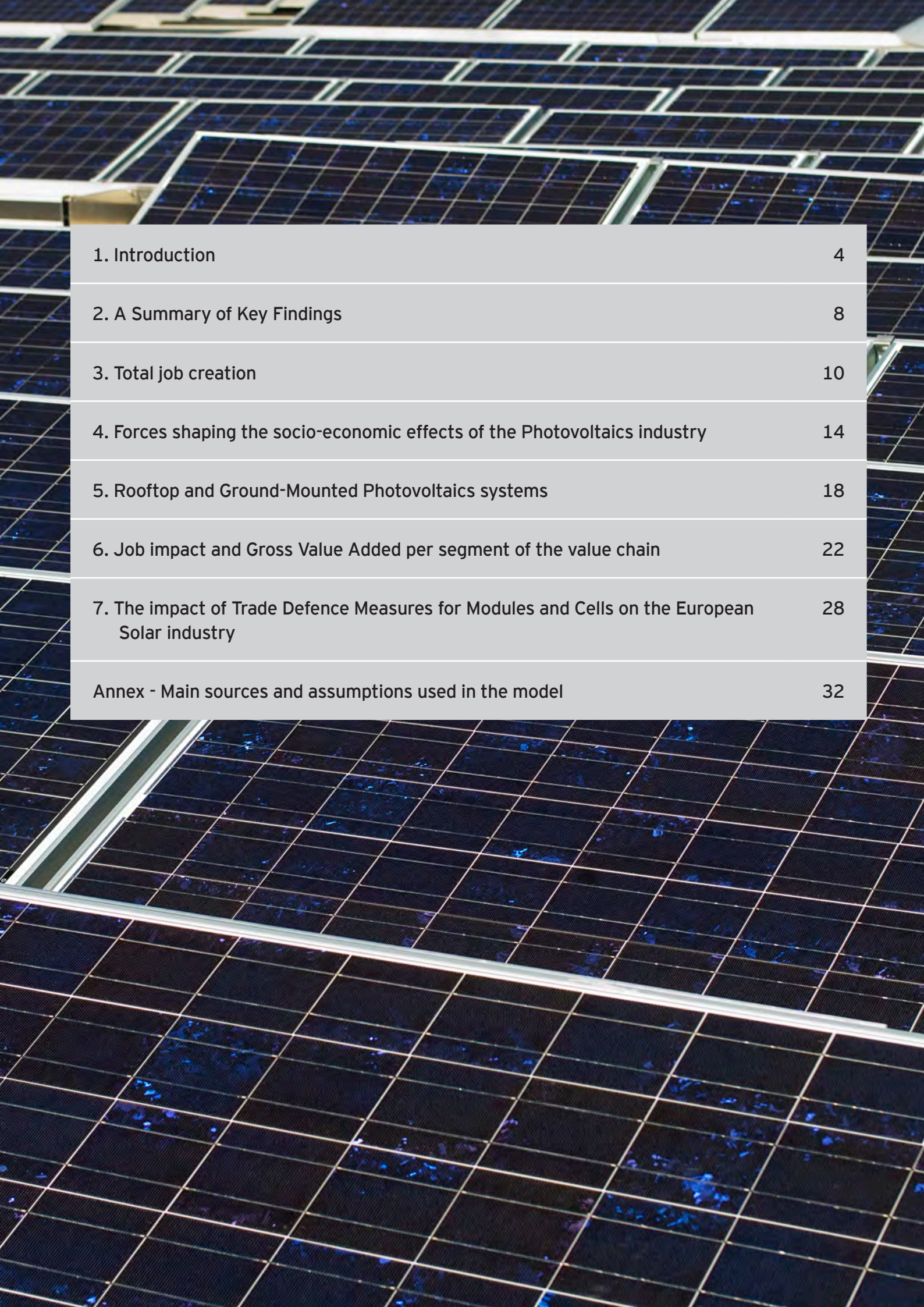
EY
Building a better working world

SolarPower Europe

This study is commissioned by SolarPower Europe.

1. Introduction

Objective of the study

Solar power has undoubtedly been praised as a promising technology to address a number of important energy challenges for policymakers and society. Solar power is also recognized as an important contributor to economic growth within the European Union (EU). The highest advantage of the use of solar energy only becomes evident when all external factors – such as job creation and Value Added – are incorporated in a social impact analysis.

The current study wants to contribute to the policy process by making credible data at a European level more available.

The purpose of this study is to capture the socio-economic contribution of the solar power industry, by assessing its direct and indirect impact on job creation and Value Added (VA) in the EU - aggregated and per Member State. The analysis is split according to the solar power value chain - upstream and downstream.

One key issue that impacts the EU solar sector relates to international trade. The EU has agreed with Chinese manufacturers on a minimum import price (MIP) and annual import quota for modules and cells in December 2013. The agreement would be valid for a two-year period, and is thus due to expire end of 2015.

This study also assesses the impacts of the Minimum Import Prices (MIP) on employment in a targeted way, through modelling and comparing an alternative scenario without minimum import prices (MIP) with the baseline scenario, with the MIP, for 2 countries (Germany and Italy).

Methodology

The Input-Output model developed by EY allows assessing the socio-economic contribution of Renewable Energy Sources (RES) with regards to jobs and value added creation (direct and indirect) based on several input data.

The direct impacts are generated by capital and operational expenditures (CAPEX and OPEX) required to build and operate solar power equipment. Additionally, annual and cumulative installed capacities as well as domestic shares are taken into account.

Data is separated for each step of the solar power value chain and for rooftop (which includes residential, commercial and some industrial systems) and ground-mounted PV market segments. The indirect impacts are jobs supported by suppliers selling products or services to companies in the solar power value chain.

Indirect impacts in each segment of the value chain are calculated using national input-output tables sourced from Eurostat, which represent the structure of national economies. Each of the CAPEX and OPEX segments of the PV value chain is assimilated to the best fitting sector. The expenditure in each segment of the value chain is thereby "injected" into the input-output table, which then enables measuring, on average, how that expenditure is re-spent across the suppliers of the PV industry.

Scope

Data is specifically gathered for the key solar power markets in the EU: Germany, France, Spain, Italy, Belgium, UK, Greece. Results for other EU countries are obtained by extrapolation.
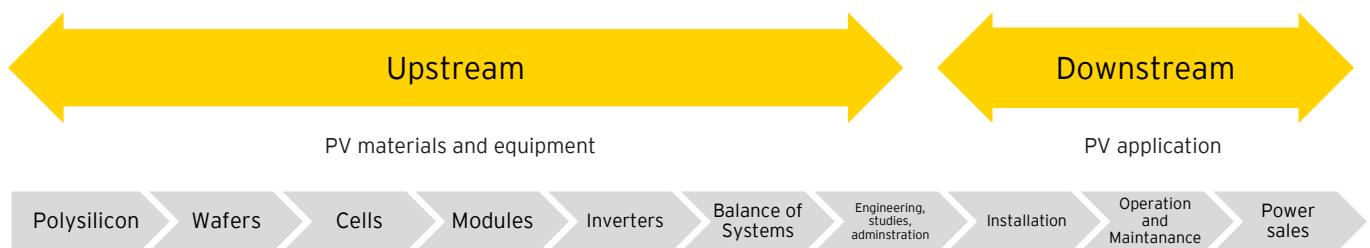
The analyses included crystalline-silicon (c-Si) and Thin-film (TF) technologies, which account for the largest share of the global PV market today.
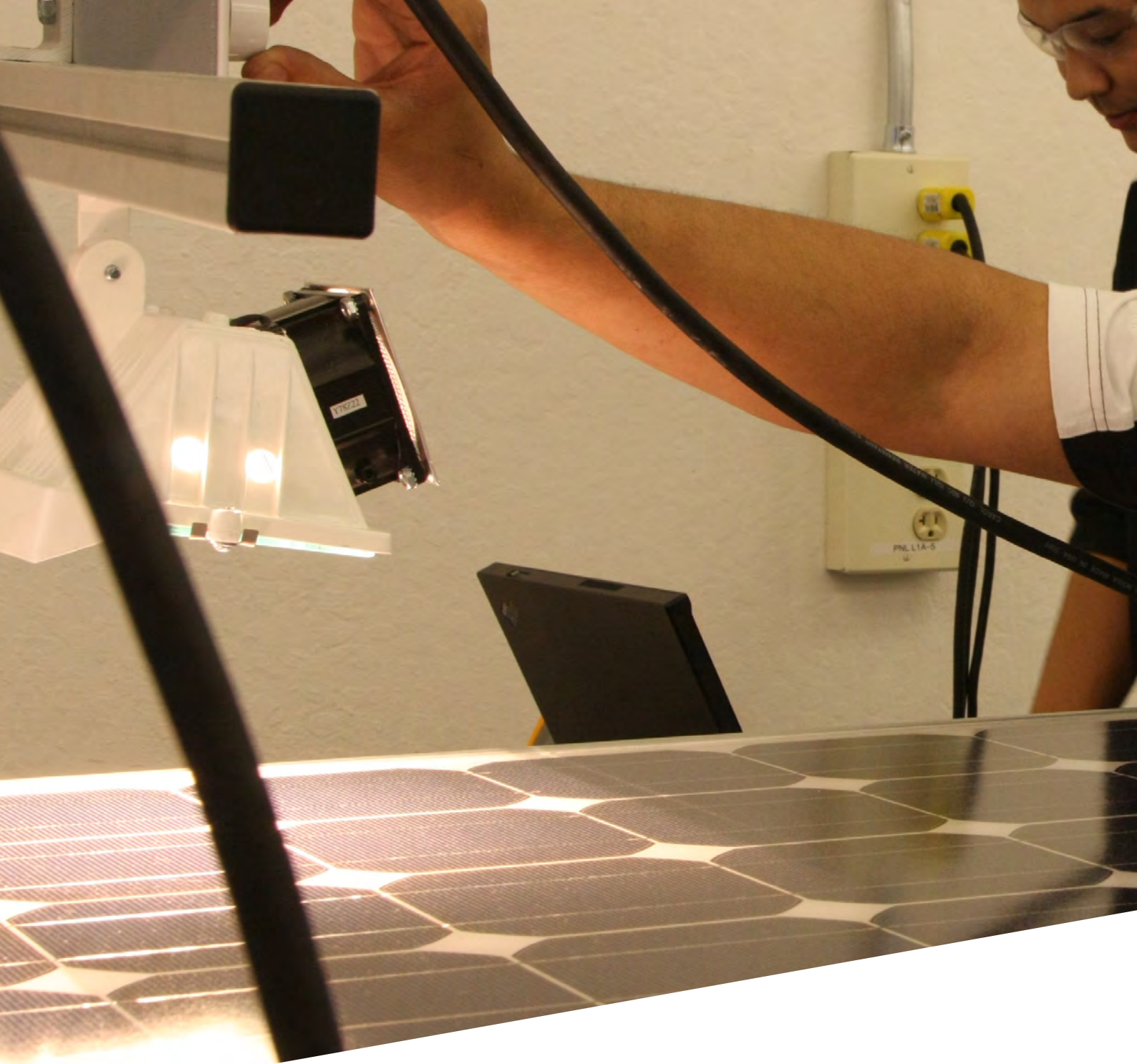
The timeframe for the analysis is 2008 to 2020. Taking into consideration that 95% of historical production occurred between 2007 (end of the polysilicon shortage) and today, 2008 is taken as the starting point for the study. 2020 is taken as an end-point for the forecasting, as too many uncertainties exist after that. Productivity gains to 2020 are reflected in unit costs.

All assumptions used in the model are set in a conservative way. A list of the assumptions and main sources used in the model are detailed in the annex and discussed throughout the report.

Break-out of the value chain

The main products and services in the solar power 'lifecycle' are captured in the value chain which is used in this model for gathering input data and presenting results. It starts with the raw material and module production and continues all the way to installation and operation. Equipment is integrated in the upstream value segments of relevance. Power sales are included in the downstream value segment.

Upstream	Downstream
PV materials and equipment	PV application

| Polysilicon | Wafers | Cells | Modules | Inverters | Balance of Systems | Engineering, studies, adminstration | Installation | Operation and Maintanance | Power sales |

2. A Summary of Key Findings

1. A large share of the jobs and of the value created by the PV industry are created in Europe.
2. The declining trends observed in 2014 (compared to 2008) are expected to be reversed in the short term, with increased job creation and GVA in 2020 already.
3. The removal of the MIP in December 2015 would have a positive effect on employment throughout the value chain in Europe. In such a scenario, 22,000 additional jobs could be created in Germany and Italy alone.

‣ Although the European Photovoltaic sector has been severely challenged in terms of installed capacities and turnover since 2011-2012, the sector continues to prove its socio-economic value in Europe, both in terms of job creation and Gross Value Added (GVA).

‣ In 2014, the PV sector in Europe represented nearly 110.000 full-time Equivalents (FTEs) and more than €5.600M GVA created.

‣ By 2020 it is expected to sustain more than 136.000FTE's and to generate nearly € 6.670M GVA on a European level.

‣ All countries, except the UK, had fewer jobs and a lower GVA in 2014 when comparing with the situation in 2011.

‣ Yearly installed capacities in the European countries clearly have a significant impact on job and GVA creation as there is a direct impact on less manufacturing and services needed.

‣ Only two countries (France and the UK) had significantly higher annually installed capacity in 2014 compared to 2008. Annually installed capacities from 2014 to 2020 are still expected to increase in all countries, although at a slower pace than before in the current scenario including trade defence measures.

‣ The average PV system price in Europe has decreased by 70% in 2014 compared to 2008. Although a lower unit cost makes PV systems more attractive, it also means less labor is needed for the same MW installed capacity. In addition, GVA decreases because a lower unit cost means fewer revenues per MW installed.

‣ Rooftop PV installations support almost 3 times as many jobs and GVA than Ground-Mounted installations. This can be explained by their installed capacities, unit cost per MW and labor needs for installation, maintenance and operations.

‣ Respectively 86% and 83% of the impact on jobs and GVA in 2014 is linked to the downstream activities of the PV value chain. Downstream activities of the PV value chain are more labor intensive than upstream activities. Particularly the sector of engineering, studies and administration shows less sensitivity to the downsizing of the PV market.

‣ The manufacturing of Balance of Systems (BoS) represent half of the upstream impact in jobs and GVA creation. In 2008, manufacturing of modules still created most of the upstream jobs, but this has clearly changed.

‣ Downstream, a strong growth for 2020 is expected of the share of Operations and Maintenance (O&M) in both jobs and GVA supported.

‣ An analysis of the impact of the expiry of the Minimum Import Prices (MIP) set by the EU on modules and cells imported in the EU, shows there would be positive employment effects throughout the PV value chain. The positive employment effects are higher downstream then upstream. This would be the result of a higher demand, following lower system prices.

3. Total job creation

Capturing the socio-economic impact of the PV industry, both Gross Value Added (GVA) and jobs are calculated. GVA is the economic added value which is created when producing a good or providing a service (M€). Jobs are the total amount of full-time equivalent (FTE) jobs created by the PV industry directly and indirectly. This study includes all market-relevant technologies, i.e. crystalline silicon and thin-film technology.

Both direct and indirect jobs and GVA are included. Direct jobs and GVA are related to the PV industry specifically (e.g. manufacturing of PV modules, installation and maintenance of PV systems…), while indirect jobs and GVA stem from supplying industries (e.g. transport, manufacturing of certain materials, professional services…).

Figure 1 shows that the level of jobs has declined in the EU solar sector since 2008 to 2014, but that modest growth is forecast under current conditions through to 2020. This is further elaborated in the table opposite.
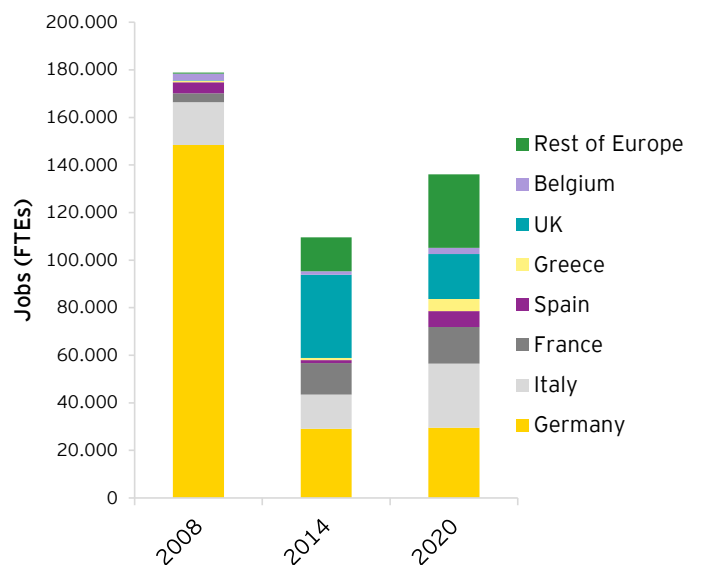

Figure 1: Direct and indirect jobs supported by the PV industry in EU 28

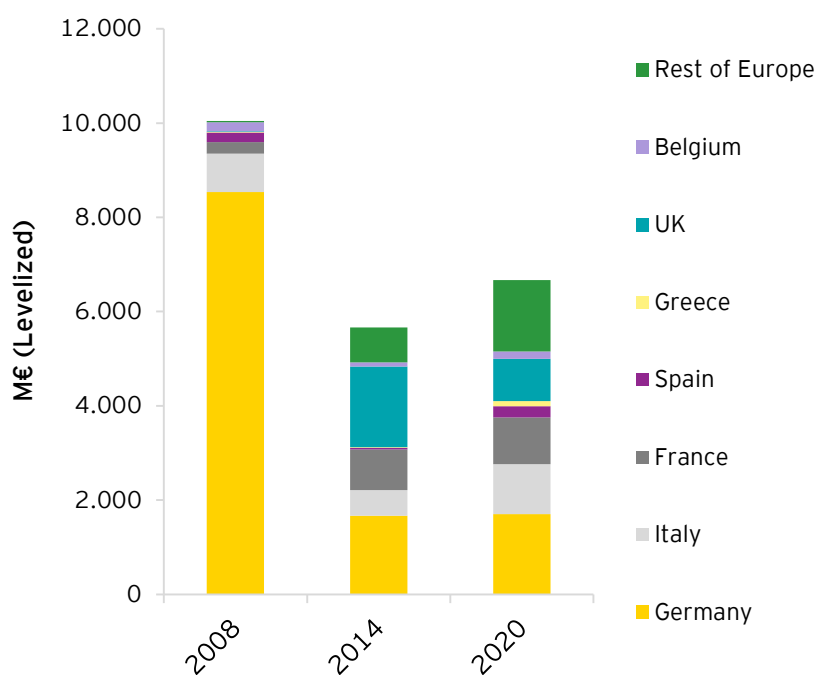| Total jobs per year (FTE)								
	EU 28	Belgium	UK	Greece	Spain	France	Italy	Germany	Rest of EU
2008	178.879	2.818	224	579	4.654	3.701	18.052	148.385	465
2014	109.650	1.456	35.049	891	1.177	13.338	14.304	29.131	14.304
2020	136.096	2.536	18.999	5.039	6.699	15.393	26.903	29.599	30.927

Figure 2: Direct and indirect GVA (Gross Added Value) created by the industry in EU 28

Likewise figure 2 shows that GVA has decreased from 2008 to 2014, with again a modest growth predicted for 2020, under the present conditions governing the solar sector in the EU. This is further demonstrated in the table below.

Gross Value Added (GVA) per year (M€)								
	EU 28	Belgium	UK	Greece	Spain	France	Italy	Germany	Rest of EU
2008	10.044	191	12	13	207	243	816	8.536	26
2014	5.662	89	1.710	16	33	864	541	1.671	739
2020	6.671	158	896	107	240	991	1.060	1.704	1.516

EU level

Up until 2011-2012, Europe has experienced a very strong PV market development. In 2008, the PV industry supported a total workforce of 178.879 FTEs and €10.044M in GVA. The PV market showed a constant growth between 2008 and 2011, when it reached its highest level in both job support and GVA. Since 2012, jobs and GVA in the PV industry have fallen. This results in 109.650 FTEs and €5.662M in GVA in 2014.

It is estimated that by 2020 the workforce and GVA will reach 136.096 FTEs and €6.671M GVA. This is an increase of 24% for FTE's and a 18% increase for GVA compared with 2014. The forecasts are made in a medium market scenario, reflecting the current market conditions.

Country level

Compared to the situation in 2008, the socio-economic contribution of the PV industry has fallen in most countries (Belgium, Germany, Italy and Spain). Only the UK and France experienced a significant increase in supported jobs and GVA in the same period of time. Germany, with the largest PV sector in 2008, suffered a significant market downturn. Although the cumulated capacity in Germany has continued to grow, it slowed down over the years. The annual installed capacity in 2014 is only 40% compared to the installed capacity of 2008. This results in an 80% decline of both jobs and GVA in 2014 compared to 2008.

In the UK, on the other hand, the PV industry boomed and grew exponentially since 2008 making it a leading player in the European solar industry in 2014.

4. Forces shaping the socio-economic effects of the Photovoltaics industry

Several forces define the socio-economic impact of the PV industry. We estimate that the most significant impacts on both job creation and GVA are: annual installed capacity, efficiency gains in manufacturing and services and the decline of incentive schemes for installation in Europe.

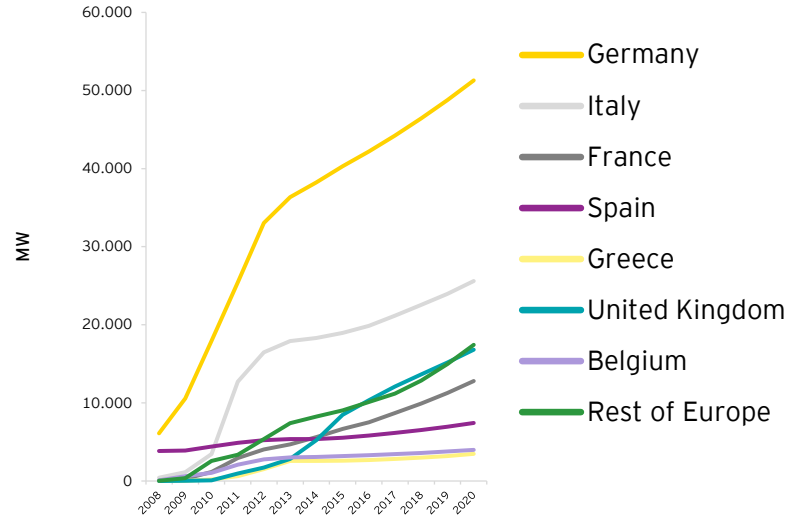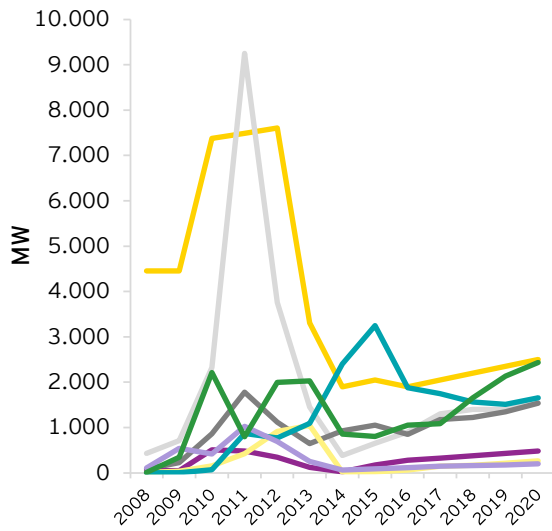## Annual and cumulative installed Capacity in evolution

Figure 3: Annual installed capacity (MW) per country per year

Figure 4: Cumulated installed capacity (MW) per country per year

	Annual Installed capacity (MW) per country							
	EU 28	Belgium	UK	Greece	Spain	France	Italy	Germany	Rest of EU
2008	5.158	109	7	11	52	80	432	4.454	13
2014	6.575	66	2.402	17	22	927	385	1.898	858
2020	10.725	199	1.656	264	482	1.538	1.650	2.500	2.437

	Cumulated installed capacity (MW) per country							
	EU 28	Belgium	UK	Greece	Spain	France	Italy	Germany	Rest of EU
2008	10.650	109	22	11	3.856	80	432	6.112	28
2014	86.762	3.104	5.231	2.596	5.388	5.632	18.313	38.235	8.263
2020	138.907	3.989	16.834	3.480	7.456	12.820	25.613	51.285	17.431

As Figure 3 shows, the European solar market progressed rapidly between 2008 and 2011: total installed capacity was 4 times higher in 2011 compared with 2008, which means 42.404MW were installed over three years. The solar market suffered a considerable slowdown in 2012-2013. Figure 4 demonstrates that as a result, cumulated capacity grew by 65% between 2011 and 2014. This means almost 9.000MW less were installed over the same timespan compared with 2008-2011. In 2014, the annual installed capacity was more than three times lower than annual installed capacity in 2011.

This decline is largely caused by regulatory changes in several countries (e.g. Belgium, Spain and Germany) where public policy has evolved to limit prosumers as a consequence of, for instance, grid fees and the reduction/termination of incentive schemes. In Spain for example, which had the second highest cumulated capacity in 2008, retroactive changes, solar taxes and fines for non-declared prosumers have considerably reduced solar installation. In 2014, Spain fell to the fourth place and it is estimated that it will only have the fifth largest cumulated capacity by 2020. Germany, Europe's largest PV industry, saw its annual installed capacity decrease due to reduced incentives, while module prices set at the MIP level could not follow this trend. This created market uncertainty.

Only two countries (France and the UK) had significantly higher annually installed capacity in 2014 compared to 2008. France continues to have a relatively small cumulative capacity installed compared to the other EU countries and job support and GVA have reduced since 2012-2013. The UK market has grown exponentially since 2011 and has become one of the main drivers of the European solar market, along with Germany and Italy. An important factor for the increase in the UK is the introduction of a feed-in tariff scheme in April 2010. It resulted in 869MW installed capacity in 2011, which was almost 13 times higher than the installed capacity in 2010.

The drop in the solar market results in less upstream and downstream activity and consequently, a decrease of jobs created and GVA. The only segment of the value chain that increased is operations and maintenance. Operation and maintenance activities are based on cumulated capacity rather than annually installed capacity and the demand for professional services for both new and existing PV installations has increased.

The effects of productivity gains on system prices

The average solar system price in Europe has decreased by 70% in 2014 compared to 2008. In 2014, the average price for rooftop systems (commercial, residential and industrial) was 1,7 €/W and for ground-mounted systems 1,0€/W. This is a significant decrease compared with 2008 (5,5 €/W in average for both rooftop and ground-mounted) and even 2011 (2,7 €/W for rooftop PV systems and 1,9€/W for ground-mounted).

This results in an average annual price decrease of 12% from 2008-2014. The price decline of solar products is mainly caused by increased efficiency and experience in the PV industry, partly the effect of more competition and a global production chain.

Although a lower unit cost and increased efficiency of modules makes solar PV systems more attractive, it also means less material and therefore labor is needed for the same MW installed capacity. In addition, GVA decreases because a lower unit cost which can mean fewer revenues per MW installed. This could have been offset with more installations in Europe. However, the installed capacity did not increase and productivity gains amplified the drop in jobs and GVA.

The effect of a globalized value chain

Cost reductions in solar systems are realized through the utilization of global value chains. The bulk of value added in the solar value chain remains in the EU, and the benefits of a globalized value chain support cost reductions in key components like modules and cells, which have been able to realise considerable efficiencies and economies of scale in Asia. In 2011 the demand peak in Germany and Italy generated a global over capacity that supported price decreases.

The full benefits of these cost reductions have not been realised in Europe, as imports of modules and cells have been limited since the end of 2013 due to the EU's trade defence measures, such as the MIP, without a noticeable increase in European production. Reduced prices have thus not been linked to increases in demand, which would normally be expected.

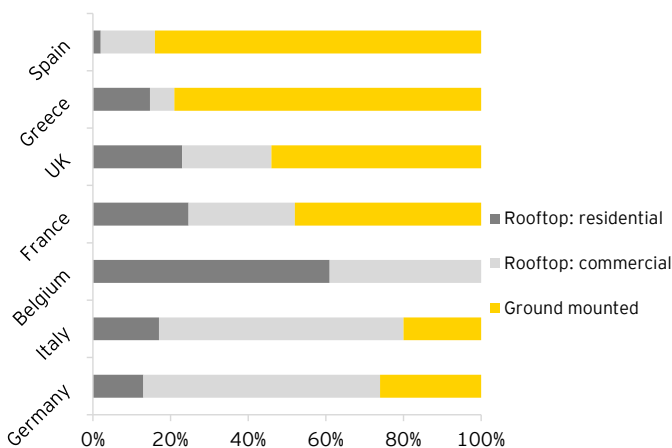# 5. Rooftop and Ground-Mounted Photovoltaics systems

Figure 5: Market shares per PV market segment in 2014

The solar PV market is divided in two market segments: rooftop (RT) and ground-mounted (GM). The rooftop market segment has residential, commercial and industrial applications while ground-mounted systems are mostly large scale utility installations. The division is very dependent on the individual country, as depicted in Figure 5. In Belgium, Italy and Germany, rooftop installations have the largest market share, while the opposite is true in Greece and Spain. For the UK and France, market segmentations between rooftop and ground-mounted are more balanced.

The European PV market has a very diverse segmentation per country, depending on:

‣ supporting schemes;
‣ the overall market context per country;
‣ profitability of investments in large PV solar plants.

In Spain, for example, high feed-in tariffs and high levels of sun irradiance (in the south of Spain twice as high as central Europe) made investments in grid connected large scale PV systems very profitable, which resulted in a sharp growth of ground-mounted PV installations in 2007-2008. The share of ground-mounted systems in the installed capacity in 2008 was almost 90%. However, slashed feed-in tariffs and a limitation on installed capacity made the share of the ground-mounted segment in the cumulated capacity decrease to almost 85% in 2014.

In Belgium, the ground-mounted market is almost non-existent, as PV installations >250kW are not promoted efficiently and the purchase price of injected electricity is not high enough to make investments in large solar plants profitable. Solar PV installations <250kW are supported with 'green certificates' and support schemes (e.g. tax incentives and VAT reduction), which explains the high level of residential solar rooftop installations.

Figure 6 outlines the split in jobs between the segments in the EU, with the rooftop segment supporting many more jobs than the ground-mounted segment both historically and for the future. The same is true for GVA, as Figure 7 shows.
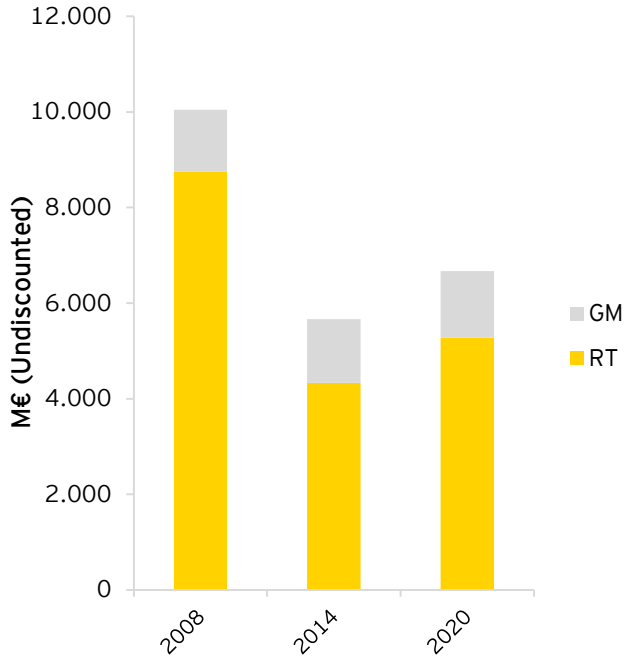

Figure 7: Gross Added Value (GVA) created by the PV industry in EU28, by market segment (rooftop and ground-mounted)

As demonstrated, rooftop (RT) PV installations support almost three times as many jobs and GVA than ground-mounted in 2014. This can be explained by their installed capacities, lower unit cost per MW and lower labor needs for installation and maintenance & operations.

When comparing the annually installed capacity (in MW) for 2014, the capacity of rooftop PV installations was more than 1.5 times greater than ground-mounted in the EU28. The most remarkable difference between rooftop and ground-mounted PV installations can be found in Germany, where the installed capacity for rooftop systems was almost 3 times greater than for ground-mounted systems; which means a difference of more than 900MW. In Spain, Greece and the UK, on the other hand, installed capacities for ground-mounted systems were almost 220MW higher than rooftop PV systems.
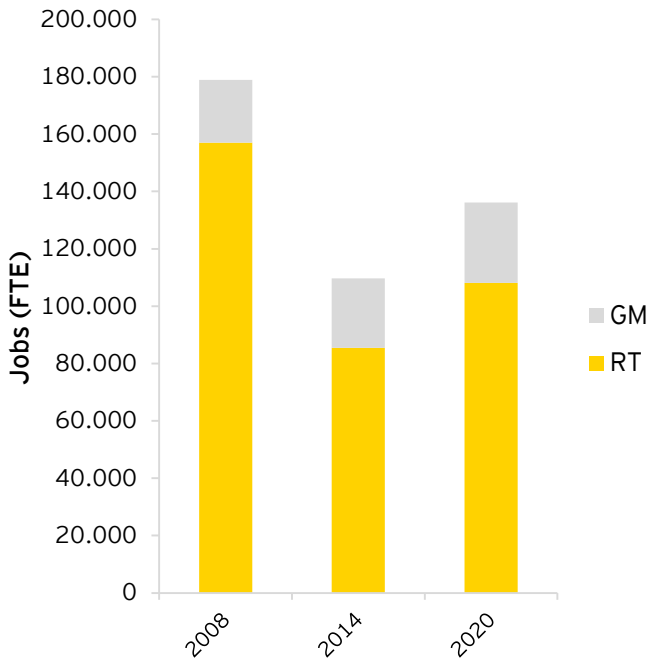

Figure 6: (Direct and indirect) jobs supported by the PV industry in EU28, by market segment (rooftop and ground-mounted)

Solar PV Jobs & Value Added in Europe

Another important factor is that ground-mounted systems are almost half the price of rooftop systems per MW. Ground-mounted systems, in general, have more MW per installation, which offers the advantage of economies of scale, lowering the unit cost. As installation and operations & maintenance are easier and less time-consuming for ground-mounted systems, these activities have a lower cost per MW. This means that fewer jobs are supported per MW compared to rooftop PV systems.

Unlike PV modules, inverters and Balance of System components (which can be traded on global markets), installation and operations & maintenance activities are entirely sourced locally. Economies of scale, easier installation, improved maintenance and operation impact GVA and jobs.

6. Job impact and Gross Value Added per segment of the value chain

Solar PV Jobs & Value Added in Europe
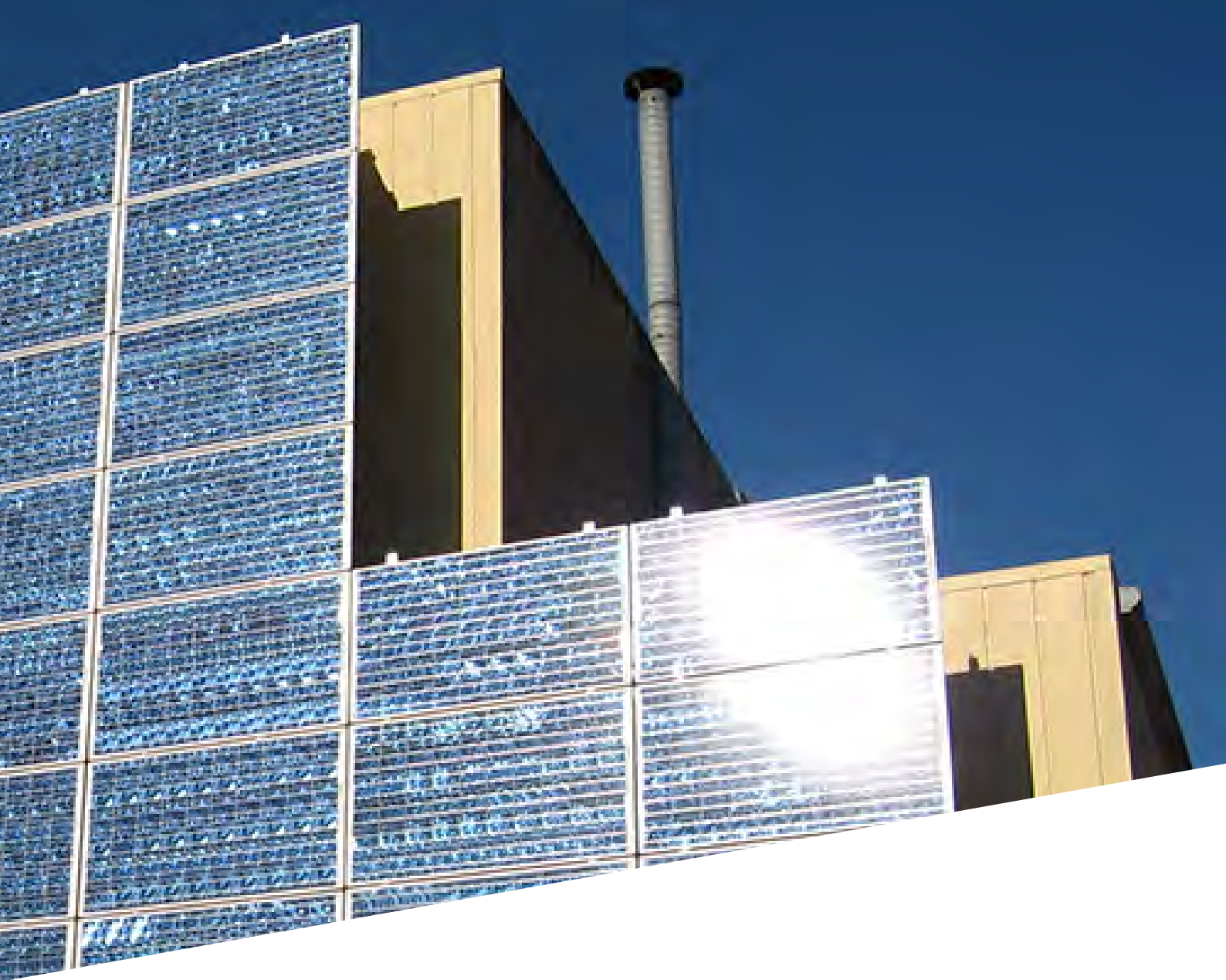
The value chain for PV systems can be split between upstream and downstream activities.

- Upstream activities are the processing of raw material: manufacturing of polysilicon, wafers, cells, modules, mounting and tracking systems and electrical components (Balance of System).
- Downstream activities are services provided within the PV industry such as engineering, administration, installation, operations & maintenance and power sales.

In this chapter, firstly jobs and GVA for upstream and downstream are compared for 2008, 2014 and 2020. Secondly, a breakdown of upstream and downstream value chain activities for the EU28 is given with the relative shares (%) of total jobs and GVA for 2014. Thirdly an overview per country is given with the absolute job support and GVA for 2014 and 2020.

There is a strong correlation between jobs created and Value Added in the activities of the value chain.

Job support and GVA have decreased since 2008 for both upstream and downstream activities, as demonstrated in Figures 8 and 9.

The effects on job support and GVA of the different forces are most visible in upstream activities, where a decrease of 75% in both job support and GVA is measured between 2008 and 2014. For downstream activities, the effects are less significant with a decrease of 21%-23% in the same period. Two reasons are economies of scale and the learning curve, which affect upstream (manufacturing) activities more than downstream (services) activities. On the other hand, downstream activities are more labor intensive. When comparing the unit cost (€/W) for PV modules (upstream) and installation (downstream) of 2008 and 2014 for example, the relative reduction for PV modules was almost 3 times greater than for installation.

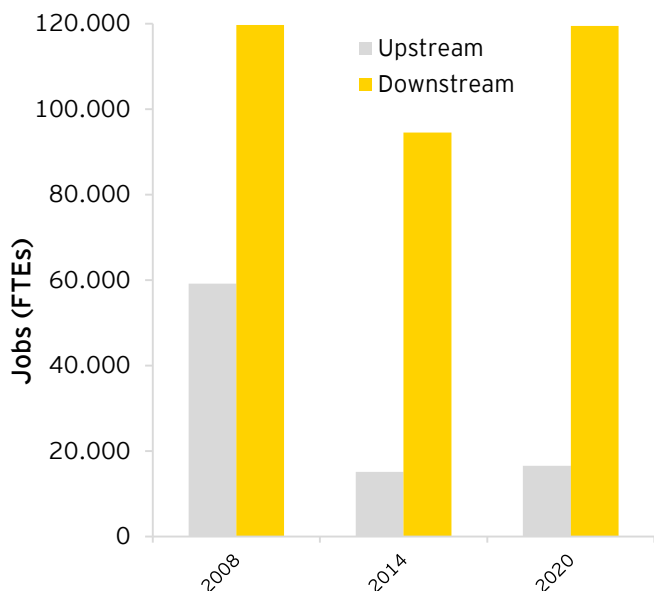## Job support and GVA creation upstream and downstream activities

Figure 8: Direct and indirect jobs supported by the PV industry in EU28, by value chain structure (upstream and downstream)
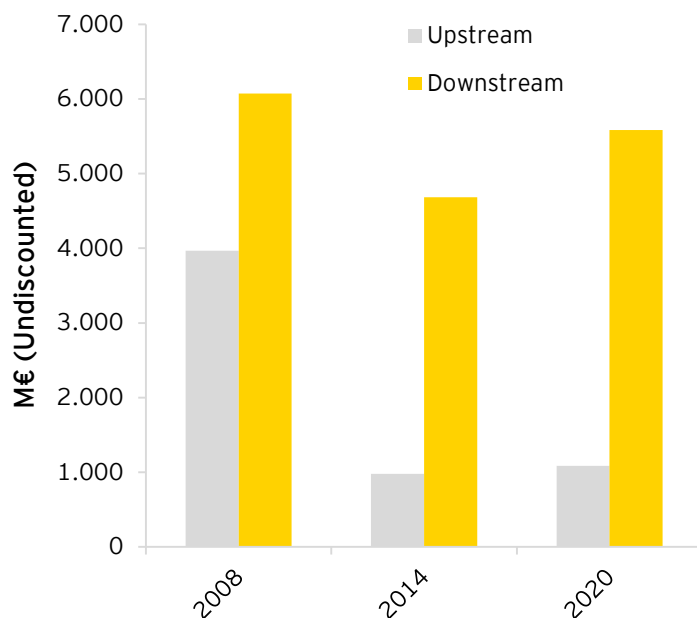

Figure 9: Gross Added Value (GVA) created by the PV industry in EU28, by value chain structure (upstream and downstream)
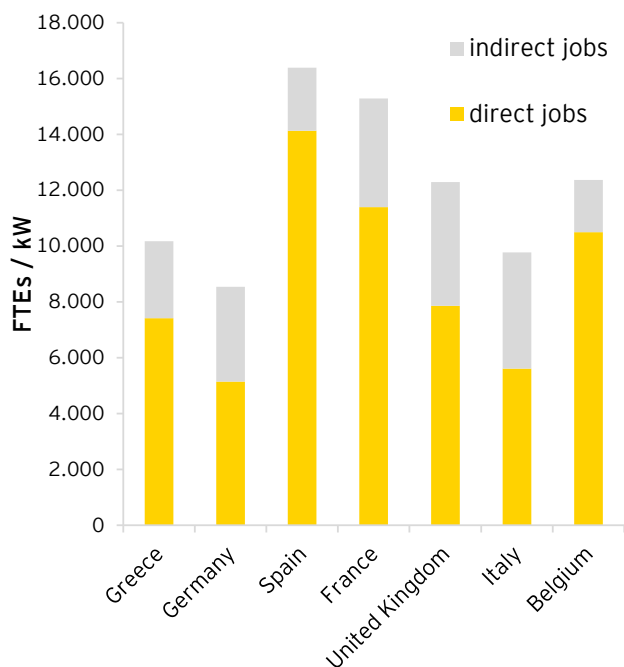

Figure 10: Number of jobs downstream per kW in 2020, direct & indirect, both market segments
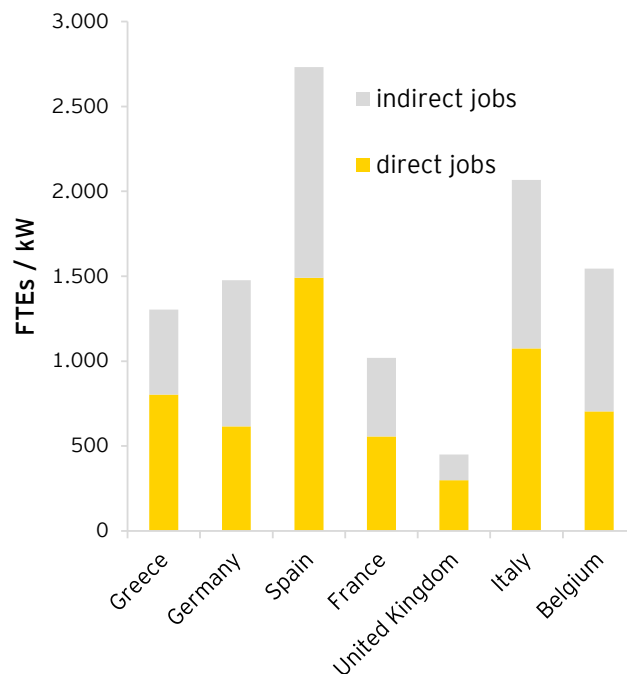

Figure 11: Number of jobs upstream per kW in 2020, direct & indirect, both market segments

Jobs supported through downstream activities per kW energy production give an indication of both the yearly jobs created by operations & maintenance and the efficiency of a solar PV investment in the countries under review. Countries with a high solar irradiation level have a higher energy production per installed capacity. This is expressed by calculating the load factor (the ratio of the actual generated energy and the maximum output of the total installed capacity over a period

of time). Spain, for example, has an average load factor of 20% and the UK (highest jobs support) has an average of 7%. This is - theoretically, not considering policy measures and assuming a similar cost of capital - one of the reasons why investments in PV systems in Spain are more profitable than installing the same capacity in the UK.

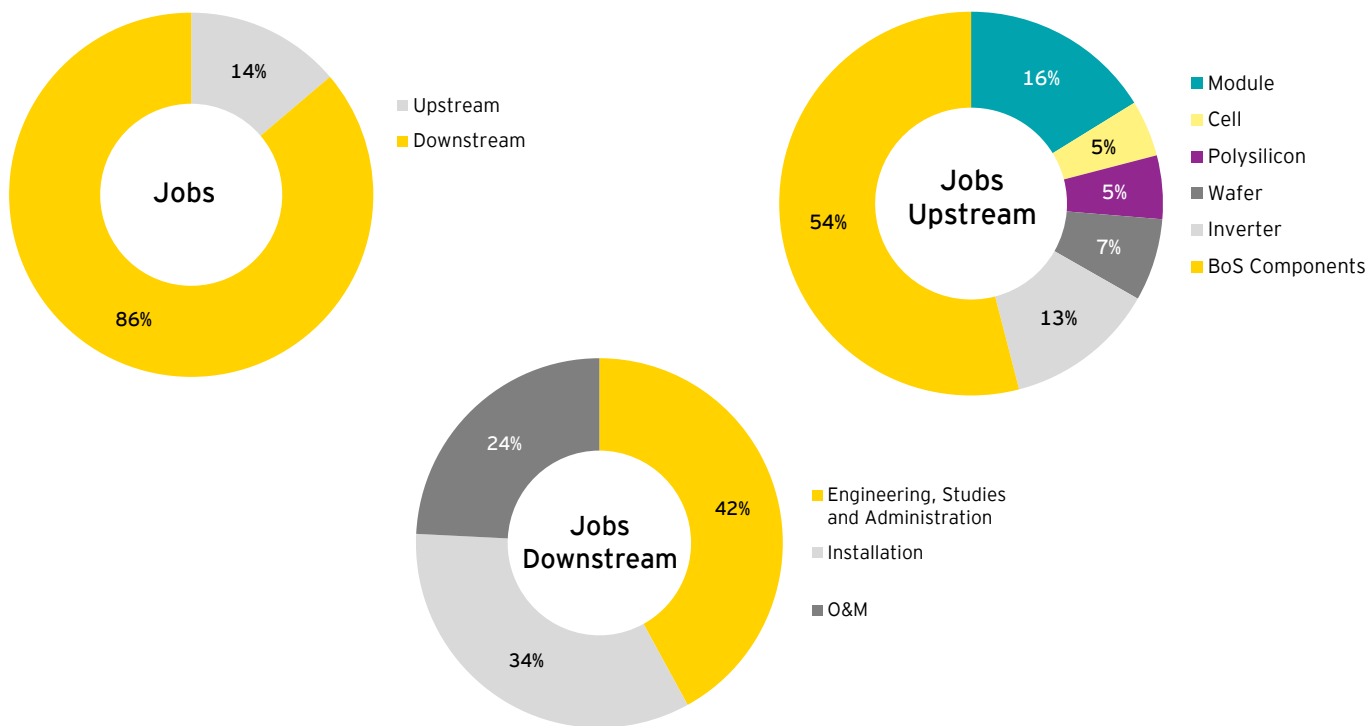## Breakdown of value chain activities for EU28 2014-2020

Figure 12: Direct and indirect jobs supported by the PV industry in EU28, by value chain activity in 2014 (incl. equipment)
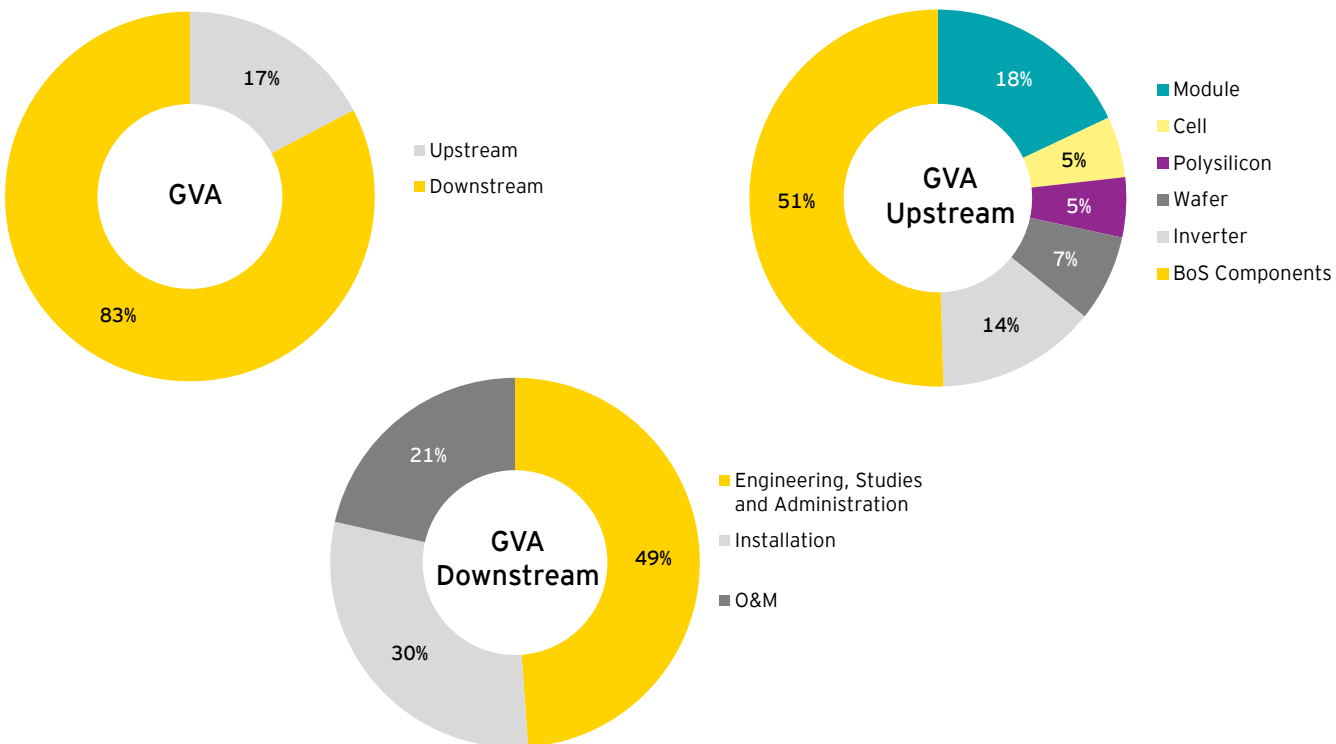

Figure 13: Gross Added Value (GVA) created by the PV industry in EU28, by value chain activity in 2014

Breakdown of value chain activities per country for 2008, 2014 and 2020

In the table below, the share of jobs supported and GVA for the different steps in the value chain are outlined per year.

		Share of jobs support and Gross Added Value per step of the value chain per year for EU28					
		Jobs supported (% total FTE)			GVA (% total M€)		
		2008	2014	2020	2008	2014	2020
Upstream	Module	8%	2%	2%	10%	3%	3%
	Cell	4%	1%	1%	5%	1%	1%
	Polysilicon	4%	1%	1%	4%	1%	1%
	Wafer	4%	1%	1%	5%	1%	1%
	Inverter	6%	2%	2%	7%	2%	2%
	BoS components	7%	7%	6%	7%	9%	8%
Downstream	Engineering, studies, admin.	50%	36%	33%	45%	40%	36%
	Installation	16%	29%	25%	15%	25%	21%
	O&M	1%	21%	31%	1%	18%	27%

As demonstrated in the table above, in the upstream segment, the majority of jobs and GVA creation shifted from PV modules in 2008 to Balance of Systems components in 2014-2020. The manufacturing of Balance of Systems components creates more than 50% of total upstream jobs and GVA. The relatively high and constant share in job support and GVA can be explained by the lower learning curves for Balance of Systems manufacturing (10%) compared to other upstream activities (20%) and a high national share of production compared with the other upstream activities. The manufacturing of Balance of Systems components also holds an important share of total job support and GVA, which will increase as improved and standardized mounting systems shift the system assembly from the field to the factory, resulting in more efficient installation.

In the downstream segment, engineering, studies and administration services provide the highest job support and GVA - highlighting Europe's excellent scientific institutes - but the share in total job support and GVA creation has decreased compared with 2008. It is also true that innovation is hugely important to generate more FTEs in Europe, in services, engineering, etc. Although all downstream activities have a maximum national share, engineering, studies and administration require in general a more specialized and skilled workforce (engineers, consultants, financial specialists,...) and is, as such, more labor-intensive than other downstream activities.

The share of operations and maintenance for both jobs supported and GVA had a strong growth between 2008 and 2014 and will increase to 31% for job support and 27% for GVA creation for the total value chain in 2020. The unit cost of maintenance and operation per kW is relatively low and remains constant considering that services increase and improve but also the competition does. Job support and GVA is based on the cumulated installed capacity and not installed capacity as these services are important in the total life cycle of PV installations.

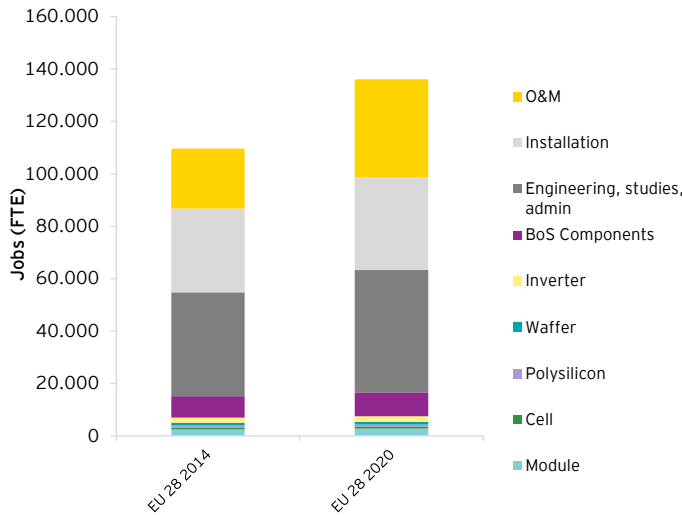## Breakdown of the value chain per country in 2014 and 2020

Figure 14: Number of jobs supported in 2014, direct & indirect, both market segments, by step of the value chain

Job support and GVA per step of the value chain per country is very diverse, as installed capacity and national shares of production differ per country. Job support and GVA creation by the downstream activities is always higher than upstream activities.

As Figure 15 reveals, Germany has the highest national shares of production in Europe for upstream activities. This is one of the reasons why Germany has the second highest job support (after the UK) in 2014, although installed capacity is significantly lower than in the UK for 2014. Some countries, such as Belgium, Spain and Greece have low installed capacity and a low national share of production for upstream activities. This explains the limited job support and GVA in these countries.

Although the situation doesn't change significantly between 2014 and 2020, some minor changes can be identified as depicted in Figure 15. The almost exponential growth of installed capacity in the UK is expected to stabilize and decrease to the same level as Italy in 2020 (see figure 3: Annual installed capacity (MW) per country per year). As national shares of productions in the UK for most upstream activities are lower than in Italy, the total job support is slightly lower although installed capacity is slightly higher.
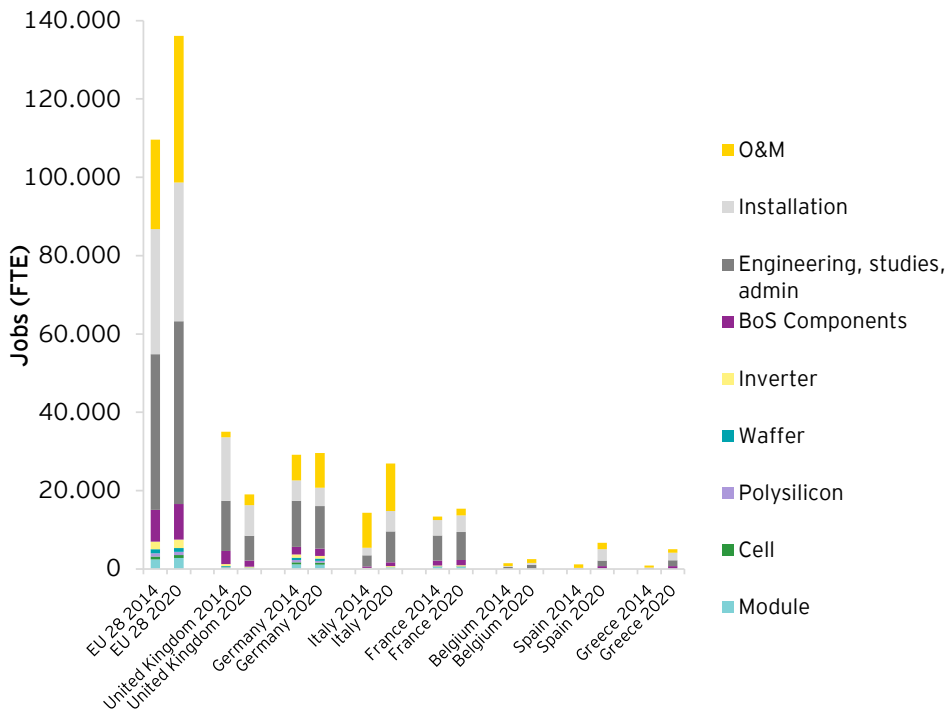

Figure 15: Number of jobs supported in 2020, direct & indirect, both market segments, by step of the value chain

7. The impact of Trade Defence Measures for Modules and Cells on the European Solar industry

Solar PV Jobs & Value Added in Europe

Context and scope

Since December 2013, Chinese manufacturers and the European Union have agreed a minimum import price (MIP) and annual import quota for cells and modules. Anti-subsidy and anti-dumping duties have also been applied to imports of modules and cells from China. As the agreement would be valid for a two-year period, the continuation is currently under discussion.

Debate is ongoing on whether a (non-)prolongation of the measures would benefit the European solar PV market. The question is whether these measures really help European producers in the longer term, or whether they impact demand negatively by keeping prices artificially high.

The analysis in the scope of this study is limited to Germany and Italy, the major European solar power markets. The socio-economic impact has been analyzed in an 'alternative' market scenario with no MIP or measures. This scenario is outlined against a baseline scenario with MIP and measures.

The current study does not aim to provide a full answer. Further detailed research is needed to fully quantify and compare the extent to which prices of modules and cells have an immediate effect in the value chain.
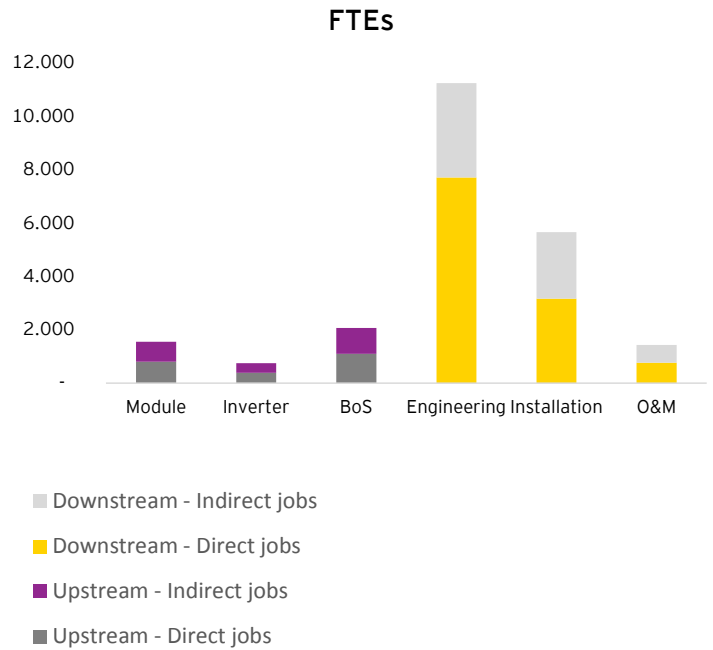
Increased installed capacities

The immediate estimated effect of the expiry of the measures is an increase in installed capacity forecast from 2015 to 2020. The estimation is that lower prices for modules are translated in lower prices at consumer level stimulating demand.

The extent to which price decreases of modules would have an immediate effect on demand is subject to specific factors (not further investigated in the scope of this study):
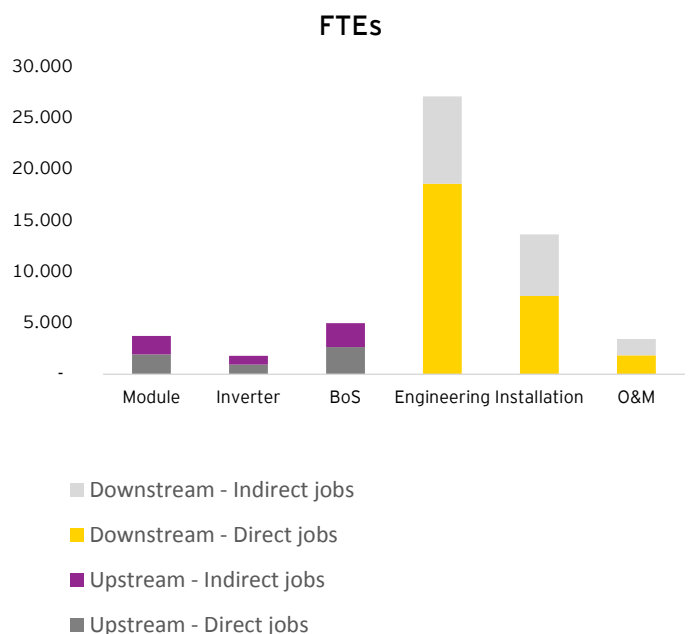
‣ Firstly price decreases are a natural market development, brought about by cost reductions, higher efficiencies and economies of scale. They are thus to be expected in the future.
‣ Secondly, the European solar industry might choose not to pass on the price decreases of modules and cells in their sales prices because it is currently economically challenged. Although there will be pressure to pass the savings on from the introduction of tenders under the European Commission State Aid Guidelines who suggest price will become even more important for installations in Europe.
‣ Thirdly, demand is stimulated not only by lower system costs for modules, which have much more opportunity for price decreases, but also by price decreases in other parts of the value chain – such as for Balance of System costs.
‣ Last but not least, demand proves also to be dependent on other factors such as government support. The evolution of these support schemes is not taken in consideration in the current analysis.

Knowing this, our model shows linearly increased capacities to the level prior to the implementation of the anti-dumping duties (mid 2013), reflecting the fact that: 1) price competition for modules from Asia would lower their prices and make solar PV economically more attractive and 2) taking into consideration national regulations that are not expected to stimulate installations of solar energy plants as much as they did before 2013. It is also the case that some solar plants today can be realized with grid parity and cost improvements.

Market scenario without MIP - net jobs created compared to the baseline scenario for Germany and Italy in 2020

FTEs

- Downstream - Indirect jobs
- Downstream - Direct jobs
- Upstream - Indirect jobs
- Upstream - Direct jobs

Market scenario without MIP - net jobs created compared to the baseline scenario for EU 28 in 2020

FTEs

- Downstream - Indirect jobs
- Downstream - Direct jobs
- Upstream - Indirect jobs
- Upstream - Direct jobs

Results for Germany and Italy show there would be a positive impact on job creation throughout the value chain in 2020 if the MIP is removed, despite a light decrease in domestic market share for modules. In total over 18.000 extra jobs would be created in Germany alone in this market scenario (no MIP and installed capacities back to the level of mid 2013).

This evolution is most visible in the downstream phase and especially engineering phase (with appr. 8.500 more supported jobs in Germany in 2020 in this scenario), as the downstream portion of the value chain is undertaken with local companies with higher intensity ratios per M€ spent than in the upstream phase. There are similar results for Italy as for Germany, but seen the size of the market, on a smaller scale.

For the extrapolation of the impacts in Germany and Italy to the EU28 the same share between these countries and the EU28 has been taken for the alternative as for the baseline scenario.

An overview:

	EU 28		Germany & Italy	
	Direct	Indirect	Direct	Indirect
Total net jobs created upstream 2020	5.524	4.985	2.293	2.070
Total net jobs created downstream 2020	28.015	16.091	11.631	6.680
Total net jobs created in 2020	33.539	21.076	13.924	8.750

Expected job impact

The results in the 2 countries under analysis show it is likely that the lower system prices resulting from the expiry of the MIP would result in more employment in the European solar PV market – throughout the value chain and especially downstream. In such a scenario, 22,000 additional jobs would be created in Germany and Italy alone. Extrapolation to EU 28 shows the potential of over 54.000 (direct and indirect) extra jobs created.

Removing the MIP would thus have a positive employment effect in the value chain resulting from higher demand.

Annex - Main sources and assumptions used in the model

The Input-Output model used in this study is based on three categories of data: PV system prices - spending in national economies are used as job creation and Value Added vectors, installed PV capacities, and national shares of production. This chapter details the key data sources and assumptions for the main parameters used in the model.

System prices:

▸ Value chain split:
  1. Split of the share in the value chain between modules, cells, polysilicon and waffers costs: based on own research of SolarPower Europe in 2013
  2. Split of modules (incl. cells, polysilicon and wafers), inverters, BoS, Engineering/studies/administration, Installation and Operation & Maintenance: 'Cost Maps for Unsubsidised Photovoltaic Electricity', Joint research center' for 2013-2014. Data of ADEME 'Marches et emplois lies a l'efficacité énergétique et aux energies renouvelables' for 2008-2014 (installation separately).
▸ (Financial) lifetime of 25 years for solar systems is used.
▸ Aggregated system prices upstream are based on:
  ▸ Rooftop: 'Cost Maps for Unsubsidised Photovoltaic Electricity; Joint Research Center' for 2013 and 2014. For 2008-2012, the same evolution as PV modules of ADEME was used.
  ▸ Ground Mounted: Cost of ADEME 2011 is known for 2014. The same evolution as PV modules of ADEME was used for cost inverter 2008-2012.
  ▸ BoS is the calculated difference of total BoS data ADEME and the calculated cost of inverters
▸ Aggregated system prices downstream are based on: 'Cost Maps for Unsubsidised Photovoltaic Electricity; Joint Research Center' (€/kWh)
▸ System prices per country are mostly based on IEA annual report , when not available they are completed with several national sources provided by national PV associations.
▸ Regression was used to forecast system prices 2014-2020. Mostly exponential or power regression was used. Choice of regression is based on best fit (R^2) with existing data and prices with normal 'levelling' evolution for later years. If forecast residential is lower than commercial or commercial is lower than ground-mounted. Price is kept constant for the following years. For Greece: no system prices for ground-mounted were available, this information was therefore based on a proportion ground-mounted/commercial for Spain, Italy and France.
▸ Market shares for Residential, Commercial/industrial and Ground-Mounted are mostly based on data IEA (annual reports). Also data local experts gave us were used. For some countries 2008-2011 was not available, in these case data was either completed using linear regression of other data showed clear evolution or leveled if data shows only slight changes in available data. Market shares of the last available year were used for the forecast (2015-2020).

Capacities:

▸ Annual and cumulative capacities per country are based on SolarPower Europe's GMO study 2014-2019 – medium scenario. The forecast of the Installed capacity 2020, is a linear regression based on the capacities installed in the years 2016 through 2019.
▸ Load factors (measure of the functioning hours of solar power units/plants) are calculated by dividing the [generated power (MWh)] with [cumulated installed capacity (MW) * 8.760h per year. Data is based on BMI-research for installed capacity and generated power (2008-2015). Linear regression has been used to forecast both installed capacity and generated power (2015-2020).

National shares of production:

Some national shares of production seemed to be difficult to assess and have therefore been estimated based on: qualitative information gathered through interviews from experts in the national sector associations and numbers of manufacturers in the countries.

Indirect jobs and GVA impacts:

Indirect impacts in each segment of the value chain are calculated using national input-output tables sourced from Eurostat. Each of the CAPEX and OPEX segments of the value chain is assimilated to one of the 66 sectors. Module manufacturing is paired with "Electrical Equipment" as per Eurostat's classification; engineering services are paired with "Architectural and engineering services; technical testing and analysis services"; operations and maintenance are paired with "Repair and installation services of machinery and equipment".

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This study was commissioned by SolarPower Europe.

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