POLICY PAPER

MANUFACTURING PV CELLS AND MODULES: EUROPE CAN DO BETTER

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A new investment cycle is expected in the photovoltaic sector to meet the demands of a growing global market. In a context where the bulk of the photovoltaic cells and modules are manufactured outside the European Union, mostly in China, the EU needs to be fully part of this new investment cycle in order to maintain its leadership on research & development, on machinery and to re-install a leadership in equipment production. The overall objective is that by 2020 the EU is in a position to meet at least 20% of its own market with cells and modules manufactured domestically. The European Union should also aim to maintain its expertise on system integration such as small-scale PV solutions for developing countries.

This goes along the full implementation of the 2020 energy and climate framework, as well as the adoption of ambitious 2030 objectives since the promotion of a European industrial policy on photovoltaic is mostly relevant in a context of a growing domestic market.

This document presents ideas to relocate photovoltaic manufacturing industry to Europe through innovative projects such as the xGWp initiative jointly proposed by Fraunhofer ISE, CEA-INES, CSEM and Meyer Burger.

Introduction

Photovoltaic (PV) is considered both an indispensable contribution to climate change mitigation objectives[1] and a key technology to allow the EU to move to a 100% renewable energy system. It also represents part of the solution to EU energy security and energy poverty issues. For example, the United Kingdom situation showed how photovoltaic has the potential to significantly improve fuel affordability indices for vulnerable communities.[2]

In 2013, PV represents 3 % of the EU electricity mix.[3] The booming period ended with the explosion of the "solar bubble" in several countries, leading to difficult years marked by over-capacity in global cells and modules production and strong market contraction. However it is expected that demand would stabilise itself as future projections estimate that 7 to 10 GW/year could be installed in the EU alone.

The once leading European PV industry, manufacturing wafers, cells and modules, has nearly collapsed under the pressure of shrinking European markets and fierce competition from Chinese companies. The remaining manufacturers can only cover a small fraction of the reduced domestic demand. European providers of equipment for cells and modules manufacturing are still world leaders, but risk to lose this position without local clients. Current policies condemn the EU to

remain incapable to meet the demand of its domestic market in PV equipment (cells and modules) from its own manufacturing capabilities for a long time. This situation is not acceptable as president Juncker announced he wants *"Europe's Energy Union to become the world number one in renewable energies*".[4] Hence we need to maintain the European leadership on PV manufacturing equipment and re-industrialise Europe on cells and modules through targeted investments to create green growth and jobs along the whole PV value chain.

1. Global and EU market structure

1.1. Past market developments

After a period of rapid expansion, the European PV market has been shrinking over the past few years, with a 20% decrease in new installations in 2012 (17.7 GW) compared to 2011 level (22.3 GW) followed by a 38% decrease in 2013 (11 GW).[5]

This contraction is largely due to political decisions linked to the regulatory framework (e.g. on feed-in tariffs, grid access, taxation issues) as well as other reasons specific to Europe. In parallel the world PV market grew by more than 25% in 2013 (38 GW of newly-installed capacity compared to 30 GW in 2012) and a growth of 20% is expected for 2014. This growth is driven by China, Japan, the United States and other emerging markets in the Asia-Pacific region.

However, Europe still shows the largest cumulative capacity, hosting about 57 % of the 140 GW installed at global level, although this share is down from 70% in 2012.[6] The market situation varies greatly varies from one Member State to another, with ten countries reporting new PV installations of at least 100 MW in 2013. While the market in Germany (+ 3.3 GW), Italy (1.5 GW) and France (+ 0.6 GW) has strongly declined compared to previous years, installations in the United Kingdom (+ 1.5 GW) and Romania (+ 1.1 GW) showed remarkable growth. In addition, countries like Greece (+ 1 GW) slightly increased too.[7]

Regarding capacity production, we should distinguish equipment (production lines) from cells and modules. While the EU shows a continuous leadership on the former, the situation is more worrying on the latter. Annual global modules and cells production amounted to 50 GW in 2012.[8] This led to a situation marked by significant over-capacity, up to 80%.[9] This over-capacity led to a sharp decline in module prices and was mostly due to the practices of Chinese manufacturers selling PV panels at very low prices, heavily subsidised by regional governments following a purely political approach. In addition, Chinese manufacturers benefitted from scale and supply chain-advantages, with aforementioned provincial subsidies and tax holidays being "*key enablers*".[10] European producers could no longer resist unfair competition and lost most of their market shares, leading to heavy socio-economic consequences. In the absence of any commercial logic, this restructuration of the world PV market profited to several Chinese manufacturers. As pointed out by the IEA, "*the historical price advantage of a China-based factory over a US-based factory is driven not by country-specific factors, but by scale, supply-chain development and access to finance*".[11] At the same time, EU leadership in PV production machinery is also under threat because of Chinese protectionist measures imposing an 80% share of Chinese equipment in PV production lines in the near future. This calls for an EU reaction, not only articulated around anti-dumping defence mechanisms but also proposing an industrial policy initiative.

Today, although more than 350 companies produce solar cells worldwide, Chinese manufacturers occupy nine of the top ten positions. 75% of the 40 GW of PV cells were produced in China and Taiwan in 2013. The top 5 companies are the following:[12]

Company	*Outputs for 2013 (GW)*
Yingli Green Energy (Chinese)	3.2
Trina Solar (Chinese)	2.58
JA Solar Holding (Chinese)	2.07
JinkoSolar (Chinese)	1.94
Canadian Solar (Canadian, manufactured in China)	1.74

Amongst important non-Chinese actors we can find the Americans First Solar and SunPower (owned by French oil company Total), with respectively 1.63 GW and 1.13 GW produced in 2013. Although R&D activities are still located in the US, the manufacturing process takes place in Malaysia. However, there are efforts to re-industrialise the US also in this sector: SolarCity's subsidiary Silevo is constructing a new technology Gigawatt PV factory - supported by a New York State contribution of 750 M$.

This has strongly reduced the role of Europe in the global market for cells and modules. Capturing about 5 % of the world market, Europe occupies the fifth position after China, Taiwan, Japan and Malaysia, far away from its first place in 2008. Many factories have been shut down or companies have been sold to Asian investors, such as Q-Cells, Conergy, REC (producing in Asia) etc. Besides smaller producers in Germany, France and Italy, the only large one is SolarWorld having a manufacturing capacity of over 1 GW in Europe and the US after having acquired the PV activities of Bosch.

1.2 Market projections

Scenarios for the worldwide deployment of PV technology vary significantly between scenarios. For 2020, cumulative installed capacity could vary from 400 to 515 GW according to the International Energy Agency. For 2030, it could go up to 1,721 GW under the high-renewables scenario from the IEA, while the 2DS scenario foresees 841 GW.[13] Other forecasts, such as the Greenpeace advanced scenario, anticipate up to 1,764 GW by 2030. [14]

The future of the European market is uncertain for the coming years, due to several reasons such as difficult access to capital and uncertainties on the regulatory framework. However, prospects on the longer term are much more favourable, with PV possibly making up to 6-8% of European electricity by 2020 and 10-15% by 2030 according to various scenarios involving climate-friendly policies, a leap from the 3% it represents now. [15]

In their National Renewable Energy Action Plans (NREAPs), 26 Member States have set specific PV solar energy targets of 84 GW for 2020, a threshold already reached in 2014.[16] The IEA analysis suggests that the European market will be in need of nearly 49 GW of cumulative PV modules to meet growing demand, with steady projections around 7 GW annually. More ambitious high-renewable scenarios envisage up to 200 GW to be installed in Europe in 2020 and 500 GW by 2030.[17]

Most of these capacities constitute smaller-scale solar PV installations: in 2013, residential- and commercial-scale projects accounted for an estimated 80% of total solar PV capacity growth.[18] Of course, these prospects are dependent on a number of technological developments expected to further accelerate an already impressive cost reduction rhythm (PV module prices were divided by five in six years,[19] and a further halving of costs is anticipated by the IEA[20] in the long-term). According to the European Commission, it is expected that if these technology developments are realised, the cost of electricity from PV systems will be comparable to the retail price of electricity in 2015[21] and move closer to "socket parity" as per the IEA terminology, a situation allowing customers to save money by generating electricity themselves rather than buying it from the grid, to the extent

of possible self-consumption, which depends on the temporal match between PV generation and power demand.[22]

As over-capacities tend to recede and production lines should be modernised, a new investment cycle is necessary to meet this demand. Europe should be fully part of it through targeted investments aimed to set the EU back on the scene of cells and modules while maintaining its leadership on machinery and other parts of the value chain (inverters, balance systems).

2. Need for investments for a European green growth

2.1. Triggering the right investments between Member States

The EU needs to make the right investments in order to deliver cost-competitive, high-tech PV modules and cells ensuring the best possible integration in the built environment and connectivity to the smart electricity grid at little or no additional costs compared to competitors. In order to make such investments, both research institutes and equipment manufacturers in the most advanced Member States are called to gather their forces and present joint projects.

In parallel, the European Commission is called to mobilise all potential sources of investments, including NER 400, the European Investment Fund and the Juncker Investment Plan to support such joint projects. Only in these conditions can Europe be back in the PV game and become the renewables world leader as proposed by the new European Commission.

The EU is not starting from scratch and has already solid arguments to show.

- Firstly, worldwide production lines are using cutting-edge European manufacturing technology and the EU is still a leader in machinery production.
- Secondly, the EU is a leader on other segments of the supply chain, indispensable for successful grid integration of PV panels. If the EU market share is only 5% for cell and modules manufacturing, it goes up to 40% for inverters and 30% for balance of systems.[23]
- Thirdly, the cost reduction achieved in the recent past is beneficial for the market.

Hence we are still in the game! The EU should not lose future battles on high-tech PV products as we lost the battle in other sectors, such as flat screens, where former EU technological advantage was progressively overtaken by Korean companies. With production lines allowing an annual output of 1.4 GW, the EU could meet at least 20% of its own market with cells and modules manufactured domestically. This is a reasonable industrial objective for 2020.

2.2. A concrete example: the xGWp project

Only few concrete industrial projects emerge, one of them being the xGWp initiative from Fraunhofer ISE, CEA-INES, CSEM and Meyer Burger. The xGWp combines the best of thin film and crystalline silicon technologies and shows interesting process improvements to assemble high-performance, cost-competitive PV tandem cells and modules in Europe. The project requires a 50 M€ investment for the first phase (90 MW first production line), followed by a 500 M€ investment for the second phase consisting in the launch of the new GW factory.

This joint project could lead to the creation of 1 000 direct jobs and considers establishing its production site in Alsace, eastern France. This is far from negligible in a context where Europe holds 16 800 jobs related to cells and modules manufacturing.[24] This constitutes an important signal to show that a nuclear phase-out in the region (with the Fessenheim power plant called to be decommissioned in the coming years) can open a new industrial era with green jobs offered to local

economy, and constitutes a great example of the energy transition to shift towards a 100% renewable system in Europe.

3. Recommendations

- *European Commission*: mobilise resources under the Juncker Investment Plan to support industrial projects on cells and modules manufacturing in Europe;
- *European Commission*: use the full extent of our EU commercial policy to avoid constrained technology transfers to our competitors, including local content requirements, negotiations in the WTO and possibly defence mechanisms;
- *European Investment Bank*: target PV manufacturing projects through support schemes such as guarantees under the European Investment Fund;
- *Member States*: use structural funds to promote investments in PV manufacturing factories.
- *European Commission and Member States*: emphasise the role of photovoltaic to our development policy through the installation of small-scale PV solutions in developing countries.

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[1] IPPC, *Renewable Energy Sources and Climate Change Mitigation*, https://www.ipcc.ch/pdf/special-reports/srren/SRREN_FD_SPM_final.pdf.
[2] P. Rowley, P. Leicester, P. Thornley, S. Mander, C. Jones, *Wise-PV: Whole System and Socio-Economic Impacts of Wide Scale PV Integration*, European Photovoltaic Solar Energy Conference and Exhibition, 2014.
[3] EU Energy in figures, Statistical Pocketbook 2014, http://ec.europa.eu/energy/publications/doc/2014_pocketbook.pdf
[4] Jean-Claude Juncker, *A New Start for Europe: My Agenda for Jobs, Growth, Fairness & Democratic Change*, http://ec.europa.eu/about/juncker-commission/docs/pg_en.pdf
[5] EPIA, *Global market Outlook for PV 2014-2018*, http://www.epia.org/fileadmin/user_upload/Publications/EPIA_Global_Market_Outlook_for_Photovoltaics_2014-2018_-_Medium_Res.pdf
[6] Arnulf Jäger-Waldau, *2014 PV Status Report*, European Commission Joint Research Centre.
[7] International Energy Agency, *Medium-Term Renewable Energy market Report 2014*.
[8] European Commission, *2013 Technology Map of the European SET-Plan*, https://ec.europa.eu/jrc/sites/default/files/jrc13_tmap_08ap14_ns-print.pdf
[9] IHS 2013, quoted in https://um.baden-wuerttemberg.de/fileadmin/redaktion/m-um/intern/Dateien/Dokumente/5_Energie/Erneuerbare_Energien/Sonnenenergie/Studie_XGW_Fabrik.pdf
[10] Alan C. Goodrich, Douglas M. Powell, Ted L. James, Michael Woodhouse and Tonio Buonassisi, *Assessing the drivers of regional trends in solar photovoltaic manufacturing*, in Energy Environ. Sci., 2013, 6, 2811.
[11] International Energy Agency, *Technology roadmap Solar PV Energy*, 2014 edition.
[12] Arnulf Jäger-Waldau, *2014 PV Status Report*, European Commission Joint Research Centre.
[13] International Energy Agency, *Technology roadmap Solar PV Energy*, 2014 edition.
[14] European Commission, *2013 Technology Map of the European SET-Plan*, see link above.
[15] EPIA, *Global market Outlook for PV 2014-2018*, see link above.
[16] European Commission, *2013 Technology Map of the European SET-Plan*, see link above.
[17] International Energy Agency, *Technology roadmap Solar PV Energy*, 2014 edition
[18] International Energy Agency, *Medium-Term Renewable Energy market Report 2014*.
[19] *Ibid*.
[20] International Energy Agency, *Technology roadmap Solar PV Energy*, 2014 edition.
[21] European Commission, *2013 Technology Map of the European SET-Plan*, see link above.
[22] International Energy Agency, *Medium-Term Renewable Energy market Report 2014*
[23] Arnulf Jäger-Waldau, *European Photovoltaic Market contracts in a rapid expanding global market*, 2014.
[24] *Ibid*.