STRATEGIC PERSPECTIVES FOR EUROPEAN SOLAR PV MANUFACTURING – 2022

THE EUROPEAN SOLAR MANUFACTURING COUNCIL – FOR A EUROPEAN PV MANUFACTURING RENAISSANCE

The European Solar Manufacturing Council (ESMC) is the organisation representing the interests of the European PV manufacturing industry. The industry organisation represents key European industrial companies, organisations and research centers active in the PV sector. ESMC aims at promoting and supporting the PV manufacturing industry and its value chain at the European level, speaking with one voice.

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TABLE OF CONTENTS

..... 1

1. GLOBAL AND EUROPEAN PV MARKET DEVELOPMENT 3

GLOBAL PV MARKET STATUS 3

2. PV MARKET FORECAST 5

3. THE SEGMENTATION OF THE PV MARKET 5

4. GLOBAL AND EUROPEAN INDUSTRY STATUS 6

SHORT TERM INDUSTRY SUPPORT 7

5. PV, AN INDUSTRIAL ADDED VALUE FOR EUROPE 7

CURRENT IMPORT DEPENDENCY 7

JOBS ..... **Fel! Bokmärket är inte definierat.**

6. ESMC'S STRATEGY 8

SUPPORT PV MANUFACTURING IN EUROPE THROUGH APPROPRIATE POLICIES 10

SUPPORT PV MANUFACTURING IN EUROPE THROUGH APPROPRIATE MARKET DEVELOPMENT ... 12

ALLIANCE BUILDING 12

ESMC KPIs FOR 2022-2023 ON BOOSTING LOCAL PV MANUFACTURING IN EUROPE 13

1. GLOBAL AND EUROPEAN PV MARKET DEVELOPMENT

GLOBAL PV MARKET STATUS

Solar photovoltaics (PV) has developed fast in the recent decade. So fast that it has become a mainstream source of electricity, competitive in an almost all countries in the world, substantially contributing to decarbonizing the power mix and electrifying the world. In 2021 about 5%of the global electricity consumption was covered by PV power[1].

Looking back, the global PV market crossed the annual 100 GW mark in 2017 (103 GW). Then followed annual additions of 104 GW in 2018, 112 GW in 2019, 145 GW installed in 2020, record-breaking year despite the pandemic, and preliminary 175 GW of additional PV capacities in 2021.

The European Union lost its position as the second largest global PV market and ranked third in 2021 by installing close to 26,8 GW. Outside of the EU, the rest of Europe added around 3 GW. The increasing installation volumes signal a strong market growth, despite the Covid-19 pandemic, including disrupted supply chains and polysilicon shortage, causing price increases and prolonged project times in many parts of the world.

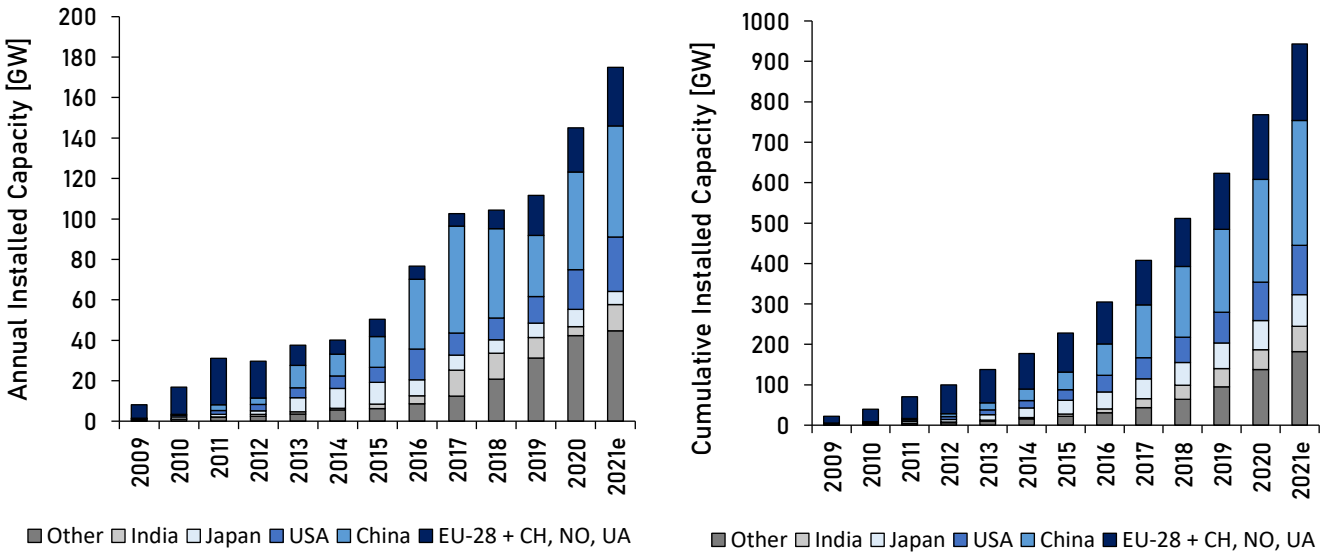

Figure 1. Evolution of the global annual and cumulative installed capacity with focus on main markets (Elaboration by Becquerel Institute 2009-2020). 2021 global market estimates[1].

SOLAR PV GROWING IN EUROPE

Contrary to the general belief, the European PV market went down due to the decrease of financial incentives after 2011, and the systemic opposition from incumbent actors of the electricity markets. With punitive measures in Spain, Italy, Belgium, Romania, and Czech Republic, with changes of policies in Germany, Greece and with market limitations in France as well as in several of the countries previously mentioned, the annual European PV market went down from 23 to 5-6 GW during several

[1] IEA PVPS Task 1, Snapshot of Global PV Markets — 2022

years. The transition from Feed-in tariffs (and similar schemes) to tenders, merchant PV and self-consumption schemes was chaotic and lacked vision, ensuring a collapse of the PV market in several key markets. Of course, the growth that drove the market in some countries was not sustainable, but a better managed transition would have avoided transforming the leader of the global PV market into a laggard.

However, the new dynamics are positive, and the regulations tend to stabilize, offering a better perspective than a few years ago. Most importantly, as these market figures in Figure 2 show, the market increased again in 2020, despite the turmoil caused by the COVID-19 pandemic. Regarding the total of 19.8 GW added in the European Union in 2020, the largest European markets were Germany (4.9 GW), followed by Spain (3.5 GW), the Netherlands (3.0 GW) and Poland (2,6 GW). Another four countries added more than 500 MW, namely Belgium, France, Italy and Hungary.

In 2021, the European Union exceeded its market level of 2011 for the first time, with estimated 25.9 GW connected to the grid[2]. This corresponds a 34% market growth compared to 2020, despite the negative effects from covid-19 and supply shortages. Germany remains the top market in Europe with an annual market of 5.3 GW, again followed by Spain (3.8 GW), the Netherlands, (3.3 GW), Poland (3.2 GW) and France (2.5 GW).

The following figure highlights the evolution of the European PV market and its recovery after almost a lost decade. Imbalances between countries are still visible, with the Netherlands installing significantly more per inhabitant than Spain or Germany.

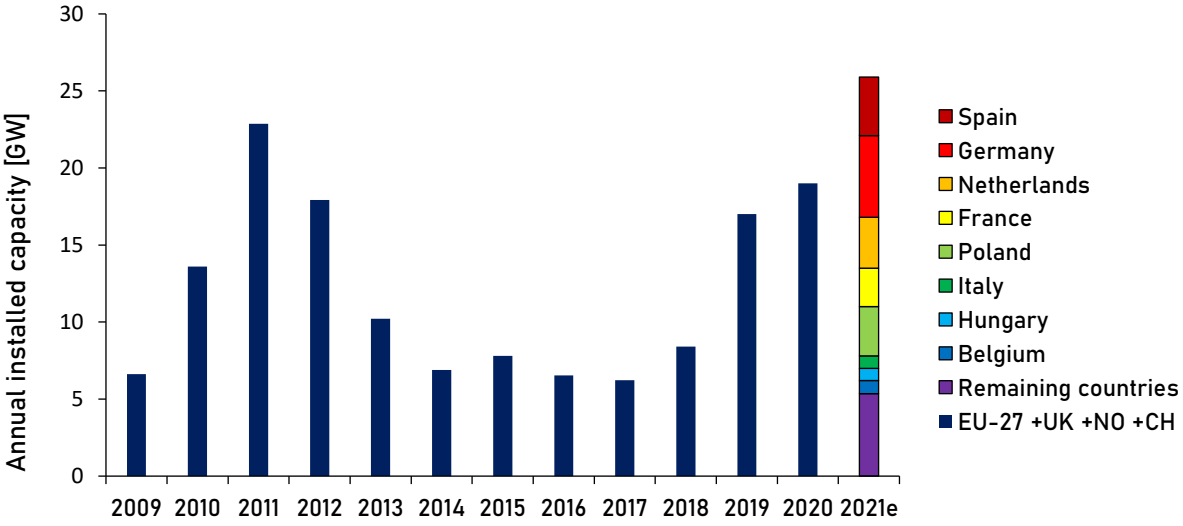

Figure 2. Evolution of annual PV Installations in Europe (Source: IEA PVPS for 2009-2020, 2021 estimates[2])

2 Solar Power Europe — EU Market Outlook For Solar Power 2021 - 2025

2. PV MARKET FORECAST

The dynamics of the PV market globally are increasingly driven by the intrinsic competitiveness of PV electricity on electricity markets, while more countries are putting regulations in place to support PV development. Globally, the sector of renewables has been resilient with regards to the prevailing Covid-19 crisis. In addition, the potential for growth and positive driving forces are still present and will continue to stimulate the PV market. Therefore, the PV market in European countries in 2022 and 2023 should experience growth compared to its 2021 level. Nevertheless, the consequences of the Covid-19 pandemic and other disruptive market events, especially in the financing sector, will continue to impact the market in 2022. **Still, it is eventually foreseen that the PV capacity installed globally in 2022 should be at least equal to 2021's figure. ESMC anticipates a strong boost in 2022, where as much as 40 GW could be installed in an effort of Europe to reduce the fossil energy dependency of Russa.**

The European Union experiences a slightly different evolution compared to the global one, since PV has been developed here for more than 15 years. With close to 165 GW of cumulative installed PV capacity at the end of 2021, the EU covers roughly 7,2% of its electricity demand with PV[3]. The electricity demand has not grown since 2008 and the shift to electricity for transport and heating has not yet materialized into a respective significant increase, thanks to counteracting energy efficiency measures. In the EU, policy drivers remain essential to stimulate PV development. Promising measures are the 2030 decarbonization targets, but also the support for energy communities, electric mobility and green hydrogen.

Much more remains to be done to achieve a level of market development significant enough to meet the decarbonization objectives needed to avoid a catastrophic global climate change. By 2050, between 5 and 10 TW of cumulative solar PV could be needed in Europe to meet the objectives of the Paris agreement[4]. Such levels of PV installations require that all options to develop PV are being considered, covering buildings with BAPV and BIPV, using the existing ground space for utility-scale plants, agricultural PV and floating PV. Roads and infrastructures should not be forgotten, and vehicle integrated photovoltaics (VIPV) deserve additional attention due to their demand side capabilities in addition to electricity production and storage, as well as their ability to reduce charging needs.

3. THE SEGMENTATION OF THE PV MARKET

The PV market consists of a combination of several segments with different characteristics and actors, and increasingly, components. Historically, the PV market developed due to policy decisions, which shaped the segments in one way or another, in accordance with local constraints. This is clearly visible in Spain that was dominated by ground-mounted PV applications, while Belgium focused on distributed applications. Other countries made different choices but, overall, these are consistently levelling and shifting towards PV deployment strategies based on key parameters linked to population density, solar irradiation, electricity prices and socio-economic aspects.

Globally, an accelerated development of distributed PV installations can be observed. At a lower magnitude, floating and agricultural PV, also called agrivoltaics, have grown as emerging market

[3] IEA PVPS Task 1, Snapshot of Global PV Markets — 2022
[4] LUT University (2020): 100% Renewable Europe: How To Make Europe's Energy System Climate-Neutral Before 2050

niches. Market dynamics at segment level cannot be dissociated from the willingness to develop manufacturing in Europe.

While reaching low-cost levels for PV is essential, in some segments the competitiveness of PV systems is already granted and could sustain slightly higher prices. Hence, the choice of developing some market segments rather than others is not politically neutral. European manufacturers could benefit (and it is already partially the case) of more targeted development in some segments, especially with regards to distributed PV.

4. GLOBAL AND EUROPEAN INDUSTRY STATUS

The PV value chain spans through different technologies, incorporating material and equipment providers, the production of PV modules (directly or through ingots, wafers and cells) and the balance of system components (inverters, mounting structures etc.).

While the PV industry started in Europe, Japan and the USA, it developed massively in Europe before 2010 and moved to Asia in the years 2010-2020. Many of the innovations included in today's Asian products have been developed by European universities, R&D centres and companies. The European industry now has the opportunity to respond to the growing market demand with more advanced, reliable and sustainable technologies than those available on the market today.

The European industry covers the whole PV value chain (figure 3). It includes a world-class polysilicon producer, currently looking for ways to reduce its CO_2 emissions. Wafer manufacturing is done at a 1 GW-scale fabrication plant based on hydropower and with plans for expansion. Additionally, a breakthrough kerfless wafer technology is currently under development. Cell manufacturers are small, but they are working with innovative technologies resulting in higher efficiencies compared to mainstream technologies, thus with a higher energy output per unit area. Tandem structures, which are being evaluated in R&D centres, show a rapid growth. This technology would greatly boost the efficiency of the cells. Then, even if module manufacturers in the GW-scale are currently not on the market, there are plenty of small to medium-size companies assembling modules. They employ innovative technologies to reduce the cell-to-module losses, for example by using conductive back sheets, smart-wire interconnection technology, or even manufacturing modules with the lowest CO_2 emissions in the world. Some companies focus on specific products like back sheets, glass coatings to improve the reflective properties of the modules, trackers for bifacial applications, inverters, and cooling frames, respectively.

Finally, key equipment suppliers still exist, but the situation is fragile. Even with the European strength in innovation, the European share in the global PV value chain remains very limited. There is a strong will from different stakeholders in the industry to build a 5GW+ factory, using European technologies. Eventually, this will allow delivery of advanced PV products that would be more sustainable, e.g. by requiring fewer resources than conventional technologies or by guaranteeing ethic working conditions for all involved workers, while staying cost-competitive at system level.

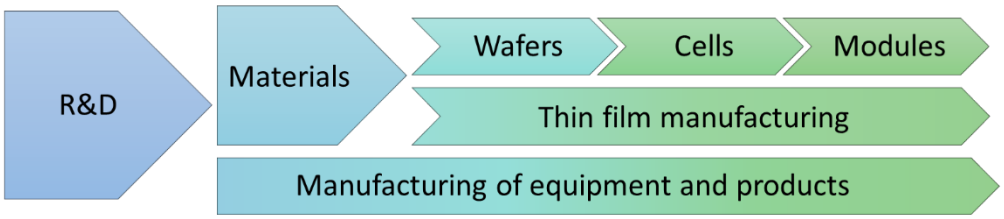

Figure 3. Simplified representation of the PV module value chain.

SHORT TERM INDUSTRY SUPPORT

According to ESMC's analysis on the EU recovery and Resilience plans released in 2021, a total of €477 million have been identified as possible direct support for PV manufacturing, in investments to be made before 2026. This could help initiate the rebuild of the European PV industry, as they consist of both loans and grants to establish or strengthen the PV value chain in Italy, Romania, and Croatia. This rather limited support, however, shows that PV manufacturing still has not reached enough attention in European policies. The Recovery and Resilience Facility could have been a well-timed and impactful system to accelerate the reestablishment of the European manufacturing industry. Therefore, ESMC considers the lack of the Member States commitment to PV industry in most RRPs as a missed opportunity. Especially since the last years have shown how the prevailing pandemic, from which the RRF is aimed to help Member States recover, has contributed to disruptions in the supply chain of solar PV. However, the financial support envisaged in the RRPs is only a small part of the potential systemic and integrated European support for the PV manufacturing industry in Europe. Other instruments (solar PV strategic positioning, appropriate legislative framework, IPCEI) are equally important, and are addressed hands on, to send the right signals and assurance for the PV manufacturing industry to meet the European PV demand from the local PV production.

5. PV, AN INDUSTRIAL ADDED VALUE FOR EUROPE

For over two decades, Europe has been leading the technological development, state of the art manufacturing, sustainability of production, quality, and efficiency of solar PV products. There is hardly any other sector in the EU that received as much public dedication and thrilled more young people, engineers, and scientists.

However, the European PV manufacturing industry has been suffering in the last years from fierce competition with the rising giants from Asia and USA, leading to a sharp overall decrease of competitiveness of its incumbent players. This has led to the disappearance of several actors and has put the entire PV value chain at risk. One important part of that value chain, the European cell manufacturers have almost completely disappeared, which endangers the whole EU PV ecosystem.

CURRENT IMPORT DEPENDENCY

An ESMC customs data analysis reveals a significant imbalance between import and export of PV products in Europe. The study is based on trade data managed by the International Trade Centre (ITC), namely in the HS customs code *854140: Photosensitive semi-conductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; Light emitting diodes* into or out of Europe. The results presented in Table 1 indicate a considerable dependency on hardware from other regions.

Results show that the imbalance between Extra-European import and export has increased by 87% monetary value in total between 2016 and 2020 (92% between 2016 and 2019). In relative terms, Europe exported a value amounting to 27 % of its imports in 2016, which decreased to 15 % in 2019 and 17% in 2020. **As the market is growing, Europe is becoming increasingly import-dependent.**

Table 1. The total value of traded *Photosensitive semi-conductor devices, including photovoltaic cells whether assembled in modules or made up into panels; Light emitting diodes* with European countries from 2016 to 2020. All data is presented in thousands of US$ and collected from ITC data base trademap.

	2016 [kUS$]	2017 [kUS$]	2018 [kUS$]	2019 [kUS$]	2020 [kUS$]
Extraeuropean import	6 330 809	6 484 161	8 106 778	10 471 637	10 413 196
Extraeuropean export	1 701 633	1 645 606	1 720 856	1 564 790	1 766 641
Imbalance	- 4 629 176	-4 838 555	-6 385 922	-8 906 847	-8 646 555

Table 2 presents the Intereuropean trade, based on export data, where all countries' separate trade to other European countries have been summarised. Note that re-distribution of modules and cells between countries in the Single Market is to be expected and that the values shown in Table 2 may partially include value already accounted for once in Table 1.

Still, it shows that the Internal European Market is strong and that most of the countries' export is Intereuropean, which captures the interregional manufacturing volumes. Yet, it's evident that the Extra-European import amounts to much more than the internally traded value.

Table 2. The total value of internally traded *Photosensitive semi-conductor devices, including photovoltaic cells whether assembled in modules or made up into panels; Light emitting diodes* with European countries from 2016 to 2020 registered in ITC data base trademap. All data is presented in thousands of US$.

	2016 [kUS$]	2017 [kUS$]	2018 [kUS$]	2019 [kUS$]	2020 [kUS$]
Intereuropean trade	4 989 042	5 350 049	5 513 785	6 171 691	6 616 593

ECONOMIC VALUE CREATED AND CAPTURED IN EUROPE

Yet, the industry is not dead. With the support of a unique R&D landscape, it continues to innovate, evolve, grow, and position itself in various segments of the value chain. Some actors have gained a world-class expertise and leading positions, but they could suffer from the lack of commercial opportunities at the industrial level in Europe.

Hence, PV manufacturing now needs to be recognized as a sector of strategic importance for the EU economy, providing energy independence, industrial jobs, and economic growth. The European PV business will generate hundreds of billions of euros in revenues, employ dozens of millions of people, in addition to making a significant contribution to fighting climate change.

6. ESMC'S STRATEGY

Considering the presented context and elements, the European Solar Manufacturing Council (ESMC) has defined a strategy and course of action to foster the renaissance of the European PV sector.

This strategy focuses on making solar photovoltaics (PV) a central element of the energy transformation process in Europe, through a sustainable yet ambitious development of PV installations in combination with a dynamic and competitive manufacturing industry covering the entire PV value chain on European soil.

The ESMC envisions a set of policies and regulations aiming at developing the PV market and the massive redevelopment of all segments of the PV value chain in Europe. This industry will feed the

expected massive development of PV installations in Europe and globally. The following measures are highlighted as of critical importance in addressing the issue.

Solar PV deployment and market clarity — the key factors to reduce energy dependence on third countries. EU should not only awake from the energy dependence on Russia but should also take fast and dedicated measures to boost the deployment of renewables in the EU. ESMC congratulates the foreseen target that the largest share in gas import reduction from Russia till 2030 will be taken by solar and wind deployment along with heat pumps installations (205 bcm gas import reduction out of the total 279 bcm reduction[5]). ESMC proposes to prepare detailed yearly European-wide solar PV deployment plans for the period of 2022–2025, stating ambitious deployment of renewables during this period. It is instrumental to start implementing the targets immediately, while concentrating the effort on renewables. Such plans send the appropriate market signals and ease planning adequate implementation measures.

Solar PV deployment and PV manufacturing in Europe — different sides of the same coin. Quick and ambitious extended solar PV deployment plans in the REPowerEU proposal should be equally reflected by the EU support of the PV manufacturing industry in Europe. In 2020, the global EU manufacturing share in PV was 11% for polysilicon, 2–3% for modules, 1% for solar wafers and 0.4% for solar cells, while we stood for 15% of the global deployment. This led to a total trade deficit of about 7.88 billion euros from PV cells and modules for Europe in 2020. In the recent EU strategic dependencies assessment solar PV panels and technologies were acknowledged to be important. The EU strategic dependencies assessment also points out that public policy measures might support the industry's efforts to address the import dependency and overcome market failures. ESMC emphasizes that without properly addressing domestic PV manufacturing in Europe (the current challenges of the industry and market failures), EU is at risk of turning diminishing gas import dependence on Russia to long-term raw materials and PV hardware import dependence on China.

The EU strategy on solar energy is a right and timely decisive step, but clear and quick measures are needed. The EU solar strategy is already foreseen to encompass PV manufacturing issues and measures to enhance the strength, sustainability, resilience, competitiveness, and innovation of the solar energy value chain in addition to the strategy milestones on accelerating the deployment, facilitating system integration and maximizing the socio-economic benefits. ESMC proposes that along the adoption of the EU strategy on solar energy, a concrete action plan should be proposed to re-establish PV manufacturing capacities in the EU, including adequate public policies, financial support and other necessary measures.

Competitiveness of the PV manufacturing industry will be ensured only under competitive capital financing conditions. The EU strategy on solar energy is just a starting point to ensure market trust in PV manufacturing capacity expansions in the EU. A key component on this track, which needs to be practically aligned by the market, is financial capital at competitive costs — equity, debts and loans and credit guarantees. ESMC advocates for the sustainably competitive European PV manufacturing sector by empowering the Recovery and Resilience Facility, Just Transition Fund, Important Projects of European Interest (IPCEI) for PV and other support measures to secure the long-term supply of PV components along the entire value chain. Both financial capital in competitive conditions and an IPCEI for PV are key instruments to re-establish PV manufacturing capacities and reduce the strategic energy dependencies of the EU.

[5] REPowerEU Plan

SUPPORT PV MANUFACTURING IN EUROPE THROUGH APPROPRIATE POLICIES

The central point of ESMC's activities aims at supporting PV manufacturing in Europe along the whole value chain. This could be achieved by using smart instruments aligned with the market and policy evolutions. A general set of industrial policies will be required: ESMC favours a systemic approach to EU-based production for the current and future energy system. It aims at creating a level playing field with foreign (especially Asian and American) competitors. To reach this objective, a set of policy instruments will be required:

1. **PV in the post-Covid-19 environment**: PV as a key enabling technology within the European Green Deal and Recovery Packages. Transfers from already existing R&D&I- or development frameworks is essential. PV must be advertised as a clear and powerful solution to fight the economic downturn and mitigate climate change effects. In that respect, the existing and new stimulus packages must comprise dedicated lines for PV development, including manufacturing. As several countries have shown, the support for the energy transformation depends on the public acceptance of the measures and developments. PV does not escape this reality and well-paid jobs are part of the winning solution to public acceptance of the energy transformation. This comprises installations, but also industrial- and R&D&I jobs.

   RRF: As part of a wide-ranging response, the aim of the Recovery and Resilience Facility (RRF) is to mitigate the economic and social impact of the coronavirus pandemic and make European economies and societies more sustainable, resilient, and better prepared for the challenges and opportunities of the green and digital transitions. During 2021, ESMC addressed the EU Commission and followed the development of the Recovery and Resilience plans (RRP), and thereafter studied and summarized the total support for PV manufacturing in the endorsed plans.

2. **Protect and expand strategically important value-chains locally**: the COVID-19 crisis illustrated the difficulties in several European countries to produce ad-hoc equipment at reasonable price when traditional global trade options are under heavy pressure. Medical systems are only one of many value chains that must be preserved and reinforced in Europe in the coming years. Energy, food, and military security are examples of fields of activity where such a regional and local focus is crucial, while maintaining an open economy. One cannot systematically rely on imports for key parts of the PV technology, as has been stated for a long time by the European PV industry. As PV's share of the electricity mix is increasing and PV is becoming one of the most economic energy sources, it is of strategic importance to have a regional and local PV value chain. One key element would consist of a fair tax system, which would not disadvantage local actors.

3. **Support technological evolution** by setting up dedicated schemes to ease the depreciation, re-usability, and reconditioning of fast-changing equipment technologies.

4. **Sustainability policies** such as eco-design, green public procurement, ecolabel, and energy label, or "environmental (embodied CO2-content including transportation, scarce and hazardous materials etc.) and social footprint": simple but honest and traceable regulation schemes must be developed and applied to promote high environmental standards including carbon footprint. In addition to sustainability, social and quality standards are core elements

of manufacturing in Europe. In this respect, the current work[6] of the European Commission is an essential pillar to be supported and incentivized. Solar PV should also receive proper recognition in the Just transition fund project plans to be framed in the coming year.

As the European Commission is considering introducing environmental policies for PV and other markets, ESMC promotes a specific position aiming at mandatory policies rather than voluntary schemes, with a preference for a strong EcoDesign scheme. The inclusion of CO2-footprint, in addition to other environmental requirements, is a key success for ESMC, and we actively follow the development, both in an internal working group and in collaboration with partner organizations.

Additionally, as solar PV inevitably plays a significant role in Europe's Green transition, the forming of an Important Projects of Common European Interest (IPCEI) for solar PV manufacturing is considered a strategically important step for EU. This would help stimulate and restore the European solar industry, while establishing manufacturing of more advanced, reliable and sustainable technologies than those available on the market today.

The Treaty on the Functioning of the European Union provides for the possibility of approving state aid for 'Important Projects of Common European Interest' (IPCEI). IPCEIs allow European Member States to jointly support transnational cooperation projects with major synergies that make an important contribution to economic growth, jobs and the competitiveness of the EU industry and economy. ESMC initiated a process and a working group in spring 2021, in collaboration with the European Solar Initiative. Throughout 2021, the IPCEI consortia attracted over 50 European companies and research organizations.

5. **Financing tools:** Public (local, regional, national, European) and private financing tools will have to be fine-tuned to support local manufacturing. A special focus on the European Investment Bank (EIB) activities and rules of engagement are needed, combined with a novel, off-takers based approach, to de-risk the establishment of PV manufacturing. New investment schemes such as crowdfunding, crowdlending, Venture Capital, business angels or pension funds could be favoured, depending on the business segment and the technology novelty.

6. **Export facilities:** the EU PV market must be favoured by European manufacturers but should not stop at the European borders. In addition to tuning existing export policies and networks, an internal expert network – by invitation only or for members with special affiliation, should be formed. In addition, a database of experts and structures (e.g. GIZ, SE4ALL) should contribute to support the industry with the right tools.

[6] Expert input paper – EcoDesign and energy labelling for photovoltaic modules, inverters and systems in the EU

SUPPORT PV MANUFACTURING IN EUROPE THROUGH APPROPRIATE MARKET DEVELOPMENT

Market- and industry developments can hardly be separated. A market development disconnected from industrial development would result in a continuous insufficient acceptance from the public and policymakers. As a result, market development should be developed in parallel and in symbiosis with manufacturing options, to maximize European based added-value and the creation of high employment possibilities. Based on the following concepts, EU can develop an appropriate solar PV market, as this technology is the key electricity generation source of the 21st century:

1. **Wide-spread distributed PV**: self-consumption and energy communities, including novel decentralized and collective self-consumption concepts and peer-to-peer innovations.

2. **Competitive PV** is there, shifting policies to **accompany industrial PV development** in Europe, including tenders for utility-scale PV plants.

3. **Integrated PV: A double concept**: "PV everywhere" and "Dual Use-Territory (DUT)" including integrated PV concepts such as:

    a. BIPV: promoting BIPV in Europe and globally, including smart simplified BIPV regulations and products will create a new market for PV development.

    b. VIPV: PV in the automotive sector, accelerating the energy revolution though PV integrated in EVs with local PV-loading facilities. The use of PV embedded in EVs or to charge EVs with green electricity will contribute decarbonizing the automotive sector faster.

    c. All other integrated PV concepts and dual-use ones such as floating PV (FPV), agriPV (APV), PV noise barriers, PV above roads, PV above parking lots, etc.

4. **Connecting Information technology to Smart Grids**, digitalizing the energy systems including potential use of innovative technology to allow a seamless integration of high renewable energy shares in energy networks.

5. **Solar Fuels**: Green Hydrogen and similar clean synthetic fuels from solar PV will allow fully decarbonizing the energy sector, and the industry, at the lowest cost.

ALLIANCE BUILDING

PV must be seriously considered and requires massive support from all industries and sectors that it will significantly reshape in the coming years. ESMC proposes to build powerful alliances, which will increase the added value of these sectors and drive the acceleration of their adaptation to the energy transformation.

1. **The energy sector at large**: energy companies should realize the opportunities that PV offers, both in the power and general energy sectors.

2. **Building sector**: In addition to retrofitting solar panels on rooftops, new buildings as well as renovations are part of the markets to explore for PV to massively develop in Europe, offering new opportunities and joining forces with the heating and cooling sectors, smart buildings, and

energy communities. BIPV is only one of the multiple aspects of the inclusion of PV in the building sector.

3. **Transport sector:** VIPV can revolutionize transport, from automotive and trucks to aviation and the maritime transport sector. But it offers other possibilities to include PV as a part of its energy perspectives, e.g., via the integration of PV into the transport infrastructure such as roads, rail stations, sound barriers, EV charging stations and compensation areas.

4. **Heavy industries:** PV has a key role to play in decarbonizing heavy energy industries such as steel and concrete, through replacing carbon by green hydrogen, and by direct use of clean electricity.

5. **Energy vectors and storage**: this comprises the production and distribution green hydrogen and joined business models for PV, but not exclusively. There are both numerous and promising connections with the transport and building sectors and an increasing use of batteries and other storage systems in innovative business models will favour the PV development.

6. **Telecommunications and ICT**: while smart grid concepts emerge to allow integrating a higher share of distributed variable renewables within the grids, the need for ad hoc communication increases. This is also the case for tools to involve the existing ICT actors and to merge the worlds of energy and communication.

ESMC KPIs FOR 2022-2023 ON BOOSTING LOCAL PV MANUFACTURING IN EUROPE

Scaling up of PV manufacturing capacities, PV innovations and integrated PV solutions should be the backbone of the ESMC priorities for 2022-2023. Concrete measures in achieving these goals should be reflected by the below key concrete actions of the EU and the Member States.

1) **Financial support for European PV manufacturing**
    a. Key supportive parameters for financing adopted and financing fund fixed in the EU Solar PV Industry Alliance
    b. Further intermediation between the PV manufacturing industry and the Member States Governments through utilization of the financial support in the Recovery and Resilience Facility, Just Transition Fund and Innovation Fund
    c. Launch of the PV-IPCEI framework in the Member States and pre-notifying the first projects to the European Commission by 2022
2) **Measures for off take for the European PV manufacturing**
    a. A stipulated 5% "Innovative renewable energy" of all renewable energy capacity in the Renewable Energy Directive
    b. Local content proportion in the EU
3) **Appropriate regulatory framework adopted for the European PV manufacturing**
    a. Key parameters adopted in the EU Solar PV Industry Alliance
    b. EcoDesign, Energy Labelling, sustainability criteria and labour standards proposed and adopted by the middle of 2023
    c. Concrete plans of PV hardware inclusion in the Carbon Border Adjustment Mechanism

4) **Recommendation and guidelines for the European PV manufacturing industry seeking competitive advantage for integrated PV solutions, through customized solutions for:**

   a. Rooftop PV
   b. Buildings (BIPV)
   c. Agrivoltaics (APV)
   d. Transport (VIPV)
   e. Floating PV (FPV)
   f. PV in noise barriers, roads, parking, etc.
   g. Sustainability/Circularity/low-carbon-based PV design and technology concepts towards improved recyclability, reduced embodied carbon, etc.
   h. Hybrid renewable power plants including i.e. PV and electrical and/ or hydrogen-based energy storage

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