Commissariat à l’énergie atomique et aux énergies alternatives
Atomic Energy and Alternative Energies Commission

Answer to the European Consultation

EU strategy for solar energy

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Summary

CEA welcomes the European Commission's willingness to adopt a strategy for solar energy, an energy that is central to achieve European climate objectives.

The challenge for the European Union is twofold:

- Create the conditions for a massive deployment of solar photovoltaic and thermal energy production capacities;

- Push for the emergence of a European solar industry, to ensure the Union's strategic autonomy and avoid substituting its current dependence on fossil fuels for a dependence on imported components. Currently, only 3% of the photovoltaic panels installed in the EU are produced in Europe.

However, this industry will only emerge if the EU develops a comprehensive approach to master the entire industrial value chain, from R&D to large-scale deployment.

For the European solar industry to grow, the EU must ensure that international competition takes place on a level-playing field. This requires a set of measures (fiscal, customs, regulatory, etc.) that favour local and environmentally friendly production.

The European Union must maintain its efforts to reduce the carbon footprint of solar energy over its entire life cycle. These measures will be favourable for the emergence of a European solar industry, as the energy used to produce components and panels is less carbon-intensive in the EU than in the countries currently supplying it.

As solar energy is by nature intermittent, its deployment must be accompanied by measures designed to increase the flexibility of the electricity system: making demand more flexible, developing means of storage and furthering interconnections between low-carbon hydrogen and heat networks, etc. The development of the technologies allowing for the conversion and storage of solar energy in a chemical form (solar fuels and chemicals) is an area where Europe is a pioneer. It should be developed in the future by focusing on the entire value chain to enable the emergence of European players and ecosystems.

In order to preserve European industrial competitiveness, the European Union must allow and encourage the implementation of mechanisms to regulate the price of electricity and other decarbonised energy vectors, in order to bring selling prices to consumers closer to production costs.

Finally, the emergence of a strong European solar industry requires a clear industrial policy, which provides long-term visibility to the companies of the sector.

CEA welcomes the will of the European Commission to adopt a strategy for solar energy. Solar energy is part of the solution to the climate challenge, but also part of the European Union's sovereignty. If photovoltaic panels and components are today largely imported – more than 90% if we consider the complete value chain – the current geopolitical situation highlights the imperative need to strengthen Europe's strategic autonomy, which requires the deployment of European value chains.

Towards the rise of a European solar industry

Europe has some of the building bricks of the solar photovoltaic industrial value chain: production of polysilicon, wafer, cells and modules, etc. However, these bricks, although essential for the emergence of a solid European industry, are still largely insufficient, far from being up to the scale of European demand for photovoltaic panels, and poorly integrated with each other. The polysilicon produced in the EU is mainly exported to China to be transformed into ingots, then wafers, then cells, then modules... which then return to Europe. **Strengthening and integrating the different components of the solar photovoltaic industrial value chain is therefore essential for the European Union to build an industry that meets its needs.**

In this respect, the CEA fully shares the European Commission's precise analysis of Europe's strategic dependencies in the solar photovoltaic technologies and modules sector, as well as the resulting recommendations[1].

Heat production accounts for 50% of European energy demand[2]. Solar thermal energy is a tool to decarbonise this heat in the short term. This is all the more true as the cross dynamics of the deployment of low-carbon electricity generation capacities and demand – in particular to serve new uses (mobility, hydrogen, heating, etc.) – point to tensions in terms of supply in the years and decades to come.

The deployment of solar heat production capacities, using mature thermal technologies, could lead to a reduction of up to 40%[3] in the consumption of gas, oil and coal under European temperatures for the residential sector, heating networks and part of industrial energy consumption (e.g. agro-industry, drying, paper mills, heat consumers of 80°C - 150°C).

The sharp gas and liquid fuels price rise, combined with taken regulatory measures and the increase of the carbon value (due to the EU ETS and national taxes), should incentivise an acceleration of the deployment of solar heat, which itself should allow for economies of scale and lower production costs for solar heat (currently between €10 and €90 per MWh). The take-off of a European sector of manufacturers, installers, suppliers of decarbonised solar heat needs a coordinated support policy (CO_2 price, incentives for local production) to accelerate the deployment of mature technologies and the transfer of future technologies developed by research and technology organisations (150-350°C and high temperature >400°C).

[1] "EU strategic dependencies and capacities: second stage of in-depth reviews" : https://ec.europa.eu/docsroom/documents/48878
[2] https://heatroadmap.eu/heating-and-cooling-energy-demand-profiles/
[3] http://ship2fair-h2020.eu/main-goals

Supporting the European localisation of value chains

The European Union is an international leader in terms of solar technologies. This is an asset that should be preserved and consolidated. However, the experience of recent years has shown that this is not enough to make these technologies available on an industrial scale. **The Union must also develop a general vision of value chains** – from the supply of materials to the manufacture of photovoltaic and thermal panels – so that the European industry can grow around these technologies. Embracing this view on the need to dispose of local value chains is essential for the EU to reduce its dependence on Asia for solar technologies.

Our dependence on imported fossil fuels should not be replaced by a dependence on imported components in a strategically key sector like solar energy. Developing solar energy is one of the ways to reconcile climate policy – with the objective of achieving carbon neutrality by 2050 – with industrial policy. The European Union will need solar energy to reduce its dependence on fossil fuels, which still account for almost 80% of the final energy consumed in the EU[4]. It therefore needs to dispose of the appropriate technologies, industries and supply chains of materials and components.

In order to ensure that international competition takes place on a level playing field, the EU must adopt a set of fiscal, customs and/or regulatory measures leading to a minimum share of local and environmentally friendly production (border barriers, calls for tender oriented towards local content, etc.). If manufacturers are not certain of having a market, they will not thrive. However, their development is obviously a prerequisite for lowering costs. The European Union must therefore guarantee a market for its manufacturers. This is the approach adopted by countries such as the United States and India to ensure the development of their solar photovoltaic industry, despite production costs being 30 to 40% higher than in China in the case of the United States.

Support for the solar photovoltaic industry outside the European Union

In the United States of America

- Fiscal incentives to support domestic production.

- Legislation to encourage the adoption and deployment of solar energy, including a production tax credit and an investment tax credit to encourage solar projects that rely on domestic manufacturing.

- Coordination of trade policy on the federal scale to create a level playing field for the US solar industry and its workers.

In India

- Production linked initiative (PLI): direct subsidies to Indian-based photovoltaic panels projects producing more than 10 GW/year. The response from the industry to this initiative has exceeded expectations.

[4] IEA, https://www.iea.org/data-and-statistics/data-browser?country=EU28&fuel=Energy%20consumption&indicator=TFCbySource

- Access to competitive financing (lower weighted average cost of capital, around 7-8% in India against 12-14% elsewhere).

- Domestic content requirement in all PV tenders, in a large and fast growing market.

- Border customs barriers: on 9th March 2021, the Indian Ministry of Finance introduced a 25% customs duty on PV cells and a 40% duty on PV modules, effective from 1st April 2022.

The EU should define its priorities regarding the integration of a high level of solar energy production and frame its R&D policy accordingly (integration into buildings, land use, recycling, etc.).

The EU can also, as India does, directly support industrial projects in order to limit CAPEX and OPEX levels.

These combined approaches must be adopted on a scale of several tens of GW of panel production capacity per year, on the European scale, at a rapid pace and with continuous support to projects over a time frame of at least 10 years. This will attract investors and allow an ecosystem to gradually emerge and become competitive.

Reducing the carbon intensity of solar energy

The European Union must continue its efforts to reduce the carbon intensity of solar photovoltaic energy and thermal energy over their entire life-cycles.

Having complete value chains back in Europe is a way to reduce the carbon intensity of solar energy. This is because the European Union and its Member States have the power to set and enforce standards – including environmental ones – on their territory, which is not the case for components produced abroad and imported. Furthermore, the European Union has set itself ambitious decarbonisation targets which, if met, will lead to energy mixes that are less carbon intensive than those of the world's other major industrial powers. Producing solar panels and their components in Europe will therefore make it possible to reduce the carbon footprint and the carbon intensity of solar energy.

The carbon intensity of solar energy must be considered over its entire lifecycle. Solar energy, both photovoltaic and thermal, does not emit greenhouse gases in operation. However, it does emit greenhouse gases – like all energy sources – over its lifecycle. Monitoring and furthering our efforts to reduce greenhouse gas emissions from solar energy must therefore cover the entire lifecycle. It is regrettable that in the European taxonomy of sustainable investments, the criterion of 100 gCO_2e/kWh imposed on hydraulic energy has not been applied to all other sources of energy, and in particular solar photovoltaic energy. This would have provided an incentive to reduce life-cycle emissions, in particular by locating the value chains in the European Union.

Promoting the storage potential of solar energy

Solar energy is intermittent by nature. Its deployment must therefore be accompanied by discussions and actions aimed at developing flexibility levers, particularly on the demand and storage sides, as well as developing interconnections between low-carbon energy networks.

The means of storage cover electricity, heat, hydrogen and future low-carbon liquid and gaseous fuels, including those derived from solar energy.

For the future, it seems essential to identify solar fuels and molecules as forms of solar energy themselves, alongside the more established technologies that are solar photovoltaics and solar thermal technologies.

Efforts to relocate battery production, particularly Li-ion batteries, must also be maintained and strengthened. Generally speaking, the solar energy innovation policy must be directly associated with all the sectors and vectors that can be coupled (storage, mobility, buildings, H2, heat, electricity).

In the short term and as a complement, it is also necessary to develop the means of massive storage of electricity through other ways (thermal or compressed air) as additional assets of flexibility and stability.

Decoupling low carbon energy and fossil fuels prices

Solar energy, like all low-carbon sources of energy, provides protection against fluctuations in the market price of fossil fuels: the less the European Union will depend on fossil fuels, the more the competitiveness of its industry can be preserved from their price rises. However, replacing carbon-based energy with low-carbon energy is not enough.

The European Union must encourage the implementation of an energy price regulation that allows private and professional consumers (including industry) to benefit from the "protection" constituted by low-carbon energy, particularly in a context of high fossil fuel prices. Supplying energy at market prices – i.e. at the marginal production cost of gas-fired power stations for electricity – does not allow consumers to benefit from the low costs enabled by low-carbon energy. This threatens their competitiveness in the short term.

Finally, innovation is only one link in the value chain. It must be supported, but in order to do so, there needs to be industrial actors ready for uptake. The future of solar photovoltaic energy and thermal energy in the European Union therefore depends on the establishment by the EU of **a clear industrial policy, providing long-term visibility to the actors of the solar sector.**

Consolidating Europe's technological leadership to support the industry

The European Union's ability to build an internationally competitive industrial solar sector can only rely on R&D and innovation, which are the first link in the value chain. Europe can rely on its technological research organisations (RTOs), which have been able to maintain R&D with a high level of technological maturity, ready to be transferred to industry.

In support of the industrial ambition that must be at the heart of the European strategy for solar energy, the main R&D challenges for the coming years are:

In the field of solar photovoltaics

- *High-efficiency photovoltaics dedicated to the massification of electricity production.* The challenge is to make the best use of the available surfaces – on which the panels will be installed – by equipping them with high-performance installations to produce the maximum amount of energy per unit area. The latest generations of cells, using heterojunction technology, can achieve yields of 25%, compared with around 20% for previous technologies. The aim is to improve efficiency to over 25% on large-area silicon cells and eventually to over 30% with so-called tandem technologies, i.e. combining silicon and perovskite;

- *The integration of photovoltaic modules in various supports such as buildings, vehicles, infrastructures ("photovoltaic everywhere").* The aim is to add new functionalities to these, made possible by the energy autonomy provided by the modules, and thus increase their value through the indirect benefits they provide. One of the strong assets of photovoltaics is that it opens the door to energy autonomy, which makes it possible to envisage "nomadic" applications, including aeronautical and space applications, as well as solutions for mobility and maritime or land transport. This field does not follow the same logic as grid-connected photovoltaics, as it is functionality rather than productivity that is sought.

- *Splitting up and recycling PV module components to allow for their reuse and adopt a more circular approach in solar photovoltaic energy production*. In order to reduce its environmental footprint – greenhouse gases emissions, consumption of primary raw materials – and increased dependence on imports, the deployment of solar energy and energy storage must follow a circular economy approach, that encourages the inclusion of component recycling as part of the value chains, and incentivises the reuse of secondary materials.

In the field of solar thermal energy

- The search for new sustainable devices that are the least intensive in terms of materials and greenhouse gas emissions in order to replace heat production from fossil fuels with solar heat, whose lifecycle GHG emissions are low.

- Reliable integration through the deployment of storage and hybridisation of the solar resource, and large-scale deployment of heat in medium temperature (T<200°C) industrial processes.

- At high temperatures (T>400°C), the development of specific solar technologies (heat carriers, solar reactors) for the chemical, mineral and metallurgical industries.

Conversion and chemical storage of solar energy

The conversion and chemical storage of solar energy as solar fuels and commodity molecules for the chemical industry – from abundant molecules such as CO_2, N_2, H_2O... – appears to be promising. It could indeed contribute to decarbonise the energy and chemical industries and to reduce the Union's dependence on imported fossil resources, as well as to ensure a transition towards a circular economy with the creation of local value chains. As it provides dense storage capacities, on the short and long terms, it is very topical in a context of an energy system with a high penetration of renewable energy.

There are two main approaches to converting and storing solar energy in a chemical form:

- multi-stage conversion by electrolysis from renewable and low-carbon electricity (e-fuels) that can be deployed on an industrial scale by 2025;
- direct conversion (or artificial photosynthesis), which is more prospective; its first industrial-scale developments are indeed expected from 2030 onwards. The EU has solid assets in this field with a cutting-edge academic and industrial community brought together and structured within the European SUNERGY initiative, which must be supported so that the innovations contribute to the creation of European players and ecosystems.

All these research objectives should be integrated into a large Horizon Europe R&D partnership to promote the acceleration of technological maturation and industrial deployment of these different technologies. This partnership should be of a co-programmed nature, with cooperation between public and private actors to ensure that the research effort supported in Europe is transferred to the private sector to result in marketable innovations.

The current period is a key moment in this respect. It is now that the European Union must promote the rise of an integrated industrial sector in the field of solar energy, at a time when massive investments will be made not only to replace first generation installations but also to considerably increase installed capacities. Otherwise, Europe will remain both economically and strategically dependent for its solar energy needs in the long term. But public R&D efforts, which have enabled Europe's current technological leadership, may also be difficult to sustain without an industrial sector ready to take advantage of them.