



Technology Brief

Update of Solar Photovoltaics in the Technology Catalogue (August 2026)

The Danish Energy Agency has published an updated Technology Catalogue chapter for solar PV in august 2026.

Major changes in updated Technology Catalogue

The updated technology catalogue chapter reflects the ongoing global technology development and deployment of solar PV in Denmark and revises technoeconomic assumptions such as cost, efficiency and area requirements, adds other plant typologies with battery co-located systems to the quantitative data, and gives a perspective on sourcing considerations in a European context.

Technological development and cost reductions

The updated chapter takes stock on the expected technological development of various cell architectures and describes a shift from the previous sustained high to more moderate cost reductions through learning, alongside higher than previously expected efficiency gains by an expected commercialization of tandem cells over the next ten years. As single junction technologies are approaching a practical limit in cell efficiency, tandem concepts like perovskite cells can increase efficiency compared to single junction technologies by combining two or more layers and utilizing a larger part of the solar spectrum. Challenges around stability, mass production, material consumption and supply chain will need to be addressed to realize this development.

Alongside expected changes in cell architecture, the cost development is subject to new structural drivers. The solar cell itself, which has historically driven the majority of cost reductions through added production output and learning¹, is becoming a progressively smaller share of total module cost. Instead, an increasing share of costs is associated with materials and components such as glass, silver, encapsulation materials, and transport, where there is limited potential for further technology-driven cost reductions. This raises the catalogue's long-term cost projection compared to the previous edition.

As previously, the new edition of the chapter has quantified financial assumptions of current solar PV plants predominantly based on interviews. Together with the

¹ Wright's Law has described the solar module cost reduction following a strict downward trend each time the cumulative PV module production doubled, the module price dropped about 25.7% over the past 44 years



expected technological development, comparative cost reduction curves of the various solar PV plants are shown in Figure 1².

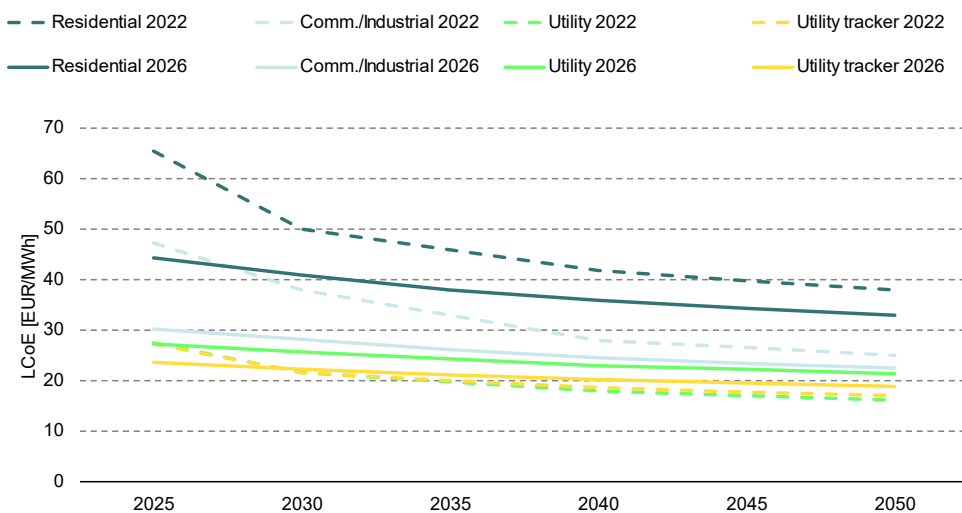


Figure 1: LCoE trend of datasheets from 2022 and 2026 edition

Expressed through the Levelized Cost of Electricity (LCoE), rooftop solar PV plants see notable production cost reductions in the short term due to substantially lower O&M cost, which is driven by the development of cheaper inverters and lower replacement cost over the plant's lifetime. This trend is seen for both residential and commercial/industrial rooftop plants. With this update, industrial rooftop plants in the small MW range and on flat roofs are expected to have production cost close to ground mounted utility scale plants.

Production cost for utility scale plants of the base year 2025 remain on the same level as the previous edition, but see a lower cost reduction trend due to expected lower learning and a higher technological maturation of cell development. Utility scale tracker systems benefit more than conventional utility scale systems from a higher DC/AC ratio, driven by low module prices, module efficiency gains and thus lower area requirements. In the current edition, the production costs are lowest for tracker systems for current and future plants.

However, as LCoE does not reflect income streams, the lowest production cost from a plant perspective is not the only metric to consider.

² Production costs are calculated with a socioeconomic financial rate of return of 3.5 pct. over the plant's expected lifetime.



Co-located solar PV with battery energy storage systems (BESS)

Both capture prices for solar PV, and investment cost for battery cells and systems, have fallen. Therefore, Denmark and several other markets have seen deployment of batteries co-located with both new and existing solar PV plants.

Reflecting this market development, the updated catalogue chapter adds three datasheets on co-located batteries for residential and commercial/industrial rooftop as well as utility scale ground mounted systems, and quantifies representative plant designs in a Danish context.

For utility-scale PV and BESS co-located plants in Denmark, market participants converge to systems in which the battery capacity typically is dimensioned at 30-50 pct. of the solar PV module capacity, and with an emerging standard of 4-hour discharge systems. The design is driven by the gradual saturation of the ancillary-service market, by the higher hedge value that a longer-duration battery offers to lenders, and by the simpler financing structure of projects where wholesale arbitrage is the principal revenue source. By dimensioning the grid connection capacity at around half the module capacity, excess production during sunny midday hours can be stored in the battery for later feed-in, which saves grid connection capacity that can be sparse in locations favourable for new sites.

Figure 2 exemplifies the capacity dimensioning of a conventional solar PV plant compared to a battery co-located solar PV plant with the same installed module capacity, as quantified in the chapter. Seen from the point of grid connection, the full load hours of the battery co-located plant rise accordingly by ca. 50 pct. Beyond this grid connection optimization, flexible dispatchability allows for plant dispatch at high value hours such as evening hours with otherwise low solar irradiation.

It is expected that batteries will be installed with higher discharge times within the next ten years given the continuous technological improvement, scaling and learning of BESS. From 2035, 6-hour systems are expected to be the norm. The slightly higher capital expenditure for the plants is expected to be more than mitigated by added revenues from the larger battery.

There is no representative datasheet for tracker-based systems, as it is observed that solar PV plants either are installed with BESS, or tracker systems. Both BESS and trackers have a benefit of added peak shaving compared to a conventional solar PV site, however peak shaving can be delivered more effectively and flexibly by battery co-located solar PV plants.



Figure 2: Representative plant design of conventional solar PV and battery co-located solar PV plants with equal module capacity

PV component sourcing considerations

The EU has set an ambition of 750 GW of installed solar PV by 2030, but current forecasts indicate this target is unlikely to be met. At the same time, the EU is trying to rebuild domestic manufacturing capacity through the Net Zero Industry Act, which targets 30 GW of annual PV module production in Europe. Additional policy initiatives such as the proposed Industrial Accelerator Act and the Cybersecurity Act strengthen this direction by promoting “Made-in-EU” criteria in public procurement and limiting reliance on high-risk foreign suppliers for critical energy infrastructure.

Despite these efforts, the global PV industry remains heavily dominated by China. Europe currently has around 81 PV module manufacturers, with a combined capacity of ca. 14 GW, though not all production is active and several planned projects are uncertain or have been cancelled. This makes the goal of a fully integrated European value chain of 30 GW by 2030 difficult to achieve. The most realistic near-term expansion opportunity lies in module assembly using imported cells, as assembly lines are relatively easy to deploy and not a key bottleneck.

A major constraint is cost competitiveness. Producing solar modules in Europe is estimated to be about 10 €/ct/Wp more expensive than in China, driven by higher costs for equipment, facilities, labour and materials. This results in higher plant investment costs and the LCoE being roughly 15 pct. higher compared to Chinese-supplied modules. These challenges are intensified by Chinese overcapacity,



estimated at two to three times global demand, which keeps market prices below sustainable production costs and makes European production difficult without policy support.

Perspectives for Denmark

The updated technology chapter for solar PV shows that the profitability of new solar PV plants more than ever is driven by the optimization of grid connection, flexibility of dispatch and energy arbitrage in high volume energy markets, rather than defined by the lowest LCoE and production cost of a plant. It is expected that the utility scale build-out of solar PV in Denmark going forward is driven by co-location of batteries. Cost improvements for rooftop plants, especially large-scale industrial plants, highlight a viable alternative where cost of land, and self-consumption of power is high.