Federal Ministry
for Economic Affairs
and Climate Action

IN FOCUS

INTEGRATED PHOTOVOLTAICS LEAD TO HIGHLY EFFICIENT LAND USE

Integrated photovoltaics offer enormous potential: in theory, more than 3,000 gigawatts of power could be installed in Germany. The greatest advantage is that, unlike ground-mounted photovoltaics, integrated PV systems do not require any land of their own. However, some regulatory and economic barriers still need to be removed.

Share of renewables continues to rise. (Source: Michele Ursi/Shutterstock)

The Federal Government aims to achieve an 80% share of renewables in gross electricity consumption by 2030. The expansion of photovoltaics plays a central role in achieving this goal: the Renewable Energy Sources Act (EEG) sets out a target of 215 gigawatts (GW) of installed PV capacity in 2030. This means that the annual expansion of photovoltaics must be further increased. In 2023, more than 14 GW of PV capacity were installed; the goal is to achieve an annual increase of 22 GW from 2026. By end of the first half of 2024, the installed photovoltaic capacity already exceeded 85 GW, of which around 25% was produced by solar parks built on open farmland or meadows.

In addition to ground-mounted PV, it may make sense to also consider areas that primarily serve other purposes: agricultural, traffic and water areas and the shells of buildings. The greatest advantage of so-called 'integrated photovoltaics' is that they will not lead to any conflicts over land use. As a result, PV systems are certain to achieve a very high level of social acceptance. Another advantage of integrated photovoltaics is their high local added value

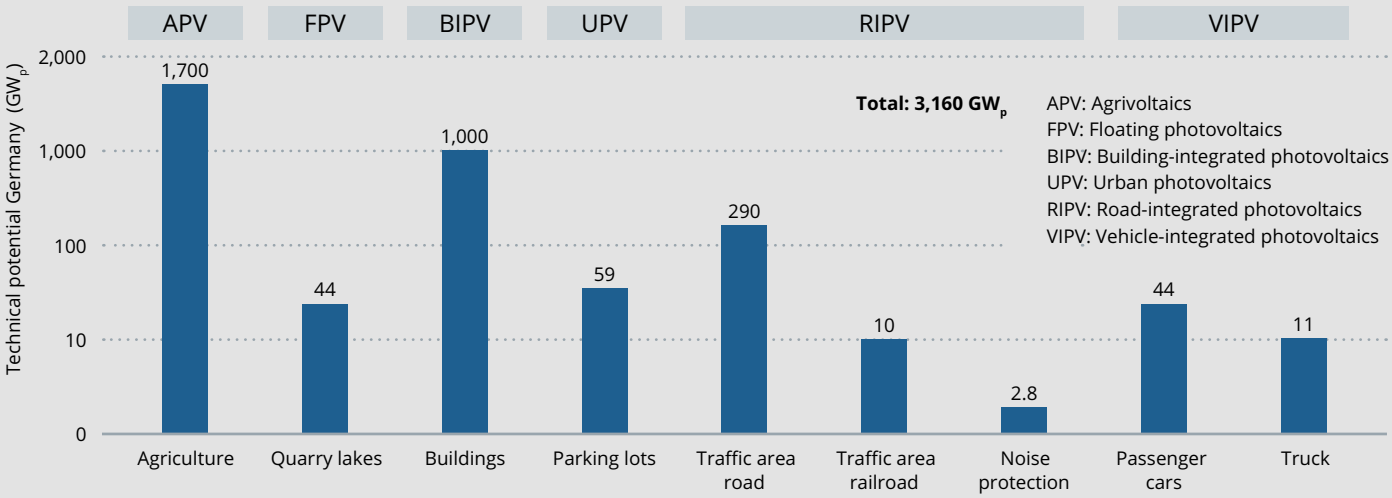

Figure 1: Technical potential for integrated PV applications in Germany (GW_p) (Source: Based on Fraunhofer ISE)

According to the Fraunhofer Institute for Solar Energy Systems ISE, integrated photovoltaics could technically achieve an installed capacity of more than 3,000 GW peak nationwide (see Figure 1) – theoretically, it would therefore be possible to use integrated photovoltaics to achieve the planned expansion targets for both 2030 and 2040. This is offset by the high costs associated with the installation of integrated PV.

Diverse applications

There are many different ways to integrate PV systems into existing areas. For example, farmers can install semi-transparent modules above orchards, vegetable crops and grain fields that supply electricity and at the same time protect their produce from heavy rain and other extreme weather conditions. There is also a high technical potential for the use of integrated photovoltaics in agriculture and buildings (see Figure 1). Integrated into building sleeves, photovoltaic systems can also take on tasks such as thermal insulation or wind and weather protection. In the body of cars or trucks, PV generates energy for the vehicles' batteries.

Solar modules can also be installed as a noise barrier. As a roof for traffic areas and parking spaces, they keep out precipitation and sunlight. Opencast mining and quarry lakes are also promising locations for integrated photovoltaics.

Higher costs

In Germany, integrated photovoltaics, with the exception of building-integrated photovoltaics, is currently still in its infancy. One reason for this is the lack of a regulatory framework that allows their full potential to be tapped. In addition, the electricity production costs are significantly higher than those of conventional systems, meaning that the construction of these systems is currently not very attractive and there is therefore little need to adjust the regulatory environment. However, this gap is constantly shrinking thanks to technical developments and the increasing number of integrated PV power generation systems that are being installed. Another barrier is that the established planning, production and installation processes, for example in the construction or transport sectors, generally do not provide for the integration of photovoltaic components.

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IN BRIEF

How important is photovoltaics for the German energy transition?

In addition to wind energy, photovoltaics is becoming the central generation technology in Germany's energy system. PV systems with a combined output of over 85 GW are currently installed in Germany. Around three quarters of these are rooftop systems. According to long-term scenario calculations by the Federal Ministry for Economic Affairs and Climate Action, 400 to 435 GW of PV capacity must be installed by 2045 at the latest, depending on the scenario, in order to achieve Germany’s climate targets.

What potential do the different types of integrated photovoltaics have in Germany?

By far the most promising form is a system called agri-voltaics, i.e. the coupling of electricity generation and agriculture – Fraunhofer ISE sees a technical potential of 1,700 GW in this area. This is followed by building-integrated photovoltaics with 1,000 GW and street systems with 290 GW. The potential in vehicle bodies, in spaces over parking lots and on lakes, however, is significantly lower.

How does the current photovoltaic strategy promote the expansion of integrated photovoltaics?

The solar package of May 2024 simplified the expansion of ground-mounted and rooftop systems in order to further boost the expansion of integrated photovoltaics. It further facilitates the utilisation of agri-PV systems. In addition, obstacles to the use of rooftop PV systems were reduced, for example by granting exemptions from the direct marketing obligation for PV systems with a high self-consumption rate, by accelerating grid connections, including through a right of use for connection lines for ground-mounted PV systems and shorter deadlines for meter replacement for rooftop PV systems. These measures are intended to increase the expansion of PV capacity in order to achieve the targets by 2030.