Seamless-PV drives the implementation of new integrated photovoltaic (IPV) solutions in different market sectors. The objective is to develop advanced manufacturing equipment, processes and digitalisation strategies focusing on glass-glass lamination as well as lightweight composite and polymer-based technologies.

Facing at real industrial environments and different market demands and opportunities, Seamless-PV sets up six pilot line levels and 11 different IPV demo cases across Europe, divided between integration in noise barriers, buildings, electric vehicles, and agriculture.

PV in Vehicles: powering the future of mobility

Becquerel Institute, a key partner of the project, has analyzed the market potential of various IPV segments, in the report "*IPV market potential and comparative long-term impact scenarios*". This includes aksi Vehicle-Integrated Photovoltaics (VIPV). The aim of this analysis, summarized here, is to demonstrate the potential and attractiveness of VIPV and to support exploitation activities and market entry strategy.

▲ *Examples of VIPV applications*

The methodology is divided into two main sections:

Technical Potential

Gross Technical Potential: this includes the cumulative number of vehicles (both internal combustion engine and electric, existing and new) in Europe up to 2050. Vehicle projections are based on the IEA Global EV Outlook 2024, considering two scenarios: the IEA Stated Policies Scenario (STEPS) and the IEA Announced Pledges Scenario (APS). Vehicles are divided into four categories: light vehicles (LV - passenger cars), light commercial vehicles (LCV - vans), heavy commercial vehicles (HCV - trucks), and buses.

The number of vehicles is then converted into surface area (km^2) based on the maximum exploitable surface area estimated for each vehicle type. Exploitable surfaces in 2024 are estimated to be lower and gradually expand until 2050 with the advancement of lightweight and flexible PV technologies.

Realistic Technical Potential: this excludes surfaces that are not permitted or are subject to technical constraints, taking into account the reduction in exploitable surface area.

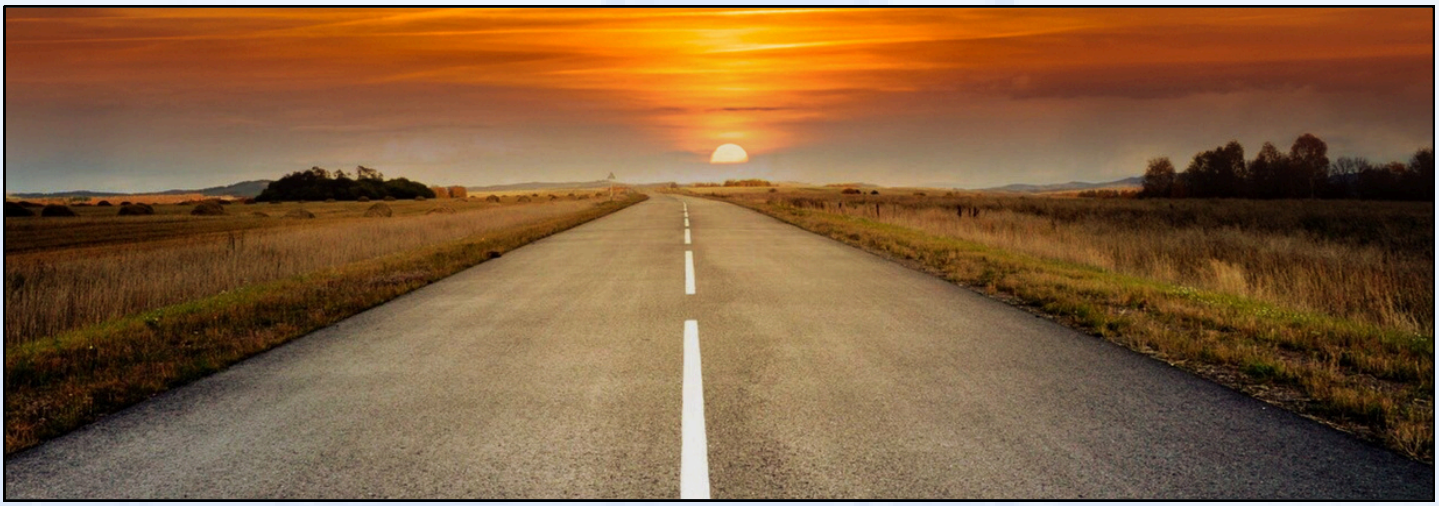
Economic Technical Potential: This only includes the share of vehicles for which PV installation is economically feasible. Generally, new vehicles, especially electric ones, are expected to be the most likely to integrate PV. For commercial vehicles and buses, a business model for PV installation might exist even for internal combustion engine (ICE) vehicles.

Specific Market Potential

Total Addressable Market (TAM): this is defined as the maximum potential for a specific application. For VIPV, the TAM considers only the integration of the solar system into vehicle parts (not retrofitting) and assumes this primarily occurs on new electric vehicles. The TAM also accounts for the gradual increase in exploitable vehicle surface area over time due to technological advancements.

Serviceable Addressable Market (SAM): this represents the portion of the TAM that is accessible and relevant, taking into account limitations such as regulation and geographical area. For VIPV, the SAM is calculated using the innovation diffusion model (S-curve), which describes the pattern and speed of innovation adoption in the market.

Three adoption scenarios (Low, Medium, High) are projected to reflect different growth trends and penetration rates of VIPV, based on EV projections (STEPS and APS). Surfaces are converted into installed capacity (GW) based on projected modular efficiency, estimated from the latest available data, such as ITRPV 2024.



Key Results for Vehicle-Integrated Photovoltaics (VIPV)

Estimated Cumulative Capacity (SAM):

- By 2030: Growth is projected from 10.88 MW (Low scenario) to 15.54 MW (High scenario). Although a more general estimate indicates "around 30 MWp" for 2030, the detailed projections show slightly lower figures.
- By 2050: The cumulative VIPV potential could reach between 7.398 GW (Low scenario) and 16.885 GW (High scenario). This exponential growth reflects the potential for transition from pilot projects to mainstream adoption.

Contribution by Vehicle Type:

- The vast majority of VIPV potential in all scenarios comes from light vehicles (LEV), i.e., passenger cars. This is due to their high numbers and the presence of an already established EV market. VIPV technologies are more attractive in lighter vehicles, as lower energy consumption means PV-generated energy has a greater impact on the vehicle's overall energy needs.
- Light commercial electric vehicles (LCEV) represent the second most promising segment, due to their larger surface area and higher numbers (compared to buses and HCEV), but with a lower probability of integration than LEVs.

- Heavy commercial electric vehicles (HCEV) have the highest surface potential but lower numbers and fewer market incentives for VIPV compared to PV applied to vehicles.

- Buses represent a niche with considerable surface potential, but VIPV solutions are not expected to gain significant traction, with conventional lightweight solar panels being a more likely preferred alternative.

Challenges and Drivers for VIPV

Despite strong potential, current VIPV adoption faces significant barriers:

- High production costs for specialized solar modules.
- Technical complexity in vehicle integration.
- Low consumer awareness.
- Complexity in maintenance and replacement of the VIPV system.
- The increasing energy density of batteries and the spread of ultra-fast charging stations could reduce the attractiveness of the extra range provided by the PV system.

However, there are also important drivers that can favor VIPV adoption:

- The acceleration of the EV market in Europe, supported by EU emission targets and policies.
- Growing consumer demand for sustainable mobility, with VIPV offering the added benefit of extending driving range and reducing grid dependence.
- Economies of scale and improved integration technologies will reduce costs, making VIPV more attractive to manufacturers and consumers.
- VIPV can find its niche in high-end vehicles, serving as a premium feature, and can be used by brands to differentiate themselves from the competition.

LEARN MORE

If you want to learn more, check out all the **materials** and **results** available on **seamlesspv.eu**

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