**Institution of Engineering and Technology (IET) plug-in solar PV position paper**

## Toplines

The IET recognises the potential for plug-in solar PV to provide an accessible entry point to small-scale generation. However, current evidence demonstrates that, without appropriate controls, it introduces material risks.

We recommend that

- Plug-in solar PV is only permitted within a tightly defined framework.
- System size is limited to one unit (800W) per residence balcony as has been enforced in Germany.
- Installations must clearly work safely with existing circuit protection, or the existing protection must be upgraded where necessary.
- Distinct electrical risks, including residual current device (RCD) performance and circuit overcurrent protection[1], are explicitly addressed.
- Measures are set to prevent unsafe combinations of systems and misuse.
- Voltage impacts and network effects are assessed alongside wider system changes.
- Product standards, enforcement, and consumer communications reflect real world usage patterns, not idealised compliance. REF013/2526[2] should be built on.
- Consideration must be given before installing heavy panels in unsuitable locations as it could lead to structural failure with panels falling from balconies during installation or maintenance.

## Current wiring regulations advice

BS 7671 establishes requirements for the safe design of electrical installations. These requirements assume that work is undertaken by competent persons and that installations are subject to appropriate inspection and testing. Plug-in solar PV systems challenge this model by enabling connection by consumers without professional oversight.

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[1] The IET specified “final circuit overcurrent protection” as we do not believe that the distinction between ring and radial circuits should have any impact on potential risks associated with plug-in solar.

[2] ARCEIO, RAF103/2526 Plug-in PV Systems in the United Kingdom RAF013/2526 Plug-in PV Systems in the United Kingdom (2026)

Under BS 7671, key requirements relevant to plug-in solar PV include:

- Protection against electric shock through appropriate earthing and bonding arrangements and disconnection of faults.
- Protection against overcurrent and overload through correctly rated devices.
- Consideration of bidirectional power flow when generation is connected.
- Suitability of equipment, including inverters and connection accessories.
- Verification through inspection and testing.

In private/social rented properties, legislation requires that landlords have their properties inspected every 5 years. However, up to now, properties have not been assessed for the connection of new electrical sources, and there is no equivalent requirement for owner-occupiers. As a result, installations may range from legacy fuse wire protection through to modern RCBO based systems. This creates uncertainty regarding suitability for connection of generation by unskilled persons.

Typical domestic protection arrangements include:

- Most two-pole RCCBs, for example those in split load consumer units, are inherently suitable for bidirectional use.
- Many existing RCBOs installed in UK domestic properties may not have been assessed or marked for bidirectional operation. RCBOs are preferred in modern installations but they must be suitable for bidirectional power flow. Consumers should not assume an RCBO is bidirectional unless its design, markings and manufacturer information confirm that it is[3]. BS 7671 requires that electrical installations are designed, installed and verified by competent persons for the intended use. BS 7671 does include requirements for the user of the installation and it does not state what can or cannot be plugged in to a socket-outlet, for example.

Plug-in solar PV units circumvent the requirements for existing electrical installations as, historically, electrical installations have not been designed to import electrical energy by means of a plug-and-socket arrangement. Further, the conventional 13 A plugs and socket-outlets to BS 1363-1 (current version was published in 2023) used in the UK states that "*plugs shall not be used for the connection of electrical power generators to socket-outlets"*. This creates a gap between regulatory intent and real-world application.

In 2024, BS 7671:2018 was amended to include requirements for protective devices that deal with power flow in both directions, e.g. RCDs that have electrical sources connected to both sides need to be bidirectional. Further, many legacy RCDs in the UK are of Type AC

[3] PluginSolarHub. RCBOs, Bidirectional Current and Plug-in Solar in the UK | PluginSolarHub (2026)

which are unable to adequately deal with DC currents emanating from electronic equipment, such as inverters in PV installations".

**Current safety barriers**

Potential rollout barriers due to safety fall into two broad categories: household level risks and system level risks. Within these, two distinct electrical issues must be treated separately, RCD behaviour and circuit overcurrent protection.

**Household level risks**

- Domestic installations vary widely in condition and protection. Plug-in solar purchased online or from retail outlets, therefore, may be connected to circuits that lack appropriate residual current protection, use unsuitable legacy protection, or do not incorporate devices rated for bidirectional operation. There is a significant risk that underlying faults in domestic wiring may be exposed or worsened.

- The interaction between microinverters and RCDs is a known issue. Direct current leakage can reduce the sensitivity of RCDs, a phenomenon sometimes described as blinding. This may impair fault detection and increase the risk of electric shock under certain circumstances.

- A less visible but important issue arises from the characteristics of circuits. Protective devices continuously monitor and measure electrical current and occasionally voltage to detect dangerous faults.

- There is strong evidence that products are marketed in ways that encourage multiple installations or 'daisy chaining'. This can result in power levels far exceeding safe assumptions. Whilst a single plug-in solar PV unit of ≤800 watts presents low risk, the connection of multiple units introduces uncertainty that is not currently managed.

- Plug-in solar PV units are likely to be installed outdoors in the United Kingdom, often on garden walls, fences or sheds rather than balconies, however, there are hundreds of thousands of flats with balconies in the UK. The absence of suitable external socket-outlets is likely to result in extension leads being used, possibly routed through windows and across outdoor areas. This introduces both electrical hazards and trip risks. This raises issues like:

    - The use of long or even 'daisy-chained' extension leads may introduce high earth loop impedance values and hence fault currents below the detection capability of consumer unit protection, especially ring main protection.

    - Panels are relatively heavy and may be installed in unsuitable locations. This could lead to structural failure with panels falling from balconies at great heights and falls during installation or maintenance putting the houseowner at risk of a civil case if they are installing it themselves.

- Consumers may not appreciate that performance figures assume ideal conditions. In practice, output is often limited to baseline demand in the range of 150 to 300 watts. Repeated inverter disconnection due to high supply voltage could further exacerbate dissatisfaction.

**System level risks**

- In some parts of the UK, customers experience persistent overvoltage conditions, with measured supply voltages occasionally exceeding the statutory upper limit of 253 V for extended periods, prompting DNO investigation and remedial action. Additional distributed generation could increase voltage further. Evidence shows that microinverters are inclined to trip at voltages below G98 specified 'no trip' test values, leading to underperformance and reputational risk. There is currently limited published modelling of low voltage network impacts from widespread plug-in solar deployment. This should be addressed alongside ongoing voltage management initiatives. It is understood that the ENA, on behalf of its member companies, consulted on lowering the LV voltage limit from -6% to -10% but the Electricity Safety, Quality and Continuity Regulations (ESQCR) will need to be amended, and the Secretary of State would need to authorise the change before implementing the change.

- Without an obligation to notify them, distribution network operators (DNOs) will have limited visibility of plug-in generation. While individual plug-in PV units are small, clustering effects can be significant at feeder level.

- In theory, localised uptake within streets or neighbourhoods can lead to voltage rise and trigger G98 over-voltage protection and trip the inverter. These effects are difficult to predict and manage without monitoring or registration mechanisms. G98 is being amended to reflect the potential voltage rises.

- At a national level, the total contribution of plug-in solar PV is likely to be modest when compared with rooftop solar deployment under existing policy frameworks. Even large-scale uptake would represent a relatively small proportion of total generation capacity.

**Further possible risks for consideration**

There are several potential risks that coincide with the increased adoption of plug-in solar PV technologies in the absence of installation and use regulation/use requirements. These risks need to be identified, assessed and accounted for. The risks include, but are not limited to, the following:

- An increased risk of fire if products are of poor quality;
- An increased risk of electric shock to homeowners;

- An increased risk of other electrical equipment failure as a result of poor voltage management/spikes;
- An unknown impact to house insurance (including landlord insurance) if there are no electrical inspections;
- An increased risk of an unsafe island mode leading to live electrical hazards for occupants and fire services during outages
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Government also need to consider fire risks as a broader issue. Fire is not a risk solely association with plug-in solar PV systems, you can equally purchase unsafe extension flexes online that are likely equally lethal. Government needs to clearly set out a roadmap as to what they are planning to do to enforce product safety standards for electrical products bought online, as well as in-store. These risks are considerably greater in apartments, and multi-occupant buildings, which might be the target market for such portable solutions where people don't have their own roof space.

Until the risks that electrical products pose are considered and addressed through legislation or frameworks, they will pose health and safety, fire and financial risks.

**Electromagnetic compatibility considerations**

Electromagnetic compatibility is an important consideration for plug-in solar PV in domestic environments. Evidence indicates[4] that while systems operate safely and remain stable, conducted emissions can exceed expected limits for residential equipment when operating at maximum output. These exceedances are not associated with unsafe behaviour such as loss of protection or system instability. However, they do highlight variability in product performance and a gap between standard compliance testing and real world operating conditions. Given that domestic installations already contain a high proportion of power electronic equipment, additional sources of continuous generation may increase overall levels of electrical noise. While the impact of individual devices is likely to be limited, cumulative effects remain uncertain. EMC should therefore be treated as a material consideration within any deployment framework. In practice, this requires testing at maximum rated output, clear product requirements, and effective market surveillance to ensure that only suitable products are placed on the market.

**What does good practice look like**

Good practice for plug-in solar PV installation must be grounded in compliance with BS 7671 and a structured risk management approach. Systems should be limited to a maximum of approximately 1kW peak, with a strong presumption of one unit per property; a safety trial undertaken by government shows that devices vary in export behaviours, with some exceeding declared ratings[5]. Systems below 4 amperes present comparatively lower risk.

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[4] ARCEIO. RAF013/2526 Plug-in PV Systems in the United Kingdom (2026)

[5] ARCEIO, RAF013/2526 Plug-in PV Systems in the United Kingdom. (2026)

Multiple units should only be permitted where installed as a conventional compliant generation system. However, we have real concerns about the ability to effectively regulate such a measure.

Connection should only be permitted where circuits are protected by fuses, circuit-breakers for household use and RCD-protected circuits, and where protective devices are suitable for bidirectional operation and compatible with inverter characteristics. Installations relying on fuse wire protection should be excluded. Where circuit-breakers are installed, their suitability (particularly in older installations) should be verified to ensure compliance with current standards and appropriate operational characteristics. This would require a basic assessment of the installation condition prior to connection. Undertaking an assessment of this kind could risk removing the cost benefits for the consumer that supermarket/online sellers can provide.

Where plug-in solar is sold it should come with guidance that explicitly communicates RCD requirements and compatibility, circuit overcurrent risks, and safe installation guidance. Market surveillance should ensure that adverts that recommend ‘daisy chaining’ are removed and standards should define safe mounting and maintenance arrangements suitable for everyday shoppers. It would be useful to provide users with realistic performance expectations in line with government recommendations through a public awareness campaign and product advertisement requirements.

Finally, it should be explored whether a formal risk register should underpin policy development, ensuring that both household and system risks are systematically assessed and mitigated.

**European models**

Germany and Spain have adopted more permissive approaches to plug-in solar, but these operate within different technical, regulatory, and housing contexts that limit direct comparability with the United Kingdom. Germany seeks to reduce the risk of undetected overload by limiting each property to one plug-in solar PV unit at a maximum rating of 800 Wbut it is still an issue.

Plug-in solar is most commonly associated with apartment living and balcony installations, where physical constraints limit the number of systems per property and reduce aggregation risk. Historically, Germany required connection via a specialist “Wieland” plug, designed to prevent electric shock by avoiding exposed live pins, although this required professional installation. Updated standards (DIN VDE V 0126-95) now permit the use of standard household plugs for certified systems up to 800 W, provided inverters automatically disconnect when unplugged or when grid supply is lost. Regulatory frameworks include defined capacity limits, simplified registration through a national database, and requirements for a bidirectional meter, alongside legal provisions that generally require landlords to permit installations subject to reasonable safety conditions.

Differences in earthing arrangements also influence the behaviour of protective devices and inverter leakage currents. Plug-in solar installations are widely available at relatively low cost

and can provide meaningful benefits where generation aligns with household demand, particularly for those without access to rooftop solar, although performance is highly dependent on orientation, shading, and usage patterns.

Taken together, the United Kingdom's reliance on BS 1363 socket-outlet systems and the variability of domestic electrical installations, the variability in installation condition, and the lower prevalence of balconies mean that these European models cannot be directly transferred without very careful and considered adaptation in line with recommendations in this paper.