

Fire protection of photovoltaic installations

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Speaker

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Promat



Promat since 1958

People



DEDICATED EXPERTS
1.300 employees

Presence



WORLDWIDE PRESENCE
Europe, Americas & Asia Pacific

Financial standing



TURNOVER : € +/- 400 MILLIO...

Production sites



17 PLANTS
Worldwide located

Fire protection of photovoltaic installations

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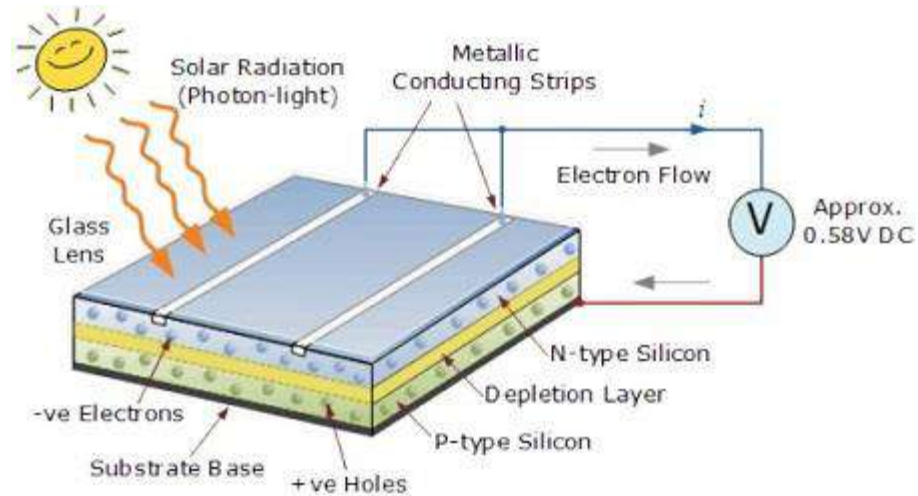
The European Green Deal



The Energy from the sun - solar energy



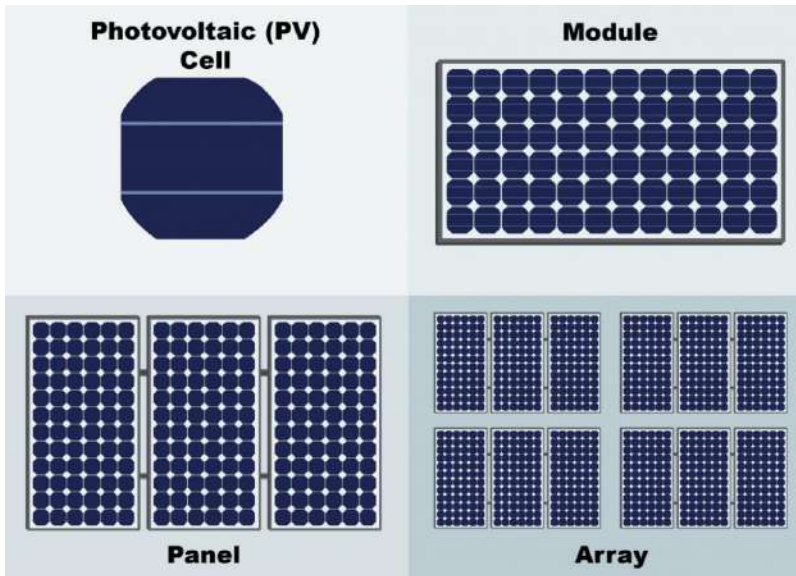
Generation of electricity from solar radiation: Photovoltaic cell



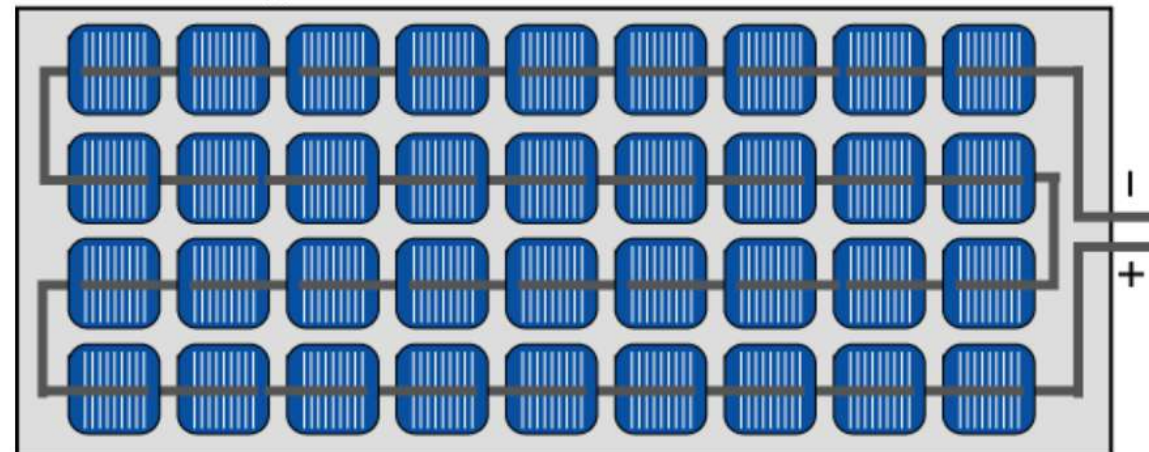
Solar cells produce energy by allowing photons or particles of light extract free electrons from atoms, generating a flow of direct current (DC).

- **Negative electrode** - collects electrons
- **Anti-reflective layer** - limits light reflection
- **The first, thin layer of silicon n-** positively or negatively charged
- **P-n junction (junction 2 of semiconductors)** which determines the appearance of voltage on the electrodes in the cell
- **A proper, thicker layer of p-silicon** charged inversely to the first layer.
- **The positive electrode** is located at the bottom of the cell.

Generation of electricity from solar radiation: Photovoltaic module



- Single cells, to obtain higher voltages are combined into modules
- Cells in a photovoltaic module can be connected in series, parallel or hybrid.
- The modules are combined into PV panels, resulting in commercial elements with specific dimensions and power.



PV pannels structure

Types of Solar Panels

Monocrystalline



- £ Most expensive
- ⚡ Highest efficiency
- 🕒 Lasts 25-40 years
- 👁️ Black colour

Polycrystalline

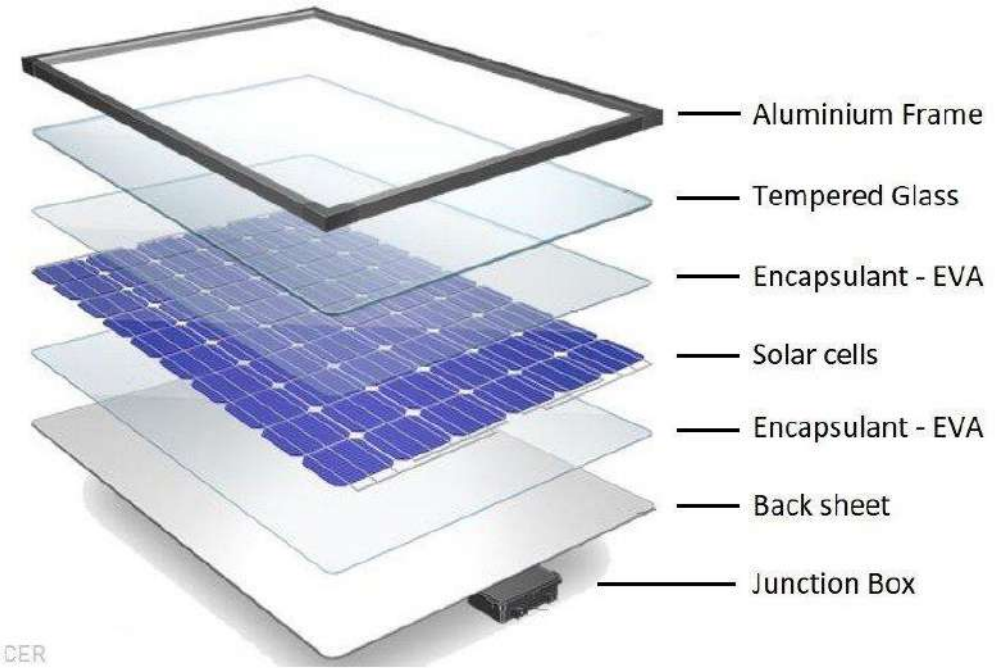


- £ Moderately priced
- ⚡ Medium efficiency
- 🕒 Lasts 25-35 years
- 👁️ Blue colour

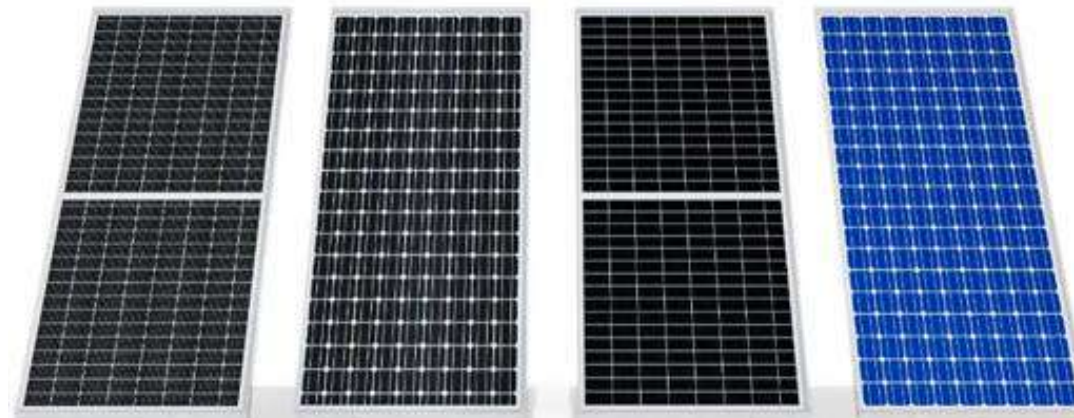
Thin-Film



- £ Least expensive
- ⚡ Lowest efficiency
- 🕒 Lasts 10-20 years
- 👁️ Panel colour varies

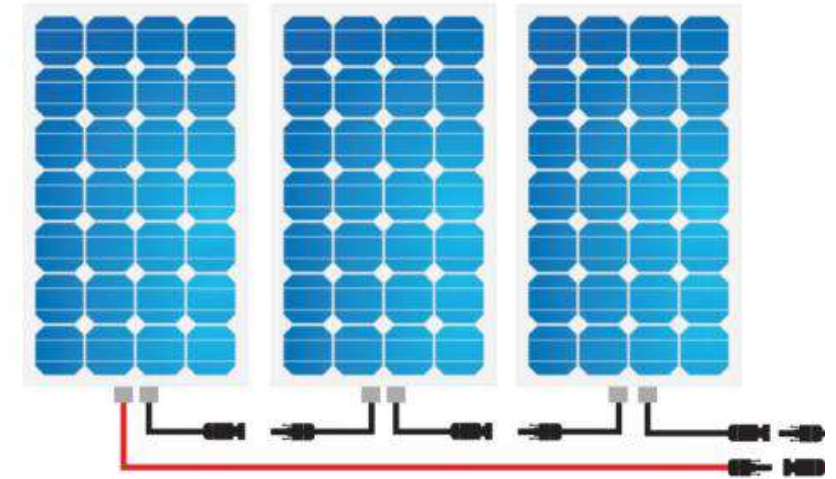
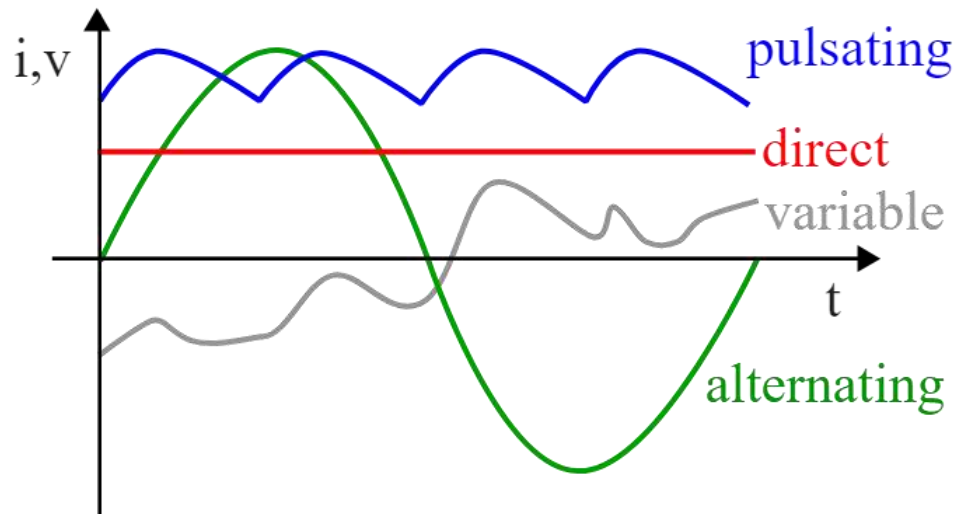


Fire rated class of PV panels A>B>C (UL790)



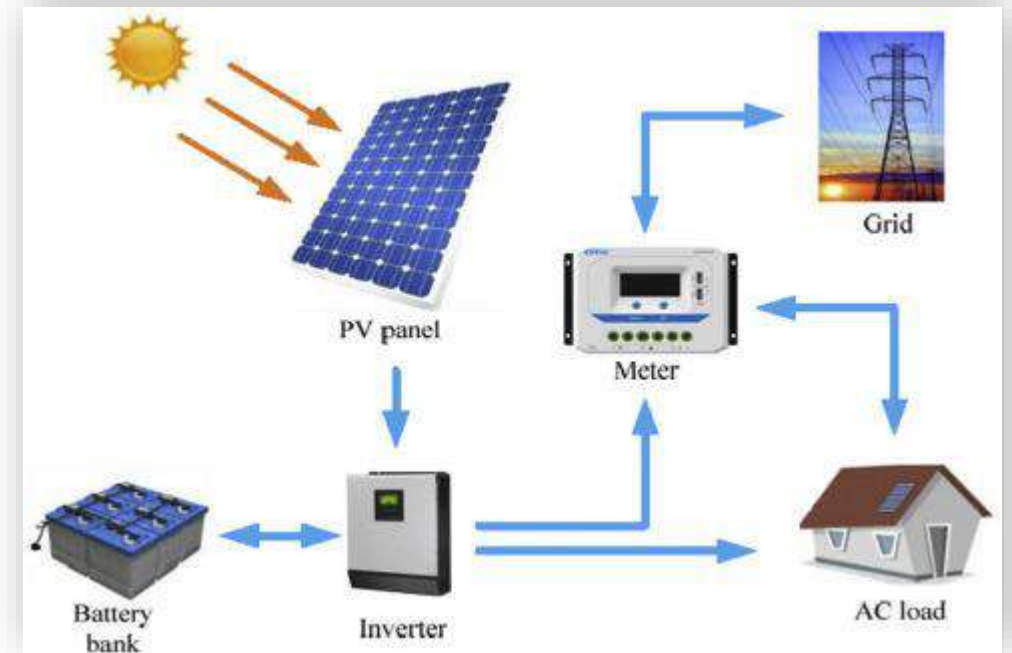
Direct (DC) and alternating current

- **AC (alternating current)** moves alternately in one direction or the other, and its intensity changes over time depending on the frequency. Quite easily detected by rescuers
- **DC current (direct current)** is characterized by the fact that it always flows in the same direction and its polarity does not change, making it difficult to detect by rescuers.



The power of PV panels connected in parallel adds up and can easily reach several hundred V (DC) for non-commercial users. Much more for commercial installations.

PV installations components



PV installations examples



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ACADEMY



PV installations examples



Do PV fires occur?



Do PV fires occur?



Do PV fires occur?

📍 Lidl, Italy



Do PV fires occur? The Walmart case

Walmart installed Tesla solar systems on its 240 stores.

Due to the occurrence of the series of fires in 2012 and 2018, seven of the installations were disconnected and Walmart sued Tesla for negligence.



Do PV fires occur? The Amazon case



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The main causes of PV installations fires



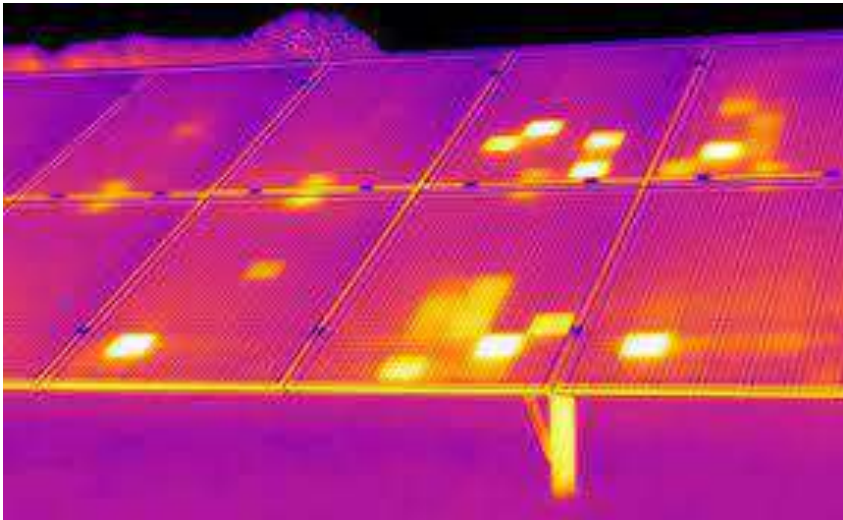
- Poor Quality of the components of the installation, especially the cables and MC 4 connectors.
- Installation mistakes, wrong chosen parts of the system and incompatible components, especially MC4 connectors; not good enough cross section of the cables or cost savings on the neuralgic points of the installation.
- Incorrectly routed cables, too small distance between the roof and the installation.



The main causes of PV installations fires



- Hotspots, damaged cells in the PV modules caused by the transport, wrong handling or assembly. Hotspots in somecases can reach up to few hundread Celsius degrees
- Bird nests, rodents
- Wrong installation of the inverter, installation on the flammable material
- Electric arcs formed on exposed/damaged conductors



How often PV Fires occur?

- In GB based on 1 mln of PV installations, 58 fires occur (data from 2017).
- In Germany based on 1,3mln of PV installations, 430 fires occur (data from 2015).
- In Italy based on 478k PV installations, 700 fires occur (data from 2012)
- In Poland based on 1,3mln PV installations, 145 Fires occur (data 2018-2021)



How often PV Fires occur?



- In many countries the fire brigade didn't make detailed statistic concerning PV fires.
- Concerning the fact that PV installations and its components are aging, and the fact that a lot of them were not installed properly, we can expect that the number of PV fires would be increasing.

Why are PV fires dangerous?



- Until the PV panels have access to light, they will produce direct current with a voltage of several hundred V, exposing to risk the people extinguishing the fire.
- Electric arcs, especially in series-connected installations. The arcs can have a temperature of 5-6 thousand degrees Celsius and cause extensive burns to the body and be a direct cause of fire flare-up.

Why are PV fires dangerous?



When rescue services arrive at the scene of a fire, they do not fully know what technology they are dealing with and whether the users' assurances that the installation is not under voltage are sufficient.



An installation fire may spread to the building's structural elements and thus ignite.

Why are PV fires dangerous?

- PV modules have a negative impact on roof's properties during the fire, as they cause additional fire hazard, resulting as additional possible fire sources from installation.
- By creating a chimney effect between the modules and roof covering, the reflection effect enhances the power of the fire between the module and the cover.



European Union plans

Necessity of using a PV installation:

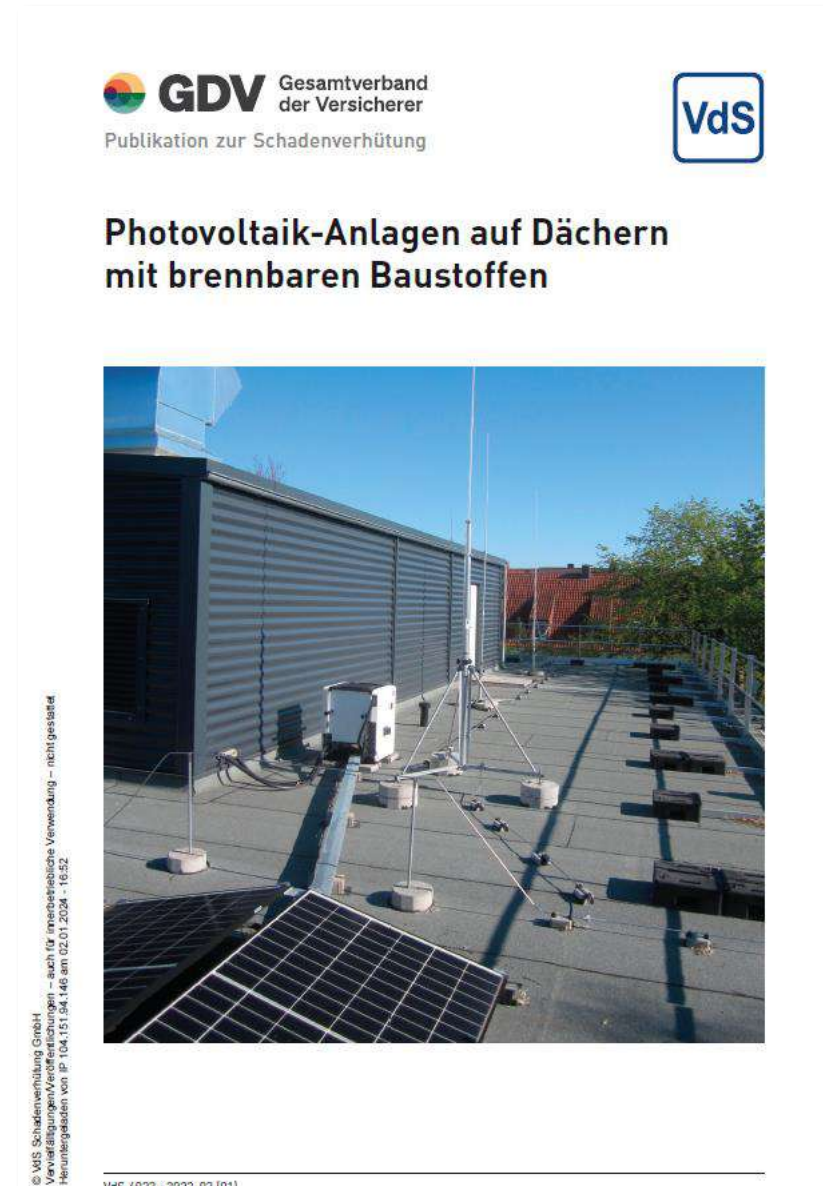
- as of 2027: all new commercial and public buildings with a roof-area over 250 m²;
- as of 2028: all existing commercial and public buildings with a roof with an area of over 250 m²;
- as of 2029: all roofs of new residential buildings;

Annual capacity increase in 2025 - 320 GW

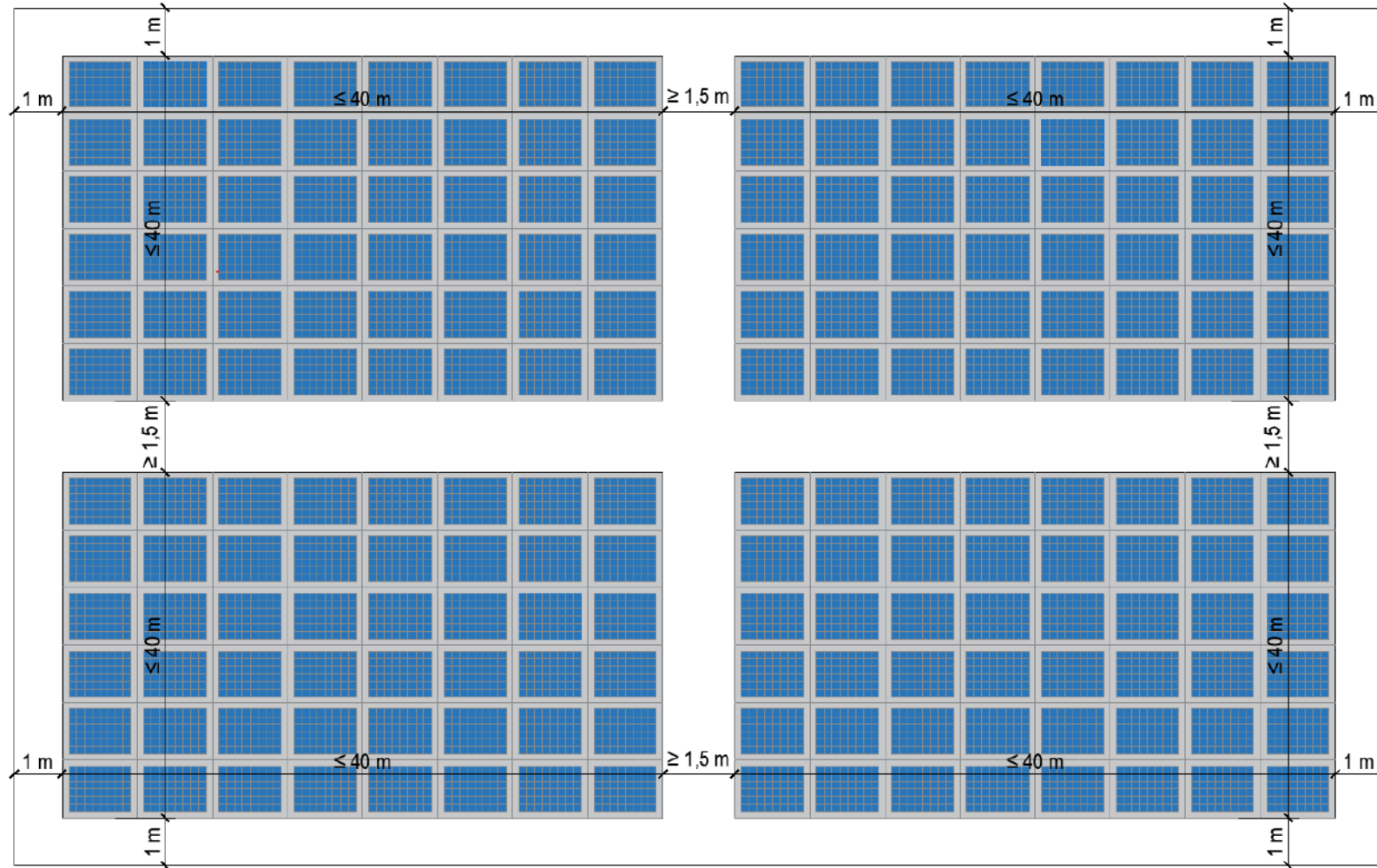
Annual planned capacity increase in 2030 - 600 GW



What about regulations?

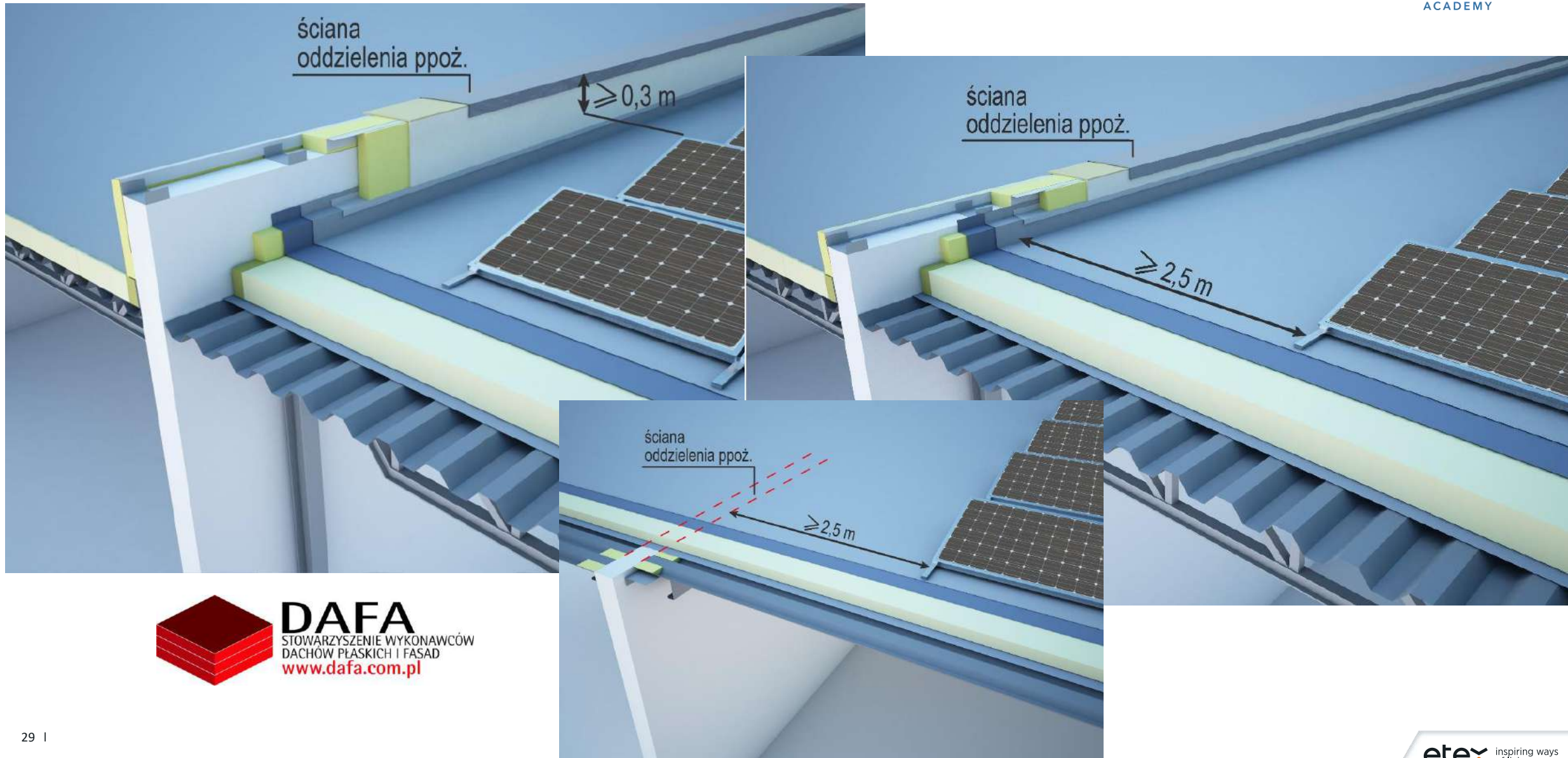


Regulations: grouping of PV panels



- Minimum 1.5 m distance among modules, allowing rescue and fire-fighting interventions
- This belt should be there free from obstacles (including other installations, skylights, flapssmoke).

Regulations: distance of PV panels



The problem is recognized by the insurance companies

“Fire is a serious concern in the event photovoltaic systems.... Fire starting from the module may cause a more intense fire than the fire source used to test the coverage roof when it achieved a Class A rating.” “Do not install PV systems on flammable roofs... No install panels on roof coverings containing foam plastic insulation (polyethylene, polystyrene, polyisocyanurate) below the covering”



“RSA has suffered losses resulting from the spread of panel fire solar panels on flammable roof coverings. Presence of modules on the roof enabled the transfer of thermal radiation to the module from the roof in the opposite in the case of fire and causes a change in the direction of the flames much closer to the roof than in a typical roof fire.” “Solar panels should not be placed on flammable roofs or roofs with combustible thermal insulation.

The problem is recognized by the insurance companies

- “ARC (AllianzRisk Consulting) **strongly does not recommend installing photovoltaic systems on buildings industrial and commercial buildings with flammable roofs**(fully flammable or with flammable insulation



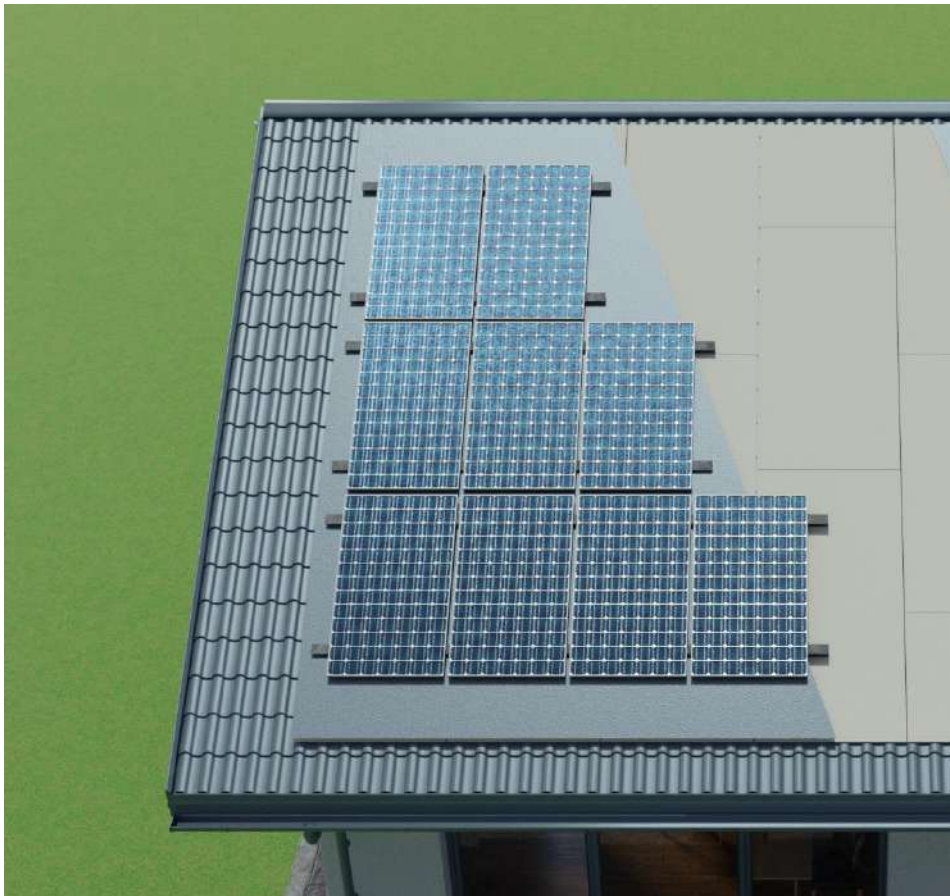
“Traditional roof systems and photovoltaic modules have been tested completely independently... there is no research standard in Europe that would shade offset panels with roof covering.” “In the case of roofs with flammable elements under and above the roof covering Roof insulation **should be installed with a non-flammable board, such as calcium –silicate boards to reduce the likelihood of fire flammable roof or sheathing insulation.**

„PV installations significantly increase the probability of the fire on the buildings, **we recommend to use the fire protection systems, certified by PZU lab**”

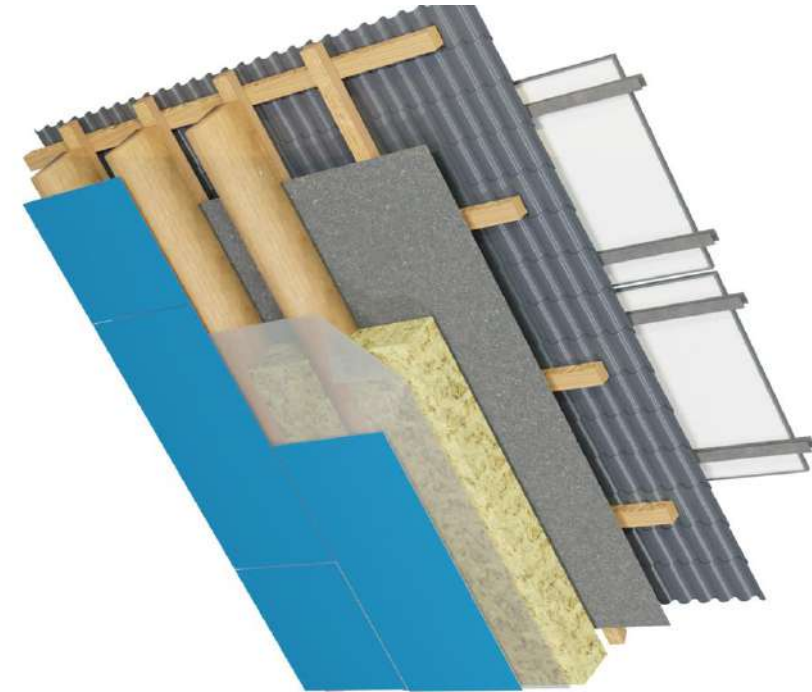
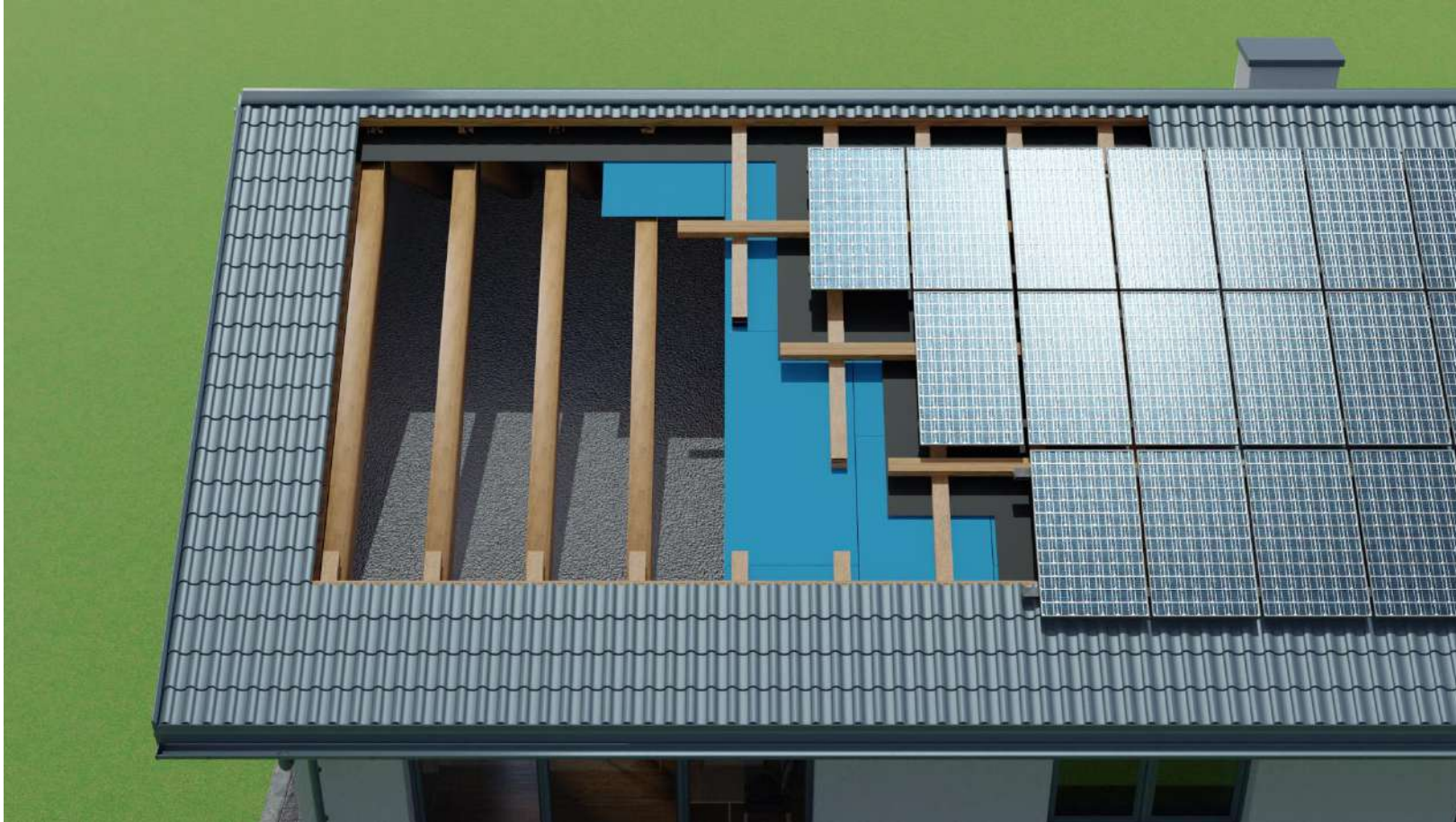


Promat solutions for PV panels fire protection

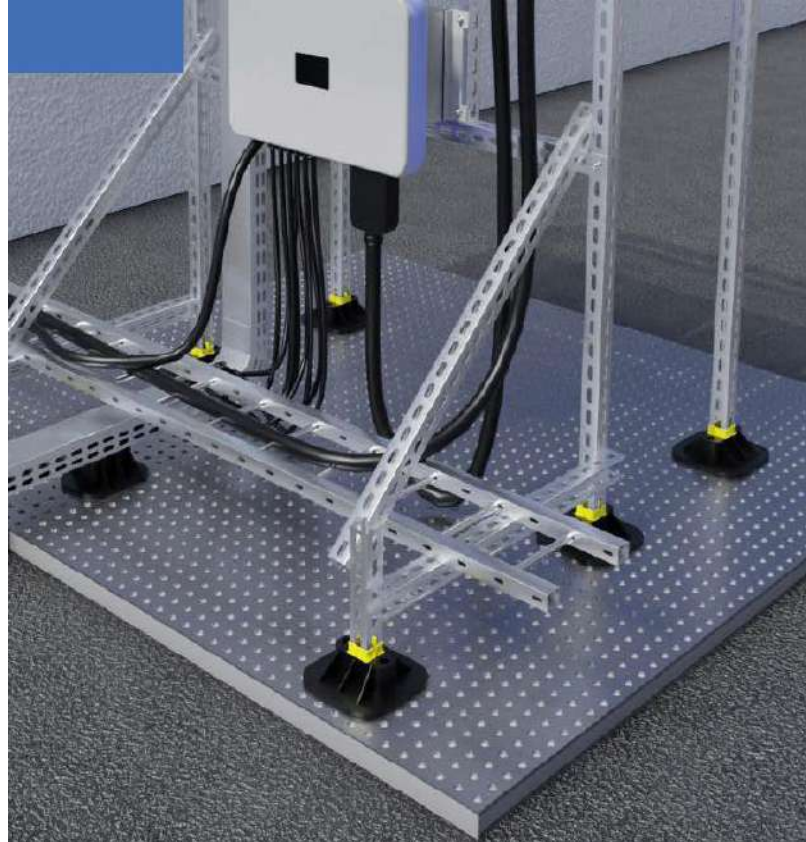
Protection of roof beams with Promatect-H boards



Protection from inside – Promatect 100X



Protection of the flat roofs and inverters with Durasteel boards



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Zabezpieczenie przeciwpożarowe systemów fotowoltaiki

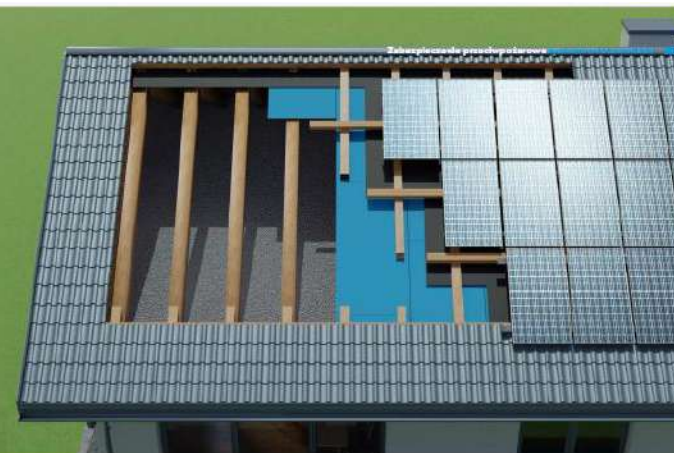


etex inspiring ways of living

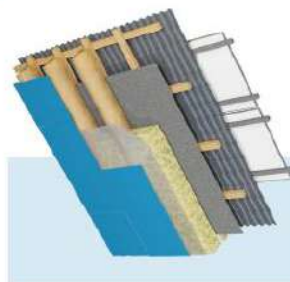
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Zabezpieczenie fotowoltaiki w budynku o dachu drewnianym – zabezpieczenie od wewnątrz budynku



Jeżeli w trakcie budowy Twojego wymarzonego domu zdecydowałeś się zainstalować fotowoltaikę pomyśl o odpowiednim zabezpieczeniu jej przed ewentualnym wystąpieniem pożaru instalacji. Podejmując temat zabezpieczenia ogniochronnego na etapie wykańczania poddasza lub strychu masz możliwość zaoszczędzić pieniądze i wykonać zabezpieczenie oraz wykończenie przy użyciu jednego produktu spełniającego obie funkcje.



Promat stwarza możliwość zabezpieczenia poddasza do klasy odporności ogniowej REI10 oraz ograniczyć promieniowanie ciepłe do wnętrza domu. Aby spełnić te warunki należy zastosować płytę PROMATECT®-100X o charakterystycznym niebieskim kolorze i grubości minimalnej 12 mm. Zabezpieczenie wykonanie odbywa się na

stelażu pod suchą zabudowę czyli z profili stalowych CD i UD co jest łatwe i szybkie w montażu. Płyta PROMATECT®-100X podobnie jak płyty gipsowo-kartonowe jest łatwa w wykończeniu dzięki czemu doskonale się sprawdza jako warstwa finalna naszej przegrody. W przypadku wybuchu pożaru instalacji fotowoltaicznej

pożar nie rozprzestrzeni się do wnętrza budynku dzięki czemu możemy uratować dom przed całkowitym spalaniem. Dodatkowym atutem tego typu systemu jest też: ograniczenie rozprzestrzenienia się ognia wewnątrz budynku na sąsiednie pomieszczenia po więźbie dachowej.

Drugim wariantem zabezpieczenia jest zastosowanie płyty ogniochronnej PROMATECT®-H gr.10mm na powierzchni więźby dachowej od strony zewnętrznej

budynku. Płyta usytuowana jest pod powierzchnią gdzie znajduje się fotowoltaika w zamiast deskowania lub bezpośrednio pod membraną. PROMATECT®-H spełni

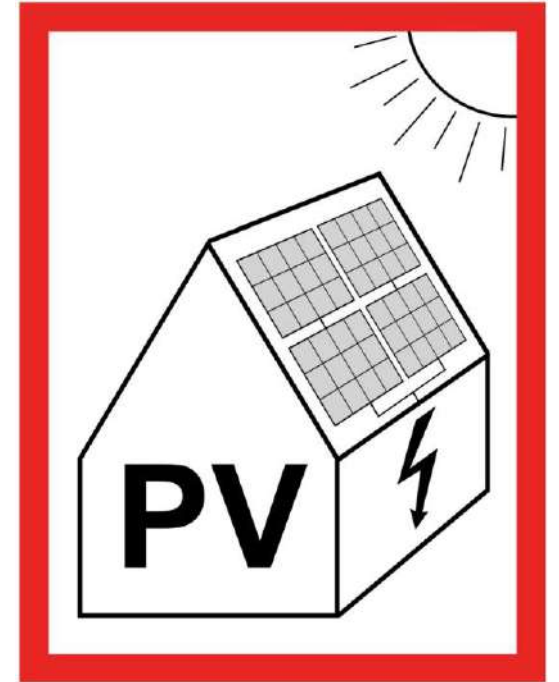
tą samą funkcję jak płyta PROMATECT®-100X od wnętrza domu. Zastosowanie płyty od zewnątrz dodatkowo usztywnia dach wzmacnia konstrukcję drewnianą.



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How to improve safety in PV installations?

- Install PV systems with profesional certified companies
- Build up system with the good Quality components
- At least once per year make a complete inspection of the installation
- Use the certifird passive fire protection on the buildings to readuce spread of the fire to the building
- Install special dedicated PV fire extinguishers close to the installation



Thank you

Jacek Ćwikliński