PV Fire Safety on Roofs – the need for a guideline

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 952395

Heerenveen, Netherlands, 2022

https://www.youtube.com/watch?v=YeM5g96zKI0

Peterborough, UK, 2024

https://www.itv.com/news/anglia/2024-02-23/drone-footage-shows-fire-tearing-across-roof-of-70m-lidl-warehouse

Heerenveen, Netherlands, 2022

https://www.youtube.com/watch?v=YeM5g96zKI0

Fires still occurring on the next day

Back to operation in 1 day

Peterborough, UK, 2024

https://www.cambsnews.co.uk/news/lidl-makes-speedy-recovery-from-solar-panel-fire-at-70m-peterborough-depot/22359/

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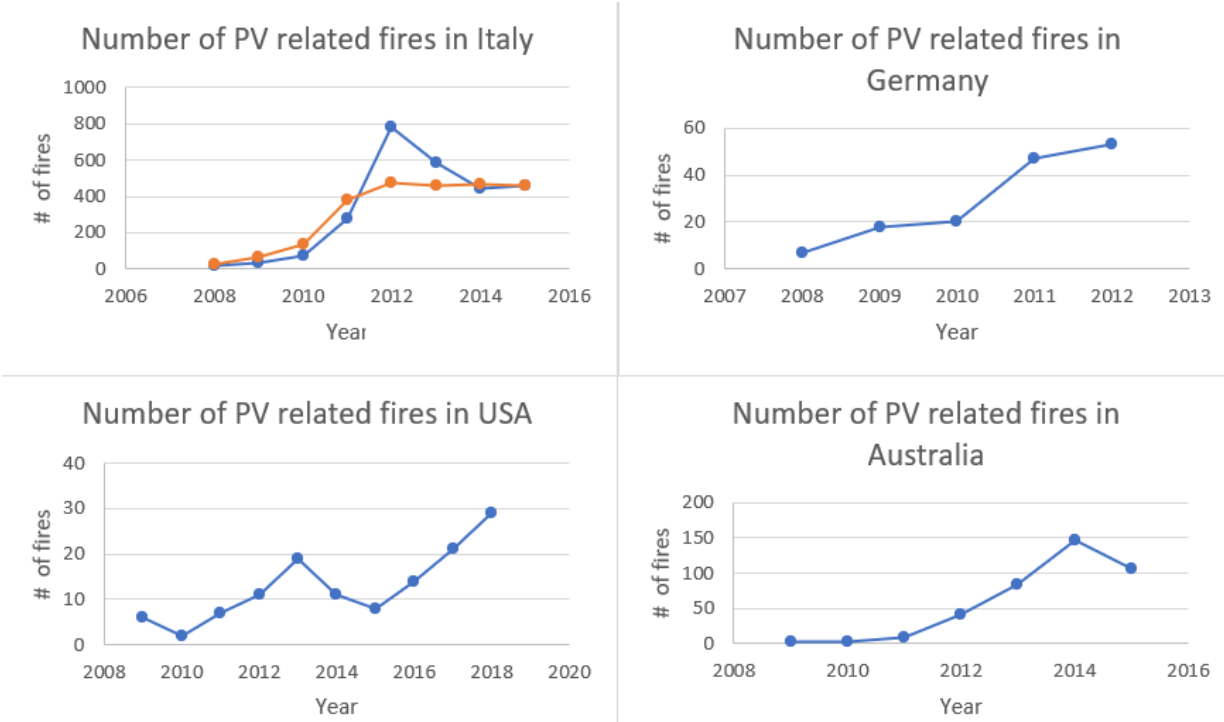
The number of fires is growing

- **Growth of PV-related fires in numbers**
- **Statistical estimate – 29 fires / GW**
  - **2025 – over 9k PV-related fires in EU**
  - **2050 – ~1 mio PV-related fires worldwide**



Mohd Nizam Ong NAF, Sadiq MA, Md Said MS, Jomaas G, Mohd Tohir MZ, Kristensen JS. Fault tree analysis of fires on rooftops with photovoltaic systems. *Journal of Building Engineering*. 2022

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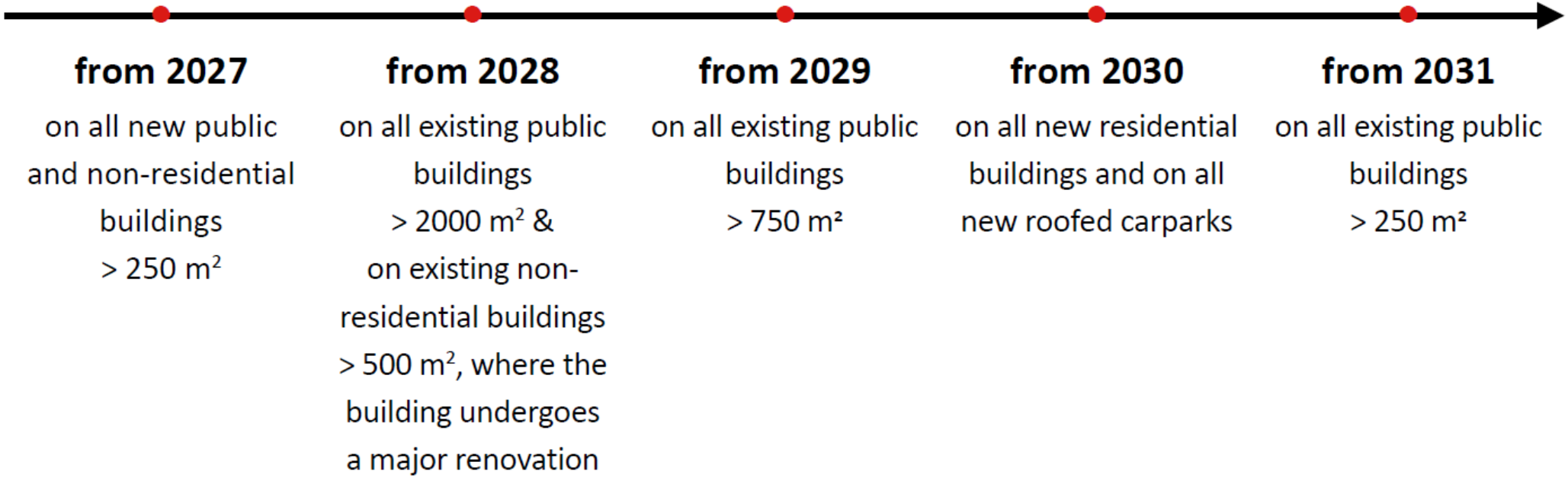
The incentive(s)

- REPowerEU – EU's plan to stimulate the PV installations

Member States shall ensure the deployment of suitable solar energy installations as follows:



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Recent guidelines & guideline documents

Insurance companies	• Allianz (Germany) • AXA XL (French) • RSA Insurance (UK)
Safety consultancies	• SZPV (Slovenia) • BVS (Germany) • VdS (Austria)
PV Producers	• LONGi (China) • Canadian Solar (Canada) • JA Solar (China) • LG (South Korea)

- Focus on addressing the ignition
- Rarely consider risks on systemic level
- Poor link to scientific-based data
  - Experiments/data needed to validate the measures

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The gap

Not addressing the effects of PV installation on the building fire risk at a systemic level

Photographed by Studio Rakun, Jani Pavlin s.p. for the Fire Brigades Association Črnomelj, Slovenia

Fire Safety Guideline for Building Applied Photovoltaic Systems on Flat Roofs

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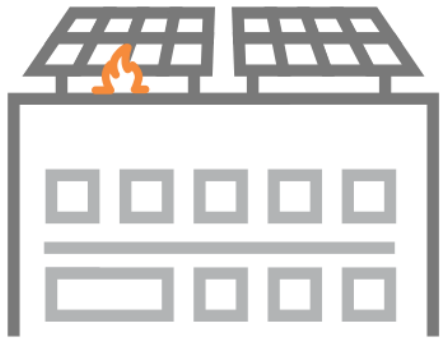
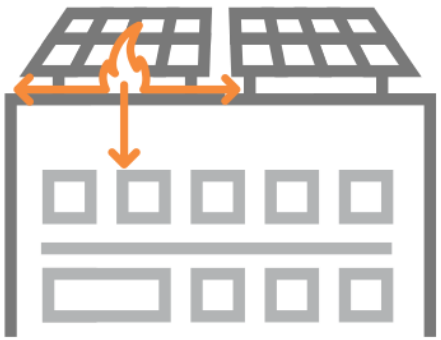
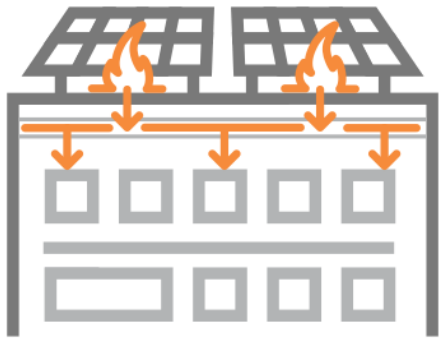
1 Ignition hazards



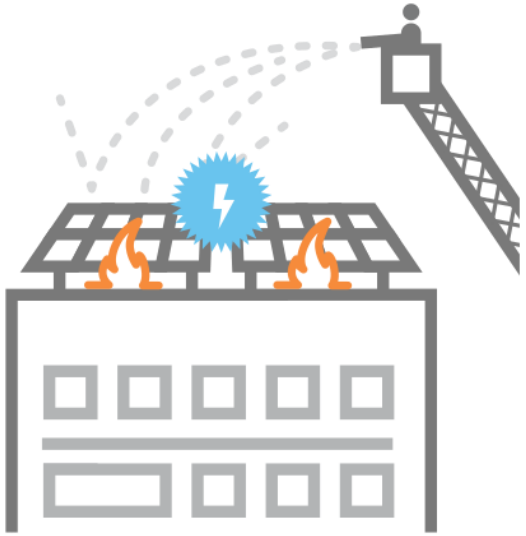
2 Fire dynamics



3 The roof construction



4 Firefighting operations



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RISK = probability x consequence

- Failure of the component/product (over-current, hotspots)
  - poor quality of:
    - components
    - installation
    - maintenance
  - soiling, wildlife, shading, weather

- Enabling fire spread
  - larger area
  - faster spread
- Breach of compartmentation
- Obstructing the work of firefighters

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PV system – overview

- Materials (roof (cover & structure), panel parts, components of el. network, mounting system)

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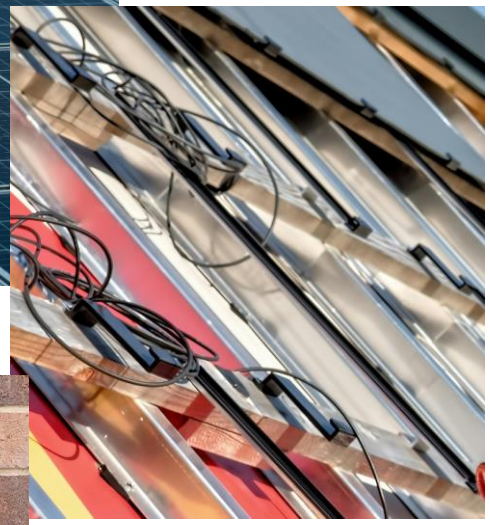

https://energyfollower.com/wp-content/uploads/2021/03/residential-solar-inverter.jpg

HelioVolta, PVEL - PV Evolution Labs, 2022. The Ultimate Safety Guide for Solar PV Connectors

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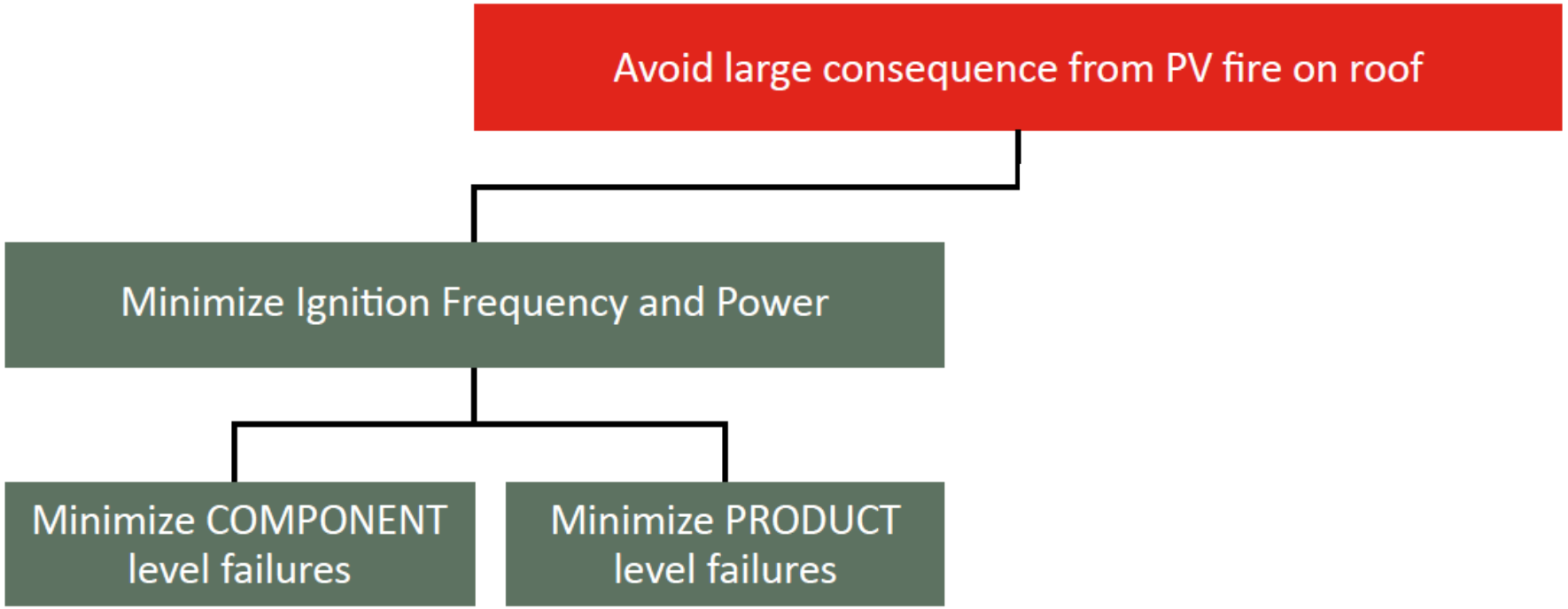
Managing the risks – Fire Safety Concepts Tree



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PV system – overview

- Materials (roof (cover & structure), panel parts, components of el. network, mounting system)
- Components (panel, cables, connectors, isolators, inverters, combiner boxes…)
- System (height, inclination, array size, separation distances…)

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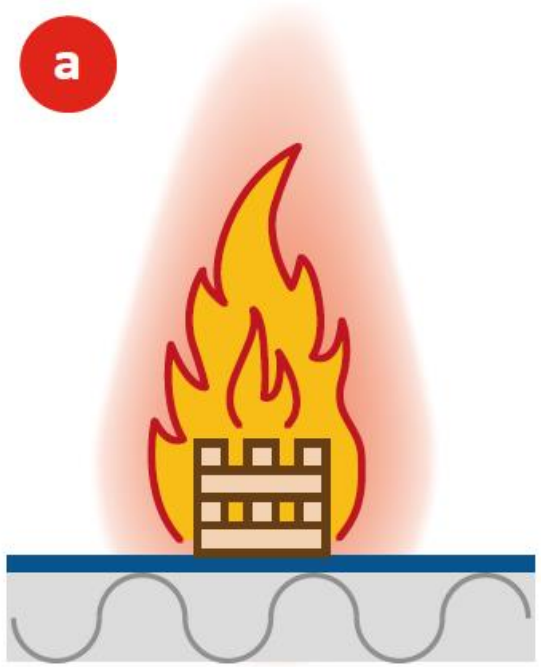
Key systemic influence – heat feedback



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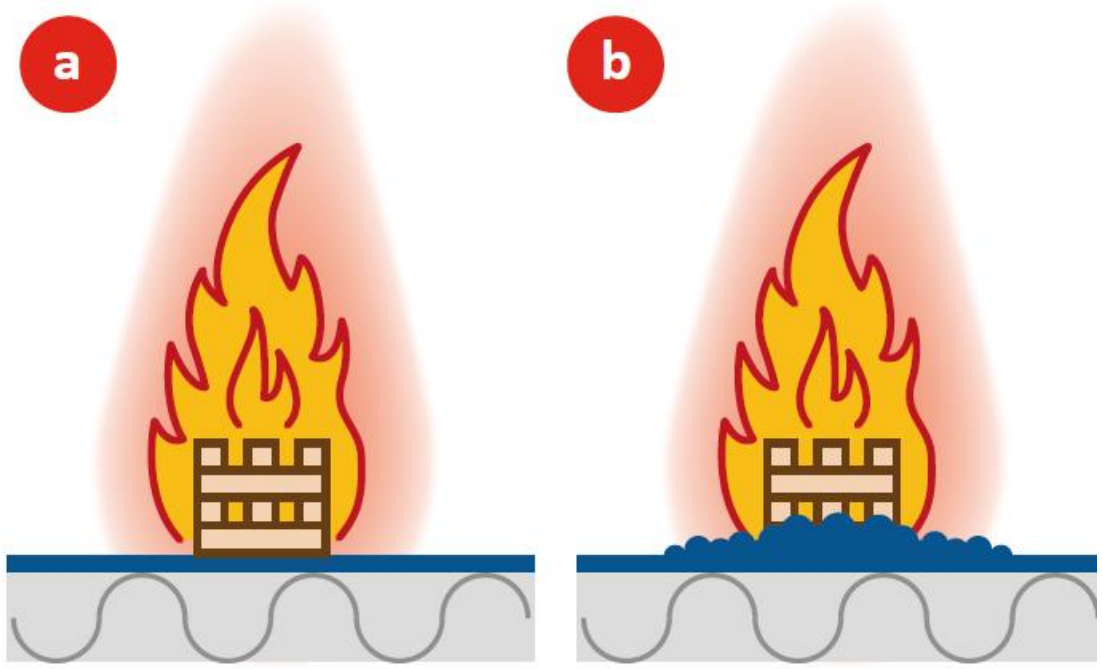

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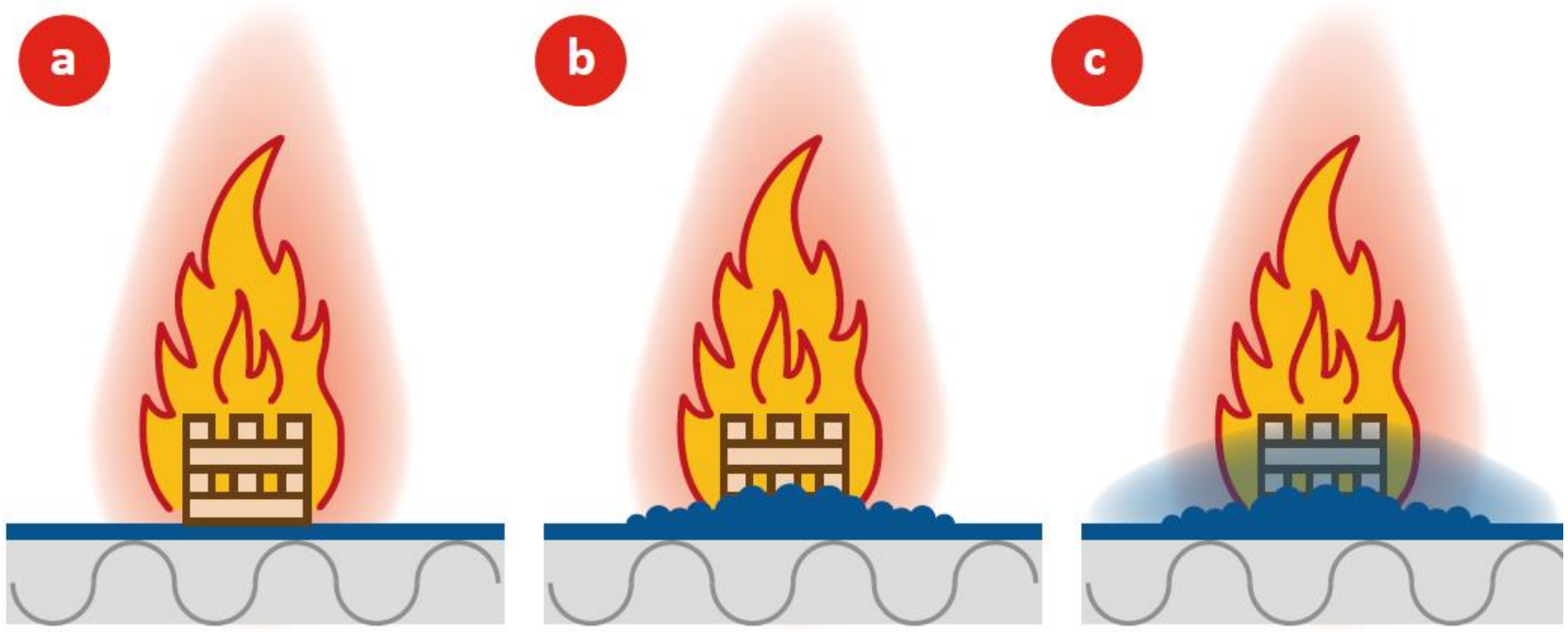

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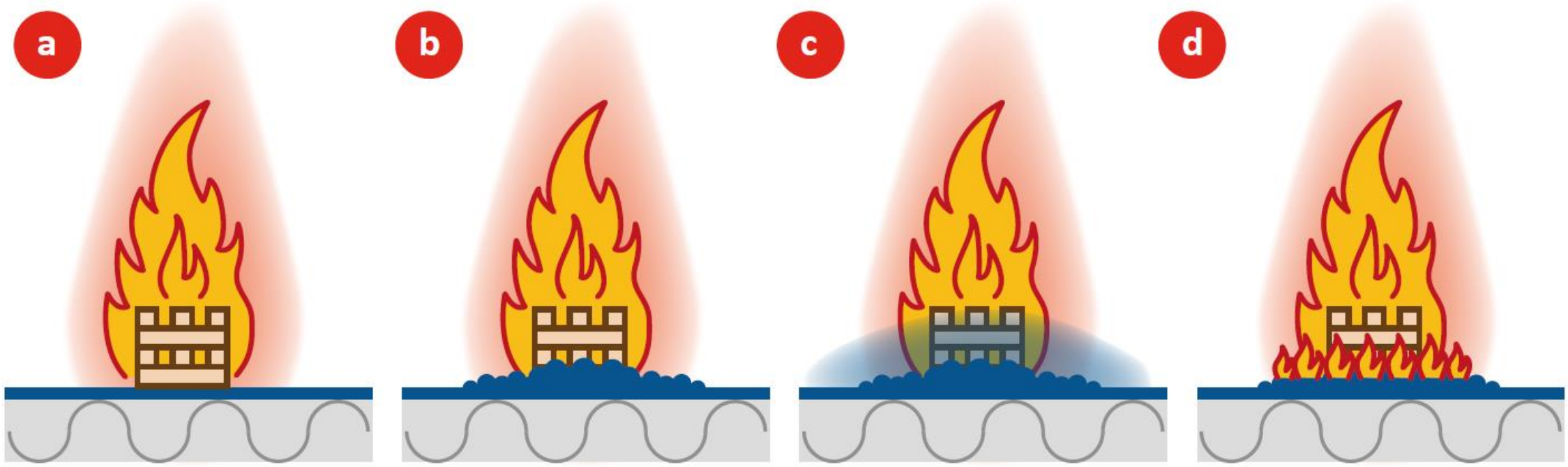

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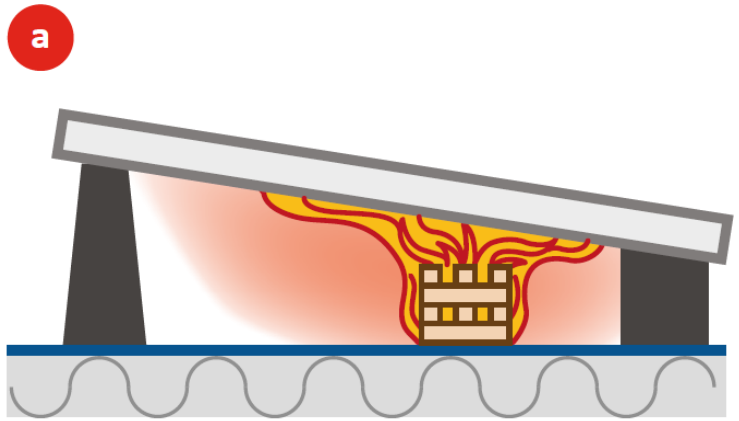

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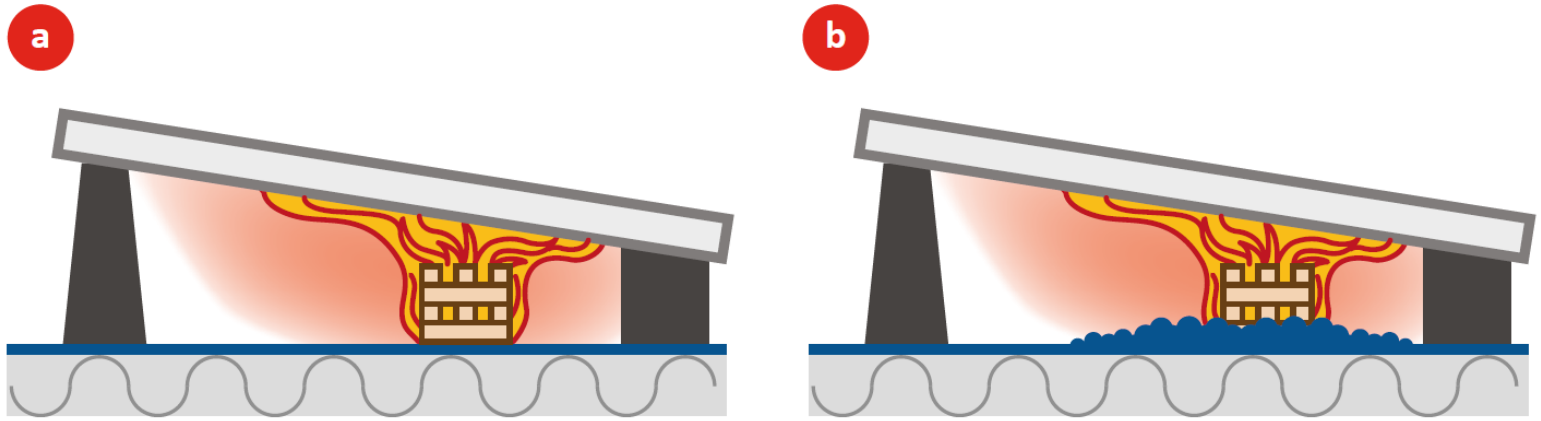

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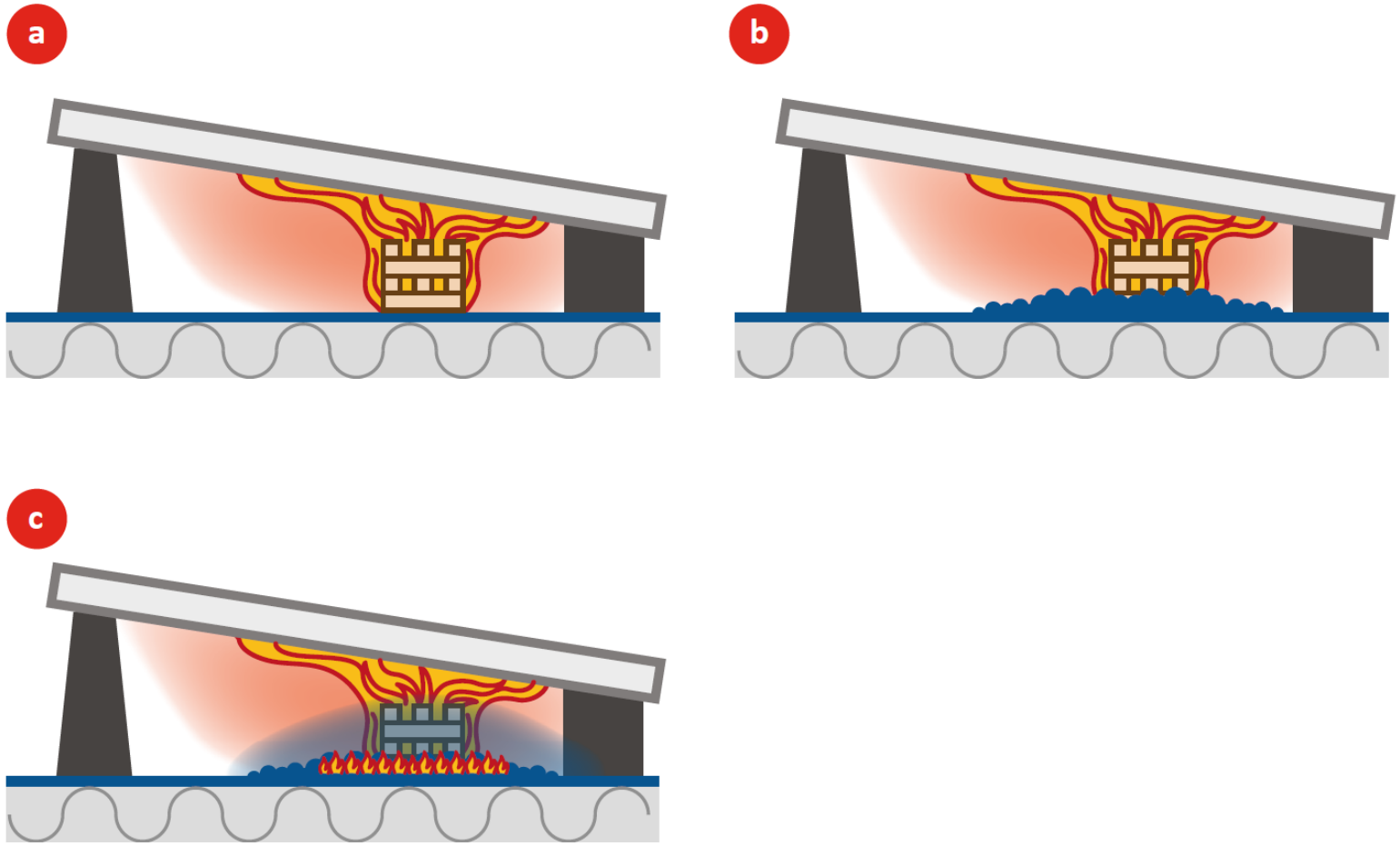

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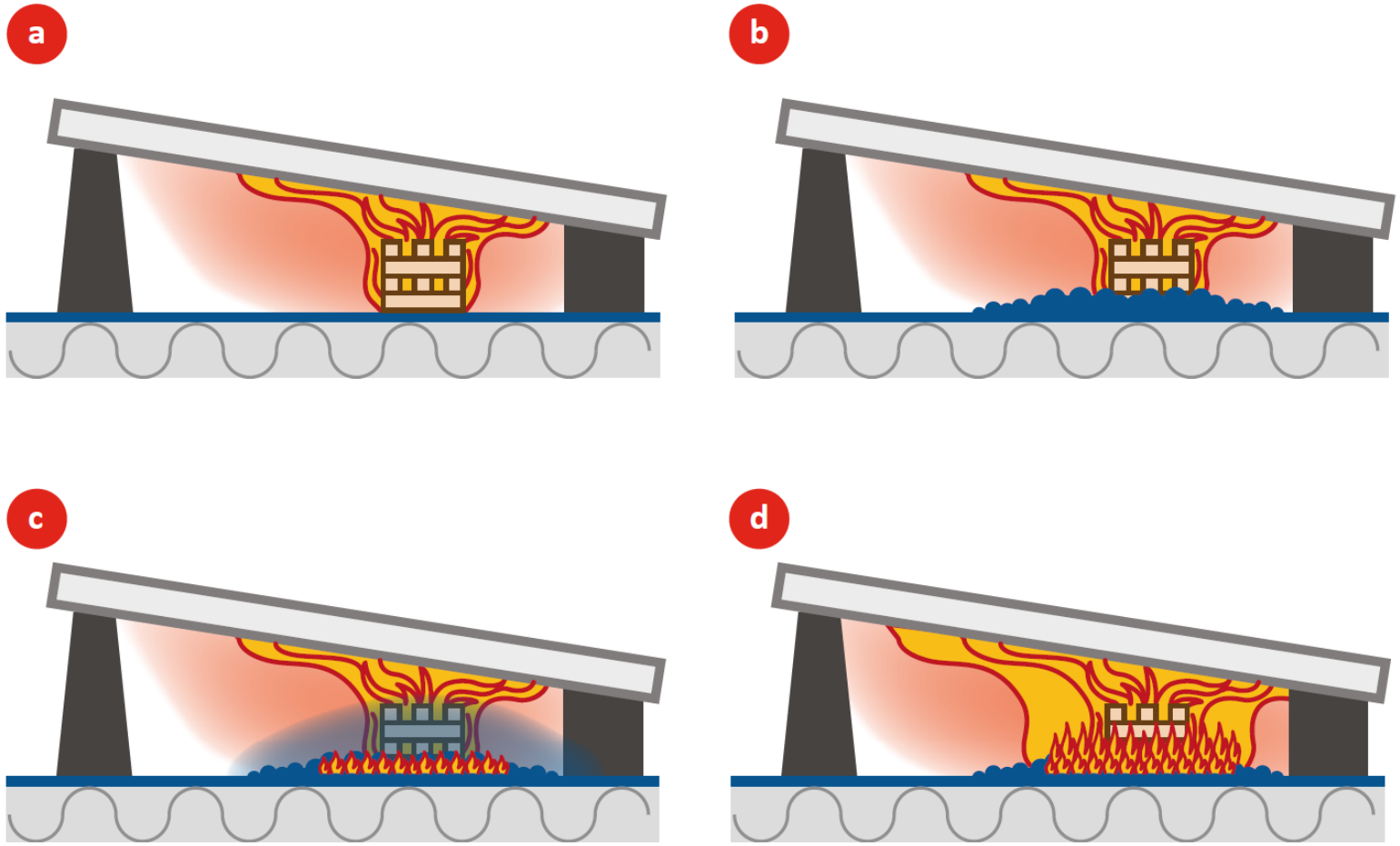

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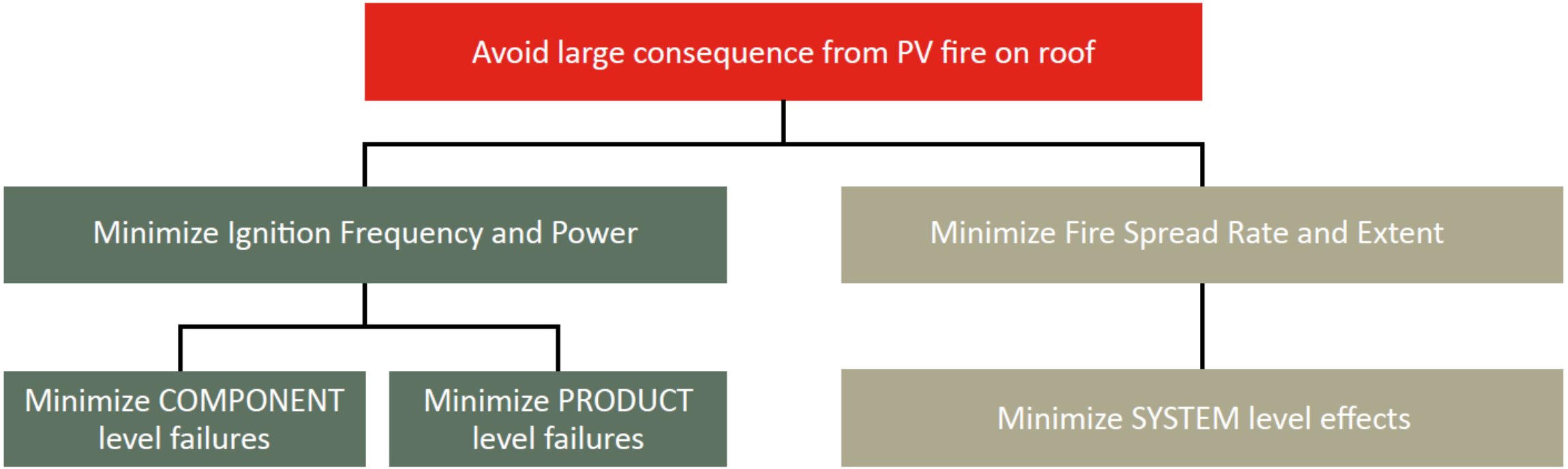
Managing the risks – Fire Safety Concepts Tree



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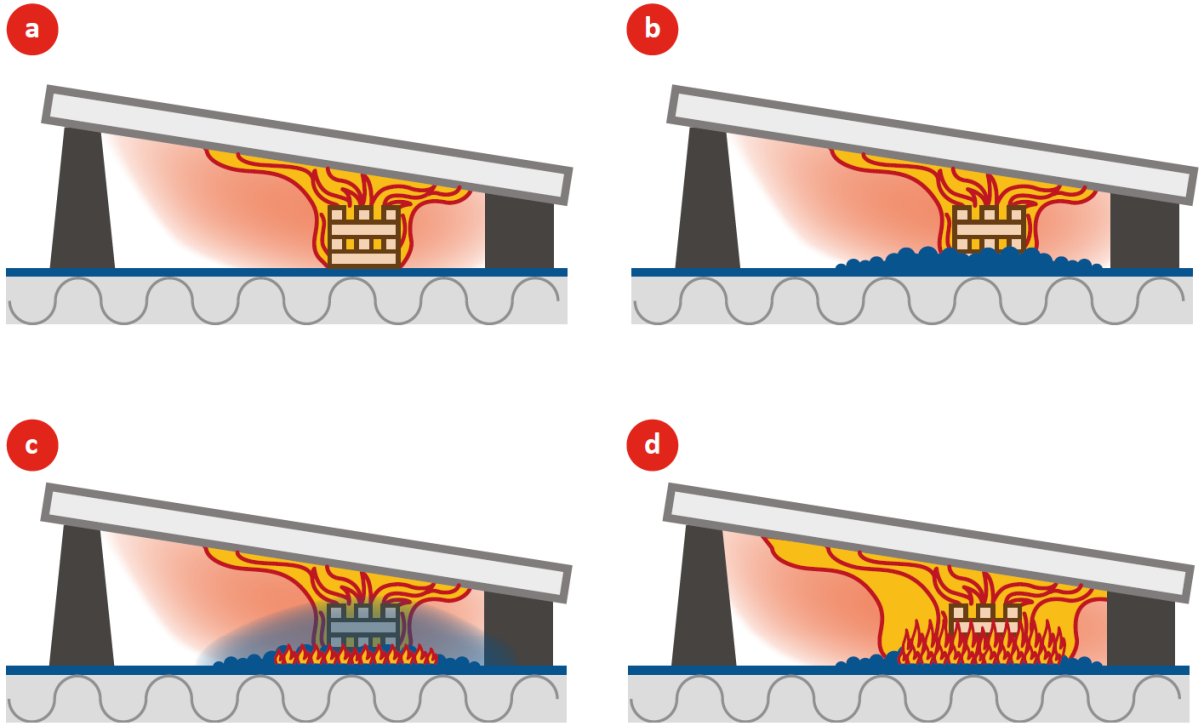
Tackling the risks – panel installation

- Materials
- Components

- Orientation (flat, south, east-west, vertical)

- Height (critical gap)



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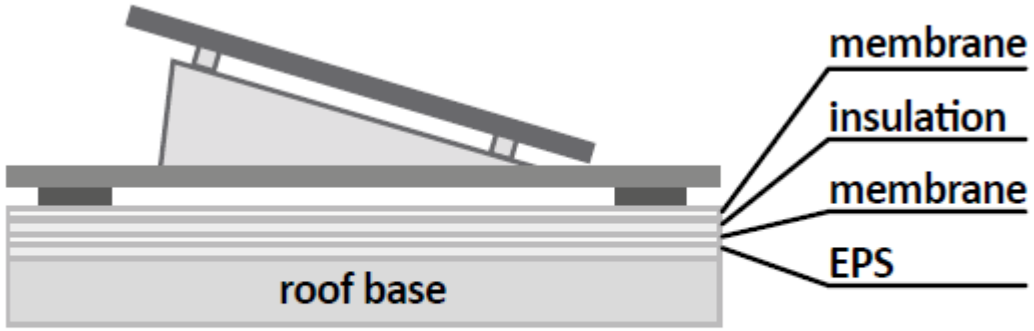
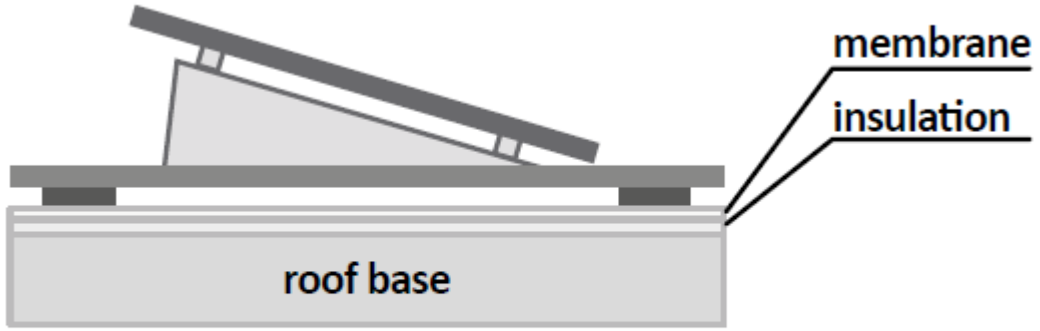
Tackling the risks - Materials

- No matter (B_{roof}) membrane type, PV facilitate fire spread
- Need for a mitigation layer



Typical roof buildup for RETROFITTING



Typical roof buildup for NEW BUILDING

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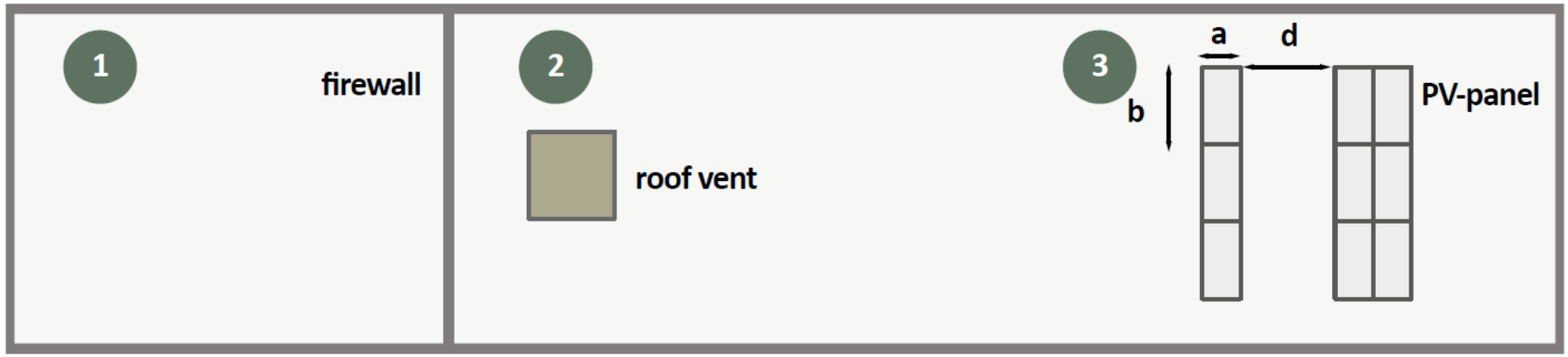
Tackling the risks – array configuration

- Array design
  - Separation distance
  - Size of the array
- Consider roof elements (firewalls, vents, skylights…)



top view

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Tackling the risks – firefighting

- Rooftop access and operations
- Reduce electrical risks (shutdown or low ΔV)
- Application of extinguishing medium

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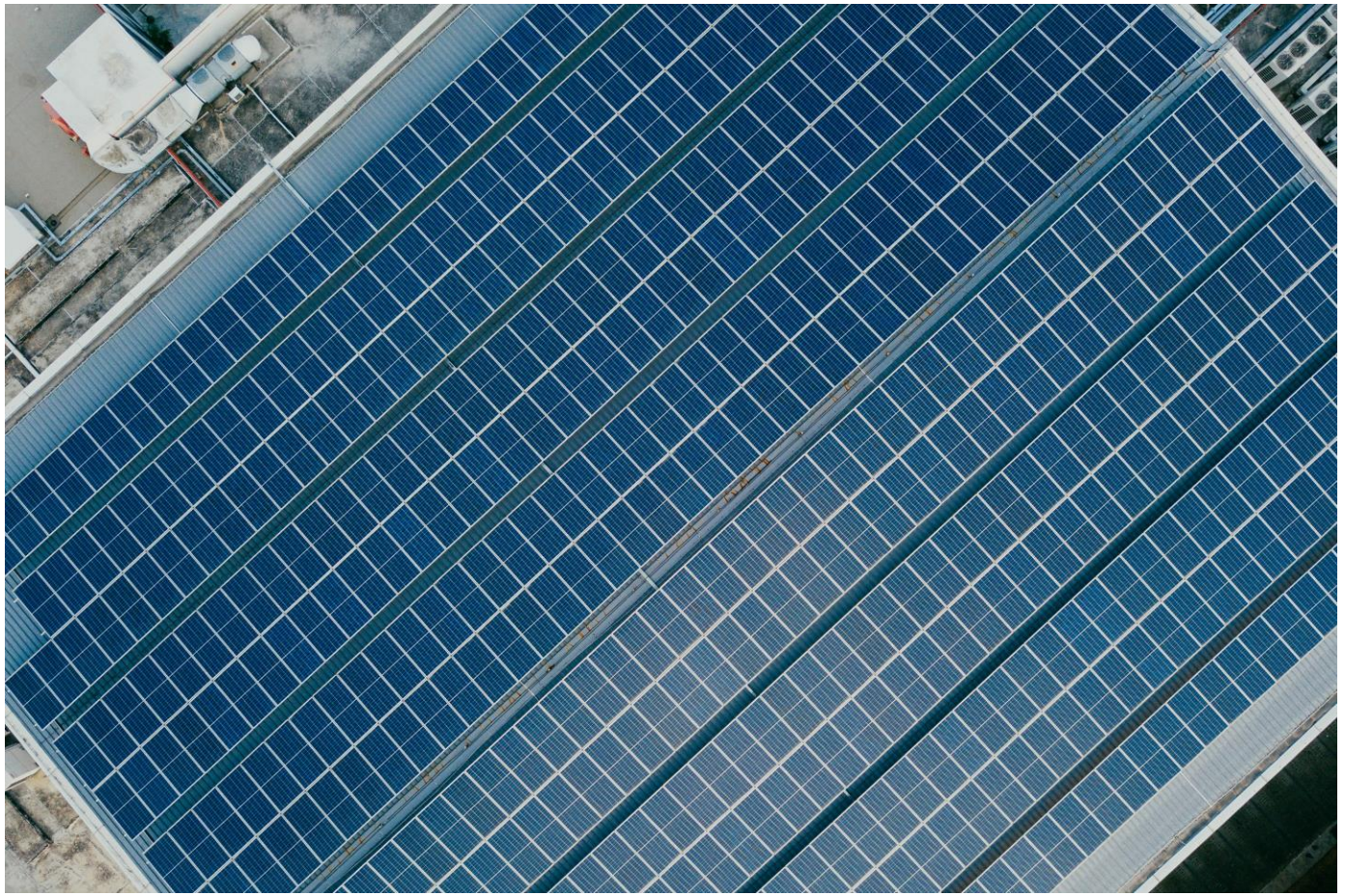
Tackling the risks – general concerns

- Detection systems
- Personnel qualifications
  - Installation
  - Maintenance
- Lack of data for statistics
- Lack of information available to firefighters



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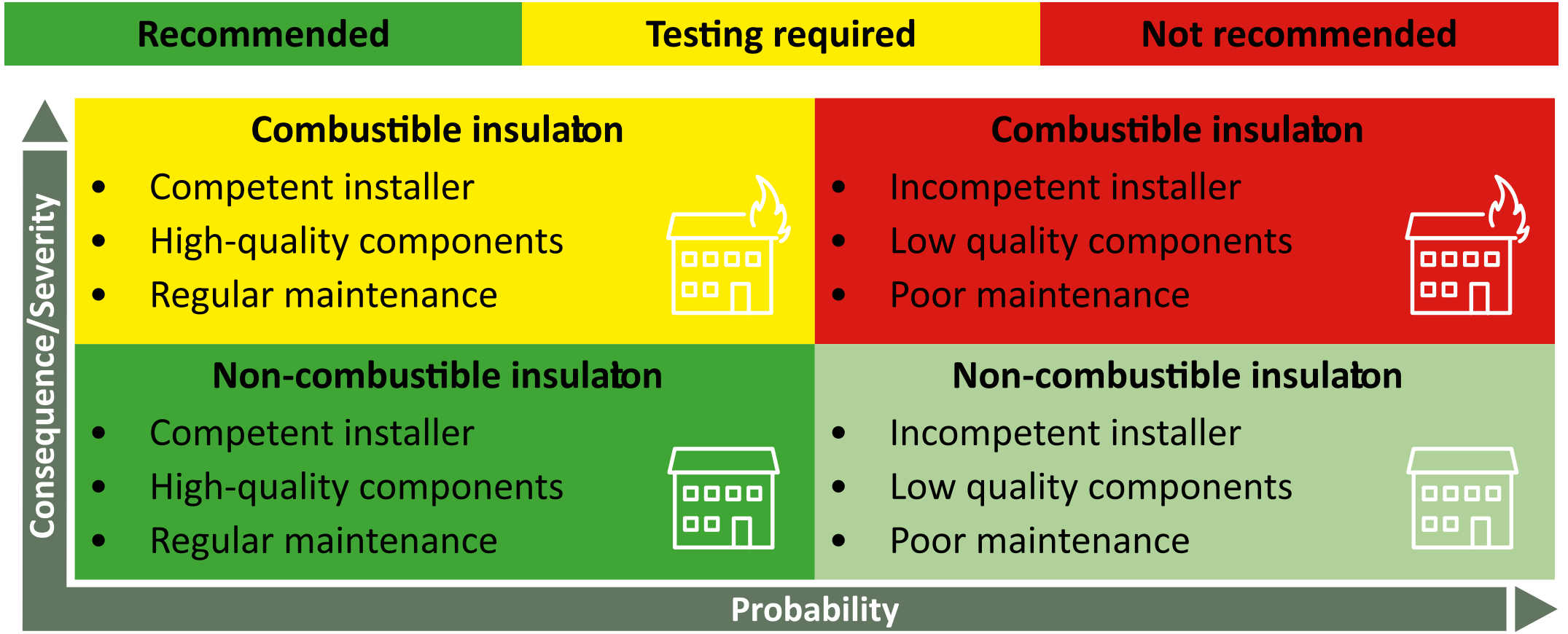
Conclusions

- PV systems alter the fire risk of the buildings
- The number of installations (and fires) is increasing
- Assessing and mitigating the risks on the systemic level is crucial to enable robust solutions

Photo: Municipality Medvode

Outlook



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