THE ROOF COMES FIRST · WHITEPAPER

Rooftop PV on existing commercial buildings

A decision framework for resolving roof constraints before the PV investment

> CORE PRINCIPLE
>
> **Resolve the roof questions before the PV investment is committed.**

BASELINE → ASSET → STRUCTURE → ROOF → MOUNTING → RISK → PV → EVIDENCE → APPROVAL → INVESTMENT → DELIVERY → LIFECYCLE

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Use and scope. This paper is a decision framework for project coordination. It is not a substitute for project-specific structural, fire, electrical, roofing, code, insurance, contractual or legal advice. Requirements vary by jurisdiction, insurer, manufacturer, building and assembly. The responsible professionals and approving parties remain responsible for project-specific decisions.

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Author’s perspective

This series is a synthesis of published research, fire tests, standards, approvals and insurer guidance on fire safety and rooftop PV, written from an explicit roof-first perspective: I look at the complete commercial roof system and the building beneath it rather than at individual product classifications. Within that perspective I summarise what the evidence shows, add my own technical analysis and, where relevant, propose design principles. Those proposals are marked as mine and kept separate from what has been demonstrated.

My background is in architecture and building engineering. Over the past three years I have discussed this subject with engineers, risk specialists, insurers and test institutes, and I have been involved in setting up and supervising fire-test programmes for AllShield's own roof systems. That experience shapes the questions I ask; the papers test those questions against external evidence. How the sources were selected, and what remains open, is described at the end of each paper.

These papers are prepared by Olivier Langejan as lead author with support from a small team. His own professional focus is building and roof design; specialist findings are drawn from the cited evidence, with AI assistance disclosed separately in Method and sources.

I am affiliated with AllShield, which develops BarrierSheet and other roof fire-protection solutions. That commercial relationship is relevant and is therefore stated explicitly. The analysis does not assume that an AllShield product provides the effects discussed. The starting point is the physical or economic problem. Where an AllShield product is discussed, it is treated as one product-specific example and its performance should be read only within the boundaries of the cited tests, approvals and roof assemblies.

In this paper I apply that roof-first approach to existing commercial buildings. On an existing building the roof is not a design choice but an inherited condition: its structure, build-up, remaining service life and fire behaviour are already in place before the PV project starts. The paper therefore does not ask which product or system should be used, but in which order the roof questions should be resolved before the PV investment is committed. It organises those questions into a baseline assessment and ten decision gates. Where BarrierSheet appears, it is one product-specific application example and should be read within the boundaries of its cited evidence.

Executive summary

Rooftop PV on an existing commercial building should not begin with the question of how many modules can fit on the roof. It should begin with the roof.

Before a PV investment is committed, the parties responsible for the building should establish what roof is actually present, what structural capacity and useful life remain, what intervention may be required, how PV changes the risks associated with the roof and what evidence supports the resulting roof-PV configuration.

This is primarily a question of decision sequence. A PV installation may remain on a building for 25 to 30 years while the waterproofing beneath it may have considerably less life remaining. Structural reserve may be limited. The roof may contain combustible materials, retained moisture or undocumented alterations. Its membrane may be fully adhered or mechanically attached. Existing ballast, drainage, rooflights, plant, penetrations and access requirements may further constrain the design.

These questions cannot be resolved by the PV layout alone. They also interact. A fire-mitigation measure may add weight. A mounting strategy selected to avoid roof penetrations may require ballast. Raising an array may change the fire scenario while increasing wind-design complexity. Re-covering a roof may resolve a remaining-life problem while changing permanent load, roof details and the evidence required for the new assembly.

A solution at one stage can therefore reopen an earlier decision.

This paper organises the project into ten decision gates:

> **1 Asset · 2 Structure · 3 Roof · 4 Mounting · 5 Risk · 6 PV · 7 Evidence · 8 Approval · 9 Delivery · 10 Lifecycle**

Before those gates, an unnumbered baseline assessment establishes what roof is actually present and how reliable the available information is. After Gate 8, an investment milestone asks whether the business case still works once the required roof, structural, risk and PV interventions are known.

The framework does not prescribe one universal roof construction, fire-mitigation measure or approval route. Some roofs can remain. Others require repair, re-cover or replacement. Some structures have sufficient reserve for additional load; others do not. Some roof-PV combinations are directly supported by applicable evidence; others require mitigation, additional assessment or a different design.

The purpose of the framework is to make those differences visible early enough for the project to act on them.

Why this framework is needed

Audience and regional scope

This paper is written primarily for asset owners, asset managers and owner-side technical project leads who have to decide whether rooftop PV is feasible on an existing commercial building. Structural engineers, roof and building-envelope consultants, PV designers, fire and property-risk specialists, insurers, manufacturers and contractors are secondary readers who close individual technical gates within that decision process.

The framework is international in intent, but its sources are not jurisdiction-neutral. It draws on EU legislation, German and UK insurer-oriented guidance, North American building-envelope guidance, FM property-loss-prevention requirements and project-specific test and approval evidence. Each source should therefore be read within its own legal, geographical or approval scope; none is treated as a universal substitute for the others.

This paper is the existing-building companion to the companion paper in this series on new commercial buildings, which applies the same ten-gate sequence where the roof can still be designed from the start.

Existing roofs are not blank design surfaces

Commercial rooftop PV is frequently initiated as an energy project. Early discussions therefore tend to focus on available area, module count, expected yield, grid connection, investment cost and return.

An existing roof brings a different starting point. The structure already carries loads. The roof assembly has already aged. Waterproofing, insulation, attachment methods, penetrations, drainage and fire characteristics have already been determined, sometimes decades earlier and sometimes with incomplete documentation.

PV inherits those conditions.

Technical suitability therefore cannot be established from the PV system alone. The building, roof and PV installation have to be considered as an interacting system.

A useful way to understand the problem is to picture a common commercial-roof situation rather than an abstract PV project. A lightweight steel deck supports an insulated low-slope membrane roof. Rooflights, smoke vents, drainage outlets, service penetrations and rooftop plant already divide the available surface. The roof may have been repaired or altered several times during its life. A new PV project proposes to fill much of the remaining area with closely spaced modules, for example in east-west or portrait fields.

The PV design is therefore being introduced into an already occupied technical surface. Additional load has to be carried by the existing structure. Mounting and ballast interact with the roof assembly. Drainage and maintenance routes have to remain accessible. The materials beneath the array affect the consequences if an electrical fault produces ignition.

Not every commercial roof looks like this. The physical problem is nevertheless representative: PV is being added to a building system that already has structural, waterproofing, access and fire constraints.

Policy is increasing the pressure to use existing roofs

The European policy direction makes this question increasingly relevant. Article 10 of Directive (EU) 2024/1275 requires Member States to ensure the deployment of suitable solar installations on specified categories of buildings where they are technically suitable and economically and functionally feasible. For certain existing non-residential buildings larger than 500 m², the Directive establishes requirements connected to major renovation or specified permit-triggering works, with the relevant deadline set at 31 December 2027. National implementation criteria and exemptions remain decisive. [1]

The phrase technically suitable matters. Available roof area alone does not establish suitability. Structure, roof condition, remaining life, mounting conditions, safety requirements and the resulting roof-PV configuration all affect the answer.

The Directive therefore creates a useful policy context for a question that remains technical and commercial: before a building owner treats the roof as an energy-generating surface, what must be established about the roof itself?

The service-life mismatch

One of the clearest examples is remaining roof life. A proposed PV installation may be expected to operate for decades. If the waterproofing beneath it is likely to require major intervention much earlier, the project can create a foreseeable future conflict: PV modules, mounting equipment and electrical infrastructure may have to be removed to reach a roof that was already known to require work.

IIBEC Technical Advisory 27-2025 advises the building-enclosure consultant to provide input on the estimated remaining life of an existing roof receiving PV so that repairs can be properly planned. [3]

FM takes a more prescriptive property-loss-prevention position. Its recommendations for existing roofs include roof-age and deterioration criteria, discussed at Gate 3. [2]

The broader decision question is not whether one particular age automatically makes a roof unsuitable. It is whether the expected remaining performance of the roof is compatible with the period for which the PV investment is expected to remain in place.

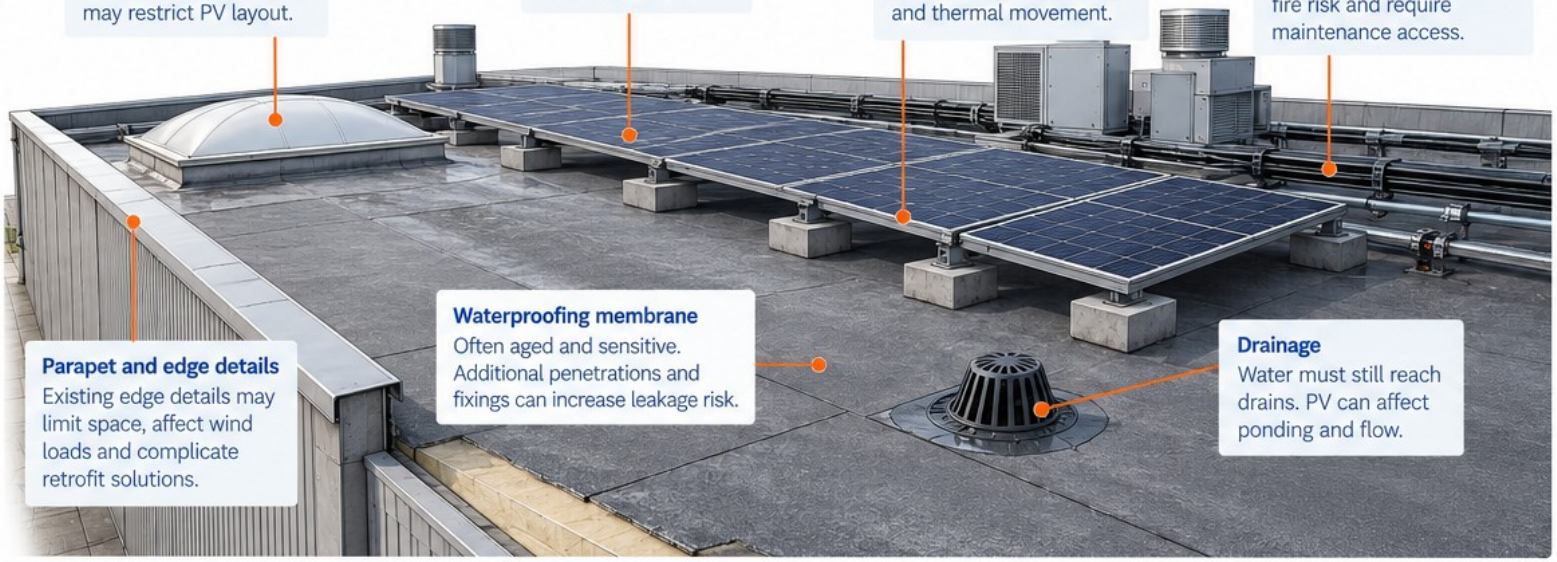
FIGURE 1

The existing roof reality

A PV system is added to an already complex building element.

An existing commercial roof is not a blank surface. It already has a structure, waterproofing, insulation, penetrations, drainage and operational constraints. Adding PV increases load, changes fire dynamics and can affect maintenance and access.

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Key issues on existing roofs

Load
Structural reserve may be limited.

Fire behaviour
The existing roof build-up can contribute to fire spread under PV.

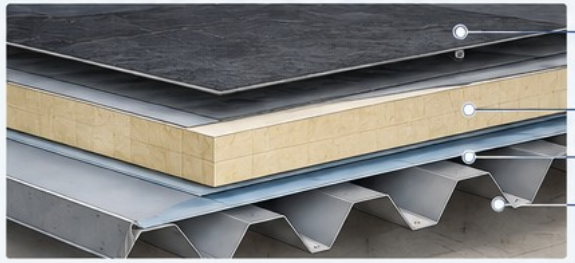
Drainage
PV can affect ponding and water flow.

Access
Inspection, maintenance and emergency access must be preserved.

Remaining life
The roof may have less life remaining than the PV system.

Complex interfaces
Rooflights, parapets, services and existing materials create additional risks.

Typical existing roof build-up (example)



Every roof is different.

The configuration, condition and constraints of the existing roof determine the options for a suitable PV installation.

Three layers of requirements

Existing-roof PV decisions become confused when different kinds of requirements are treated as though they were interchangeable. They are not.

This paper separates them into three layers.

Regulation and code

The first layer consists of the legally applicable building, structural, fire, electrical, occupational-safety, planning and grid requirements in the jurisdiction where the project is located.

In Europe, this can include national implementation of European directives, Eurocodes with national annexes and national or local building and fire requirements. Other jurisdictions use different regulatory frameworks.

Compliance with insurer guidance does not replace compliance with law or code.

Property-risk and insurer requirements

The second layer concerns property protection and insurability.

FM Property Loss Prevention Data Sheets are used extensively in this paper because they provide detailed property-risk guidance for commercial and industrial roofs with PV. Their role is not that of European legislation. They are relevant because international asset owners and insurers may apply property-protection requirements that extend beyond minimum regulatory compliance.

Other insurer and risk-engineering guidance serves a similar role. In Germany, VdS 6023:2026-05 provides a relevant insurer-oriented damage-prevention perspective for rooftop PV on industrial, commercial and municipal buildings. [4] UK guidance such as RC62 provides another regional perspective. [5]

These sources may overlap with regulation, supplement it or impose different conditions. That is precisely why their requirements should be identified before the project design is treated as complete.

Evidence and approval

The third layer concerns what can actually be demonstrated for the proposed configuration.

Test reports, classifications, listings, engineering assessments and system approvals do not themselves determine the applicable law or the owner's risk appetite. They answer another question:

> **What performance has actually been demonstrated, for which configuration and within what limits?**

A favourable property of one component does not automatically describe the complete roof-PV system. A roof classification obtained without PV does not necessarily describe the same roof once modules are installed above it. An approval for one assembly should not be assumed to extend to another.

The project therefore has to understand all three layers that apply to it:

> **regulation and code → property-risk requirements → evidence and approval**

None automatically substitutes for the others.

FIGURE 2

Three layers of requirements

Different purposes. A complete project must address all three.

The same roof-PV project is subject to legal requirements, property-risk expectations and evidence for the actual configuration. The layers may overlap, but none replaces the others.

1	**Regulation & code** Legal requirements	EPBD (EU) 2024/1275 National building codes Fire, structural, electrical requirements Planning and permitting Local requirements	Sets the legal and minimum compliance requirements.
2	**Property risk & insurer requirements** Loss prevention and risk acceptance	FM DS 1-15 VdS 6023 RC62 (UK) Other insurer and risk-engineering guidance	Defines project-specific loss-prevention and risk requirements.
3	**Evidence & approval** Demonstrated performance	Test reports Classifications Listings Approvals (e.g. FM)	Shows performance for defined configurations and stated boundaries.

Compliance, risk requirements and evidence answer different questions.

Who owns the process?

Each technical gate in this framework has a specialist responsible for closing the relevant technical question. That does not mean that the structural engineer, roof consultant, fire engineer or PV designer should own the complete framework.

The framework needs a process owner.

For most projects, that should be the asset owner or an owner's technical project lead acting on the asset owner's behalf.

The process owner does not overrule specialist judgement. The role is to make sure that each gate has an identified technical owner, that the evidence required to close it is documented and that assumptions made by one discipline are visible to the others.

The process owner also has to recognise when later information reopens an earlier decision. A change in roof build-up may affect structural load. A fire-mitigation measure may affect mounting. A condition imposed by an insurer may invalidate an evidence route. An unresolved question should not continue through the project merely because a later design stage has already started.

> **The specialists own the answers within their competence. The asset owner owns the decision process.**

This paper therefore does not attempt to replace specialist engineering. Its purpose is to connect engineering and investment decisions in a sequence that makes their dependencies visible.

Three principles behind the framework

Establish inherited constraints

An existing building comes with constraints that cannot simply be designed away. Before the PV system is optimised, the project has to establish the as-found structure, roof build-up, remaining service life, drainage, mounting interfaces, access constraints and other inherited conditions that can determine whether the investment is feasible at all.

This principle is broader than fire safety. It is the organising premise of the framework: inherited building constraints define the design space within which structural, roof, mounting, risk and PV decisions can subsequently be made.

> **Unknown conditions should not be treated as favourable conditions.**

Reduce the probability of ignition and failure

Good PV equipment selection, electrical design, installation, commissioning and maintenance should reduce the probability of faults and ignition.

Prevention matters.

Electrical protection, correct installation and maintenance can reduce ignition probability, but FM itself notes that electrical guidance cannot fully eliminate roof-PV fire risk. The design question therefore cannot end with prevention. German insurer-oriented guidance such as VdS 6023 also identifies electrical faults and arcing as relevant PV ignition scenarios. [2][4]

Probability can be reduced, but the design should not assume that an electrical fault or ignition event is impossible throughout a multi-decade operating life.

Limit consequences if prevention fails

Consequence-limiting design asks a second question:

> **If a credible electrical fault produces ignition beneath or within the PV array, what prevents that local event from escalating into major roof involvement and property loss?**

The answer cannot be based on the PV module alone or on the visible roof covering alone. FM describes how the behaviour of a fire beneath PV depends substantially on the roof covering and insulation below the array and treats the roof and PV combination as an interacting system. [2, §3.2]

Independent research points in the same direction. A literature review commissioned by England’s Building Safety Regulator found that rooftop PV can alter thermal exposure, trap heat beneath modules and redirect flames towards roof surfaces, while peer-reviewed experiments have shown that the gap between a PV module and roof can materially affect flame spread beneath the array. [13][14]

This does not mean that every roof requires the same fire-protection construction. It means that the consequences of credible ignition should be considered explicitly and supported by evidence relevant to the resulting roof-PV configuration.

How do we reduce the probability of ignition?

If ignition occurs, what limits escalation and loss?

The decision sequence

The framework is sequential for decision control, but iterative in practice. A gate is closed only for the configuration currently being assessed. If that configuration changes materially, the relevant earlier gate may need to be reopened.

The principal feedback loops are Roof → Structure, Mounting → Structure, Risk → Structure, Risk → Mounting, Evidence → Roof / Mounting / Risk, Approval → any earlier gate affected by a condition of acceptance and Lifecycle → reassessment after material change.

These feedback loops are not exceptions to the model. They are part of it.

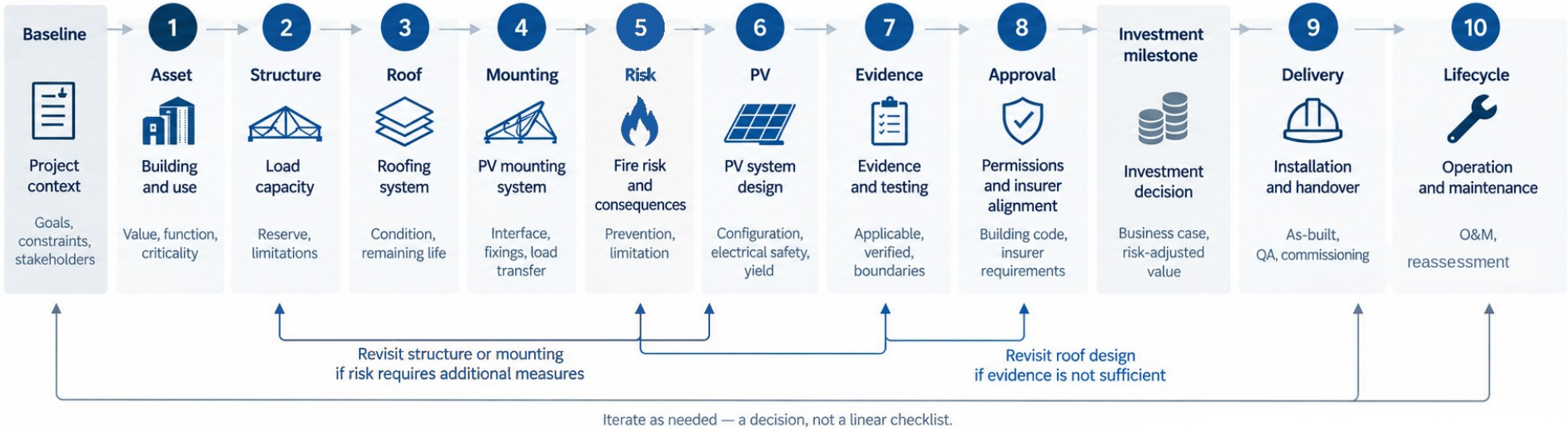
FIGURE 3

The ten-gate decision framework

A structured path from asset to long-term performance.

Each gate answers a key question, is closed by the relevant specialist and builds on the previous decisions. Later information can reopen earlier gates. Iterate as needed — a decision, not a linear checklist.

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How to use the gates

Each gate answers five practical questions:

Decision. What question must be sufficiently resolved?

Technical owner. Which specialist or decision-maker has the competence to close it?

Minimum evidence. What information should exist before the project relies on the answer?

Outcome. What routes remain available once the gate is closed?

Consequence of late resolution. What can be disrupted if the issue is discovered only after subsequent work has been completed?

The consequence-of-late-resolution statements in this paper are editorial judgements, not measured risk scores. Their purpose is to show where late discovery can invalidate substantial earlier work.

The gates describe the order in which decisions should become sufficiently resolved. They do not prescribe the order in which specialists should first be contacted.

Several disciplines may need to work in parallel. The insurer, for example, appears formally at Gate 8, Approval, but insurer or risk-engineer input may be required much earlier if acceptance conditions could affect Structure, Roof, Mounting, Risk or Evidence.

> **The formal gate tells the project when an answer must be closed, not when the conversation should begin.**

Two illustrative buildings

The examples used throughout this paper are fictitious. They are not AllShield projects and their characteristics are illustrative only.

Their purpose is to demonstrate one requirement of a credible decision framework:

> **Different buildings should be capable of producing different answers.**

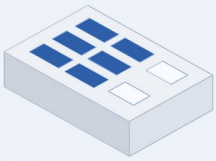
	Variant A	Variant B
Building	Logistics building with lightweight steel roof structure	Commercial building with well-documented roof
Structural reserve	Limited	Adequate for proposed system
Roof documentation	Incomplete	Substantially complete
Remaining roof life	Requires investigation and likely intervention	Compatible with intended PV horizon
Roof intervention	Refurbishment may become part of PV project	Existing roof can remain
Primary constraint	Interaction between weight, roof intervention and risk	Working within retained assembly
Design freedom	Can increase if refurbishment is justified	More constrained by inherited assembly

FIGURE 4

Two projects. Different routes. Same framework.

The framework adapts to project conditions, not the other way around.

A Limited reserve, roof refurbishment required



Illustrative, fictitious

GATE 2 STRUCTURE
Limited additional capacity

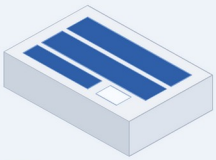
GATE 3 ROOF
Refurbishment becomes part of the project

GATE 5 RISK
Mitigation must fit the weight budget

GATE 7 EVIDENCE
Evidence for the new build-up

OUTCOME
The roof intervention joins the PV project. Options that fit the weight budget are then tested against the available evidence.

B Adequate reserve, existing roof retained



Illustrative, fictitious

GATE 2 STRUCTURE
Adequate reserve

GATE 3 ROOF
Existing roof retained

GATE 5 RISK
Mitigation must work with the inherited roof

GATE 7 EVIDENCE
Evidence for the inherited roof; may be unavailable

OUTCOME
The existing roof stays. Later gates work within the inherited assembly.

Same questions. Different answers.

A framework that always led to the same construction would not be a decision framework.

Variants A and B as described in the paper ("Two illustrative buildings"). Both are fictitious.

Baseline assessment

Establish what roof is actually present

> **Do we know enough about the existing roof to make reliable decisions about adding PV?**

For new construction, the designer specifies the roof assembly. For an existing building, the project team first has to establish what assembly is actually present.

Original drawings can help, but they do not necessarily describe later repairs, overlays, substitutions, localised replacement, new penetrations or deterioration.

The baseline assessment therefore converts an assumed roof into an as-found roof. Its purpose is not to deliver every engineering answer before Gate 1. It is to establish enough reliable information for the later specialists to know what they are assessing.

Relevant baseline information can include roof-cover type and approximate age, known roof layers, insulation type and thickness, coverboard where present, deck type, roof-cover attachment or adhesion, retained aggregate or ballast, roof slope, penetrations, expansion joints, rooflights, rooftop plant, drainage, previous leakage or repair history, visible deterioration, warranties, structural information and previous alterations.

Where uncertainty is material, further investigation may be necessary.

There is no single investigation technique suitable for every roof. Depending on the construction and the decision being made, characterisation may involve document review, visual inspection, moisture surveying or targeted intrusive investigation. The method should suit the roof assembly and its limitations should be understood.

Some moisture-survey techniques, for example, are constrained by conductive materials or by overburden such as gravel, ballast or pavers. The baseline should expose these limitations before later decisions begin relying on assumptions about hidden condition.

Hazardous legacy materials

Where a proposed intervention will disturb existing roof layers, applicable regional requirements may require investigation for hazardous legacy materials.

For European projects, asbestos requirements arise through occupational-safety legislation implemented nationally. The exact procedures and duty holders differ between jurisdictions. [6]

> **Before an intervention that may disturb older roof materials is fixed, asbestos and other relevant hazardous legacy materials should have been identified in accordance with the applicable regional requirements.**

Other legacy materials, including tar-containing roof layers, may also be relevant depending on building age, roof type and jurisdiction.

Baseline versus Roof

The baseline asks: What roof are we dealing with and how confident are we in that information?

Gate 3 asks: Can that roof continue to perform for the intended PV project and what intervention is required?

Keeping these questions separate prevents the baseline from becoming a complete roof-engineering study.

Early preliminary go/no-go

> **Is there already enough evidence of a structural, roof-life, mounting, hazardous-material or insurer constraint to justify redirecting or stopping the project before detailed PV engineering continues?**

This is not one of the ten formal gates. It is an efficiency check.

	Variant A	Variant B
Finding	Incomplete records and uncertainty over local repairs and condition	Records align substantially with observed roof
Additional work	Further roof and structural investigation	No major baseline discrepancy
Outcome	Proceed with identified uncertainties	Proceed on sufficiently characterised roof

1 Asset

Start with what the building must protect

The first formal decision is an asset decision.

Before structure, roof composition or PV layout are assessed in detail, the owner should establish what the building is expected to protect, how long the asset is expected to remain in use and what level of disruption or loss would be material.

The same roof condition can lead to different decisions on different assets. A distribution centre with alternative logistics capacity does not present the same consequence profile as a production facility where roof damage could interrupt a critical process for months.

Mandatory technical requirements do not become optional when the business consequence is lower. The asset context determines what the owner is trying to protect and what consequences later technical decisions should seek to avoid.

Define the investment horizon

PV business cases are normally built around expected electricity production over a long operating period. The roof beneath the system has its own remaining life, maintenance cycle and future intervention needs.

Those horizons should be visible from the beginning.

At Gate 1, the owner does not determine whether the roof can last as long as the PV system. That belongs to Gate 3. The owner does, however, define the period against which the roof consultant must assess that question.

> **Over what period is the roof-PV investment expected to remain technically, operationally and commercially viable?**

Define whole-life performance objectives

Where embodied or whole-life carbon is a project objective, it should be stated alongside cost, service life, resilience and operational requirements rather than inferred later from material choice.

Low structural mass, noncombustibility and low embodied carbon are different design objectives. None should be used as a proxy for another. The project should compare functionally equivalent roof-PV options using evidence appropriate to each objective.

Identify the consequence of failure

A roof leak above a warehouse aisle does not have the same consequence as water ingress above critical manufacturing equipment. Temporary removal of a small PV array is different from dismantling a system occupying most of an operational facility.

The asset owner should therefore identify operations that are particularly sensitive to water ingress, fire, restricted roof access or prolonged shutdown.

Early insurer involvement can also be valuable. The insurer does not design the project, but property-risk conditions identified now may affect decisions long before formal Approval at Gate 8.

	Variant A	Variant B
Investment horizon	Long-term hold	Long-term hold
Consequence profile	Material logistics interruption	Moderate commercial interruption
Asset implication	Roof-life mismatch must be addressed within project	Same horizon but no intervention assumed

Gate 1 : Asset	
Decision	Are the building function, consequence profile and investment horizon sufficiently defined?
Owners	Asset owner or investment decision-maker, with early insurer or risk-engineer input where relevant.
Minimum evidence	Building use, critical operations, investment horizon and material business-interruption exposures.
Outcome	Proceed, redefine objectives or defer.
Consequence of late resolution	Technical disciplines can optimise against the wrong investment horizon or consequence assumptions.

2 Structure

Establish the real weight budget

The first major technical constraint is the structure.

The relevant question is not simply whether the roof can carry PV. It is how much capacity remains after existing permanent loads, environmental loads and required safety margins have been accounted for, and how much of that remaining capacity can reasonably be allocated to the complete PV intervention.

The intervention can include more than modules and rails. Mounting equipment, ballast, walkways, cable infrastructure, changes to the roof build-up and risk-mitigation measures may all add permanent load.

FM Data Sheet 1-15 gives an indicative allowance of 2 to 3 psf, approximately 0.10 to 0.14 kPa, for PV panels and hardware, plus any ballast, while referring detailed structural assessment elsewhere. [2, §2.1.5.2]

That figure is not a calculation method. FM identifies the issue. The structural engineer determines the capacity.

Structural capacity is a finite design budget

Treating structural reserve as a finite design budget changes the project discussion.

Where reserve capacity is generous, several technically viable solutions may remain available. Where reserve is limited, every kilogram per square metre used by one measure reduces what remains available for another.

Ballast, new roof layers, protection measures or water-based systems can therefore compete for the same reserve.

Existing load matters

The structural engineer is not starting from a blank design. Previous overlays, rooftop plant, modifications and deterioration may already affect the as-found condition.

The baseline should therefore provide the structural engineer with the best available information on the actual building rather than only original drawings.

FM's own wind-review requirements illustrate this system perspective by requesting information including roof-cover age and type, insulation, fastening method, deck type and existing deck securement. [2]

Snow, rain and drainage

Dead load is only one part of the assessment. PV arrays can alter snow accumulation. Structural deflection can worsen ponding. Ballast and mounting can redistribute loads. Drainage can be affected by equipment location.

The roof should therefore be assessed as it will operate with PV, not merely by adding module dead weight to an old structural calculation.

Removing weight can be part of the solution

Where reserve capacity is limited, strengthening is not the only possible response. A roof intervention may allow existing dead load to be removed or redistributed.

Whether that is appropriate belongs to the relevant engineers and roof specialists. The important point is that structural feasibility is not always binary.

	Variant A	Variant B
Structural finding	Limited additional capacity	Adequate reserve
Implication	Tight weight budget	Weight not dominant
Design response	Avoid unnecessary load, reconsider ballast	Wider range of options
Gate likely to reopen	After Roof or Risk	Only after material change

Gate 2 : Structure	
Decision	Has available structural capacity been established sufficiently to define the load budget?
Technical owner	Competent structural engineer.
Minimum evidence	Assessment of structure and deck, permanent and environmental loads, proposed PV/mounting loads and intended load path.
Outcome	Proceed, reduce load, change mounting, alter roof intervention, strengthen, reduce PV scope or stop.
Consequence of late resolution	A structural constraint can invalidate roof, mounting and PV decisions simultaneously.

3 Roof

Decide what roof the PV system will live on

Structure determines what the building can carry. Gate 3 determines what roof the PV system will actually live on.

The central question is not whether the roof is watertight on the day of inspection. It is whether the roof can continue to perform the functions required of it over the intended PV investment period and what intervention is necessary if it cannot.

The baseline established what is present. Gate 3 interprets that information in terms of condition, remaining life, drainage, maintenance and future access.

A roof has more than one function

PV discussions can reduce the roof to waterproofing. That is too narrow.

IIBEC TA 27-2025 identifies functions including watertightness, water and ice shedding, drainage, thermal performance, wind resistance and access. It also advises that the building-enclosure consultant provide input on estimated remaining life for existing roofs receiving PV. [3]

A roof can therefore be currently watertight while still creating a foreseeable service-life conflict with a long-duration PV investment.

FM's ten-year recommendation

FM takes a more prescriptive property-loss-prevention position.

Its April 2026 Data Sheet 1-15 recommends that an existing roof more than ten years old be replaced or re-covered before installing PV expected to remain for 25 to 30 years. It also advises against installation where the existing roof shows deterioration such as leaks, cracking, delamination or blistering. [2, §2.1]

This is an FM property-loss-prevention recommendation, not a universal engineering rule stating that every roof older than ten years is unsuitable.

> **Does the roof's expected remaining performance align with the intended PV horizon?**

Retain, repair, re-cover or replace

Gate 3 should produce an intervention strategy rather than merely a condition grade.

Possible outcomes include retaining the roof, repairing defined defects, refurbishing or re-covering, partial renewal or replacement.

If the existing roof remains, later gates must work with the inherited assembly. If the roof is re-covered or replaced, the project gains some design freedom.

That decision can reopen Structure because permanent load changes. It can also change Risk and Evidence because the future assembly may behave differently from the inherited one.

The actual build-up matters

An existing commercial roof cannot be described adequately by its visible membrane alone.

FM's plan-review requirements ask whether the existing roof cover remains and request information on roof cover, insulation, noncombustible coverboard where present, adhesion and other assembly details. [2]

A description such as “TPO roof” or “Class A roof” is therefore not enough to define what later disciplines are assessing.

Hidden condition and moisture

Visible inspection alone may not reveal hidden condition. Where uncertainty could materially affect the intervention decision, the roof consultant may require additional investigation. The correct method depends on the assembly and the question being investigated.

> **Do not treat uncertainty about hidden roof condition as evidence that the condition is satisfactory.**

Drainage remains a roof function

PV arrays, walkways, ballast and cable routes must not prevent water from reaching drains or other outlets. Structural deflection can also worsen ponding.

FM requires rainwater paths to remain unobstructed by PV. [2, §2.1.5.3]

The roof consultant should therefore identify areas that must remain accessible or unobstructed before the final array is fixed.

Existing warranties

An existing roof warranty should not be assumed to continue unchanged after PV is installed.

Manufacturer requirements vary, but published policies from several major commercial roofing manufacturers show that adding PV to a warranted roof can trigger notification, technical review, installation requirements, documentation and post-installation inspection before warranty coverage is continued or reinstated. The applicable warranty holder should therefore be consulted before the mounting strategy and roof interfaces are fixed. [7]

This does not establish one universal industry procedure. The conditions remain manufacturer- and roof-system-specific.

Re-cover details

A re-cover or replacement can increase the finished roof level. That can affect parapets, equipment curbs, penetrations, drains, overflow scuppers and available flashing heights.

Technical reroofing guidance describes the physical conflicts that can arise where additional insulation or roof-system thickness reduces available vertical clearances or interferes with existing drainage and perimeter details. [8]

The applicable dimensions and required modifications remain project- and jurisdiction-specific.

Material efficiency and embodied carbon

Where carbon performance is part of the project brief, retain, repair, re-cover and replacement options should be compared as complete roof build-ups rather than by material category alone. Retaining serviceable layers can avoid premature replacement, while a new build-up may improve other performance criteria; the appropriate balance is project-specific.

Mass is not a carbon metric and combustibility is not a carbon metric. Environmental claims should therefore be supported by project-appropriate EPD or LCA evidence using a comparable functional basis, alongside fire, structural, thermal, waterproofing and durability evidence.

Hazardous legacy materials

Where roof layers will be disturbed, hazardous legacy materials can change programme, cost and the appropriate intervention. The baseline identifies whether investigation is required. Gate 3 translates that information into the chosen roof strategy.

	Variant A	Variant B
Remaining life	Not sufficiently aligned	Suitable for project horizon
Roof outcome	Refurbishment becomes part of project	Existing roof retained
Design consequence	New build-up can be considered	Later gates inherit existing assembly
Gate reopened	Structure	None unless conditions change

Gate 3 : Roof	
Decision	Can the existing roof remain beneath the proposed PV system for the intended investment horizon and, if not, what intervention is required?
Technical owner	Roof or building-enclosure consultant, with relevant manufacturers and specialists where required.
Minimum evidence	Documented build-up, condition assessment, estimated remaining life, relevant investigation, drainage/detail review, warranty position and access requirements.
Outcome	Retain, repair, refurbish/re-cover, partially renew, replace or stop pending further information.
Consequence of late resolution	A late roof-intervention decision can alter cost, structural load, mounting, risk strategy, evidence and the investment case.

4 Mounting

The mounting system has to fit the roof

Once structural capacity and the roof strategy are known, the mounting concept can be selected against actual constraints.

A mounting system transfers wind and gravity loads into or across an existing roof assembly. It can add weight, penetrate waterproofing, bear on the roof surface and affect future access.

> **Which mounting and attachment strategy is compatible with this structure, this roof assembly and the applicable wind requirements?**

Ballasted does not mean structurally neutral

Ballasted PV can avoid roof penetrations, but its weight must fit within the Gate 2 budget.

RC62 notes that ballasted systems can materially increase roof loading and that structural deflection can contribute to water pooling. [5]

FM adds specific conditions for new ballasted, tilted-panel systems. Its guidance requires installation over an adhered membrane, limits ballasted rigid PV to a maximum roof slope of approximately 2.4° and advises against such systems on roofs with aggregate or where an adjacent higher roof contains aggregate. [2, §2.1.2.3.1]

Those are conditions of FM's ballasted-system guidance. They should not be broadened into a universal prohibition on PV over aggregate-surfaced roofs.

Mechanically attached roof covers

The attachment of the existing membrane can also influence mounting.

FM notes that mechanically fastened roof covers can billow under wind pressure and requires PV installed over such a roof cover to be mechanically fastened. [2, §3.4.1]

The wider lesson is that the visible membrane does not define the mounting condition by itself.

The load path has to be credible

For mechanically secured systems, the question continues below the membrane.

The structural engineer and PV designer need a credible path from module and mounting hardware through the roof into the supporting structure.

FM's standing-seam guidance illustrates the same principle: an external clamp is only one part of the load path. The seam, clips and supporting structure also matter. [2]

Penetrations create interfaces

Mechanical attachment can reduce ballast but may introduce penetrations or local details that must remain watertight throughout the system life.

The roof consultant and relevant manufacturer should therefore be involved in those interfaces.

IIBEC likewise treats anchored, ballasted and clamped PV as building-envelope interfaces that need to preserve waterproofing, drainage, thermal performance and wind resistance. [3]

Mounting and access develop together

Maintenance routes, fire-service access, rooflights, drains, expansion joints and rooftop plant interrupt the PV field. Access cannot simply be carved out after the array is optimised for yield.

	Variant A	Variant B
Structural context	Tight weight budget	Adequate reserve
Roof context	Refurbished assembly	Existing roof retained
Mounting challenge	Minimise load while preserving roof	Verify compatibility with retained roof
Design freedom	Limited by weight	Wider subject to roof conditions

Gate 4 : Mounting	
Decision	Is the mounting strategy compatible with structural capacity, roof assembly, wind design, waterproofing and future access?
Technical owner	PV designer and structural engineer, with roof consultant and relevant manufacturers for interfaces.
Minimum evidence	Mounting arrangement, wind basis, ballast/anchorage requirements, load path, roof/deck attachment information and relevant manufacturer acceptance.
Outcome	Proceed, change attachment, reduce ballast, modify roof intervention, change layout or stop the proposed route.
Consequence of late resolution	Mounting incompatibility can reopen Structure, Roof and PV simultaneously.

5 Risk

Do not assess each risk in isolation

Once a plausible roof and mounting configuration exists, the project has to ask what risks the completed roof-PV system introduces or changes.

Fire is important, but it is not the only issue. Wind, hail, snow, water accumulation, electrical faults, access, maintenance and business interruption can all affect the loss profile.

More importantly, a measure selected to reduce one risk can increase another.

> **What consequences need to be limited, and does the proposed mitigation cause another gate to fail?**

Under PV, roof composition matters to fire growth

FM states that rooftop PV changes exterior fire behaviour and that fire growth depends significantly on the roof covering and insulation beneath the array. [2, §3.2]

This system effect is also supported outside FM guidance. The 2026 Building Safety Regulator literature review synthesised experimental evidence showing altered thermal exposure beneath rooftop PV, while Kristensen, Binte Mohd Faudzi and Jomaas demonstrated experimentally that module-to-roof gap height can materially affect flame-spread behaviour. [13][14] FM Research has separately evaluated roof-coating mitigation in rooftop PV fire scenarios, further illustrating that mitigation performance has to be considered at roof-PV system level. [15]

The fire question therefore cannot be reduced to the combustibility of the module or the classification of the exposed roof covering. The roof and PV interact.

Because ignition cannot be excluded, this gate also has to answer a more specific question: if a local fire develops beneath the array, what prevents it from becoming a building-scale loss? That question concerns the consequence side of the risk, not the probability of ignition, and it is where the composition of the inherited roof matters most.

Professional boundaries matter

IIBEC TA 27-2025 recognises that PV fire-safety assessment will often lie outside the normal expertise of building-enclosure consultants. [3]

The roof consultant establishes the roof and protects enclosure functions. The structural engineer closes structural questions. PV and electrical specialists address the PV system. Where fire behaviour is material, competent fire or property-risk specialists should assess it.

The framework connects those conclusions rather than replacing them.

There is no single mitigation route

FM DS 1-15 illustrates several routes for existing roof covers that remain. Depending on the conditions, these include matching an FM Approved roof-PV assembly, an FM Approved retrofit roof coating, specified re-cover routes, certain insulated metal-roof configurations or raising panels at least 0.9 m above the roof. A separately designed water-spray route is also described. [2, §§2.1.1.2–2.1.1.3]

IIBEC approaches the subject differently and identifies measures including noncombustible pavers in some existing-roof situations where the structure can carry the additional load. [3]

These routes are not interchangeable. Each creates different consequences for weight, wind, waterproofing and evidence.

The routes below are compared against the same project questions. They are not ranked; availability depends on the actual roof, the project conditions and the source requirements.

Route	Structural load	Wind / geometry	Roof / waterproofing	Evidence / main boundary
Match an FM Approved roof-PV assembly	Assembly-dependent	Must match listed geometry and securement	Inherited roof may need intervention to match the listed build-up	Strong where the project falls within the listed configuration; not generic approval for an arbitrary existing roof.
FM Approved retrofit roof coating	Generally low added dead load	PV geometry and wind still require project review	Requires compatible roof/substrate and application conditions	Applies only within the coating approval conditions and the actual roof configuration.
Defined re-cover route	Adds permanent roof load	PV configuration remains part of the route	Introduces new coverboard/membrane and detailing	FM DS 1-15 includes route-specific conditions; one route requires glass-backed PV panels.
PV raised at least 0.9 m	Mounting/support load remains	Wind demand changes materially	May avoid changing the roof build-up	FM route is conditional; wind guidance must be revisited for the greater height.
Separately designed water-spray system	System, piping and water may add load	Project-specific	Introduces service, penetration and maintenance interfaces	Separate system to design, accept, inspect and maintain; not an assembly shortcut.
Noncombustible pavers in applicable IIBEC cases	Adds permanent load	Layout can affect array and access	Adds roof-surface interfaces and maintenance load	Advisory measure in defined situations, not assembly approval; structural reserve is required.

When fire mitigation and structural capacity compete for the same kilograms

Gates 2 and 5 can create one of the most important trade-offs in an existing-roof PV project.

A lightweight building may have little residual structural capacity after existing loads, environmental loads and PV have been considered. Some risk-mitigation strategies also add permanent load.

Concrete pavers, additional roof layers, heavier constructions, ballast or water-based protection can therefore consume part of the same reserve.

> **How much of the available structural weight budget should be allocated to limiting fire consequences, and which evidenced solution achieves that objective without causing the Structure gate to fail?**

Where Gate 3 has already concluded that refurbishment is necessary, the project gains an opportunity to reconsider the roof build-up. Lightweight solutions can become valuable in that context, but low weight alone proves nothing. The proposed configuration still has to satisfy the applicable performance and evidence requirements.

FIGURE 5

When gates collide: weight versus fire consequence

Fire-consequence measures compete with other demands for the same structural reserve.

One weight budget, several claims

Available structural reserve (set at Gate 2)

Illustrative, not to scale



- PV system and mounting
- Ballast, if used
- New roof layers
- Fire-consequence measure
- Snow and water margin
- Unallocated

FM DS 1-15 gives an indicative 2 to 3 psf (0.10 to 0.14 kPa) for panels and hardware, excluding ballast.

Every kg/m² allocated to one measure is not available to another.

Gates 3, 4 and 5 all draw on the reserve set at Gate 2.

Routes named in the sources

Not interchangeable; each changes other gates.

FM Approved roof-PV assembly
Must match the listed configuration (Gates 7, 8)

FM Approved retrofit roof coating
Applies within its approval conditions (Gates 3, 7)

Re-cover: noncombustible coverboard + glass-backed PV
Changes load and roof details (Gates 2, 3)

PV raised at least 0.9 m above the roof
Changes wind demand; standard coefficients do not apply above about 0.6 m (Gates 2, 4)

Separately designed water-spray system
A further system to design, approve and maintain (Gates 8, 10)

Noncombustible pavers (IIBEC, some Class B or C roofs)
Adds permanent load (Gate 2)

Which evidenced solution limits fire consequences within this project's weight budget?

Weight alone proves nothing. Complete roof-PV assemblies are compared for load, fire performance, wind, waterproofing, evidence and lifecycle.

Sources: FM DS 1-15 (April 2026) §§2.1.1.2, 2.1.5.2, 3.4.14 [2]; IIBEC Technical Advisory 27-2025 [3].

Raising panels illustrates risk displacement

FM includes a route in which PV panels are installed at least 0.9 m above the roof. The same recommendation directs attention back to wind because the greater height changes wind demand. [2, §2.1.1.2]

FM's wind guidance further notes that above approximately 0.6 m, the prescriptive and boundary-layer wind coefficients described there are no longer applicable in the same way. [2, §3.4.14]

A measure introduced to address fire can therefore reopen Mounting and Structure.

	Variant A	Variant B
Structural reserve	Limited	Greater reserve
Roof state	Refurbishment planned	Existing roof retained
Risk implication	Mitigation must fit tight weight budget	More weight may be possible but roof remains inherited
Main trade-off	Consequence limitation versus load	Mitigation versus retaining existing roof

Gate 5 : Risk	
Decision	Have material risks introduced or changed by PV been identified and can mitigation be implemented without causing an earlier gate to fail?
Technical owner	Relevant competent specialists, including fire/property-risk input where material.

Gate 5 : Risk	
Minimum evidence	Assessment of relevant fire, natural-hazard, structural and electrical interfaces and consequences of mitigation.
Outcome	Proceed, mitigate, change mitigation, reopen earlier gates, redesign or stop.
Consequence of late resolution	A late risk requirement can invalidate an otherwise completed roof, mounting or PV design.

6 PV

Usable PV area is an output

Only after structure, roof, mounting and major risk constraints are sufficiently understood can the project determine how much roof area is genuinely usable for PV.

An aerial image can estimate gross area at the start of a project. That may support an early business case, but it is not final technical capacity.

The completed array has to coexist with drains, rooflights, plant, expansion joints, access routes, fire-service requirements, wind zones and roof-maintenance areas.

Usable PV area is therefore partly an output of the earlier gates.

A full roof is not necessarily an optimised roof

Maximising module density can increase generation, but it can also reduce access to drains and roof details, restrict inspection and complicate repair.

IIBEC emphasises access for maintenance and emergency personnel and continued functioning of the building enclosure. [3] FM also provides property-risk layout recommendations concerning array dimensions, separation and clearance from roof features. [2]

The important principle is that space required for safe roof operation should be reserved before final yield is calculated.

The PV designer now has a better brief

Project-specific fire-service or authority requirements may impose additional access, separation or operational constraints. These should be established before the usable PV area is treated as final.

By Gate 6, the PV designer knows the structural load budget, roof intervention, mounting concept, access and drainage requirements and material risk constraints.

> **Within these conditions, what PV configuration produces an acceptable technical and commercial result?**

If the resulting yield is lower than the preliminary business case assumed, that is not a failure of the framework. It is information the investment decision needed.

	Variant A	Variant B
Gross area	Large	Large
Usable area	Reduced by structural/access constraints	Higher proportion retained
Business-case effect	Yield revised downward	Preliminary yield largely retained
Outcome	Smaller but better-defined opportunity	Fewer constraints preserve area

Gate 6 : PV	
Decision	Has the technically usable PV area and configuration been established after building and roof constraints are applied?
Technical owner	PV designer using inputs from the relevant disciplines.
Minimum evidence	Coordinated layout showing roof interfaces, access, drainage, plant, rooflights, setbacks and mounting zones.
Outcome	Proceed, modify layout, reduce area, change orientation/mounting or return to investment assumptions.
Consequence of late resolution	An unrealistic gross-area assumption can materially change yield and project economics.

7 Evidence

A technically plausible solution is not yet an evidenced solution

By Gate 7, the project should know what it intends to build.

The question now changes from could this configuration work? to:

> **What evidence demonstrates the relevant performance of this configuration?**

This distinction is particularly important for existing roofs because the actual construction may differ from what was tested, classified or approved.

Membrane, insulation, coverboard, deck, attachment, PV module, mounting method, slope and retained layers can all affect whether evidence applies.

Gate 7 therefore examines the distance between the project as designed and the configuration for which evidence exists.

A component property is not an assembly property

FM states this principle clearly.

DS 1-15 says that the roof-PV system acts as one during a fire event and that individual components or small-scale results do not automatically establish the performance of the complete system. It also states that an FM Approved Class 1A roof without PV does not retain the relevant status merely because PV is installed above it unless the combination is specifically approved as a roof-PV system. [2, §3.2]

A material may be noncombustible. A roof may have a fire classification. A PV module may have its own classification. A complete roof-PV assembly may have been tested or approved.

Those statements answer different questions.

FM and IIBEC illustrate why scope matters

IIBEC recommends consideration of an FM/UL Class A roof for rooftop PV and identifies additional noncombustible measures in some existing Class B or C situations. [3]

FM takes a more assembly-specific property-risk position: the underlying roof classification alone does not establish the performance of the completed roof-PV system. [2, §3.2]

The labels should also not be conflated. IIBEC’s reference to Class A and FM’s Class 1A terminology arise from different classification and approval contexts; they should not be treated as equivalent labels or as interchangeable evidence for a completed roof-PV assembly.

The point is not that one source invalidates the other. Their scopes differ.

> **Acceptable according to which requirement, under which evidence route and for which exact configuration?**

Existing-roof routes have conditions

FM's own existing-roof recommendations illustrate the same principle.

For existing roof covers that remain, its guidance contains several distinct routes, including matching approved roof-PV components, retrofit coating, defined re-cover options, selected metal-roof configurations and the raised-array route discussed earlier. [2, §2.1.1.2]

The re-cover options themselves have specific conditions. One defined route, for example, combines an FM Approved Class 1A re-cover with a noncombustible coverboard directly beneath the new membrane and glass-backed PV panels. The complete conditions in DS 1-15 §2.1.1.2 still have to be checked for the project; this summary is not a substitute for the source.

For new construction or refurbishment, first establish whether the intended roof-PV build-up falls within a current applicable FM Approved RoofNav assembly and its conditions. For retained existing roofs, verify the deck, retained layers, attachment, condition and interfaces against that scope. Where the intended construction or a deviation is not covered, obtain an appropriate documented engineering assessment and acceptance. Individually FM Approved components do not by themselves form an FM Approved assembly. A project acceptance decision does not extend a listing.

Each route has its own limits.

Evidence should be read from the inside out

The project should identify exactly what was tested or approved: membrane, insulation, coverboard, deck, attachment, module, mounting system, slope and other variables relevant to the evidence.

Only then should the proposed project be compared with it.

Where the two match, the argument is relatively straightforward.

Where they differ, the deviation should be visible rather than hidden inside a broad product or system claim. The relevant manufacturer, test or certification body, insurer or competent engineer can then determine whether the evidence can be extended, whether an engineering assessment is appropriate or whether further testing is required.

Environmental evidence has boundaries too

Where environmental claims influence Gate 7, they should be traceable to project-appropriate EPD/LCA evidence and a comparable functional basis.

Application example : a low-mass coverboard within defined evidence boundaries

AllShield BarrierSheet is used here only as an example of how evidence boundaries should be read.

FM Approval Report PR472014 confirms BarrierSheet within a defined FM Approval programme under FM 4470 and FM 4478. RoofNav assembly 568563-0-0 includes specified PV panels, mounting, membranes, 2.5 mm BarrierSheet, FM Approved insulation within the assembly and a new steel deck. [9] That evidence does not make arbitrary existing roofs or re-cover configurations FM Approved. The programme uses previous test data and waivers, including the FM 4478 external-fire requirement; PR472014 does not document a new fire test with PV (PR472014, §3.2, Table 1).

Fire behaviour. ZAG concluded that, in the tested roof-PV specimens, direct flame penetration into deeper structural layers was prevented, while thermal damage and decomposition still occurred in the underlying combustible insulation and localised burn-through of the sheet was recorded in two runs. All four specimens used an anchored BarrierSheet layer. AS-1 and AS-3 placed it directly above the retained bitumen/EPS roof; AS-2 and AS-4 included 60 mm and 120 mm PIR respectively between BarrierSheet and the bituminous layers. The direct-overlay AS-1 and AS-3

configurations make the programme relevant to re-cover situations. [10, §2.1, pp. 5–6] It does not make those configurations FM Approved or classified. [10]

Historical evidence. Kiwa BDA tested a specific roof-PV configuration using a 1.2 mm BarrierSheet. Those results should not be treated as direct evidence for the current 2.5 mm FM-listed construction. [12]

Application remains case-specific: the complete proposed assembly must be compared with the scope and conditions of the evidence.

> **Evidence exists for defined assemblies; whether it extends to a given existing-roof configuration must be established case by case.**
>
> Does the evidence apply to the proposed roof-PV configuration, including the actual roof build-up, PV system, mounting, geometry and relevant project conditions?

That is the discipline Gate 7 is intended to enforce.

	Variant A	Variant B
Assembly flexibility	Some freedom because refurbishment is required	Limited because existing roof remains
Evidence strategy	Select future assembly with evidence in mind	Determine what evidence applies to inherited roof
Difficulty	Proposed new build-up may differ from evidence	Direct roof-PV evidence may be unavailable
Response	Select evidenced assembly or resolve deviations	Mitigate, assess, test or redesign

Gate 7 : Evidence	
Decision	Does available test, classification, listing or approval evidence apply to the proposed configuration and are material deviations resolved?
Technical owner	Relevant fire/risk specialists, manufacturers, testing/certification bodies and other competent parties.
Minimum evidence	Underlying reports/listings/approvals, detailed assembly descriptions, limitations and documented treatment of deviations.
Outcome	Directly covered, covered with conditions, assessment required, further testing required, alternative route required or unsupported.
Consequence of late resolution	A structurally viable and commercially attractive design may still require redesign if its evidence does not apply.

8 Approval

Evidence and acceptance are different

By Gate 8, the project may have a structurally feasible roof, an acceptable mounting concept, a defined risk strategy and relevant evidence.

That does not mean every party whose acceptance matters has agreed to it.

A building or fire authority may focus primarily on legal compliance, life safety and fire spread. A property insurer may additionally focus on asset protection, business interruption and maximum foreseeable loss. A roof manufacturer may focus on warranty and system interfaces. A certification or approval body addresses only the scope of its own scheme.

These positions can overlap but are not interchangeable.

An FM Approved assembly does not automatically satisfy every local building or fire requirement. Approval by a local authority does not automatically demonstrate that a property insurer will accept the same risk.

RC62 reinforces this distinction by recommending early consultation, where relevant, with both the local fire authority and the current or prospective property insurer. [5]

FM provides one concrete example of what an insurer-facing technical review can require. DS 1-15 §3.9 calls for project information covering the existing roof and deck, roof-cover and insulation details, attachment or adhesion, relevant geometry and the proposed PV and mounting configuration. The exact submission package and acceptance criteria remain insurer- and project-specific, but Gate 8 should result in a documented position rather than an assumed approval.

Approval conditions can reopen the design

A condition imposed by an insurer, manufacturer or authority may affect layout, separation, mounting, load, roof construction or evidence.

Such a condition is not merely an administrative addition to a finished design. The relevant earlier gate has to be reopened.

	Variant A	Variant B
Main question	Acceptance of refurbished roof-PV assembly	Acceptance over retained roof
Possible condition	Additional evidence or assembly limits	Additional mitigation or mounting conditions
Likely reopened gate	Roof / Risk / Evidence	Mounting / Risk / Evidence

Gate 8 : Approval	
Decision	Have all parties whose acceptance is required accepted the configuration within their respective remit?
Owners	Asset owner/process owner together with relevant approving parties.

Gate 8 : Approval	
Minimum evidence	Written insurer position where applicable, manufacturer/warranty confirmations, authority approvals and controlled project documentation.
Outcome	Accepted, accepted with conditions, redesign, alternative evidence or stop.
Consequence of late resolution	A late condition of acceptance can reopen virtually any preceding gate.

Investment milestone

Rebuild the business case using the real project

The original PV business case is normally based on assumptions: expected module count, indicative mounting, preliminary CAPEX and forecast energy yield.

By Gate 8, the project knows substantially more.

It knows what roof intervention is required, whether structural strengthening or weight reduction is necessary, which mounting strategy is acceptable, what risk mitigation is required, what evidence applies, what usable PV area remains and what conditions have been imposed by relevant parties.

The investment case should now be rebuilt around the configuration that can actually be delivered.

Relevant inputs can include PV CAPEX, roof repair or refurbishment, structural works, mounting requirements, risk-mitigation measures, testing or assessment costs, temporary disruption, maintenance implications, insurance conditions, embodied and whole-life carbon where relevant to the project brief, replacement cycles and the expected yield of the final usable array.

Insurance is a lifecycle cost

Insurance should be assessed as a lifecycle cost, not only as an approval condition. Where relevant, the investment model should include potential changes in premiums, deductibles, exclusions, risk-improvement requirements and availability of cover associated with the final roof-PV risk profile.

The comparison should also test whether additional CAPEX at the Roof and Risk gates reduces recurring or contingent costs over the operating period. A lower initial PV CAPEX is not necessarily the lower-cost asset decision if it creates higher insurance, maintenance or future roof-access costs over the project life.

The roof intervention should not automatically be treated as an external cost that makes PV uneconomic. If that intervention is required to make a long-duration PV investment technically and operationally viable, it belongs in the same investment decision.

Nor should the framework force a positive answer. If the required interventions destroy the economic case, the correct decision may be to reduce, defer or stop the project.

> **Now that we know what must actually be built, does the combined roof-PV investment still create sufficient value?**

The outcome is invest, redesign, defer or do not proceed.

9 Delivery

Build the configuration that was assessed

Evidence and approvals apply to a defined configuration.

Delivery has to preserve it.

Construction substitutions can change membrane, insulation, coverboard, mounting components, fasteners, spacing, attachment or other variables that formed part of the technical assessment.

A substitution that appears commercially minor may change wind performance, waterproofing, fire behaviour or the applicability of evidence relied upon earlier.

Gate 9 therefore requires change control, not merely completion inspection.

The evidenced assembly has to reach the roof

Where a performance claim depends on a specific assembly, components and interfaces relevant to that claim should be identifiable in the construction documentation and verifiable on site.

Proposed substitutions should be assessed before installation rather than rationalised afterwards.

The same principle applies to any configuration whose performance or acceptance depends on specified components, interfaces and installation conditions.

Interface responsibility and warranty continuity

Interface responsibility should be agreed before work starts. The project should define who records the pre-installation roof condition, who is responsible for damage caused during PV works, which repairs require approval by the roof-system provider and what evidence is required to preserve or reinstate warranty coverage.

Without that allocation, later defects can become disputes between roofing, PV and maintenance contractors rather than managed building defects.

QA protects evidence integrity

> **specified configuration → evidenced configuration → accepted configuration → installed configuration**

If that chain breaks, earlier conclusions may no longer apply.

	Variant A	Variant B
Delivery complexity	Refurbished roof plus PV interfaces	PV added to retained roof
Main QA risk	Substitution inside new assembly	Damage/modification to existing roof

	Variant A	Variant B
Key control	Verify evidence-critical components	Verify mounting and interfaces

Gate 9 : Delivery	
Decision	Was the configuration that was designed, evidenced and accepted actually constructed?
Owners	Asset owner/process owner, contractors and relevant QA representatives.
Minimum evidence	Approved-for-construction documents, material identification, pre-installation roof-condition record, interface-responsibility matrix, warranty requirements, inspections, controlled substitutions, commissioning and as-built record.
Outcome	Accept, correct, reassess deviation or reopen relevant gate.
Consequence of late resolution	An undocumented substitution can invalidate assumptions or evidence on which acceptance was based.

10 Lifecycle

The roof remains a roof

PV can occupy much of a commercial roof for decades.

Commissioning does not remove the roof's original functions.

Drainage still has to work. Membranes, joints, penetrations and flashings still require inspection. Rooflights, plant and safety systems need access. Electrical equipment requires maintenance. Changes to the building, array or roof assembly can alter the original risk assessment.

Dense arrays can make those tasks more difficult.

An east-west or closely spaced field can obscure large areas of waterproofing and make access to defects, drains or joints more difficult than on the uncovered roof.

Lifecycle management therefore has to be designed with the PV array rather than added afterwards.

Maintenance access has to be real

A maintenance route that exists only on a drawing but cannot practically be used does not preserve the roof.

The project should consider how drains will be inspected, how membrane defects beneath or between modules will be reached and how temporary module removal will be managed when roof repair becomes necessary.

Gate 6 therefore affects Gate 10: layout determines how maintainable the future roof will be.

Lifecycle responsibility must remain explicit

Roof and PV maintenance contracts should define responsibility for access, temporary module removal, membrane damage, penetrations, reinstatement and warranty-sensitive repairs.

Where a defect occurs, the asset owner should not depend on retrospective agreement between separate contractors about who caused it. The operating model should define how defects are recorded, attributed, repaired and closed.

Where different contractors access the roof, pre-maintenance condition records can provide a practical baseline for damage attribution, repair responsibility and warranty-sensitive work.

Evidence has a lifecycle

Gate 7 evidence applies to a defined configuration.

If modules, mounting, membrane, insulation, protection layers or other material parts of that configuration are changed later, the operated system may no longer correspond to what was originally assessed.

Lifecycle management therefore requires both maintenance and change control.

	Variant A	Variant B
Roof beneath PV	Newly defined/refurbished assembly	Retained existing roof
Priority	Preserve new assembly and evidence conditions	Monitor ageing retained roof
Challenge	Maintain access without altering assembly	Detect deterioration beneath dense PV
Reassessment trigger	Material substitutions or changes	Roof repairs, replacement or PV modifications

Gate 10 : Lifecycle	
Decision	Is the roof-PV system still being maintained and operated within the assumptions on which the original decision was based?
Owners	Asset owner, roof-maintenance provider, PV O&M provider and relevant specialists.
Minimum evidence	Inspection regime, access plan, drainage maintenance, roof/electrical inspection records, maintenance responsibility matrix, warranty-sensitive repair procedures, defect attribution/reinstatement records and change control.
Outcome	Continue, repair, modify, reassess or reopen relevant gates.
Consequence of late resolution	The system can gradually move outside the assumptions behind its evidence and approvals without one obvious design failure.

Conclusion

There is no universal technical route for existing commercial roofs with PV.

Some roofs can remain. Others require repair, re-cover or replacement. Some structures have sufficient reserve for relatively heavy measures; others do not. Some inherited roof assemblies already have a defensible evidence route; others require mitigation, additional assessment or a different construction.

The value of the framework is that these differences are resolved in sequence.

Structure establishes the available weight budget. Roof determines whether the inherited assembly can remain. Mounting connects PV to the actual building. Risk determines what consequences need to be controlled. PV converts the remaining technical area into a coordinated array. Evidence determines what has actually been demonstrated. Approval establishes whether the relevant stakeholders accept the configuration. Delivery ensures that the assessed construction reaches the roof. Lifecycle preserves the assumptions on which the original decision was based.

Only after these questions are sufficiently resolved should the owner treat the PV investment as committed.

For new construction, the companion paper in this series on new commercial buildings applies the same ten-gate sequence where the roof can still be designed from the start.

There is no universal mitigation route

A roof-PV fire strategy may involve an approved roof-PV assembly, retrofit coating, re-cover, raised array, water-based protection, noncombustible protection above an existing roof or another project-specific solution.

Each route creates different implications for weight, wind, waterproofing, cost and evidence.

The framework is therefore not a funnel towards one material or construction.

In the author’s analysis, where several constraints converge

There is a specific class of existing-roof projects in which several gates point towards the same design requirement.

Structural reserve is limited.

Roof intervention is already required.

The risk assessment identifies a need to limit the consequences of a credible PV ignition event, while the structure restricts how much additional permanent load can be introduced.

Evidence must apply to the resulting roof-PV assembly.

In these situations, low-mass consequence-limiting solutions can become particularly relevant because structural capacity and fire performance have to be resolved simultaneously.

The appropriate solution cannot be selected by material property or weight alone. Complete alternative roof-PV assemblies should be compared for permanent load, fire performance, thermal performance, embodied carbon where relevant to the project brief, wind behaviour, waterproofing, constructability, evidence, approval conditions and lifecycle implications.

> **Rooftop PV is a long-term building-system investment. The roof sets the conditions under which it can succeed.**

Appendix A : One-page decision framework

Gate	Core question	Who closes it?	Principal outcome
Baseline	Do we know what roof is actually present?	Roof consultant / relevant specialists	Known / investigate further
1 Asset	What must the asset protect and over what horizon?	Asset owner	Defined objective
2 Structure	What structural capacity remains?	Structural engineer	Proceed / reduce / strengthen / stop
3 Roof	Can the roof remain?	Roof consultant	Retain / repair / re-cover / replace
4 Mounting	Which mounting route fits?	PV designer + structural engineer	Proceed / redesign
5 Risk	What changes and how are consequences limited?	Relevant specialists	Mitigate / reopen gates
6 PV	What usable PV configuration remains?	PV designer	Final layout
7 Evidence	Does the evidence apply?	Relevant technical parties	Covered / assess / test / redesign
8 Approval	Has the project been accepted?	Asset owner + approving parties	Accept / conditions / redesign
Investment	Does the real business case work?	Asset owner	Invest / redesign / defer / stop
9 Delivery	Was the accepted design built?	Owner + QA + contractors	Accept / correct
10 Lifecycle	Is the system maintained within assumptions?	Owner + service parties	Continue / repair / reassess

Appendix B : Evidence and source matrix

Policy and property-risk layer

Source	Scope	What it supports	What it does not support	Commissioned / funded by
Directive (EU) 2024/1275, Article 10	EU legislation requiring national implementation	European policy direction for solar deployment on specified building categories, subject to technical suitability and economic and functional feasibility and the conditions in the Directive.	Does not establish that every commercial roof above a given area must receive PV irrespective of national implementation, exemptions or technical suitability. Does not establish technical suitability of any individual roof.	Not established in the cited record
FM DS 1-15, April 2026	FM property-loss-prevention guidance for roof-mounted PV	Fire and natural-hazard guidance; existing-roof age and condition recommendations; roof-PV system fire behaviour; structural load, wind, mounting and drainage considerations; defined mitigation routes and information relevant to FM plan review.	Does not constitute building law or an internationally applicable code. Does not mean that following the Data Sheet automatically establishes acceptance by every insurer or authority.	FM publication / research
VdS 6023:2026-05	German insurer-oriented damage-prevention guidance for rooftop PV on industrial, commercial and municipal buildings	Fire-risk assessment; interaction between PV ignition sources and combustible roof construction; example mitigation measures; considerations for existing installations and early insurer involvement.	Non-binding and does not establish automatic acceptance by an individual insurer. Does not provide a roof-PV assembly approval and does not substitute for applicable law or code.	VdS publication; separate funding not stated
RC62 Version 2, 2023	UK Joint Code of Practice focused on commercial rooftop PV fire safety	Fire-risk management; structural survey before installation; ballast, ponding and snow concerns; access considerations and early consultation with local fire authority and property insurer.	Voluntary guidance and explicitly not a pan-insurer position. Does not provide a generic approval route or apply as European legislation.	Issuing bodies identified in reference; separate funding not stated

Engineering layer

Source	Scope	What it supports	What it does not support	Commissioned / funded by
IIBEC TA 27-2025	North American building-enclosure technical advisory addressing low-slope roofs equipped with PV, including new and existing buildings	The role of the building-enclosure consultant in assessing estimated remaining life; preserving watertightness, drainage, thermal performance, wind resistance and access; recognition that PV fire-safety assessment often falls outside standard building-enclosure expertise.	Does not provide a roof-PV fire-approval route. Does not require roof and PV service lives to be identical. Does not replace structural, electrical or fire-engineering assessment.	Not established in the cited record
Manufacturer PV warranty policies, illustrated by Sika, Carlisle, Johns Manville and GAF	Manufacturer-specific requirements for maintaining, issuing or reinstating commercial roof warranty or guarantee coverage where PV is added	Demonstrates a common industry practice in which PV installation on a warranted roof can trigger manufacturer notification, review, documentation, approved detailing or contractors, inspections and/or other project-specific procedures before warranty coverage is continued or reinstated.	Does not establish one universal international warranty procedure. Requirements and warranty consequences differ by manufacturer and roof system.	Not established in the cited record
IIBEC: Finding Balance: The Next Chapter in Low-Slope Roof Design; Wilen: Going beyond the code	North American technical discussion of low-slope reroofing, insulation thickness, drainage and existing-roof interfaces	Supports the physical point that thicker replacement roof systems can reduce available vertical clearance and create conflicts with flashing heights, parapets, equipment curbs, thresholds, roof slope, drains and scuppers.	Does not prescribe one required insulation thickness for this framework, establish that every re-cover creates these conflicts or provide a PV-specific approval route. Applicable requirements remain project- and jurisdiction-specific.	Not established in the cited record
Building Safety Regulator / OFR Consultants, 2026	Literature review commissioned in England on rooftop-PV fire safety	Supports the proposition that rooftop PV can alter thermal exposure and fire dynamics at the roof, including heat trapping and flame redirection beneath arrays.	Research evidence rather than government policy or project approval. Does not establish performance of a specific roof-PV assembly.	Building Safety Regulator / UK government

Source	Scope	What it supports	What it does not support	Commissioned / funded by
Kristensen, Binte Mohd Faudzi & Jomaas, Fire Safety Journal 120 (2021)	Peer-reviewed experimental research on flame spread beneath PV modules	Supports the proposition that PV geometry, particularly the module-to-roof gap, can materially affect flame-spread behaviour beneath PV modules.	Does not establish a universal safe gap for all commercial roof systems or replace project-specific fire assessment.	Not established in the cited record
Zeng, Rodrique & Boardman, Interflam 2025	FM Research study of roof-coating mitigation in rooftop PV fire scenarios	Provides independent system-level research into the effectiveness of a mitigation approach under defined rooftop-PV fire conditions.	Does not make every roof coating acceptable, and does not replace assembly-specific approval or insurer acceptance.	Not established in the cited record

Product evidence layer

Source	Scope	What it supports	What it does not support	Commissioned / funded by
FM Approval Report PR472014 The programme uses previous test data and waivers, including the FM 4478 external-fire requirement; PR472014 does not document a new fire test with PV (PR472014, §3.2, Table 1).	FM Approvals under FM 4470 and FM 4478	FM Approval for specifically defined roof-PV assemblies, including RoofNav assembly 568563-0-0 with defined PV and mounting components, specified membranes, 2.5 mm BarrierSheet, FM Approved insulation within the assembly and a new steel deck.	Does not provide generic approval for existing roofs, arbitrary re-cover routes or configurations containing unspecified membranes, decks, insulation or PV systems.	AllShield
ZAG 448/25-560-1-EN	Mid- and large-scale PV-related fire testing at ZAG, commissioned by AllShield	Documents the behaviour of the tested specimens and, in the evaluated configurations, ZAG's conclusion that direct flame penetration into deeper structural layers was prevented, alongside localised burn-through in two runs and thermal damage below the sheet.	Does not constitute FM Approval or generic classification. Does not establish that underlying PIR or EPS remains undamaged. Thermal decomposition and damage still occurred in combustible layers.	AllShield

Source	Scope	What it supports	What it does not support	Commissioned / funded by
Efectis 2025-Efectis-R000982	CEN/TS 1187 Test 1 programme at Efectis, sponsored by AllShield	Documents a defined test configuration incorporating two 2.5 mm BarrierSheet layers and gives the mass of each 2.5 mm BarrierSheet as approximately 3.0 kg/m² ±10%.	Does not establish performance of a single-layer BarrierSheet configuration under this test programme. The report itself does not issue a formal EN 13501-5 classification. It is not a PV test or FM Approval.	AllShield
Kiwa BDA 24L0241/1	PV-roof testing at Kiwa BDA according to principles of CLC/TR 50670	Provides historical test data for a realistic 6 x 6 m PV-roof configuration incorporating a 1.2 mm BarrierSheet under a defined east-west PV array.	Does not provide direct performance evidence, classification or approval for the current 2.5 mm FM-listed BarrierSheet construction or for other roof-PV assemblies.	AllShield

Appendix C : Pre-PV roof checklist

Before a final PV design or tender is treated as committed, the project should be able to answer at least the following questions.

Existing roof

- ☐ What roof-cover system is actually present?
- ☐ How old is it?
- ☐ How many roof layers are present?
- ☐ What insulation and coverboard are present?
- ☐ What deck is present?
- ☐ How is the roof cover attached?
- ☐ **Are aggregate, ballast, vegetation or other overburden present, and are their condition, depth, loading and effects on the roof-PV fire scenario recorded?**
- ☐ Are previous repairs or overlays documented?
- ☐ Is there evidence of leakage, blistering, delamination, ponding or other deterioration?
- ☐ Is further moisture or intrusive investigation needed?
- ☐ Are hazardous legacy materials relevant to the planned intervention?

Structure

- ☐ What additional permanent load can the building carry?
- ☐ Have existing roof layers and previous modifications been included?
- ☐ Have snow, rain, ponding and other applicable loads been considered?
- ☐ How much structural reserve remains after the preliminary PV system?
- ☐ Is that reserve being consumed by ballast or other risk measures?

Roof intervention

- ☐ Can the roof reasonably remain for the intended PV horizon?
- ☐ If not, is repair, re-cover or replacement required?
- ☐ Does the intervention change permanent load?
- ☐ Does it affect drains, overflow systems, curbs, penetrations or parapet heights?
- ☐ What happens to the existing roof warranty?

Mounting

- ☐ Is the proposed mounting route compatible with the actual roof attachment?
- ☐ Does the design rely on ballast?
- ☐ If so, do the applicable roof, slope and wind conditions support that route?
- ☐ What is the load path into the building?
- ☐ Are penetrations or clamps compatible with the roof system?
- ☐ Can drainage and maintenance access still function?

Risk

- ☐ What are the credible PV ignition scenarios?

☐ What limits escalation if ignition occurs?

☐ Does the mitigation add weight or change wind loading?

☐ Does a mitigation measure reopen Structure or Mounting?

☐ Has insurer or risk-engineer input been obtained early enough?

PV layout

☐ What gross area was originally assumed?

☐ What area remains after access, drainage, plant, rooflights, wind and risk constraints?

☐ Can drains and critical details still be inspected and maintained?

☐ Is the final yield still consistent with the investment case?

Evidence

☐ What exact configuration was tested, classified or approved?

☐ How closely does the proposed roof match it?

☐ Which deviations are material?

☐ Who has accepted those deviations?

☐ Is the project relying on a component claim where system evidence is actually required?

☐ If carbon performance is part of the decision, are EPD/LCA claims based on comparable functional assumptions rather than product mass alone?

Approval

☐ Has the property insurer accepted the proposed configuration?

☐ Have relevant roof and PV manufacturers accepted the interfaces?

☐ Are required authority approvals in place?

☐ Do approval conditions reopen an earlier gate?

Investment

☐ Does the investment model include roof intervention, structural work, risk mitigation, testing and approval costs?

☐ Where relevant, have potential premiums, deductibles, exclusions, risk-improvement requirements and availability of cover been considered over the operating period?

☐ Are recurring maintenance and future roof-access costs included rather than only initial PV CAPEX?

Delivery

☐ Are evidence-critical materials clearly specified?

☐ Are substitutions controlled?

☐ Can the as-built assembly be verified?

☐ Is commissioning documented?

☐ Has the pre-installation roof condition been recorded and agreed?

□ Is responsibility for membrane damage during PV works allocated before work starts?

□ Are warranty-sensitive repairs and reinstatement requirements defined?

Lifecycle

□ How will drains, membrane, flashings and joints remain accessible?

□ How will the PV system be maintained without damaging the roof?

□ How will changes to roof or PV components be controlled?

□ What events require the original technical assessment to be revisited?

□ Do roof and PV maintenance contracts define responsibility for access, temporary module removal, membrane damage, penetrations and reinstatement?

□ Is there a defined process for recording, attributing, repairing and closing defects where responsibility may span roofing and PV contractors?

References

[1] European Parliament and Council. Directive (EU) 2024/1275 on the energy performance of buildings, in particular Article 10.

[2] FM. Property Loss Prevention Data Sheet 1-15: Roof-Mounted Solar Photovoltaic Panels. April 2026.

[3] International Institute of Building Enclosure Consultants (IIBEC). Technical Advisory 27-2025: Technical and Safety Considerations When Providing Building Enclosure Consulting Services on Low-Slope Roofs Equipped with Photovoltaic Arrays. 20 November 2025.

[4] VdS Schadenverhütung. VdS 6023:2026-05 Photovoltaik-Anlagen auf Dächern - Möglichkeiten zur Minimierung eines Brandrisikos. 2026.

[5] FPA / RISCAuthority / MCS. RC62 Version 2: Recommendations for fire safety with PV panel installations. Supported by Solar Energy UK. 2023.

[6] Directive 2009/148/EC on the protection of workers from risks related to exposure to asbestos at work, as amended by Directive (EU) 2023/2668. National implementation applies.

[7] Manufacturer warranty and PV guidance used illustratively: Carlisle SynTec Systems, “TecTopics: Solar Installations on Warranted Roofs,” 15 April 2025; Johns Manville, JM Photovoltaic Installation and Reference Guide, RS-9346; GAF, Photovoltaic Installations on GAF EverGuard Single-Ply Guaranteed Roofing Systems. Manufacturer-specific conditions apply.

[8] Wilen, Jason P. “Finding Balance: The Next Chapter in Low-Slope Roof Design.” IIBEC Interface, March 2026, pp. 26–33; Wilen, Jason. “Going beyond the code.” Professional Roofing, June 2020.

[9] FM Approvals. Approval Report PR472014 - AllShield BarrierSheet. 11 December 2025. Including RoofNav assembly 568563-0-0.

[10] ZAG. Report 448/25-560-1-EN, About performance comparison of lightweight non-combustible sheet in rooftop PV-related fires. 1 August 2025.

[11] Efectis. Report 2025-Efectis-R000982, Exposure to external fire to Roofing membrane + BarrierSheet on PIR according to CEN/TS 1187:2012, Test 1. July 2025.

[12] Kiwa BDA. Report 24L0241/1, External fire exposure to roofs in combination with photovoltaic arrays according to the principles of CLC/TR 50670. 2 September 2024.

[13] Building Safety Regulator / OFR Consultants. Fire safety: Thermal exposure to roofs from fires involving photovoltaic panels. Full report, Revision R02, 7 January 2026; publication page updated 13 February 2026. The findings do not represent government policy.

[14] Kristensen, J. S., Binte Mohd Faudzi, F., and Jomaas, G. “Experimental study of flame spread underneath photovoltaic (PV) modules.” Fire Safety Journal 120 (2021): 103027. https://doi.org/10.1016/j.firesaf.2020.103027.

[15] Zeng, D., Rodrique, T., and Boardman, D. “Evaluation of the Effectiveness of Roof Coating for Mitigating Rooftop Photovoltaic Panel Fire.” 16th International Conference and Exhibition on Fire Science and Engineering (Interflam), 2025.

About the author and transparency

Olivier Langejan is Chief Commercial Officer of AllShield. His architectural and building engineering background informs the series' focus on commercial roof and PV decisions. Authorship, contributions and specialist evidence boundaries are described in Method and sources.

> **The author welcomes technical review of statements that may be incorrect, overstated or materially incomplete.**

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[A1] Efectis Nederland BV. Classification report 2026-Efectis-R000318, March 2026. Reaction-to-fire classification A1 under EN 13501-1 for the specified BarrierSheet product and field of application. Product classification does not establish E, EI or REI roof fire resistance.

Method and sources

This is a targeted inventory and synthesis of identified knowledge, updated through the checks documented for 1 November 2026. It does not claim exhaustive coverage of the latest literature. Source findings, author analysis and practical design proposals remain distinct. The author endorses the conclusions within these evidence boundaries.

Authorship and contributions

Olivier Langejan is the lead author, supported by a small team. His professional focus is building and roof design. The papers synthesise the cited research, standards and test evidence; specialist fire-science and electrical findings are attributed to those sources rather than presented as expertise personally established across every discipline. The author endorses the synthesis and its stated limits. AI assistance is described separately below.

Key source boundaries

FM's public Power & Renewables release of 5 October 2026 supports early engineering input while site, technology and design decisions can still be changed. Its survey concerns the wider energy sector and does not establish rooftop-PV incident or performance data. Source: FM, "With Power and Renewables Risks Evolving, Engineering Must Move Upstream", 5 October 2026, https://www.fm.com/newsroom/news/2026/fm-power-and-renewables-press-release.

Approval Report PR472014 (11 December 2025), §§1.3, 3.2 and 9, identifies the applicable standards and evaluated assemblies and refers to RoofNav for the listing. The programme uses previous test data and waivers, including the 4478 external-fire requirement based on 4470 evidence. It does not document a new fire test with PV. Approval of a listed assembly and project-specific engineering acceptance are distinct decisions.

ZAG Report 448/25-560-1-EN, summary p. 3 and conclusion p. 46, reports prevention of direct flame penetration into deeper structural layers in the tested configurations during the documented test periods. Heat transfer, local gaps or burn-through and damage to underlying insulation were also recorded. These observations do not mean that all underlying layers remained undamaged. The programme has no unprotected reference from which a quantified reduction in risk can be calculated.

Scope and selection

This paper synthesises the decision gates for adding building-applied PV to an existing commercial roof. This is a decision framework, not a catalogue of every fire-protection product. Sources were retained for their relevance to roof condition, structural reserve, service life, mounting, fire, approvals and lifecycle interfaces. Residential pitched roofs and detailed electrical design are outside the main question.

Sources and dates

The evidence base is the research, standards, approval documents, technical guidance and incident material identified in the references. This is a targeted narrative synthesis, not a systematic review. English-language sources and relevant Dutch or German material are included where cited. The original search dates and a complete search log are not available in the retained publication record, so no reconstructed search period or exhaustive publication cut-off is asserted. Sources retain their individual publication dates. The present editorial and targeted source checks were completed on 1 November 2026.

Publication range

Publication dates and editions are identified for the individual references. This targeted synthesis does not claim exhaustive chronological coverage or a reconstructed complete search period.

Verification

This revision checked the requested wording against the source papers and carried out targeted primary-source checks for the additions and source corrections identified in its revision history. It is not a new claim-by-claim audit of the entire paper. References identify primary documents where available; secondary accounts and access limitations are identified where material. Author interpretations and design proposals do not acquire test or approval status.

Known gaps

No complete matched comparison of all feasible existing-roof mitigation routes is established. Project-specific retained layers, details and acceptance remain necessary.

Relationships and commissioning

AllShield commissioned the product-specific ZAG programme 448/25-560-1-EN and other AllShield test programmes cited in this paper. The May 2024 ZAG/FRISSBE guideline is a separate publication; its acknowledgements identify support from ROCKWOOL and the EU-funded FRISSBE project. Sharing an institute or a co-author does not make these different programmes one evidence source. Commissioning and funding are stated where known; unknown funding is not treated as evidence of independence.

Reading evidence

The series distinguishes claim status (DEMONSTRATED, PHYSICALLY SUPPORTED, CONTRADICTED or UNKNOWN) from the route to the intended roof (as tested, formally covered or engineering extrapolated). A cited test demonstrates its observed outcome for the specimen and exposure. Guidance is a recommendation and a proposed framework is author analysis; neither demonstrates a product outcome. A project acceptance decision does not extend the formal scope of evidence.

AI-assisted research and writing

Artificial intelligence was used to help identify and locate technical literature, compare findings across sources, analyse evidence boundaries, organise the argument and assist with drafting and editing. AI-generated summaries were not treated as technical evidence. The selection of sources, interpretation of the evidence, conclusions and final wording remain the responsibility of the author.

Updates

New research, test results, incidents and regulation may lead to new versions. Editorial corrections and technical additions are identified separately in the revision history. Missing sources and evidence that challenges a conclusion are welcome.

About AllShield

AllShield develops passive fire-protection solutions for commercial and industrial roof assemblies, including BarrierSheet. The author is its Chief Commercial Officer.

REVISION HISTORY

Version	Date	Changes
5.5	21 October 2026	Added the consequence question to the Risk gate: what prevents a local roof-PV fire from becoming a building-scale loss. Added the distinction between an FM Approved RoofNav assembly and project-specific FM engineering acceptance on existing roofs. Specified the ZAG build-ups, including the re-cover configurations, and the localised burn-through reported by ZAG. Stated the commissioning of the AllShield test programmes in the evidence matrix and corrected the author description. Revision history and series overview introduced with this version.
5.51	1 November 2026	Editorial corrections: reframed as a roof-first knowledge synthesis; shortened the author perspective, added method and source limitations, labelled author interpretations and corrected the requested wording and transparency statements. Technical additions and source checks: Expanded the pre-PV checklist to include vegetation and other overburden. Checked the separate May 2024 guideline and commissioning distinctions. No new assembly performance inferred.
5.52	1 November 2026	Gate 7: listing applicability distinguished from engineering acceptance for retained roofs. Method and sources: added PR472014 §3.2 and ZAG pp. 3, 46 boundaries. FM DS 1-15 April 2026 §2.1 ten-year recommendation retained as insurer guidance.
5.53	1 November 2026	Gate 7 product example: PR472014 §3.2 waiver/no-new-PV-test limit added locally; ZAG specimen description distinguishes AS-1/AS-3 direct overlays from AS-2/AS-4 with PIR (448/25-560-1-EN §2.1, pp. 5 –6). Added A1 reference; shortened repeated biography and corrected companion wording.

THE SERIES

The roof comes first is a synthesis of knowledge on fire safety and rooftop PV from a roof-first perspective, by Olivier Langejan. Each paper stands on its own; together they follow one line of thought.

At the time of this version, the series consisted of:

Paper	For	In one line
Rooftop PV on existing commercial buildings (this paper)	Asset owners, developers, project teams	A decision framework for resolving roof constraints before the PV investment is committed.
Rooftop PV on new commercial buildings	Developers, architects, project teams	Designing the roof and PV as one system from the start.
The economics of the rooftop PV decision	Asset owners, CFOs, risk managers	Probability, consequence and lifecycle cost from the asset owner's perspective, including Business Interruption.
From risk models to design requirements	Risk engineers, insurers, designers	An application of five established risk frameworks to consequence-limiting design for roofs with PV.
Beyond flame spread	Risk engineers, insurers, fire engineers	How far a rooftop PV fire can travel into the roof before it becomes a building loss, and what a separation layer changes.
What does a fire test actually prove?	Insurers, risk engineers, specifiers	What a fire test result does and does not demonstrate about a real roof with PV.
DC arcs as a heat source	Insurers, risk engineers, PV designers	How DC arc faults start, persist and end in rooftop PV.
DC arcs at the roof-PV interface	Insurers, risk engineers, PV and roof designers	What determines roof exposure to a sustained DC arc and what current evidence shows about measures to limit it.
How much does PV clearance actually solve?	Insurers, risk engineers, PV designers, asset owners	What module-to-roof clearance does and does not demonstrate about the roof beneath it.
What if the PV panel could not burn?	Asset owners, risk engineers, insurers, PV designers	What a lower-combustibility PV module does and does not change for the roof beneath it.
What does an inspection actually prove?	Insurers, risk engineers, asset owners, inspectors	What inspection can establish, what it cannot and what still protects the roof when a fault is missed.

All papers and their latest versions: allshield.com/en/olivier-langejan

Comments, corrections, missing sources, evidence that contradicts a conclusion and field experience are welcome at ol@allshield.com. Relevant input is used in future versions. To be notified of new papers and versions, send a short email to the same address.

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