

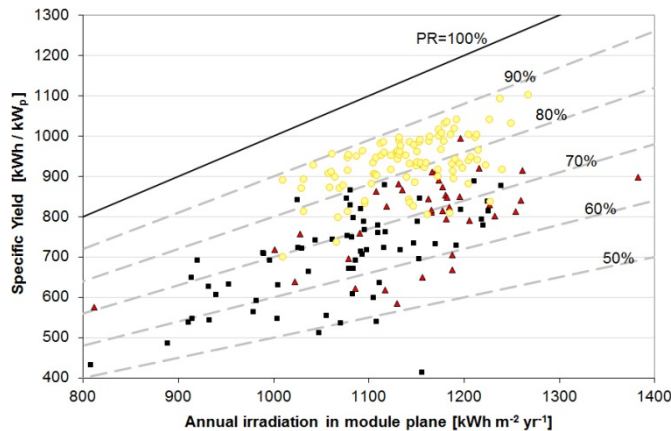


“Risk-Free Construction of Solar Roof Systems; Requirements beyond standards”

Modular Solar Roof Concept
Jörg Lübke, Architect

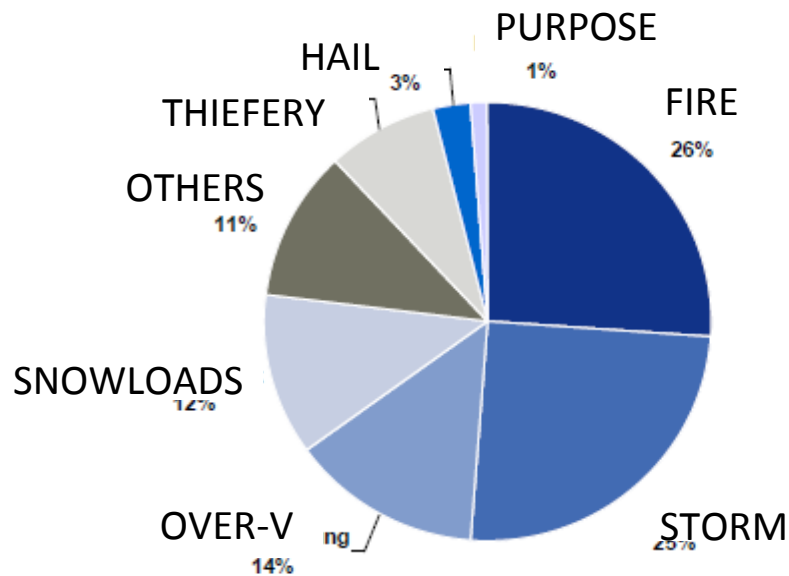
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• Execution Phase	
• Operation Phase	
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What do you expect from a PV project?

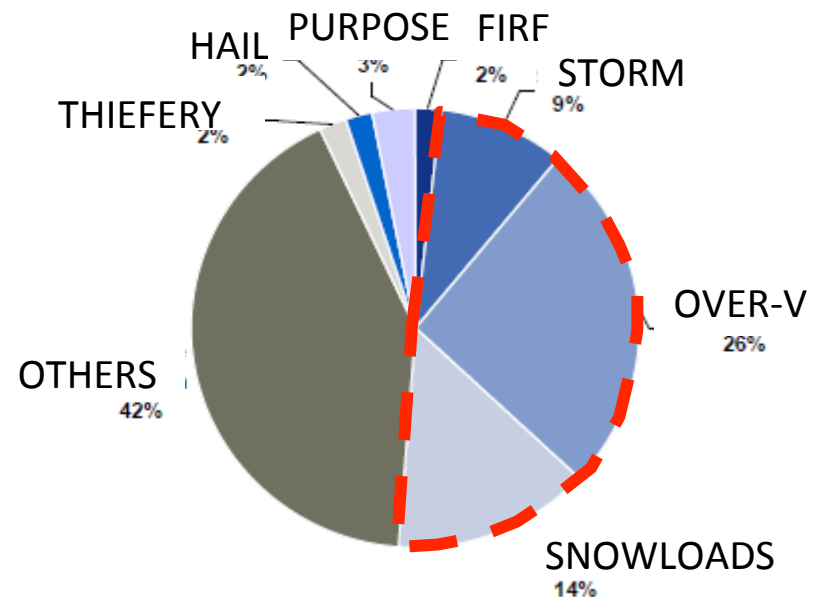


Risk análisis of PV installations

According to volume / amount



According to frequency





SOURCE: © Allianz Climate Solutions GmbH 2010

- ~ 50% of all damages are based on Storm, Overvoltage and Snowloads
- FIRE occurs rarely but in its case the damages are almost total loss
- Most of the claims would have been avoided with a carefully plant design and profesional execution!

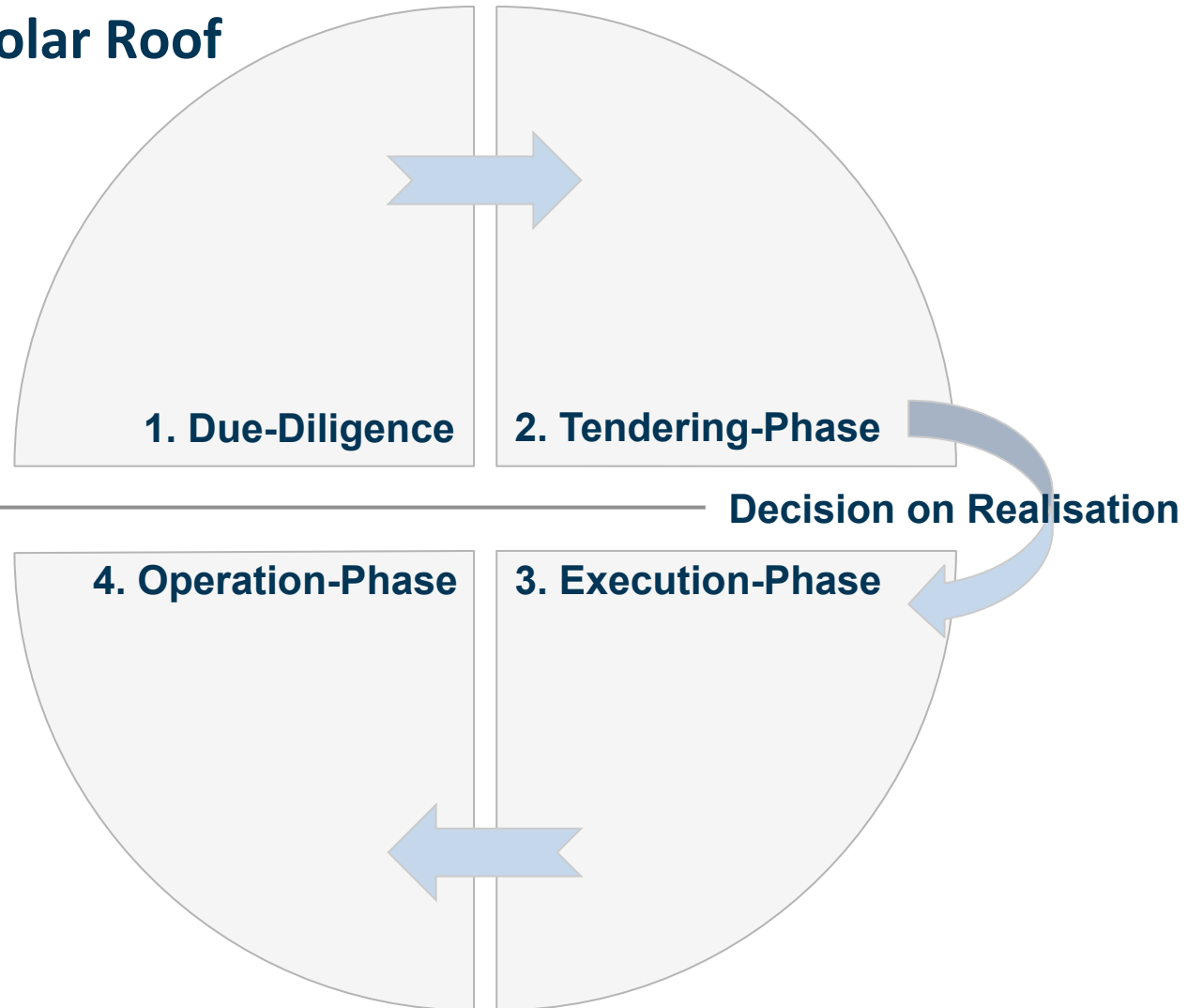
What kind of risks can occur with investments in solar?

- **Wrong assumption** regarding yield and energy production
- **Insufficient quality** of major components like modules and inverters
- **Faulty technical concept** of the solar power installation
- **Insufficient requirements and standards** of the **solar** installation
- **Insufficient standards** of the **building**
- **Compliance** with local building codes
- Consideration of **local wind and snow loads**
- **Interface roof and solar** (roof protection against solar)
- **Surveillance** of execution
- **Acceptance** of solar installation
- **Comparison** of planning and execution

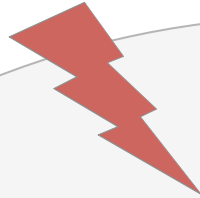
Risk análisis of PV installations

Risk Type	Area			
	Roof	PV-Generator (Modules)	PV-System	
	technical	<ul style="list-style-type: none"> damage in roof structure (limited roof load reserve) 	<ul style="list-style-type: none"> dangerous movement of PV generator short cuts /electric arc / fire hazard 	<ul style="list-style-type: none"> shortfall in energy yield short cuts /electric arc / fire hazard
	economic	<ul style="list-style-type: none"> cost for strengthening the roof structure 	<ul style="list-style-type: none"> cost for repowering cost for building repair cost for rising insurance rates 	<ul style="list-style-type: none"> shortfall in energy yield Extra cost for replacing technical components
	Technical	<ul style="list-style-type: none"> damage in roof structure damage of roofing membrane water damage 	PV-module torsion/stress <ul style="list-style-type: none"> caused by wind caused by snow caused by thermal extension 	<ul style="list-style-type: none"> shortfall in energy yield short cuts /electric arc / fire hazard
	economic	<ul style="list-style-type: none"> cost for leakage repair cost for roof refurbishment cost of PV-reconstruction 	<ul style="list-style-type: none"> Shortfall in energy yield cost for module replacement / repowering 	<ul style="list-style-type: none"> shortfall in lower energy yield cost for replacing tech. components cost for rising insurance rates

**... Modular Solar Roof
Concept**



Risks



- Wrong yield expectation
- Deviation local building codes
- Insufficient roof-top quality
- No sufficient load reserve
- Insufficient grid connection

1. Due-Diligence

What's the worst that can happen?

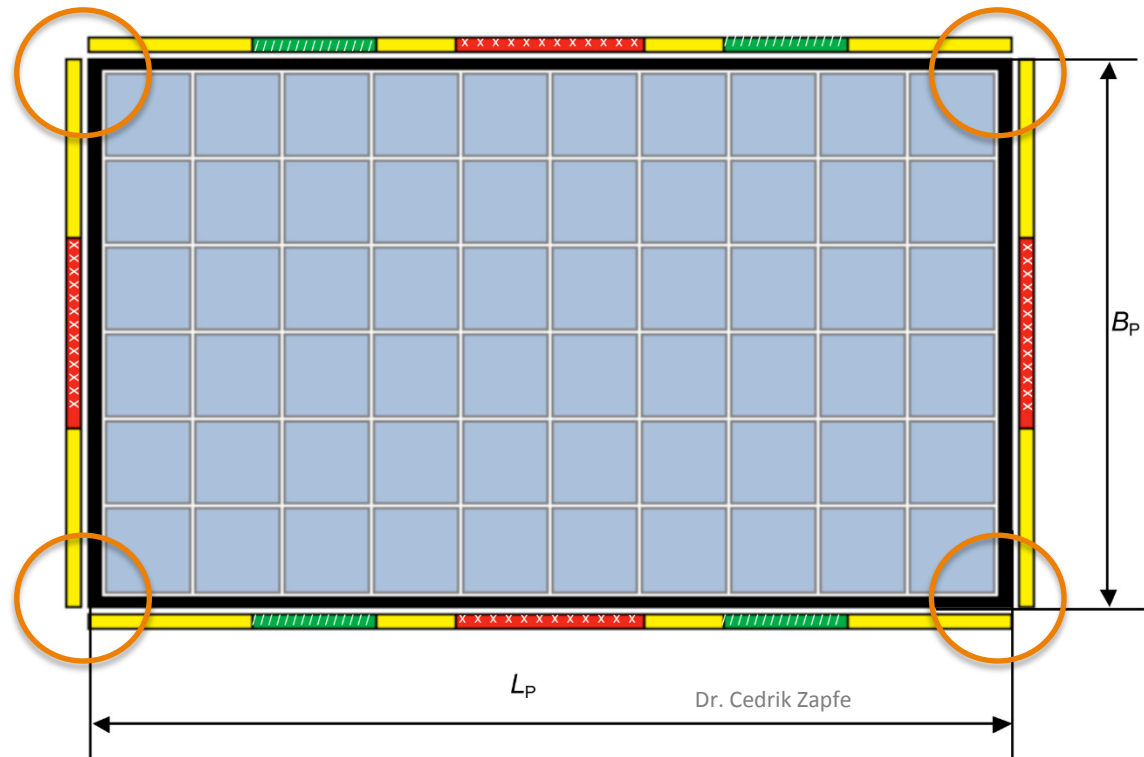
Roof not suitable for additional loads



e.g. fixation of PV-substructure and their consequences

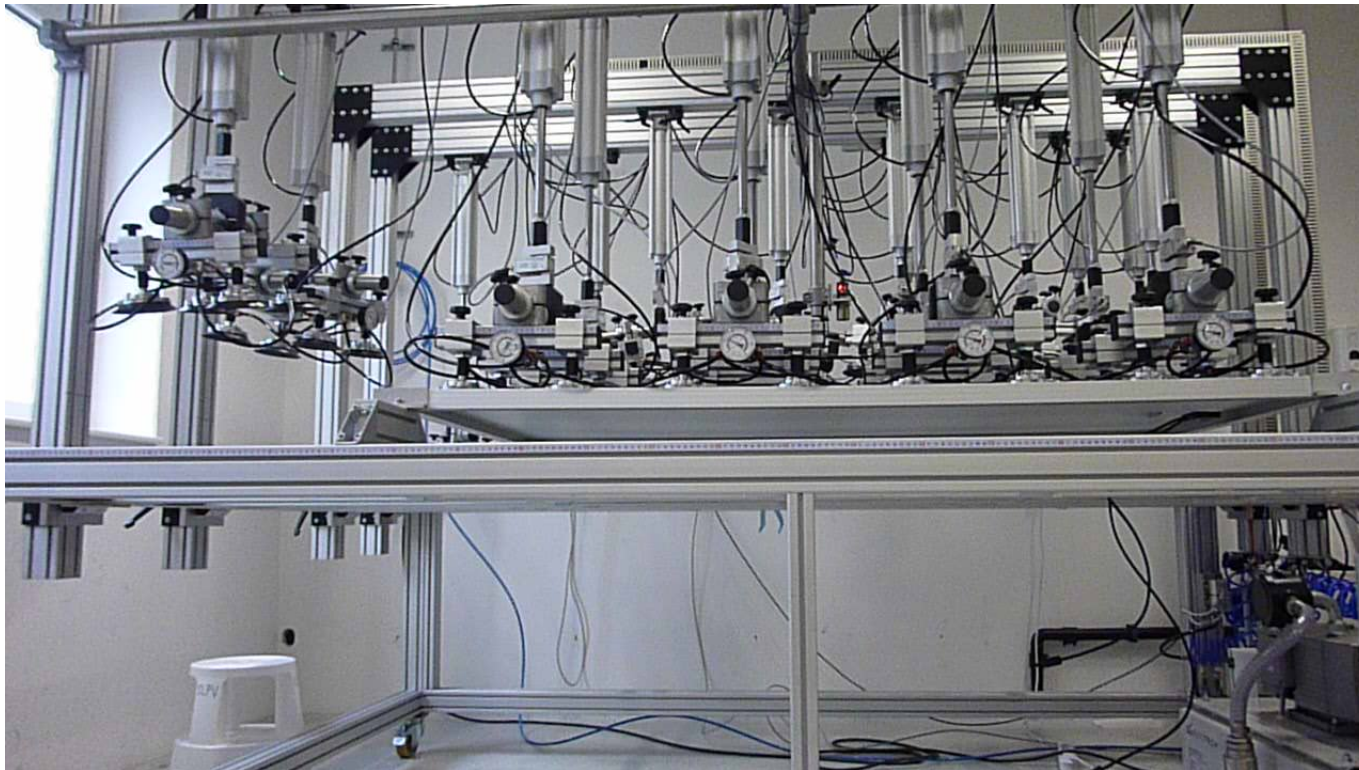
- Fixing points for PV-module as defined by german regulation VDI 6012-1.4
- Module load max 5.400 Pa
- Module load max. 2.400 Pa
- NOT allowed

 Standard market

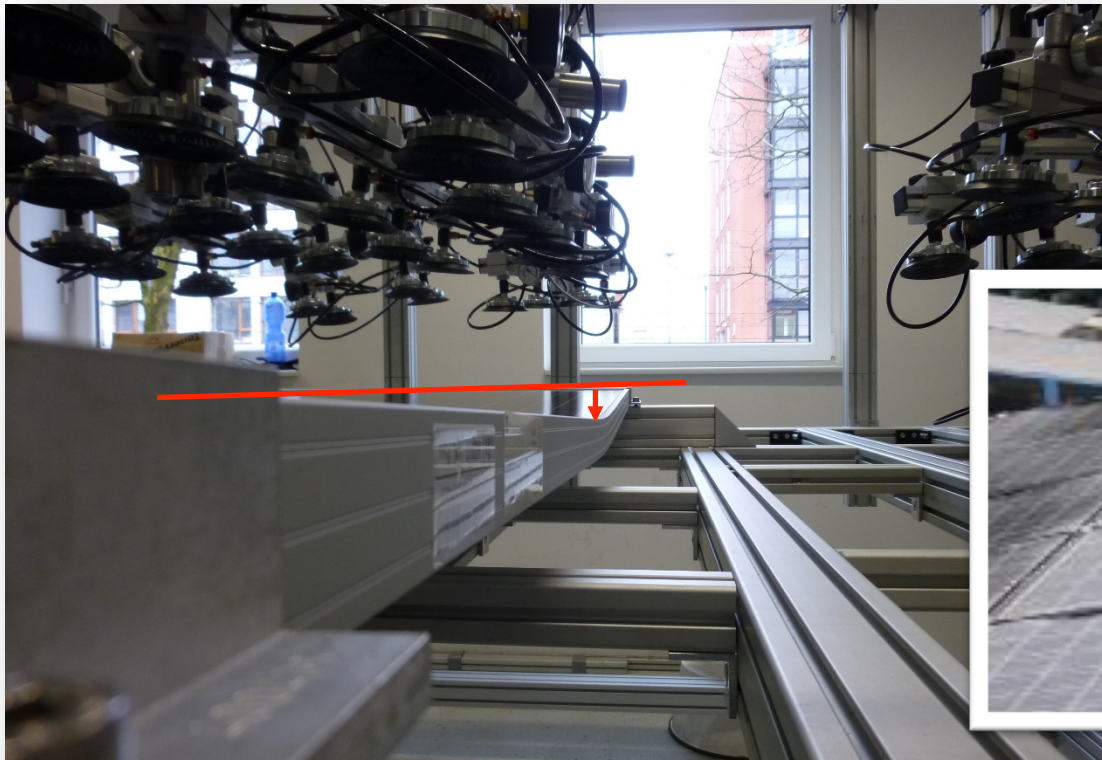


PROCESS 1: DUE-DILIGENCE PHASE - RISKS

- Mechanical system testing by Fraunhofer ISE as defined by IEC 61215



- Mechanical system testing by Fraunhofer ISE as defined by IEC 61215



Edge fixing carrying 3.200 kPa → permanent deformation

Risks





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1. Due-Diligence

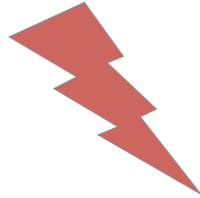
Solution



- Feasibility Studies for buildings (static, building codes, ..) 
 - Yield estimation PV 
 - Identify Business concept by potential analysis (self-consumption, FIT, PPA)
- Set-up business concept/model

Identification of „deal killers“

Risks



Examples

- Building standards undefined
- Insufficient quality components
- Lack insurability/ bankability project (Components/EPC)
- Wrong allocation strategy

2. Tendering-Phase

PROCESS 2: TENDERING PHASE

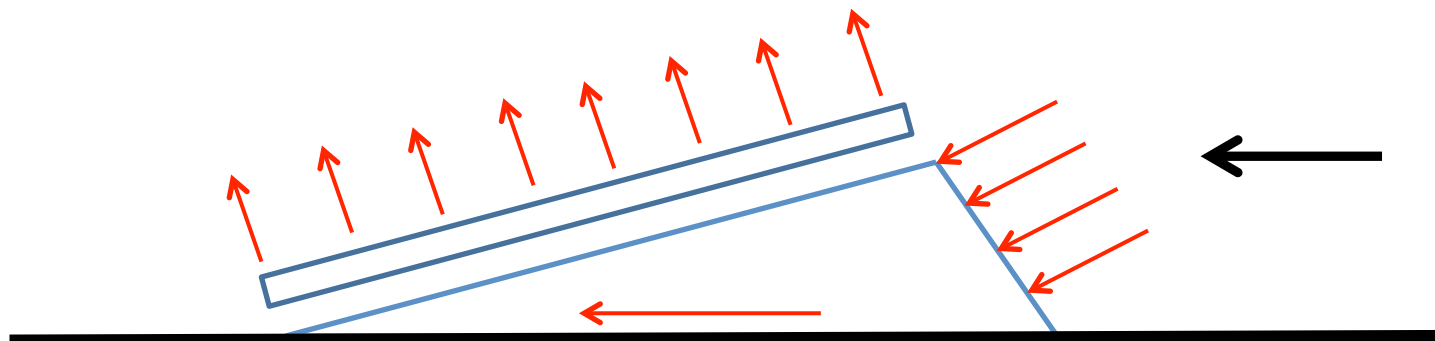
e.g.: „Definition of system fixation“

- Wind forces on PV panels:

Resulting
uplifting and
horizontal
forces

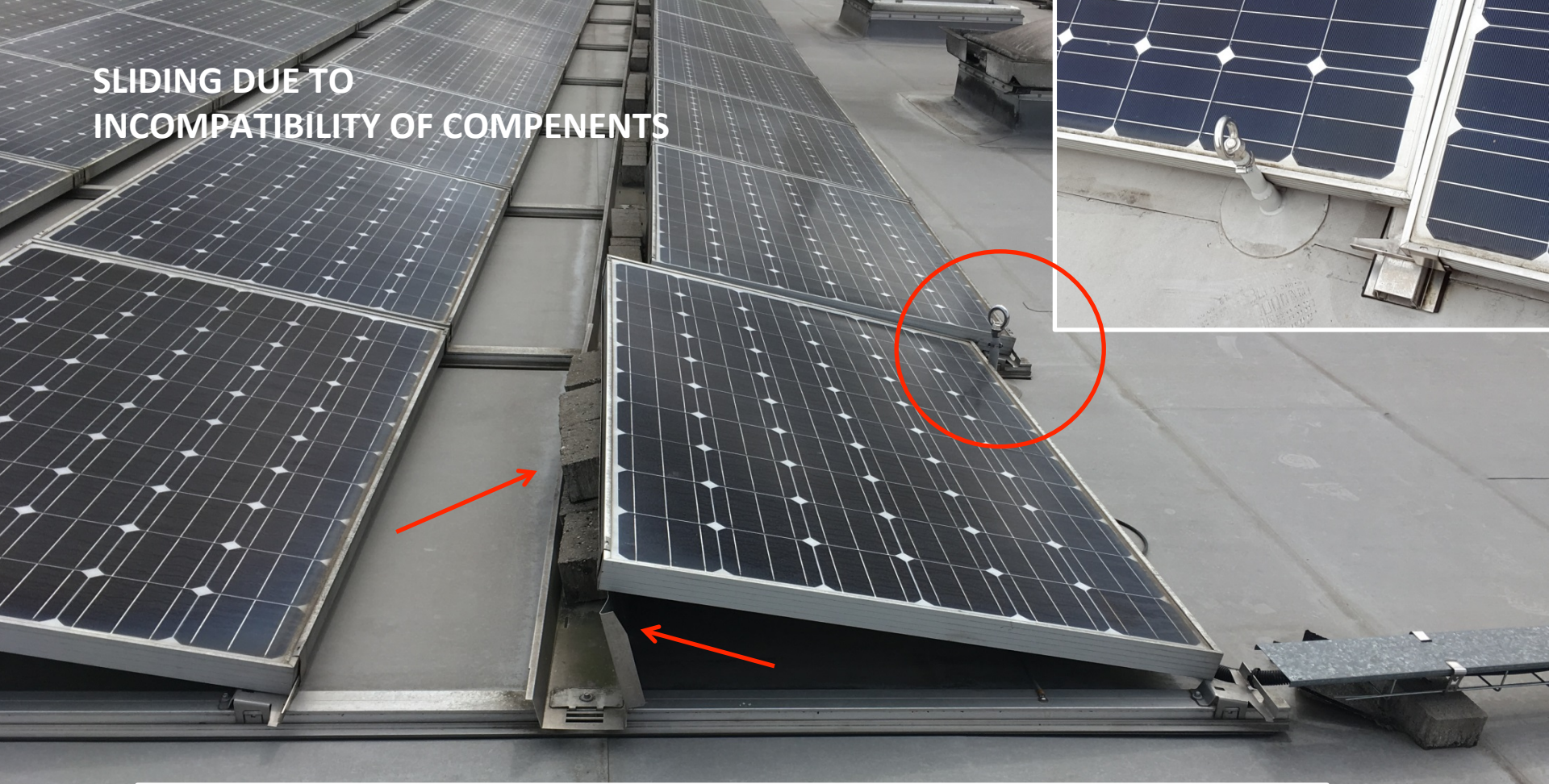
Resulting wind
forces to PV system
investigated in wind
tunnel

Wind pressure
(defined by
building code)



Thermal dilatation causes displacements

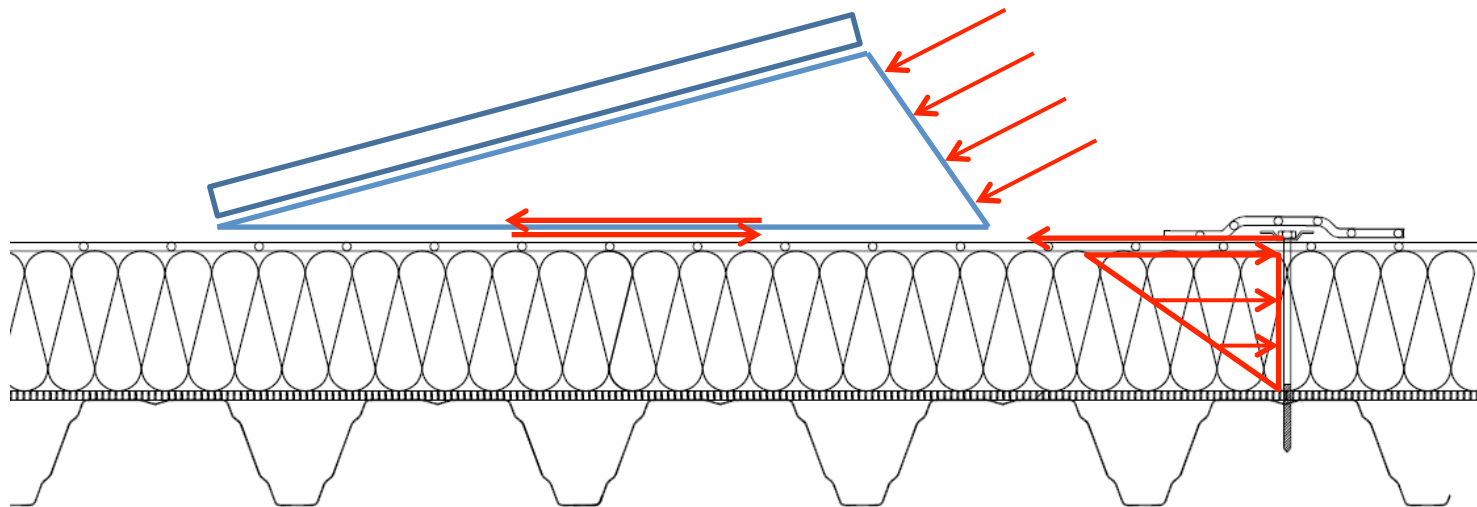
SLIDING DUE TO
INCOMPATIBILITY OF COMPONENTS



PROCESS 2: TENDERING PHASE

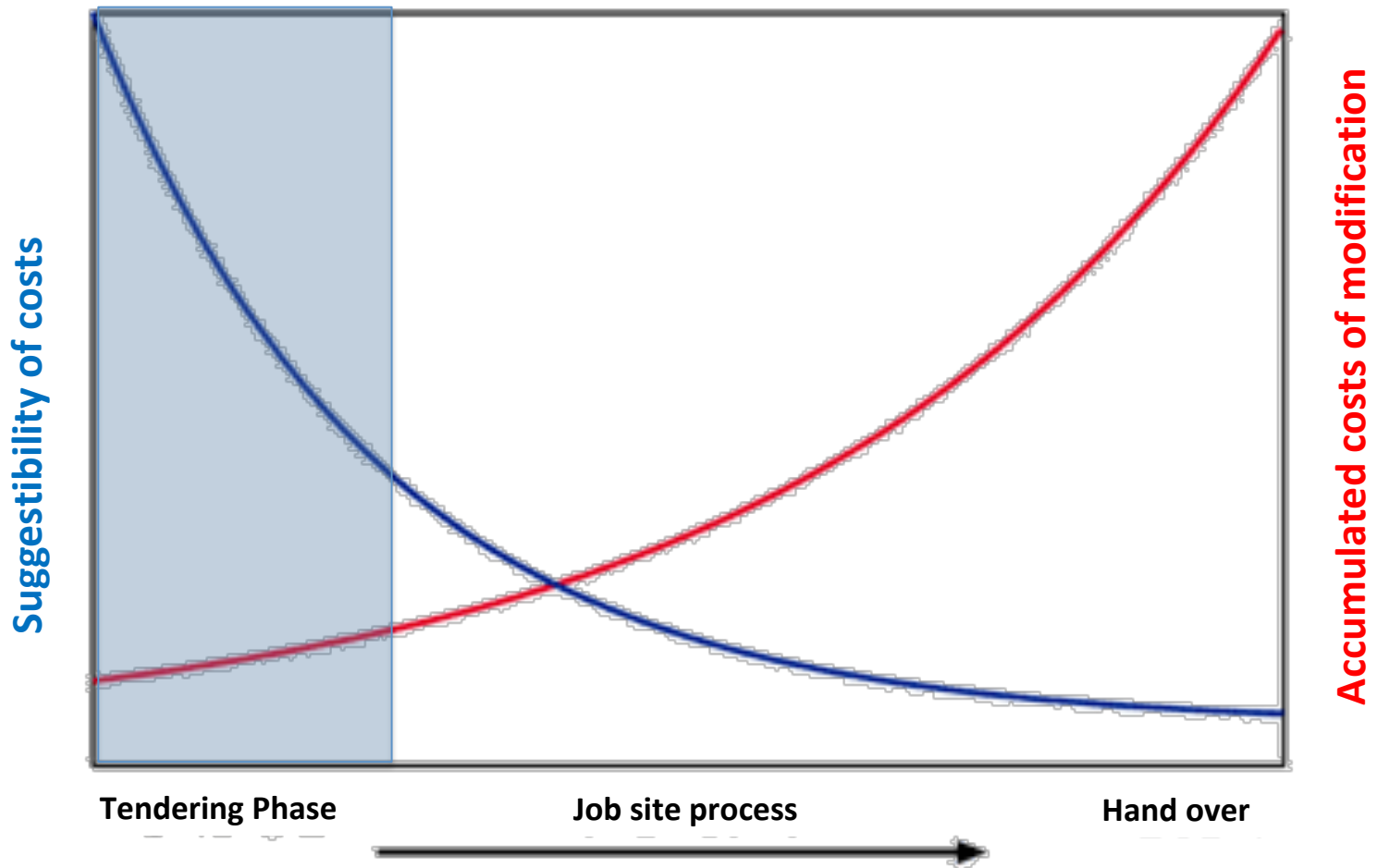
Definition of system fixation:

- **horizontal loads** will be transported via **FRICTION** to the sealing membrane
- **sealing membrane** transports loads to its fixations (screws)
- **Fixations** (screws) need to transport the loads via the thermal insulation to the purlins



PROCESS 2: TENDERING PHASE

The importance of the design phase



Risks





Examples

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Solution

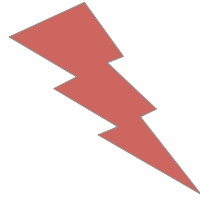


- Definition Solar Standards (QM modules)  Fraunhofer ISE
- Definition Building Standard
- Certified EPC (contractors)  centroplan
- Technical design (size- or yield optimized)

2. Tendering-Phase

Framework for Success

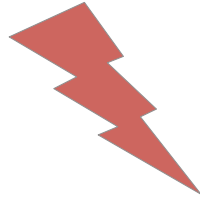
Risks



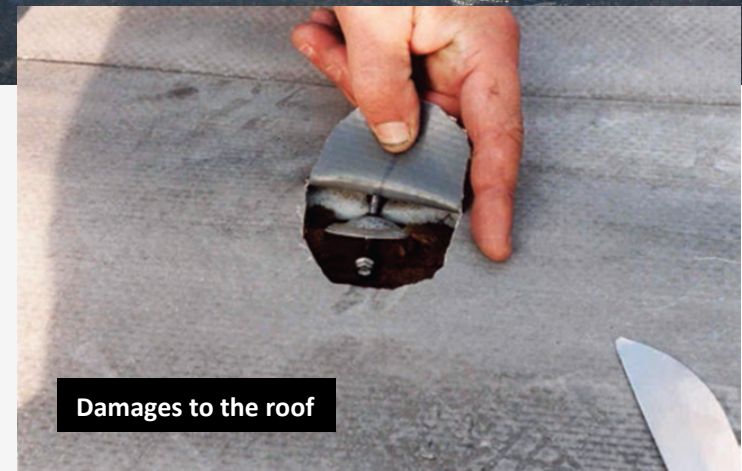
- Damages to the roof
- Project delay (Invalidity business model)
- Deviation of services from tender
- Poor interface management
- Malfunction Operating procedure Customer
- Delays (Contractual penalties)

3. Execution-Phase

Risks



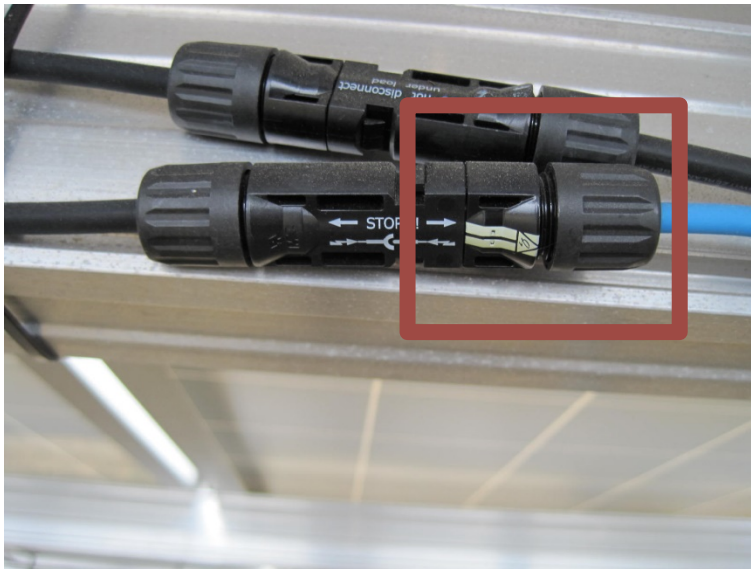
- Damages to the roof
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PROCESS 3: EXECUTION PHASE - RISKS

Damages caused by Electric Installation

- Faulty DC-wiring
- “apparently” compatible connector
- Condensation with temperature changes



Risks



- Damages to the roof
- Project delay (Invalidity business model)
- Deviation of services from tender
- Poor interface management
- Malfunction Operating procedure Customer
- Delays (Contractual penalties)

Solution

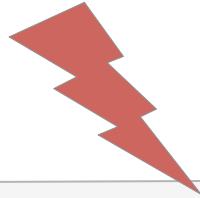


3. Execution-Phase

- Project management
- Supervision module quality
- Supervision execution
- Acceptance  Fraunhofer ISE
- Certification  VDE RENEWABLES

„Clean“ Execution

Risks



4. Operation Phase

- Insufficient Operation & Maintenance
- Overlooking loss of earnings
- Escalating running cost
- Long downtimes (bad response time)
- Miss warranty claims
- No fault detection

PROCESS 4: Unnecessary repairs and unscheduled roof renovations



Risks



- Insufficient Operation & Maintenance
- Overlooking loss of earnings
- Escalating running cost
- Long downtimes (bad response time)
- Miss warranty claims
- No fault detection

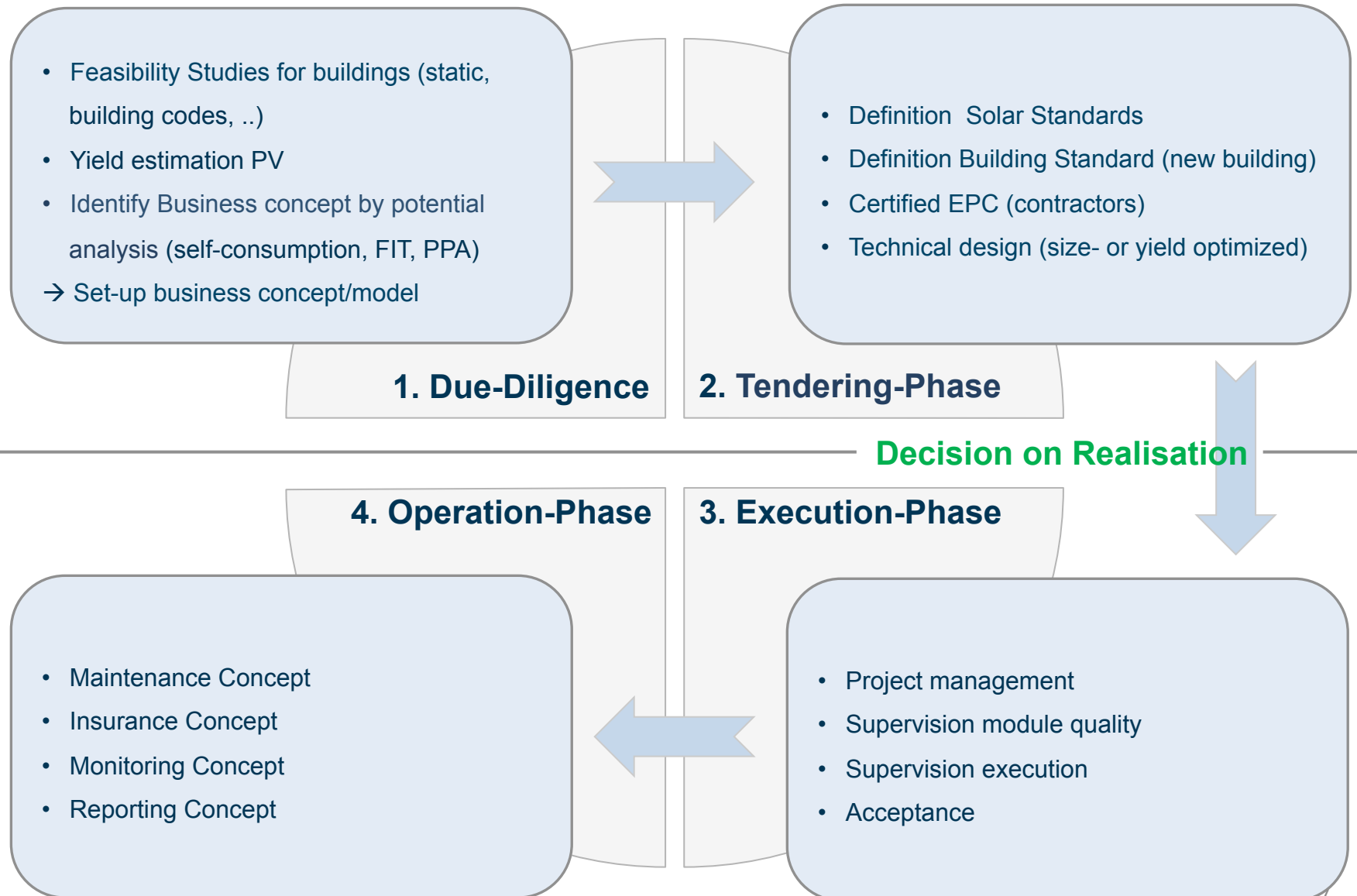
Solution



- Maintenance Concept 
- Insurance Concept 
- Monitoring Concept 
- Reporting Concept

Reaping the Awards

SUMMARY: MODULAR SOLAR ROOF CONCEPT!



SUMMARY: MODULAR SOLAR ROOF CONCEPT!

CLIENTS CHOICE....e.g. 60 kWp installation

Definition	Basic (Normative conform)	State-of-Art	Premium
MOUNTING SYSTEM	-	Mechanical fixed	Mechanical fixed (e.g. SSM-1 with 20 y. war.)
SOLAR PANELS	-	Positive "Labeling"	ISE-Post LID (down-labeling)
ELECTRICAL INSTALLATION			
Cable -trays	PVC solution	Metal solution	Metal solution
AC-Cabling	min. require.	min. require.	min. cable losses
Grounding	6 mm ²	6 mm ²	16 mm ² (electr. security)
MONITORING	Inverter solution	Independent solution + irradiation sensor	Independent solution + irradiation sensor
APROX. COST DELTA	1	+ 20%	+ 30% ++

... International Solar Roof Management

- ✓ Bundling of competences (ISE – VDE – Allianz – CP)
- ✓ Bundling of know-how
- ✓ One-Stop Service
- ✓ Flexibility
- ✓ Modular
- ✓ Customized

Thank you very much for your attention
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