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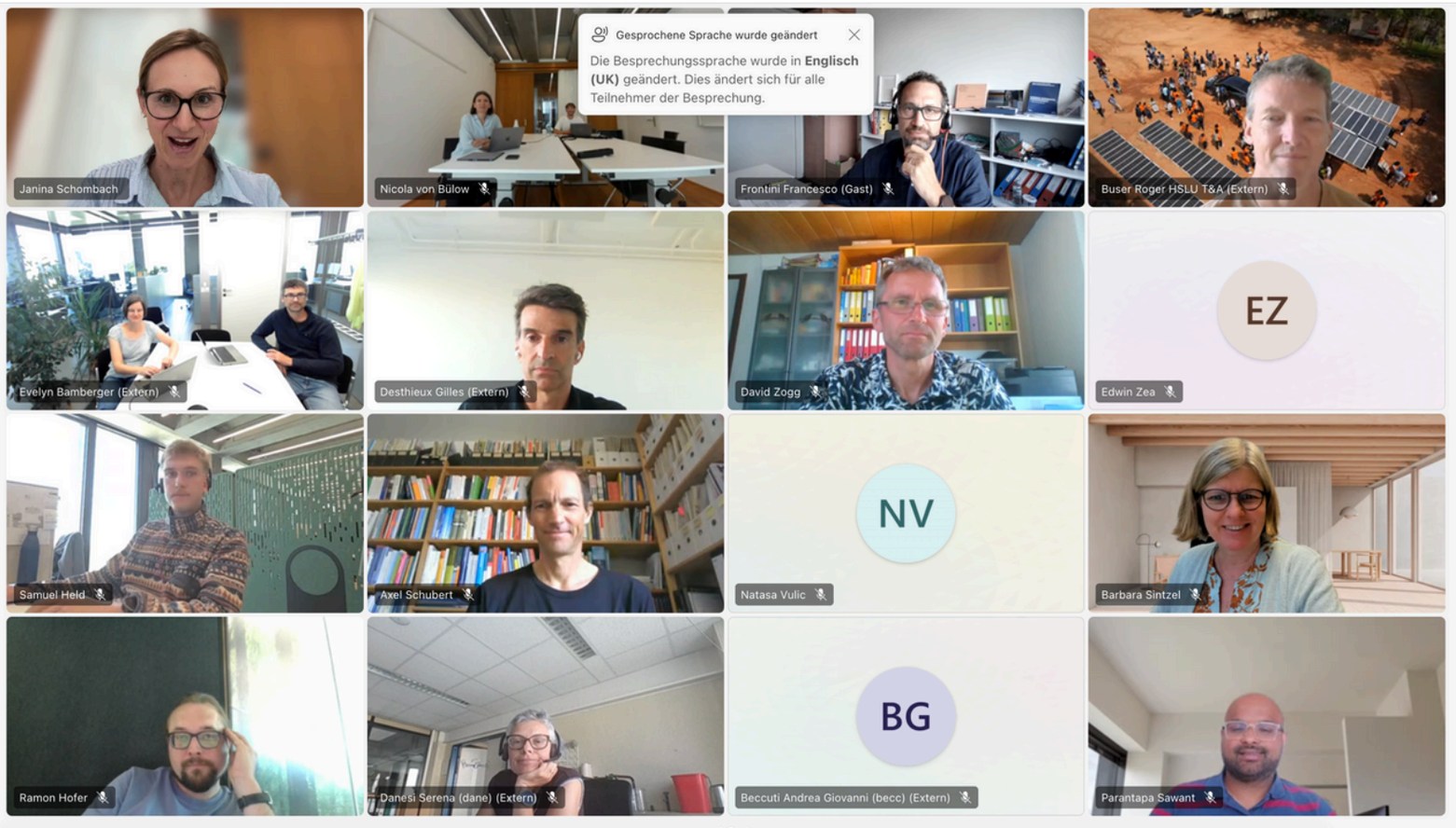
ResearchLunch #2

Impulses for the PV Roll-Out –
How R&D Can Drive Photovoltaic Expansion in Switzerland

SAVE-THE-DATE
ResearchLunch #3
Oct 30, 25



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Expert speakers from brenet member institutes

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Expert speakers from brenet member institutes

Mauro Caccivio – ISAAC, SUPSI
Reliability of PV modules in the low-cost era & solar test lab

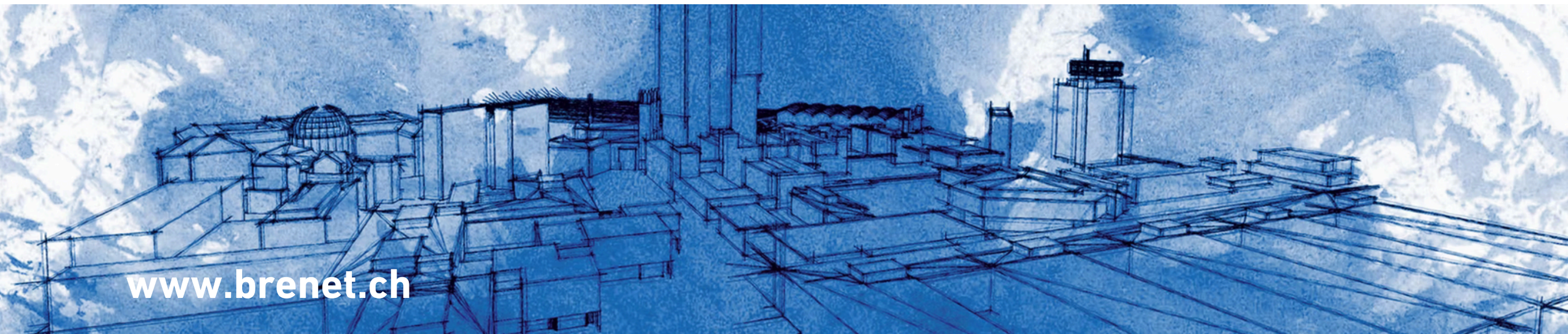
Natasa Vulic – INEB, HABG FHNW
Cost- and emission-optimized PV expansion from the user perspective

Evelyn Bamberger – SPF, OST
Swiss-Optimised PV Modules: Quality, R&D and design

David Zogg – IA, HTU FHNW
SmartGridready test lab for integrated PV systems

Gilles Desthieux – leea, HEPIA HESGE
PV modelling at the urban scale – with a focus on facades

Roger Buser – IGE, HSLU
Solar fences and alpine glare – Making PV suitable for everyday use



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Mauro Caccivio – ISAAC, SUPSI

Reliability of PV modules in the low-cost era & solar test lab

University of Applied Sciences and Arts of Southern Switzerland
Department for Environment Constructions and Design
Institute for Applied Sustainability to the Built Environment
SUPSI PVLab laboratory

SUPSI

Reliability of PV modules in the low-cost era

brenetResearchLunch#2 August 25, 2025

Mauro Caccivio – ISAAC SUPSI

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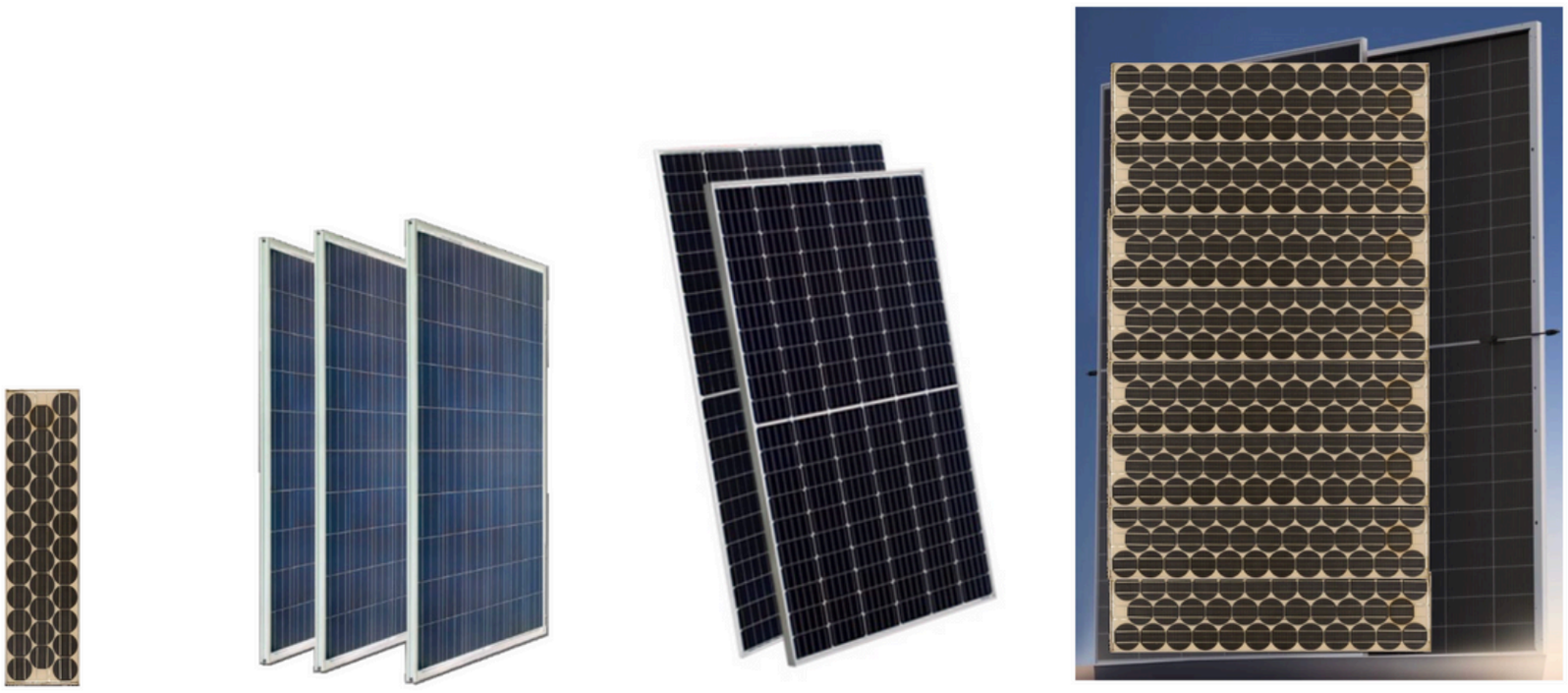
Mauro Caccivio – ISAAC, SUPSI

Reliability of PV modules in the low-cost era & solar test lab

Evolution of PV modules: higher efficiency, new dimensions!



1982: 35W

2012: 240W

2018: 320W

2024: 740W

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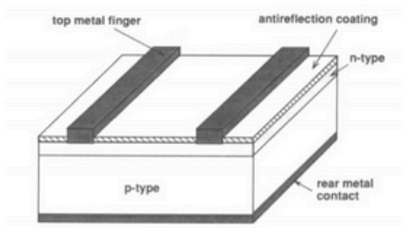
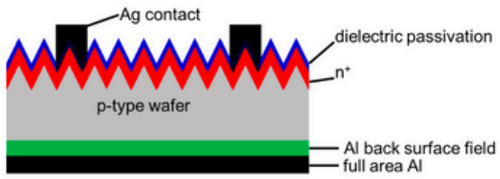
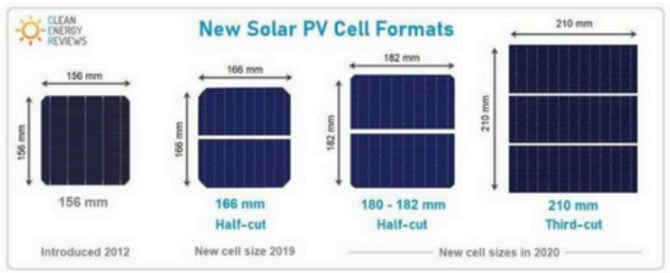
Mauro Caccivio – ISAAC, SUPSI

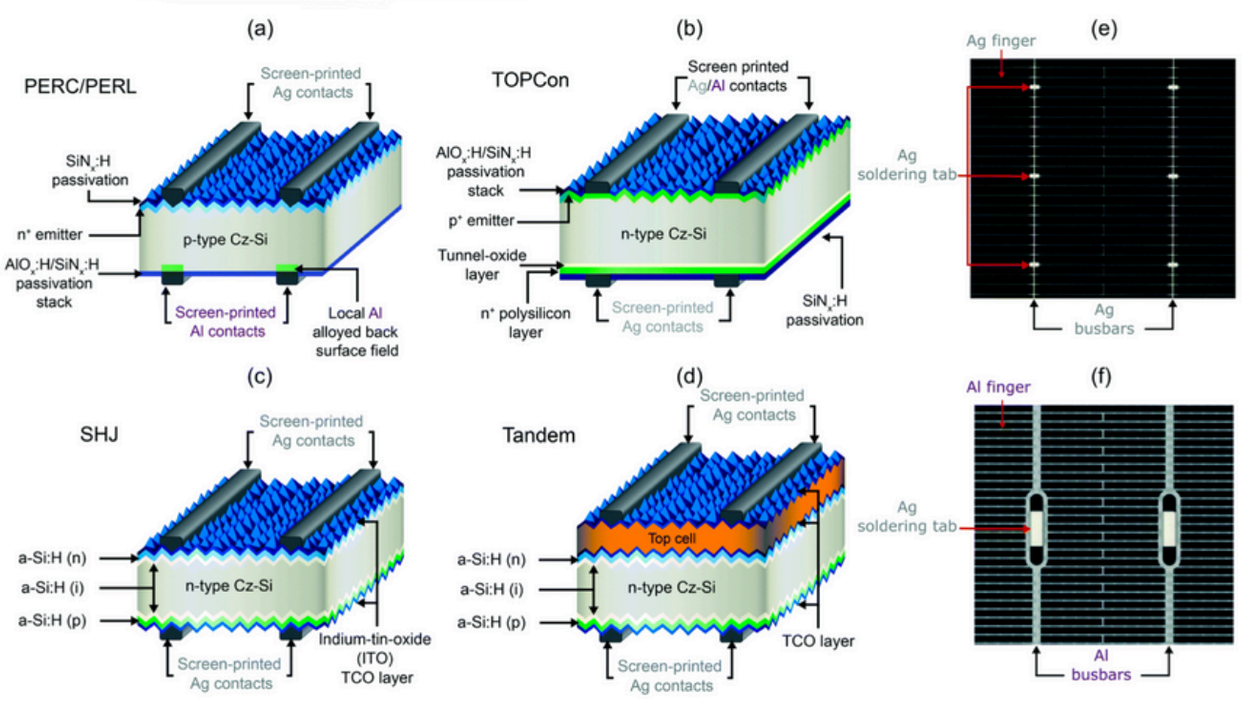
Reliability of PV modules in the low-cost era & solar test lab

Evolution of PV cells: higher efficiency, new shapes, new materials and processes

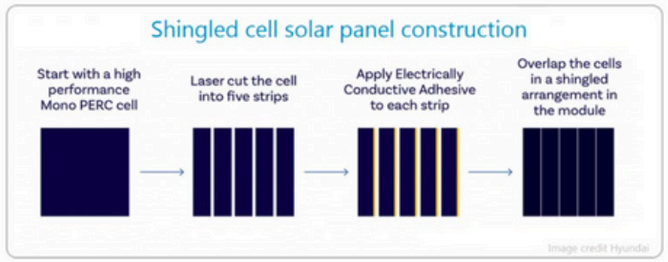




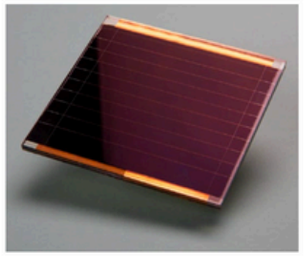




Larger and thinner cells with different shapes



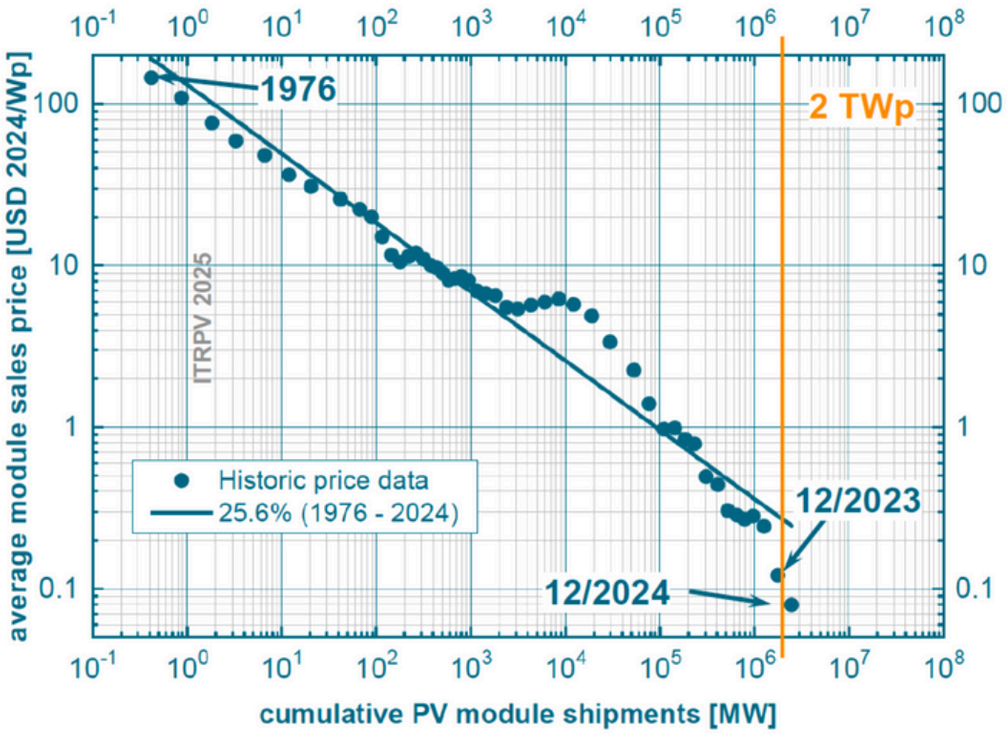
Perovskite in the future



Thin films of tens to hundred of nm!

Mauro Caccivio – ISAAC, SUPSI
Reliability of PV modules in the low-cost era & solar test lab

PV learning curve: faster than ever, Swanson's law crushed



Shipments /avg. module spot market price at year end:

ITRPV

2023: 502 GWp / 0.12 US$/Wp
2024: 703 GWp / 0.08 US$/Wp

o/a shipment: ≈ 2.472 TWp

Installation 2024: 566 GWp

➔ o/a installation: ≈ 2.176 TWp

Production capacity end of 2024: ≈ 98% is c-Si based
> 1,200 GWp poly/wafer; > 1,500 GWp (cell / module)

LR ≈ 25.8 % (1976 …. 2024)

→ again an amazing shipment increase in 2024
→ Transition from PERC to TopCon still ongoing

→ **tremendous price reductions due to oversupply**

Source: ITRPV 2025, Dr. M. Fisher, PV Cell Tech, 2025.03.11

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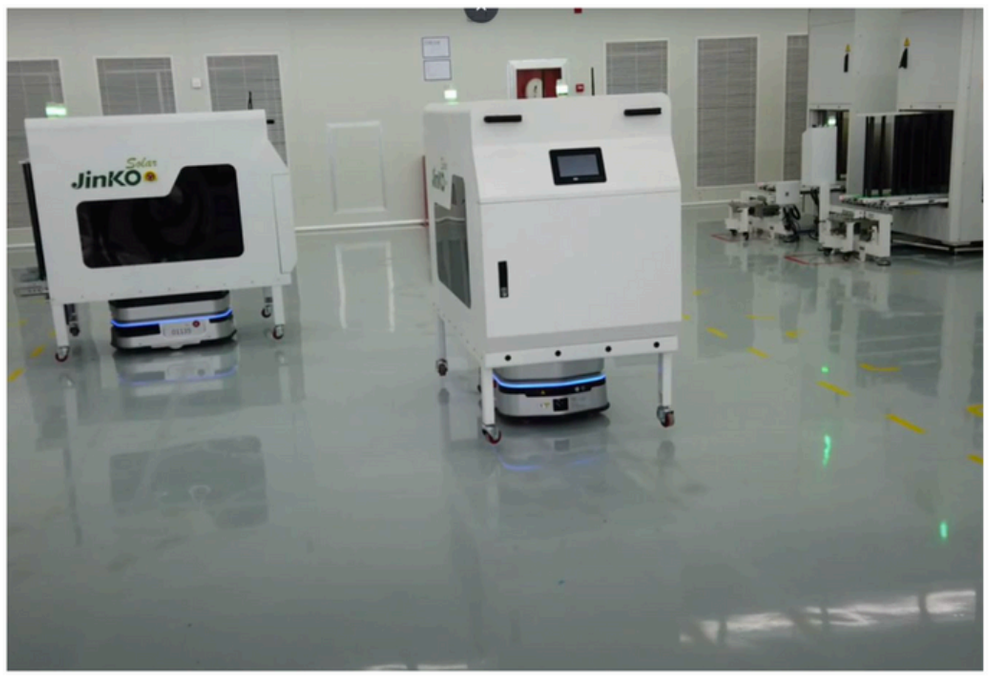
Reliability of PV modules in the low-cost era & solar test lab

PV Production: full automation, annual capacity > 1.5 TW /year, dark factories



Source: Longi, Jinko Solar

26/08/2025

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Reliability of PV modules in the low-cost era & solar test lab

Issues of the present market situation

- Overcapacity has reduced margins to unbearable levels
- Bankruptcy is a real threat for smaller players (and not only)
- Low prices have direct impact on quality: weak players are reducing investments to stay on the market
- Shift to new technologies has been faster and faster: reliability testing and norms are lagging behind

To be sustainable photovoltaics shall last and produce energy for long time

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Reliability of PV modules in the low-cost era & solar test lab

SUPSI Reliability of PV modules in the low-cost era

SUPSI PV Sector Research Priorities to impact in low cost era

- **Module and System-Level Durability** (mechanical, thermal, electrical stresses).
- **Accelerated Testing and Failure Analysis**
- **Field Performance and Degradation Monitoring**
- **Modeling and Simulation of Lifetime Performance**
- **BIPV, Integrated PV and Climate-Specific** (e.g. alpine) **Reliability Studies**

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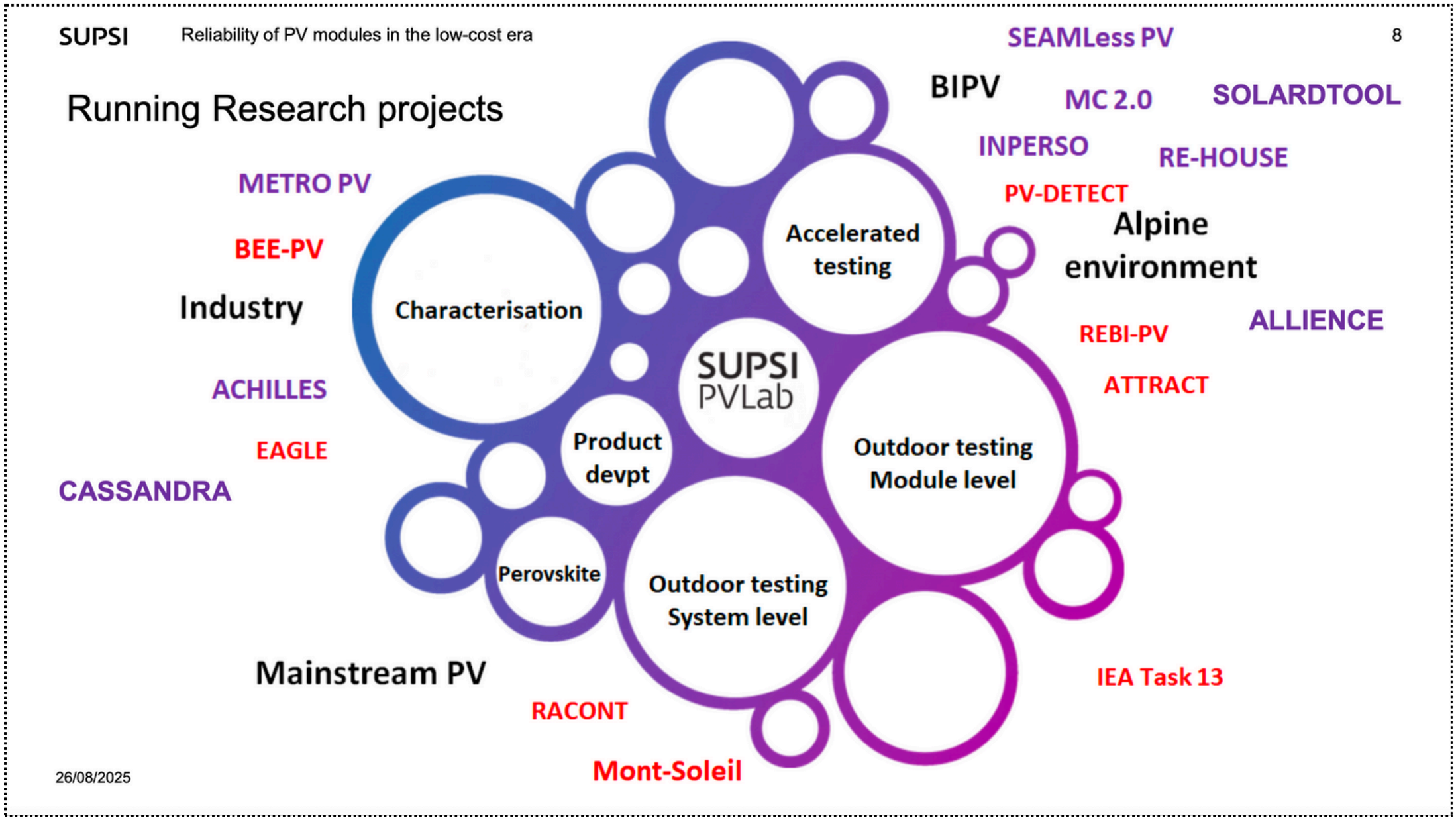
Reliability of PV modules in the low-cost era & solar test lab



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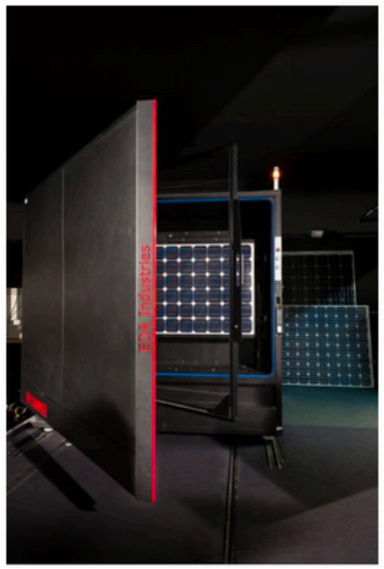
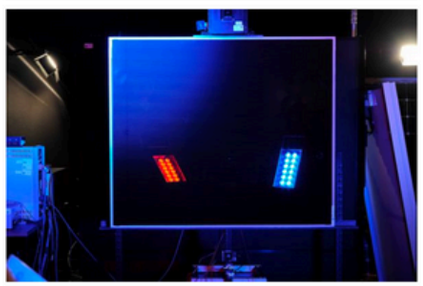
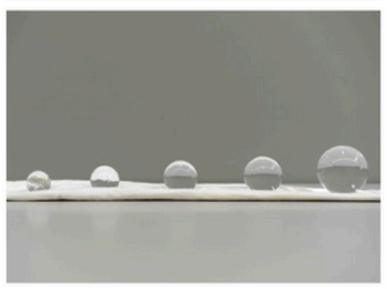
Reliability of PV modules in the low-cost era & solar test lab

SUPSI PVLab: facilities

- N.3 Pasan Flasher, class AAA, for the electrical characterisation with best uncertainty of **+/-1.1%** (non destructive spectral response measurement at module level, spectrum fine tuning with LEDs)
- N.3 continuos simulators, with visible light (2) and UV light (1), for characterisation, stabilisation and accelerated degradation of materials
- N.2 thermal chamber, 3 m^3 volume, for environmental testing with humidity and thermal cycling.
- PID testing
- N.1 mechanical load test setup up to **18.000 Pa** in pressure, with optional inclination up to 30°
- N.1 hail test set up, with max diameter of hailstone of **90 mm (accredited for IEC and Swiss norms)/ 100mm (nit accredited)**
- N.1 mechanical test machine for shear, pull test, 4 point bending test on materials and components (JB, connectors, laminates)
- N.1 megaohmeter for dry and wet insulation test
- Bypass diode thermal and reverse breakdown testing.
- N.2 IR camera systems for electroluminescence and thermal mapping
- Outdoor stand for the energy yield evaluation and comparison to other reference technologies
- Meteo station, with calibrated spectroradiometers, pyranometers and reference cells for a precise monitoring of composition and quantity of light, further to environmental parameters
- N.3 IV curve tracers for string performance measurements on the field (calibration with reference modules for uncertainty reduction) up to 1500 V.
- N.1 PV system performance checker (instant PR, energy yield)
- N.1 Insulation, short circuit current and open circuit voltage tester for PV system analysis




26/08/2025

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Natasa Vulic – INEB, HABG FHNW

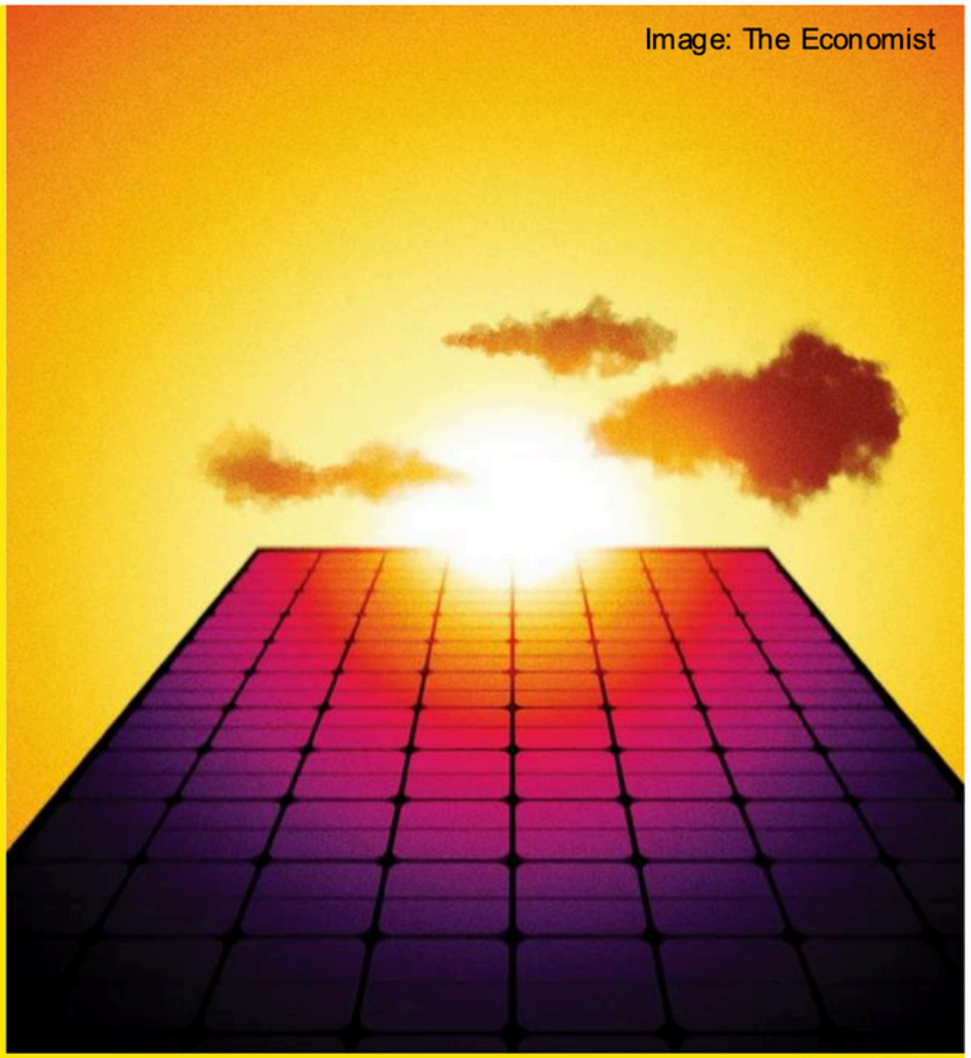
Cost- and emission-optimized PV expansion from the user perspective

n|w University of Applied Sciences and Arts Northwestern Switzerland
School of Architecture, Construction and Geomatics

member of swissuniversities

Towards sustainable PV Deployment

Current trends & future outlook



Natasa Vulic
Group Leader, Renewable Energy and Building Technology
Institute for Sustainability and Energy in Buildings

www.fhnw.ch/habg

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Evelyn Bamberger – SPF, OST

Swiss-Optimised PV Modules: Quality, R&D and design

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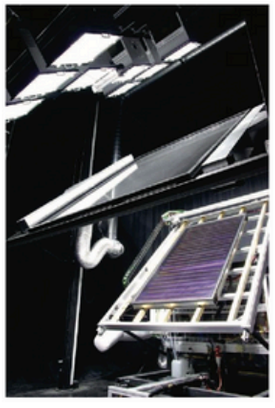
Evelyn Bamberger – SPF, OST

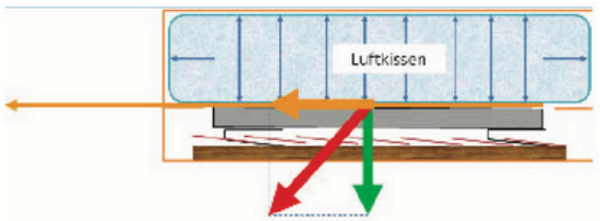
Swiss-Optimised PV Modules: Quality, R&D and design

Qualitätssicherung

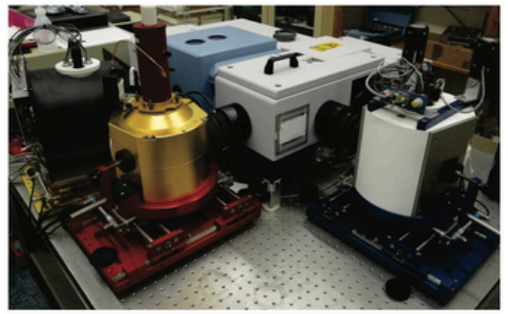
Mobiles PV-Labor

Sonnensimulator



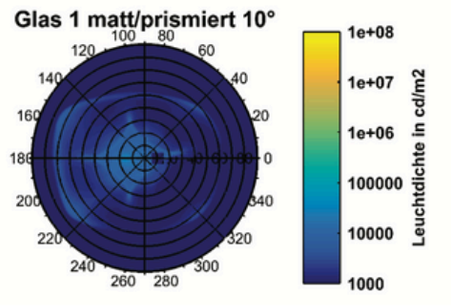


Schneelast



Spektroskopie, Solarglaszertifikat

Mechanische Belastbarkeit
Modul & Montagesystem



Reflexionsverhalten (BSDF),
Blendung

Hagel

Regendichtigkeit

In- und Outdoortests, Alterung

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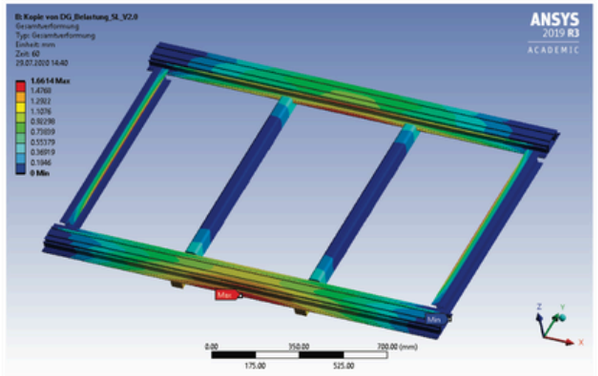
Evelyn Bamberger – SPF, OST

Swiss-Optimised PV Modules: Quality, R&D and design

PV-Integration in die Gebäudehülle

- Montagesystem und Integration im Fokus



SPF INSTITUT FÜR SOLARTECHNIK OST

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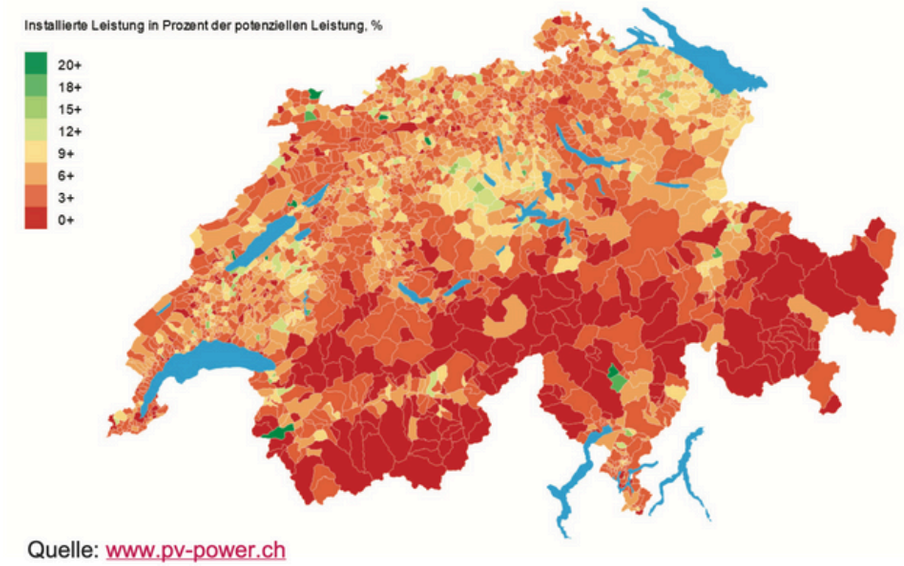
Evelyn Bamberger – SPF, OST

Swiss-Optimised PV Modules: Quality, R&D and design

Innosuisse-Projekt “Solartannen”

- Montagelösungen für PV-Anlagen an exponierten Lagen mit Standardmodulen
  - Kostengünstig & hoher Winterertrag



Quelle: www.pv-power.ch

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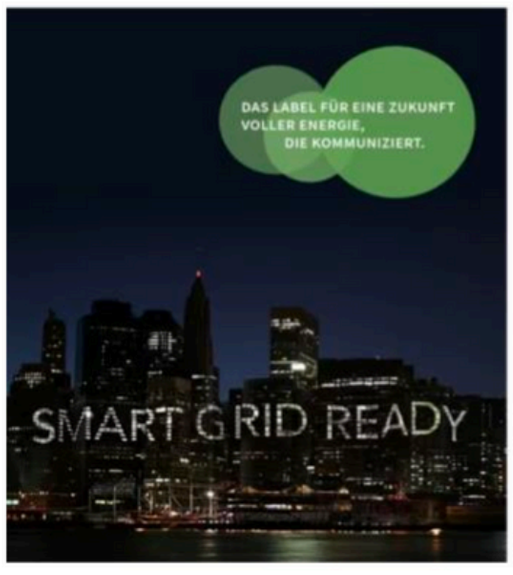
David Zogg – IA, HTU FHNW

SmartGridready test lab for integrated PV systems

n|w Fachhochschule Nordwestschweiz

SmartGridready TestLab

SmartGrid ready



Kurz-Präsentation

D. Zogg 25. August 2025

FHNW, Brugg-Windisch, Institut für Automation

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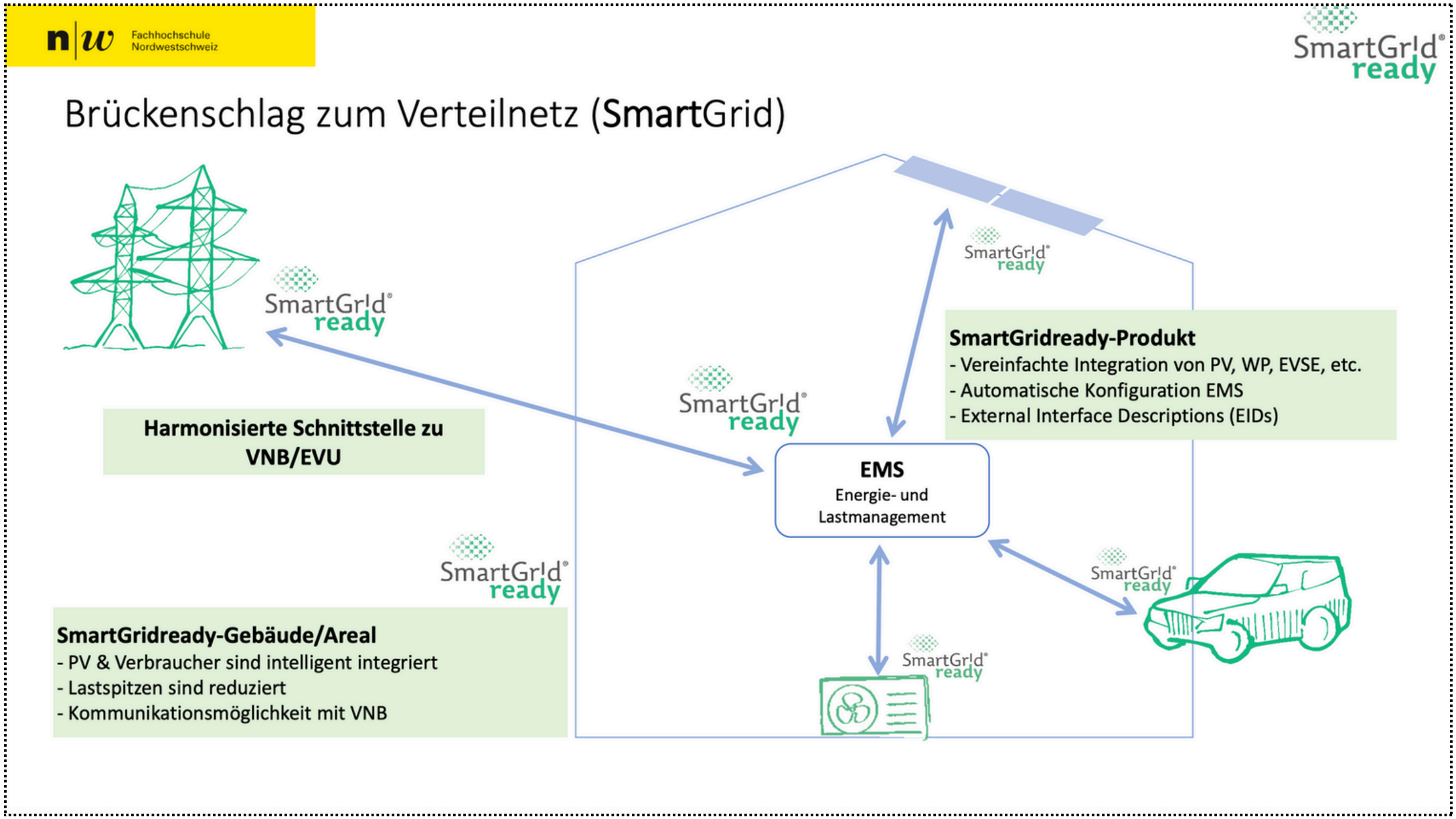
SmartGridready test lab for integrated PV systems



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SmartGridready test lab for integrated PV systems

Fachhochschule Nordwestschweiz

SmartGrid ready

Ansteuerungen heute und in Zukunft

Über Energiemanagementsysteme
– Direkte Ansteuerung über Sollwerte möglich
– Ansteuerung über Anreizsignale (dynamische Stromtarife)
– Direkte Rückmeldung, bidirektionale Kommunikation
– Information über aktuell verfügbare Flexibilität
– Fail-Save Mode bei Verbindungsausfall

Über Gateways / Smart Meter
– Diskrete Steuerungssignale direkt auf Geräte
– Rückmeldung möglich (Gateway)
– Datenauslesung über Smart Meter möglich

Über Rundsteuerungen:
– Beschränkt auf diskrete Signale
– Keine Rückmeldung
– Keine Datenauslesung

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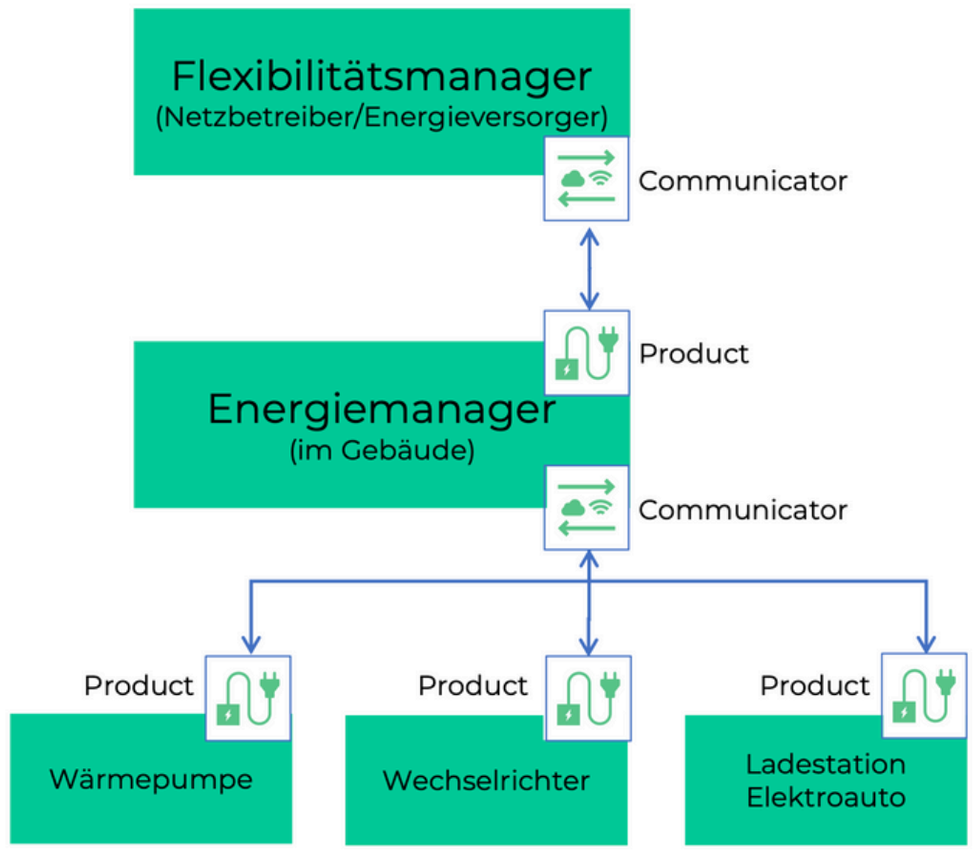
SmartGridready Schnittstelle: Product & Communicator

SmartGrid ready

In der SmartGridready Architektur können Komponenten die Rollen «Product» oder «Communicator» einnehmen.

- Ein Product stellt Eigenschaften, Datenpunkte und Ansteuerungs-möglichkeiten zur Verfügung.
- Ein Communicator liest diese Datenpunkte aus oder steuert sie an.
- Die Funktionsprofile/Datenpunkte werden in External Interface Descriptions (EIDs) digital beschrieben und eingelesen
- Die Hersteller der Produkte müssen nur ein EID mitliefern, aber nichts an ihren Schnittstellen ändern



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SmartGrid® ready

Das SmartGridready-Stufenmodell (Levels)

Ein Funktionsprofil definiert eine Auswahl von Datenpunkten, die zusammen eine bestimmte Funktionalität ermöglichen.

Die Funktionsprofile legen die Label-Stufe von 1 bis m fest.

- 1 → Aktivieren, deaktivieren
- 2 → Diskret, diverse Betriebsmodi
- 3 → Fix konfigurierte Kennlinien
- 4 → Dynamische Sollwerte
- 5 → Variable Kennlinien
- 6 → Prognose
- m → Monitoring

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Testlabor

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Mobiler Aufbau (Testwände)

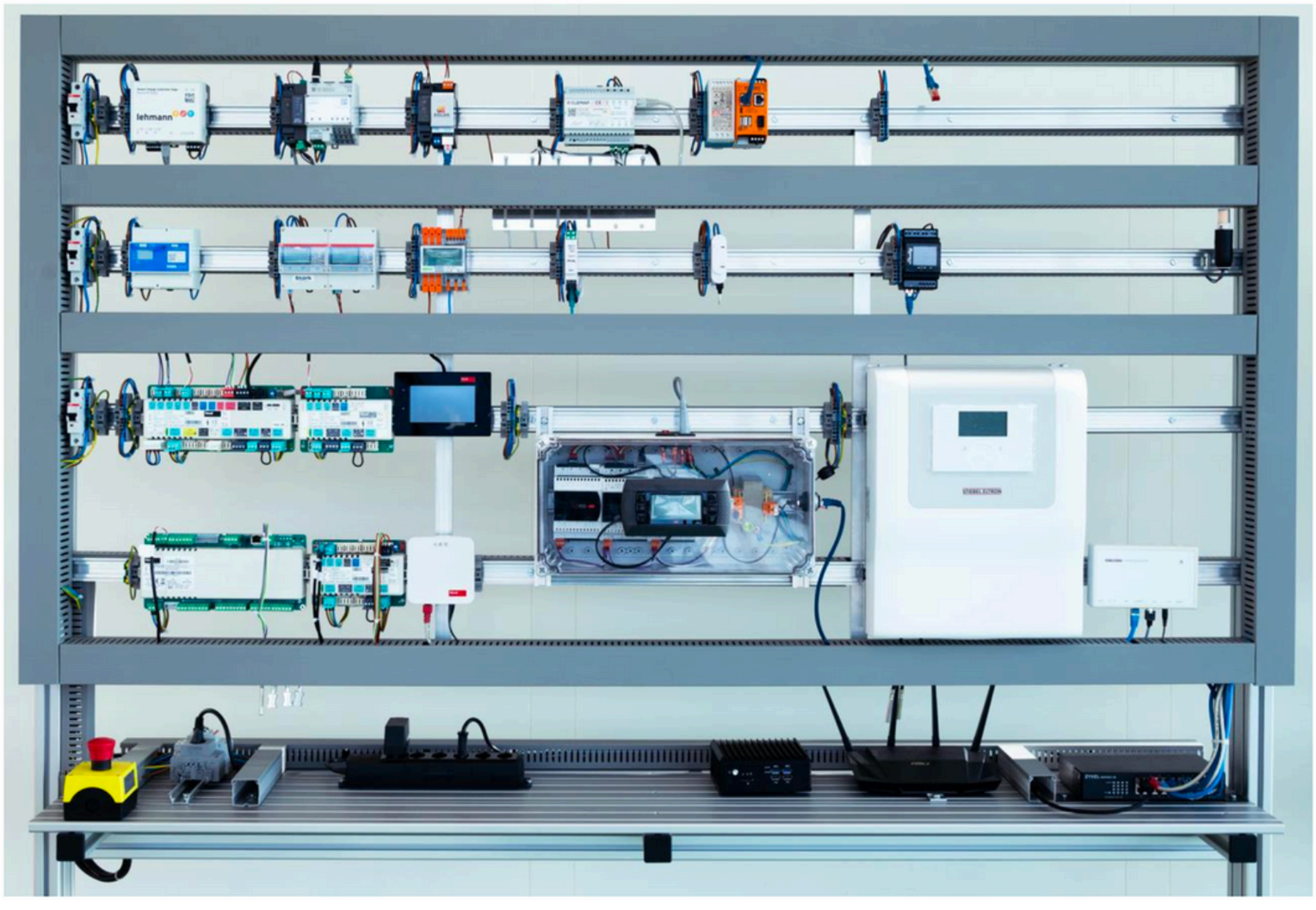
SmartGrid® ready

EMS

Stromzähler

WP-Controller

Testframework



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Mobiler Aufbau (Testwände)

SmartGrid® ready

Ladestationen

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SmartGridready test lab for integrated PV systems

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Mobiler Aufbau (Testwände)

SmartGrid® ready

Smart Meter
& Adapter

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SmartGridready test lab for integrated PV systems

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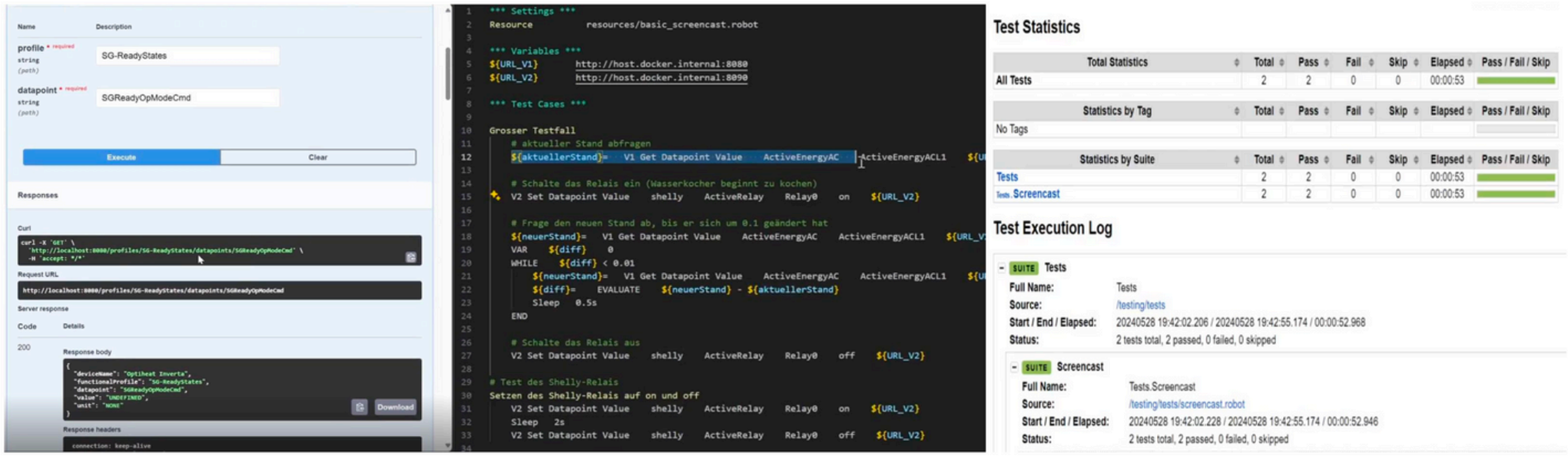
Test-Framework (Software)

SmartGrid® ready



- Teststand-Integration basiert auf **External Interface Descriptions (EID)** und **CommHandler (Java)**
- Automatisierte Testabläufe basierend auf **RobotFramework**
- Funktionstests (heute)
- Integrationstests, Dauertests (in Entwicklung)

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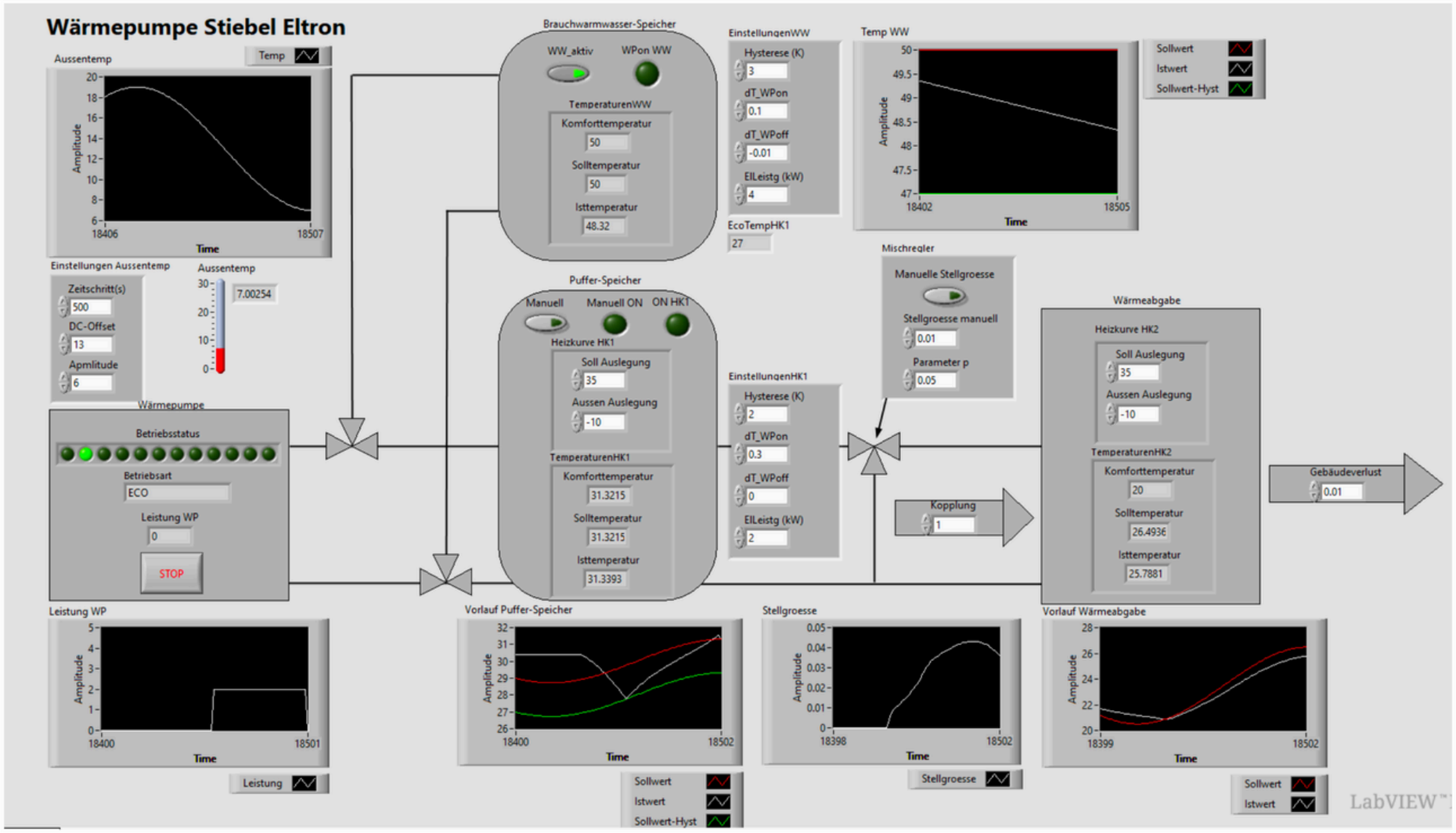
Emulation (Beispiel Wärmepumpe)

SmartGrid® ready



Quelle: Praktikum Mathis Zogg

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SmartGridready test lab for integrated PV systems

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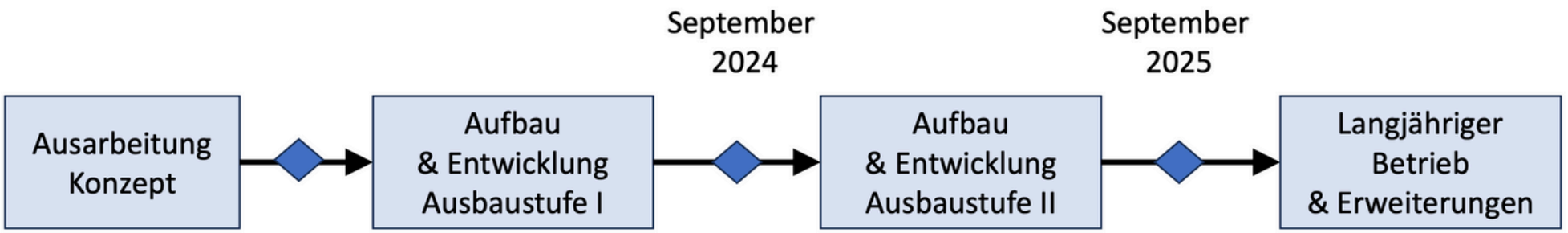
Projektphasen Testlabor

SmartGrid ready



Nov/Dez 2023

Finanziell unterstützt durch Bundesamt für Energie
In Koordination mit SmartGridready Verein

Durchführung von «Plugfests», Kursen, Schulungen
Unterstützung der Deklaration
Testumgebung für Hersteller

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Bundesamt für Energie BFE
Swiss Federal Office of Energy SFOE

https://www.fhnw.ch/de/forschung-und-dienstleistungen/technik/labore-der-hochschule-fuer-technik-fhnw/smartgridready-testlabor

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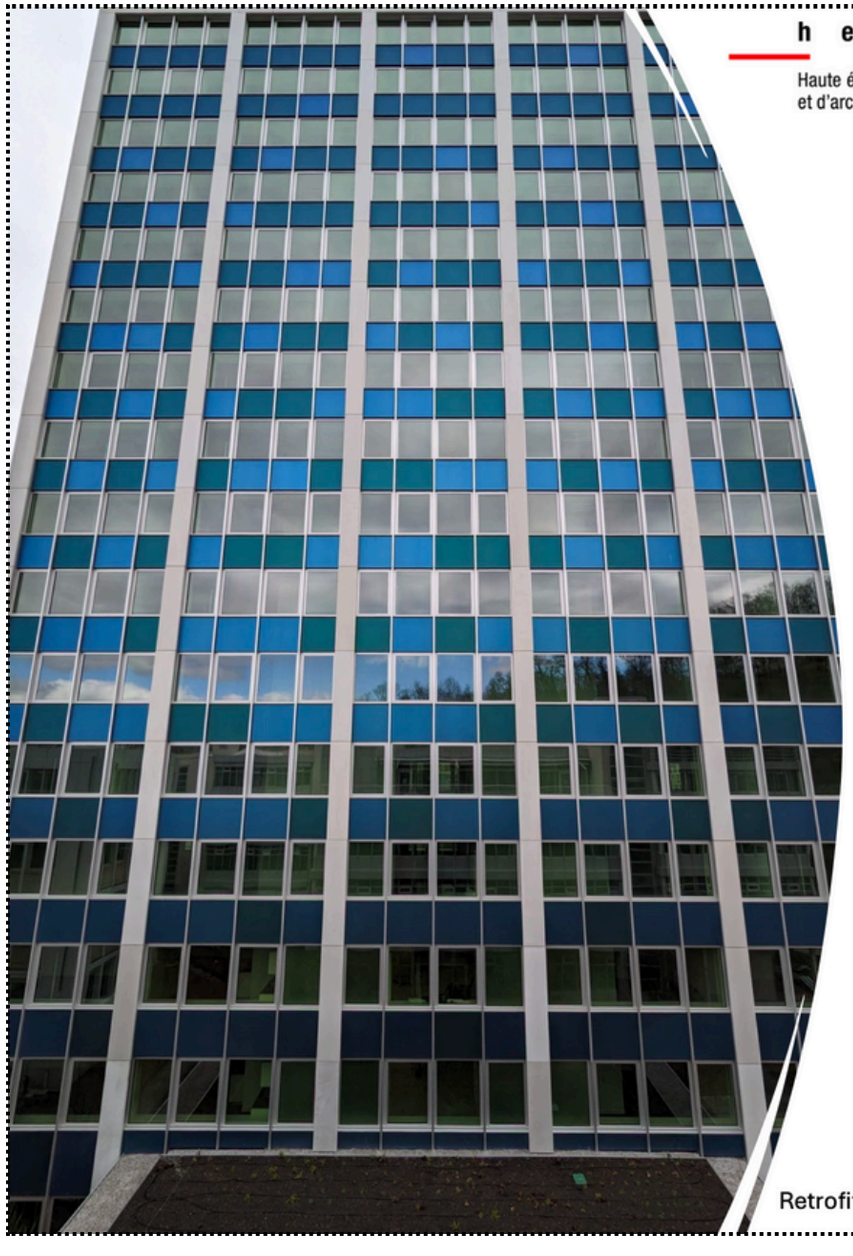
Gilles Desthieux – leea, HEPIA HESGE

PV modelling at the urban scale – with a focus on facades



h e p i a
Haute école du paysage, d'ingénierie et d'architecture de Genève

Hes·SO GENÈVE
Haute Ecole Spécialisée de Suisse occidentale

BIPV implementation potential on Geneva canton facades

Gilles Desthieux
Maxence Locatelli

Brenet Webinar #2 – 25th August 2025

Retrofit of the Firmenich tower with BIPV in Geneva

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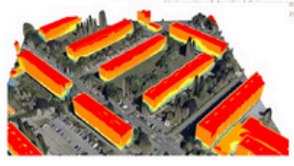
Gilles Desthieux – leea, HEPIA HESGE

PV modelling at the urban scale – with a focus on facades

Background on R&D in urban solar modelling

Solar Cadaster – Greater Geneva



Urban scale solar modelling on facades

Solar potential in the nordic cities with NTNU

Advice for property owners

Swiss expert in IEA Tasks (63 & 15)

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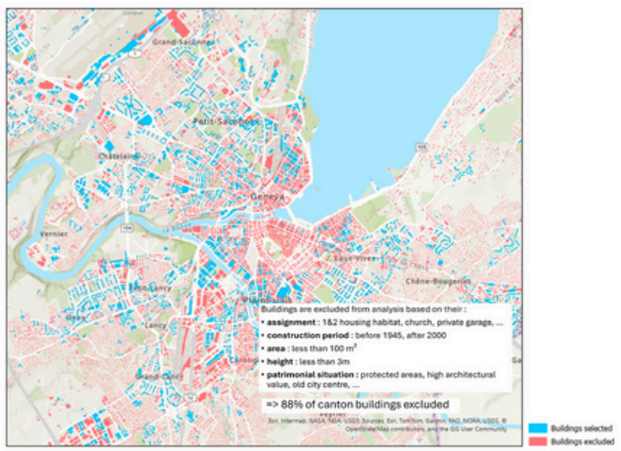
Gilles Desthieux – leea, HEPIA HESGE

PV modelling at the urban scale – with a focus on facades

BIPV Suitability Analysis – **Architectural aspects:** on field survey vs automated approach

Exclusion Map



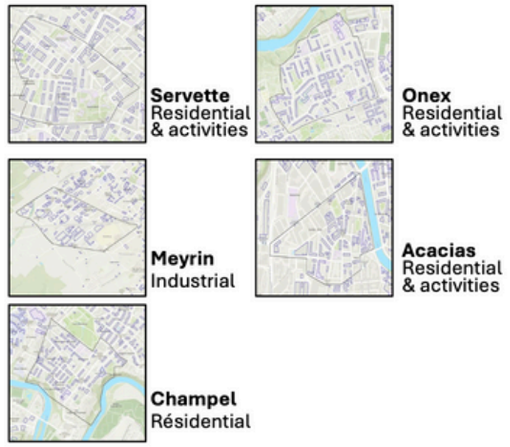
Enhance the Geneva building typology analysis with BIPV

https://www.lancy.ch/fiches-dorientation-typologique

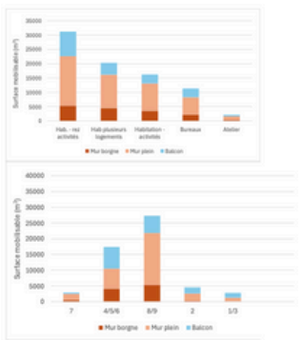
On-field survey

Tablet application

5 pilot areas



Post analysis



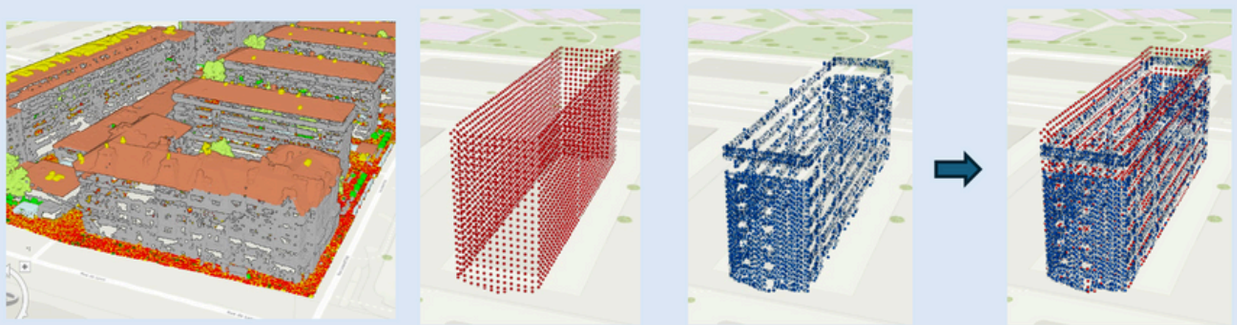
Statistics on facade area availabitlity (by building use and type)

Multicriteria analysis for BIVP facade suitability priorisation

- Building type
- Heritage protection level
- Building height
- Renovation
- Significant solid part

Global statistics by building type (solid parts, balconies and window ratio) are transferred to the rest of the canton for buildings of the same type.

Automated approach with airborne LIDAR data



Regular 3D points

LIDAR

Matching => remove the 3D points from the empty areas (windows)

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Gilles Desthieux – leea, HEPIA HESGE

PV modelling at the urban scale – with a focus on facades

BIPV Suitability Analysis – **Solar potential**


Solar potential on facades at urban scale: an integrated approach combining solar and digital building modelling

G Desthieux[1*], A Gressin[2], B Raybaud[1], J Ingensand[2]

[1] University of Applied Sciences and Arts Western Switzerland / HEPIA, Geneva, Switzerland

[2] University of Applied Sciences and Arts Western Switzerland / HEIG-VD, Yverdon-les-Bains, Switzerland

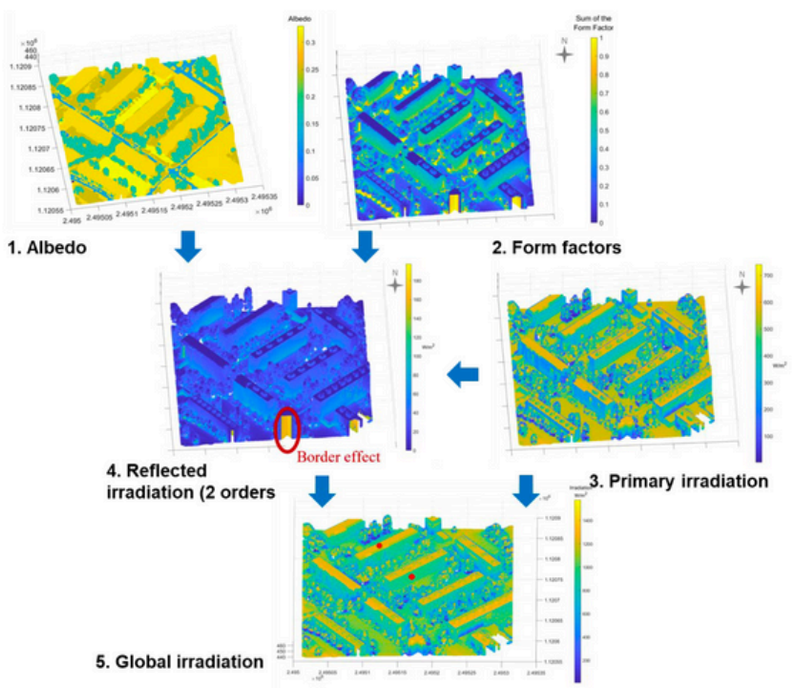

Solar Energy Advances

Adapted strategy for large-scale assessment of solar potential on facades in urban areas focusing on the reflection component

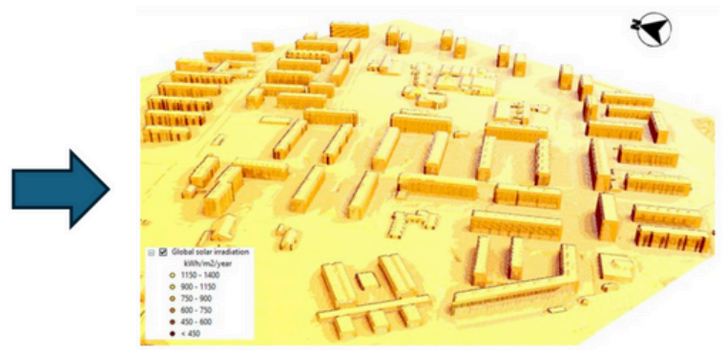
Raybaud Blaise, Desthieux Gilles*

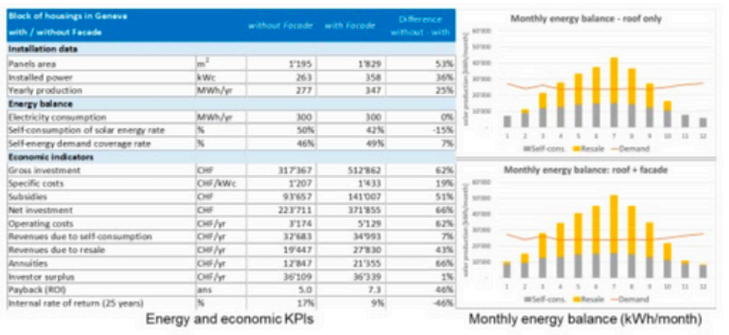
DOI 10.1088/1742-6596/2600/4/042004 https://doi.org/10.1016/j.seja.2022.100030

- Urban solar model – CADSOL (HEPIA)



Raw solar radiation on building façades and rooftops





Block of housings in Geneva with / without Facade		without Facade	with Facade	Difference without - with
Installation data				
Panels area	m^2	1'195	1'829	53%
Installed power	kWc	263	358	36%
Yearly production	MWh/yr	277	347	25%
Energy balance				
Electricity consumption	MWh/yr	300	300	0%
Self-consumption of solar energy rate	%	50%	42%	-15%
Self-energy demand coverage rate	%	46%	49%	7%
Economic indicators				
Gross investment	CHF	317'367	512'862	62%
Specific costs	CHF/kWc	1'207	1'433	19%
Subsidies	CHF	93'657	141'007	51%
Net investment	CHF	223'711	371'855	66%
Operating costs	CHF/yr	3'174	5'129	62%
Revenues due to self-consumption	CHF/yr	32'683	34'993	7%
Revenues due to resale	CHF/yr	19'447	27'830	43%
Annuities	CHF/yr	12'847	21'355	66%
Investor surplus	CHF/yr	36'109	36'339	1%
Payback (ROI)	ans	5.0	7.3	46%
Internal rate of return (25 years)	%	17%	9%	-46%

Energy and economic KPIs

Monthly energy balance (kWh/month)

Building energy and economic balance

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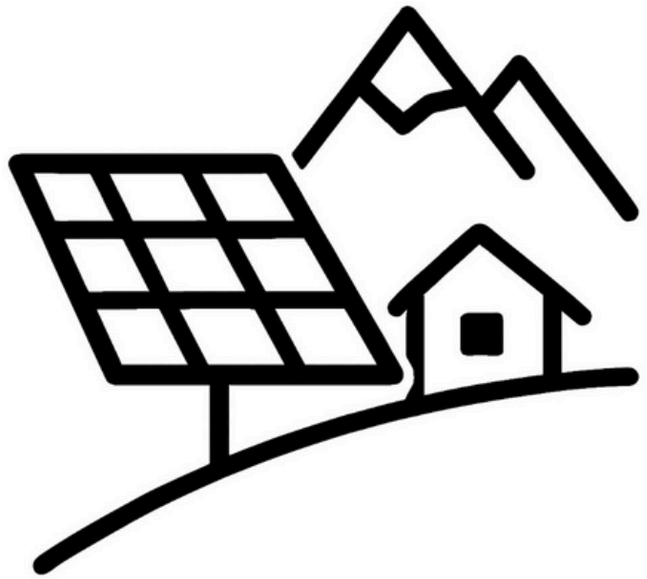
Roger Buser – IGE, HSLU

Solar fences and alpine glare – Making PV suitable for everyday use

HSLU Hochschule Luzern

Solarzäune und Alpine Blendung

PV alltagstauglich gemacht



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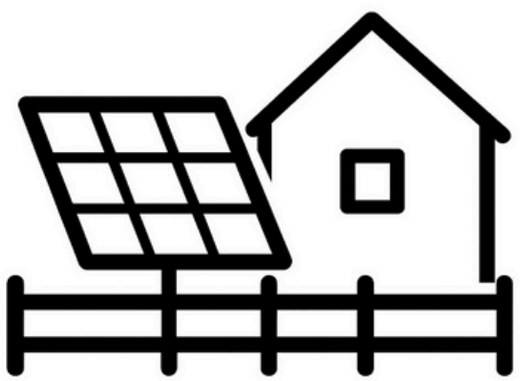

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Roger Buser – IGE, HSLU

Solar fences and alpine glare – Making PV suitable for everyday use

SolarZaun / Balkon

Pro:

- 2fach Nutzung
- schöne Varianten
- Winterstrom (O/W oder S-Ausrichtung)

Contra:

- Teurer als ein normaler Zaun
- Verschattung (Optimizer)
- Spezialmodule: Semitransparent

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Solar fences and alpine glare – Making PV suitable for everyday use

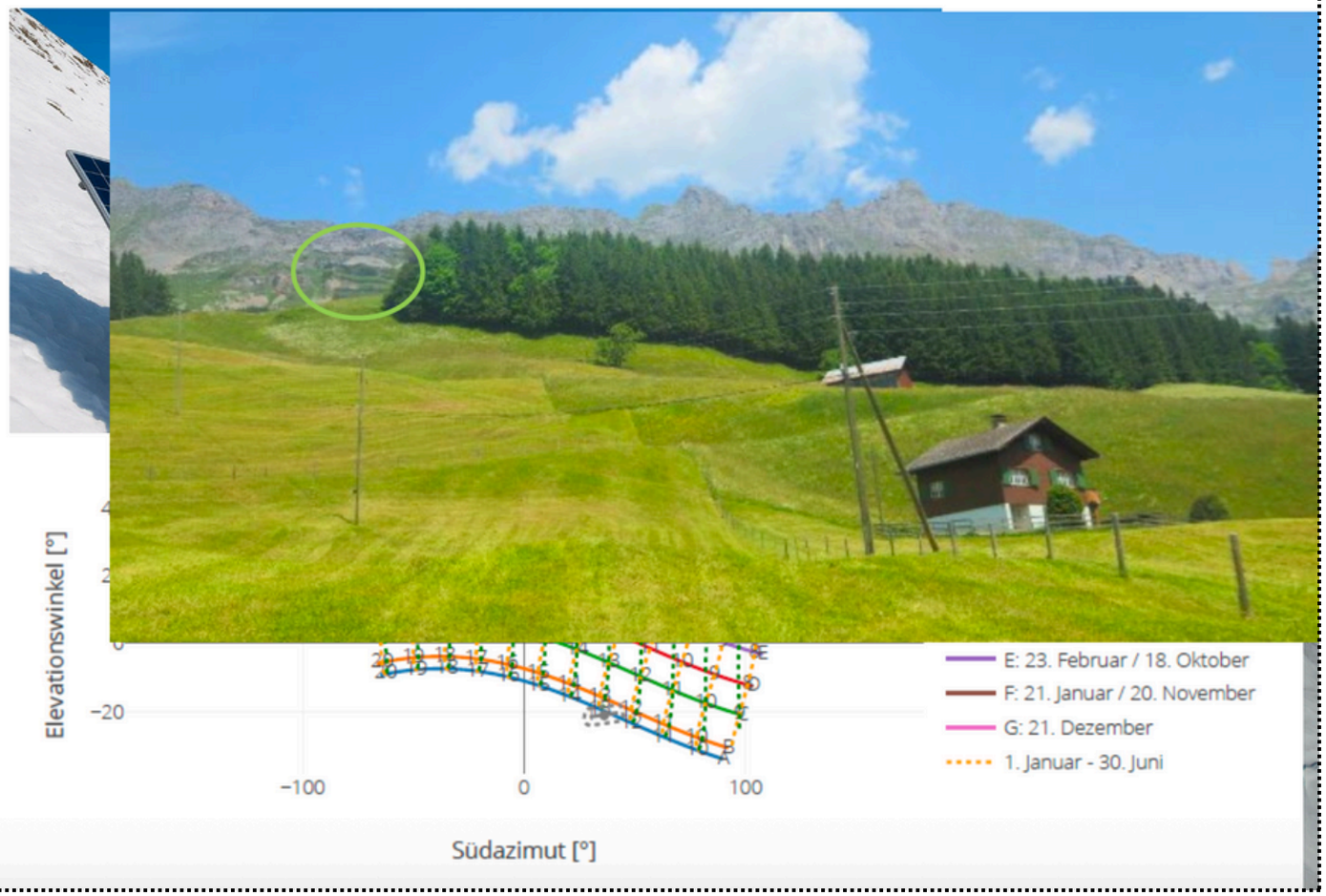
Alpine Blendung

Pro:

- Winterstrom
- ungenutzte Fläche

Contra:

- Sehr teuer, aber amortisierbar
- aufwändige Installation
- Einsprachen möglich wegen Blendung
- Spezialmodule: Blendarm (Deflect)



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brenet ResearchLunch #3

Net zero needs storage –
How thermal and electrical storage contributes to system integration and security of supply

30 Oct. 2025 | 12:15 p.m. - 1:15 p.m. | online

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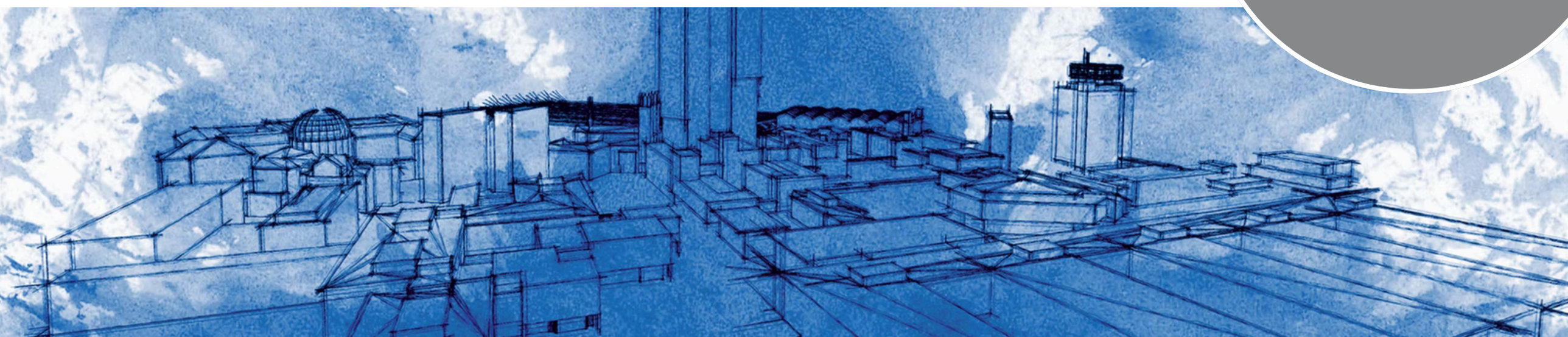

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