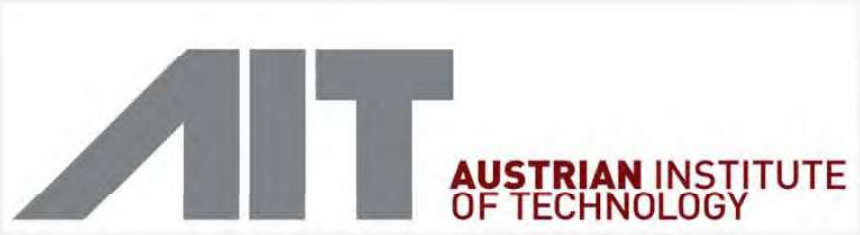
Fach-Webinar

Dr. Stephan Abermann

Photovoltaik-Technologien für die gebaute Umwelt



AUSTRIAN INSTITUTE OF TECHNOLOGY
TOMORROW TODAY

PV-TECHNOLOGIEN FÜR DIE GEBAUTE UMWELT

Stephan Abermann
Head of Competence Unit Photovoltaic Systems
Center for Energy
AIT – Austrian Instititue of Technology

AUSTRIAN INSTITUTE OF TECHNOLOGY

bmk

1.370 employees

8 Centers

Austria‘s largest RTO

Infrastructure Systems

System Competence

Applied Research

Federation of Austrian Industries

Next Generation Solutions

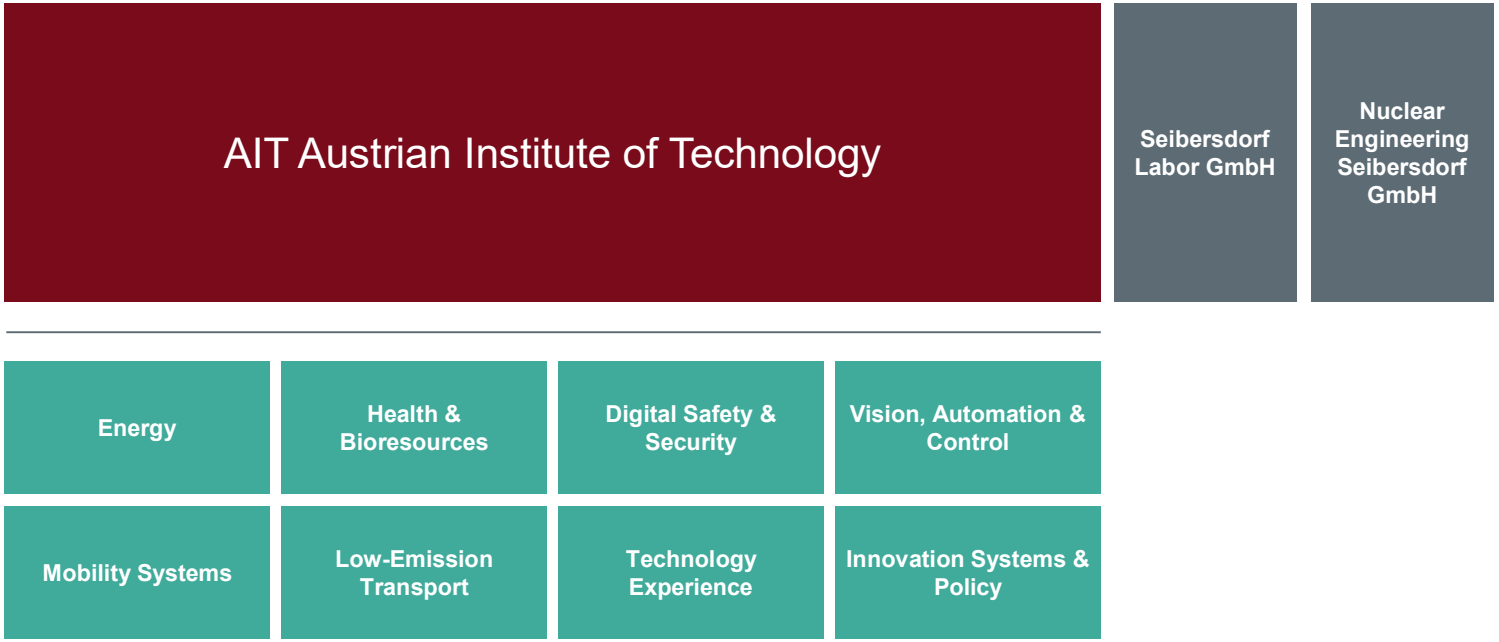
4 Subsidiary Enterprises

LKR, NES, SL, Profactor 51%

162,9 m EUR total revenue

Tomorrow Today

AIT AUSTRIAN INSTITUTE OF TECHNOLOGY



AIT CENTER FOR ENERGY

The AIT Center for Energy develops solutions for a sustainable energy system of tomorrow.

Our Competence Fields/ Units

- Smart Grids
- **Photovoltaics**
- Thermal Energy Systems
- Integrated Energy Systems
- Smart Cities and Regions

AIT Location Giefinggasse

Quelle: https://energis.com.au/2019/01/are-solar-panels-ugly/

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?

Gemeindezentrum Ludesch/A
Quelle: https://www.baunetzwissen.de/gebaeudetechnik/objekte/buero-verwaltung/gemeindezentrum-in-ludesch-a-71716/gallery-1/2

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GIPV –DIE HERAUSFORDERUNG

G/BIPV-Komponenten:

Elektronikindustrie

- Industry
  - Halbleiter / Beschichtungen / Wafer
- Technology
  - Solarzellen: kristallin & Dünnschicht
- Standards
  - IEC

Electronik- & Konstruktions-Eigenschaften und Zweck

von global zu lokal

Märkte, Regeln und Rahmen-bedingungen

Baumaterialien

- Industry
  - Stahl, Beton, Holz
- Technology
  - Ziegelwand & Dachstruktur
- Standards
  - ISO

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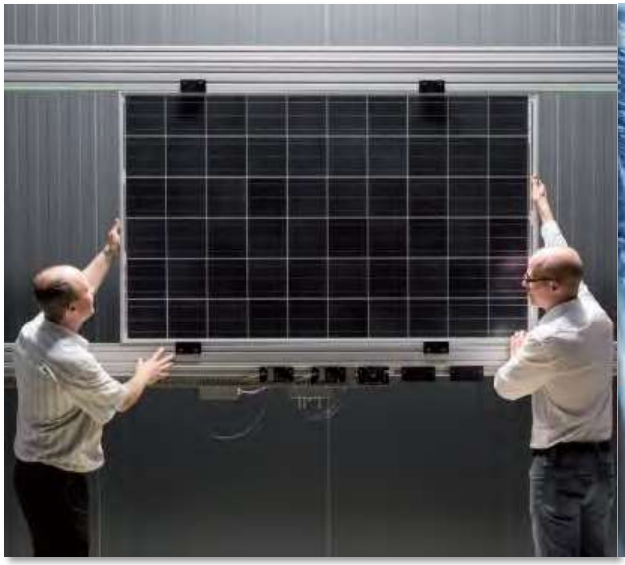
TOMORROW TODAY



PHOTOVOLTAIC SYSTEMS

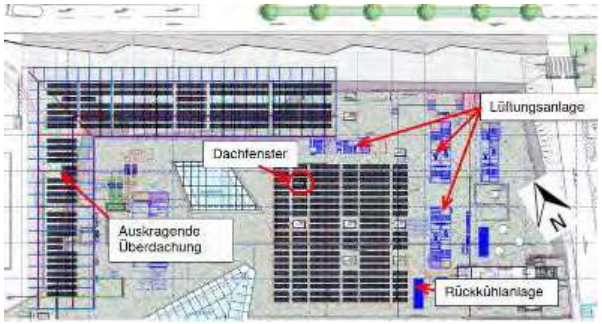
CENTER FOR ENERGY

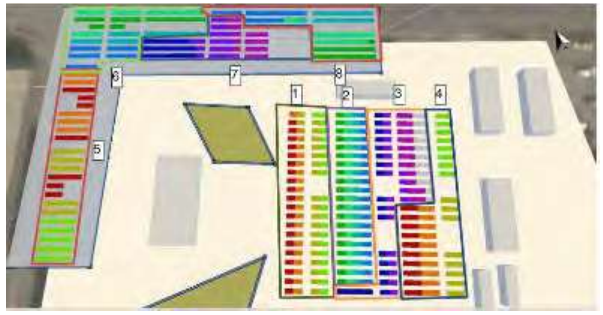
TECHNICAL AND ECONOMICAL FEASIBILITY OF PV POWER PLANTS

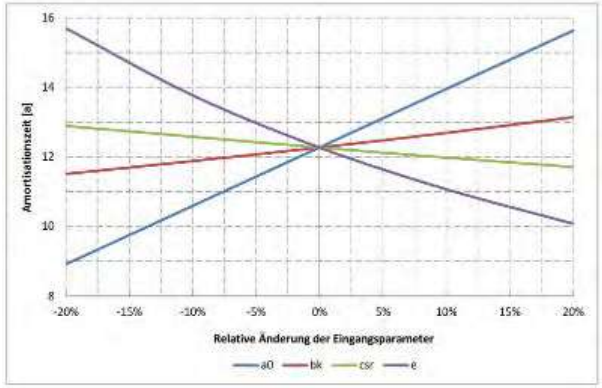
- **Technische Machbarkeit**
  - Strukturelle Rahmenbedingungen
  - Elektrische Anforderungen
  - Vorentwurf des PV-Systems

- **Wirtschaftliche Machbarkeit**
  - Bewertung des PV-Ertrags
  - Kostenschätzungen (CAPEX, OPEX)

- **Automatisierte Datenanalyse**
  - Fehler-/Verschmutzungserkennung für automatisierten Betrieb und Wartung (O&M)
  - Bewertung und Prognose des Energieertrags

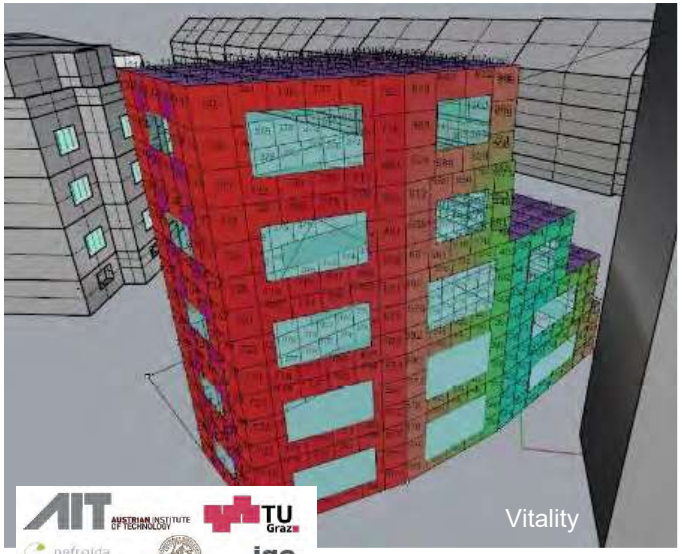






GIPV (EN: BIPV) - GEBÄUDEINTEGRIERTE PHOTOVOLTAIK

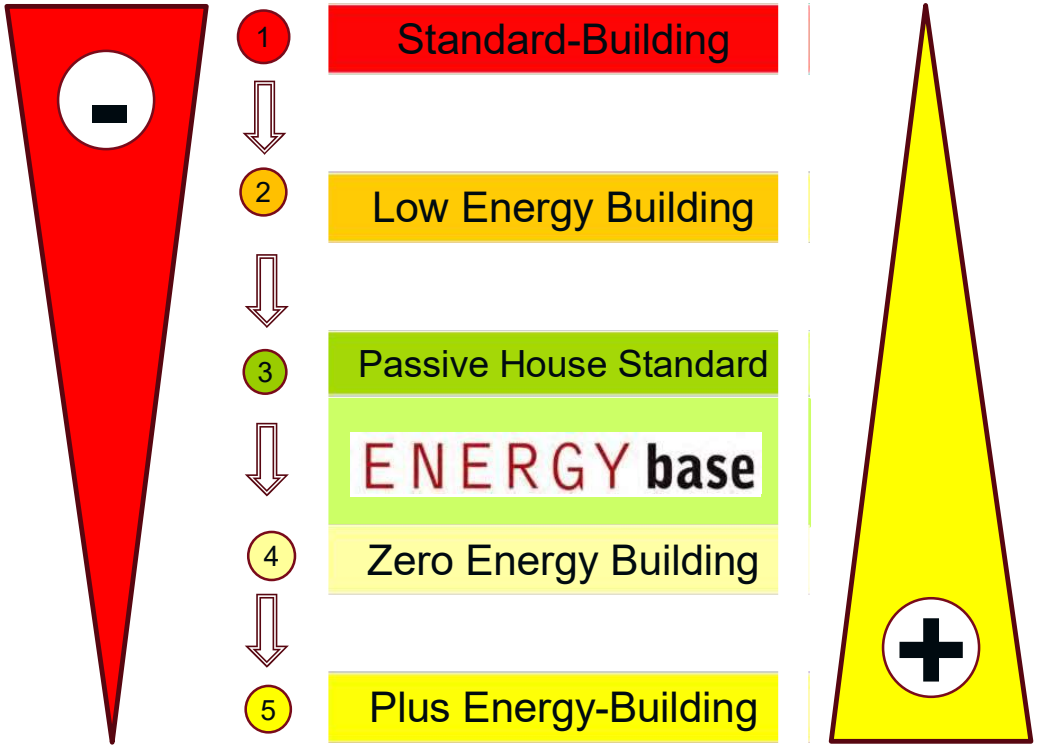
- Forschung und Entwicklung von Design, Konstruktion, Materialien und Elektronik für neuartige gebäudeintegrierte Photovoltaik-Lösungen
- Analyse der Zuverlässigkeit und Effizienz von PV-Komponenten für den Einsatz in der gebauten Umwelt
- Schaffung von Synergien zwischen Photovoltaik und Architektur



AIT ENERGY: ‘ENERGYBASE’-OFFICE BUILDING

ENERGYbase Solarfassade mit PV

by AIT (Energy Planning) and POS Architects, Ursula Schneider



Verbrauch

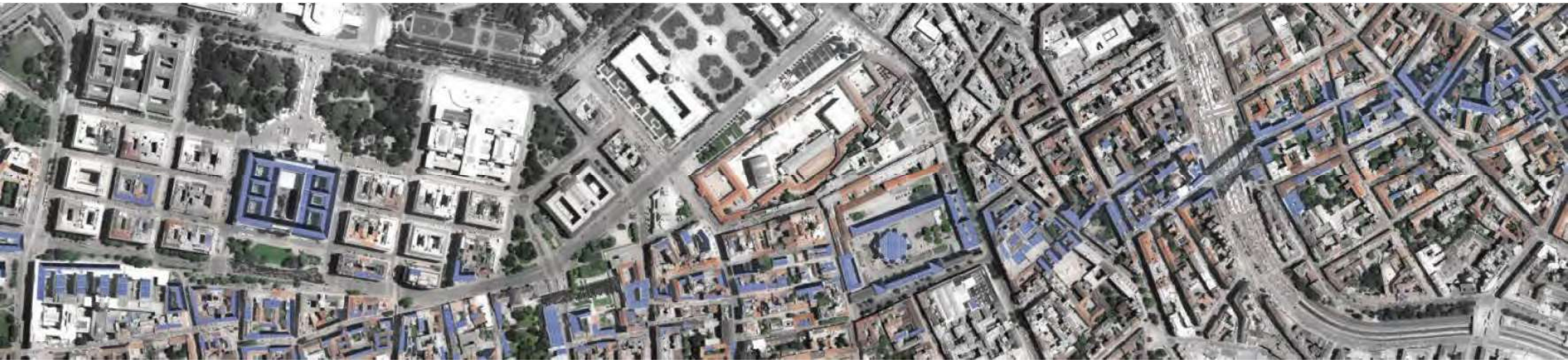
Fossiler Energien

Gebäudestandard

Solarenergie (PV)

CONCEPT AIT „PV SERPENTINE“

- Entlang U-Bahn-Linie
- Sichtbares Wahrzeichen
- Orientierung für U-Bahn Stationen
- Erneuerbare E-Mobilität
  - U-Bahn/Straßenbahn implementiert



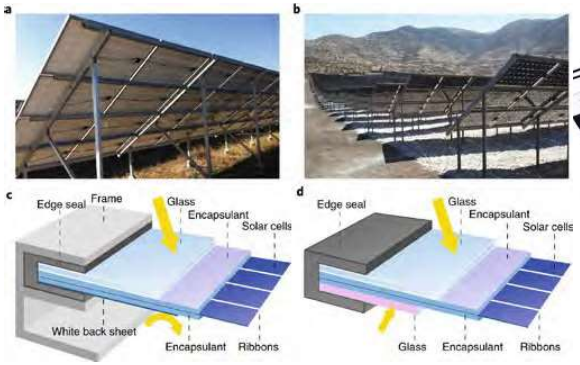
PV TECHNOLOGIEN - ÜBERSICHT

Poly/Mono Kristallin

© DAS Energy-Foil-Roofing

© Kioto Solar

Bifazial / Zweiseitig



Quelle: Nature, Autor: R. Kopecek

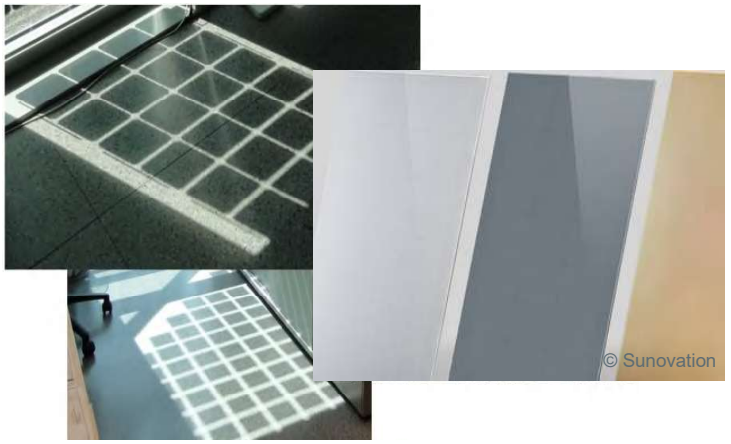
Dünnschicht (CdTe, CIGS…)

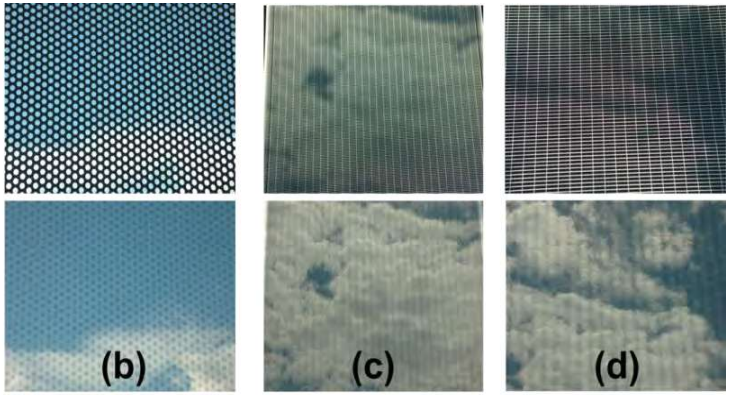
SONNENEINSTRAHLUNG & WIRKUNG DES LICHTS

- Lichtmanagement mit Photovoltaik
- Schattenwurf kann gestaltet werden
- Transparenzgrad einstellbar
- Selektives Lichtspektrum (vor allem bei Dünnschicht)
- Immer mehr Module in unterschiedlichen Farben verfügbar (Effizienzkompromiss)

© Solaxess

© Fraunhofer





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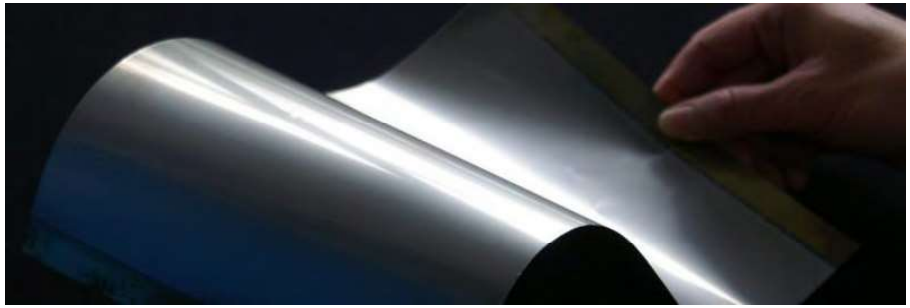
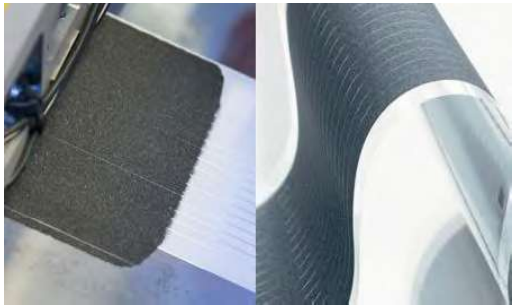
GIPV-PRODUKTE MADE IN AUSTRIA



Sunplugged – Flexible Dünnschichtmodule



Crystalsol - Gedruckte PV-Module

BIPV-Fassade mit LED by Ertex Solar

DAS-Energy Solar-Module für “Dachbahnen” oder Kalzip-Eindeckung

Siebdruck-Solarmodule Glas-Glas (Ertex Solar)

Kioto-Solar

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„BEST PRACTICES“ – G/BIPV

„BEST PRACTICES“ – G/BIPV

„BEST PRACTICES“ - VERKEHRSINFRASTRUKTUR

Quelle: https://www.mobilegeeks.de/artikel/china-erste-solar-autobahn-der-welt-eingeweiht/

„BEST PRACTICES“ - VERKEHRSINFRASTRUKTUR

PV IN DER LANDSCHAFT/ AUF DEM WASSER… ?

DOPPELNUTZUNG VON AGRARFLÄCHEN

- PV kann auf Freiflächen bzw. landwirtschaftlich genutzten Flächen installiert werden
- PV reguliert die Sonneneinstrahlung auf den Boden
- PV reduziert die UV Belastung
- PV reduziert Austrocknung und Wasserverbrauch
- PV schützt Pflanzen vor Hagelschlag
- Doppelnutzung bietet hervorragende Synergie

PV Dachgarten, energie:bau

PV AUF WOHN- UND WIRTSCHAFTSGEBÄUDEN

- **Energiehallen**
- kombinieren die Hallen-Nutzung mit der Erzeugung von Solarenergie
- ROI der Hallen durch die PV

www.eggert-stahlbau.de

www.vinpearl-baidai.info

Alt_Daber-SolarKW.jpg

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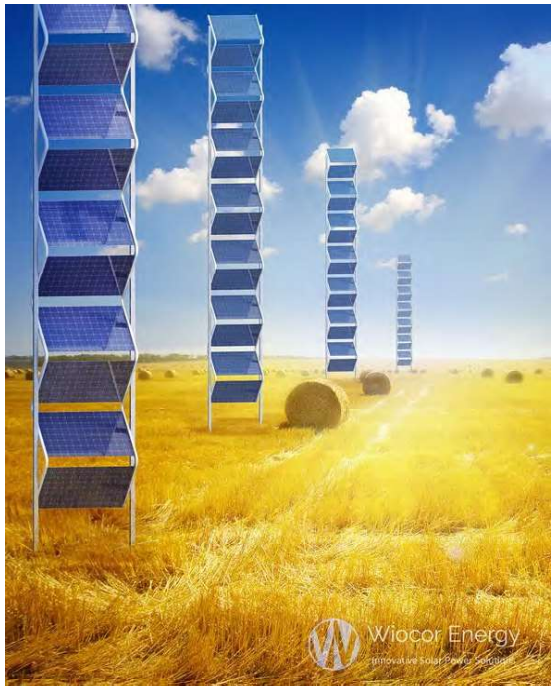
DOPPELNUTZUNG VON AGRARFLÄCHEN

- Landschaftintegration, „PV forms landscape“



solarwings, © www.swissbau.ch

Ertex Solar - Screen Printed

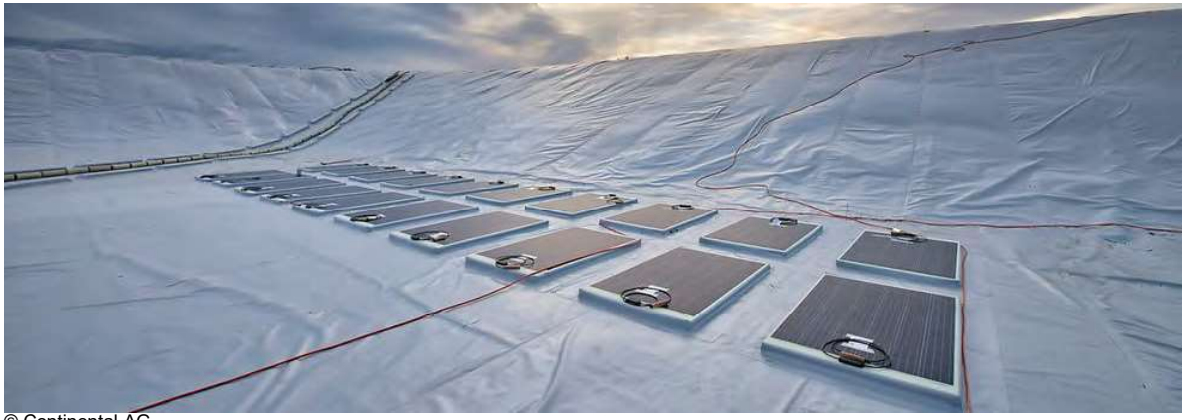
https://ensia.com

next2sun

DOPPELNUTZUNG AN WASSERFLÄCHEN

- Schutz vor Verdunstung

© Nagpurtoday



© Continental AG

Seaflex

ZUSAMMENFASSUNG: CHANCEN UND HERAUSFORDERUNGEN

+ Photovoltaik ist/ wird in immer mehr Regionen kostengünstigste Option zur Stromversorgung
+ Integration in Stromnetze und gebaute Umwelt ist der Schlüssel, um eine angemessene Rolle zu gewährleisten
+ Die großen Kostensenkungen entlang der PV-Wertschöpfungskette im letzten Jahrzehnt steigerten wirtschaftliche Attraktivität der BIPV-Produkten
− Dennoch sind viele Fälle aus wirtschaftlicher Sicht nach wie vor relativ unattraktiv
− Darüber hinaus bleibt der BIPV-Markt ein Nischenmarkt, sowohl wenn man seinen Anteil am PV-Markt als auch am Bau- und Gebäudemarkt betrachtet.
− In den meisten Fällen sind die entwickelten Lösungen maßgeschneidert was die Erschließung des Massenmarkts behindert
± BIPV-Technologien, aber auch “spezifische Systemlösungen” (Agraranwendungen, etc.) sind heute durchaus ausgereift, stehen aber immer noch vor zahlreichen Herausforderungen

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VIELEN DANK &BLEIBEN SIE GESUND!

Stephan Abermann
AIT Austrian Institute of Technology
Head of Competence Unit PVS
Center for Energy

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Stephan.Abermann@ait.ac.at
Giefinggasse 6
1210 Wien
Austria

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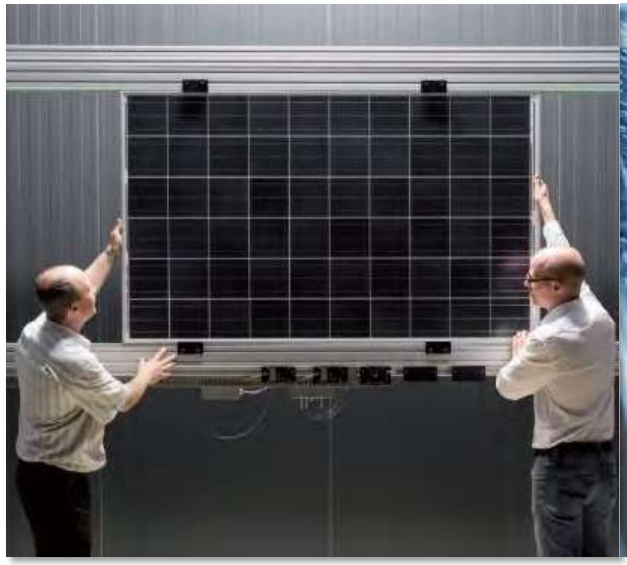
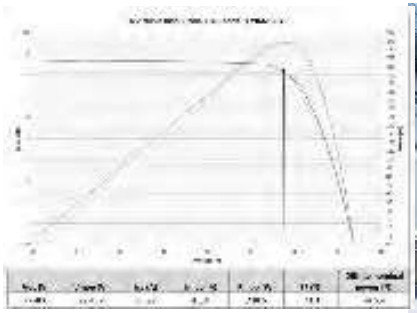


AIT LABORATORY INFRASTRUCTURE

Photovoltaic module testing and assessment

TESTING & VALIDATION OF PV-MODULES

- Precise characterization of PV technologies
- Independent performance measurements
- Rapid life-cycle test
- Pre-conditioning / reproducibility
- Advanced optical characterization
- Degradation and failure assessment (PID, LeTID)
- Periodical round-robin tests with other institutes



- **Accreditation and standardisation activities**
  - Accredited test lab according to EN ISO/IEC 17025
  - Member of IECEE CB Scheme
  - Member of national and international standardisation committees (IEC/CLC TC82, TC64)
  - First Solar accepted testing lab

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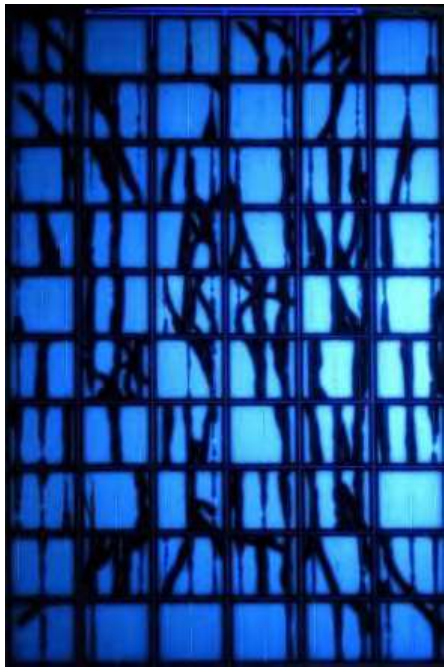
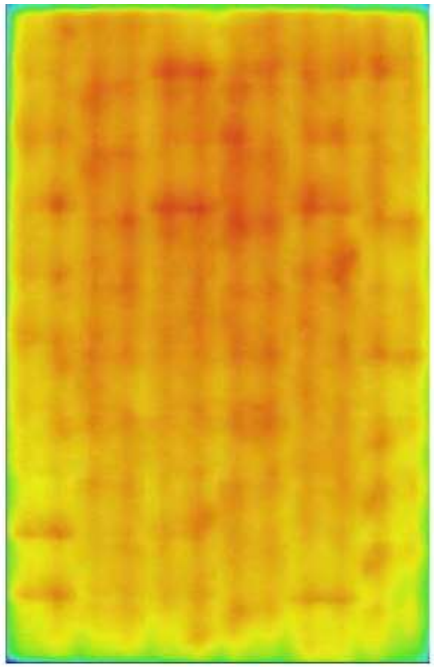
IEC 61215 : 2016	Type approval testing
IEC 61730 : 2016	Safety qualification
IEC 62782 : 2016	Dyn. machanical load testing
IEC 62804 : 2015	PID testing
IEC 62716 : 2013	Ammonia corrosion testing
IEC 61701 : 2011	Salt mist corrosion testing

PV MODULE SPECIAL INVESTIGATIONS

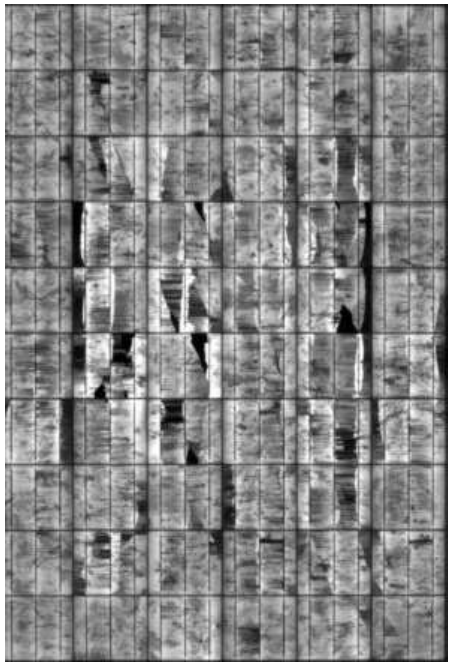
- Development and application of advanced characterization methods



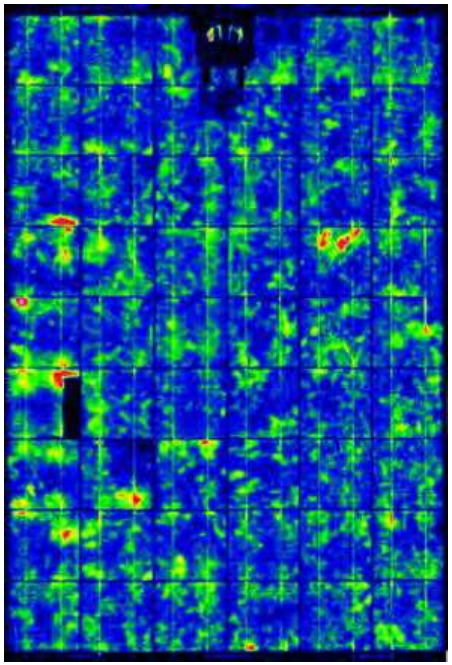
UV-Fluorescence



Thermography



Electroluminescence



Lock-in Thermography

STORAGE PROCUREMENT AND ACCEPTANCE TESTING

- **Technical System Specification**
  - Necessary functional requirements to provide the specified functionalities
  - Operational parameters and requirements, taking into account all relevant system variables
  - Specifications concerning safety aspects and system operation reliability aspects

- **Acceptance Testing**
  - Factory acceptance testing and witness of single components and the complete system using calibrate measurement equipment
  - Comprehensive laboratory assessment of performance, aging, safety aspects and environmental influences
  - Commissioning witness testing for the validation of the functionality of the system installed in the field

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OPTIMIZATION OF PV POWER PLANTS

planning, implementation, operation & maintenance

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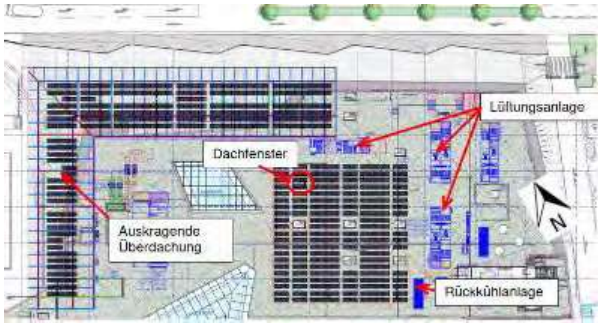
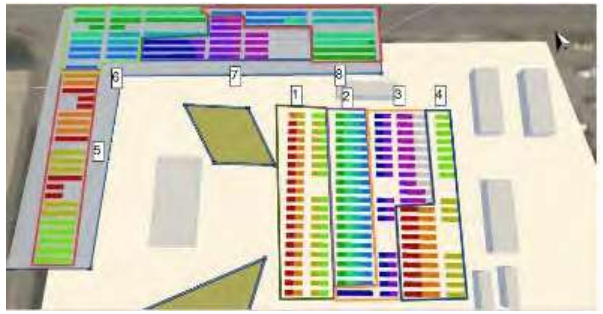
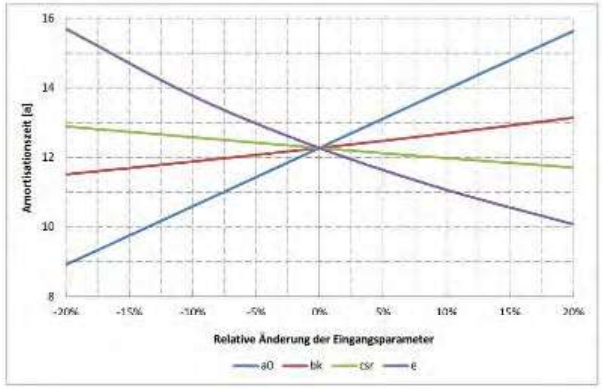
TECHNICAL AND ECONOMICAL FEASIBILITY

- Technical feasibility
  - Define general structural conditions
  - Electrical requirements
  - Predesign of PV-System
- Economical feasibility
  - Assessment of PV-yield
  - Assessments of Costs (CAPEX, OPEX)
  - Sensitivity analysis







OPTIMIZATION OF PV POWER PLANTS

- planning, implementation, operation & maintenance

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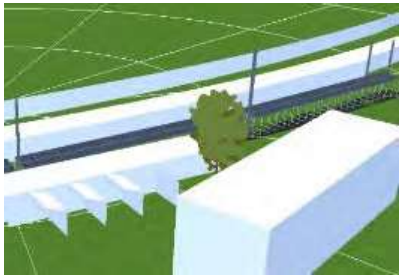
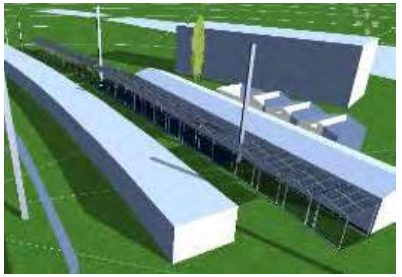
TECHNICAL AND ECONOMICAL FEASIBILITY

Example data



	PV foil /adhesive Module	Roof top mounting S,30°	Glass-Glass integrated	Folded plates
PV power [kWp]	40	30	70	70
# Modules	00	00	00	00
PV yield [kWh]	30.000	30.000	60.000	60.000
Reduction of yield due to shading [%]	7,2	14,5	13,6	15,6
Avoided CO_2-Emissions [kg/Jahr]	15.000	15.000	15.000	15.000
Spec. CAPEX [€/kWp]	1	1	1	1
CAPEX [€]	10	10	10	10
Moduletype	DAS Energy 280W	Kioto Solar 290 W	Jinko Bifacial 370	Jinko Bifacial 370

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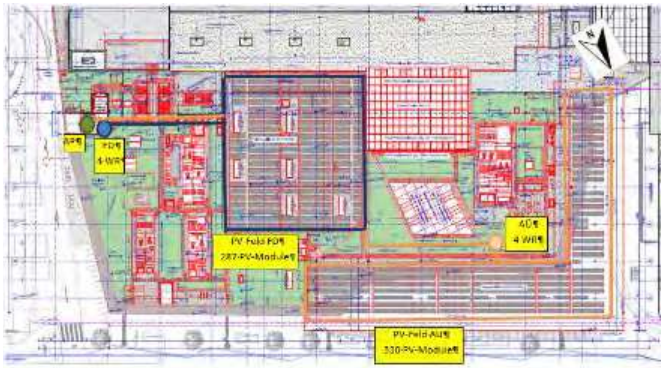
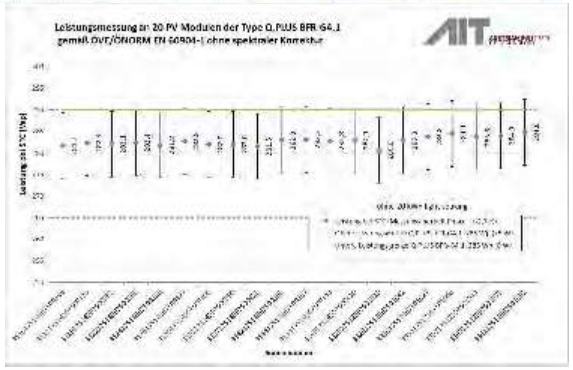
SUPPORT FOR TENDERS

- Preparing tender documents including:
  - General conditions (Object, time frame, formalities)
  - Technical Spec´s (Standards, PV-parts, Cables, Monitoring)
  - EPC (Approvals, safty, environment, documentation)
  - Quality assurance
  - Commissioning and take-over
  - Warranties
  - Penalties
  - Payment
  - Funding





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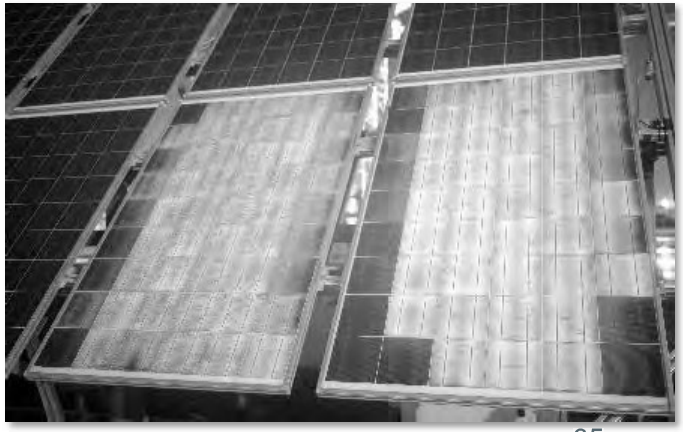
SITE INSPECTION

- Investigations in correlation with relevant standards (IEC 62446, IEC 61215)
- Assessment of PV modules, mounting structures, cabling, civil works, monitoring, O&M
- Independent technical advise; TDD for bankable reports
- Validation in accordance with terms of warranty agreements



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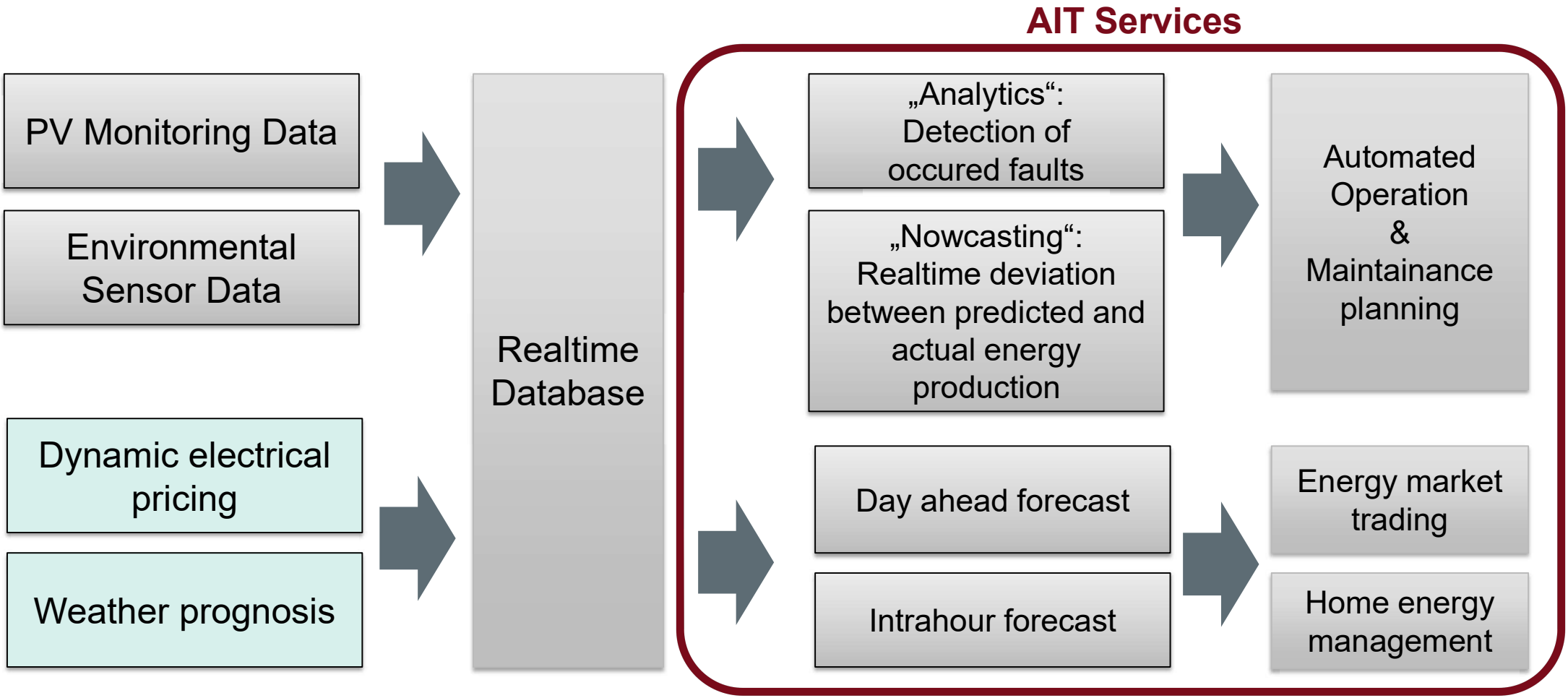
AUTOMATED DATA ANALYSIS OF PV PLANT PERFORMANCE



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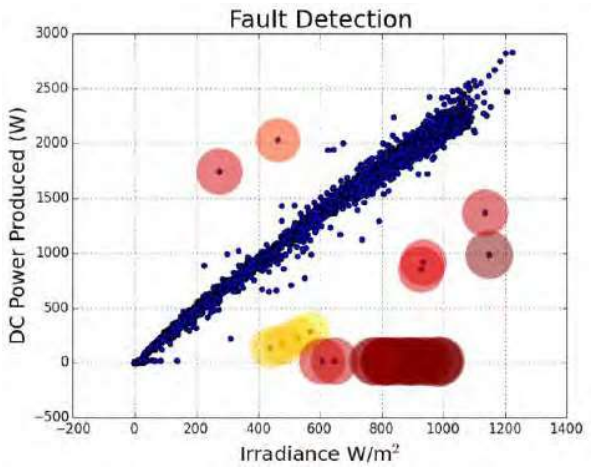
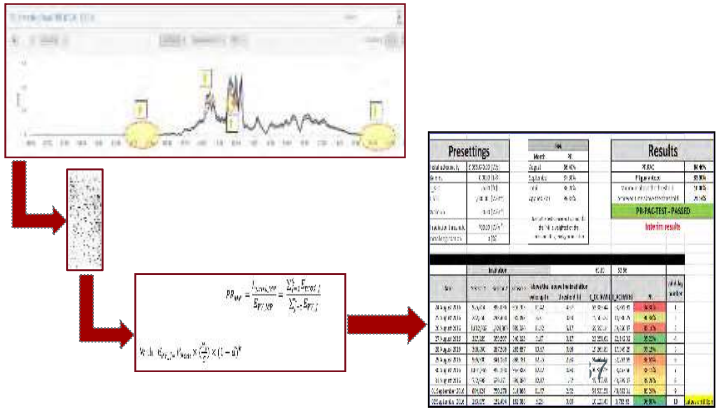
PV PLANT PERFORMANCE: AUTOMATED DATA ANALYSIS

- Effective algorithms for failure detection in PV systems
- Systematic analysis of failure patterns and assessment of their probability (e.g. PID, shading, bypass diodes, soiling, snow coverage)
- Automatic detection of individual failures based on available monitoring data.
- Impact of sensoring devices and systems
- Assessment of performance ratio





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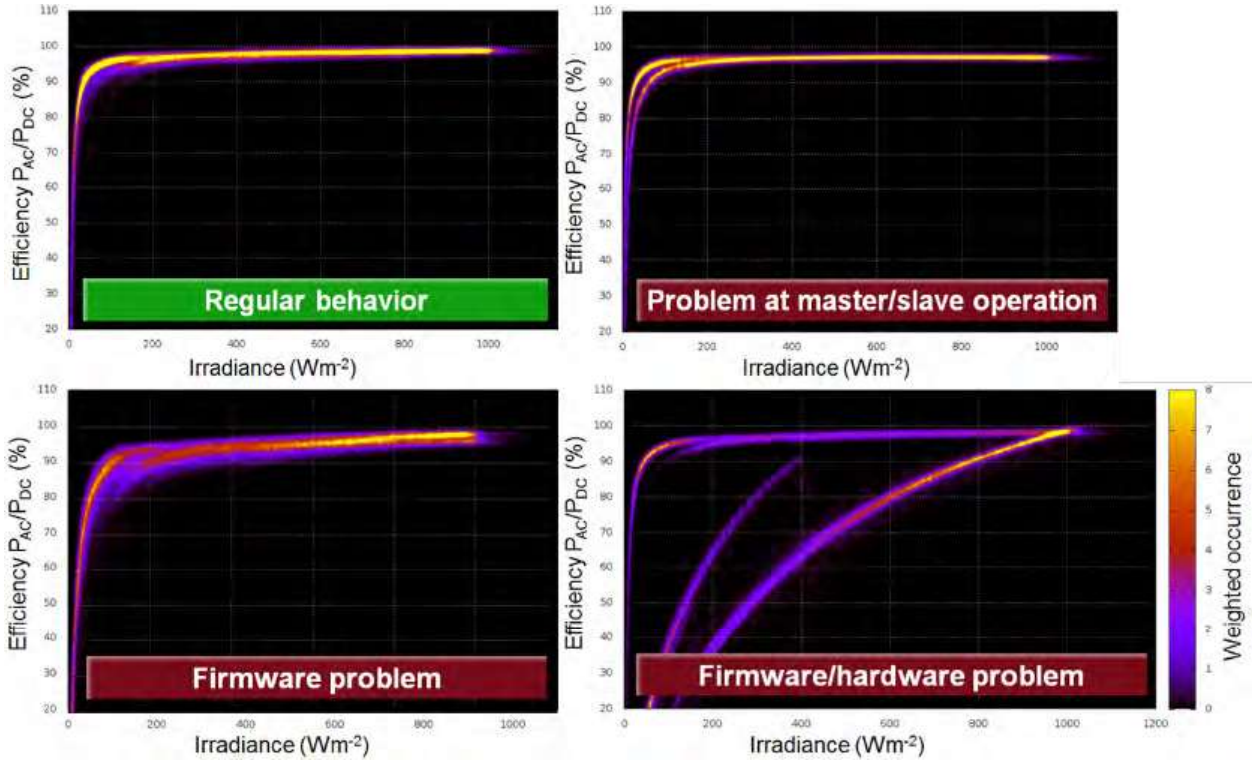
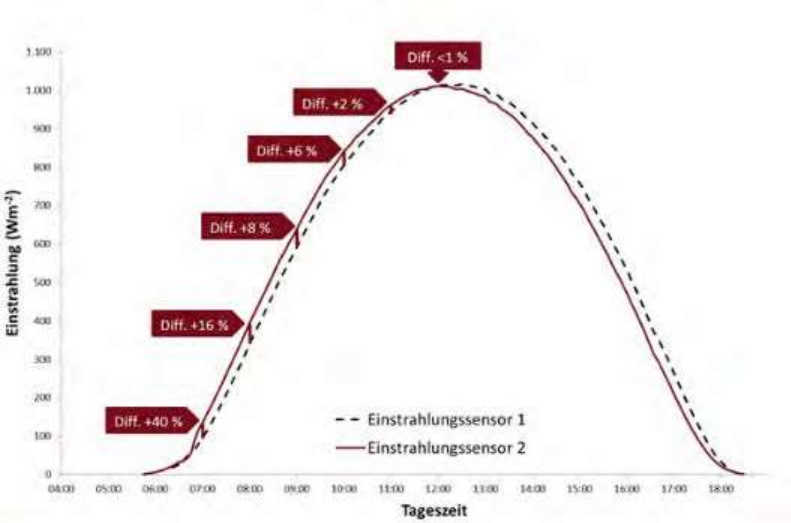
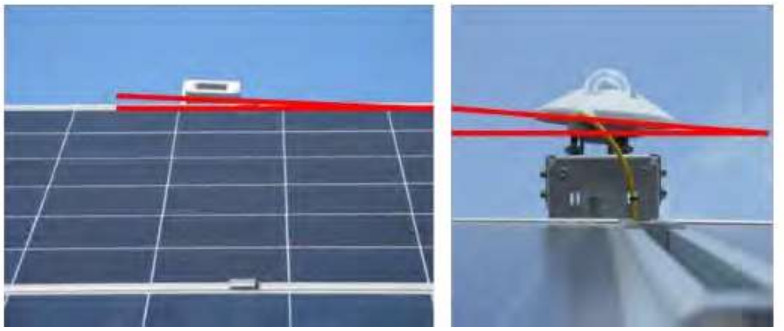
PV PLANT PERFORMANCE: AUTOMATED DATA ANALYSIS

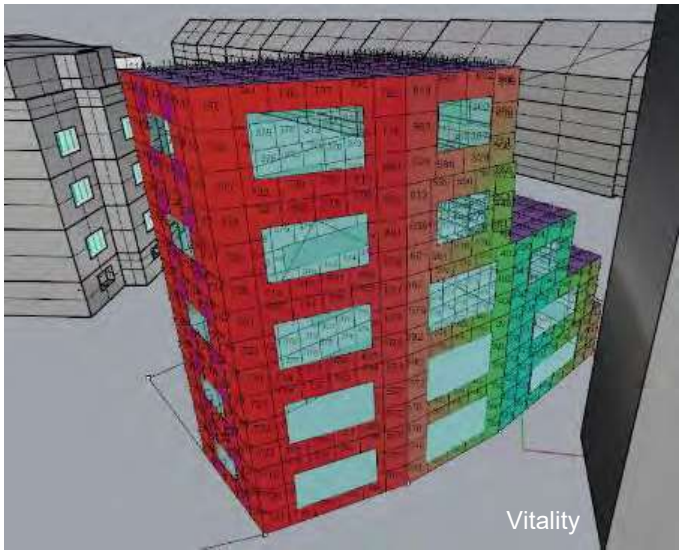






R&D PROJECTS

- Research and development of new design, construction, materials and circuitry for building-integrated photovoltaic solutions
- Analysis of long-term reliability and efficiency of PV components for the use in the built environment
- Creating synergies between photovoltaics and architecture



R&D PROJECTS

- Analysis of intelligent traffic guidance systems (VBA) with a photovoltaic power plant
- Energy profiling and optimization potential of loads
- Modelling of energy-autarkic concepts
- Development of simulation tool
- Adaptation of the first pilot project

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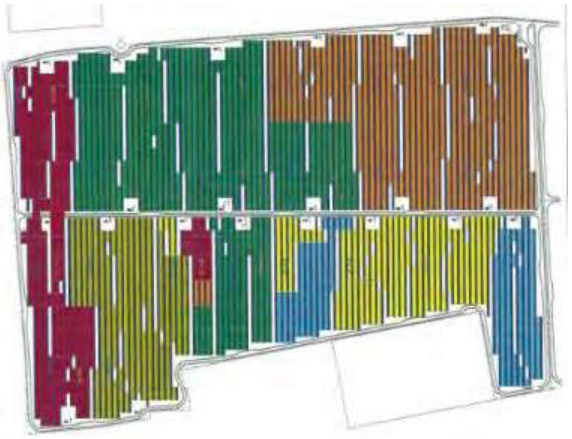
REFERENCES IN PV POWER PLANT ASSESSMENT

- Experience based on more than 500 MWp power plant assessment
- References - Cumulative installed capacity in countries

500 MWp	2 MWp	6 MWp	1 MWp	8 MWp	22 MWp	2 MWp	22 MWp
Eastern Europe	Austria	Germany	Slovenia	Italy	Belarus	Bulgaria	Greece

46 MWp	1 MWp	10 MWp
UK	Kenia	Iran



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