

IEA PVPS Task 15 Bauwerkintegrierte Photovoltaik – Highlights und Ergebnisse der ersten Projektphase

IEA-Vernetzungstreffen 2018

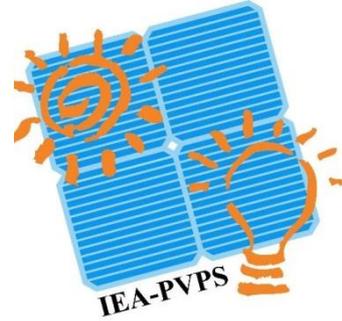
Wien, 10.10.2018

Peter ILLICH, FH Technikum Wien



Dieses Projekt wird aus Mitteln des Bundesministerium für Verkehr, Innovation und Technologie und des Klima und Energiefonds gefördert.



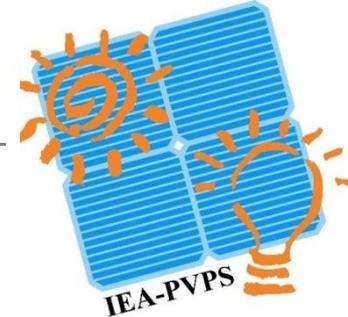


Ausgangssituation und Motivation

- **Gebäudesektor:**
 - etwa 30% des weltweiten Endenergieverbrauches
 - mehr als 55% des weltweiten Strombedarfes
(Energy Technology Perspectives, IEA, 2017)

- **100% Strom aus erneuerbaren Energien bis 2030**
 - Dafür sind etwa 15 GWp Photovoltaik erforderlich (derzeit ca. 1,3 GWp)
 - Optimale Integration von PV im Energiesystem und in Gebäude / Bauwerke
→ **Bauwerkintegrierte Photovoltaik – BIPV**

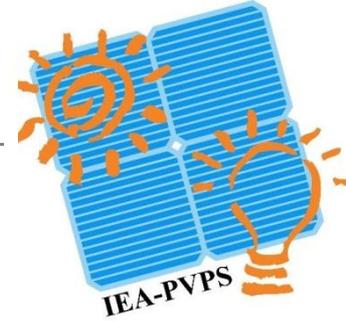
- **Wesentliche Vorteile von BIPV:**
 - Lokale, verbrauchernahe Energieerzeugung
 - Doppelnutzung bereits versiegelter bebauter Flächen
 - Kosteneffizienz und geringerer Materialverbrauch, Ressourcenschonung
 - Architektonische Qualität (Funktionalität, Akzeptanz, Ästhetik)
 - Wesentlicher Beitrag zu Klimazielen



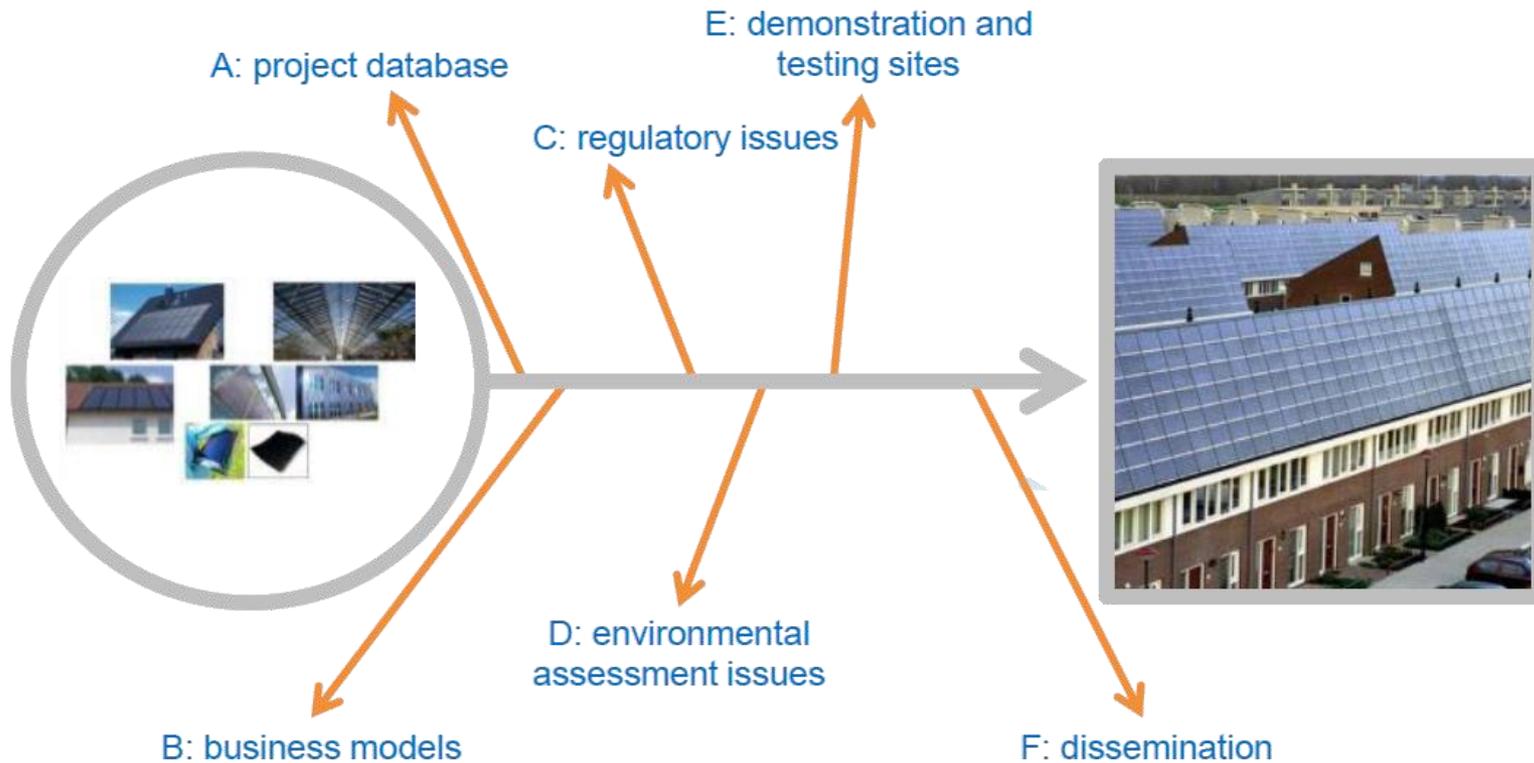
IEA PVPS Task 15 – Bauwerkintegrierte Photovoltaik

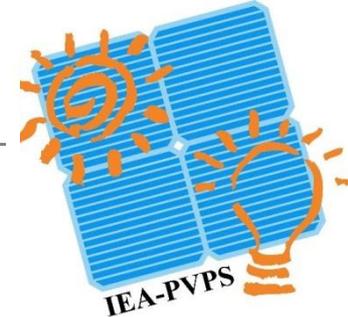
“Enabling Framework for the Acceleration of BIPV”

- Ziel: Beschleunigung der Marktintegration von BIPV
- **Umfassende Betrachtung des Themas BIPV:**
 - Technologie / R&D
 - Rechtlicher Rahmen / Standardisierung
 - Ökonomie
 - Ökologie
 - Ästhetik
- 16 beteiligte Länder, mehr als 40 ExpertInnen



Projektstruktur – IEA PVPS Task 15

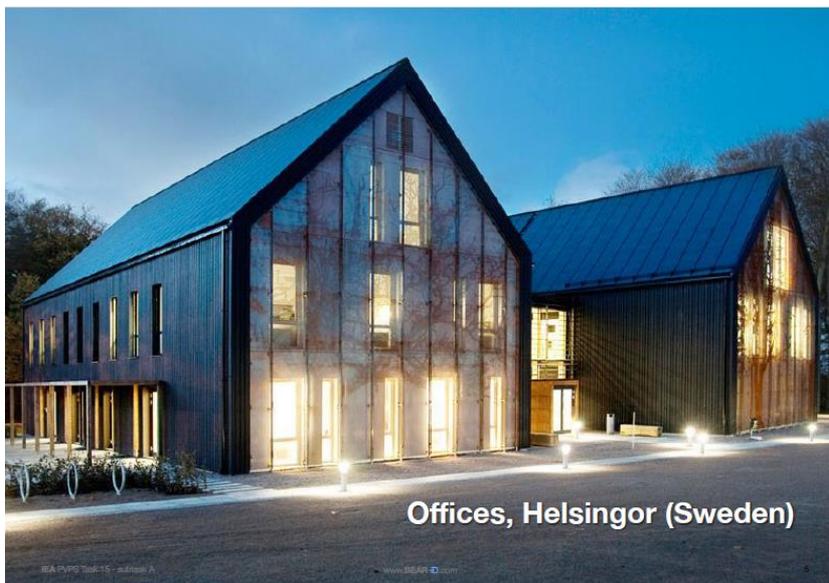




Subtask A – Projekt Database

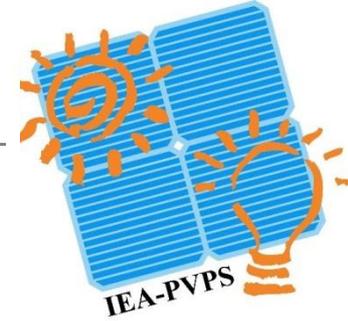
Projektdatenbank an internationalen BIPV Vorzeigeprojekten

- Vorauswahl von nationalen Best Practice Projekten anhand von Anwendungsfällen
 - 10 nationale Beispielprojekte
- Detaildarstellung von 3 nationalen Projekten innerhalb ST-A, ST-B und ST-D
 - Fronius Gebäude Wels, EnergyBase Wien, BIPV Mehrfamilienhaus Innsbruck
- Buchpublikation mit nationalen und internationalen Beispielprojekten
 - Fronius Gebäude Wels, EnergyBase Wien (Buchpublikation)



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Residential Buildings	00		
Youth housing, Slagelse (DK)	00		
Single family house, Lasa, Bolzano (IT)	00		
Single family house, Ullstraten (NL)	00		
Skarpenes Village, Arendal (NO)	00		
Frodeparken, Uppsala (SE)	00		
Hofwieserstraße, Zürich (CH)	00		
Public buildings	00		
CREA Metropolitan Rouen (FR)	00		
J&P Loughheed Arts Centre, Camrose (CA)	00		
Harbourfront Centre Theater, Toronto (CA)	00		
Environmental Institute Brussels (BE)	00		
International school, Copenhagen (DK)	00		
Songdo Global Campus, Seoul (KR)	00		
		Commercial buildings	00
		Fronius office, Wels (AT)	00
		ENERGYbase office, Vienna (AT)	00
		Aarhus hotel, Aarhus (DK)	00
		CIEMET office building, Madrid (ES)	00
		Bodegas Iturralde, Biscay (ES)	00
		San Anton Market, Madrid (ES)	00
		Enzian tower, Bozen (IT)	00
		KIRIN Brewery, Yokohama (JA)	00
		Hulic Ogikubo office, Tokyo (JA)	00
		Solar offices, Zuhuai (CN)	00
		Solsmaragden offices, Oslo (NO)	00
		Vala Gard office, Helsingborg (SE)	00
		SIE SA office renovation, Crissie (CH)	00
		Solar Silo, Bern (CH)	00
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Subtask B – BIPV Business Models

BIPV Geschäftsmodelle

- Genauere Betrachtung von insgesamt 10 verschiedenen Case Studies
- Detailbetrachtung eines österreichischen Beispielprojektes
- Internationaler Bericht publiziert



2.8 Multifamily residential building, Austria

The building is a private multifamily building from the beginning of the 20th century in the city of Innsbruck, Austria. The roof integrated PV plant of 5 kWp was installed by Becker ATB PHOTOVOLTAIC GmbH for the house owner in 2013. The main drive for this installation was to produce green electricity for self-consumption with a lower price than public electricity prices for households.

Note: This was an early installation. The aesthetic requirement of future BIPV solutions are considered to be higher.

Facts and figures

Type of installation

Roof

Building type

Residential

Year of installation

2013

Size

Area: 33 m²

Installed power: 5 kWp

Product dimensions: 1,66 m²
(1,68 x 0,99 m)

Incentives for PV or BIPV

20 % from Austrian Climate and Energy Fund

Investment cost

10 000 € (300 €/m²).

After subsidy 8 000 € (240 €/m²).

Cost comparison

N/A

Electricity production

5 000 kWh/year

Level of self-sufficiency

34 % of total electricity consumption
(one household)

Level of self-consumption

24 % of produced PV electricity is self-consumed

Electricity revenues

Self-consumption: 0.12 €/kWh

Feed-in electricity: 0.09 €/kWh

IEA INTERNATIONAL ENERGY AGENCY



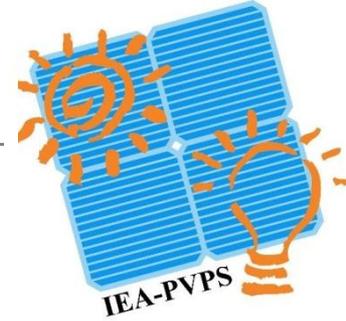
Transition towards Sound BIPV Business Models



PVPS

PHOTOVOLTAIC POWER SYSTEMS PROGRAMME

Report IEA-PVPS T15-03: 2018



Subtask C – Regulatory Issues with BIPV

Normen und Standards

- Begriffsdefinition BIPV lt. EN 50583, Identifikation von Begriffskonflikten und Handlungsbedarf
- Erfassung der existierenden regulatorischen Rahmenbedingungen
- Harmonisierungsvorschläge der Standardisierung mit Rücksicht auf gesetzliche Rahmenbedingungen
- Beitrag zu internationalen Normierungsaktivitäten (IEC/TC 82, Projektteam 63092)

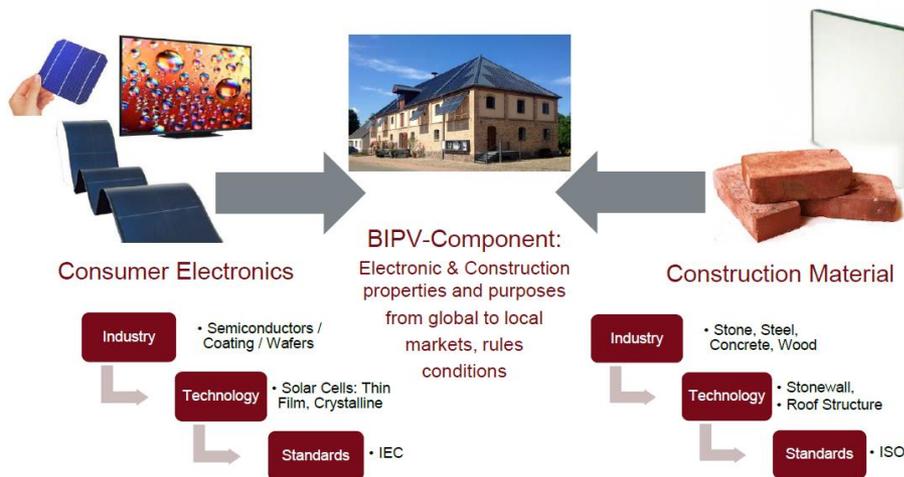
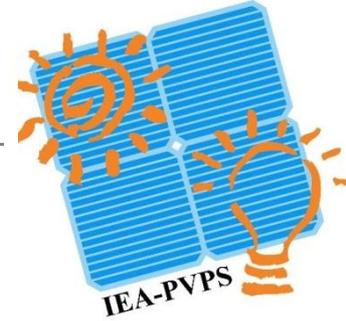


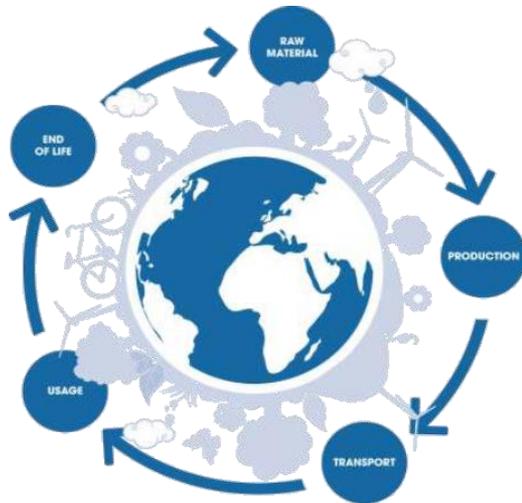
Foto: FH Technikum Wien: IEC/TC82 Meeting mit Task 15 in Wien



Subtask D – Environmental Assessment of BIPV

Nachhaltigkeit, Umweltauswirkung von BIPV

- Zusammenführung der PV- und gebäudespezifischen Nachhaltigkeitsanalysen
- Entwicklung von Methoden zur Nachhaltigkeitsbewertung der BIPV
- Anwendung der Methodik auf Beispielprojekte
- Zusammenarbeit mit IEA PVPS Task 12 und Task 13



→ Entwicklung einer Methodologie für die Entwicklung von BIPV Life Cycle Assessments

→ Durchführung von Life Cycle Assessments ausgewählter Beispielprojekte





Subtask E – Demonstration and Test Sites

Forschung und Entwicklung zur Demonstration

- **Screening internationaler F&E-Tätigkeiten**
 - Internationaler Bericht mit maßgeblicher österreichischer Beteiligung publiziert

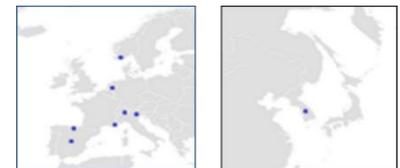
2 nationale Schwerpunkte, Leitung durch österr. Konsortium:

- **Farbgebung von BIPV Modulen/Zellen – “Ästhetik versus Effizienz”**
 - Internationaler Bericht derzeit in Ausarbeitung (internat. Koordinierung durch OFI, Österreich)

- **Internationaler Ringversuch mit 9 Partnerinstitutionen (internat. Koordinierung durch FH Technikum Wien)**
 - Vergleich von Messungen an Außentestständen
 - Leistungs- und Degradationsverhalten in:
 - » Laborumgebung, beschleunigte Alterung (AIT/OFI)
 - » Outdoor Test Sites (9 international Institutionen)
 - » Referenzgebäude (Power Tower Linz)



Foto: Teststand, SEAC, Holland



Teilnehmerländer an Ringversuch

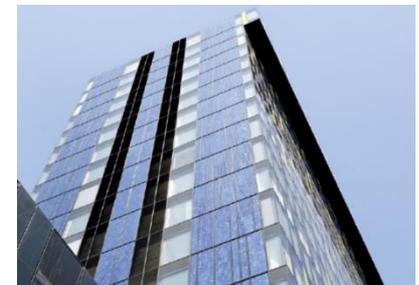
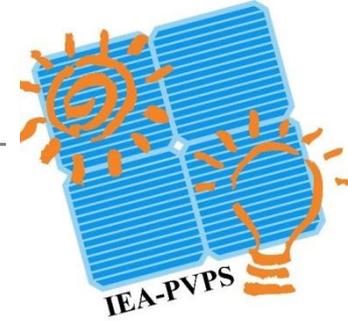
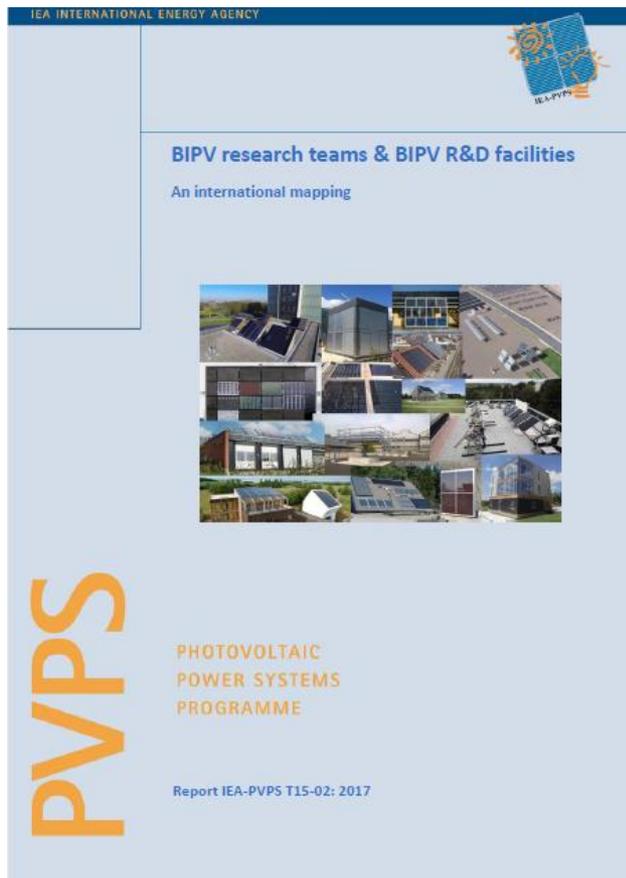


Foto: FH Technikum Wien: Power Tower Linz



Subtask E – Demonstration and Test Sites

Forschung und Entwicklung zur Demonstration – Berichtpublikation



INTERNATIONAL ENERGY AGENCY
PHOTOVOLTAIC POWER SYSTEMS PROGRAMME

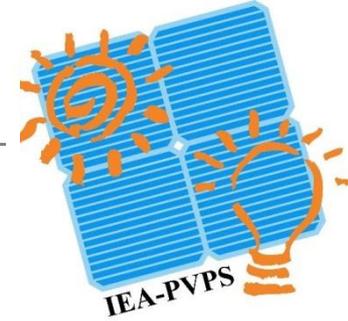
BIPV research teams & BIPV R&D facilities An international mapping

IEA PVPS Task 15, Subtask E
Report IEA-PVPS T15-02: 2017
November 2017

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ISBN 978-9-906042-65-7



Subtask E – Demonstration and Test Sites

Forschung und Entwicklung zur Demonstration – EUPVSEC Publikation



COMPARATIVE PERFORMANCE MEASUREMENTS OF IDENTICAL BIPV ELEMENTS IN DIFFERENT CLIMATIC ENVIRONMENTS – A ROUND ROBIN ACTION OF IEA PVPS TASK 15

Peter Illich¹, Gabriele C. Eder², Karl A. Berger³, Újvári Gusztáv³, Philipp Rechberger⁴, Dieter Moor⁵, Martin Aichinger⁵, Roland Valckenborg⁷, Jochem van den Brand⁷, Pierluigi Bonomo⁸, Francesco Frontini⁸, Cristina S. Polo López⁸, Matteo del Buono⁹, Anne Gerd Innesen¹⁰, Nuria Martín Chivelet¹¹, Faustino Chenlo¹¹, Asier Sanz Martínez¹², Maider Machado¹², Jun-Tae Kim¹³, Alex Masolin¹⁴, Michiel Ritzen¹⁴

COMPARATIVE PERFORMANCE MEASUREMENTS OF IDENTICAL BIPV-ELEMENTS IN DIFFERENT CLIMATIC ENVIRONMENTS – A ROUND ROBIN ACTION WITHIN THE IEA PVPS TASK 15 COLLABORATION

Peter Illich¹, Gabriele C. Eder², Karl A. Berger³, Újvári Gusztáv³, Philipp Rechberger⁴, Dieter Moor⁵, Martin Aichinger⁵, Simon Boddard⁶, Roland Valckenborg⁷, Jochem van den Brand⁷, Pierluigi Bonomo⁸, Francesco Frontini⁸, Cristina S. Polo López⁸, Matteo del Buono⁹, Anne Gerd Innesen¹⁰, Nuria Martín Chivelet¹¹, Faustino Chenlo¹¹, Asier Sanz Martínez¹², Maider Machado¹², Jun-Tae Kim¹³, Alex Masolin¹⁴, Michiel Ritzen¹⁴

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²OFI, Austrian Research Institute for Chemistry and Technology, Austria

³AIT, Austrian Institute of Technology GmbH, Austria

⁴University of Applied Sciences Upper Austria, Austria

⁵Ertex Solartechnik GmbH, Austria

⁶CSTB, Centre Scientifique et Technique du Bâtiment, France

⁷SEAC, Solar Energy Application Centre, Netherlands

⁸SUPSI, University of Applied Sciences and Arts of Southern Switzerland, Switzerland

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IEA PVPS Task 15 - BIPV

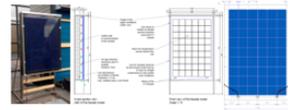
The IEA-PVPS Task 15 focuses on international networking and joint research in the area of BIPV and is subdivided into 3 sub-working groups. Within Task 15, a group of over 60 experts from 16 different countries collaborate to create an Enabling Framework for the Acceleration of Building Integrated Photovoltaics (BIPV). As part of this collaboration, a joint action was initiated to compare available outdoor test facilities in a "Round Robin" test.

Design of Experiment

"Round robin": This experiment will allow to directly compare the performance and energy yield of identical and commercially available glass/glass BIPV elements installed and monitored under well-defined conditions in different environments in outdoor test facilities.

Monitoring method and the constructive boundaries for the test stands are accorded by all participants.

→ the direct influence of the environmental and climatic conditions on the performance data and yearly yield of the BIPV elements can be concluded



Results obtained in the 3-year monitoring of the identical test-modules at the various outdoor test sites will set in relation to:

- measurement results under STC conditions in the reference lab (i.e. pre-and post-characterization) and the irradiance and temperature matrix of the energy rating standard IEC 61853-2 and the module's spectral response determined according to IEC 61853-2

- monitoring data and reliability results of the BIPV-elements within the reference BIPV building (Power Tower in Linz, Austria – BIPV facade, cold facade, ventilated curtain wall, already in operation for 10 years).

- reliability results obtained in the accelerated ageing tests in the laboratory (climate chambers, Damp-Heat and Irradiation tests).

After shipping, the test modules were installed at the selected test sites using a pre-defined mock-up construction. An accepted monitoring method is used to follow the performance with time.

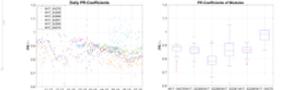
Key Information – Round Robin" Activity

- BIPV modules: identical 54 (3 X 6) cell glass/glass BIPV modules of the type W6G-6, poly-crystalline 60 Wp, solar-technical GmbH, Austria; P: 227 Wp.
- Experiment duration: min. 1 year
- Contributors: 9 participating outdoor test-stands in 7 different countries: France, Netherlands, Spain, Italy, Switzerland, Norway, South Korea and Austria as coordinator, reference laboratory and reference BIPV Building

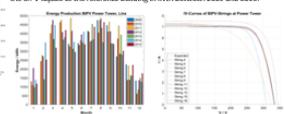


Preliminary Results

First monitoring data of the test modules at the outdoor facilities: up to date monitoring data of 4 modules were used for the first analysis. The performance ratios (PR) of the modules lie mainly between 1 and 0.75 and show differences with time of the year and installation site. The data of module M17/04775 seems to be affected by some measuring error, requiring further analysis.



Monitoring data of the reference building: the monthly energy production of the BIPV facade at the reference building in kWh between 2009 and 2015:

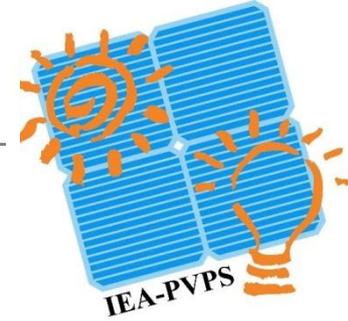


In August 2018 an on-site visit was made, where detailed thermographic imaging (IR) as well as IV curve measurements of all individual strings were performed (most strings were fully intact; some showed issues with diode defects and connection problems).

Next Steps

- Contribution of monitoring at test sites.
- Analysis of real life reliability data and accelerated ageing test results.
- Comparison to performance of reference building.
- Reporting of test results within IEA PVPS Task 15.

The work was supported by the IEA PVPS Task 15 "Enabling Framework for the Acceleration of BIPV" and the national Austrian funding of the projects no. 853256 and no. 853259, funded by the Federal Ministry for Transport, Innovation and Technology.

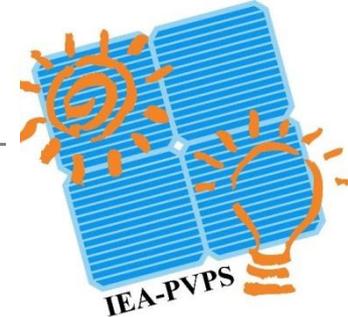


Subtask F – Disseminierung

Weitere Highlights der Disseminierung

- Allgemeine Disseminierung durch IEA, einzelne Subtasks und nationale Berichte
- **Onlinelehrmaterial** zu BIPV in Kooperation mit e-Genius (www.e-genius.at)
- Unterstützung des **technischen Museums Wien** zum Thema BIPV
- Synergien zu weiteren Projekten der **TPPV Mitglieder** (PV4residents, Infinity, smart(D)ER, Vorzeigeregion – Anträge, etc.)
- Zusammenarbeit mit TPPV beim 1. Österreichischen **BIPV Award**
- Internationales Task 15 Meeting in Österreich, 13. – 15. Juni 2018, Wien (Einbindung von smartDER und DEM4BIPV)
- Weitergabe des Wissens in der **Lehre** an Studenten und mittels Workshops bei diversen Forschungsprojekten
- Workshop im Rahmen des 8. österr. PV-Kongresses in Wien
- Disseminierung bei **nationalen und internat. Konferenzen** (PV-Tagung, SESWA, EUPVSEC, PV Symposium Staffelstein, etc.)





Zusammenfassung und Ausblick

- Zusammenfassung wichtiger nationaler Akteure im Bereich BIPV bildet eine **starke Basis für den erfolgreichen internationalen Projektverlauf**
- Mit der Österreichischen Projektbeteiligung wird die heimische **BIPV Szene national und international optimal vernetzt**
- Regulatorische Rahmenbedingungen werden durch Mitwirken nationaler Akteure im internationalen Kontext weiterentwickelt und **Handlungsempfehlungen für verschiedene Stakeholder** ausgearbeitet
- Die weitere Analyse hinsichtlich der Produktvielfalt von BIPV Elementen und deren Berücksichtigung in Planungsprozessen konnte international als **weiterer F&E-Bedarf identifiziert** werden

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Dieses Projekt wird aus Mitteln des Bundesministerium für Verkehr, Innovation und Technologie und des Klima und Energiefonds gefördert.

