

# Building Integrated Photovoltaics

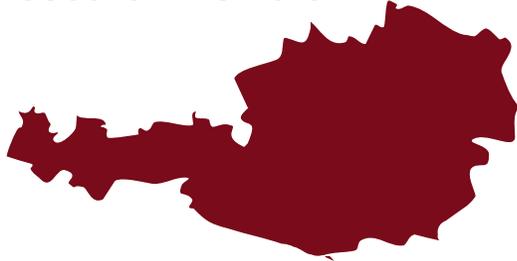
As a major energy source for highly efficient buildings

Astrid Schneider

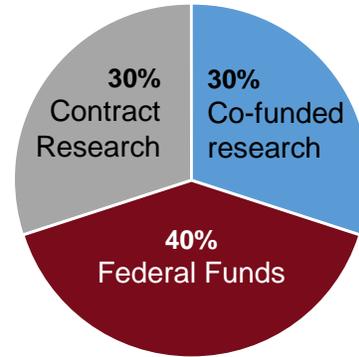
Austrian Institute of Technology

# AIT Austrian Institute of Technology

The AIT is **Austria's** largest non-university research institute



## Funding



AIT focuses on **Infrastructure-Research**



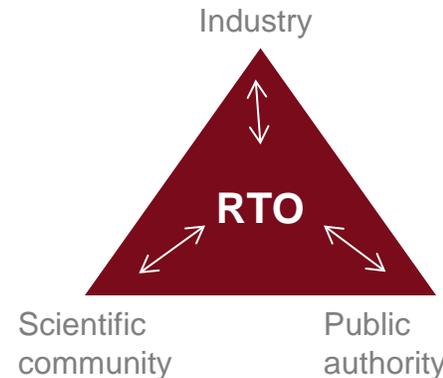
## Ownership structure

**50.46%**

Republic of Austria ( bmvfi )

**49.54%** Federation of Austrian Industries

## Role as a RTO



## Employees

1261

# AIT Energy – Research Fields

Smart Grids



Photovoltaics



Thermal Energy Systems



Smart Cities & Regions



Smart Buildings



Complex Energy Systems



# AIT Energy – Research Fields

## Smart Grids



- Network Planning & Operation
- Smart Grid Controllers & ICT
- Power Electronics & Network Components

## Smart Cities & Regions



- Urban & Regional Energy Strategies
- Energy Concepts for Urban Neighbourhoods

## Photovoltaics



- Performance & Reliability
- Building integrated PV
- Emerging Technologies

## Smart Buildings



- Building Management
- Building Optimization

## Thermal Energy Systems



- District Heating & Cooling
- Energy in Industries
- Renewable Heating & Cooling

## Complex Energy Systems



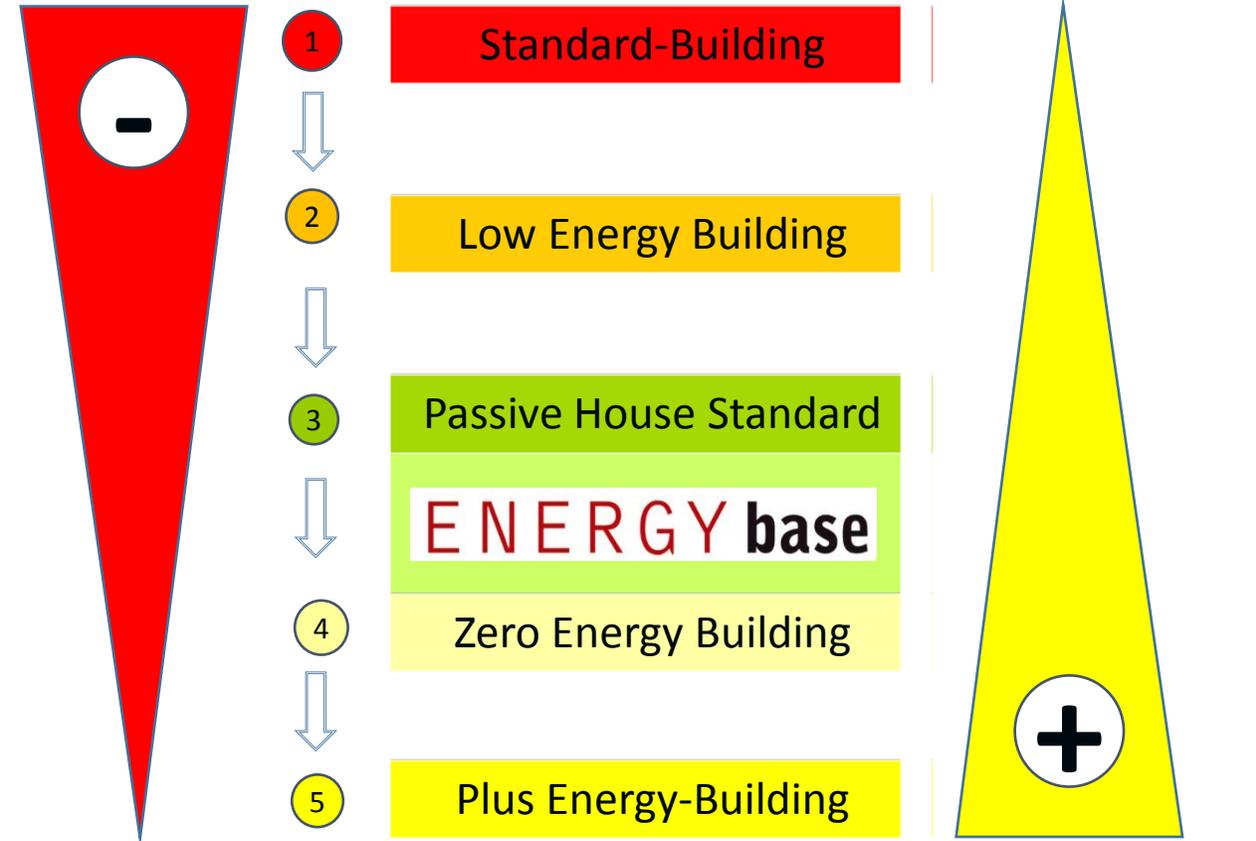
- Modeling & Simulation Cyber-Physical Systems
- High Performance Computing

# AIT Energy – BIPV-Project: ‘Energy Base’-Office Building



Energy Base Solar Façade with BIPV

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



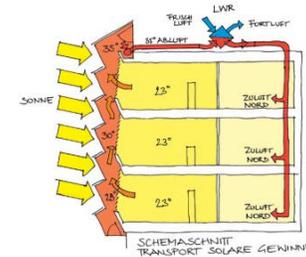
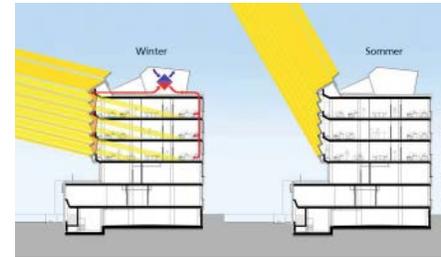
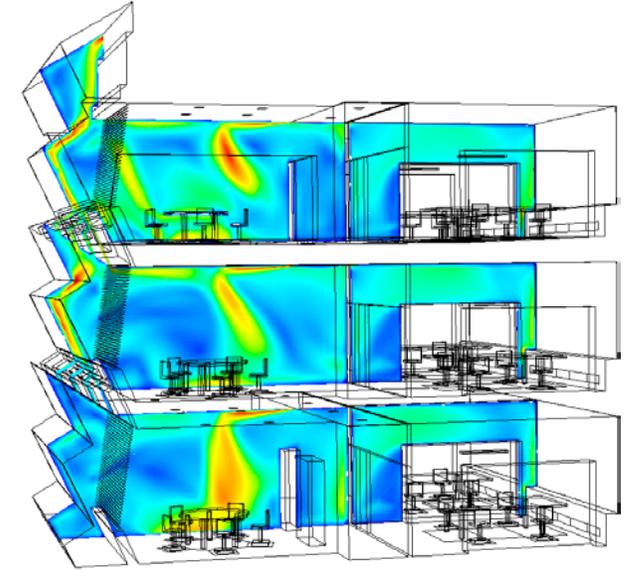
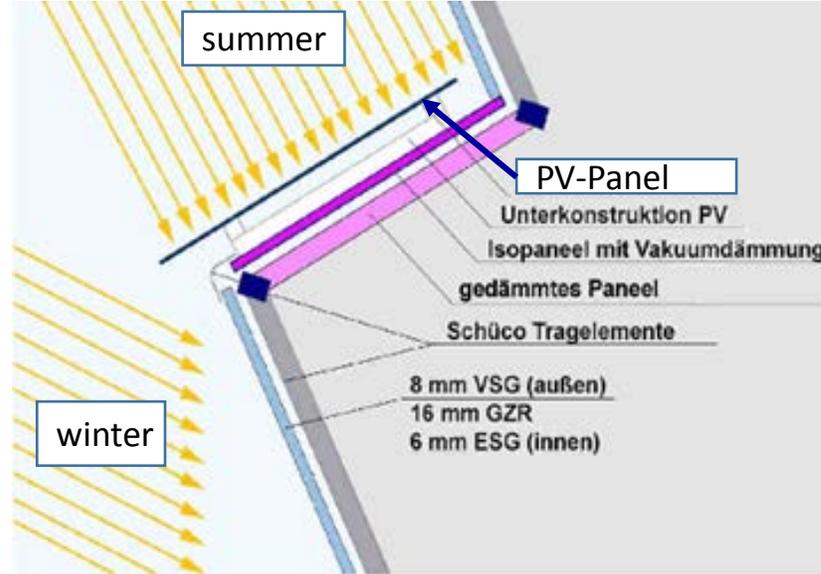
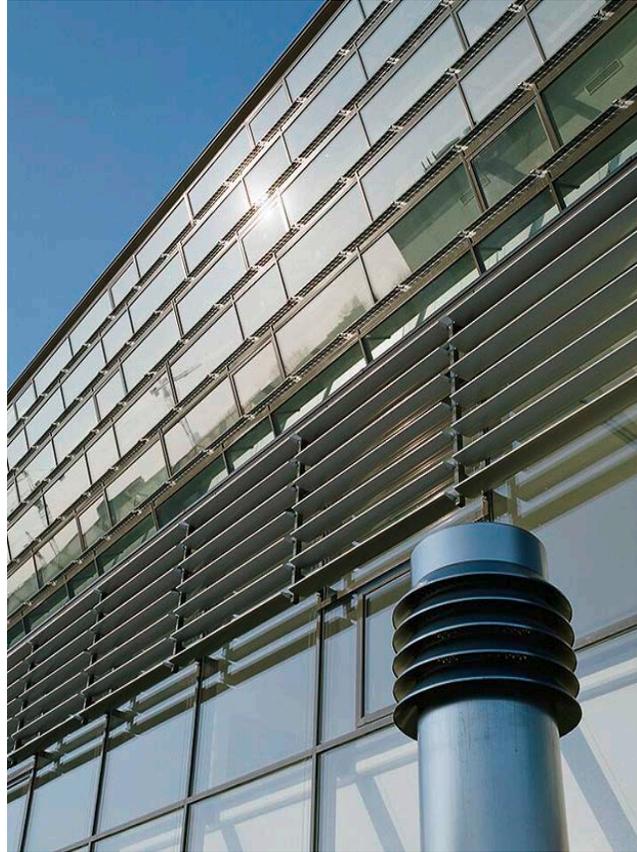
Consumption

Of fossil energy

Building Standard

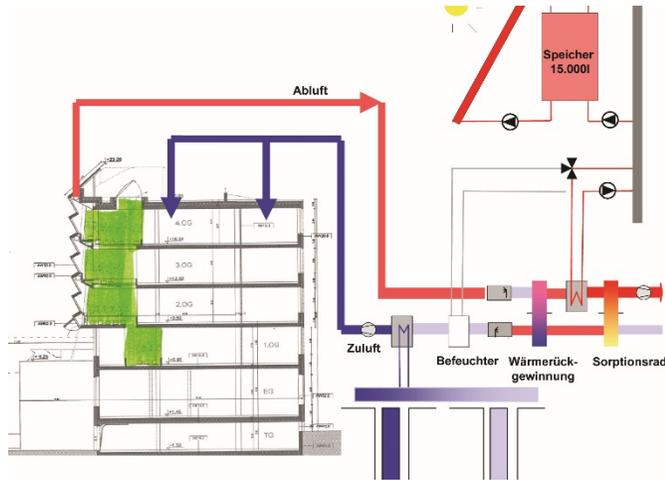
Solar Power (PV)

# AIT Energy – BIPV-Project: 'Energy Base'-Office Building



The folded façade allows efficient shading, optimized daylighting, +30% more Solar PV-Electricity Generation

# AIT Energy – BIPV-Project: ‘Energy Base’-Office Building



## Energy System:

- Photovoltaic system
  - 70% direct self consumption
  - up to 1048 kWh/kWp
- Solar thermal collectors
  - Solar cooling by sorption chilling process
- Heat pumps coupled with ground water

## Energy Balance 2011:

- |  |                 |
|--|-----------------|
| • Photovoltaic electricity generation                                      | 47,171 kWh / a  |
| • <u>Electricity consumption from grid</u>                                 | 104,136 kWh / a |
| • Sum annual electricity consumption for: heating, cooling and ventilation | 151,307 kWh / a |

Total energy consumption -80% compared to standard building: 20 kWh/m<sup>2</sup>a = 151 MWh / 7500 m<sup>2</sup> area

# AIT: 1<sup>st</sup> Price at Solar Decathlon with Team Austria - 2013



LISI | HOUSE OF THE SOLAR  
DECATHLON TEAM AUSTRIA

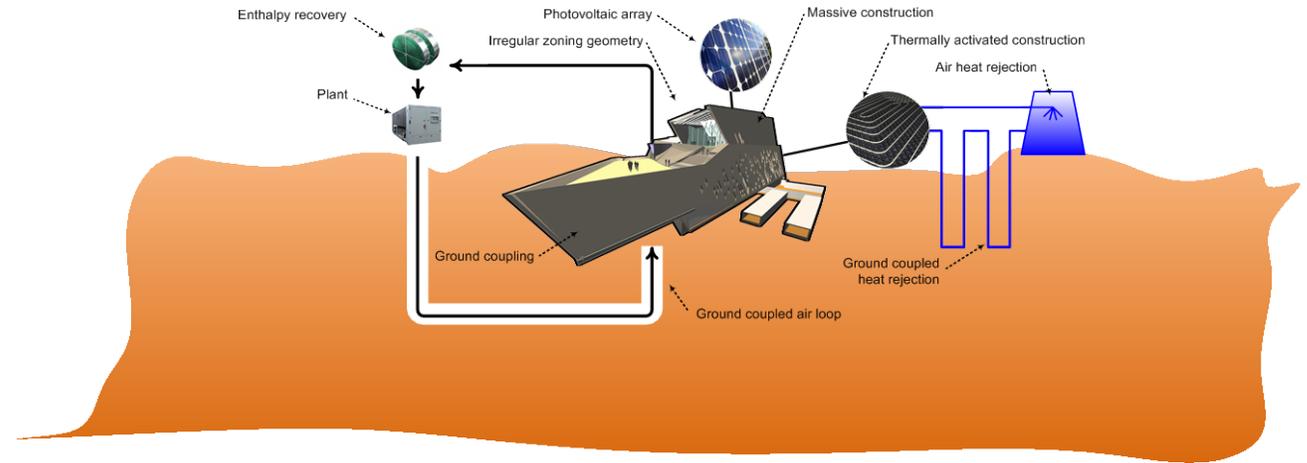


100% Renewable Solar Energy Supply – by Photovoltaics, Heat Pump. Heat Recovery

Together with:

- TU-Wien: Prof. Karin Stieldorf and her students
- FH St. Pölten, Salzburg University of Applied Sciences
- Weissenseer

# AIT Planning Support: Sheikh Zayed Desert Learning Center



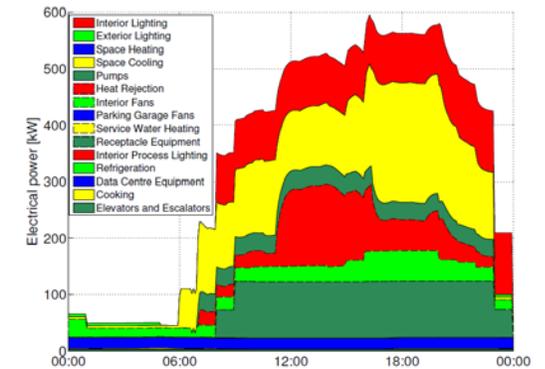
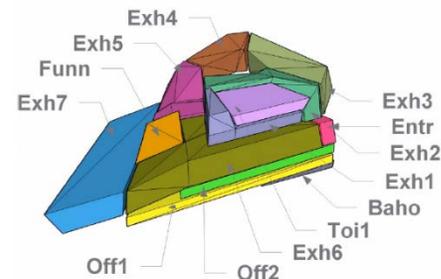
By Chalabi Architects

Simulation of building and of solar driven energy system:

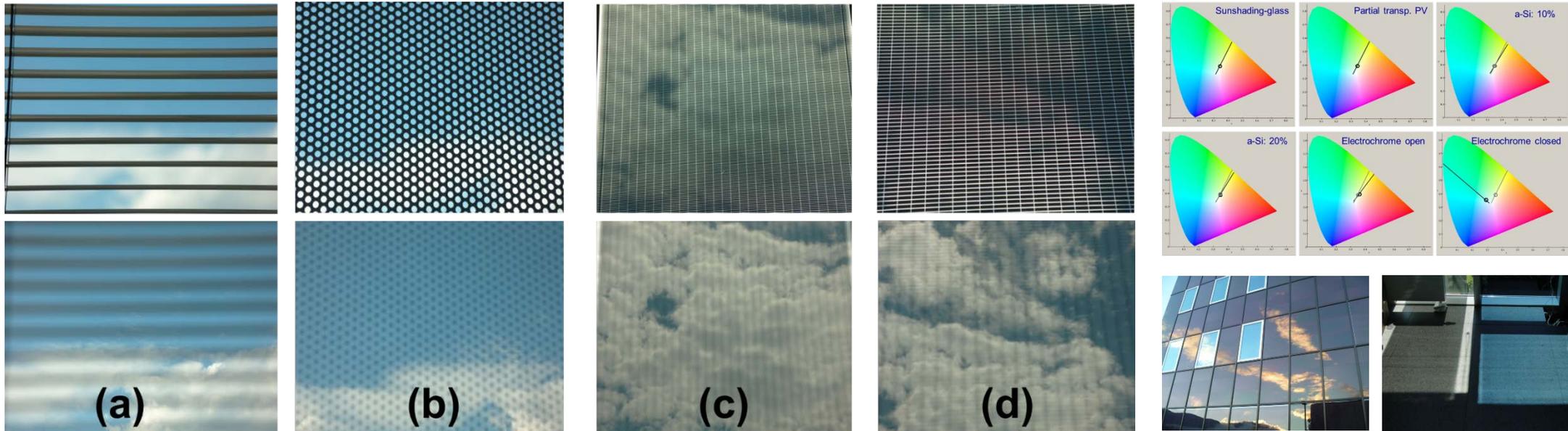
Modeling and Simulation of Solar supply by Photovoltaics and the Energy Demand

- Assessment by simulation 'Baseline' versus 'As Designed'
- Peak Load Analyses

Innovative energy system



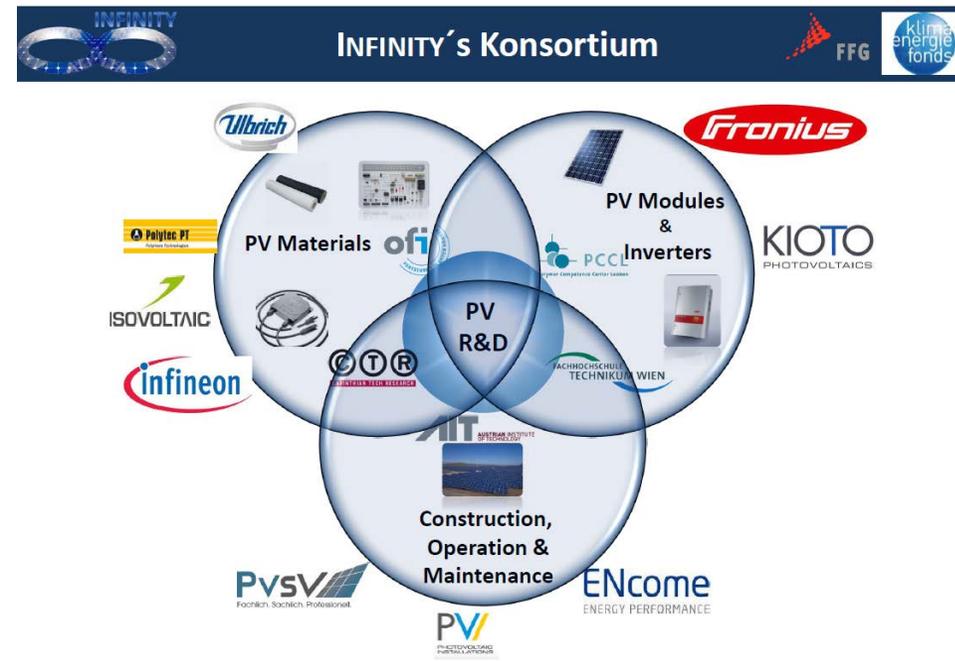
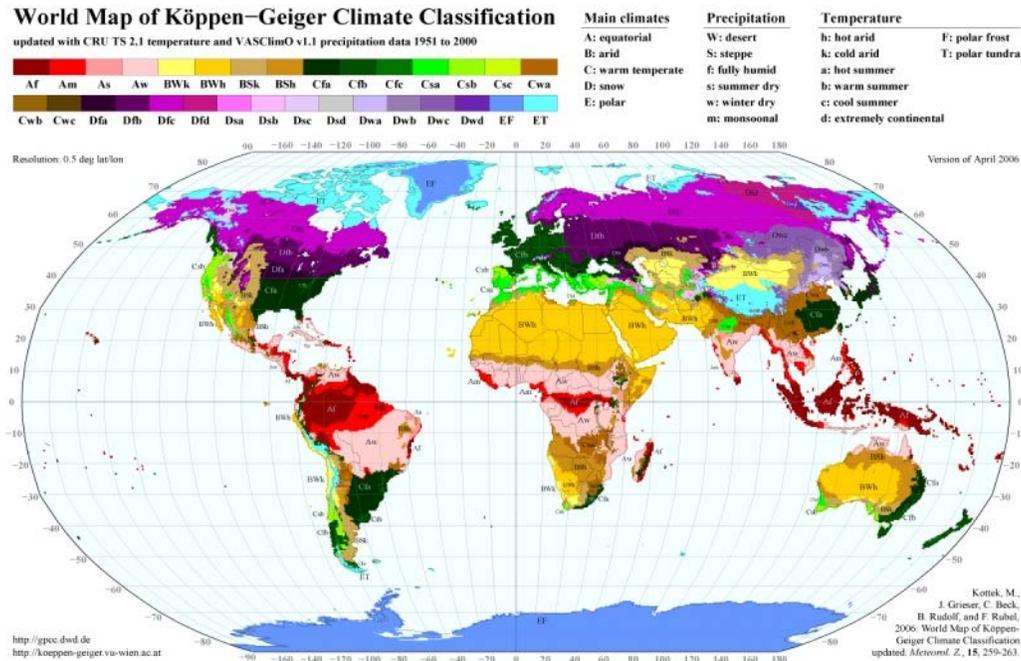
# AIT - Research Project: Optimization Daylighting & Shading



Solar Modules – semitransparent – offer optimal shading and daylighting conditions, better than electrochrome glass, due to better daylight representation (natural spectrum)

Source: AIT mppf-project

# AIT - INFINITY Research Project: Climate Adaptation of PV-Modules



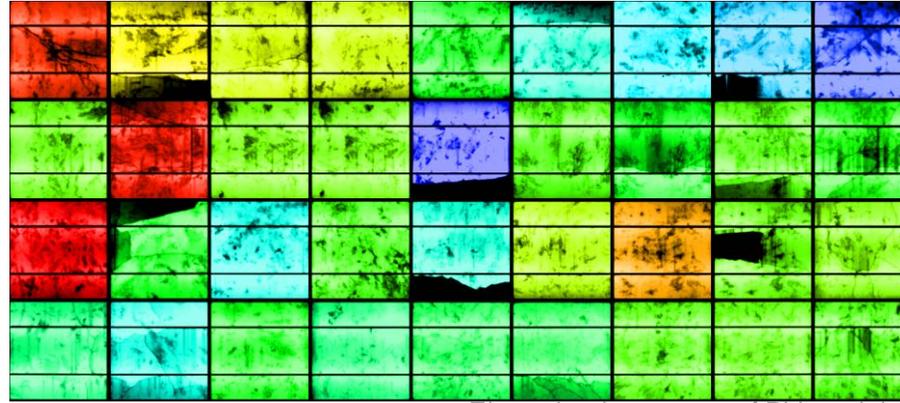
Solar Modules need to be adapted to different climate zones and their specific challenges: snow, heat, humidity, coldness

- AIT and INFINITY Partners develop new standards for reliability testing according to the climate conditions
- Today's testing = in accordance to STC = Standard Test Conditions = 25°C – in hot climates: Solar modules might become much hotter! -> relevance to efficiency and compound
- Mapping of typical defaults under different climate zones

# AIT – Laboratory Infrastructure for Research – Testing & Certification



Thin film PV-laboratory



Electroluminescence of PV module

Optical PV-defect-analysis



Hail test



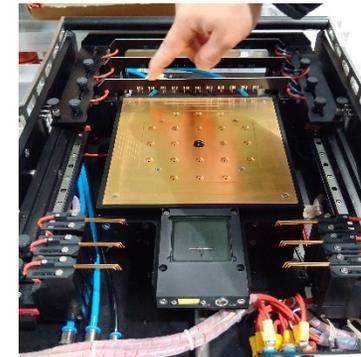
Stat. Sun Simulator 9 m2



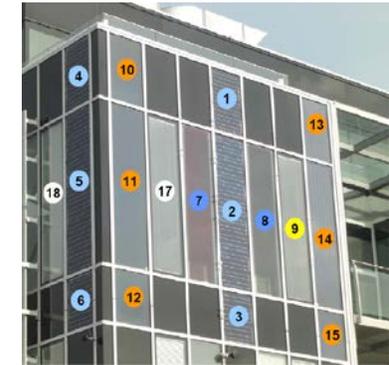
Flasher – 9 m2  
A+A+A+



Load test



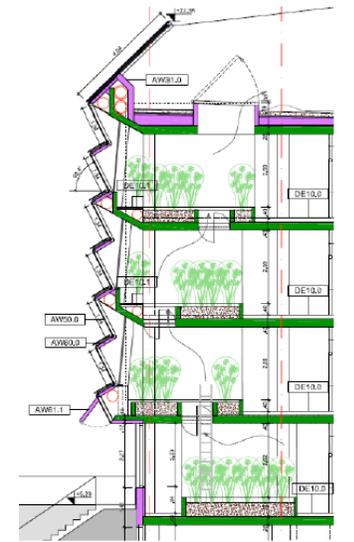
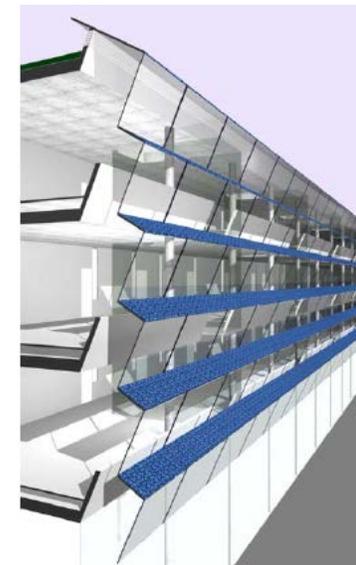
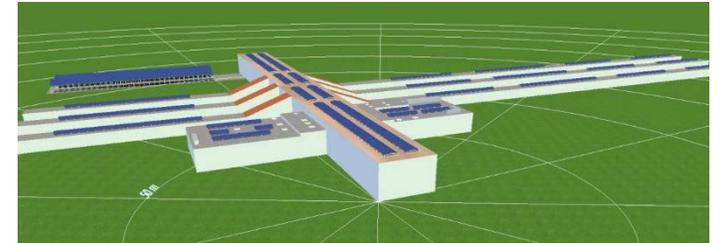
Cell measurement



Façade testing

# AIT Services for innovative BIPV-System Design

- Site analysis: Simulation Solar potentials, shading by surrounding
- Design of BIPV-System – supportive for architectural design
- Optimized daylighting and shading with BIPV-Glasses
- Selection of adapted BIPV-technologies and modules
- Support in façade construction planning – integration BIPV-modules
- Calculation energy demand and solar supply balance
- Integration in electric system (smart micro grid, batteries, demand side adaptation)
- Integration in building's ventilation and cooling system

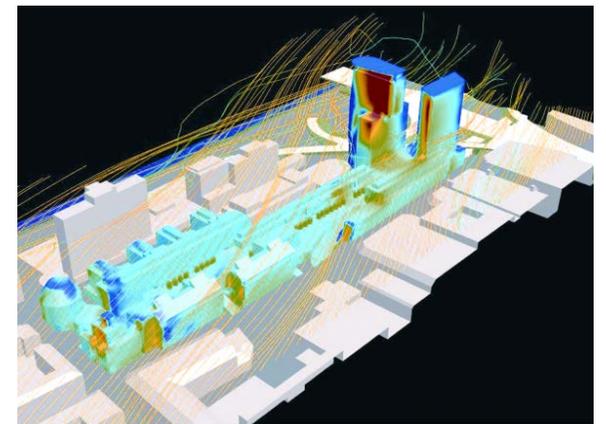
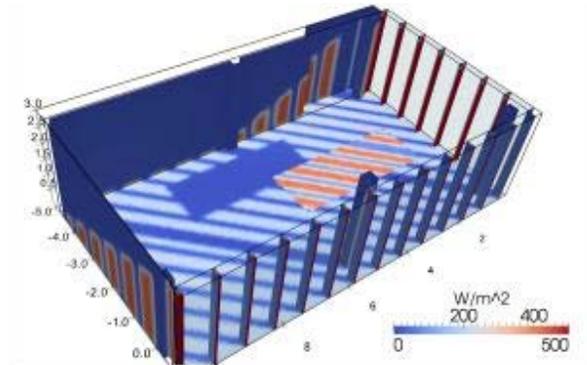


# AIT Services for innovative BIPV-System Realization & Operation

- Support in detailed technical planning
- Evaluation of BIPV concepts in accordance with relevant standards
- Technical specifications for 'call for tenders'
- Bid assessment - Economic evaluation
- BIPV-Module function-testing 'on site' before building integration
- Monitoring of BIPV-systems in operation

## Your benefits:

- Advantage in green building certification (LEED and others)
- Secured functioning – better bankability
- Higher revenues, lower operating costs



# AIT Quality Assurance of BIPV Systems – PV Module Testing

- Independent performance measurements and PV-systems control
- Type approval testing of PV modules / component tests (IEC)
- Advanced optical characterization of PV-modules 'on site'
- Accelerated aging tests: wind load, high UV-radiation, temperature
- Benchmarking of PV module types and supplier assessment
- Smart Grid test facility at AIT

Development support and accredited testing of photovoltaic components for BIPV cell and module manufacturers.



# AIT Austrian Institute of Technology

your ingenious partner

Astrid Schneider

Energy Department, Photovoltaic Business Unit

T +43(0) 50550-6408 | M +43(0) 664 88256034

[astrid.schneider@ait.ac.at](mailto:astrid.schneider@ait.ac.at)

[www.ait.ac.at](http://www.ait.ac.at)



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