BI-FACE

High-efficiency bifacial PV modules and systems for flat roofs

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CONTENTS

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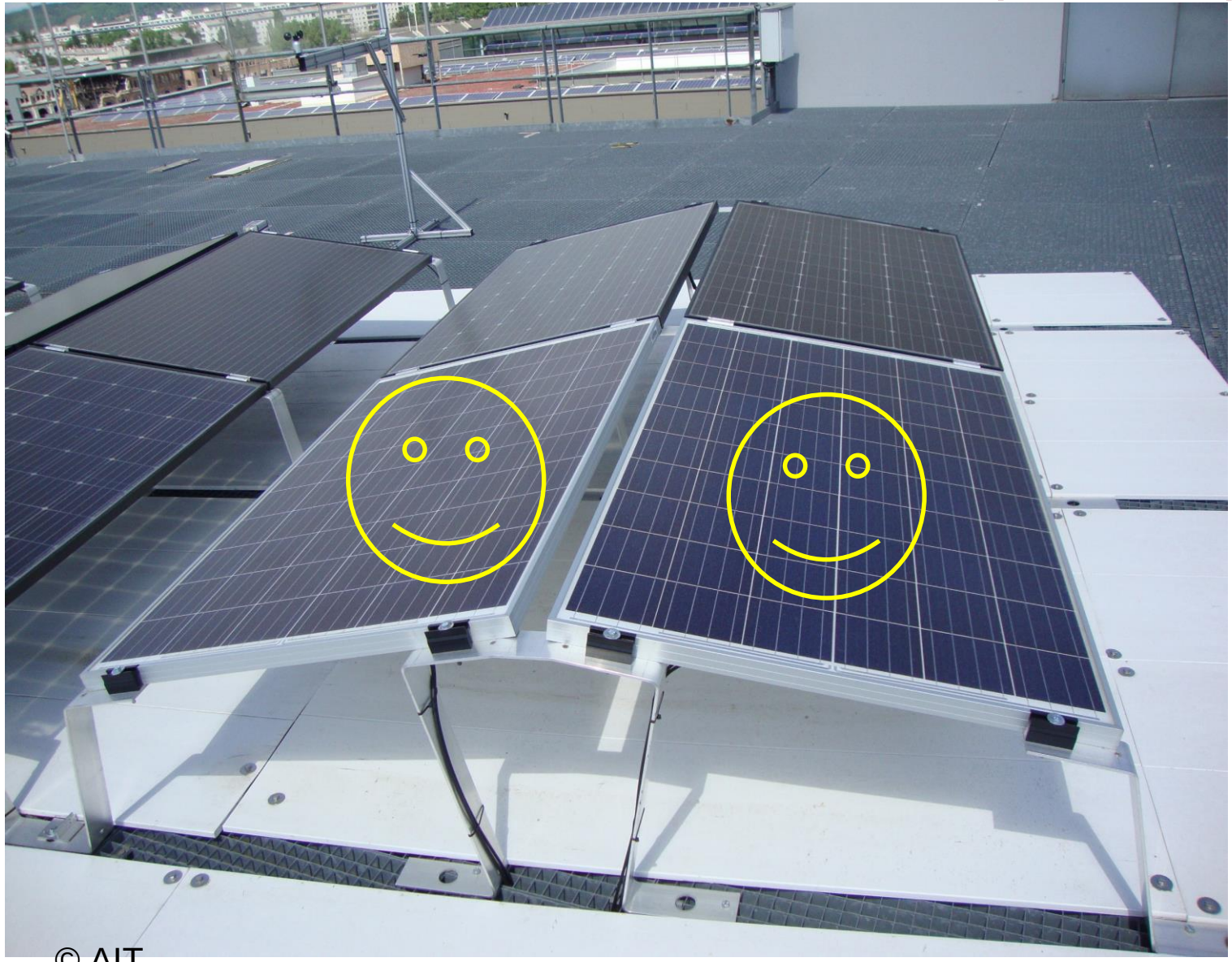
  - Improving roof top construction
  - Energy yield simulation tool considering wind load
- Results

WHAT IS BIFACIAL PV-TECHNOLOGY (BIFI-PV)?

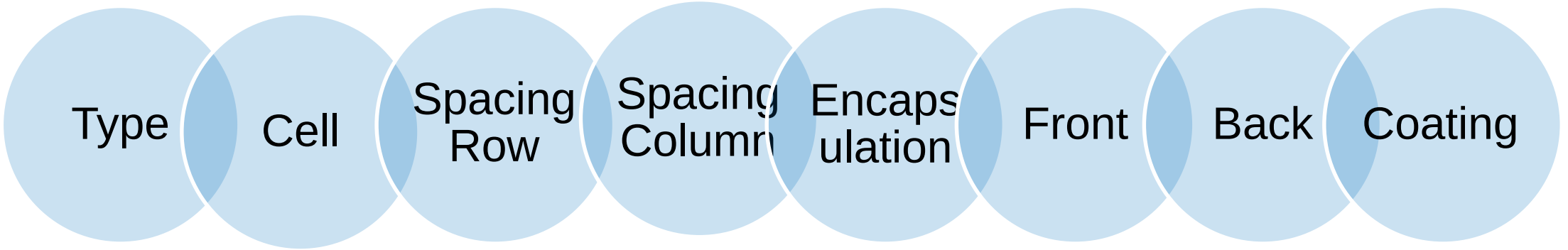


AIMS OF THE PROJECT

- Improving the bifacial system construction to meet demanding flat roof weight requirements
- Energy yield improvement, while decreasing the ratio between costs and performance
- Defining standards for characterization
- Developing appropriate measurement infrastructures
- Improved installation/application guidelines
- Quantifying the actual energy yield benefits compared to conventional PV modules under different climate conditions

MODULE DESIGN FACTORS

- **44 mini-modules** were analysed
- Data collected on: **Isc, Voc, Impp, Vmpp, Pmpp, FF,** bifaciality.
- Accelerated aging tests: Ultraviolet exposure **(UV),** Damp heat **(DH),** Potential induced degradation **(PID),** Light induced degradation **(LID)**
- Analysis were performed in R:
  - **Multiple linear regression model**
  - Tree diagram
  - Tukey HSD
  - Diagnostic Plots
  - Visualization e.g. boxplots
  - ...
- **Eight design parameters** with up to **four factor levels**

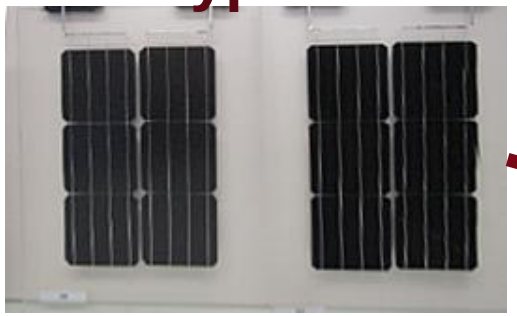


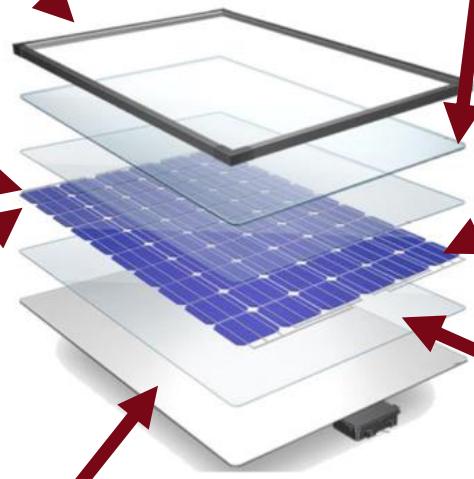
DESIGN COMPONENTS

Coating

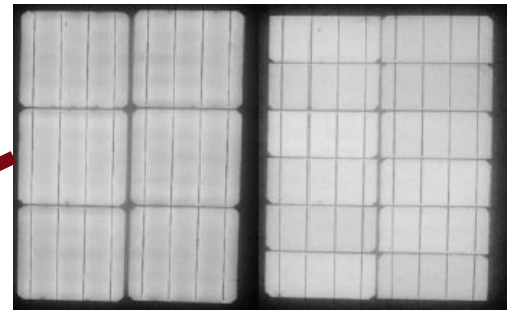
Cover
Front

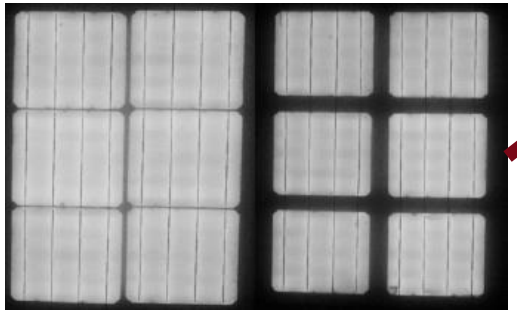
Cell Types





Cell



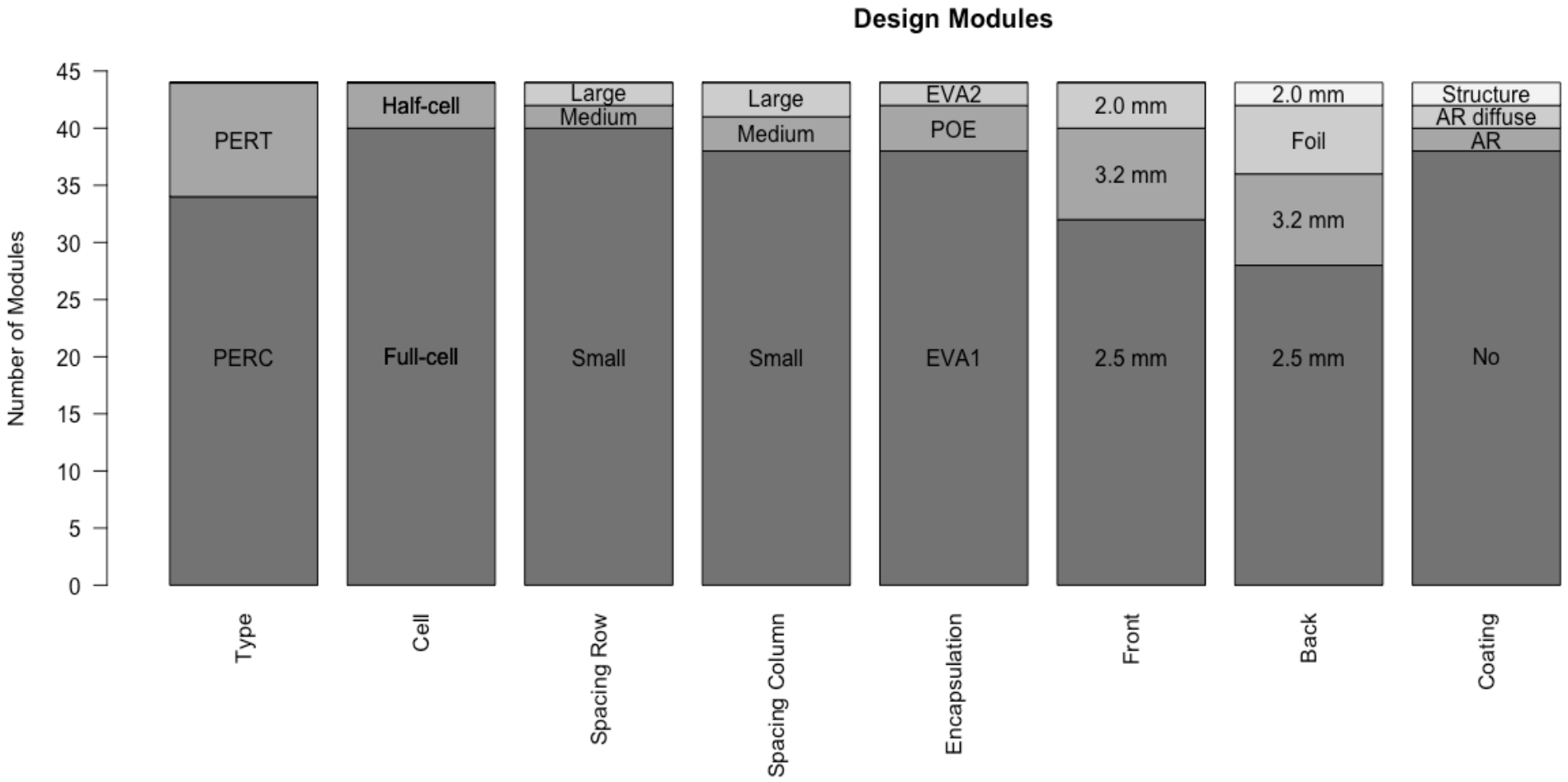


Spacing Row
& Column

Back
cover

Encapsulation
Material

NUMBER OF DIFFERENT COMPONENTS



PERC = Passivated Emitter and Rear Cell

PERT = Passivated Emitter Rear Totally Diffused cell

EVA = Ethylen-vinylacetat

POE = Polyolefin

AR = Antireflective

STATISTICAL SIGNIFICANT MULTIPLE LINEAR REGRESSION RESULTS

	Voltage		Current		Power	
	Front	Back	Front	Back	Front	Back
PERT	−	−	−	+	−	+
Halfcell	+	+	−	−	+	+
EVA 2	−		+			
F 2.0 mm	−	−			−	
B 2.0 mm						−
B Foil				−		−
AR			−			
AR diff			+		+	

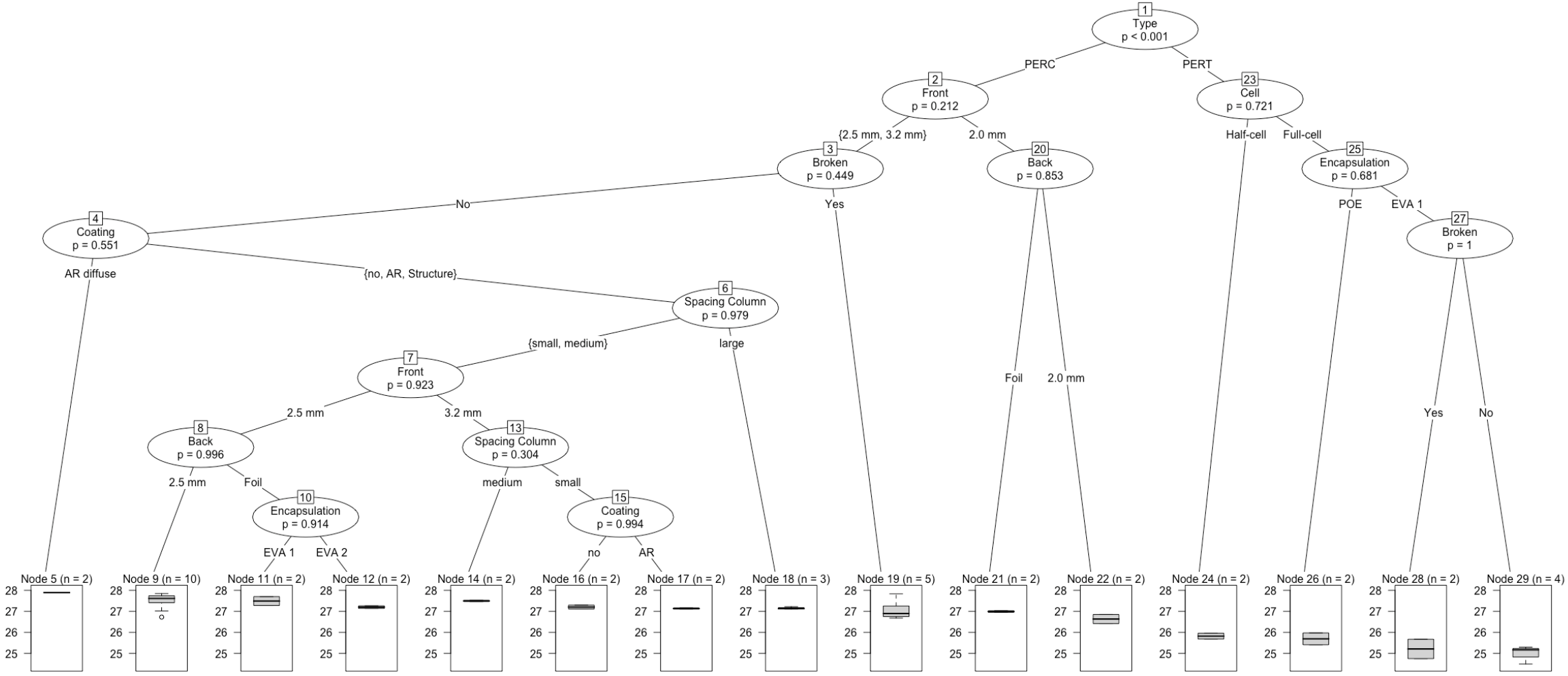
Most impactful :

1) Type - PERC
2) Half-cell
3) Coating

Most impactful :

1) Type - PERT
2) Transparent backsheet
3) Glass thickness

NON STATISTICAL TREE DIAGRAM OF THE POWER OUTPUT FROM THE FRONT SIDE



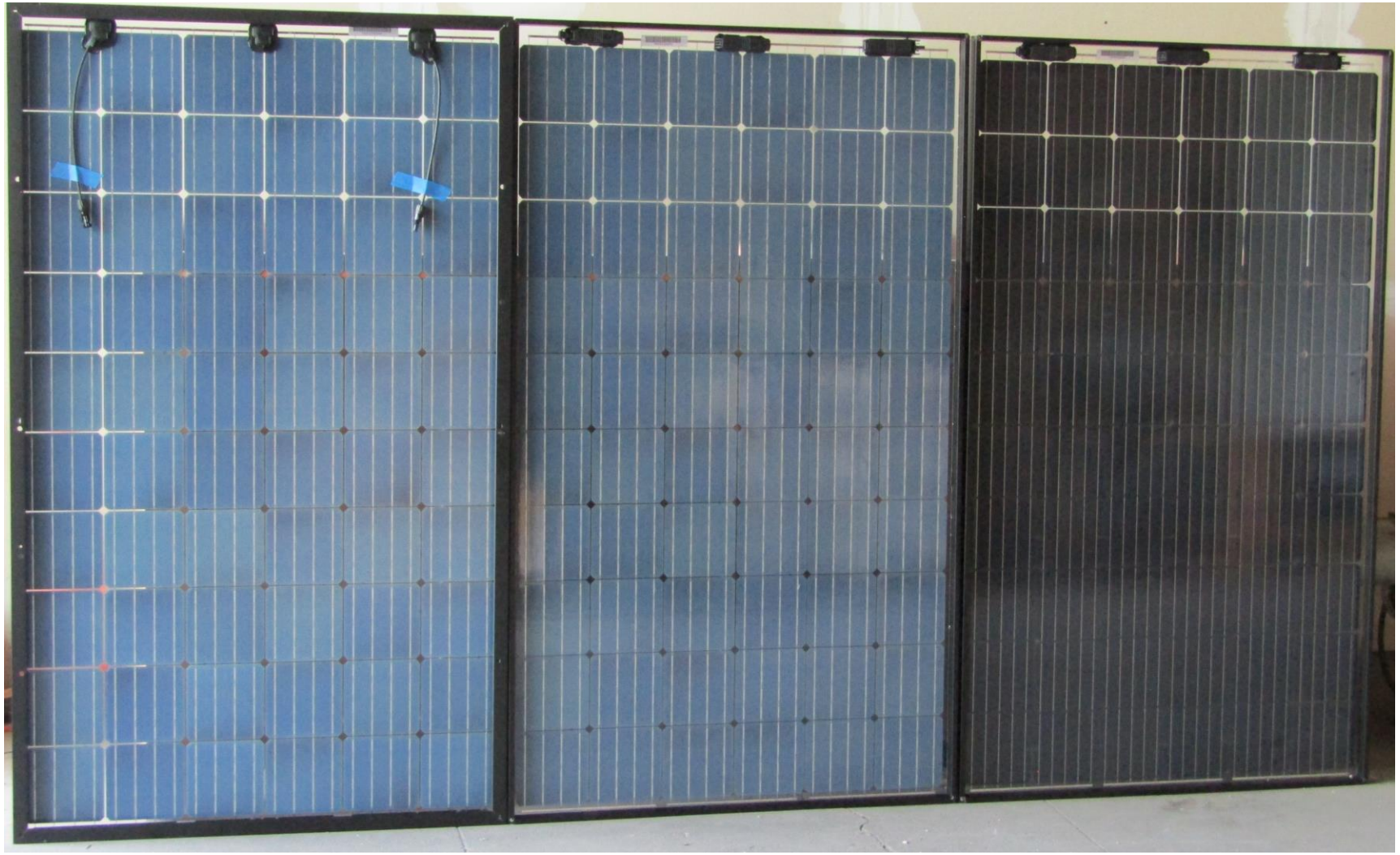
CONCLUSION MODULE DESIGN: FURTHER POWER INCREASES POSSIBLE

Bifacial PV offers huge potential to boost power:

- Combination of: PERC, **half-cell**, small spacing row and column, EVA 1, 2.5 mm glass front, 2.5 mm glass back, **AR diffuse coating**

➡ **+4.5%** increase front & **+5.7%** back possible

OPTIMIZING DESIGN STEPS



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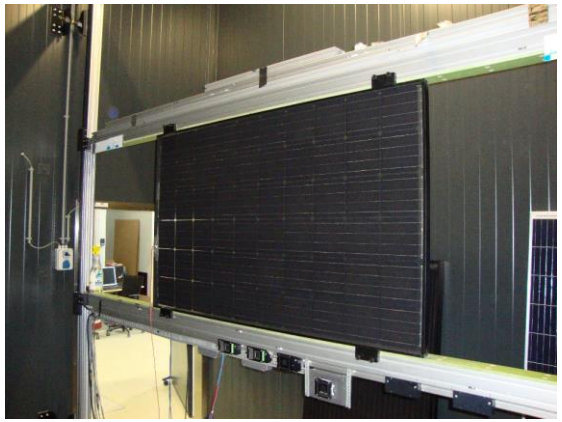
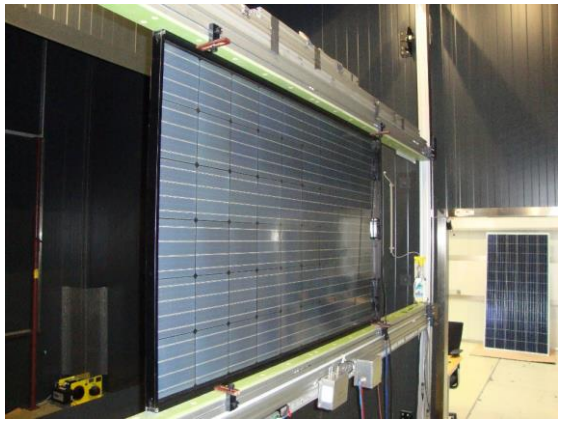
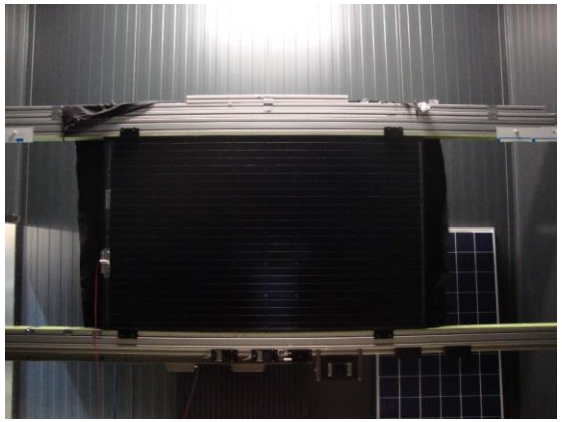
- Shading by junction box
- Frame
- bifaciality
- Transparent back sheet

INDOOR MEASUREMENTS ACCORDING TO THE NEW STANDARD







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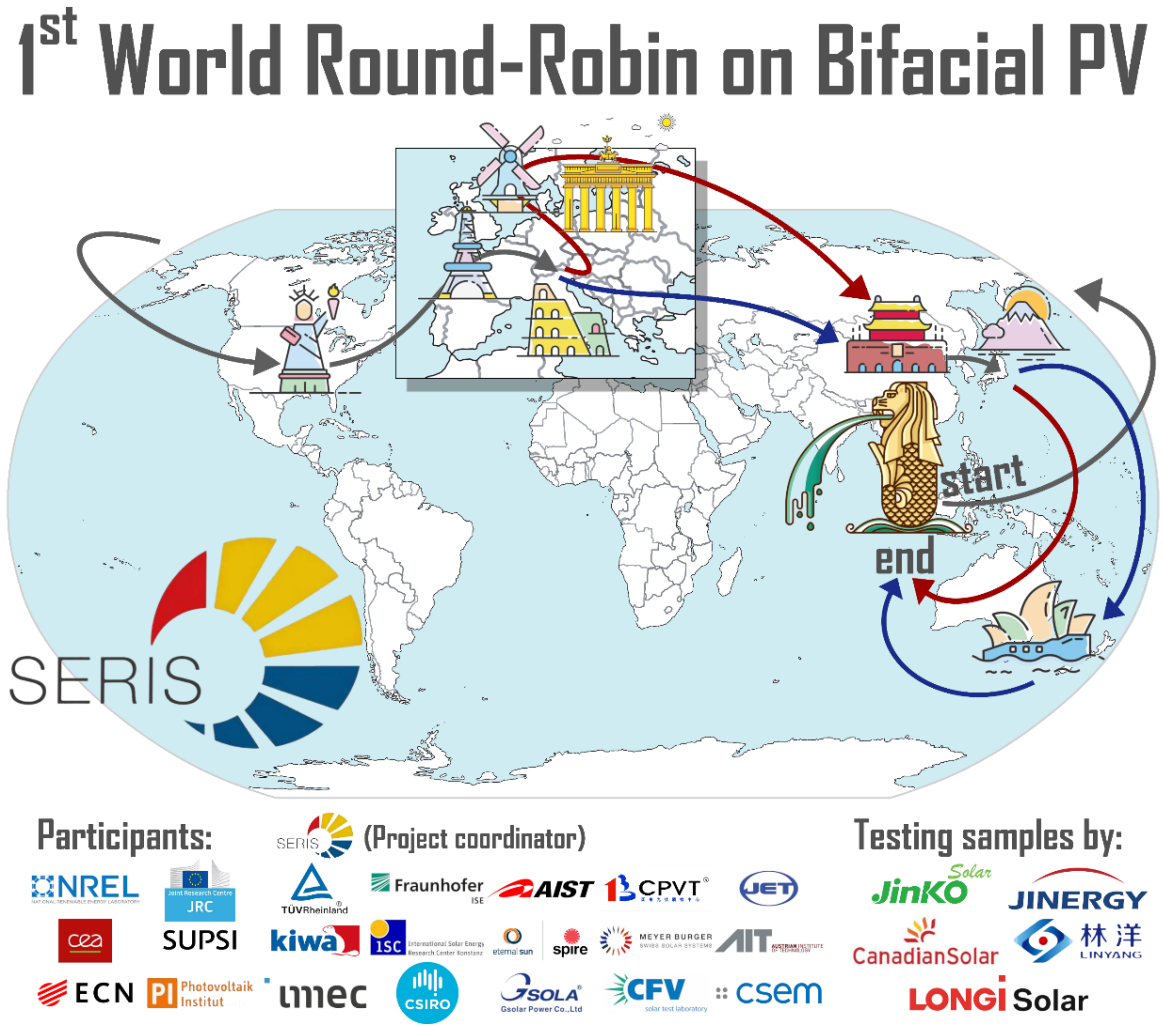
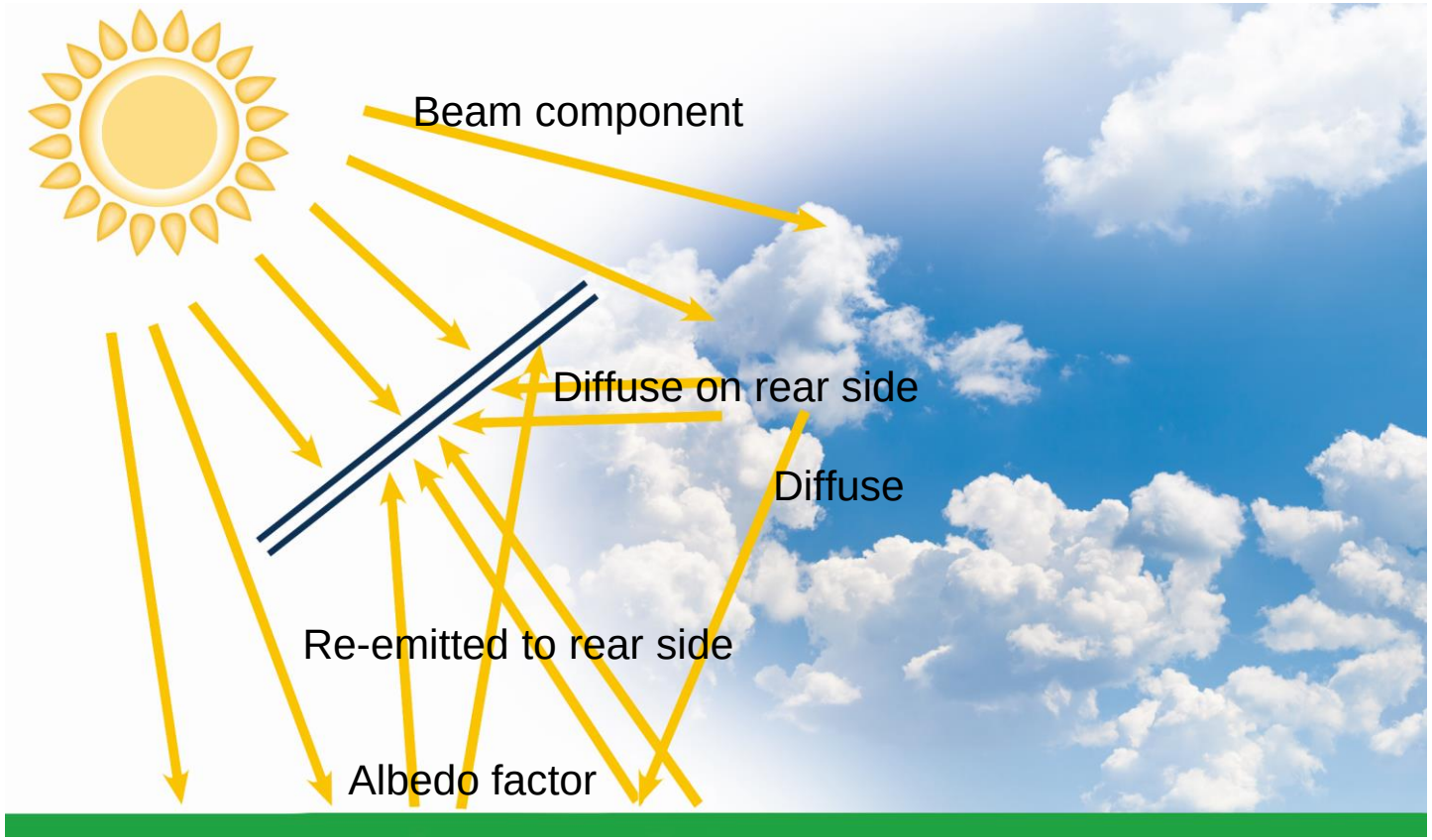
bifacial module in the flasher

International round robin measurments with 24 participants



Presented by Mauro Pravettoni, Seris
@ bifi PV virtual Workshop 2020

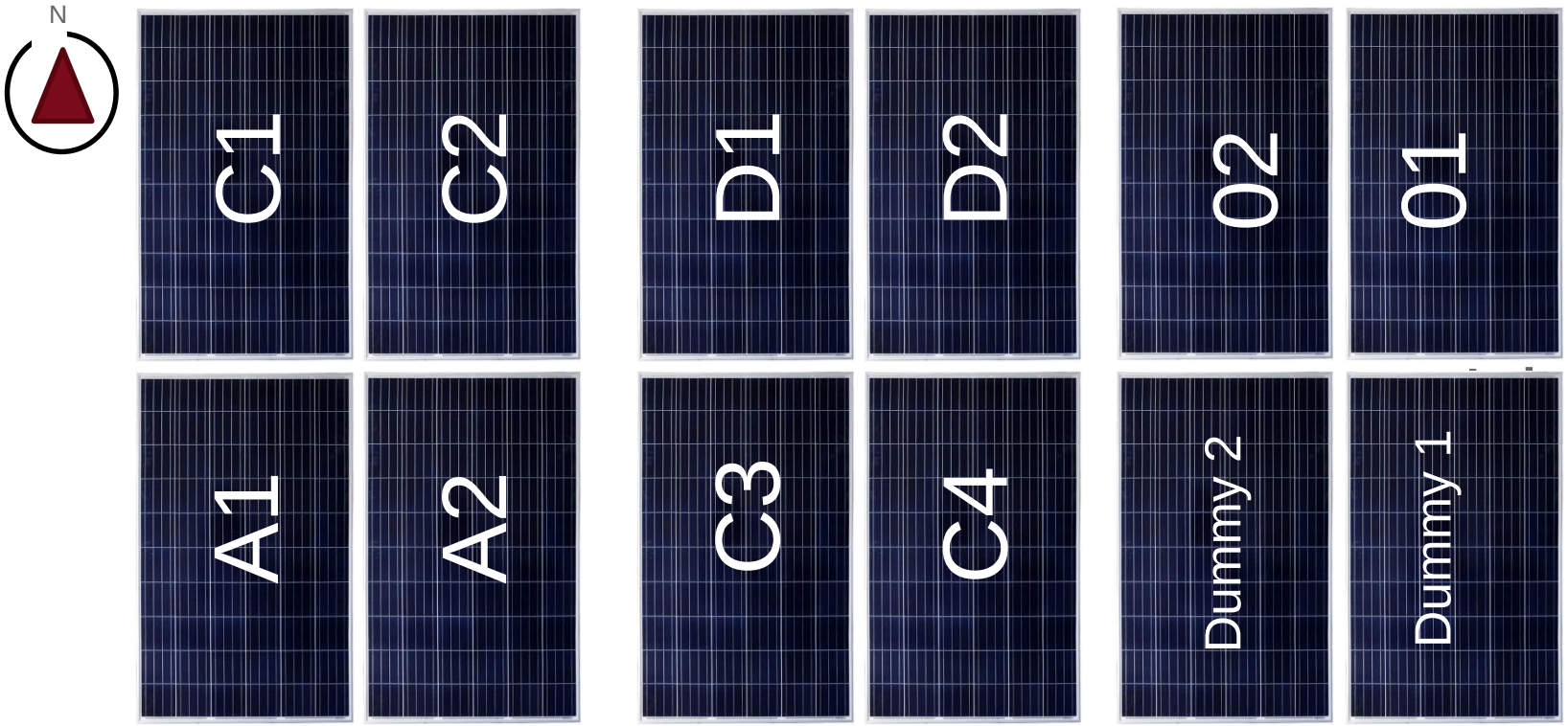
LIGHT MANAGEMENT



- Light sensitive on both front and rear side
- Highly dependent on:
  - **Module properties**
  - Height
  - Tilt angle
  - Albedo

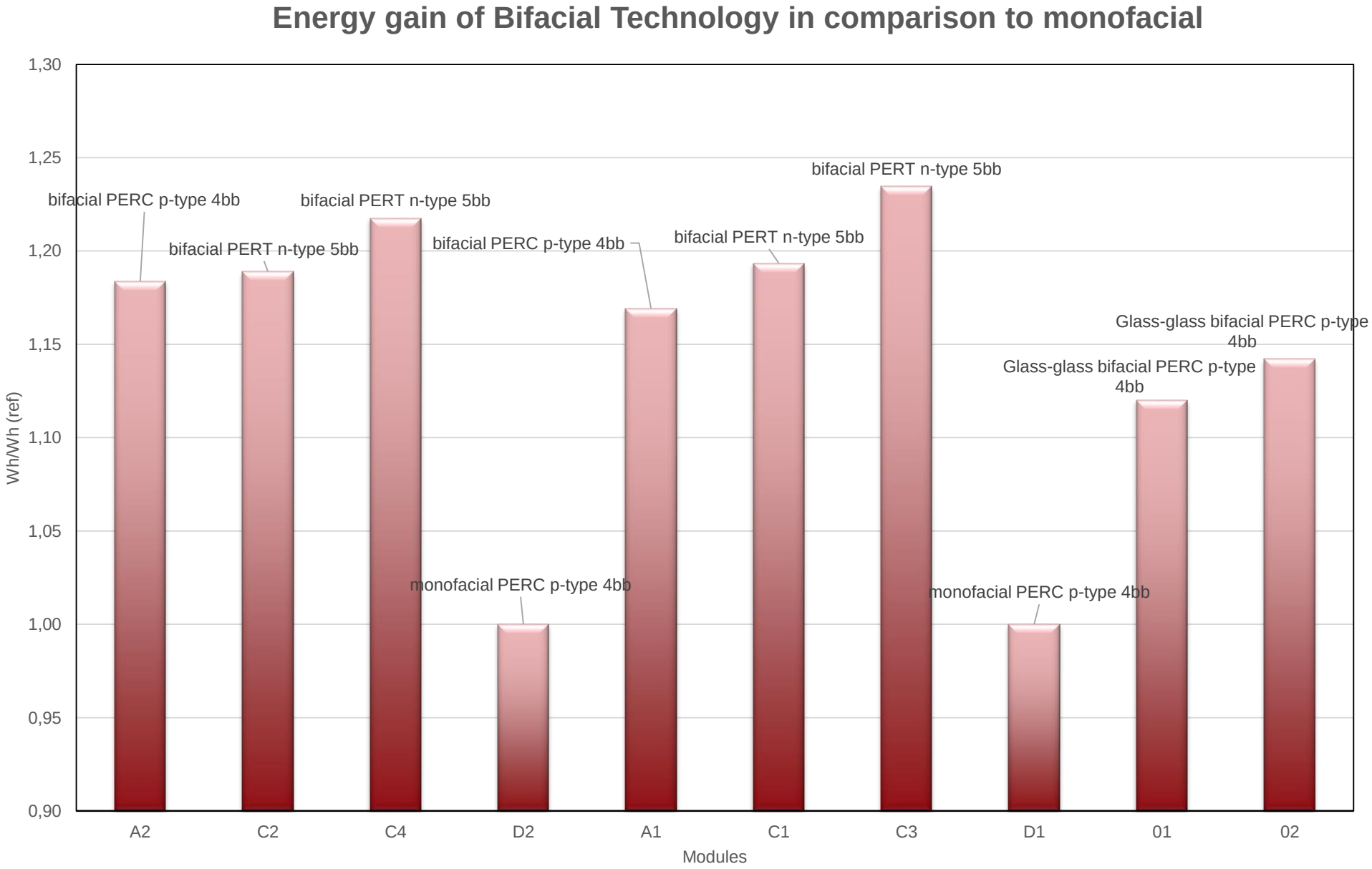
IMPROVING THE BIFACIAL SYSTEM CONSTRUCTION

SYSTEM LAYOUT AT AIT

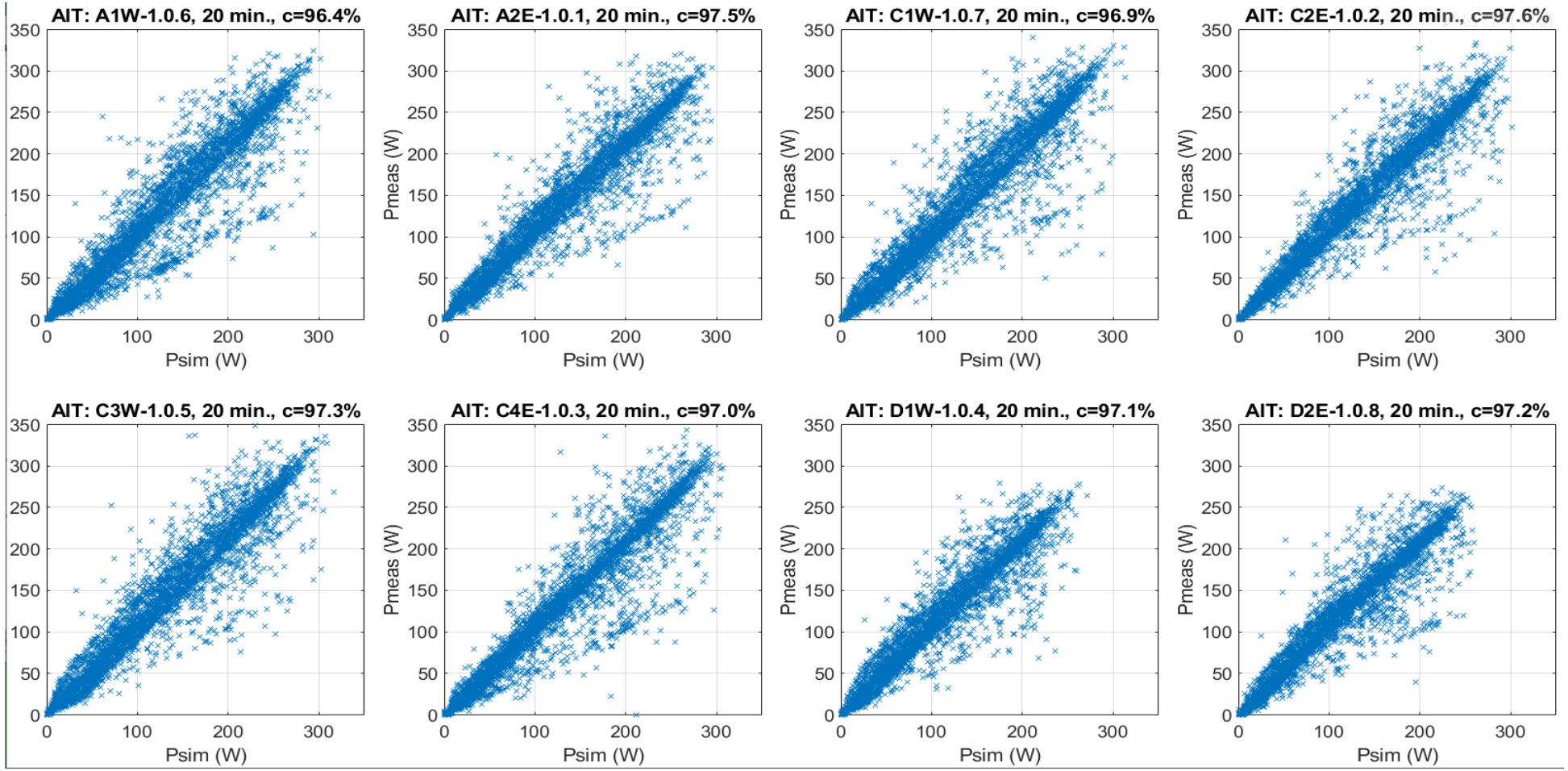


Type	facing	type
A2	east	bifacial PERC p-type 4bb
C2	east	bifacial PERT n-type 5bb
C4	east	bifacial PERT n-type 5bb
D2	east	monofacial PERC p-type 4bb
A1	west	bifacial PERC p-type 4bb
C1	west	bifacial PERT n-type 5bb
C3	west	bifacial PERT n-type 5bb
D1	west	monofacial PERC p-type 4bb
01	east	Glass-glass bifacial PERC p-type 4bb
02	west	Glass-glass bifacial PERC p-type 4bb

ENERGY GAIN IN VIENNA TWO WEEKS IN APRIL 2020



SIMULATION VS. MEASURED DATA BY TNO @AIT



RESULTS

New validated simulation tools for bifacial modules and systems, including simulation of the wind load

Validated standardization advice for characterization of bifacial modules

Developing new high efficiency bifacial modules and systems

Outdoor performance qualification of the bifacial system in different European climate zones and wind and snow load conditions

- Subtropical, Cyprus
- Temperate, Austria
- Maritime temperate, The Netherlands

Guidelines for flash testing upgrade at the module manufacturer's site

ACKNOWLEDGEMENT

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THANK YOU!

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