

Bifacial World 2017

History and Status

Radovan Kopecek et al.







International Solar Energy Research Center (ISC), Konstanz, GERMANY

Solar city of Konstanz



International Solar Energy
Research Center Konstanz



	Tue 10/24	Wed 10/25	Thu 10/26	Fri 10/27	Sat 10/28	Sun 10/29
<	13° 7°	17° 8°	19° 8°	16° 4°	11° 6°	9° 3°
						
	Teils Wolkig	Teils Wolkig	Heiter	Regen	Regen möglich	Regen möglich





bifi PV workshop

October 25/26 2017

Conference site: The Konzil

Organizers:



Sponsors:



Media partner:





bifi PV workshop

October 25/26 2017

Conference site: The Konzil

Monofaciality is so nineties!

Organizers:



Sponsors:



Media partner:





BIFACIAL FUTURE

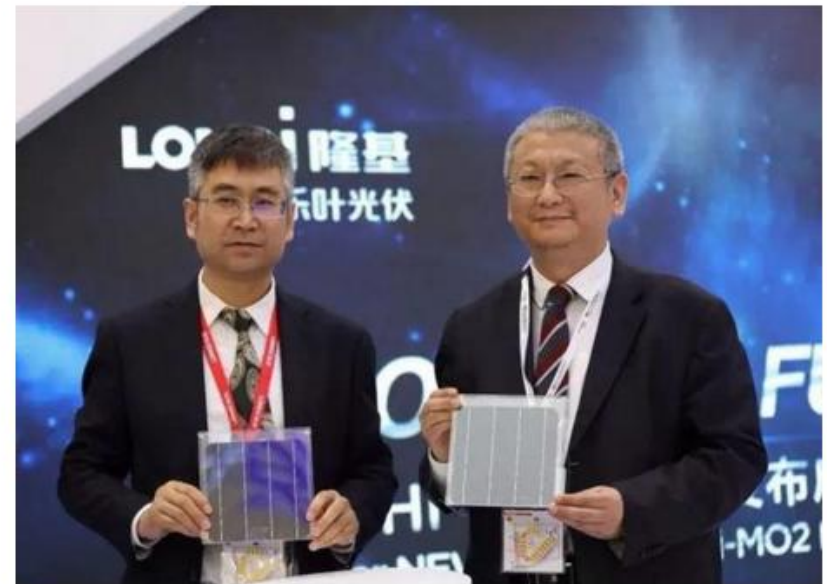


LONGI Solar

Intersolar Europe 2017: Bifacial will be mainstream in two years says LONGI

By John Parnell | Jun 01, 2017 7:32 AM BST | 0

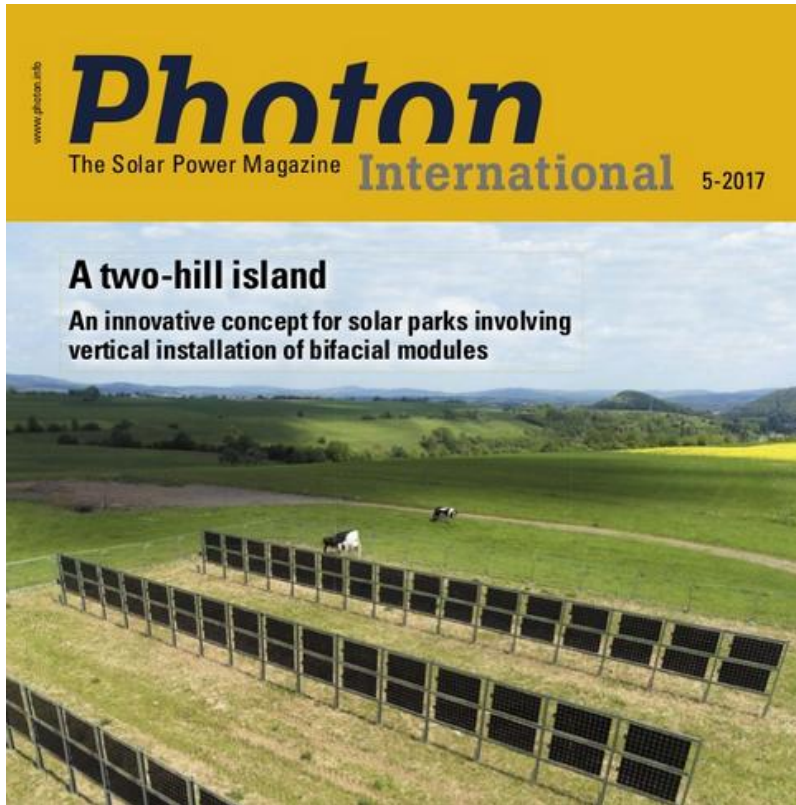
Share    



Zhenguo Lee (right) president of the Longi Group.

Bifacial modules will be the standard utility-scale PV product for LONGI Solar, according to the company's president.

BIFACIAL FUTURE



China leader project in xintai city shangdong province use 40MW jolywood n type mono double glass bifacial panels of 310wp combine with Actech single axis tracker in order to save BOS cost and maximize IRR .



- 1) Metallisation workshop started in 2008
- 2) nPV workshop started in 2011
- 3) bifiPV started in 2012



Goals of such focused workshops

- 1) Industry and institutes present new results and findings
- 2) Platform for discussions and business



nPV WS 2018 in Lausanne



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npvworkshop
Lausanne 2018

Organizers:

Fraunhofer ines ISC ISFH csem

Main: npV Chairman's Message Abstracts Program Registration Sponsoring Contact Lausanne Programme

Announcement: nPV WORKSHOP
March 21/22 2018 in Lausanne, Switzerland

because of its great success, we will for the 8th time organise the nPV workshop with the participation of scientists and industry from all around the world. As last time, we will connect it to the Silicon PV conference allowing the visitors to combine both events. The nPV workshop will take place

March 21/22 2018 in Lausanne, Switzerland.

hosted and organized by:

csem projects in solar energy PSE

linked to:

Silicon PV 2018

Organizers:

Matthieu Despeisse (csem) Arthur Weeber (ICN) Stefan Glutz (PSE) Radovan Kopecek (ISC) Delina Munoz (INES) Joachim John (IMEC) Jan Schmidt (ISFH)

www.nPV-workshop.com

Radovan Kopecek, bifiPV2017, Konstanz, October 25/26, 2017

bifiPV workshops from 2012



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- 1) bifiPV 2012 in Konstanz (120 people)
- 2) bifiPV 2014 in Chambery (80 people)
- 2,5) bifiPV 2015 in Antofagasta (40 people)
- 3) bifiPV 2016 in Miyazaki (80 people)
- 4) bifiPV 2017 in Konstanz (130 people)

all presentations at

<https://pvpmc.sandia.gov/pv-research/bifacial-pv-project/>

bifiPV 2014 in Chambery



bifiPV 2017: organisers and sponsors



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Organizers:



Sponsors:



Media partner:



bifiPV 2017: visitors

Bifacial pioneers:



Large bifacial companies:



bifiPV 2017: visitors



Bifacial pioneers:



Large bifacial companies:



1) Visitors: ca. 130 from 20 countries

2) Sessions: 8

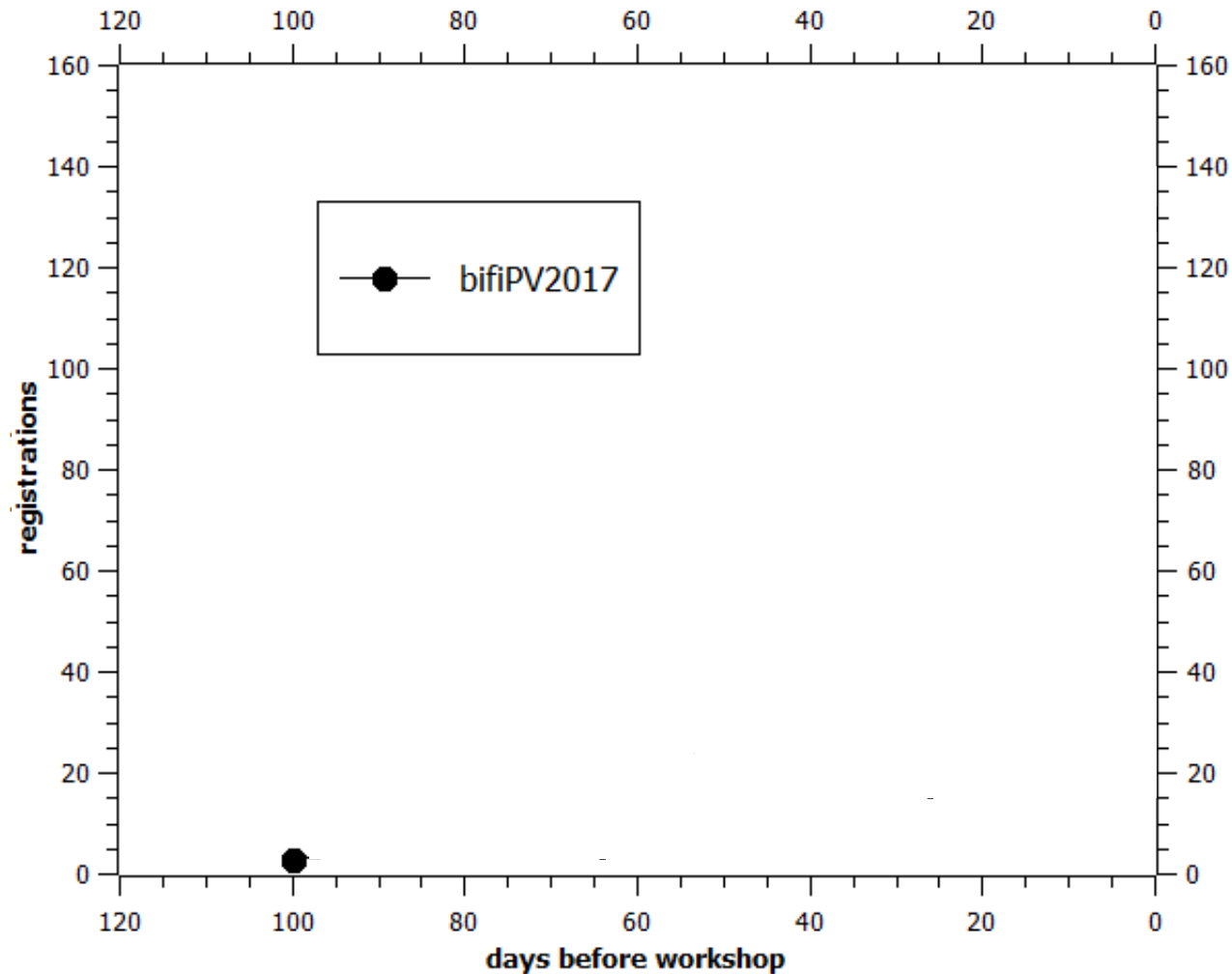
- I - Systems
- II - Solar cells
- III - Modules
- IV - Technology discussion
- V - Simulations and LCOE
- VI - Measurements and standards
- VII - Review: are we doing rights right?
- VIII - Bankability



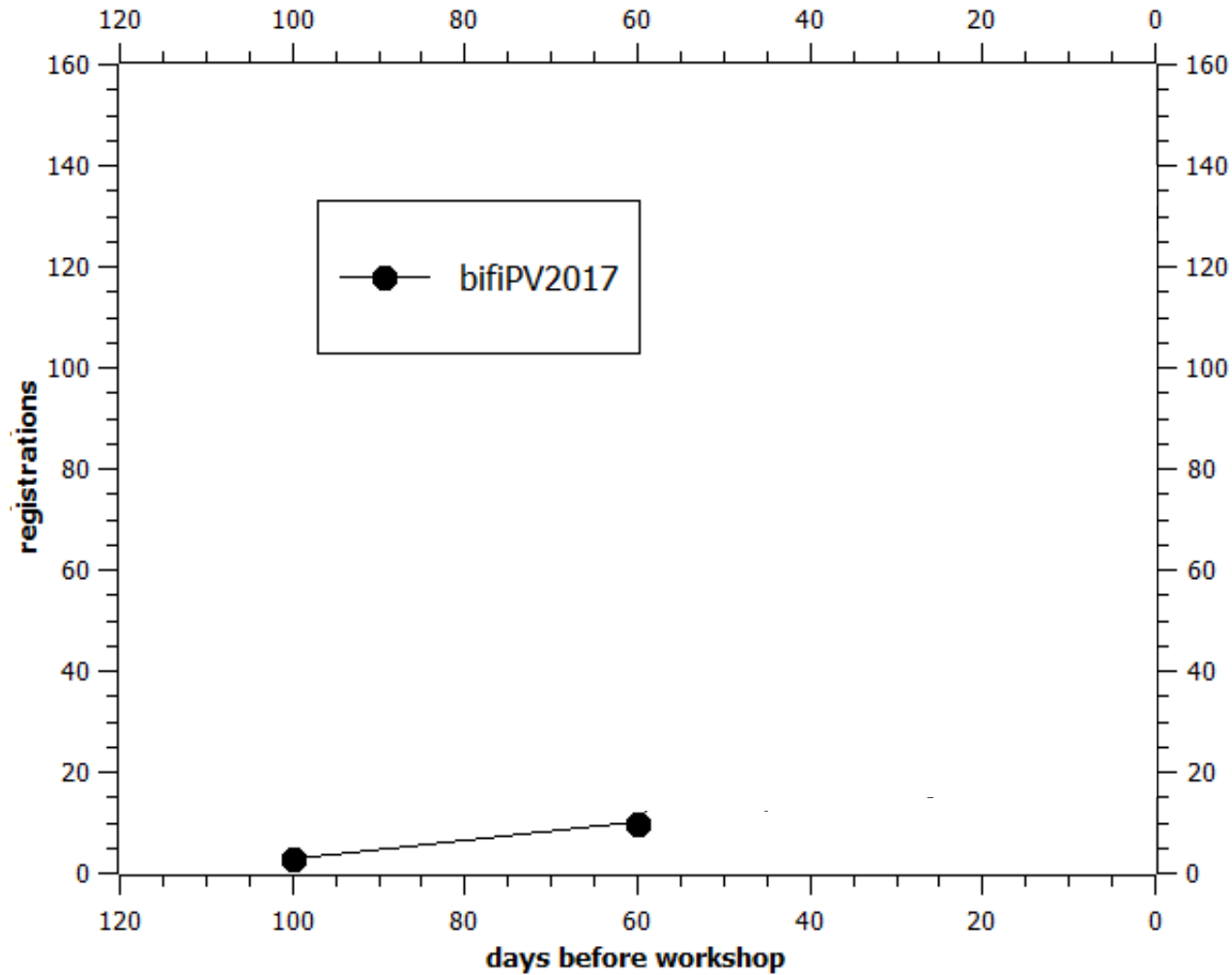
3) Presentations: 41

4) Lots of DISCUSSION

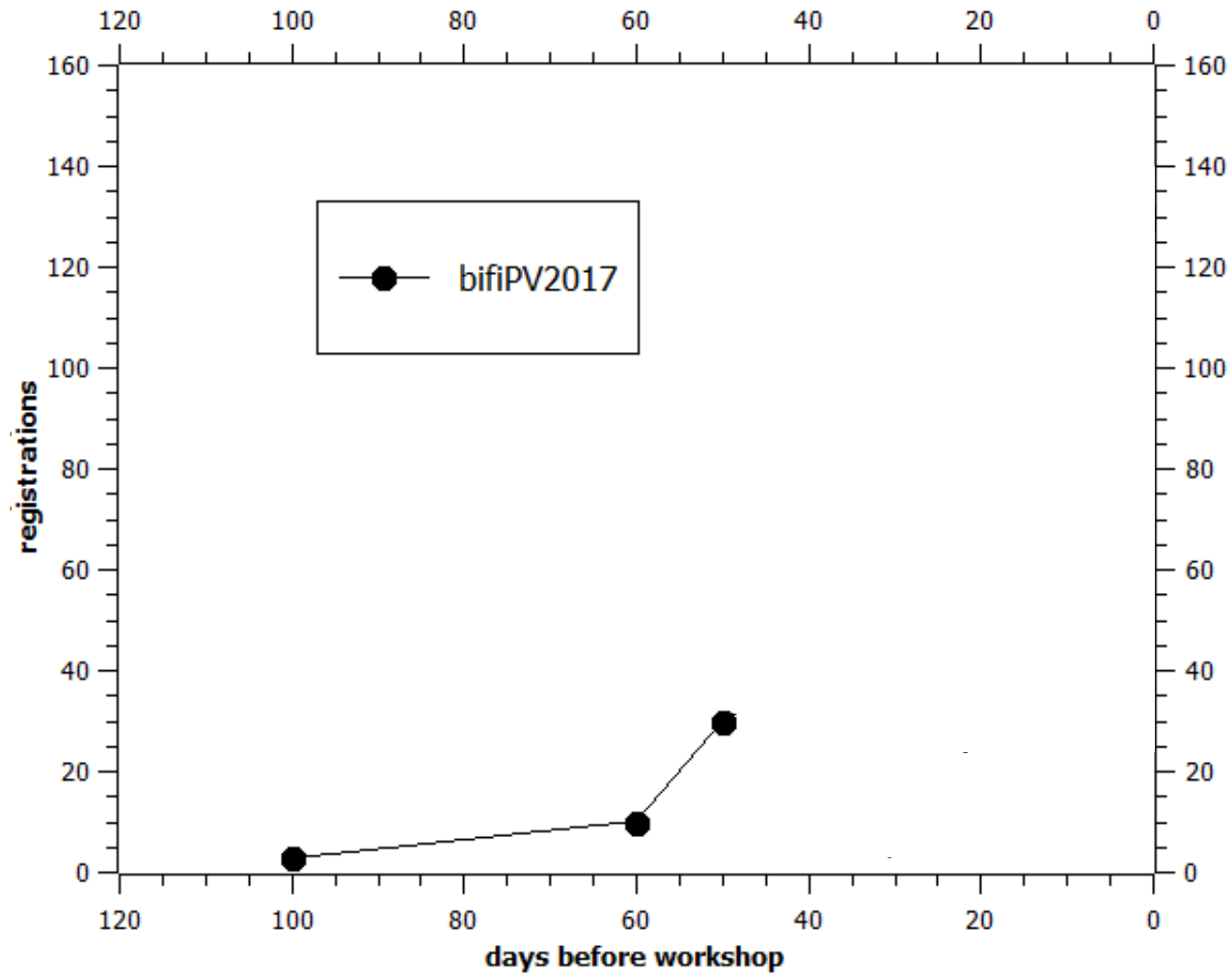
bifiPV 2017: registrations in time



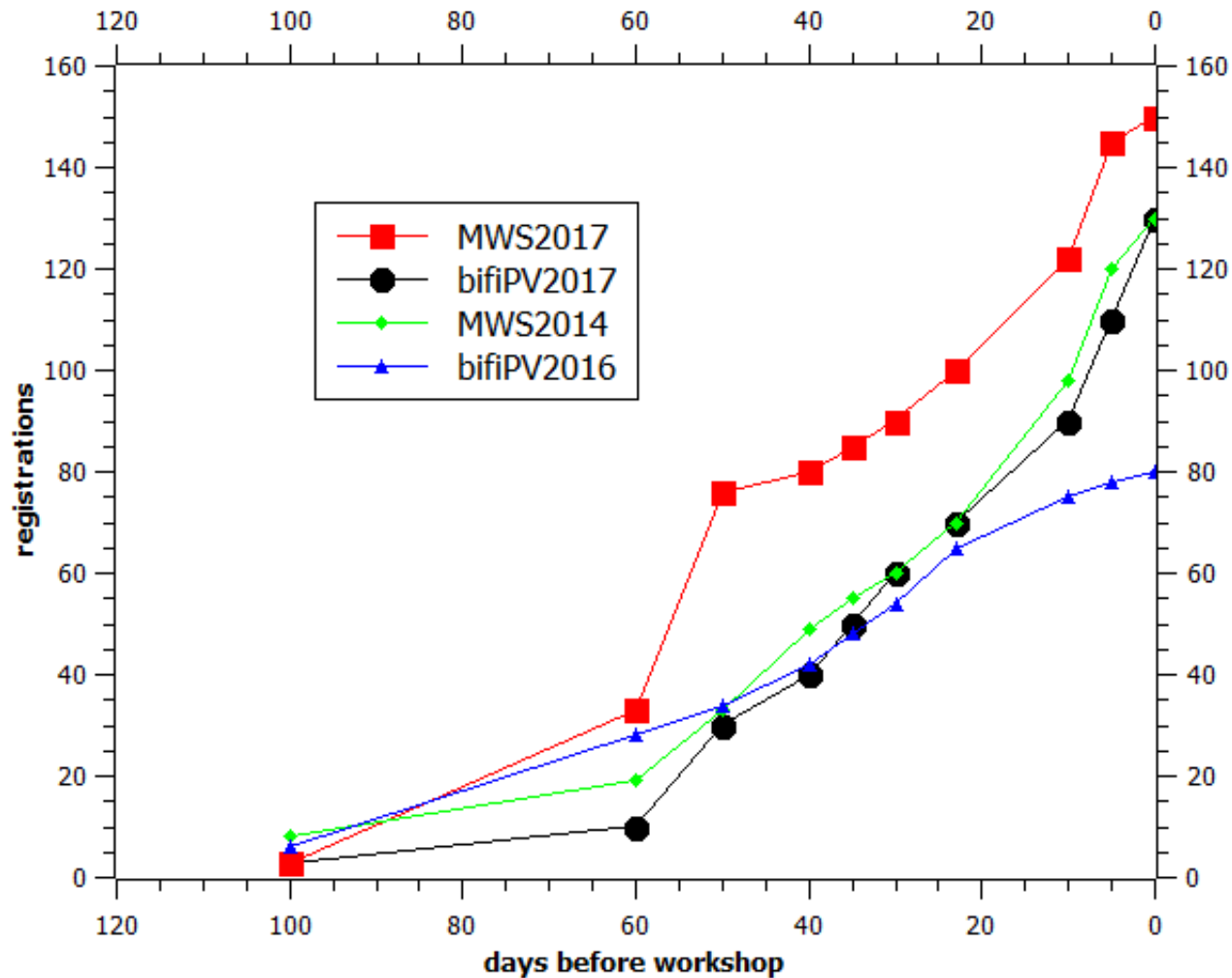
bifiPV 2017: registrations in time



bifiPV 2017: registrations in time



bifiPV 2017: registrations in time



PROGRAM of bifiPV2017

Wednesday, 25.10.2017

Session	Presenter, Institution	Topic or Title
Registration 08:00		
Opening 08:30	Radovan Kopecek, ISC Konstanz	bifiPV world 2017: status and outlook
Session I	Chair: Kopecek/Joanny	Systems: reports on large bifacial systems
09:00-09:20	Maryline Joanny, INES	overview
09:20-09:35	Ashok Sinha, Sunpreme	Sunpreme's HCT-based bifacial PV module: a compelling solution for commercial systems
09:35-09:50	Naftali Eisenberg, SolAround	Comparison of different bifacial systems
09:50-10:05	Jason Ni, Yingli	50MWp bifacial system and standards
15 min coffee		
10:20-10:35	Willem Vermeulen, Tempres	400kW bifacial system in EU and comparison with other systems
10:35-10:50	Rob Kreiter, sunfloat	Floating bifacials - reflections on power
10:50-11:05	Andreas Dreisiebener, solarspar	Small vertical E-W oriented modules on rooftop (Swiss)
11:05-11:20	Heiko Hildebrand, Next2sun	3MWp vertical E-W oriented system in Germany
11:20-11:35	Fabrizio Bizzarri, Enel	Innovative (tracked) bifacial PV plant at la silla observatory in Chile

bifiPV 2017: Wednesday program



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Session II	Chair: Libal/Romijn	Solar Cells: industrial bifacial cells for production
12:00-12:20	Ingrid Romijn, ECN	overview
12:20-12:35	Thorsten Dullweber, ISFH	Bifacial PERC+ solar cells: status of industrial implementation and future perspectives
12:35-12:50	NN, Jolywood	nPERT bifacial technology
12:50-13:05	Lev Kreinin, SolAround	pPERT as an alternative
13:05-13:20	Wolfgang Jooss, RCT	mcPERCT
70 min Lunch		
Session III	Chair: Aaken/Nussbaumer	Modules: bifacial module concepts
14:30-14:50	Hartmut Nussbaumer, ZHAW	overview
14:50-15:05	Anna Battaglia, 3sun	Si n ₊ bifacial modules: an innovative industrial perspective towards more efficient PV energy generation
15:05-15:20	Thomas Soederstroem, MB	The real power of bifacial HJT Smart Wire Connection Technology
15:20-15:35	David Dassler, FhG CSP	Bifacial gain simulations of modules and systems under desert conditions
15:35-15:50	Jai Prakash, SERIS	Shingled bifacial Photovoltaic modules
15:50-16:05	Milica Mrcalica, DSM	Advanced layers for bifacial modules
35 min coffee		
Session IV	Chair: Kopecek	Discussion about technology
16:40-17:10	Presenters from previous sessions	What is needed to be developed for bifacial technology?

bifiPV 2017: Thursday program



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Thursday, 26.10.2017

Session V	Chair: Joanny/Libal	Bifacial gain simulations and LCOE calculations
09:00-09:20	Joris Libal, ISC Konstanz	overview
09:20-09:35	Bruno Wittmer, Pvsyst	Bifacial shed simulations with Pvsyst
09:35-09:50	Lars Kunath, Polysun	Enhanced energy harvest for PV systems using bifacial modules: simulation and model verification
09:50-10:05	Djaber Berrian, ISC Konstanz	MoBiDiG: simulations and LCOE
15 min coffee		
10:20-10:35	Lars Podlowski, PI Berlin	Yield Study on Identical Bifacial Rooftop Systems installed in the USA and in Germany
10:35-10:50	Markus Klenk, ZHAW	Bifarot: an experimental way for LCOE calculation
10:50-11:05	Dimitrij Chudinzow, Uni Stuttgart	Bifacial gain simulations
11:05-11:20	Bas van Aken, ECN	Bifacial PV: hot or cool? Or both!
11:20-11:35	Chris Deline, NREL/SANDIA	Bifacial simulations
25 min coffee		
Session VI	Chair: Romijn/Fakhfouri	Measurement- and qualification standards
12:00-12:20	Vahid Fakhfouri, Passan	overview
12:20-12:35	Klaus Ramspeck, h.a.I.m.	Measurement techniques for bifacial solar cells
12:35-12:50	Gordon Deans, Aurora	Accurate inline characterization of BSF and emitter fabrication processes for high-volume bifacial cell production
12:50-13:05	Maryline Joanny, INES	Bifacial modules measurement with GE method
70 min lunch		

bifiPV 2017: Thursday program



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14:15-14:30	Juan Lopez-Garcia, EC, DG JRC	Temperature coefficients of n-type bicacial silicon PV modules under natural and simulated sunlight
14:30-14:45	Karl Berger, AiT	How to introduce bifaciality within the module type and safety testing procedures
14:45-15:00	Elias Garcia Goma, EternalSun	Single vs double side illumination indoor testing for bifacial performance characterisation
15:00-15:15	Werner Herrmann, TÜV Rheinland Energy	Performance characteristics of bifacial PV modules and power labeling
15:15-15:30	Michael Rauer, ISE	Bifacial Solar Cells under Single- and Double-Sided Illumination: Effect of Nonlinearity in Short-Circuit Current
20 min coffee		
Session VII		Technical wrap up: are we doing the right things right?
15:50-16:10	Thomas Nordmann, TNC	Critical summary and outlook for successful bifacial future
Session VIII	Chair: Moser/Nussbaumer	Bankability
16:10-16:30	Andre Richter, Meyer Burger	overview
16:30-17:00	David Moser, EURAC	Moderated podium discussion: how to speed up bifacial future?



BIFACIALITY

True bifacial module market share



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"true" bifacial c-Si modules with bifacial cells and transparent back cover
World market share [%]

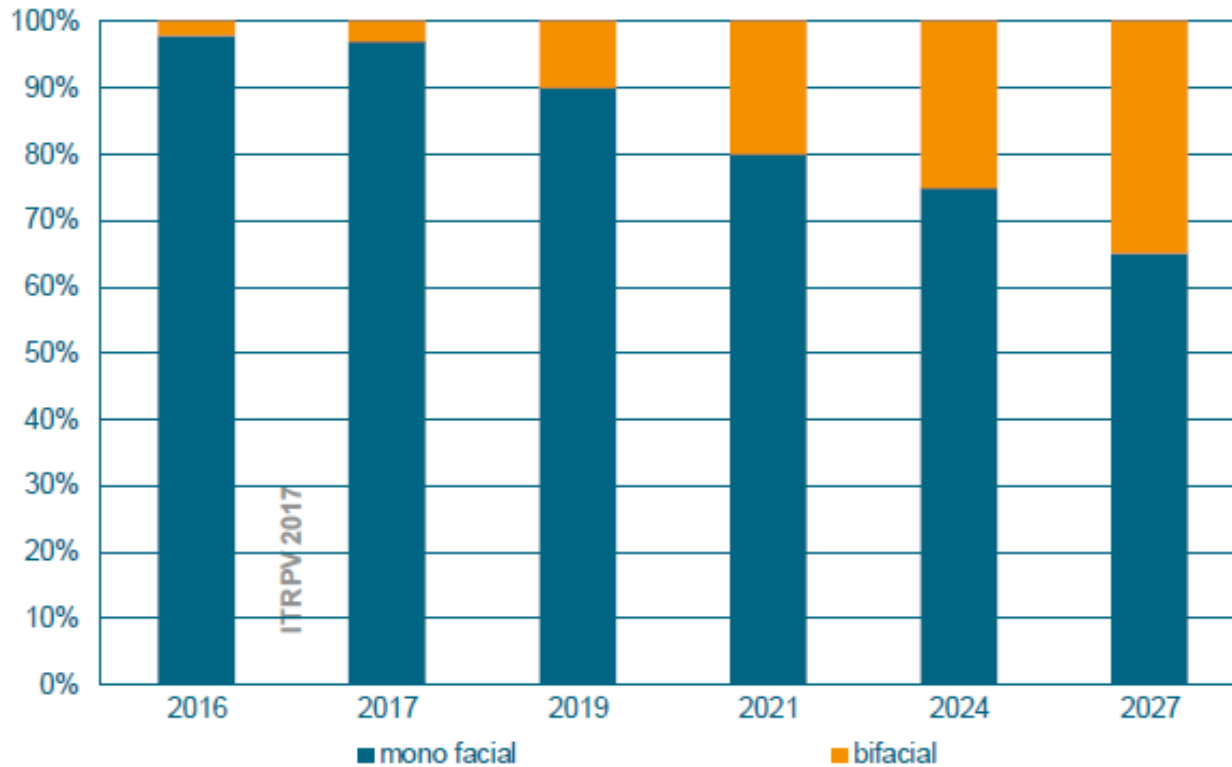


Fig. 43: Worldwide market shares for monofacial and "true" bifacial modules.

True bifacial module market share

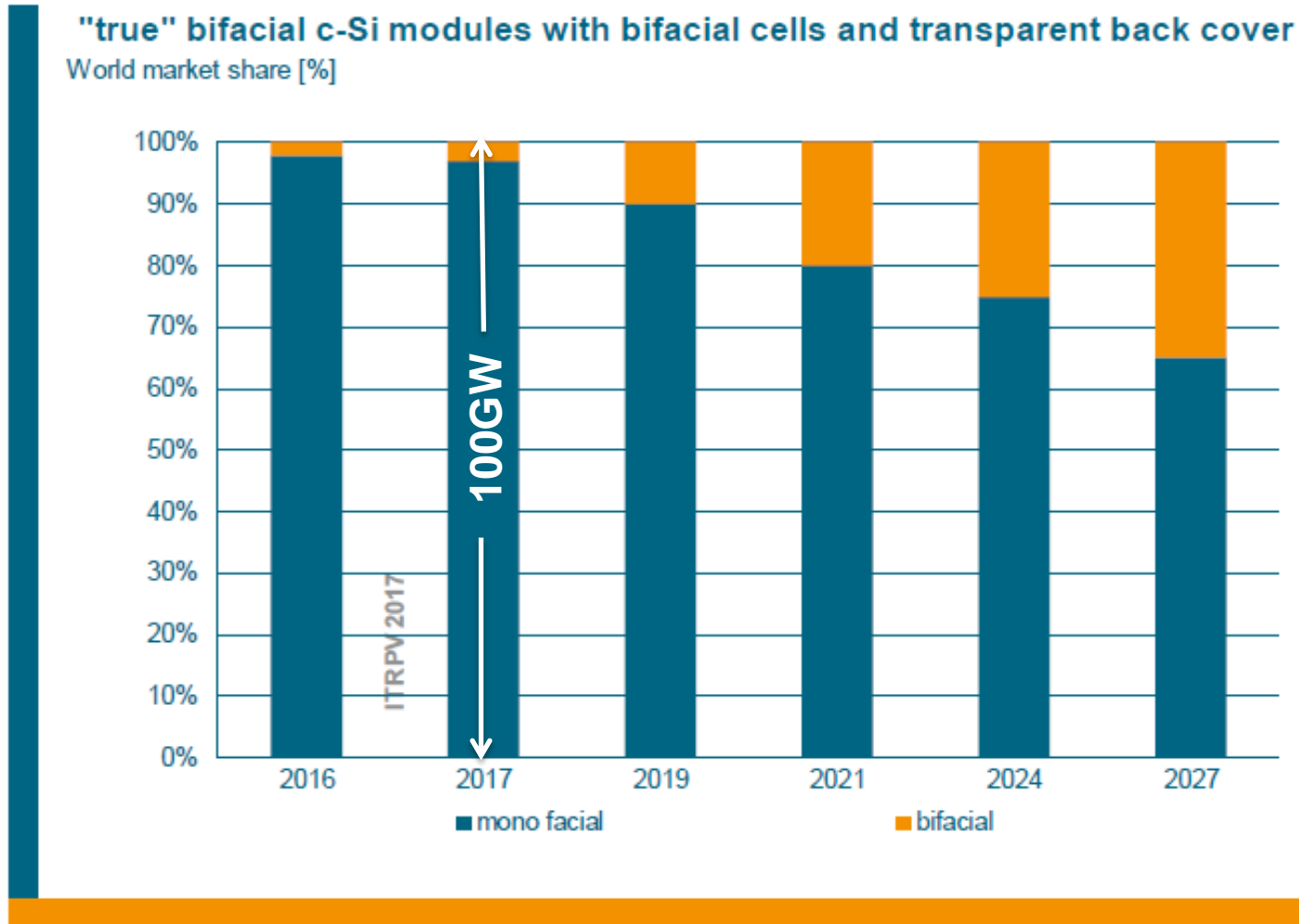


Fig. 43: Worldwide market shares for monofacial and "true" bifacial modules.

True bifacial module market share

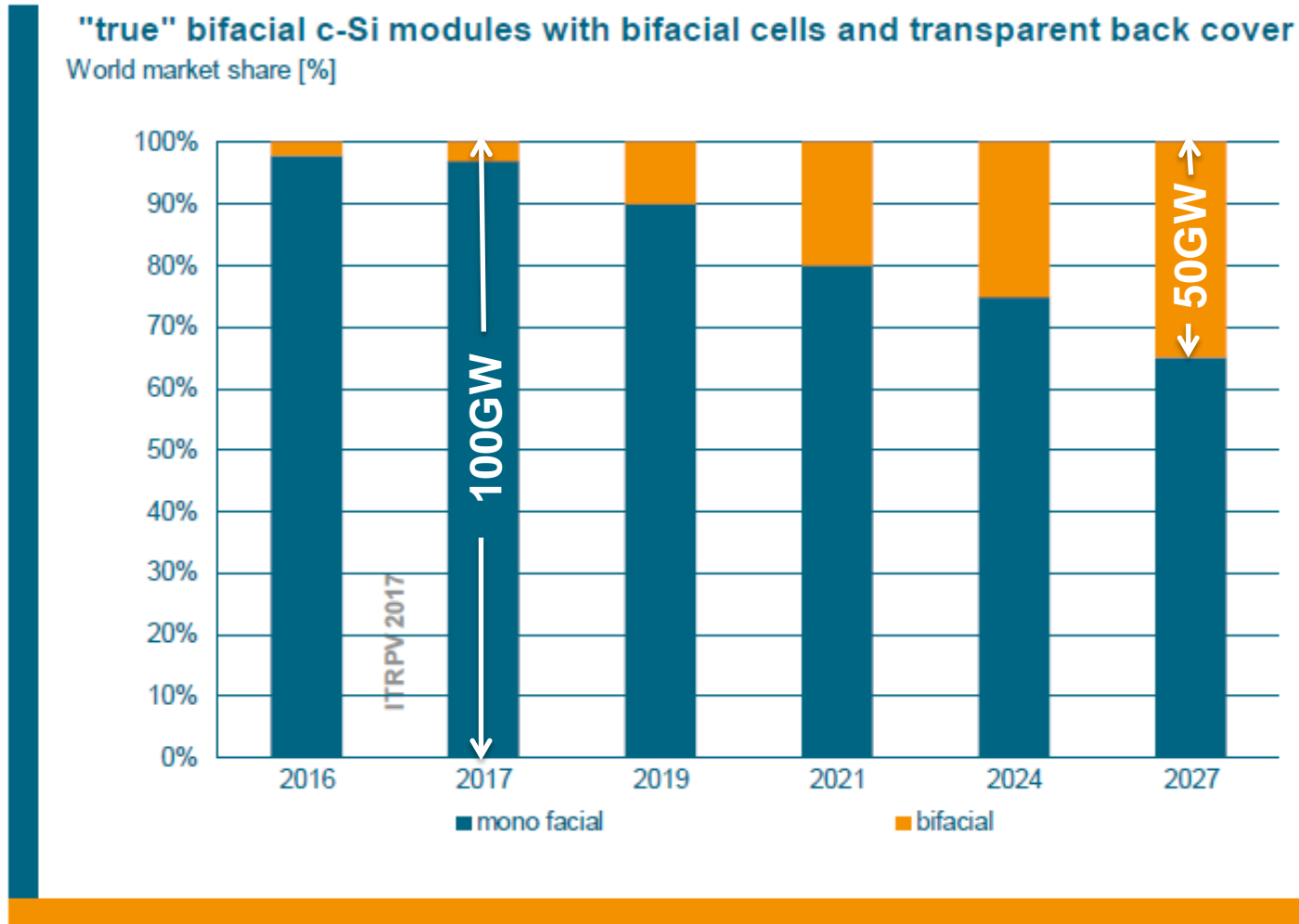


Fig. 43: Worldwide market shares for monofacial and "true" bifacial modules.

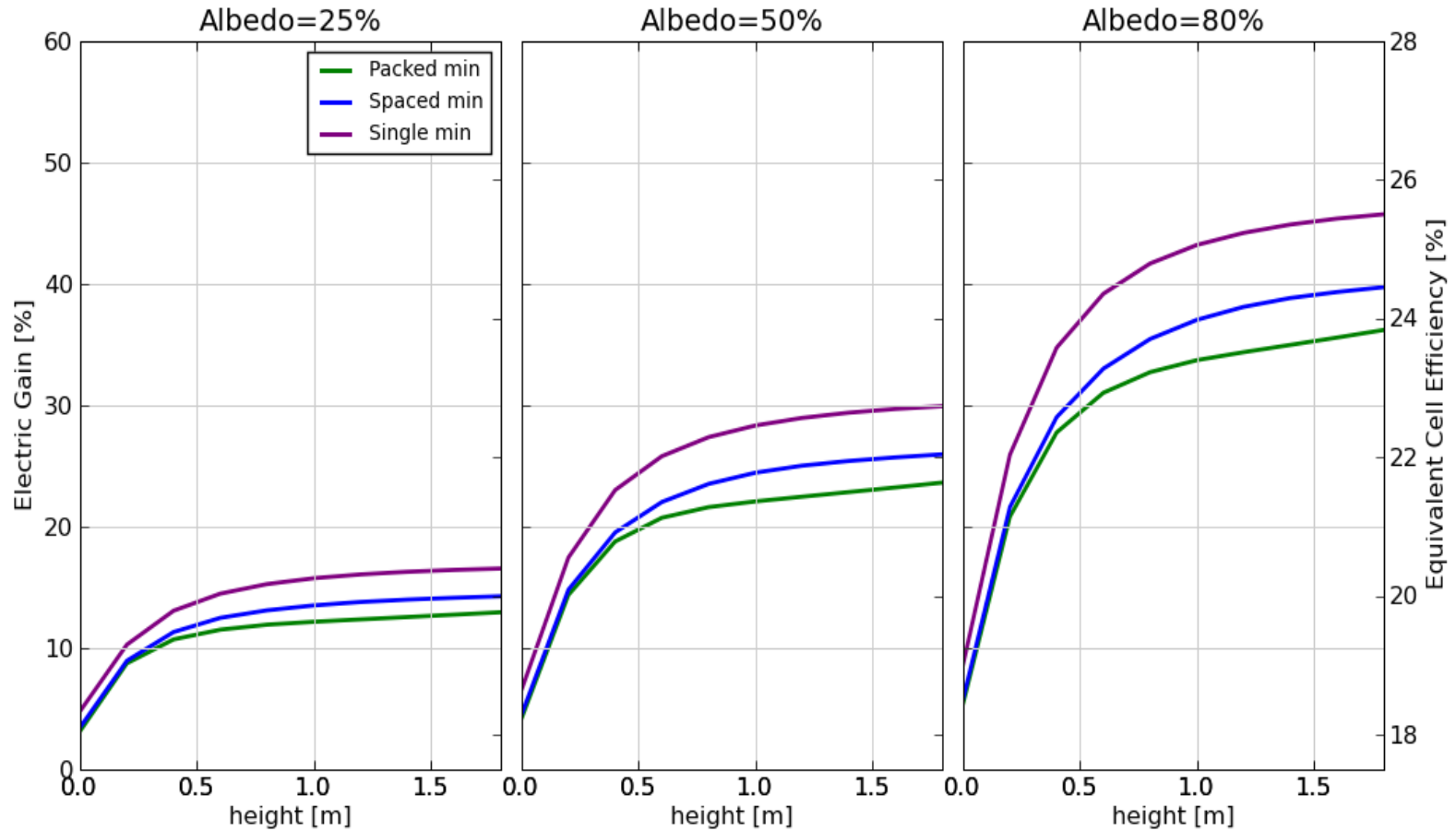


BIFACIAL GAIN

Bifacial gain: fix tilt south/north oriented



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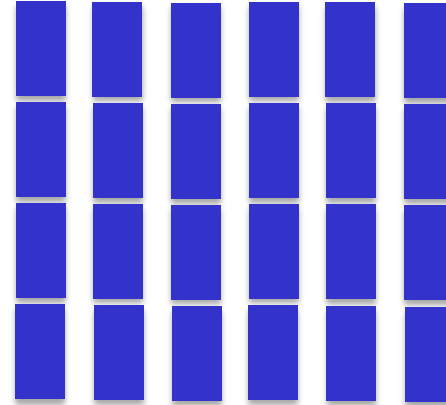
from bSolar > now SolAround

FLAT ROOF

Bifacial gain: fix tilt south/north oriented



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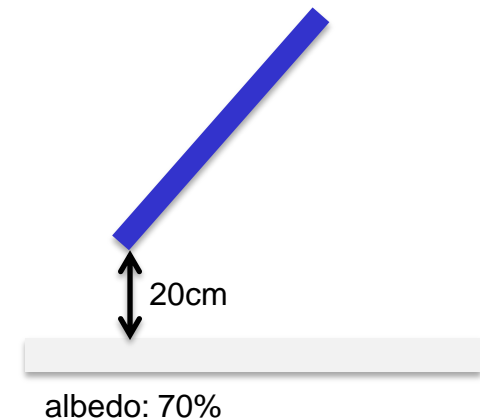
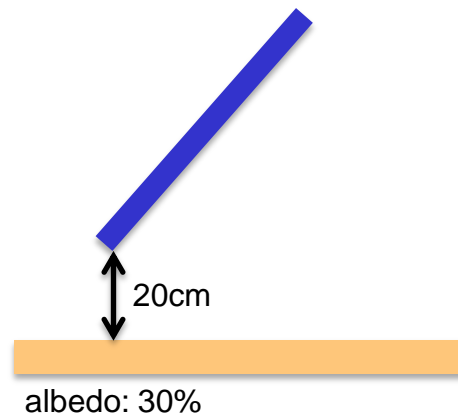
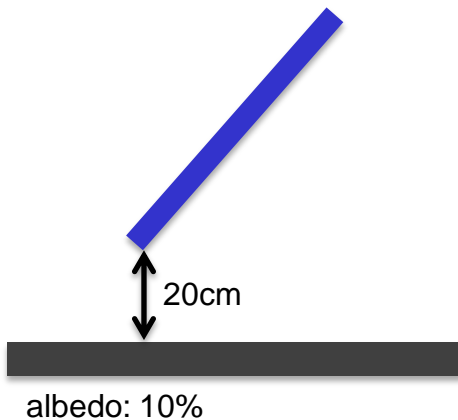


compared with monofacial south/north oriented

bifacial gain: 5%

bifacial gain: 10%

bifacial gain: 15%

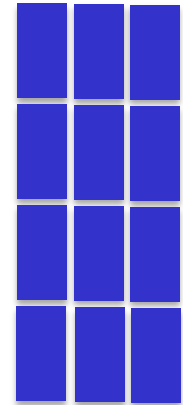
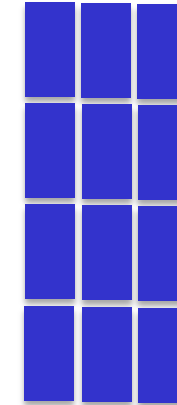
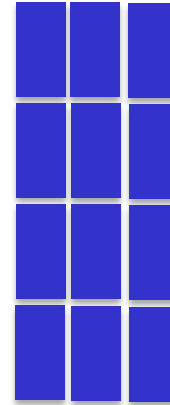


UTILITY SCALE INSTALLATION

Bifacial gain: fix tilt south/north oriented



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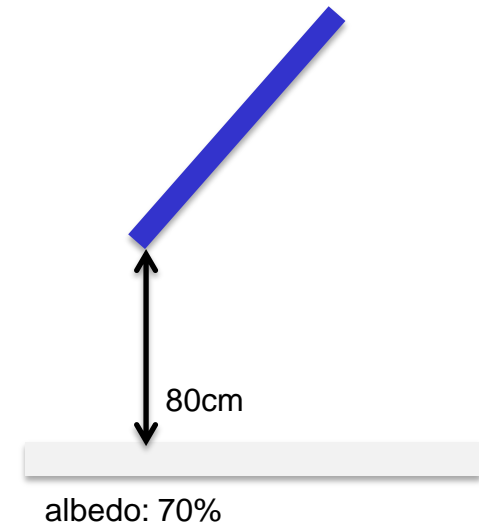
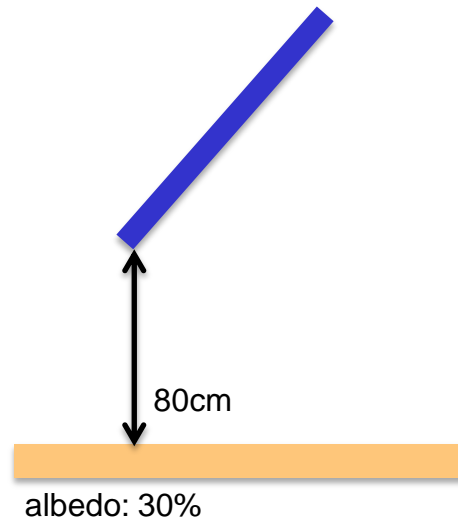
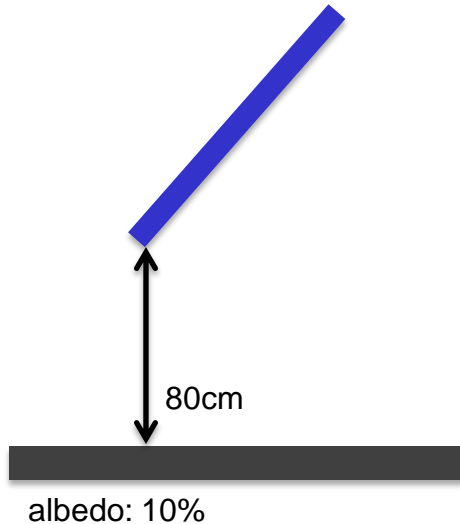


compared with monofacial south/north oriented

bifacial gain: 10%

bifacial gain: 15%

bifacial gain: 30%

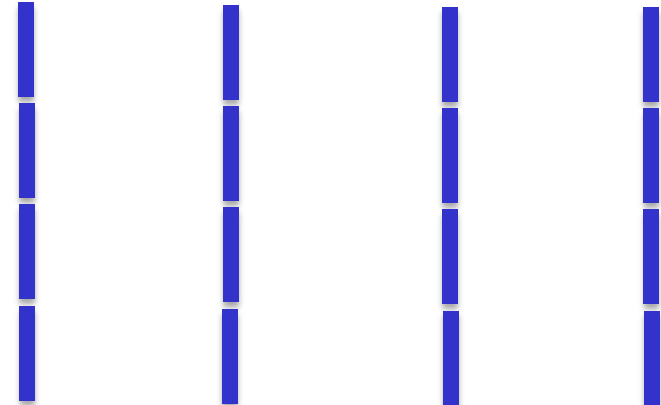


UTILITY SCALE INSTALLATION

Bifacial gain: vertical E/W oriented



Next 2 Sun

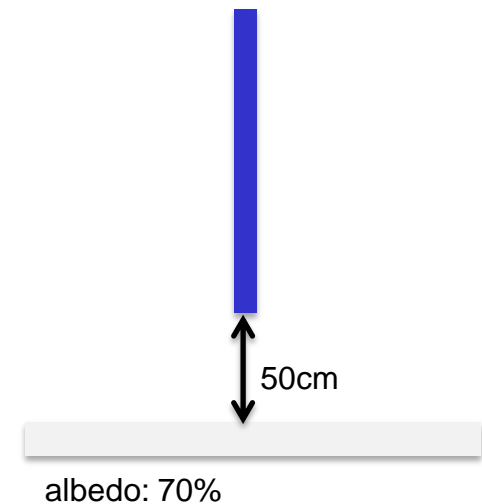
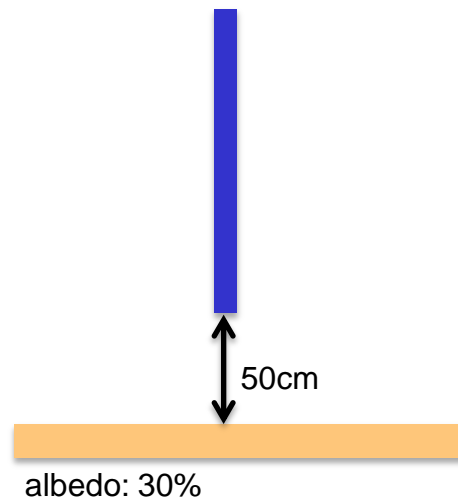
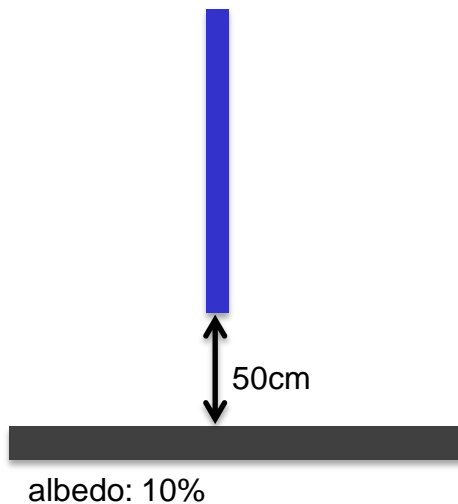


compared with monofacial south/north oriented

bifacial gain: 5%

bifacial gain: 10%

bifacial gain: 15%

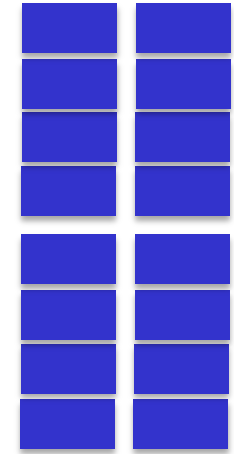
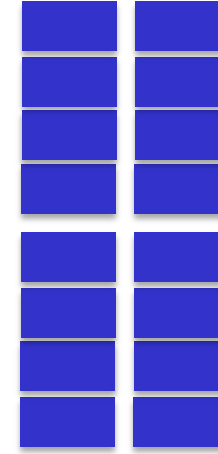
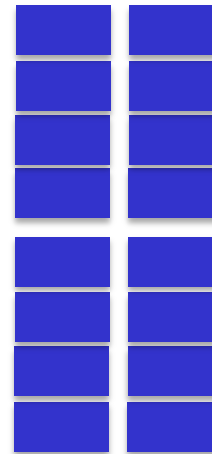


UTILITY SCALE INSTALLATION

Bifacial gain: E/W tracked



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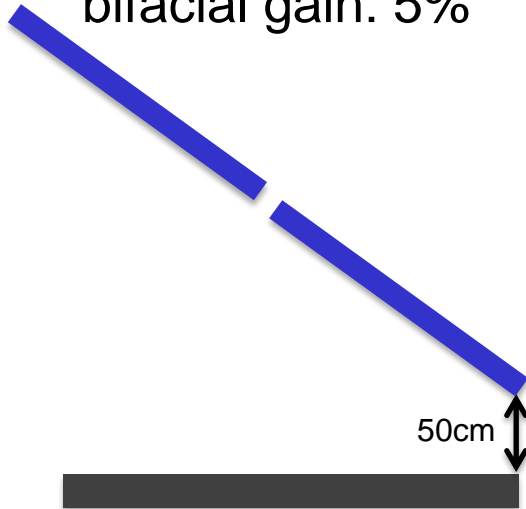


compared with monofacial E/W tracked

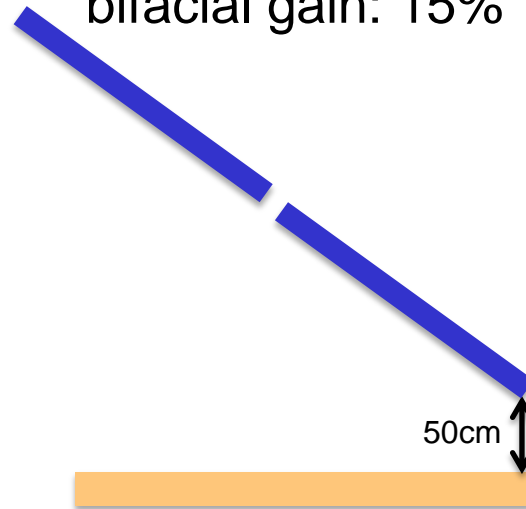
bifacial gain: 5%

bifacial gain: 15%

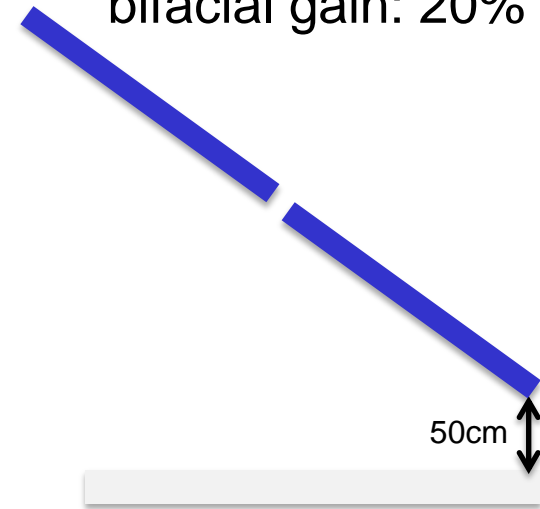
bifacial gain: 20%



albedo: 10%



albedo: 30%



albedo: 70%

The largest enemy of bifaciality is the old-fashioned “Wp thinking” of customers instead of a modern “kWh mentality”.



CHILE- a bifacial country

Chiles 's Solar Program



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PROGRAMA
ESTRATÉGICO
SOLAR

ATACAMA DESERT / STRATEGIC CHALLENGE / **DESERT MODULE / CALL FOR INVESTMENTS** / CONTACT

DESERT MODULE

& SYSTEM TECHNOLOGY PROGRAM

<http://www.desertmodule.cl/>

AtaMoS TeC: bifacial technology center



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Research Center Konstanz

ISC Konstanz to spearhead new PV research centre in Chile

By John Farnell | Aug 18, 2017 12:27 PM BST | 0

Share    

- measurements
- module development
- system development



ISC Konstanz: AtaMo technology in the field at the PDSA testing site in the Atacama desert. Image credit: ISC Konstanz.

German PV research institute ISC Konstanz is leading the development of a new solar development laboratory in Chile.


With the backing of the Chilean government, ISC Konstanz, Fraunhofer Chile, SERC and the French CEA INES will pursue the lowest LCOE possible through a range of activities including optimising desert performance, tracking and bifacial modules and system design. The work will cover soiling, system design and the best module configurations for the harsh climatic conditions.

"It will not be testing only but developing [products] too," said Radovan Kopecek, CTO at ISC Konstanz. "We will set up a module pilot line where we will test and develop new components, new stringing, new design and so on," he added.



- c-Si solar cells in future will be bifacial anyhow
- many companies are already producing bifacial cells:
PERC+, nPERT, HJT, mcPERCT
- many modules in future will be glass-glass based anyhow
- the system kWh can be extremely increased by using bifacial modules and simple tracking in addition

**>> WE HAVE TO CHANGE TO COSTS/KWH THINKING,
CREATE STANDARDS AND BRING BIFACIALITY INTO PV
MARKET**

An aerial photograph of a coastal town and harbor. The water is a vibrant blue, and a large boat is moving from the top left towards the center, leaving a white wake. The town below features a mix of green trees and buildings with various roof colors. A long pier extends into the water on the right side, with several smaller boats docked. The overall scene is bright and sunny.

**Bifacial PV will not only reduce LCOE-
it will bring you to great places!!**

ENJOY!!!