

400kW bifacial system in NL and comparison with two other systems



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bifiPV workshop Konstanz

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Quick facts



- 150 people
- Production of Diffusion, (L)PECVDsystems for Solar, MEMS & Semi
- Heating & Cooling by Air-to-air heatpumps (electricity only)
- Yearly electricity consumption= 480 MWh
- Since June 2017: 400k Wp bifacial PV park to cover 80% of electr.
- SDE+ subsidy granted by Ministry of Economic Affairs (RVO)

Top View PV Park (PV 1)

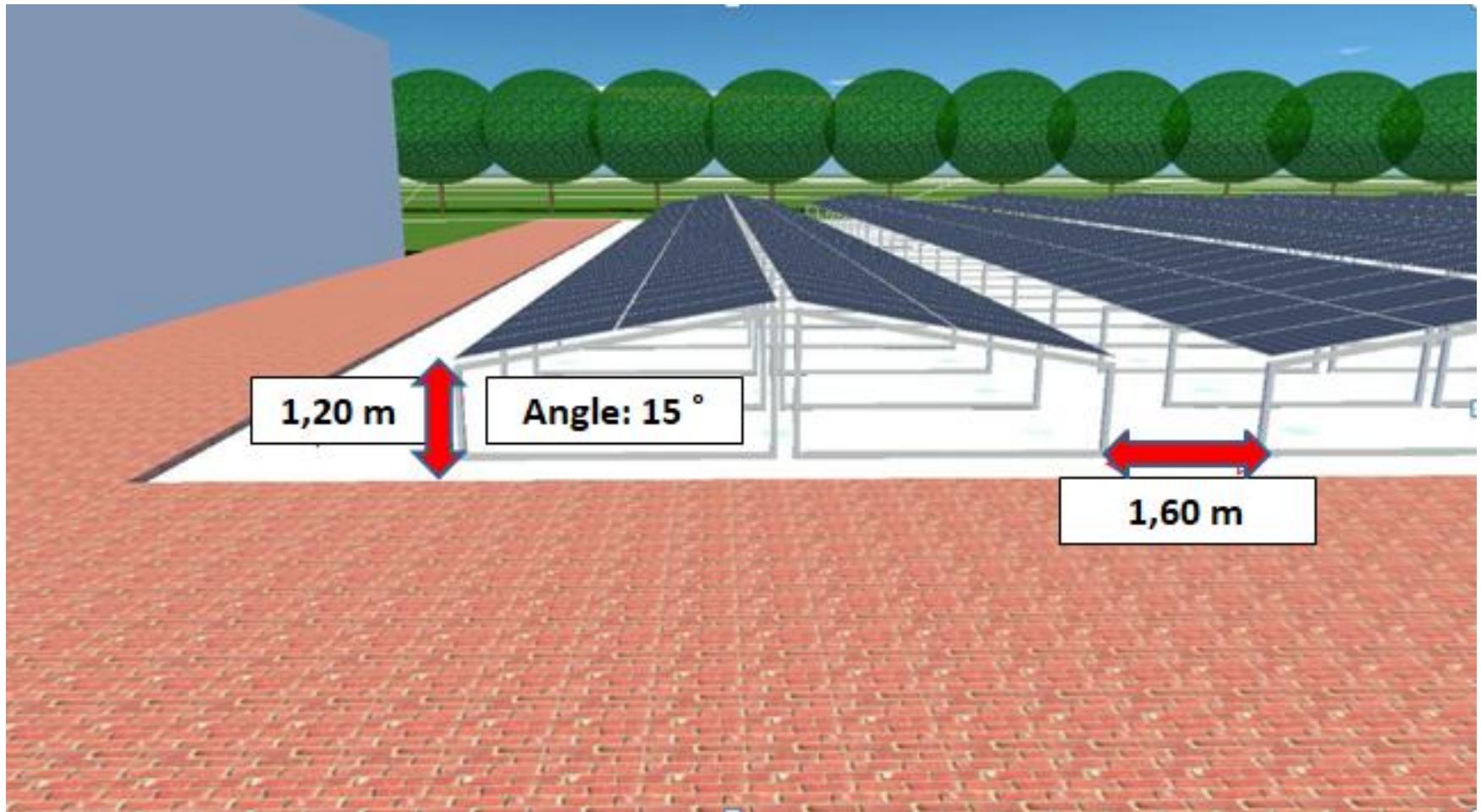
1428 bifacial modules
7 Rows of 204 modules
East-West Orientation
400 kWp (front side only)



Albedo of Pebbles: 40%



Design PV Park (PV 1)



Design E-W PV Park (PV 1)

- East West park have 400kW on 3300 m² which is 1,2 MW per Ha (10.000 m²)
- South orientation with large row-row distance would require 10.000 m² which is 0,4 MW per Ha

Kwh/m² density can be 3x higher

PV 2: Bifacial Setup

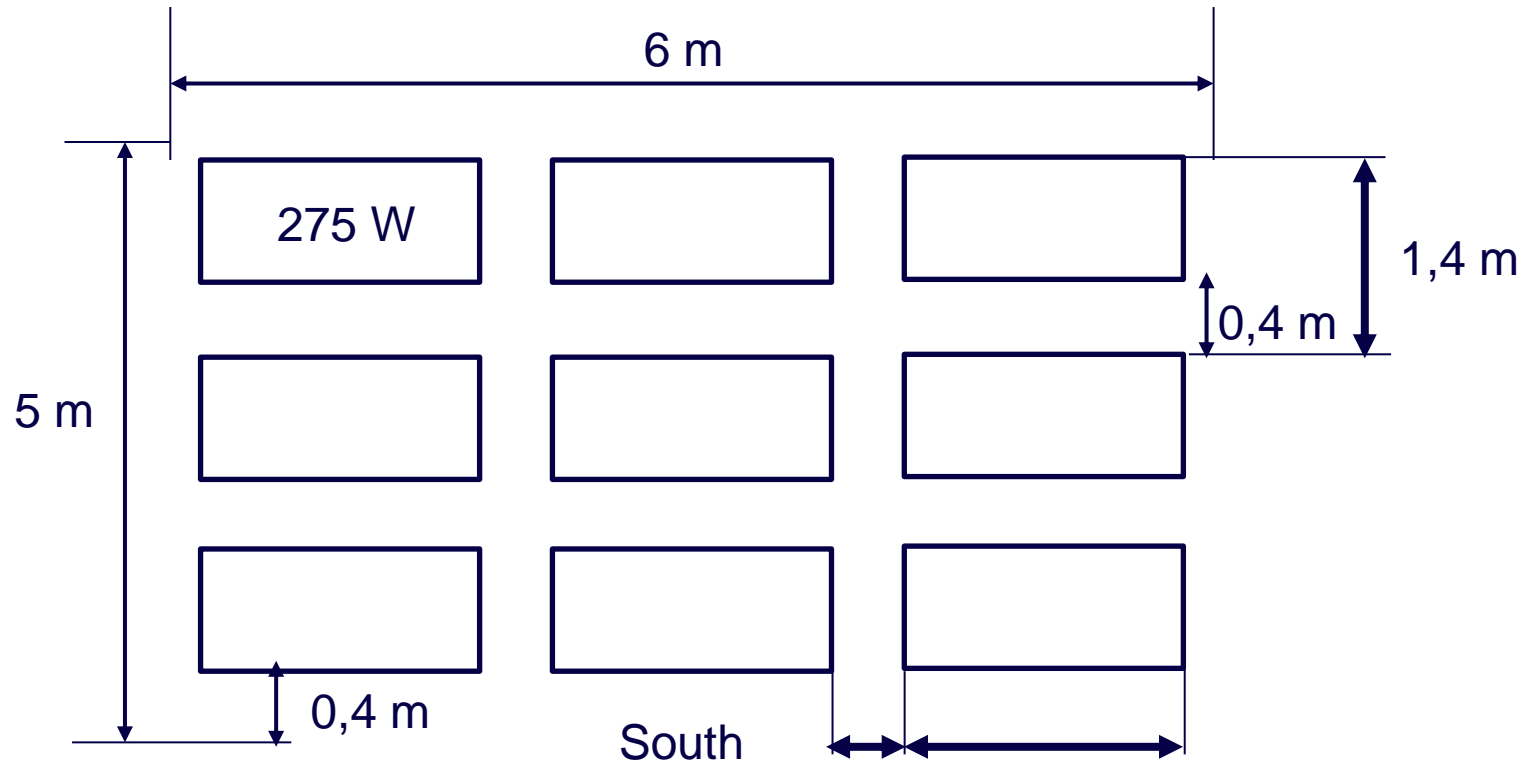


- ✓ 9 x Yingli Bifacial Panda, glass-glass 275Wp (1 STC, front side)
- ✓ Mounting system from Benz-Alu Systemen
- ✓ 1x Sofar string inverter 3000W
- ✓ Flat roof (black EPDM) painted white (Paint from O.A.F. Holland).

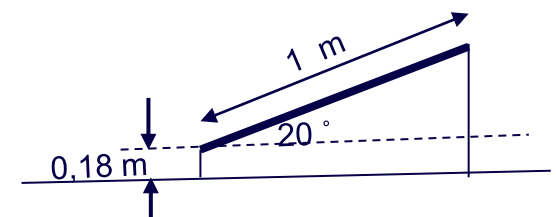
An aerial photograph of a solar panel array installed on a white roof. The panels are arranged in two rows, with a central text overlay. The background shows green trees and a grassy area.

Albedo of Paint: 63%

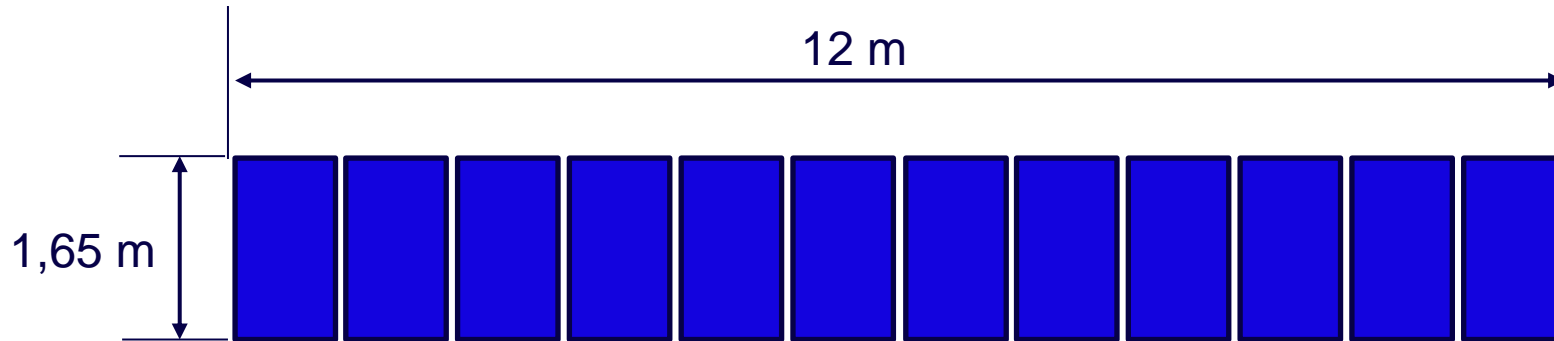
PV 2: Design Bifi PV system



9 Bifacial modules mounted in landscape 0,35 m 1,65 m
Angle: 20 degrees
Height lowest point: 0,18 m
Orientation: South
Location: Epe, NL



PV 3: Standard mono facial system



12 Panels monofacial Trina 260W black

String inverter: JSI-3000TL

Portret on rooftop

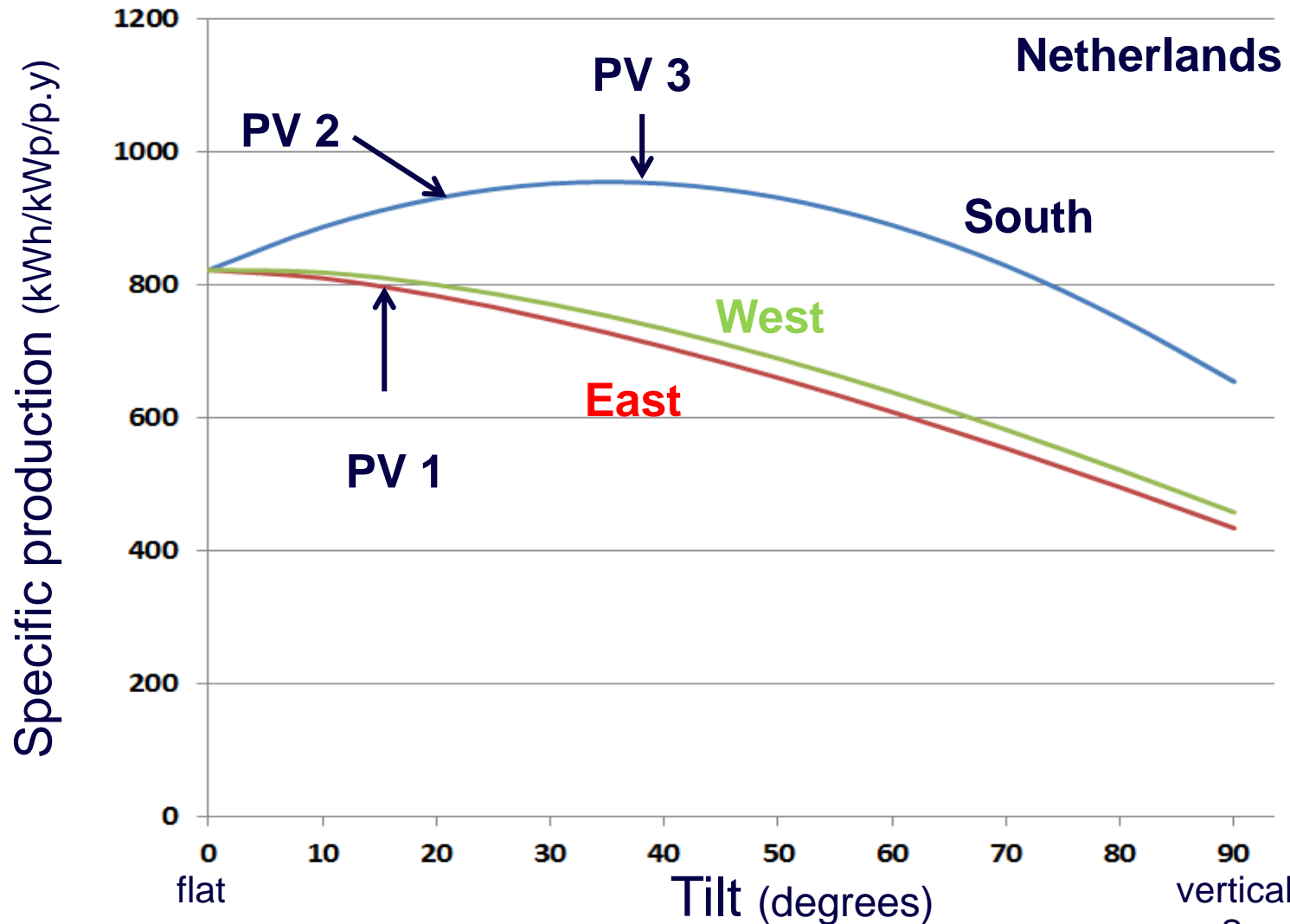
Orientation (tilt): South (40°)

Height lowest point: 2,5 m

Location: Epe (NL)



Production vs orientation, monofacials



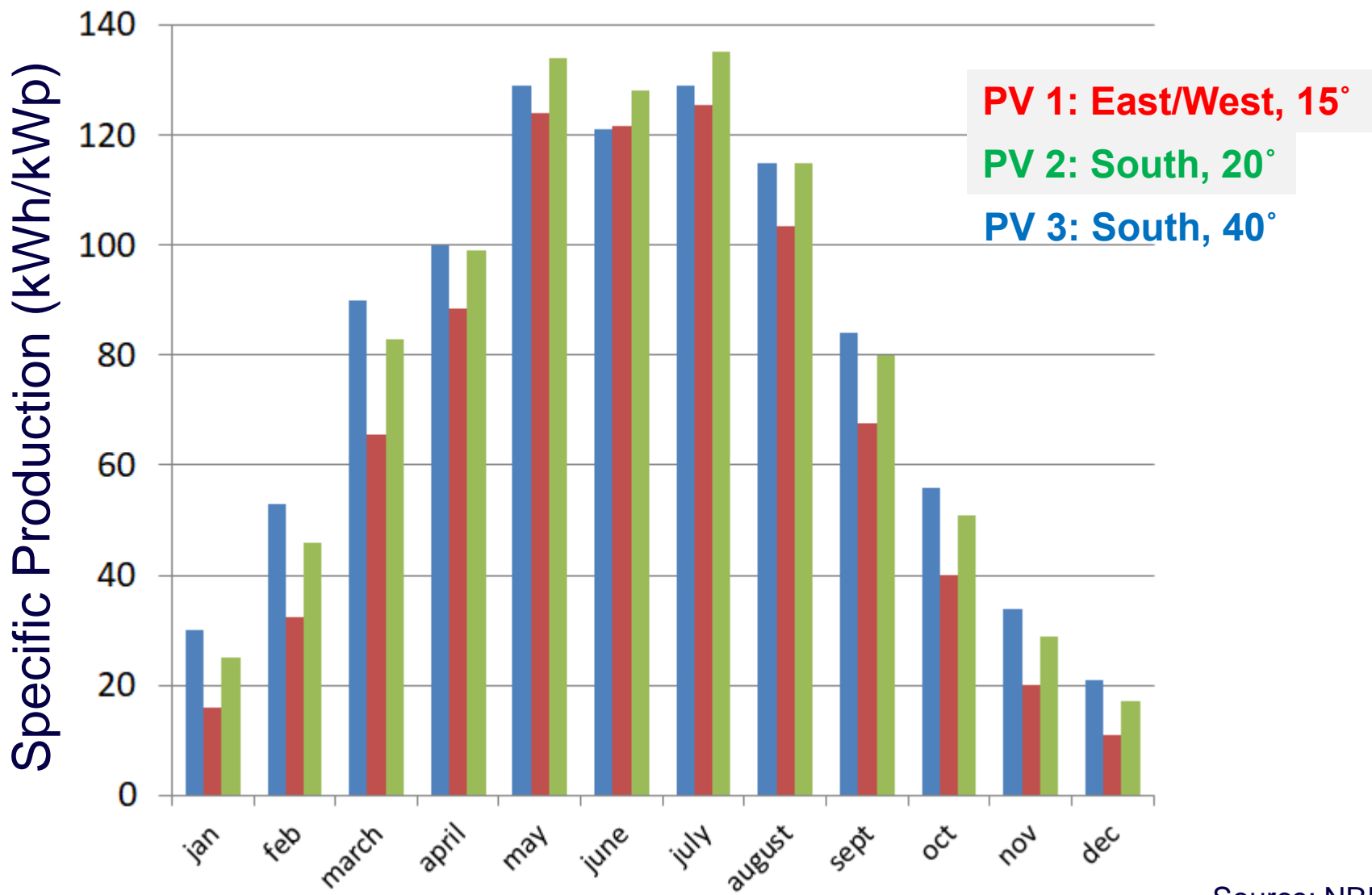
Yearly production vs orientation (monofacial)



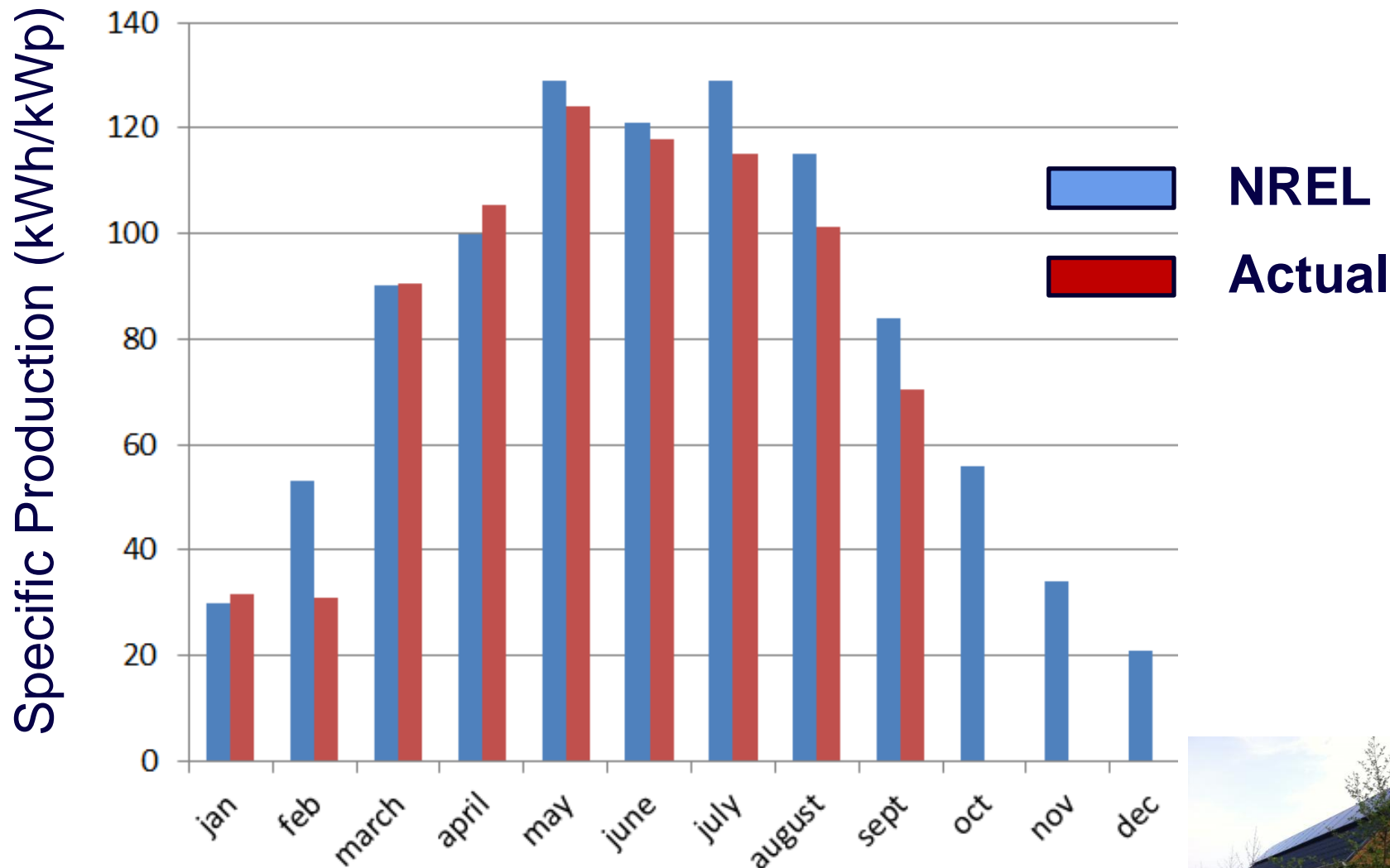
PV System	Azimuth	Tilt Angle	kWh/kWp/ p.y.	%
PV1	East/West	15°	816	-15
PV2	South	20°	942	-2
PV3	South	40°	962	0

But we want to look at monthly data

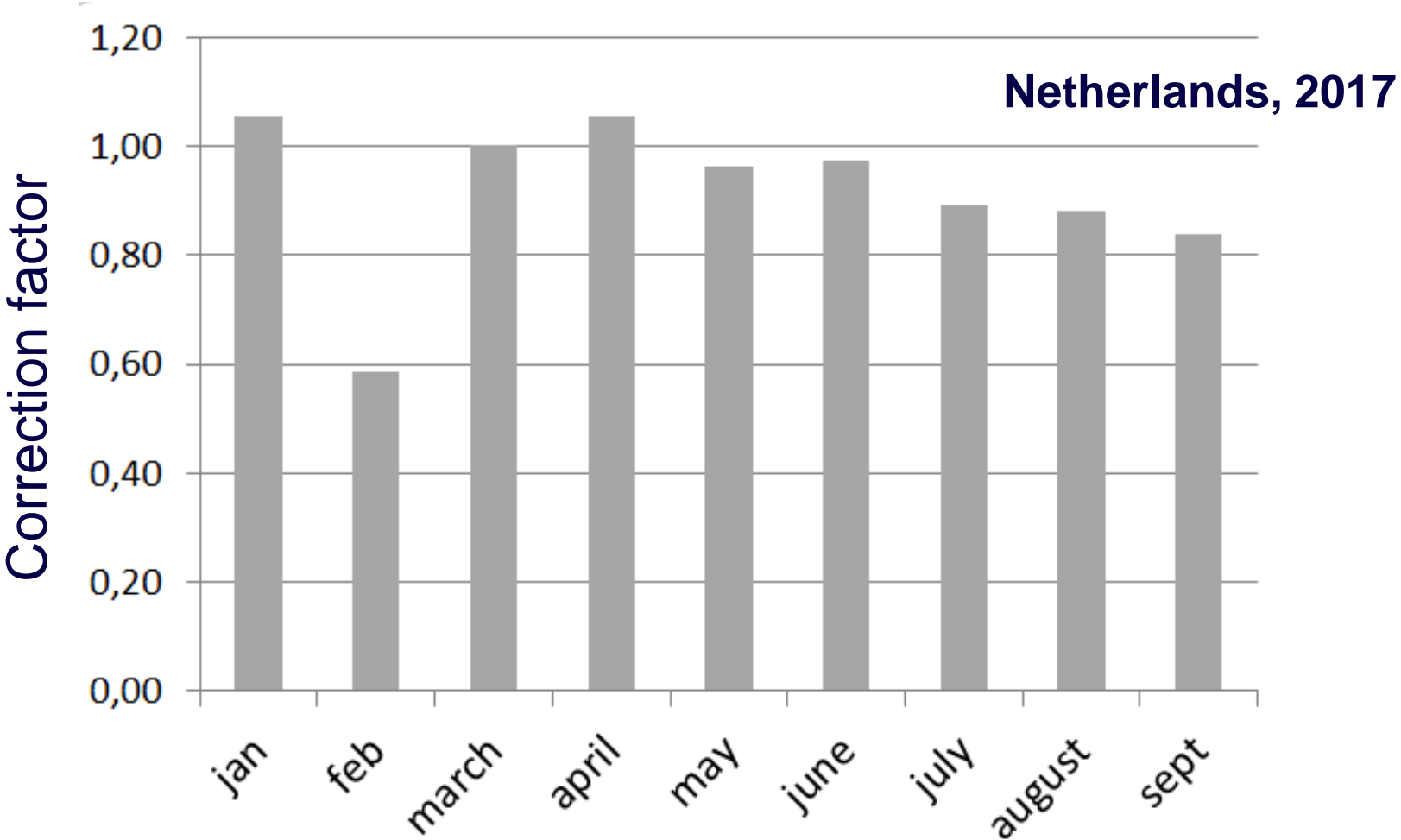
Monthly production data (monofacial)



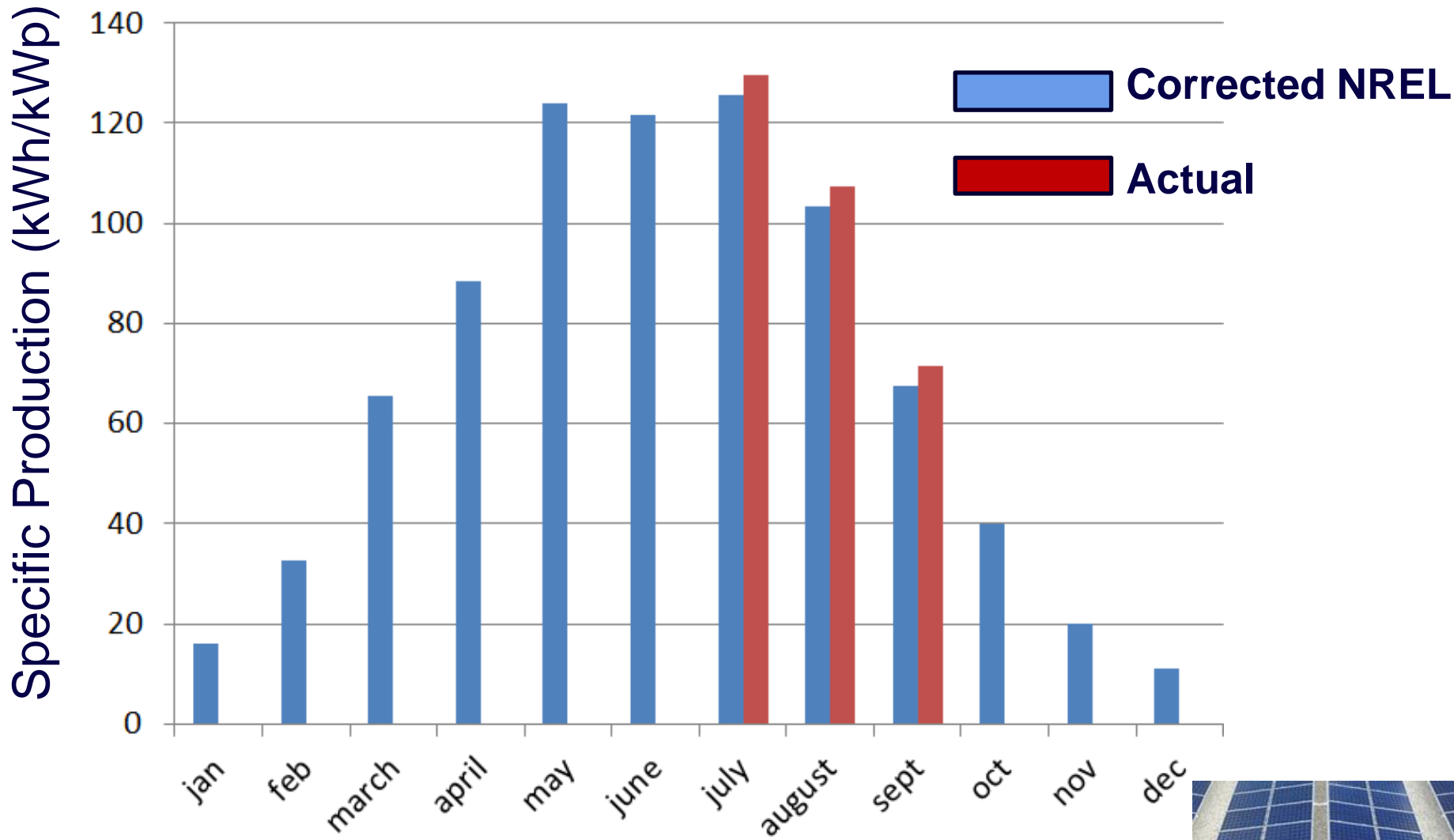
PV 3 monofacial (S, 40°) vs NREL



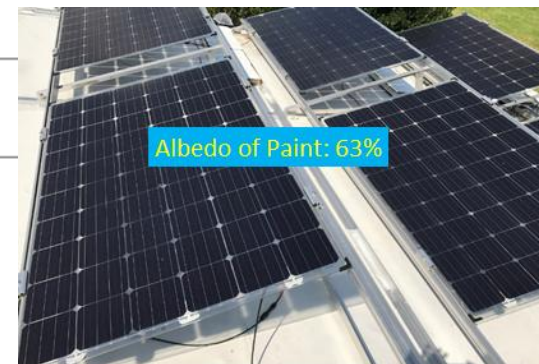
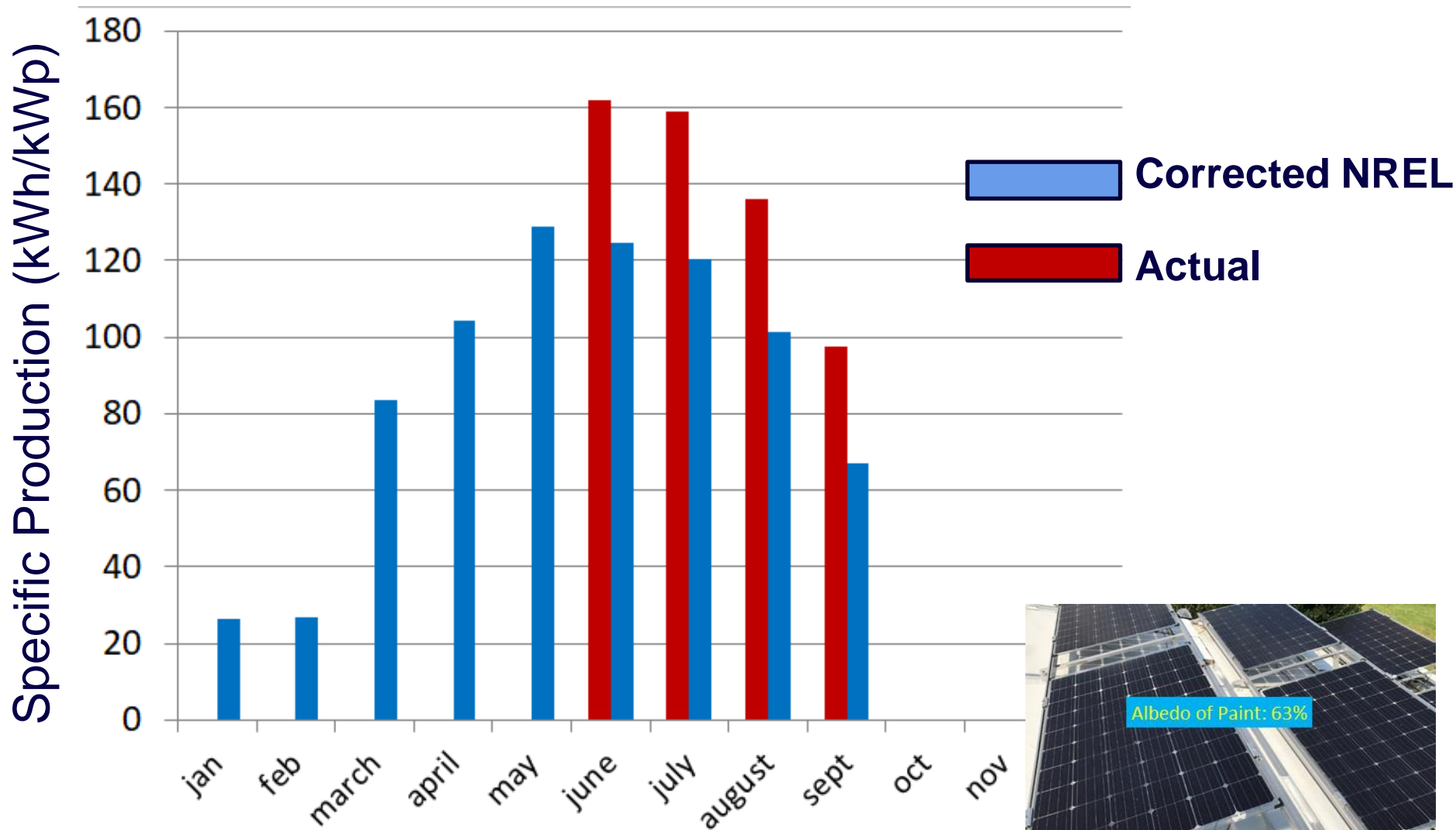
Correction factor for NREL model



PV 1: Bifi 400k E-W PV park vs corrected model

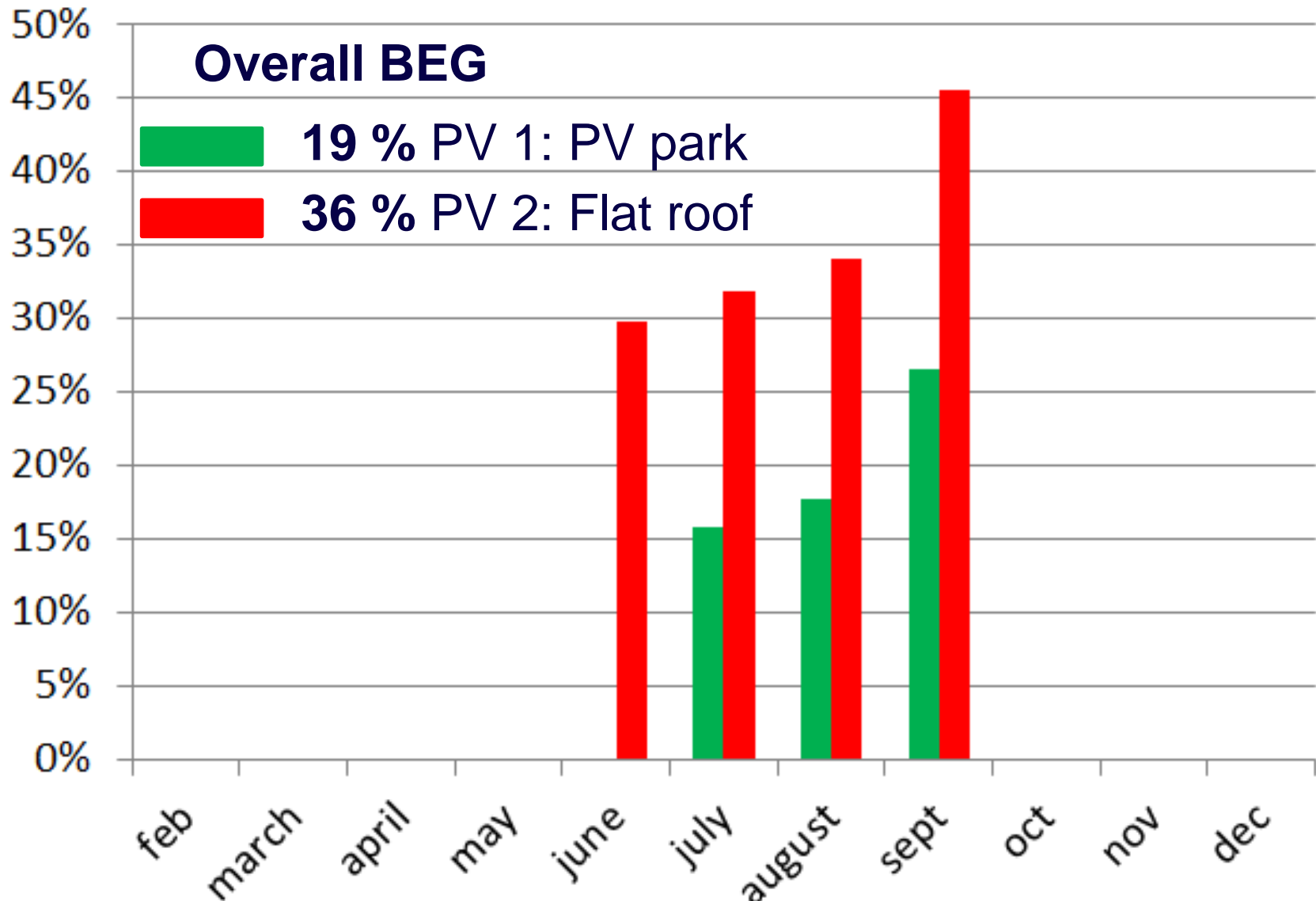


PV 2: Bifi S, 20° vs corrected model



Bifi Energy Gain (BEG)

PV 1: PV Park E/W, 15 ° and PV 2: flat roof S, 20 °



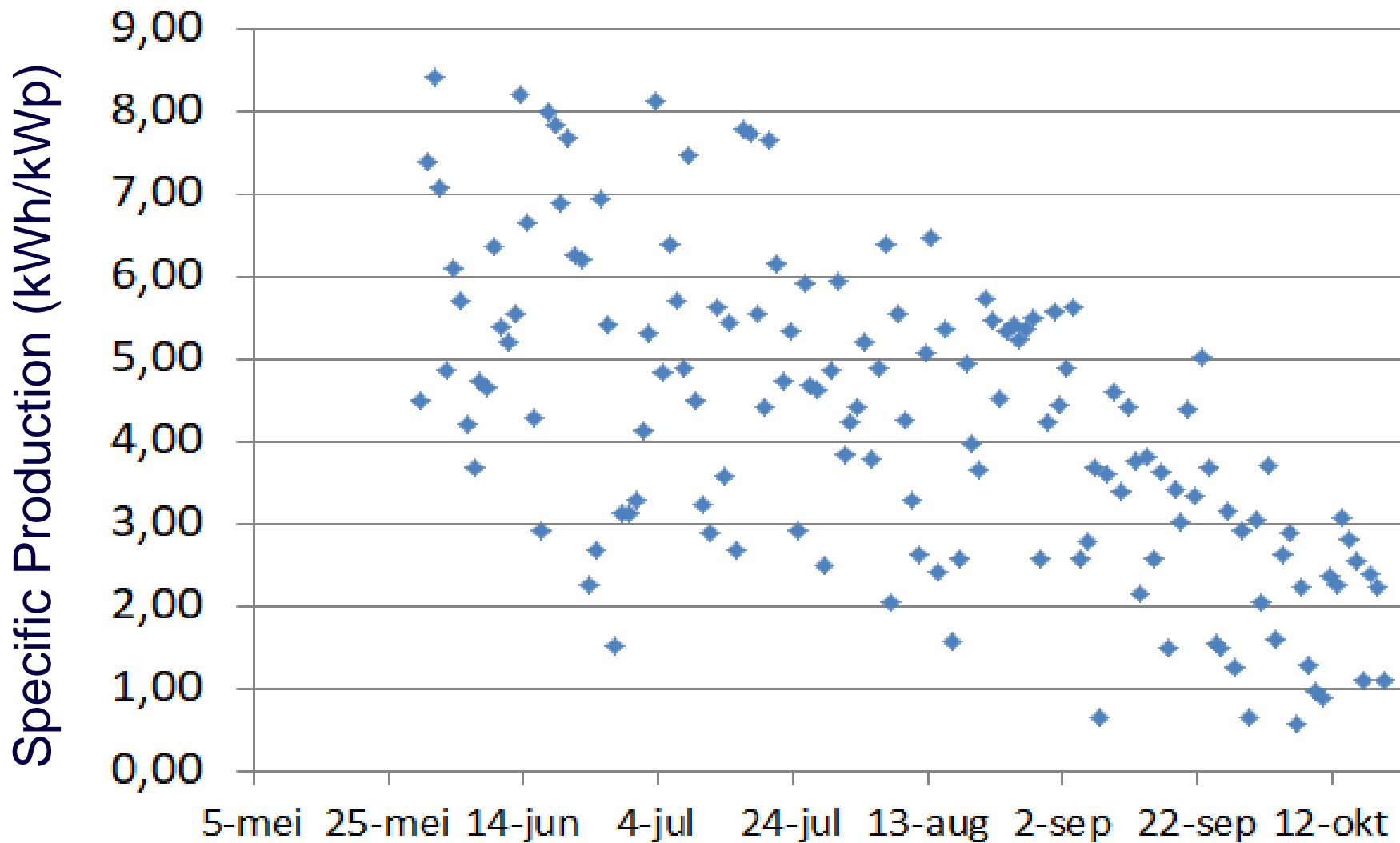
Sanity Check



Let's compare daily production data

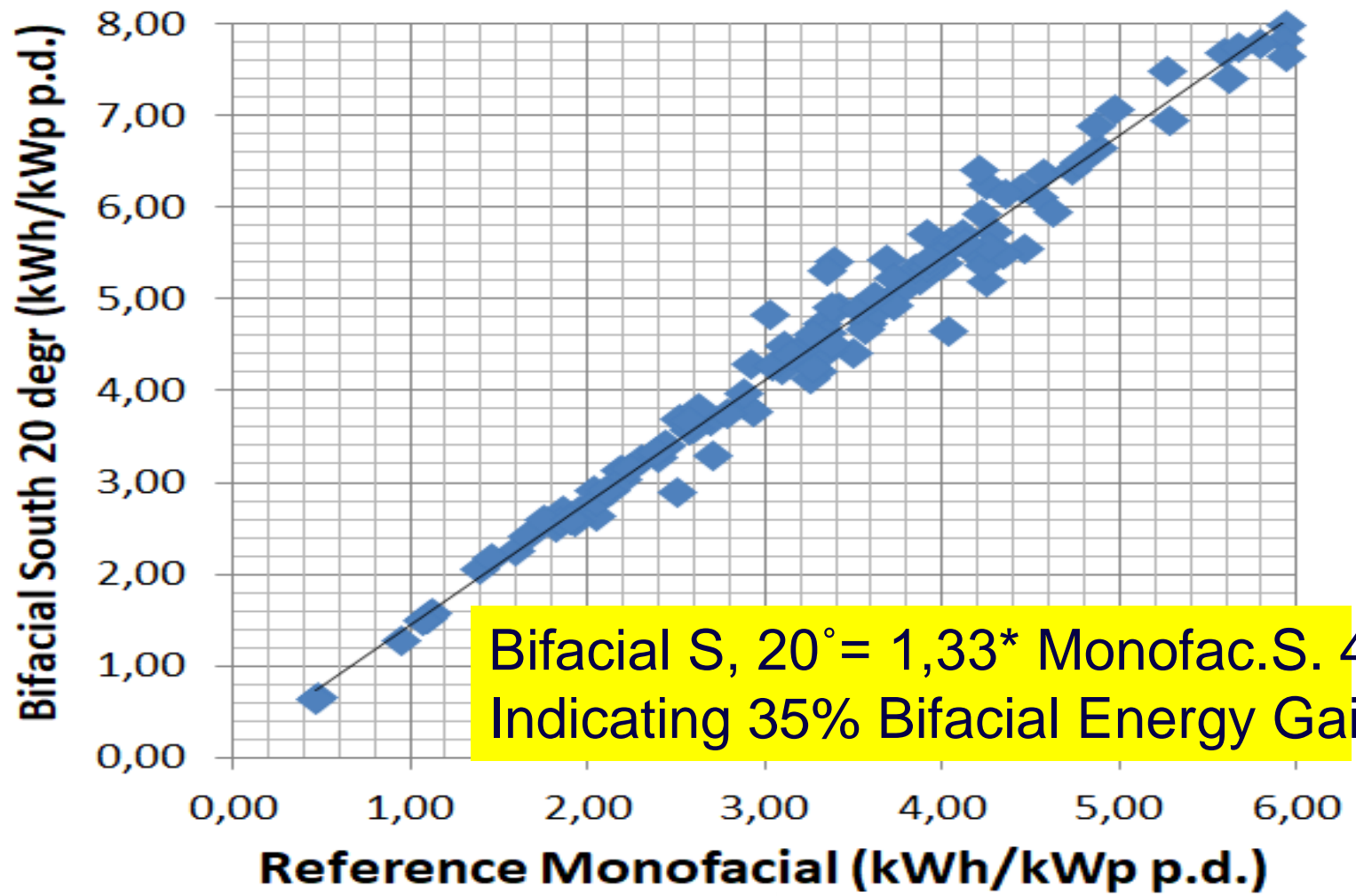
Specific Production per day

PV 2: Bifi flat rooftop



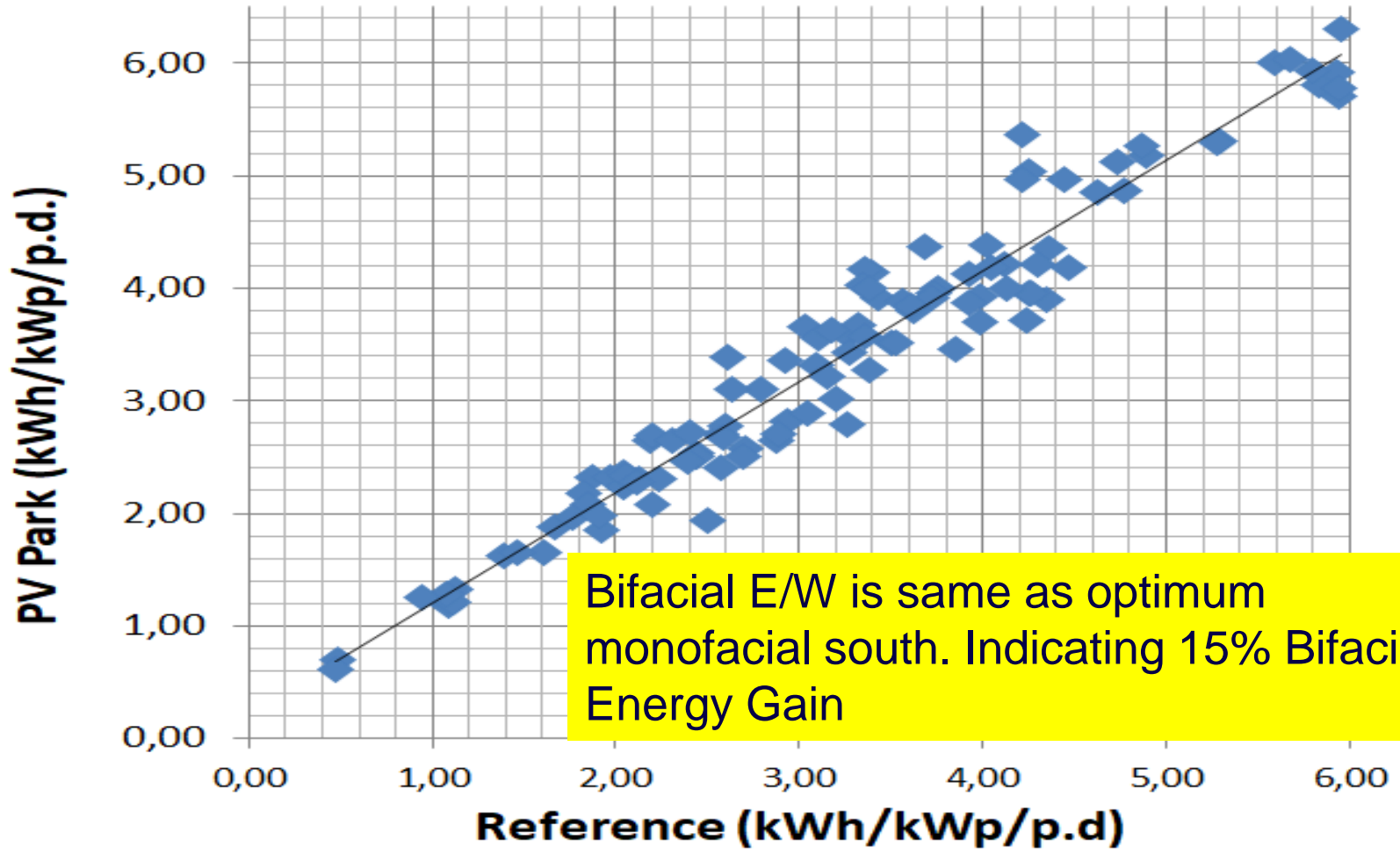
Production Comparison

PV 2 Bifi flat roof S vs PV 3 – monofi S.tilted



Production Comparison

PV 1: bifi E/W Park vs monofi- PV 3 Monofi S



Bifacial E/W is same as optimum monofacial south. Indicating 15% Bifacial Energy Gain



Conclusion

- From July-September consistent bifacial gains were seen for both bifacial pv systems
- Two methods were used to determine BEG which were all in close range. One was a comparison with PVWatts model from NREL and the other was a comparison with a monofacial pv system.
- The overall BEG from July-September were:
 - Bifacial ground mounted East-West : 15% - 19%
 - Bifacial flat roof South with spacing: 35% - 36%
- East-West can have more than 3x more density kWh/m²
- Increase of BEG was noticed towards Autumn
- Full year data is needed to characterise in more detail.



Thank you!

Questions?

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Spare slides

Performance of Reference (PV3)

Orientation: south, angle:40 degrees



Last three years: 9100 kWh
P installed: 3,12 kWp

⇒ Avg: 970 kWh/kWp p.y.
NREL: 962 kWh/kWp p.y.

✓ No deterioration noticed

✓ On sunny days still reach above max power (1 STC)

+

← 10% above Pmax

