

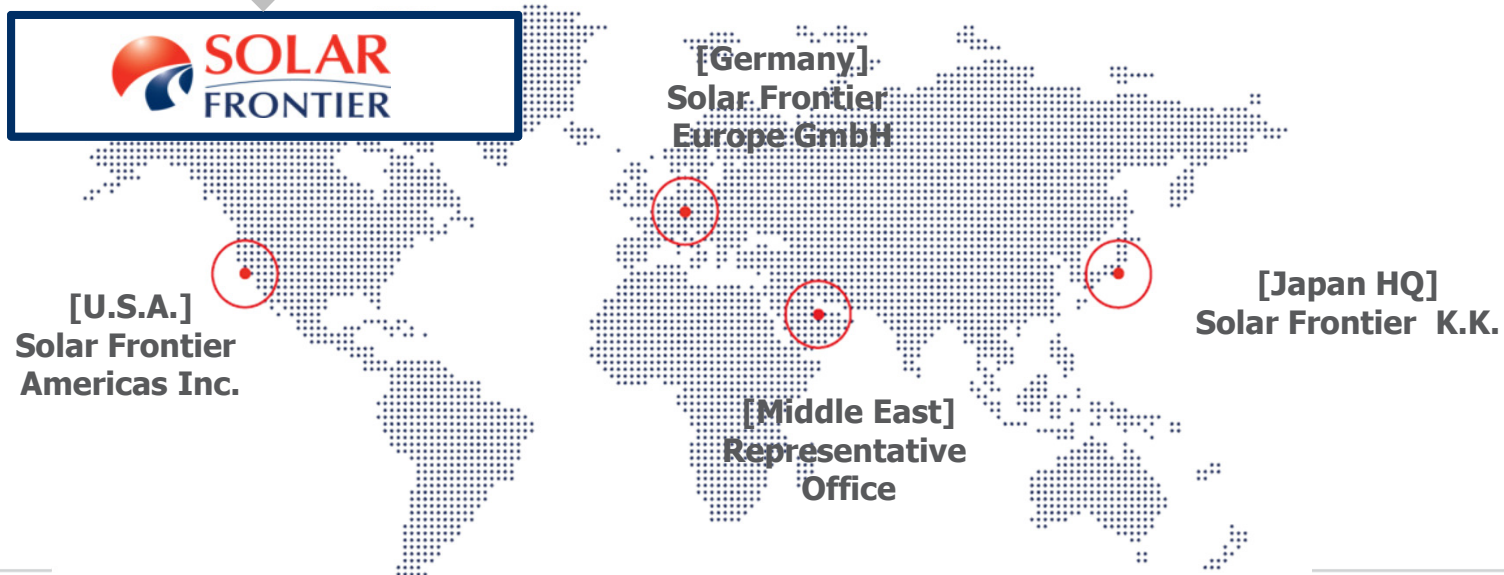
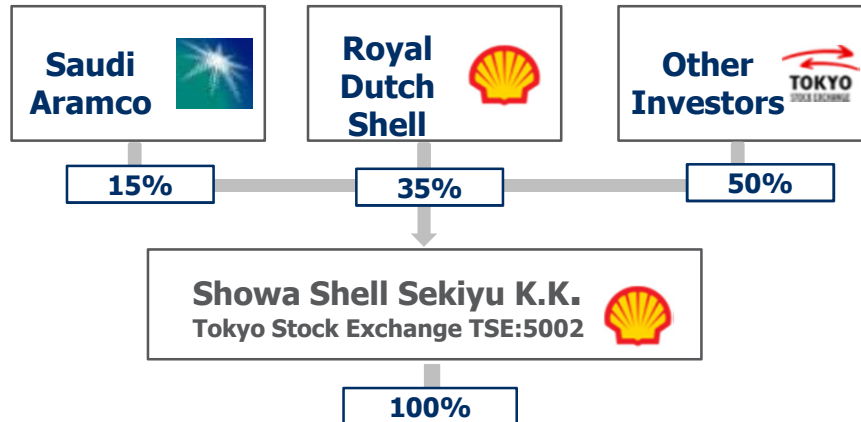
Solar Frontier 3rd Annual Solar & Off-Grid Renewables SEA Conference

November 2015

Disclaimer

- **The data presented in this document is the proprietary information of Solar Frontier K.K. and is intended for discussion purposes only.**
- **Solar Frontier does not intend to warranty any data beyond the performance specifications of CIS modules as indicated in their respective specification datasheets.**

Solar Frontier -- Founded in 2006 after decades of R&D, to commercialize Solar PV technology & to become a Global Solar Energy Solutions Provider



Solar Frontier: World's Largest CIS Module Production Plant 1+ GW Capacity



Manufacturing Excellence & Scale

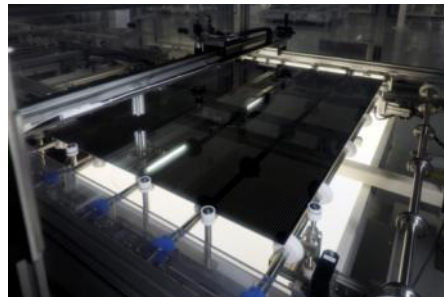
Solar Frontier's proprietary lines are fully automated, proven in mass production 1GW scale and producing modules at world-class cost



Inspiring Trust

"What impressed us most...was the level and intensity of quality control."

BNP Paribas Research, July 2011



Surpassed 3GW Shipments Worldwide in June 2015 in All Client Segments

Solar Frontier is the only CIS company to have achieved production and sales at gigawatt-scale volume

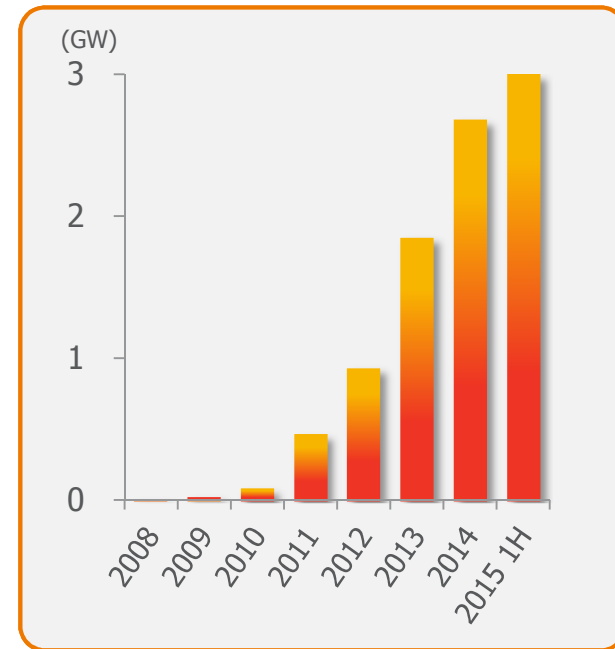
47 Countries

Direct shipments



3 GW+

Cumulative Sales



Product & Services Ensuring High ROI And Low Risk

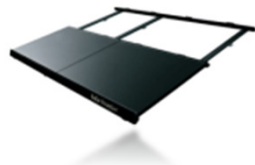
Solutions that reduce cost and improve performance at every step for residential, commercial and utility-scale customers

CIS Modules



- SF-series
- Solacis Neo (lightweight)

System Components



- Mechanical BOS
- Electrical BOS

Smart Solutions



- Optimized System Packages
- Home Energy Managements Systems

Project Development



- Power Plant development and sales

After-Sales Care



- Monitoring
- Operation & Maintenance

Residential Rooftop PV Systems

**Viareggio
Italy**

1.1 kWp



**Kyoto
Japan**

3.4 kWp



**Newcastle
Australia**

9.2 kWp



**Windhoek
Namibia**

9.2 kWp



**Backnang
Germany**

9.6 kWp



**Hawaii
U.S.A.**

16.7 kWp



Commercial Rooftop PV Systems

Tokyo Sky Tree[®], Japan



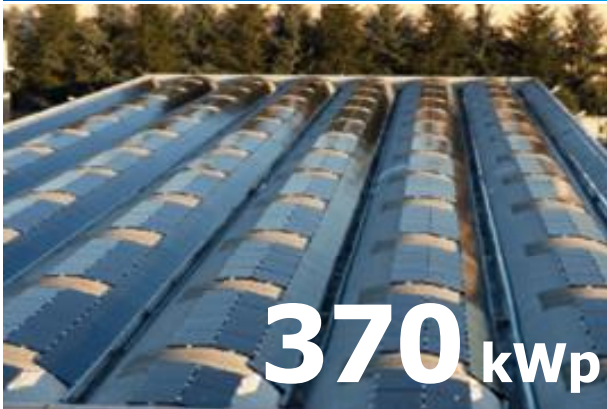
Lelystad, Netherlands



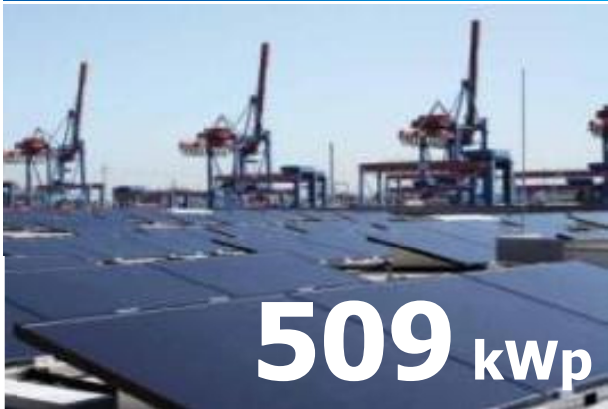
Tokyo, Japan



Burago di Molgora, Italy



Hamburg, Germany



Ground-Mount PV Systems

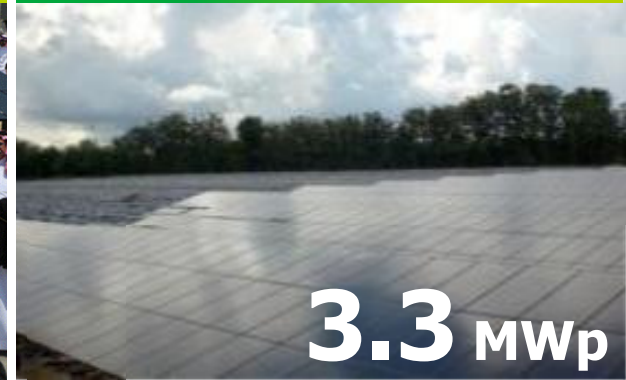
Canlubang, Philippines



Farasan Island, Saudi Arabia



Phetchabun, Thailand



Kansai Airport, Japan



Bochow, Germany



California, U.S.A.



World's Largest CIS Power Plant – Solar Frontier Technology Winner of Intersolar USA

82MW Project Catalina in the USA



Solar Power Plant Developer

Low-Risk, High Performance CIS Solar Power



Recent Headlines:

- US** 280 MW pipeline start
- UK** 100 MW pipeline start
- Japan** 300 MW, first project sold to MUFG

Project Flow:

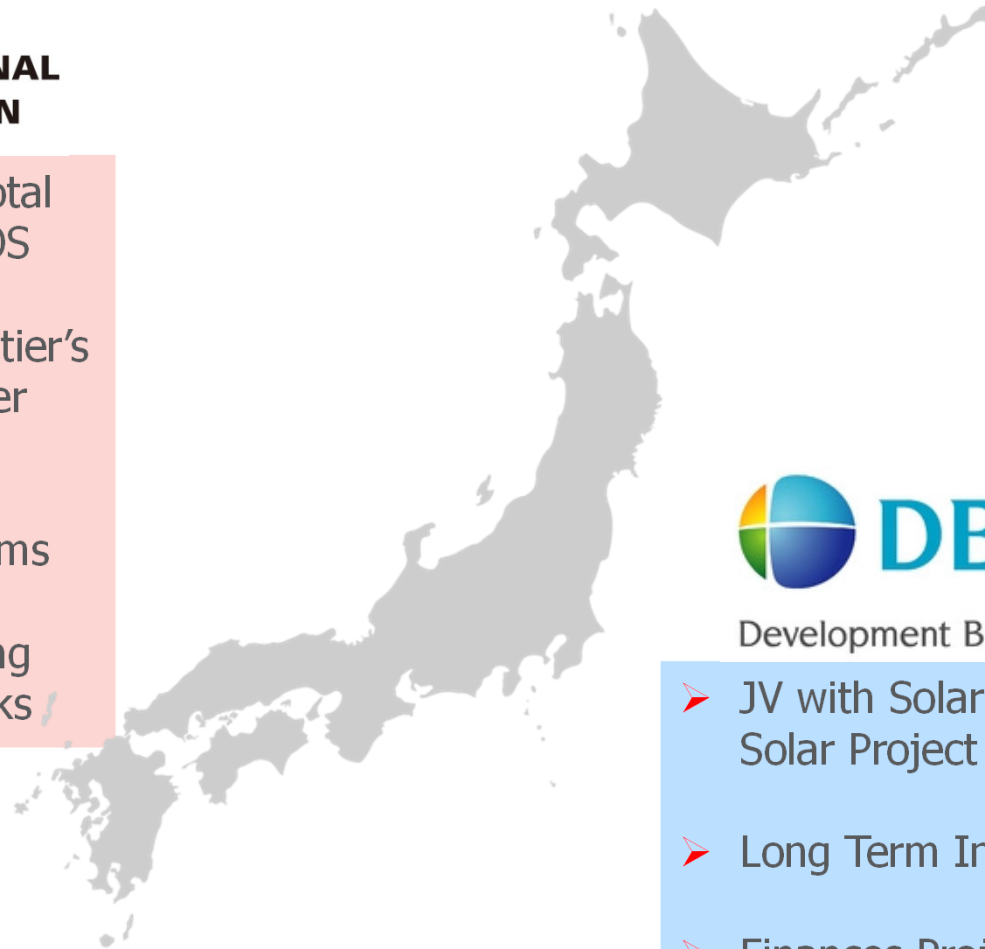


Financing Support by DBJ & JBIC (Japan Ex/Im Bank) for Solar Frontier Clients and JV Projects



**JAPAN
BANK FOR
INTERNATIONAL
COOPERATION**

- Financing Exports for Total Systems: Panels and BOS
- Financing for Solar Frontier's (& Partners') Solar Power Projects Internationally
- Favorable Financing Terms
- Direct & 2-Step Financing with Top Tier Local Banks



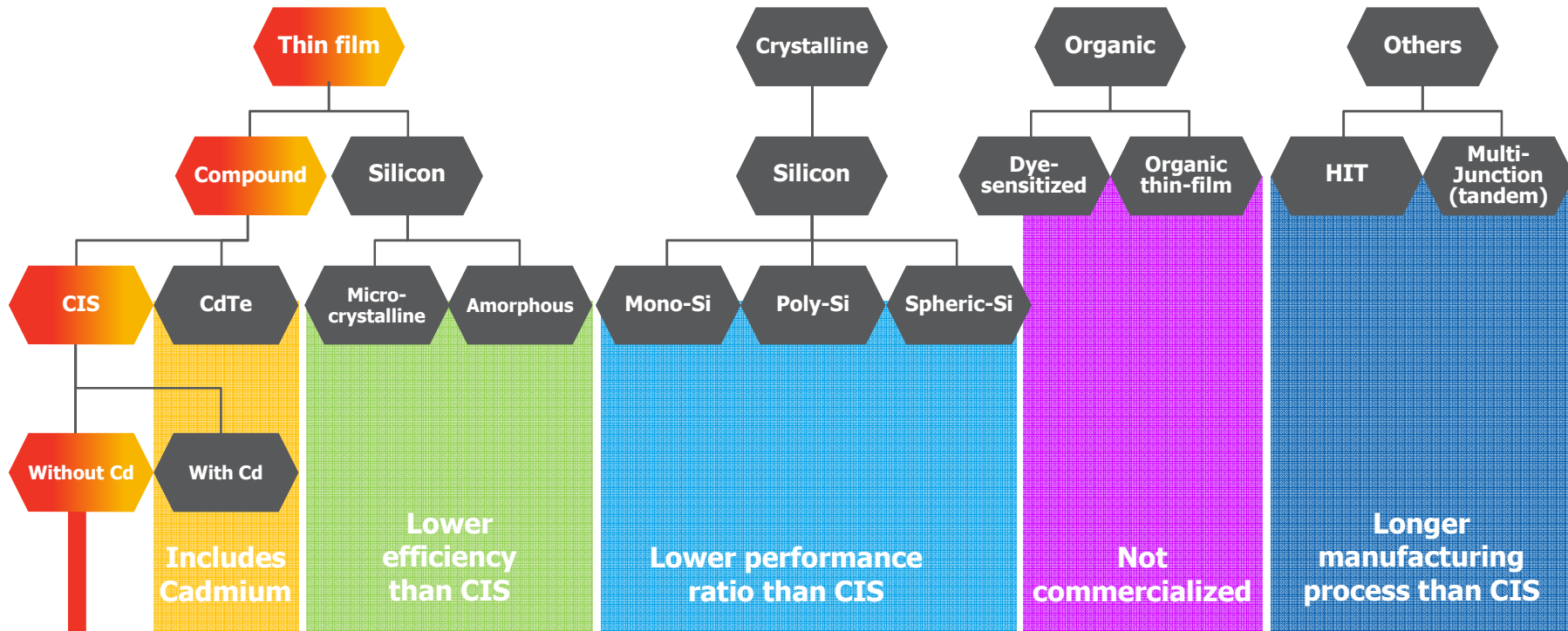
Development Bank of Japan Inc.

- JV with Solar Frontier for Solar Project Development
- Long Term Investor
- Finances Projects

CIS Technology Advantages

What is CIS?

CIS is a thin-film technology using key ingredients Copper (C), Indium (I) and Selenium (S)



Solar Frontier's CIS modules do not contain cadmium or lead



Copper



Indium



Selenium



Benefits of Solar Frontier Modules

4 Reasons for Generating More Energy



1. Heat Performance



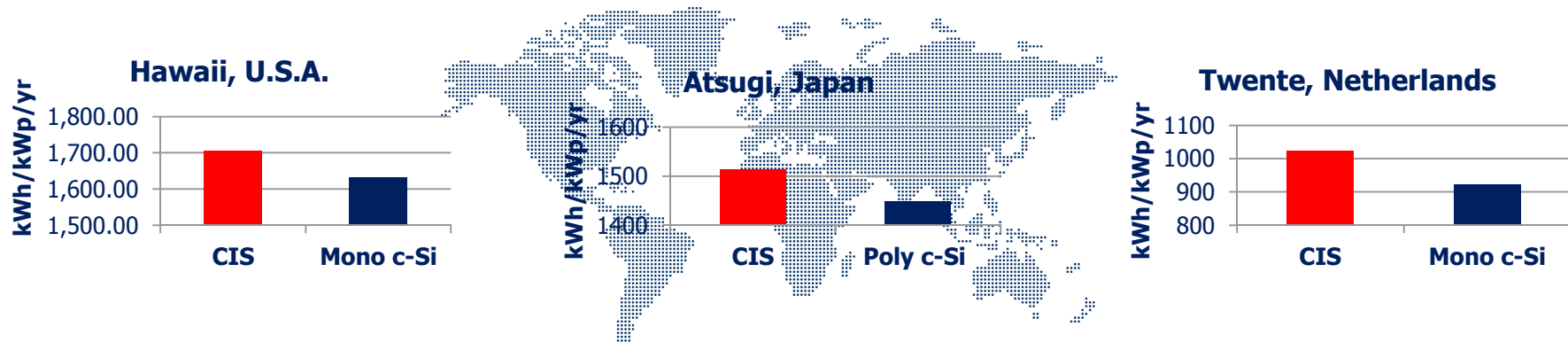
2. Light Soaking Effect



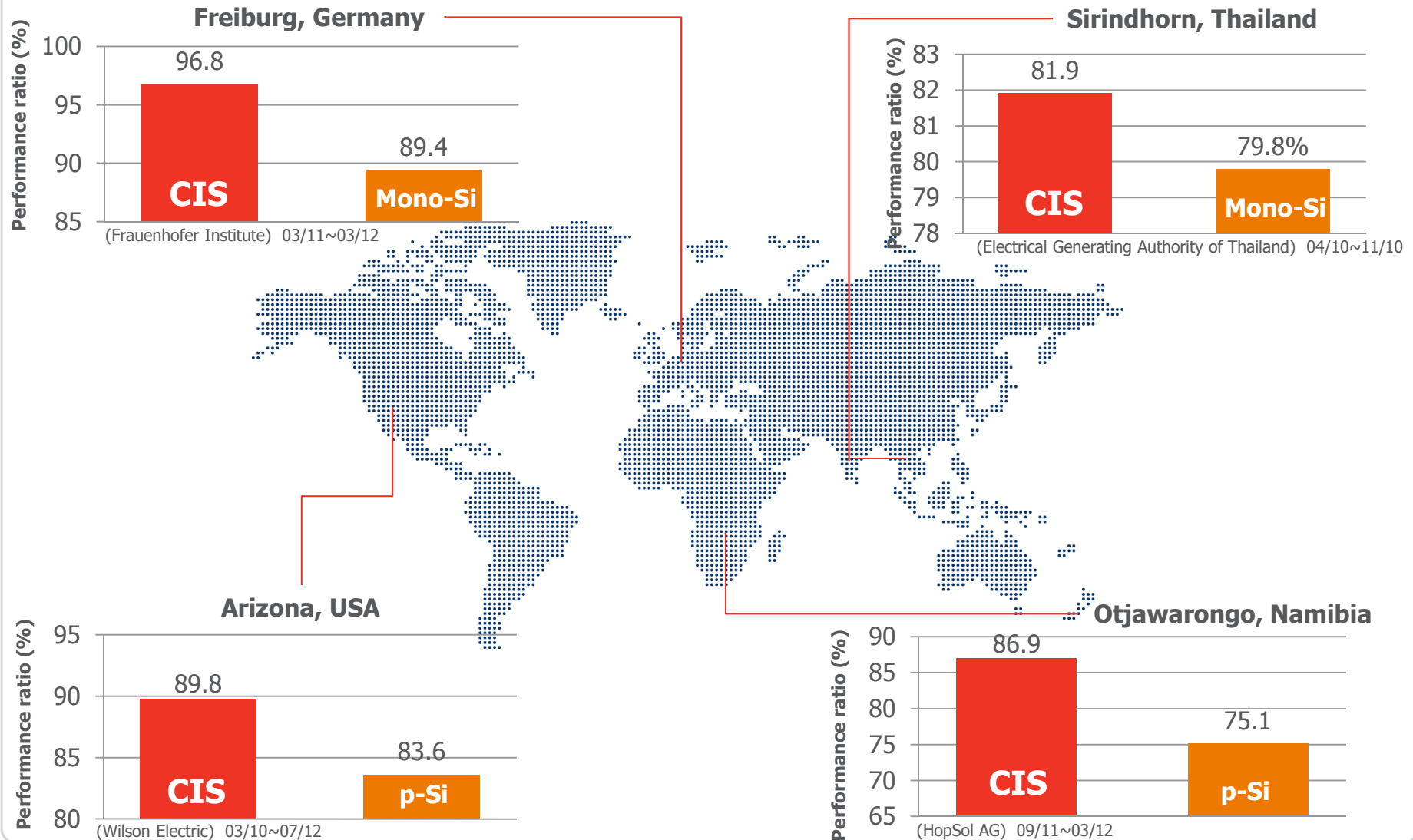
3. Shadow Tolerance



4. Low-Light Performance



More Kilowatt-hours Worldwide



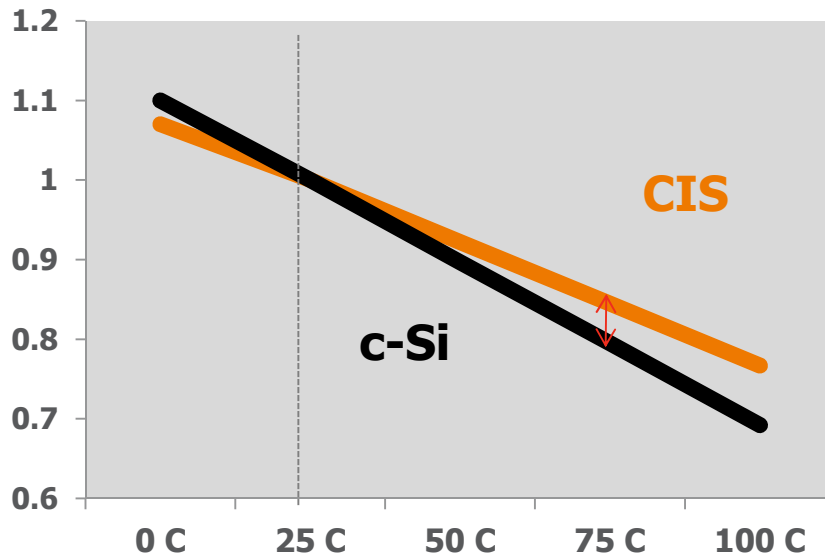
Benefit of Solar Frontier Modules



1. Heat Performance

- CIS temperature coefficient is higher than c-Si's one (-0.31 VS -0.48). This fact ensures CIS outperforms c-Si in hot conditions.

Temperature Coefficient shows the % of performance decline when temperature goes up 1 °C.



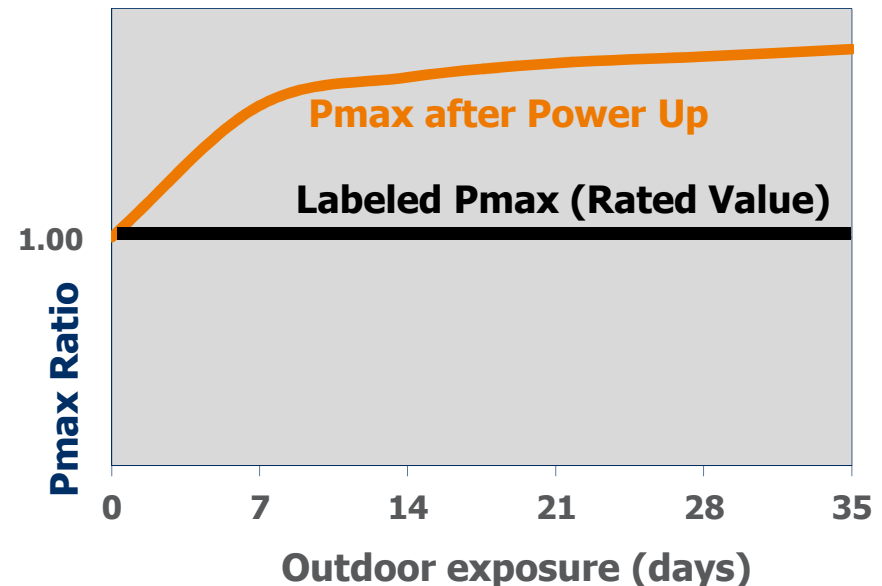
At a module temperature of 75 °C, CIS modules produce **5% more power** than crystalline



2. Light Soaking Effect

- Initial exposure to sunlight increases the rated power output of a CIS module.

This is very unique phenomena for CIS thin-film modules and does not occur in C-Si modules.



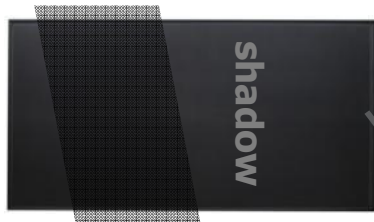
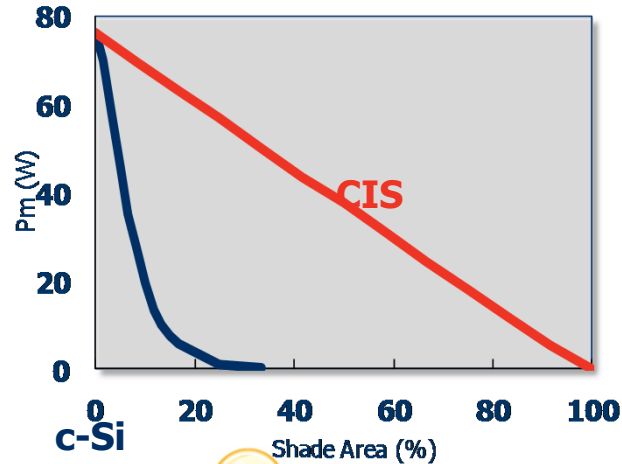
Test system data: Atsugi Research Center, 11.1kW system, 280 prototype modules used. Direction: 340° South East Tilt:20° Inverter Efficiency: 92.5%
Ref. c-Si : 0.5-2.7 %/Year (10-54% in 20 years) , p-Si : 0.3-1.3 %/Year (6-26% in 20 years) Manuel V. and Ignacio R. *Progress in Photovoltaics*, 16, 419 (2008)

Benefit of Solar Frontier Modules

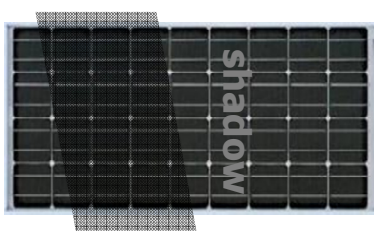


3. Shadow Tolerance

Under partially shaded conditions, the patterning of CIS modules keeps the drop of output to a minimum.



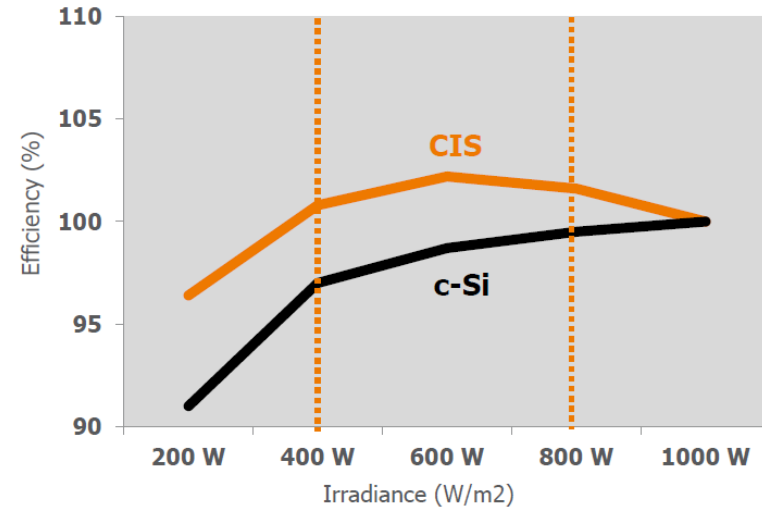
There is a partial loss of output but the overall effect is minimum.



The module's output drops significantly under partial shadow.



4. Low-Light Performance



CIS outperforms crystalline at irradiance intensities of 400-800W/m², which occurs most frequently worldwide.

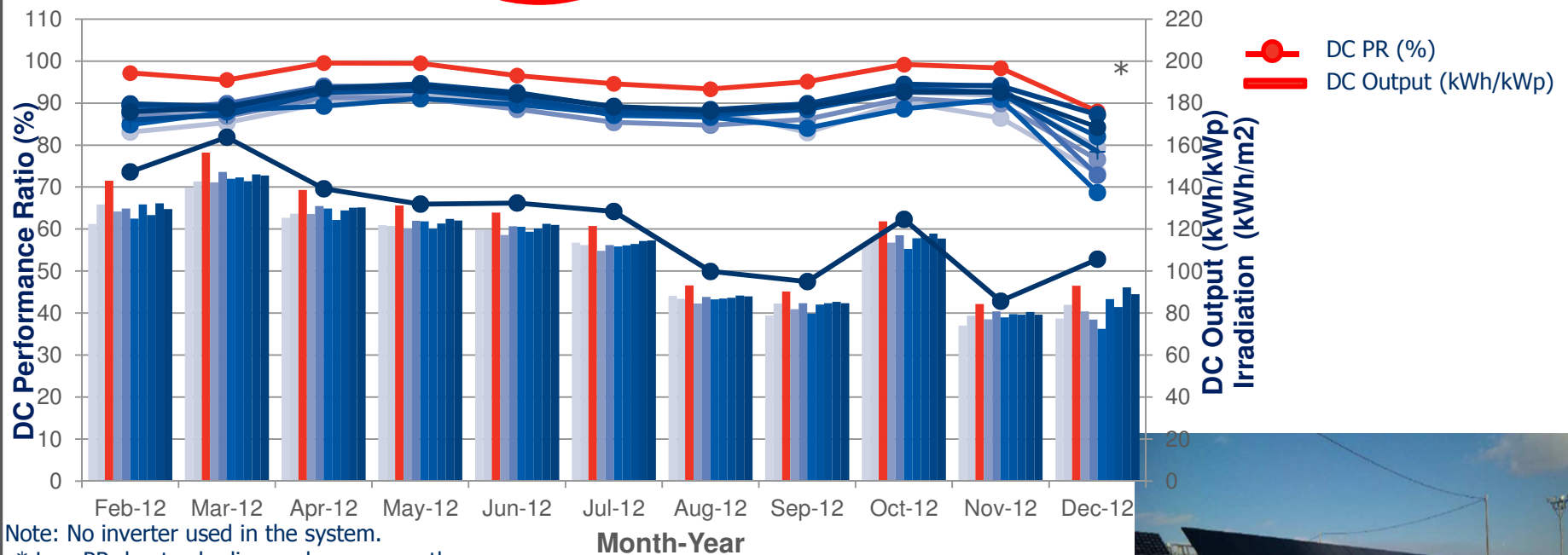
Softbank Energy Test Site: Hokkaido Japan

Monitoring Period Feb 2012 to Dec 2012

Average Irradiance 2,388 kWh/m²/yr

Module Tilt 30°

Overview	Kaneka Hybrid-Si	Panasonic Hybrid HIT	Solar Frontier CIS	Mitsubishi Mono-Si	Kyocera Poly-Si	Sharp Poly-Si	Itogumi Poly Si	Canadian Poly-Si	Suntech Poly-Si	Yingli Poly-Si
Capacity (kWp)	4.83	3.44	4.80	5.00	5.24	5.01	5.04	5.06	5.04	5.17
DC Energy Yield (kWh/kWp)	1174	1205	1303	1183	1213	1183	1205	1205	1235	1223
Average DC PR	86.7%	89.0%	96.2%	87.4%	89.6%	87.3%	89.0%	89.0%	91.2%	90.3%



Solar Frontier CIS modules perform better compared to other module technologies!



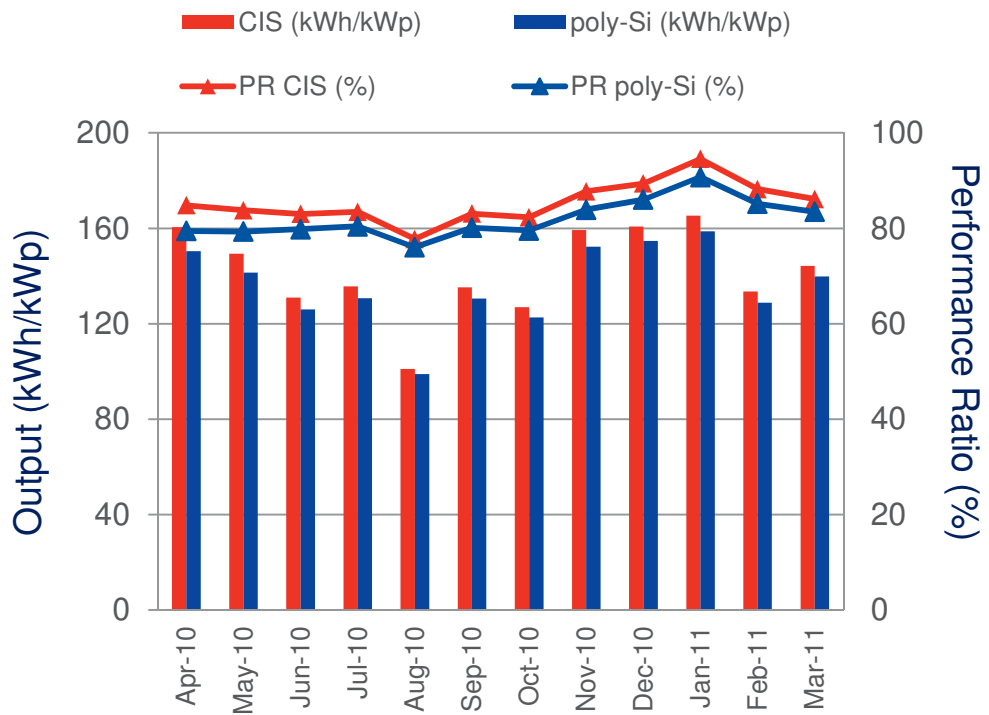
EGAT Test Site: Thailand

Monitoring Period Apr 2010 – Mar 2011



System capacity	2.00 kW
Panel type	KC 200 (200 W)
Inverter	Leonics, G-303
Installed panels	10
Panel angle, orientation	15°, South 0°
Yearly output	1,635 kWh/kWp


System capacity	2.04 kW
Panel type	SC85-EX-B (85 W)
Inverter	Leonics, G-303
Installed panels	24
Panel angle, orientation	15°, South 0°
Yearly output	1,703 kWh/kWp

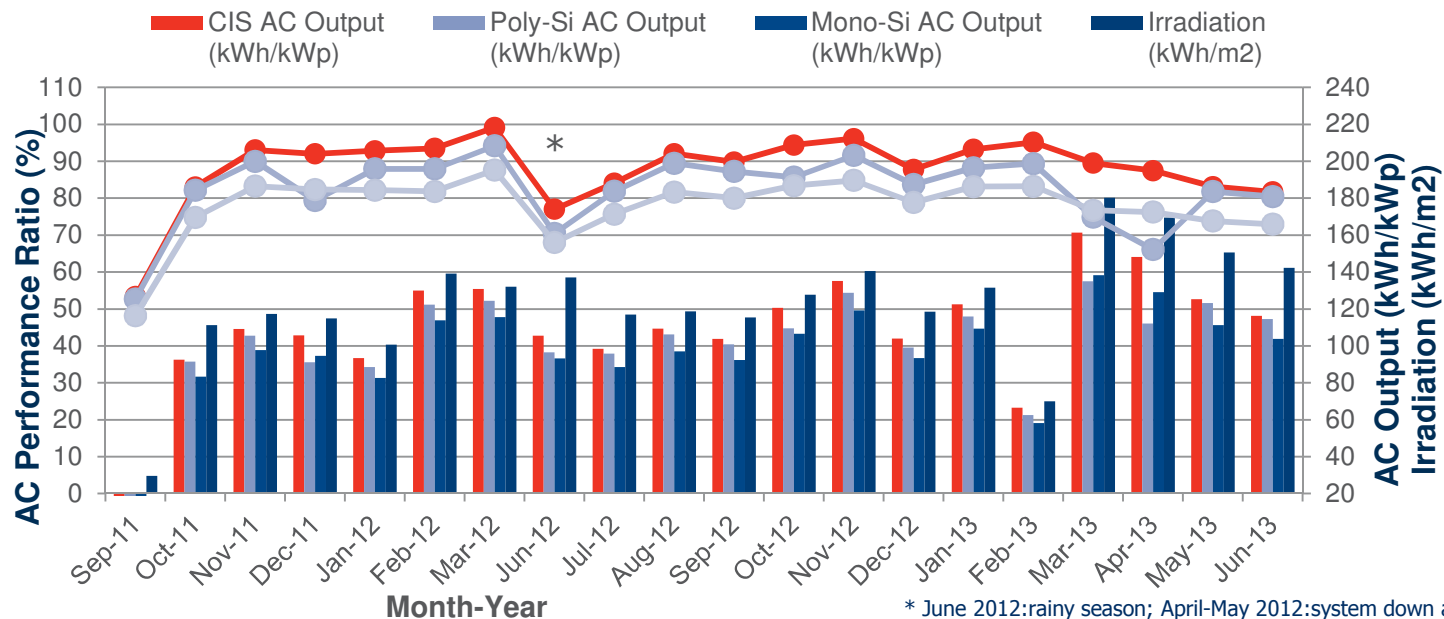


About 4% higher PR than poly-silicon throughout the year

Phoenix Solar Calamba Test Site: Philippines

Monitoring Period Sep 2011 – Jun 2013 Average Irradiance 1,664 kWh/m²/yr Module Tilt 10°

Overview	SF CIS	Poly-Si	Mono-Si	Technical Info: Azimuth: 31° Module Tilt angle: 10° Average Temp.: 22°C (71.6°F) Average Irradiance: 1,664 kWh/m ² /yr	
System Capacity (kWp)	13.4	13.5	13.9		
Inverter	Sunny Mini Central 7000HV-11 (92.1%)				
Average ACPR	89.1%	82.8%	78.8%		
AC Energy Yield	2194 kWh/kWp	2039 kWh/kWp	1942 kWh/kWp		



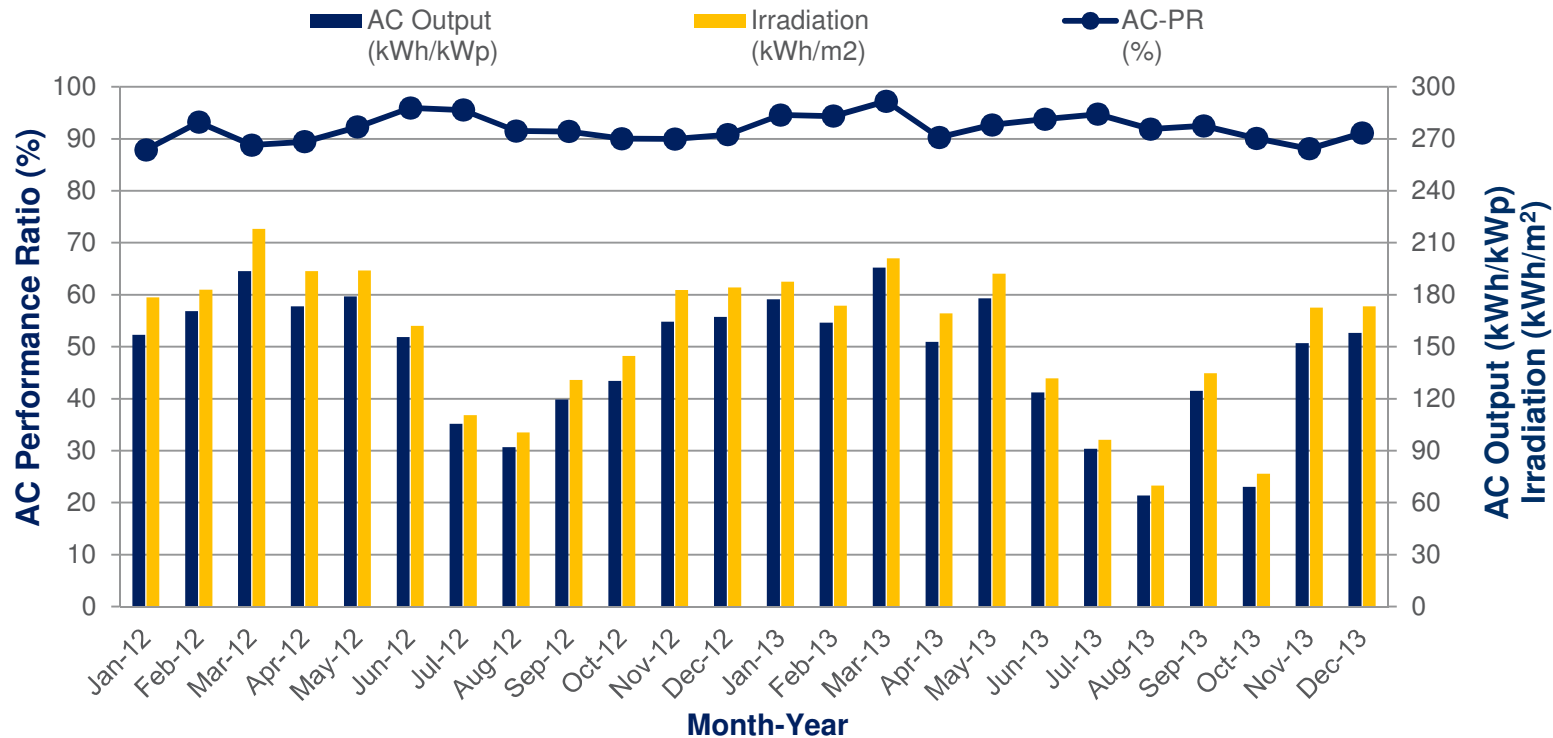
Solar Frontier CIS module shows to have better performance compared to silicon-type modules even in tropical areas like the Philippines!

Commercial Rooftop: Gujarat, India

Monitoring Period	Jan 2012 – Dec 2013	Average Irradiance	1,905 kWh/m ² /yr	Module Tilt	25°
AC Energy Yield	3457.8 kWh/kWp	Average ACPR	91.9%	Highest ACPR	97.3%

Technical Information

System capacity: 9.6 kWp
Module : SF 150 (150W)
Module Tilt angle: 25°
Inverter: REFUsoI DC380-850V (98%)
Azimuth: 180°
Average Temp.: 29°C (84°F)
Average Irradiance: 1905.3 kWh/m²/yr

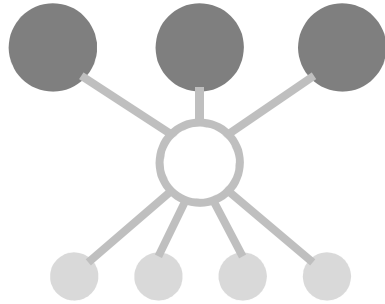


☀️ **Solar Frontier CIS module shows high performance**
 ☀️ **of more than 91% ACPR in Gujarat India**

November 2015

Solar Systems for Commercial Rooftops

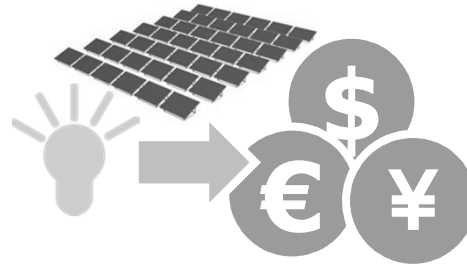
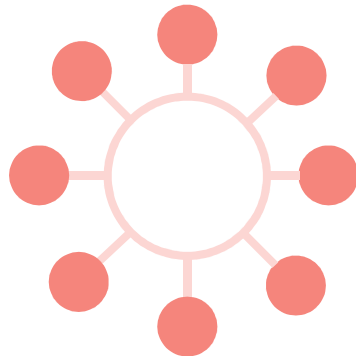
Paradigm Shift in Solar Business



Centralized



Distributed



**Investment is
Government
subsidized**



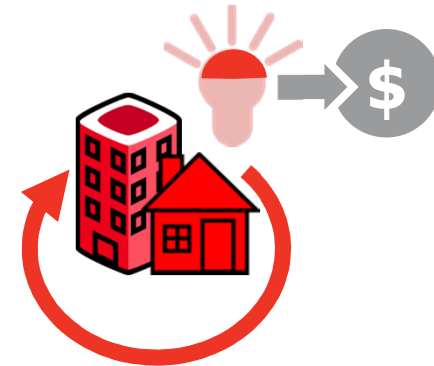
Self Consumption



**Large Scale to
Maximize
Returns**

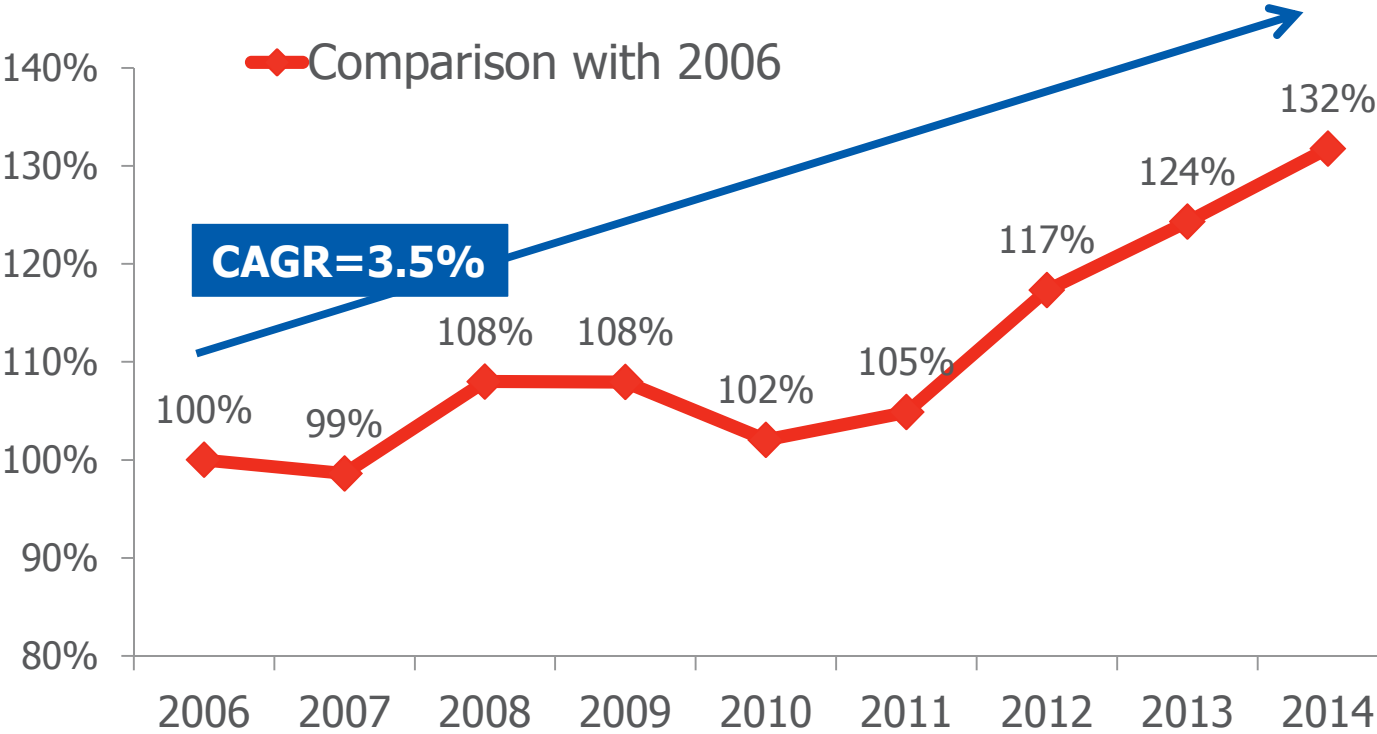


Balanced Size



Increasing Electricity Prices Puts Pressure on Companies' Competitiveness

Electricity Price of Thailand



Commercial Roof-top Solar Solutions Can Achieve Grid Parity

Nippon Yusen Ooi Terminal, Japan



Location: Ooi, Japan
Date onstream: 2010-04
System Capacity: 135 kWp

BELECTRIC Warehouse, Germany



Location: Kolitzheim, Germany
Date onstream: 2011-07
System Capacity: 554.6 kWp

Commercial Roof-top Solar Solutions Can Achieve Grid Parity

Ikaros Solar Project, Zwolle



Location: Zwolle, Netherlands
Date onstream: 2014-10
System Capacity: 854kWp

Mapletree, Japan



Location: Odawara Kanagawa,
Japan
Date onstream: 2015-11
System Capacity: 2494.8kWp

Solar Potential in SEA

Tokyo 1 (As Base)

Irradiation=1,236 kWh/m²
Power Output=109.3MWh

Bangkok 1.5

(compare with Tokyo)

Irradiation=1,790 kWh/m²
Power Output=147.7MWh

Ho Chi Minh 1.4

Irradiation=1,771 kWh/m²
Power Output=146.0MWh

Kuala Lumpur 1.3

Irradiation=1,597 kWh/m²
Power Output=130.7MWh

Manila 1.4

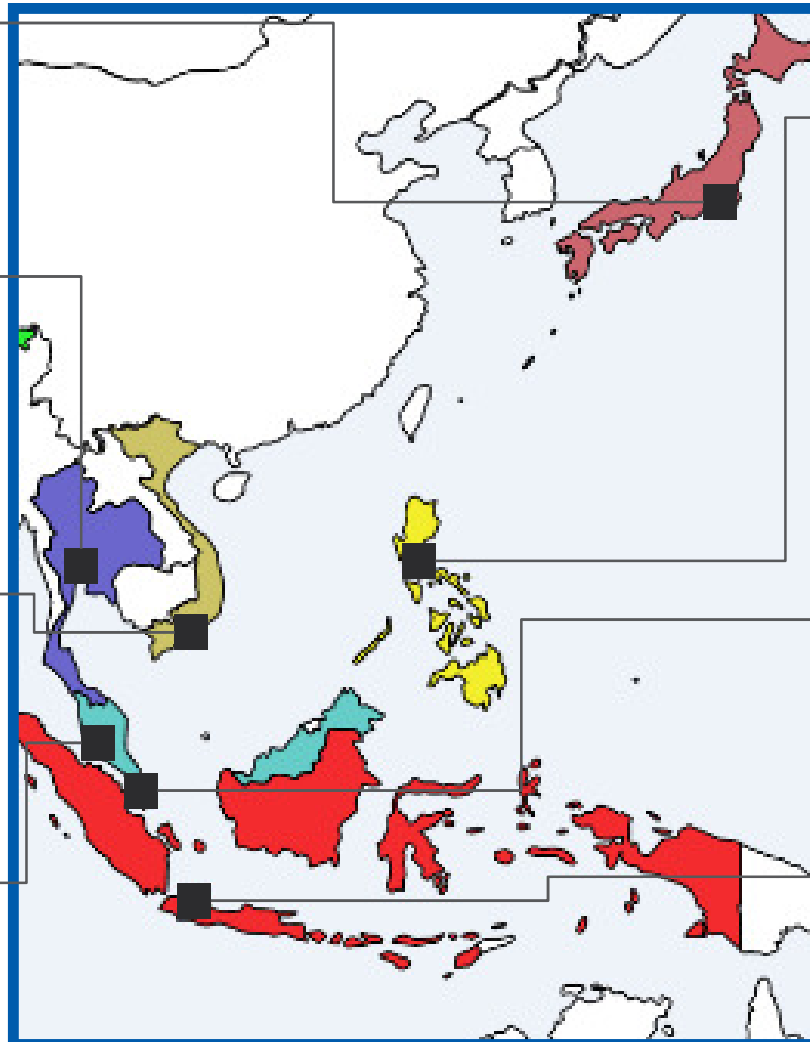
Irradiation=1,779 kWh/m²
Power Output=146.8MWh

Singapore 1.3

Irradiation=1,624 kWh/m²
Power Output=132.5MWh

Jakarta 1.3

Irradiation=1,662 kWh/m²
Power Output=137.6MWh



Advantages for Commercial Roof-Top

Reduce Electricity Cost

- Electricity price is increasing year by year
- With solar power a company can be independent of the increase and reduce total electricity cost
- You could save approximately **THB 17,162(k)** in 25 years

(*in case of 100kW)

Tax Incentives with "BOI"

- If applicable for BOI requirement, a company can **deduct 50%** of initial system investment from corporate tax up to 3 years

Reduce CO2 Emission/Improving CSR

- Contributes to reduce CO2 emission by installing solar system
- Improves sustainability, "**GREEN**" results in improving CSR
- Investor expectations / activism

Equivalent of a 100KW System

100W light bulb
× 1,000pcs



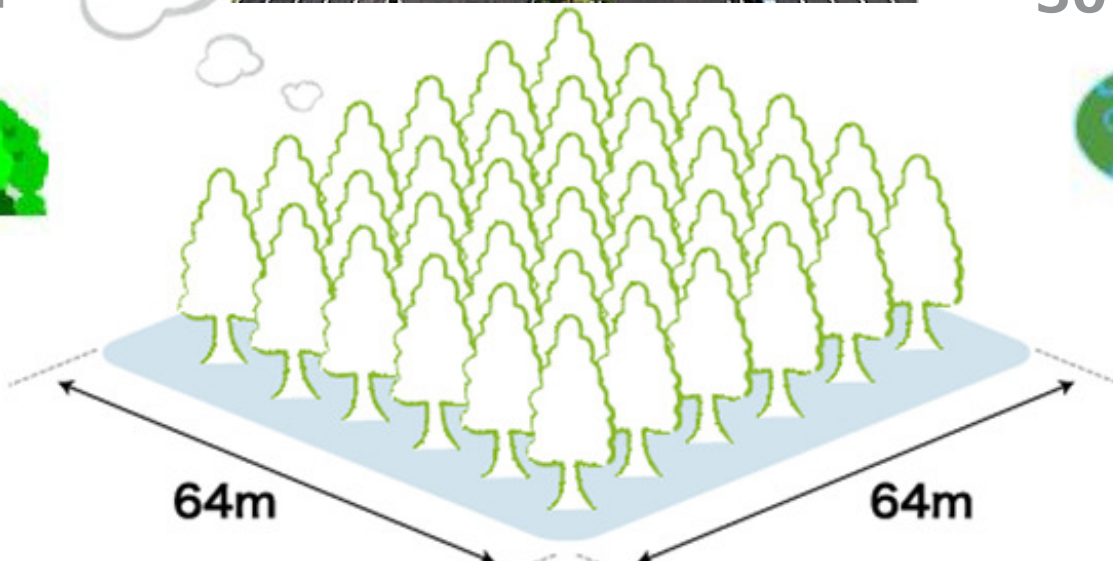
Forest
100,000m²



Household
× 30~40

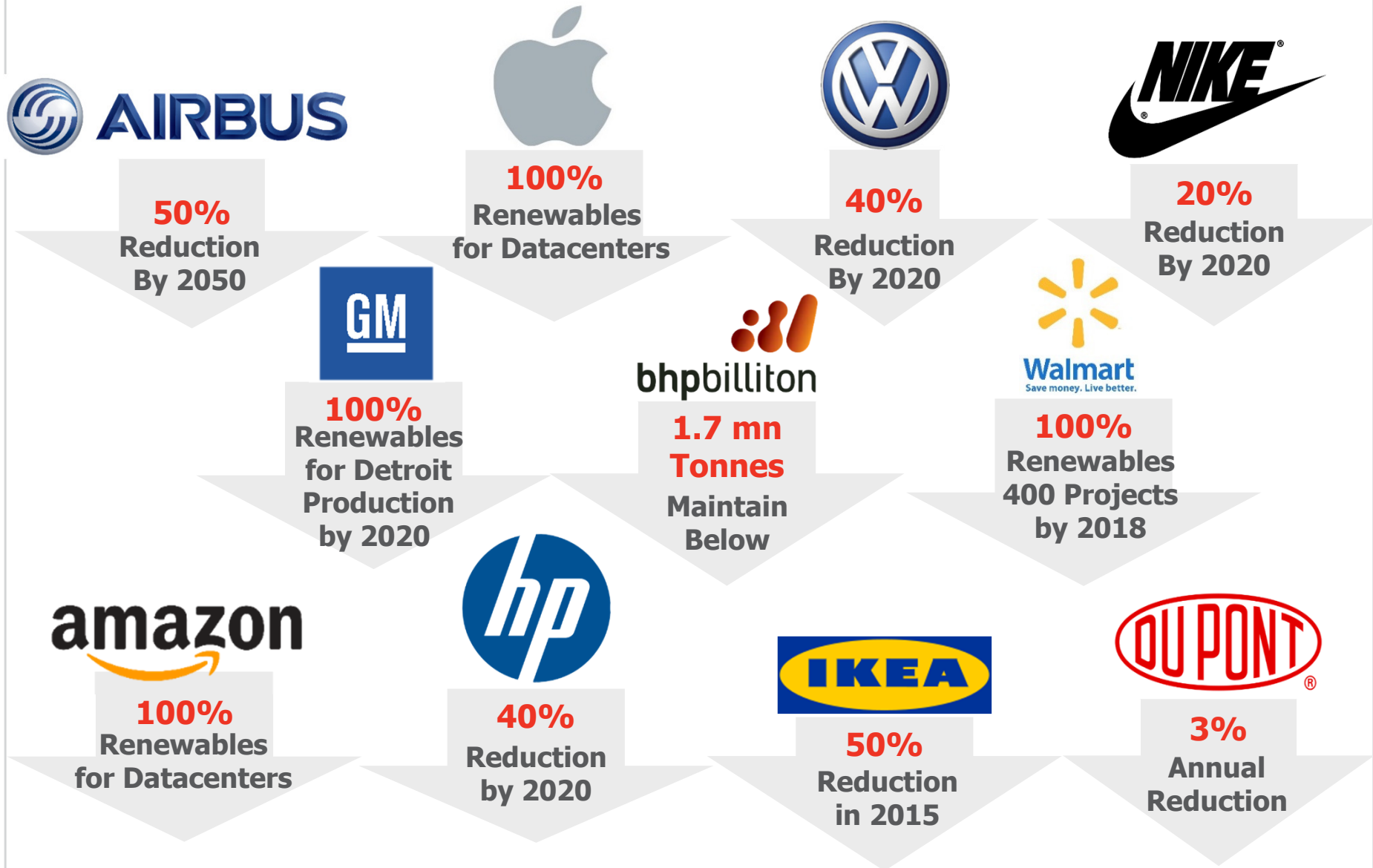


CO2 Reduction
30 t ~ /year

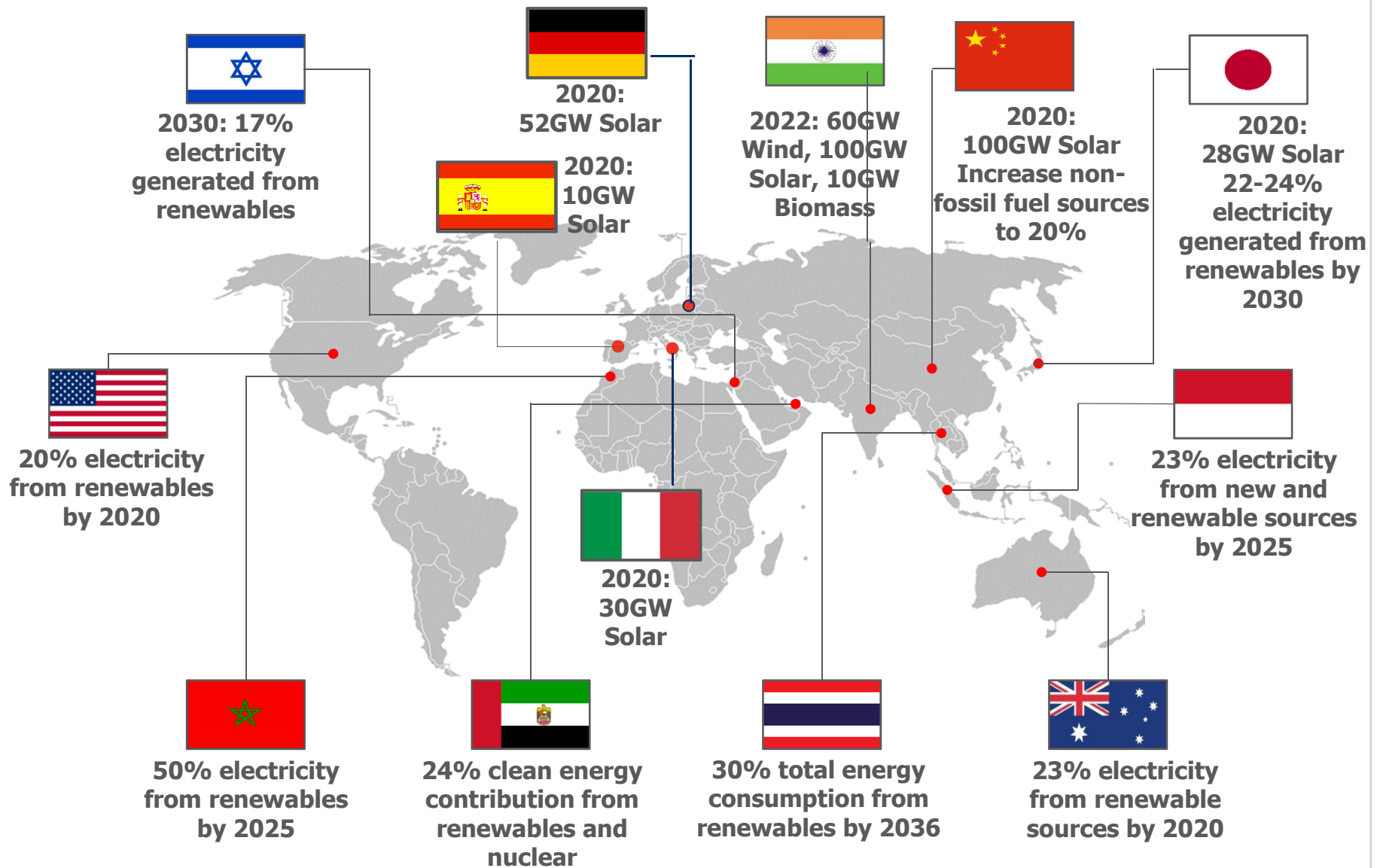


"4.25kW Solar System = 4,135m² Forest"

Corporates' Carbon Emissions & Renewables Targets



Major Countries Climate Goals



Summary: Why Do Business with Solar Frontier?

- **Our Business. Your Peace of Mind.**

- Over 100-year-old parent company, over 35 years in PV
- Background of energy companies
- World-record R&D
- Track record of 3 GW+ supplied worldwide
- World-class production
- Market-focused system solutions

- **Our Performance. Your Payback.**

- Highest performance under real conditions
- A more durable technology
- 3rd party tested and certified

- **Everyone's Planet.**

- Low Energy Payback Time (<1 year)
- Lead- and cadmium-free



Thank You !