SUMITOMO ELECTRIC

Sumitomo's Solution for Global Warming

SUMITOMO ELECTRIC INDUSTRIES, LTD.

November 8, 2016

Agenda

1. About Sumitomo Electric Industries

2. Solution for Global Warming with CPV

3. Activity of Sumitomo in Morocco

4. Application of Redox Flow (RF) Battery

About Sumitomo Electric Industries

Company Profile

Established	April 1897
Employees	240,865
Net Sales	US$ 26.0 billion (FY2015)
Operating Income	US$ 1.3 billion (FY2015)

Business Segment

Automotive

■Wiring Harnesses, High Voltage Harnesses for HEVs, Heater Control Panels, etc.

Environment & Energy

■Wire Rods, Porous Metals CELMET®, Magnet Wires, Power Cable, etc.

Information & Communications

■Optical Fiber Cable, Optical Transceivers, Traffic Control Systems, etc.

Electronics

■Flexible Printed Circuits (FPC), Thunderbolt Cables, Polyimide Tube Rollers, etc.

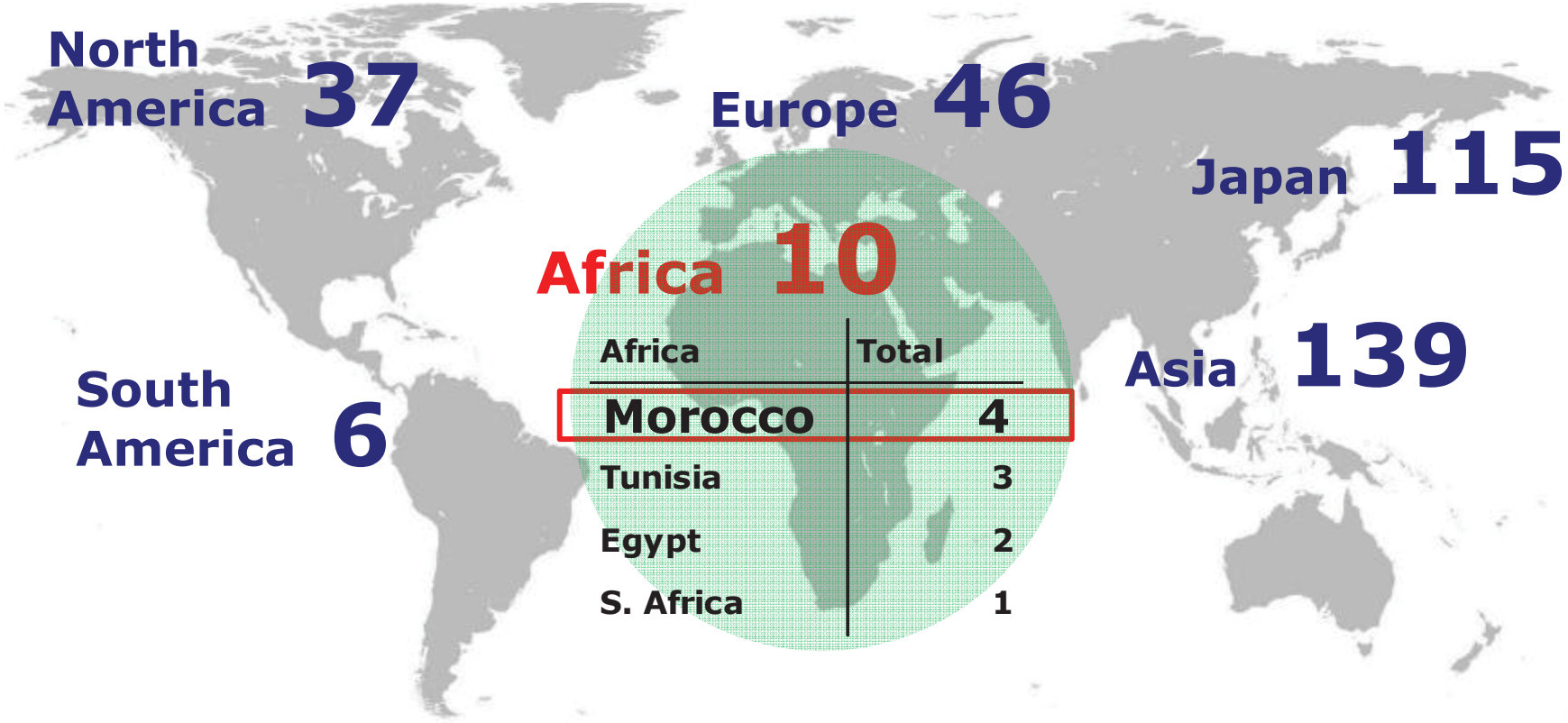
Industrial Materials

■Cemented Carbide Tools, Cutting Tools, Nano-Polycrystalline Diamond, etc.

About Sumitomo Electric Industries

Global Network

Total 353 Subsidiaries & Affiliates



Africa	Total
Morocco	4
Tunisia	3
Egypt	2
S. Africa	1

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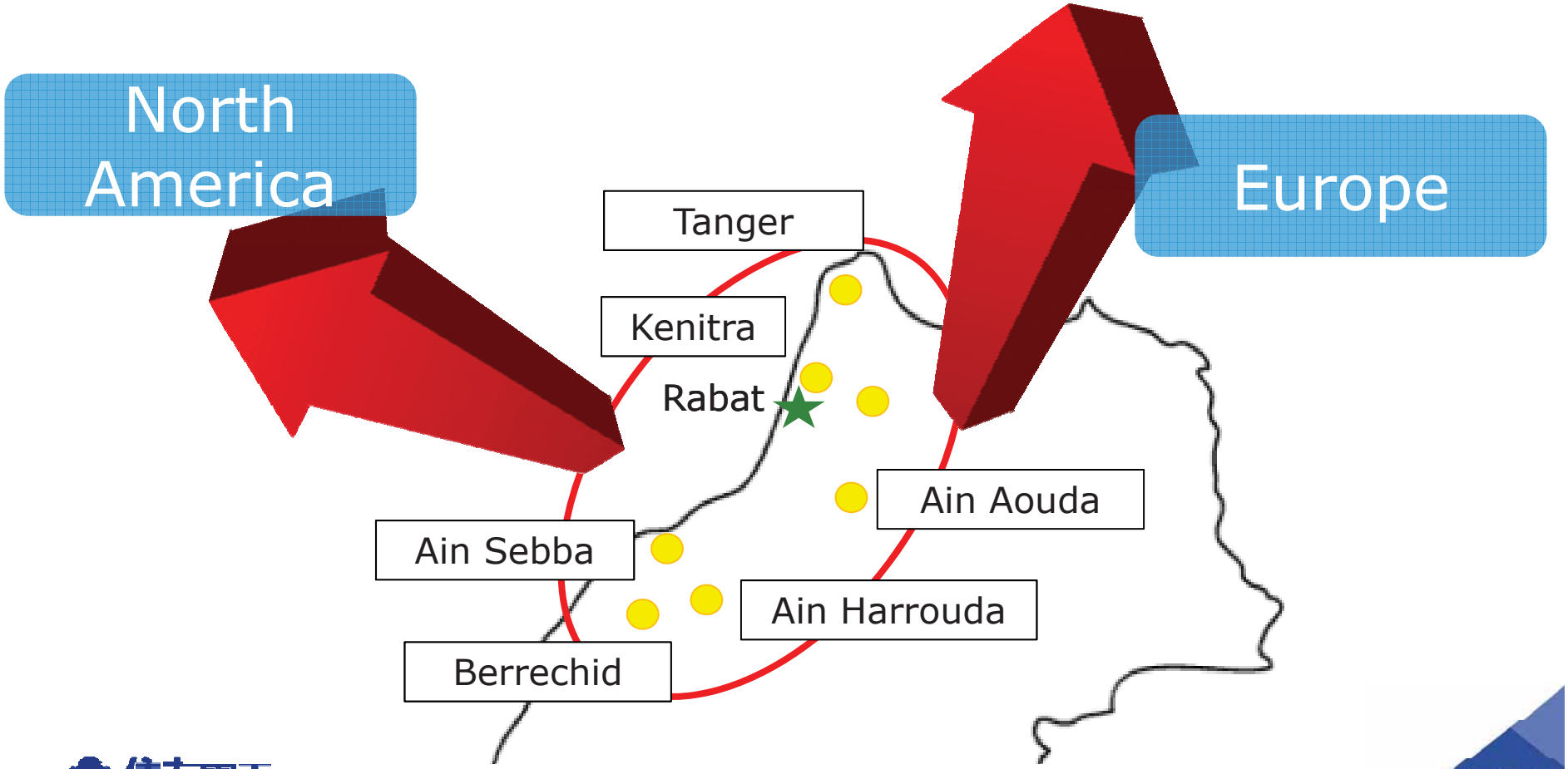
Sumitomo Electric Group in Morocco

20,000 Employees in 8 Plants

Produce and Export Wiring Harnesses



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The Energy Sector's Impact on Climate Change

Fossil Power Plants

- CO_2 Emissions
- Serious impact on global warming

PV Power Plants

- No CO_2 emissions
- No affect on global warming

(Amount of energy on the earth unchanged)

Current Issues for Si based PV

① Low Efficiency

・Si based PV converts only about 10% to 15% of solar energy into electricity(Record lab efficiencies are around 25%).

② Degraded Power Generation at High Temperature

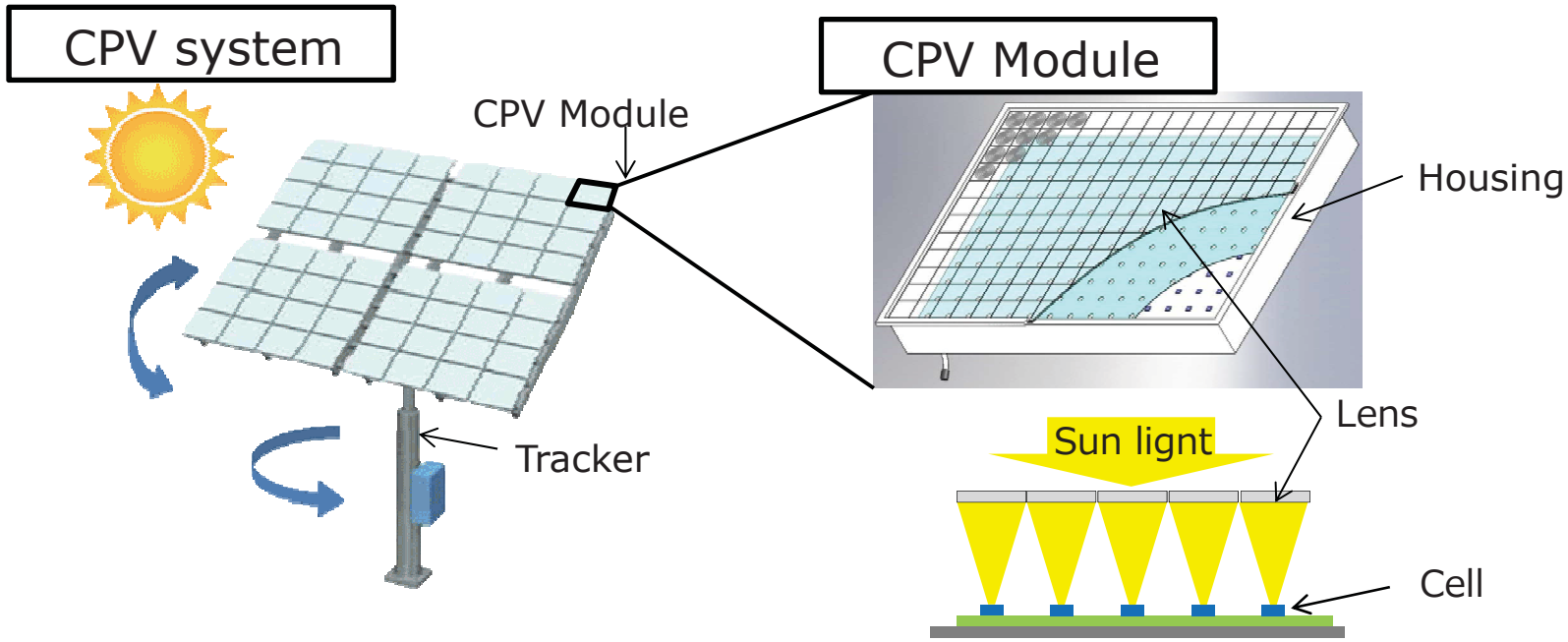
・Power generation drastically decreases at above 30℃

③ No power generation at night or on cloudy days

CPV Dramatically Improves Power Generation Efficiency

- CPV technology generates approximately twice larger output per module area
- Power generation efficiencies with CPV technology are more than 30%（Record lab efficiency is 46%）
- Higher efficiency is expected with technological advances（Theoretical efficiency is more than 80%）
- Degradation at high temperature is negligible

CPV Technology



CPV in Ouarzazate (2015-2016)

- High efficiency cell with compound semiconductor(GaAs based) applied
  - technology used in satellites
- Efficiency even improved by adopting 3 layers structure absorbing broad wave length
- Size of a cell is minimized by focusing sunlight by lenses and a tracker to reduce the cell cost

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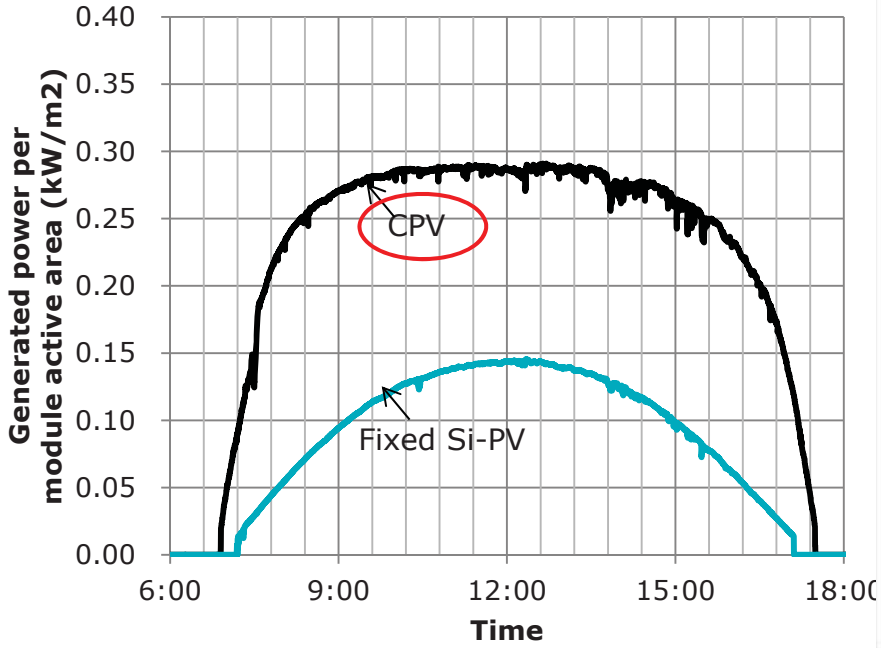
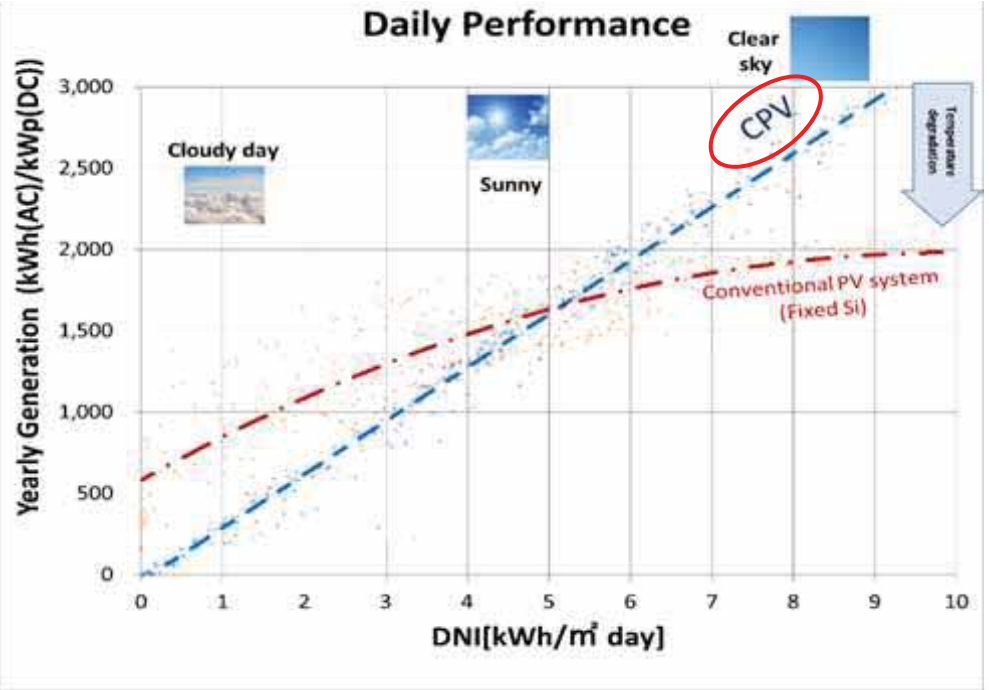
CPV Doubles Electricity Generation

Double Electricity Generation than Conventional PV System

Higher Generation in High Irradiation Area

Collected in Ouarzazate, 2015





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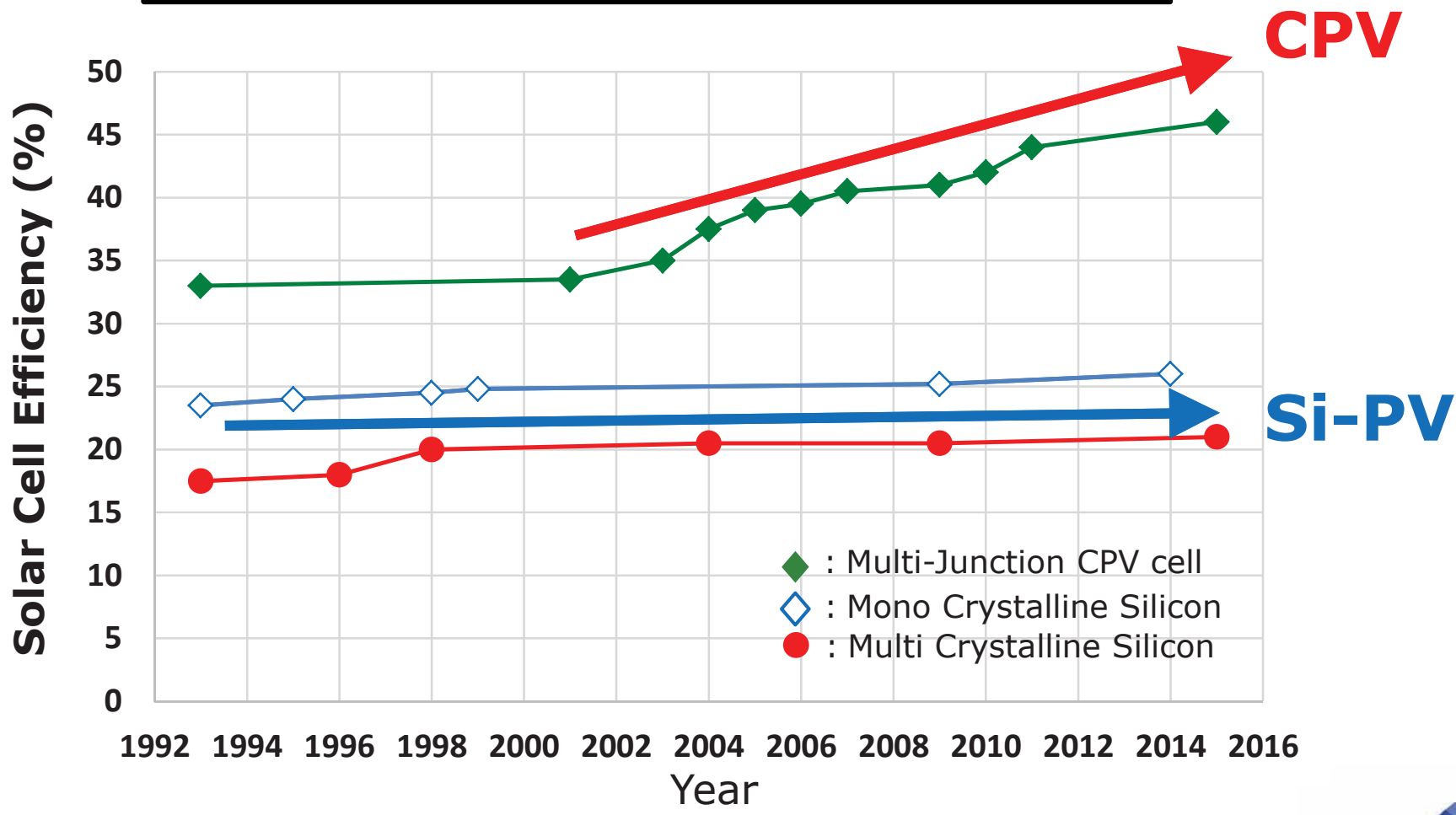
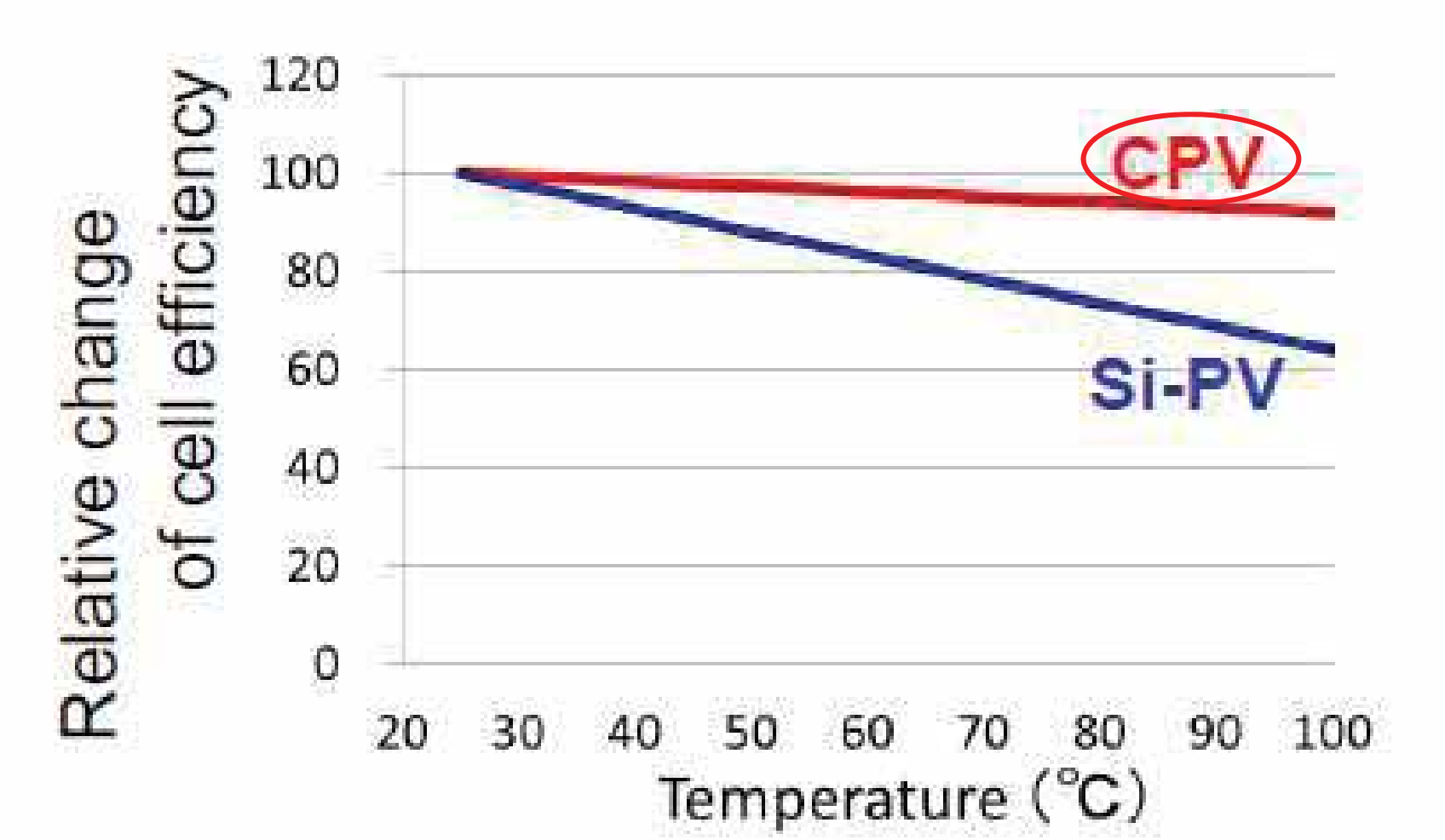
Road Map for Efficiency

Top record for CPV is 46%
More than 50% is expected in 2020



Source: Fraunhofer - PHOTOVOLTAICS REPORT 20 October 2016

Degradation at High Temperature



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Sumitomo's CPV Project and Plan in Morocco

For World-wide Business Development: Future Business Plan

I Verify CPV's Performance

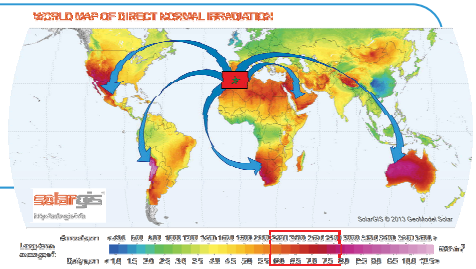
- First CPV projects in Casablanca and in Ouarzazate Excellent performance demonstrated (2013-2015)

II Enter Moroccan Solar Market

- 1MW CPV plant with MASEN in Quarzazate, Starts Operation from November 2016
- 20MW class CPV plant Establish Manufacture/Business Base for Made-in Morocco CPV

III Develop World-wide Business

- Morocco as a Manufacturing Hub for World-wide Business (MEA, Europe, the Americas)



- Bring Investment and Employment Opportunities
- Strengthen Energy Security

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Sumitomo CPV in Morocco

CPV in Casablanca (2013)

CPV in Ouarzazate (2015-2016)

Collaborated with MASEN and JICA

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II 1 MW CPV Project in Ouarzazate

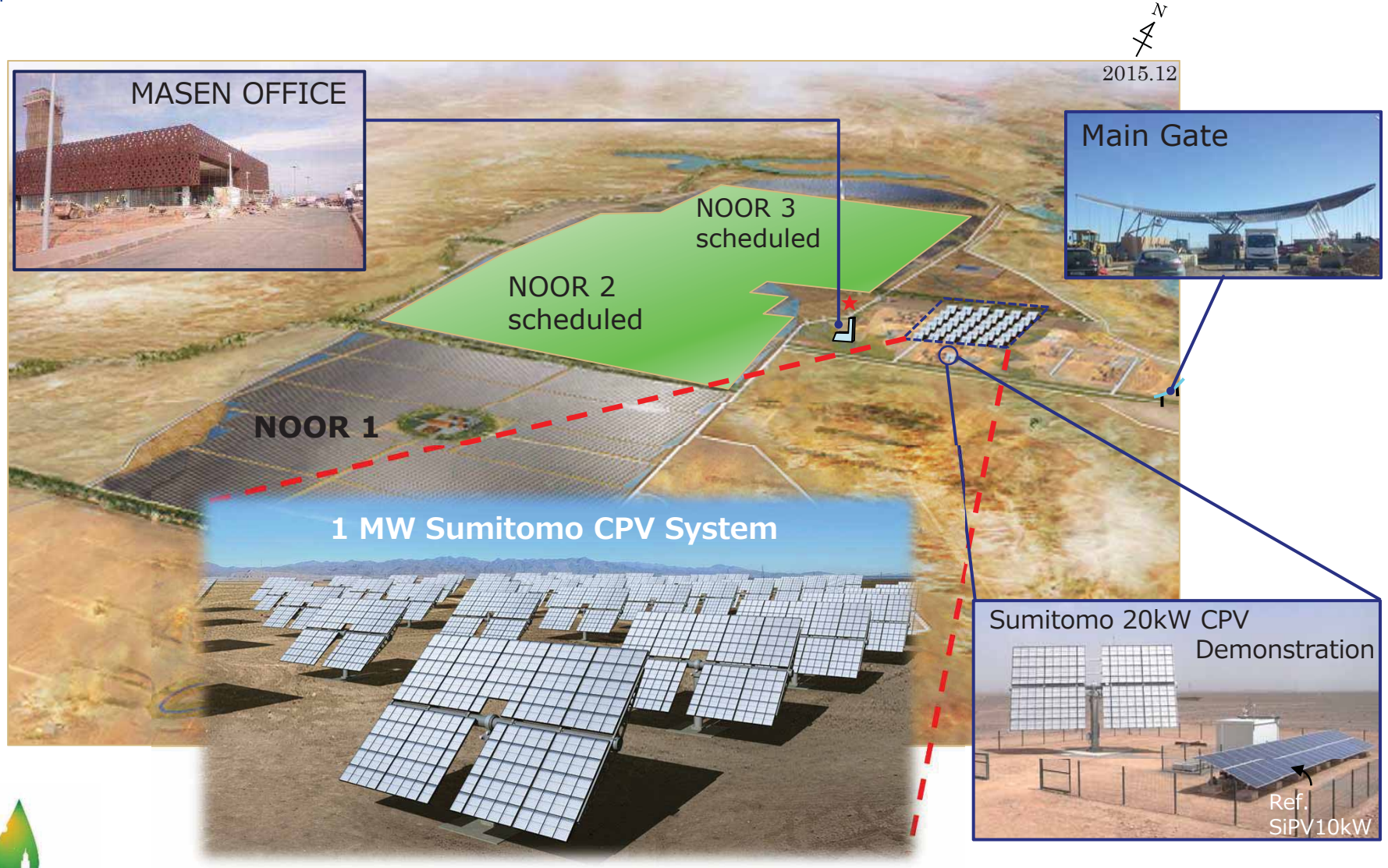
Contract for the Project signed

MASEN and Sumitomo agreed and signed on May 4, 2016, at the 4th Japan-Arab Economic Forum in Casablanca.

Outline of the Project

- Install 1MW CPV in MASEN R&D site, collect the data on power generation, and evaluate the merits of CPV
- Collaborate local institute and local suppliers for future mass production in Morocco
  - MAScIR manufactured a part of cell packaging
  - Jet Energy manufactured trackers designed by Sumitomo, and achieved construction work
- Establish O&M method and procedure
- Look for larger scale CPV projects in Morocco

Image of 1 MW CPV System in Ouarzazate



- Start operation just before COP 22 in Nov. 2016
- Application of RF battery is under discussion

MARRAKECH 2016
COP22・CMP11

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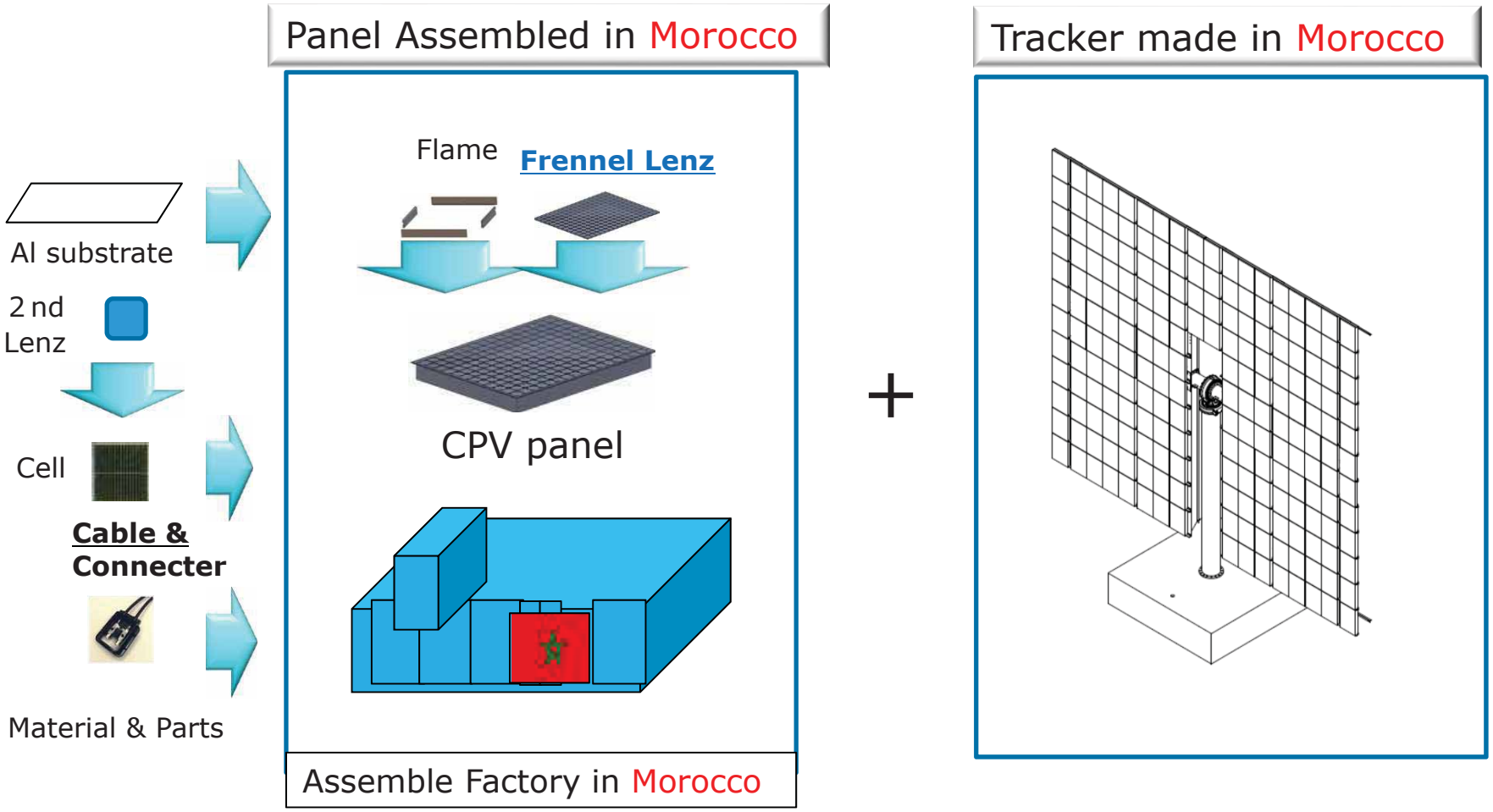
1 MW CPV System in Ouarzazate

III Sumitomo's CPV in Morocco: Near Future

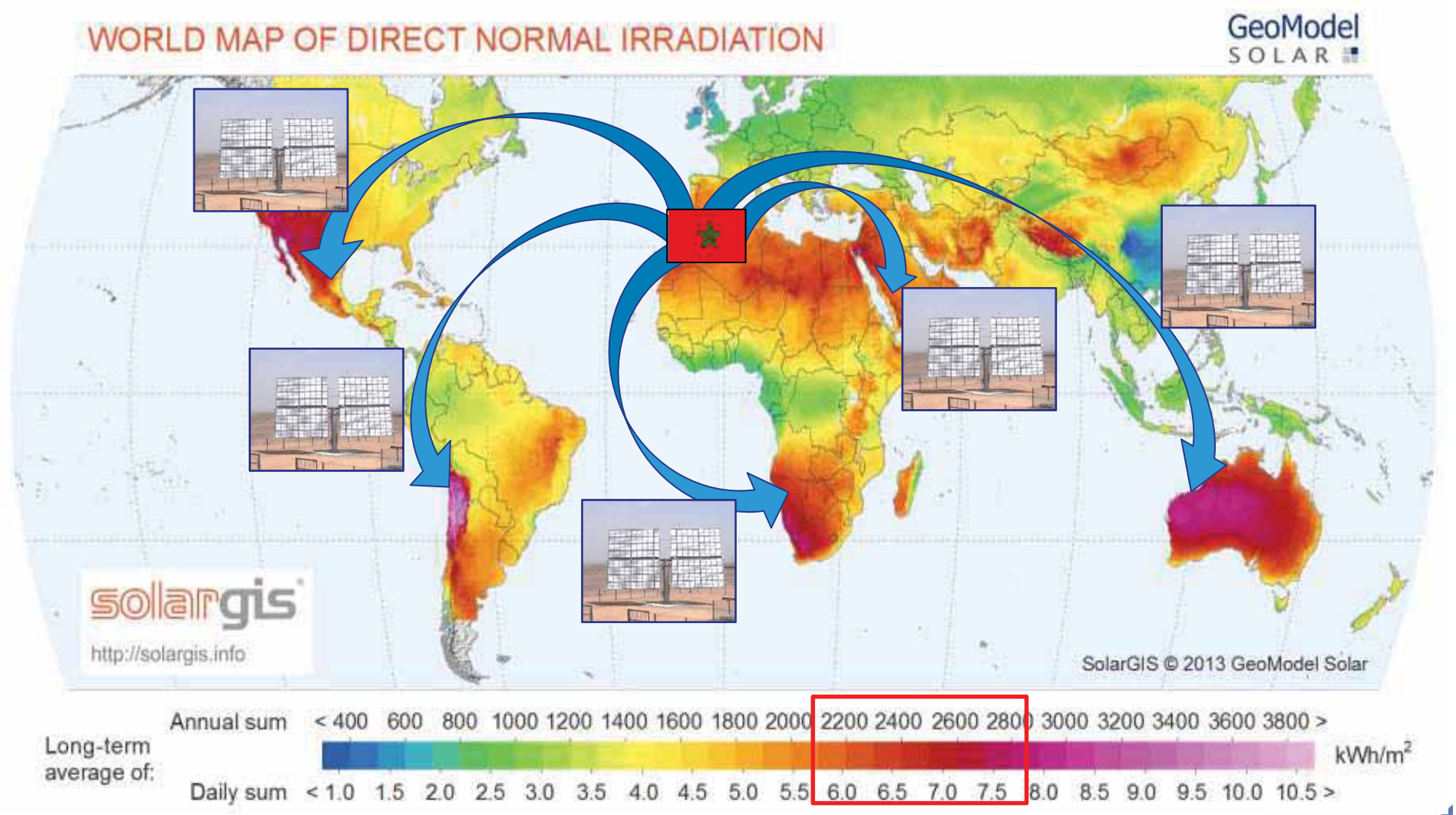
Morocco as a Manufacturing Hub for CPV Business



Installed by Engineering Company in Morocco

Sumitomo's CPV in Morocco: Near Future

Morocco as a Manufacturing Hub for CPV Business



Sumitomo's Contribution

- Participate in Renewable Energy Generation
- Create CPV Industry in Morocco
- Create Investment and Employment Opportunities
- Educate for Human Resources

King Mohammed VI stated at COP21 in December 2015

"Objective of securing 42% of the country's energy mix from renewable sources by 2020 has recently been increased to 52% by 2030."

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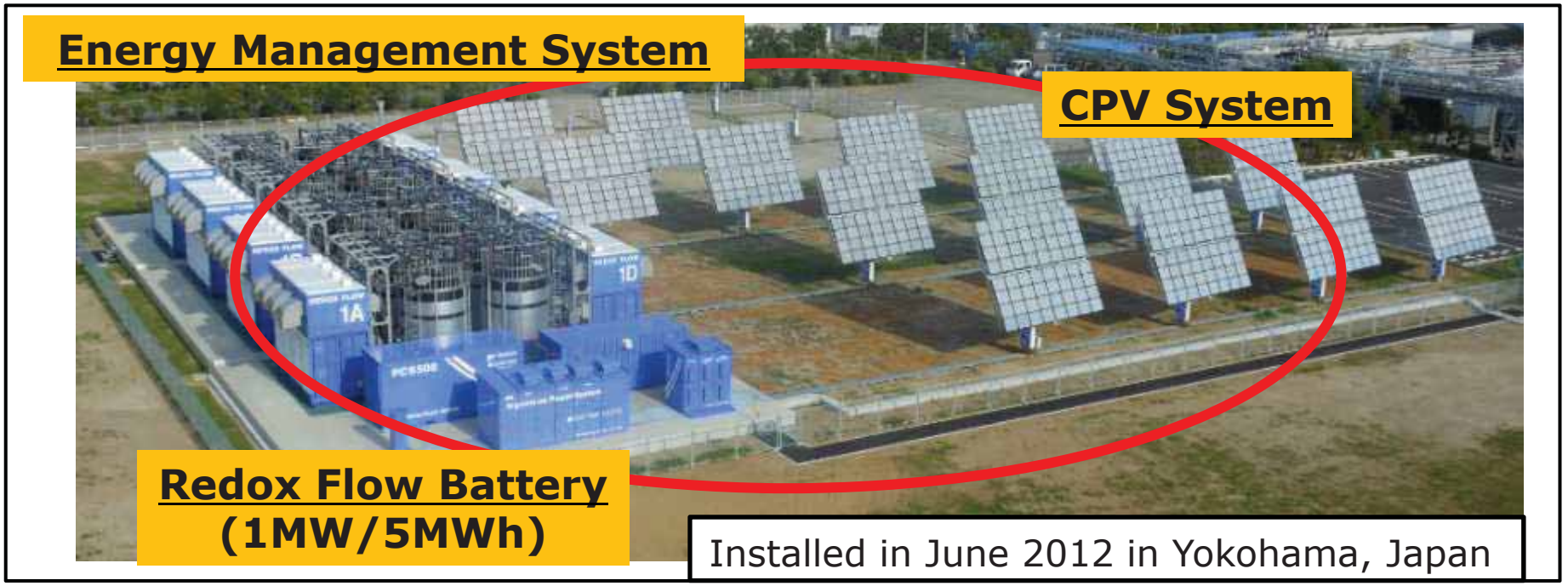
CPV and Battery



- Charging battery day time, discharging at night or on cloudy days
- Stabilize fluctuation of utility grid voltage and frequency by charging/discharging battery
- **RF Battery** (Redox Flow) is best suited for the purpose

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Features of RF Battery

1. Long Life

- **Unlimited Charge/Discharge cycle life**
- Electrolyte is reusable after decommissioning

2. Safety

- **Non-flammable Electrolyte**
- Flame Retardant Materials
- Accurate and Reliable SOC Management

3. Multi-Purpose

- **Fast Response** & **Long duration** Applications

→ **Hybrid Uses for more Flexibility and Revenue**

4. Easy Operation

- **Accurate and Real-time SOC Acquisition**
- **No Operational Constraint on cycle life**
- Operational DOD : 0~100%

5. Design Flexibility

- Separation of Power (MW) and Energy (MWh)
- Easy to build long-duration and large-scale systems

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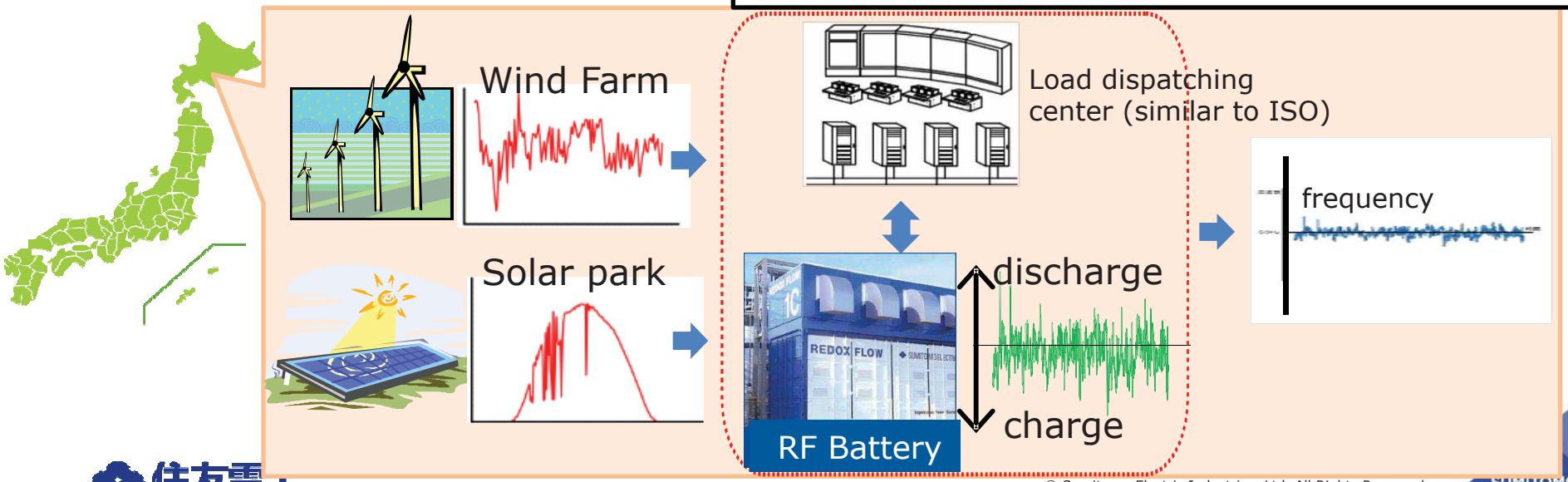
Large Scale RF Battery in Japan

- Funded by Japanese government
- Size: **15 MW, 60 MWh**
- Location: Substation of Hokkaido Electric
- Application: Multi-purpose
  - Local & Central Control of BESS Dispatch
  - Frequency control
  - Renewable generation mitigation, etc
- On-line: Dec.,2015



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