



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

The Energy Sector's Impact on Climate Change

Fossil Power Plants



- CO2 Emissions
- Serious impact on global warming

PV Power Plants



- No CO2 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

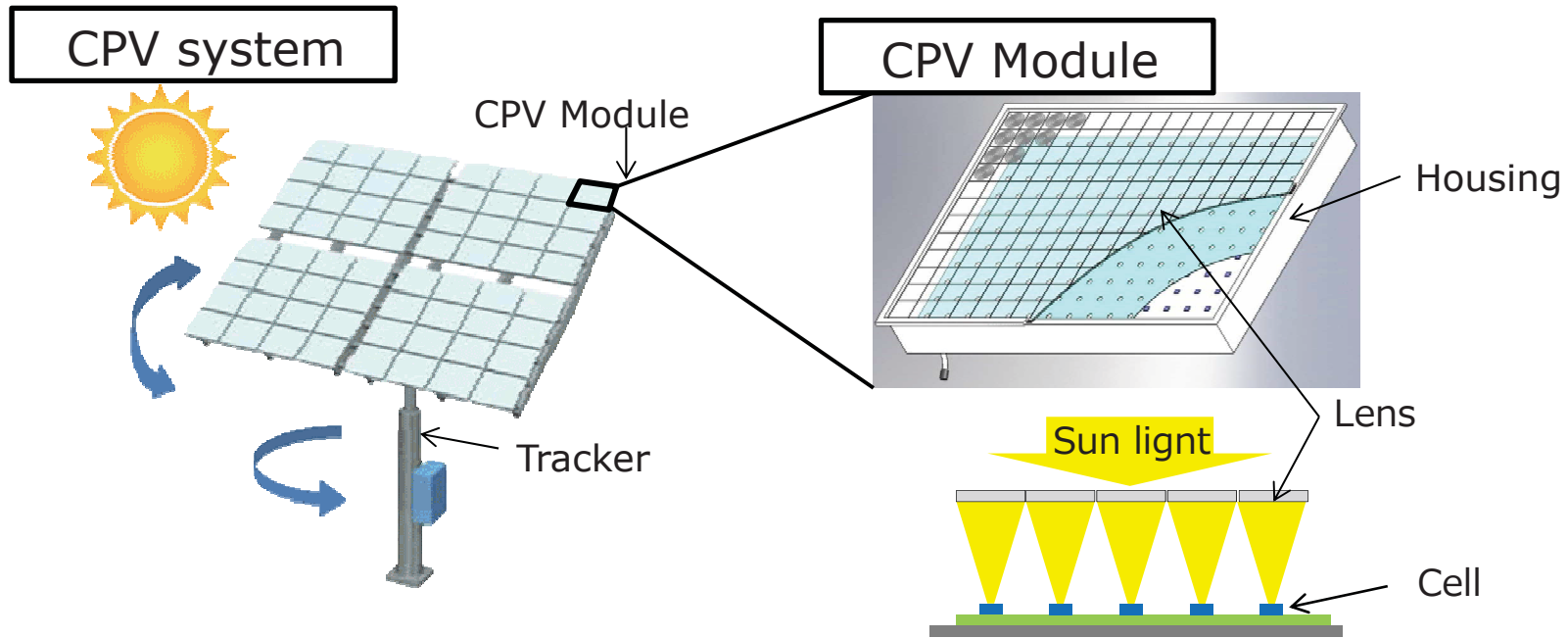
- Power generation drastically decreases at above 30°C

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)

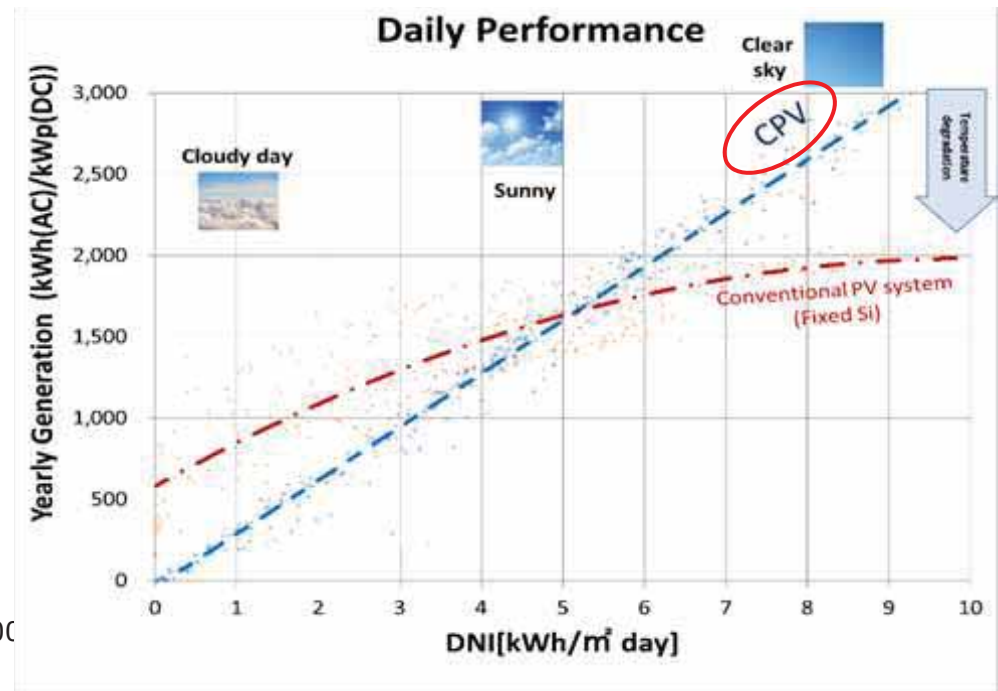
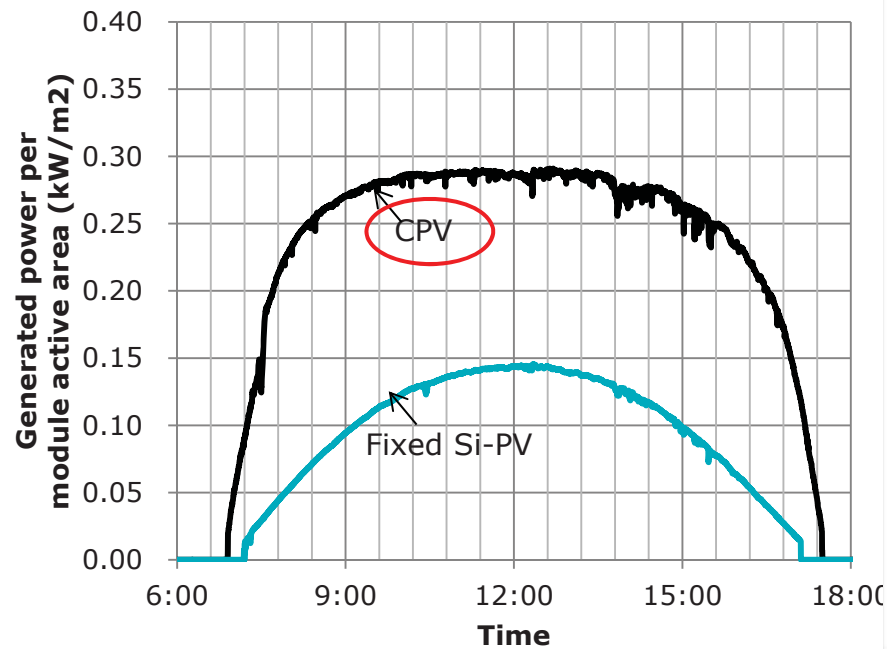
- High efficiency cell with compound semiconductor(GaAs based) applied - technology used in satellites
- Efficiency even improved by adopting 3 layers structure absorbing broad wave length
- Size of a cell is minimized by focusing sunlight by lenses and a tracker to reduce the cell cost

CPV Doubles Electricity Generation

Double Electricity Generation than Conventional PV System

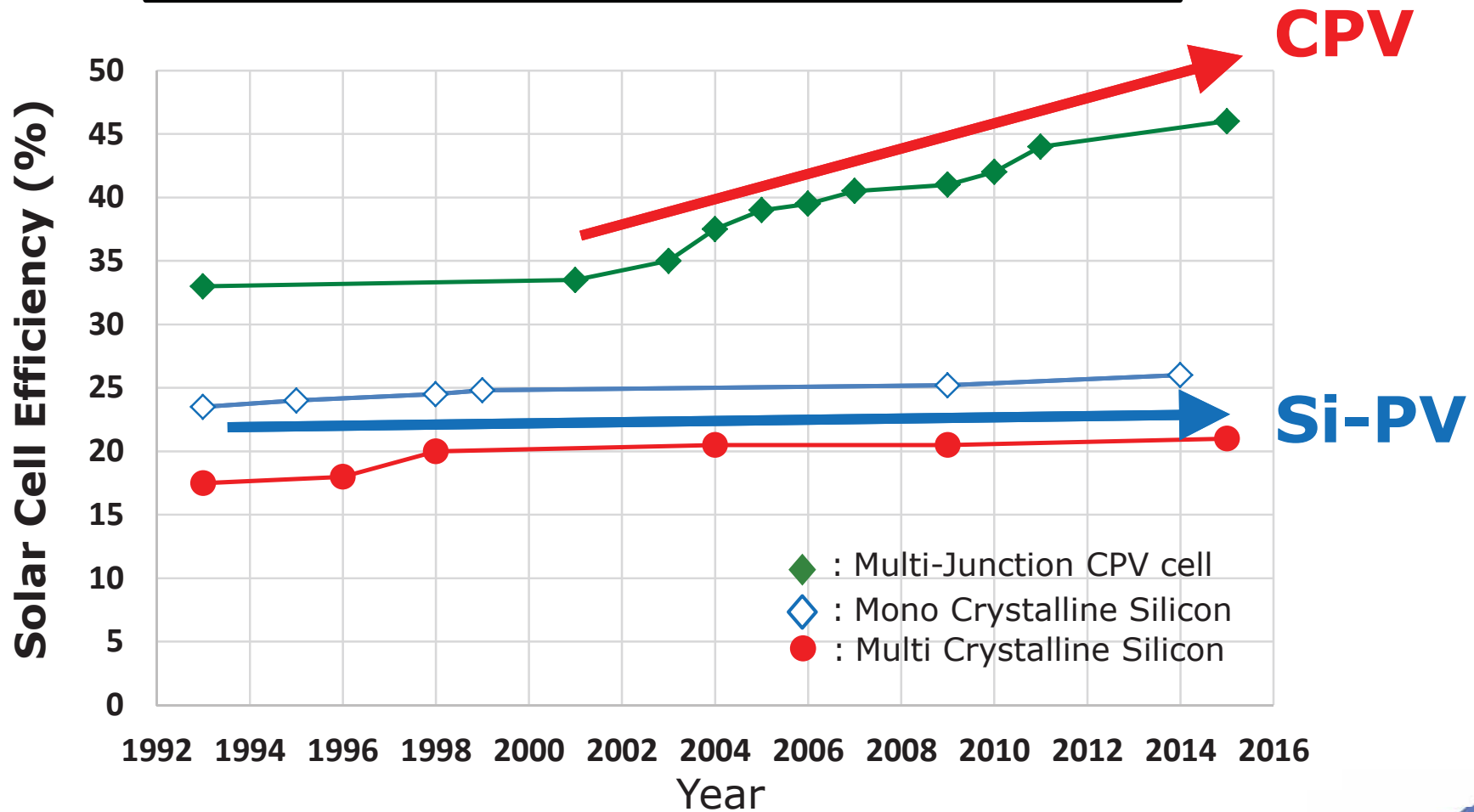
Higher Generation in High Irradiation Area

Collected in Ouarzazate, 2015

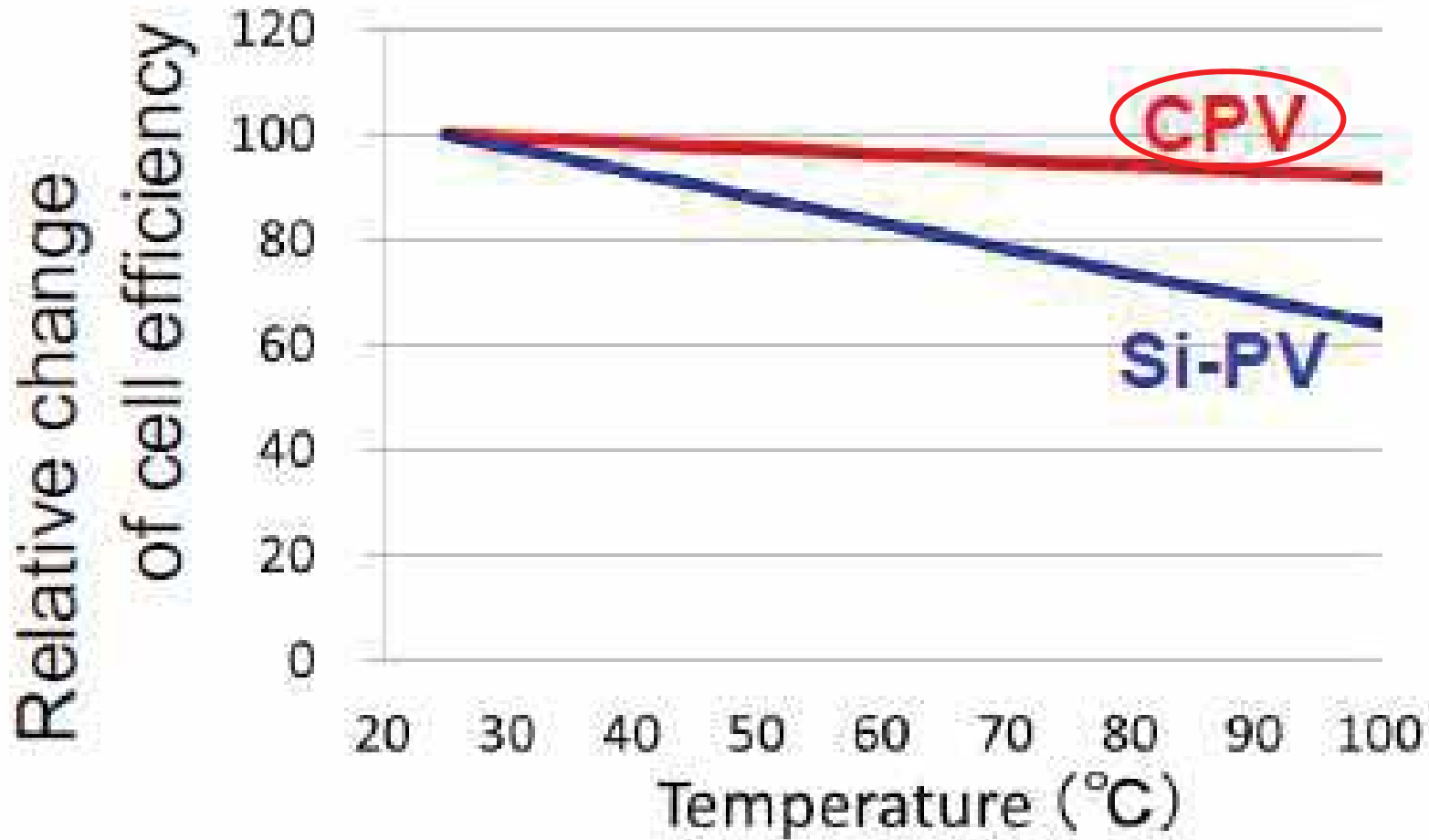


Road Map for Efficiency

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



Degradation at High Temperature





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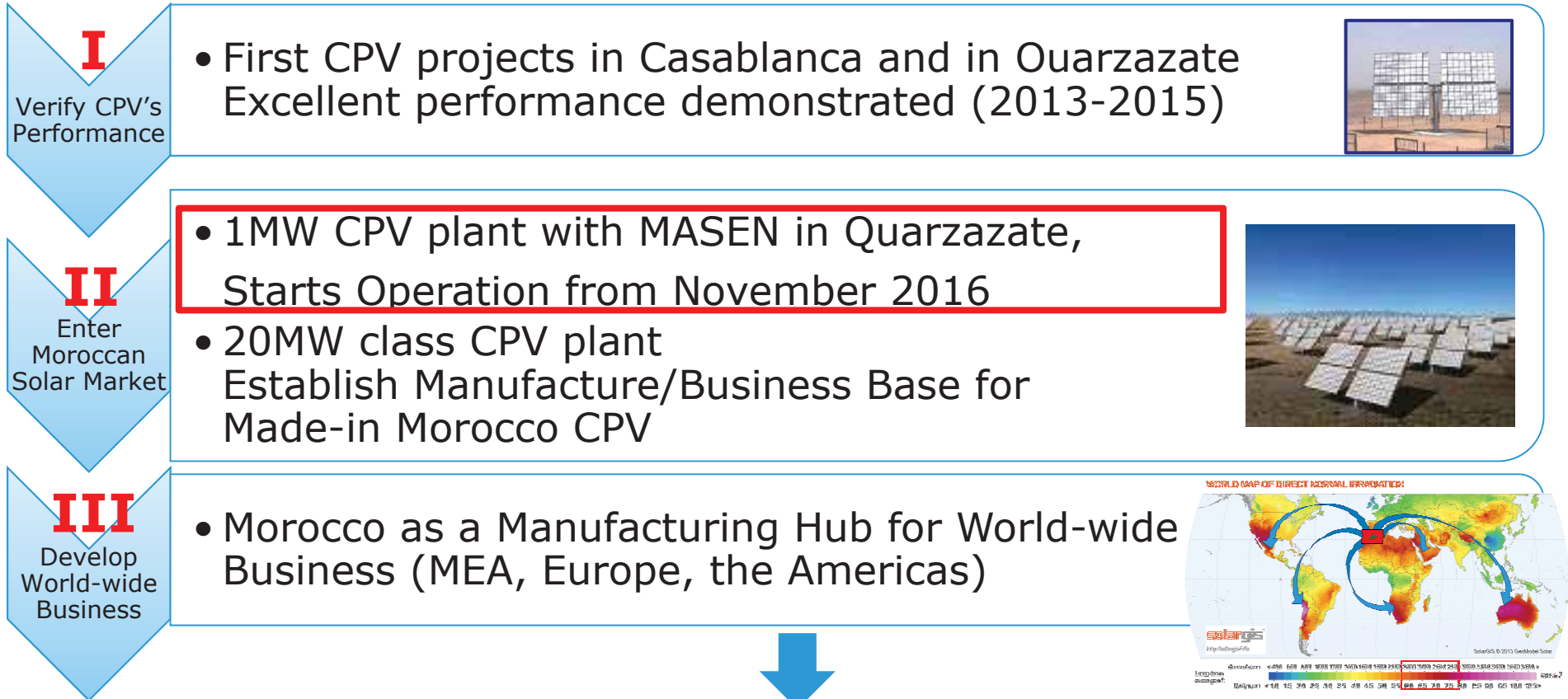
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Sumitomo's CPV Project and Plan in Morocco

For World-wide Business Development: Future Business Plan



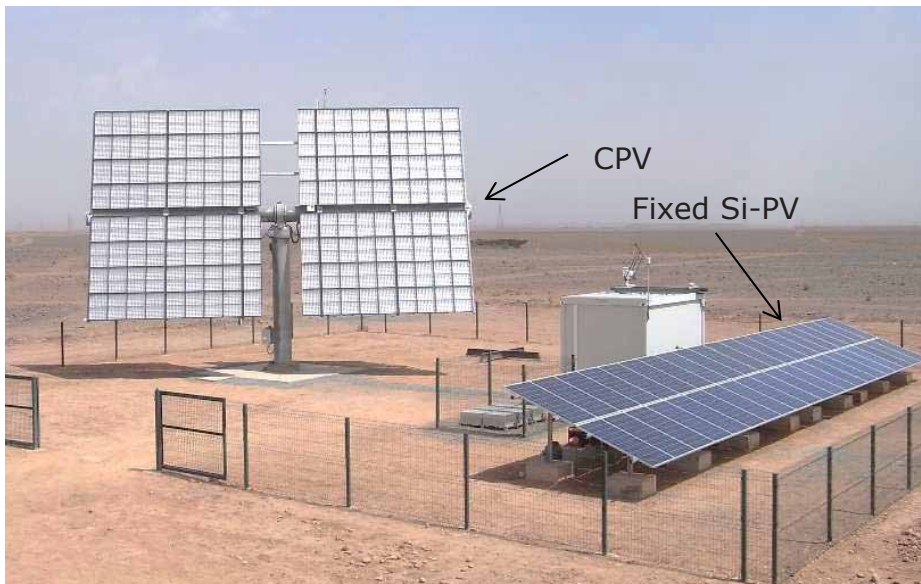
- Bring Investment and Employment Opportunities
- Strengthen Energy Security

I

Sumitomo CPV in Morocco



CPV in Casablanca (2013)



CPV in Ouarzazate (2015-2016)

Collaborated with MASEN and JICA

II 1 MW CPV Project in Ouarzazate

Contract for the Project signed

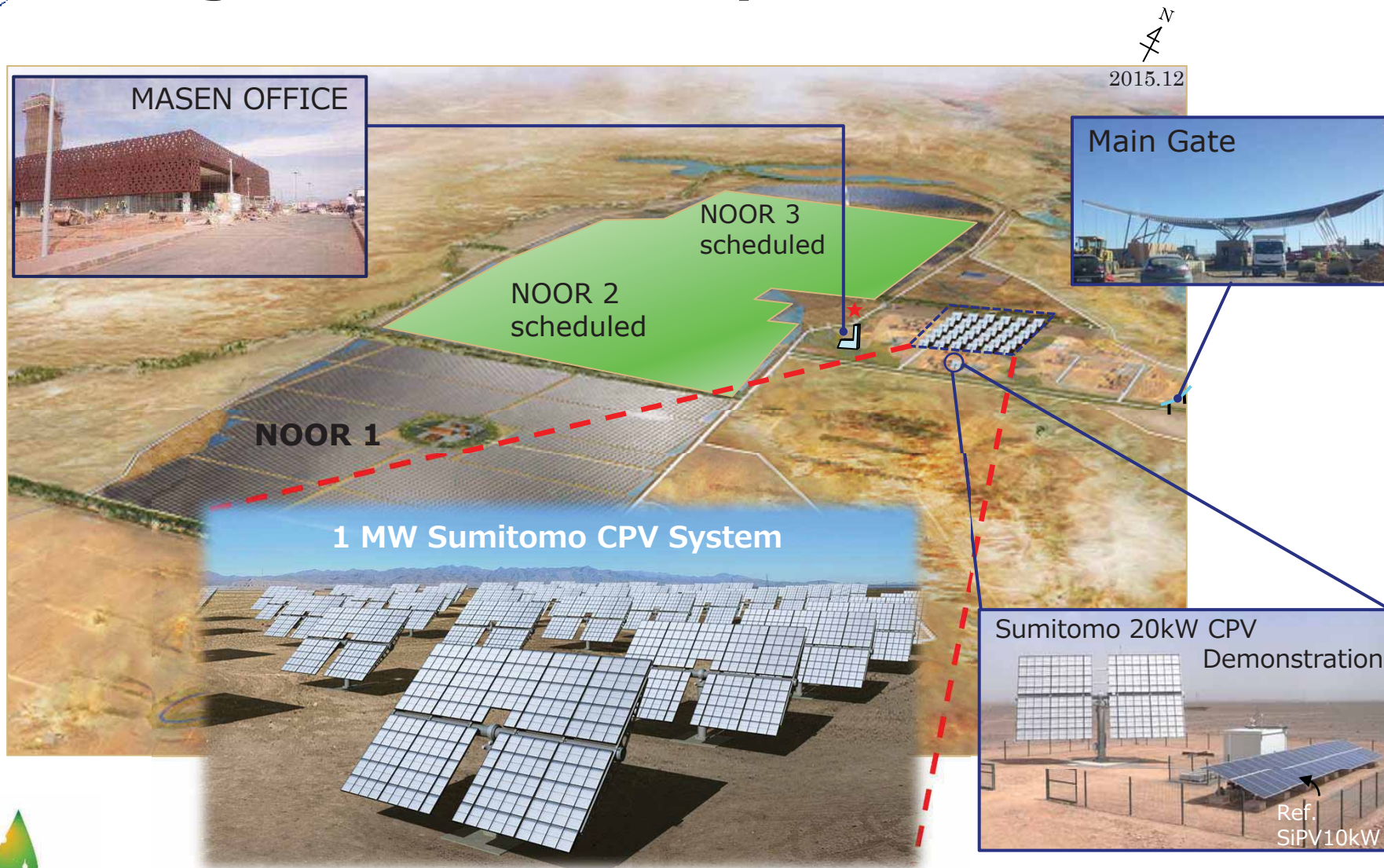


MASEN and Sumitomo agreed and signed on May 4, 2016, at the 4th Japan-Arab Economic Forum in Casablanca.

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

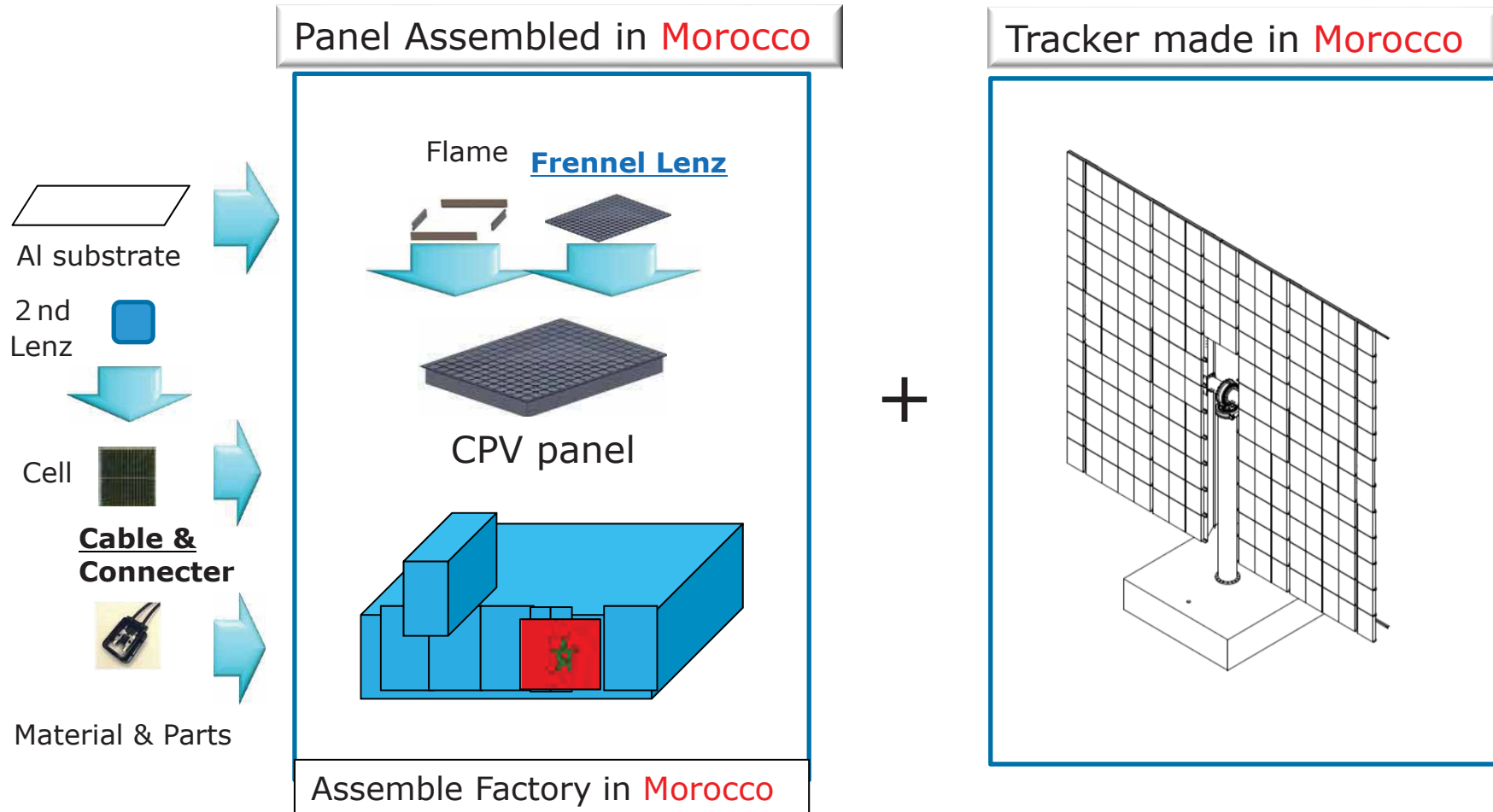
1 MW CPV System in Ouarzazate

“Panel surface upside down to reduce the dust and sand on the surface”



III Sumitomo's CPV in Morocco: Near Future

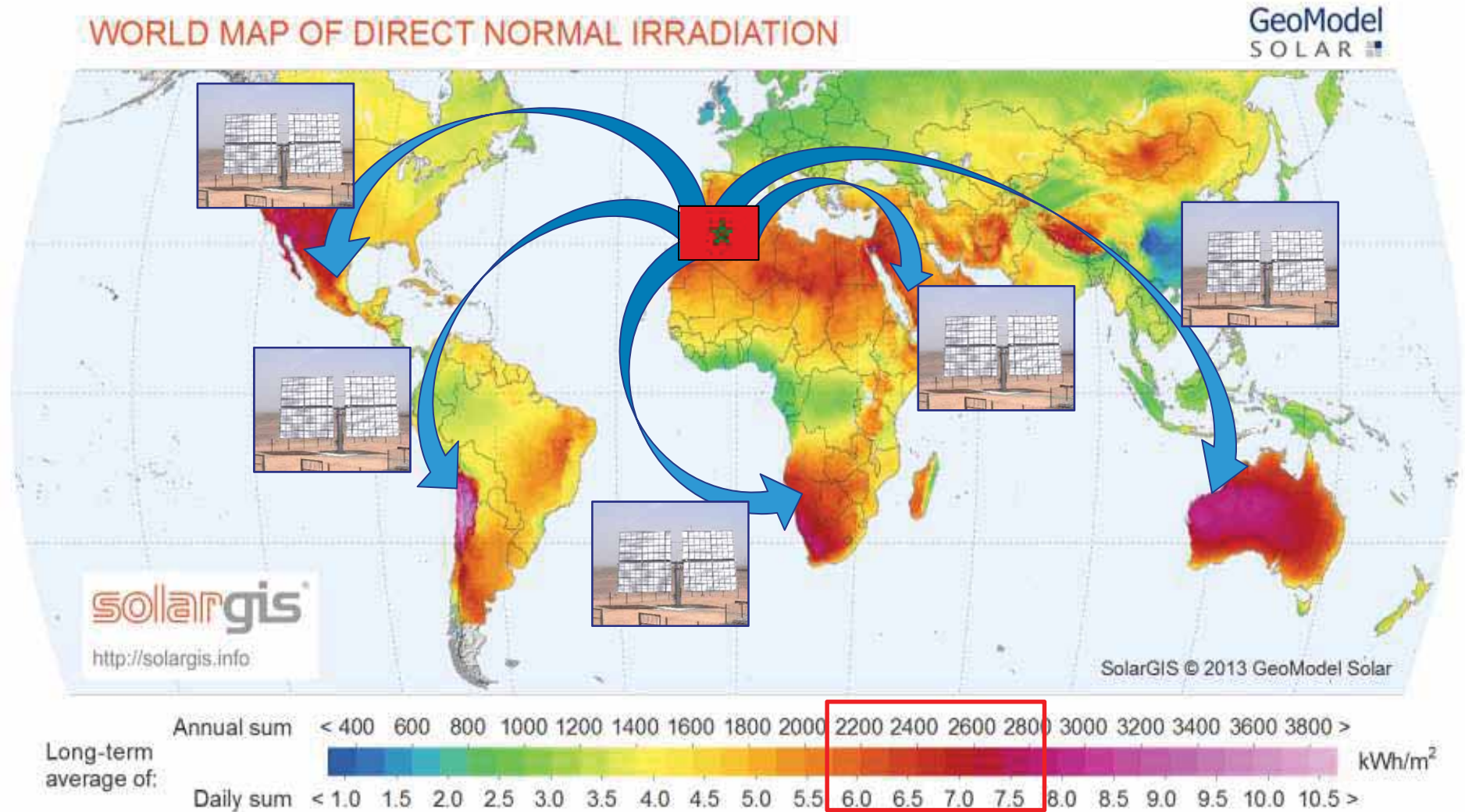
Morocco as a Manufacturing Hub for CPV Business



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."



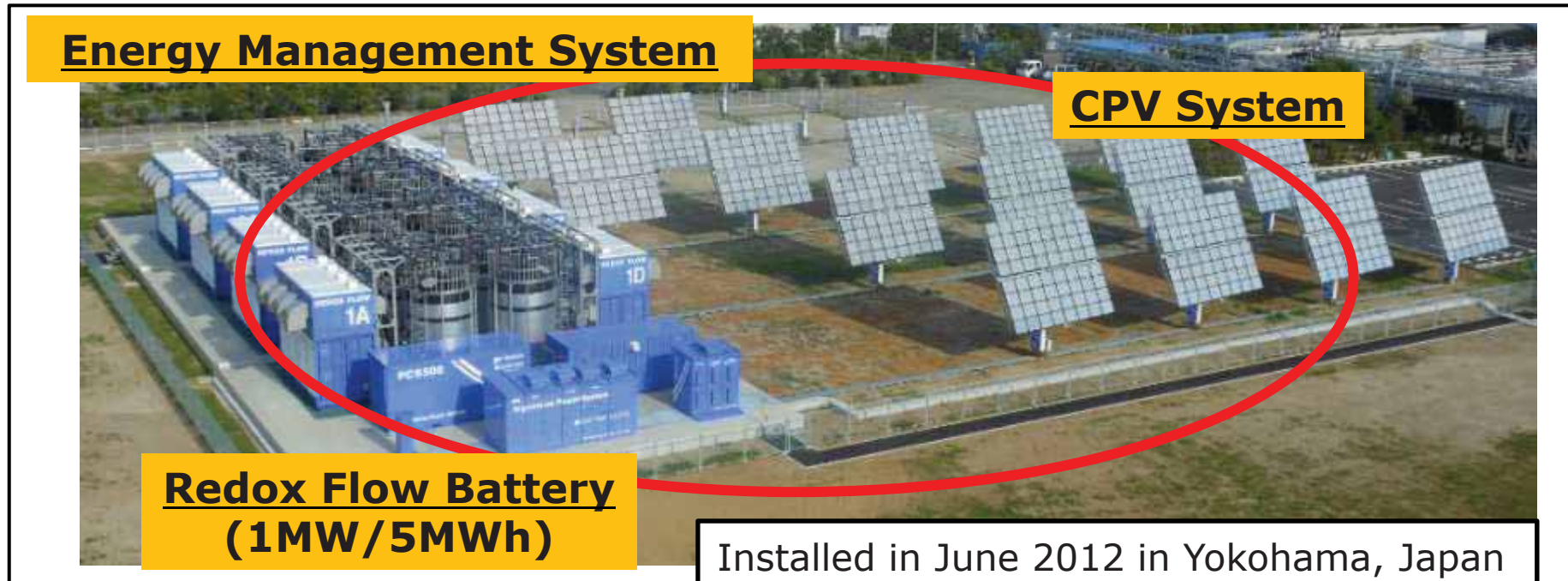
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CPV and Battery



- 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

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

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

