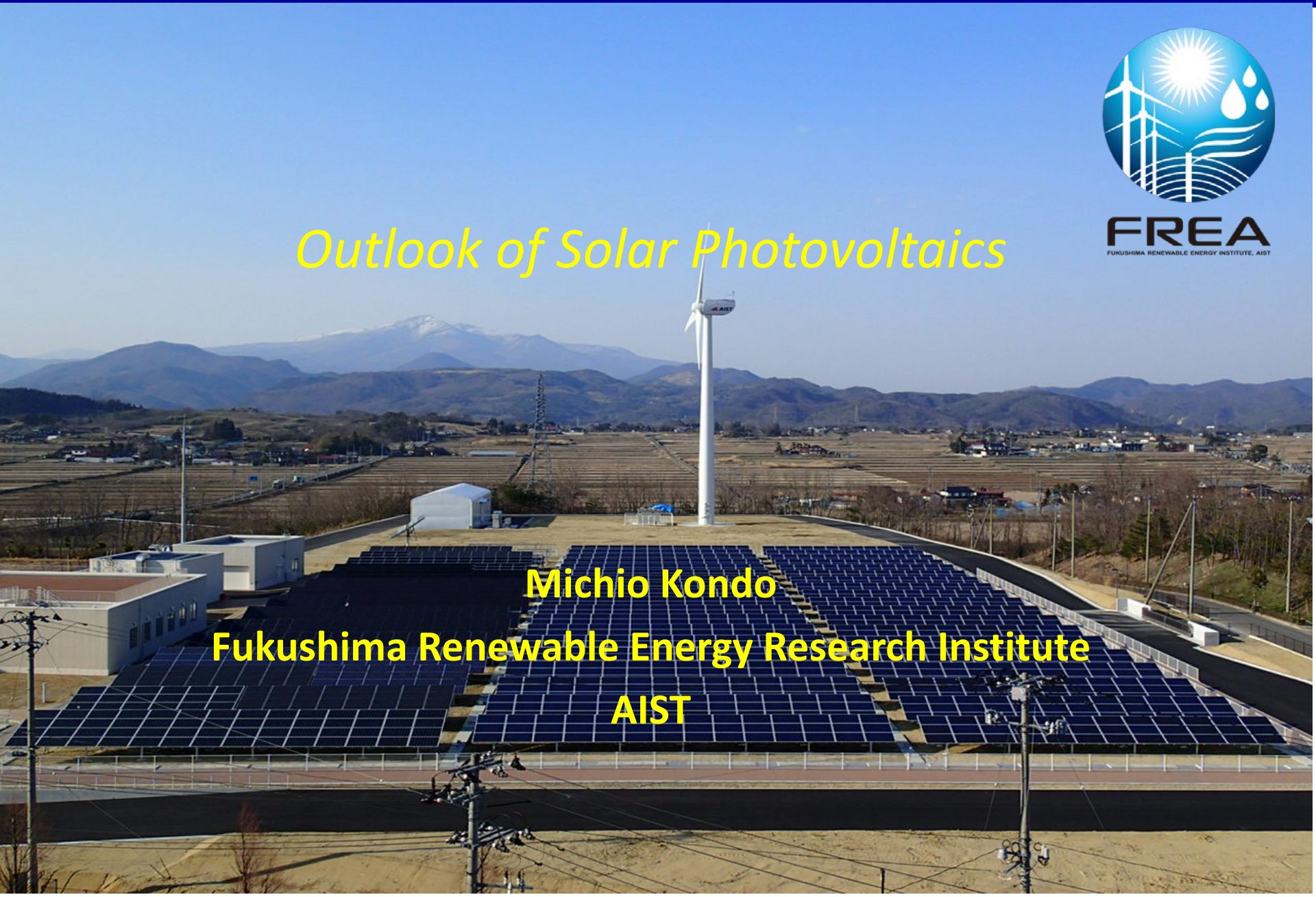
# *Outlook of Solar Photovoltaics*



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**AIST**

# PV to be a pillar of energy

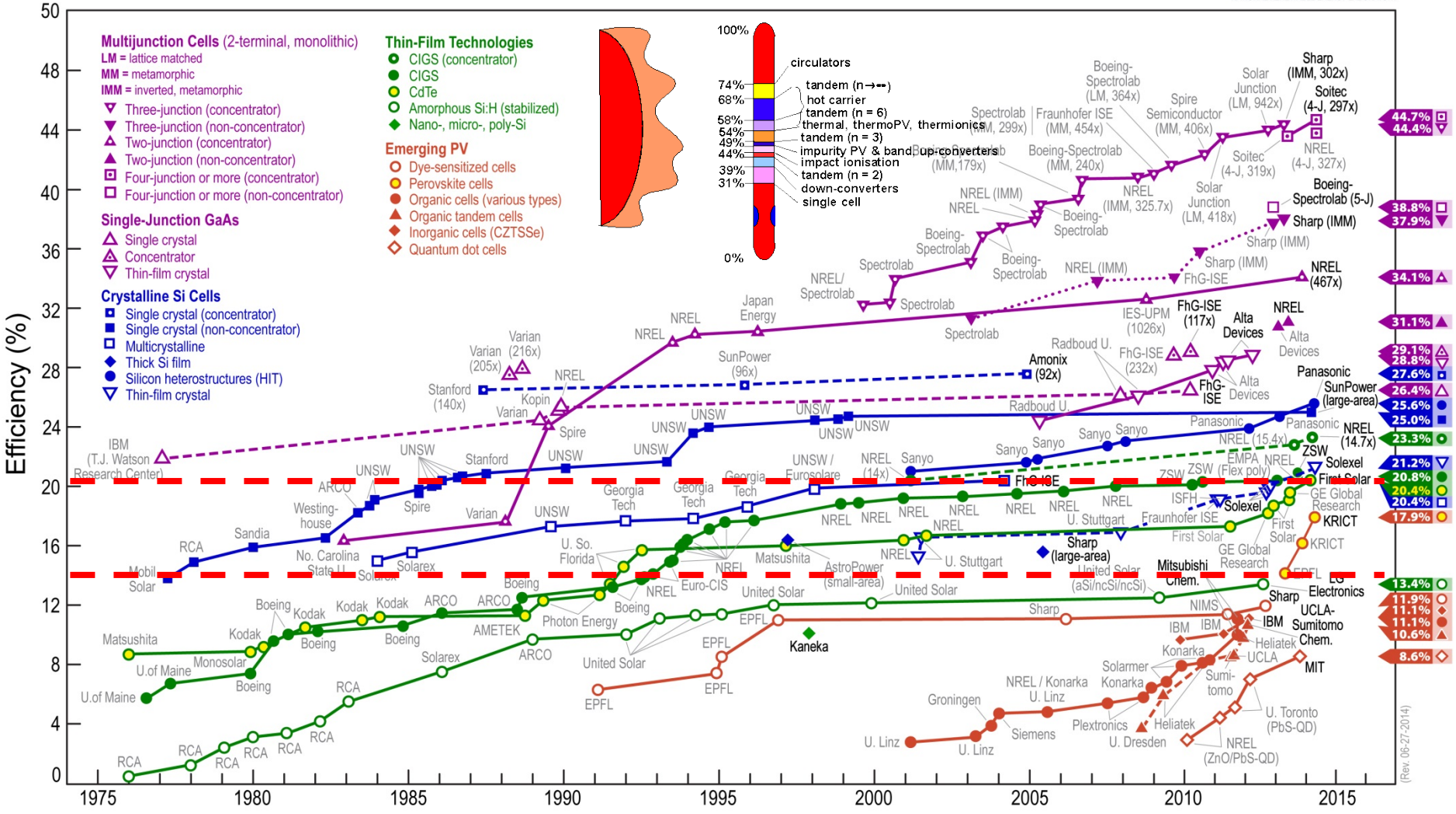
- Lower Cost & Supply Chain
  - Higher efficiency
  - Material, Process, Installation, O&M (Reliability)
- Best Energy Mix
  - PV, Wind, Gas Turbine, Base-Load,
- Energy Storage
  - Long term by H2, Short term by Pumped hydro and Battery
- Grid Operation and Monitoring
  - Demand and supply control
  - Risk of Uncertainty

# PV Technologies; Variety of materials

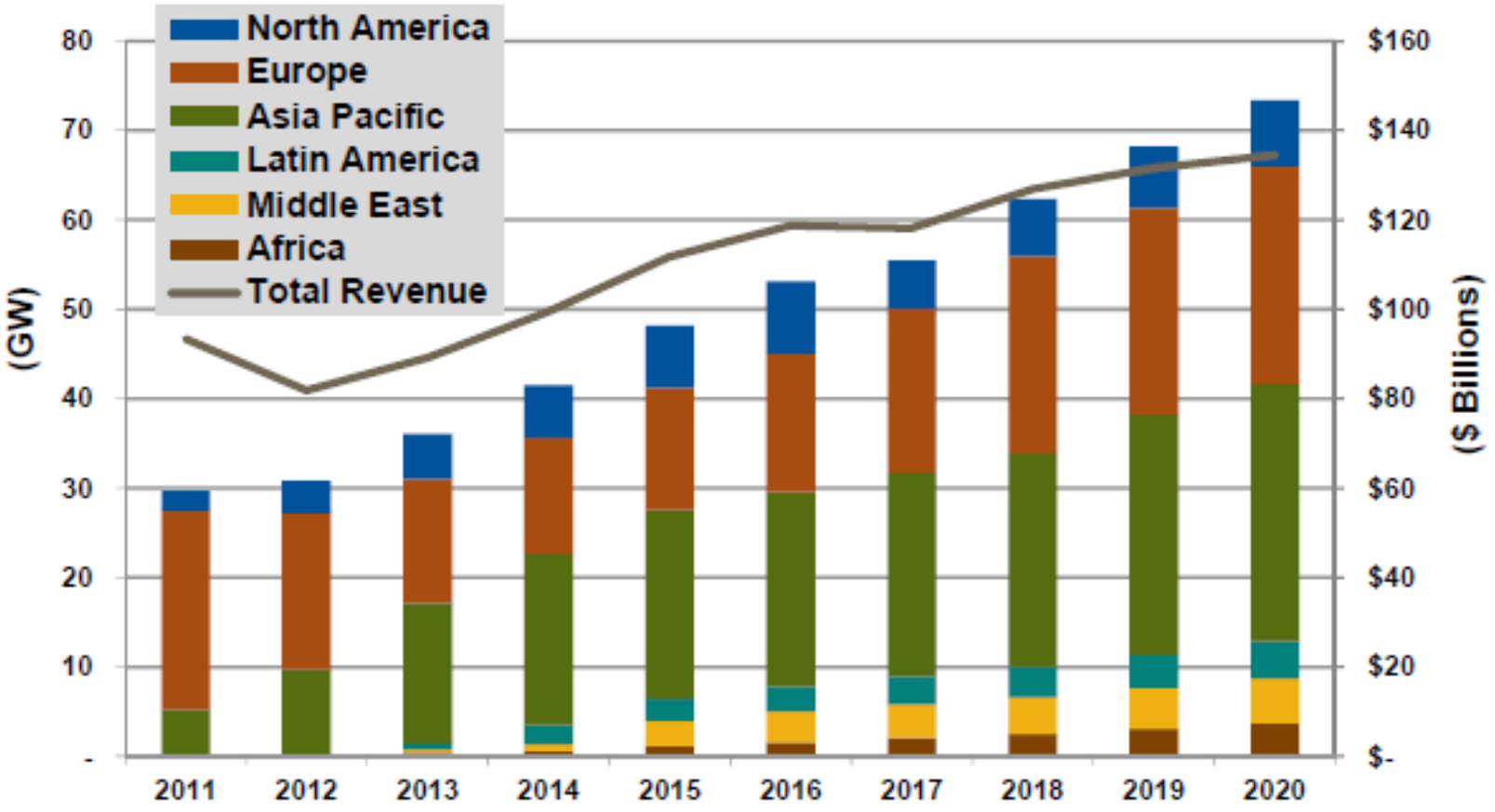
- **Silicon**
  - Mono c-Si — 25.6%
  - Multi c-Si — 20.7%
  - Thin film Si — 16.3% (~13% stab.)
- **Compound semiconductors**
  - Monocrystalline — (InGaP, InGaAs,Ge) (~44.7%)
  - Polycrystalline
    - $Cu(In、Ga)Se_2$ (21.8%)
    - CdTe (20.4% )
    - CuZnSnS (11.1%)
- **Perovskite** — (20.1%)
- **Organic**
  - Thin film (solid) (12 %)
  - Dye-sensitized (12.9 %)
- **Quantum effect** — Quantum dot, multi-quantum-well (8.6%)

# Best Research-Cell Efficiencies

NREL
NATIONAL RENEWABLE ENERGY LABORATORY



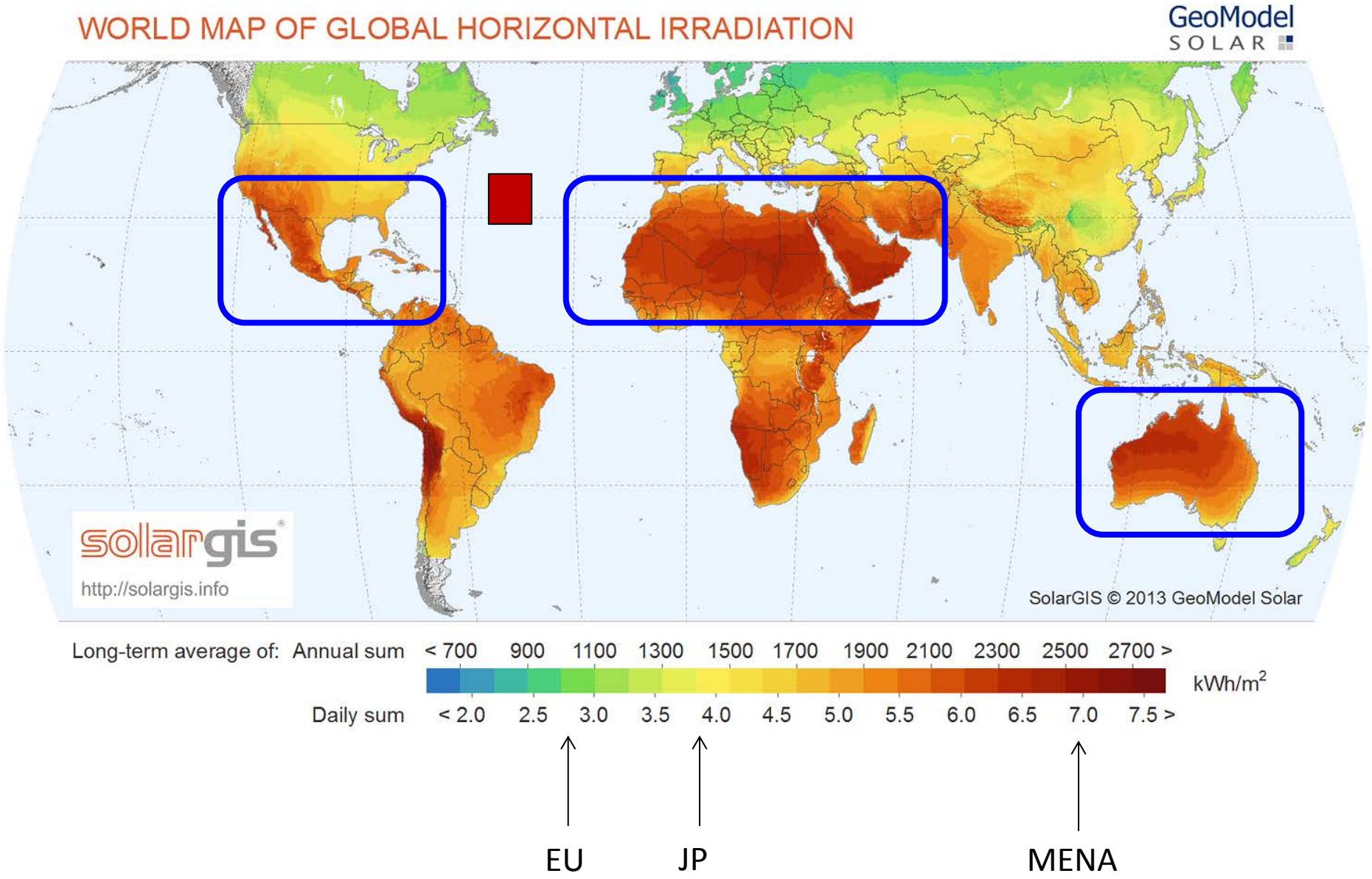
# Global Market of PV




*Source : Navigant Research*

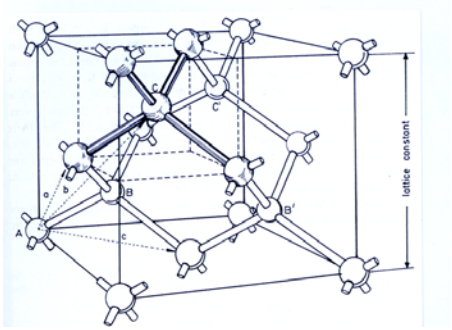
**Harsh climate; desert, tropical**

# Potential opportunity



# Strategy for Materials

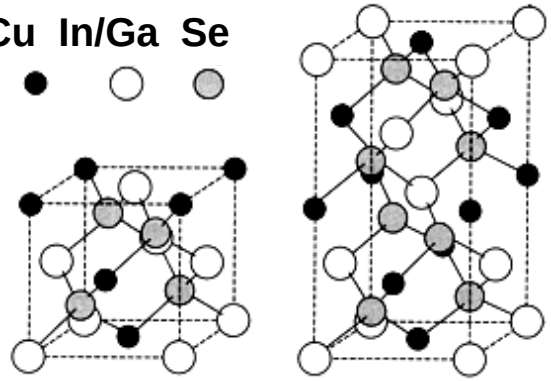
GaAs




III

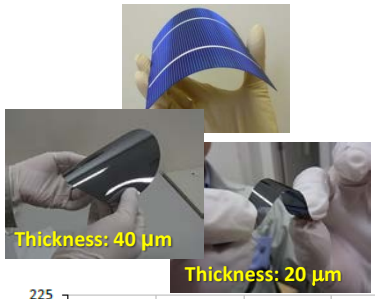
V

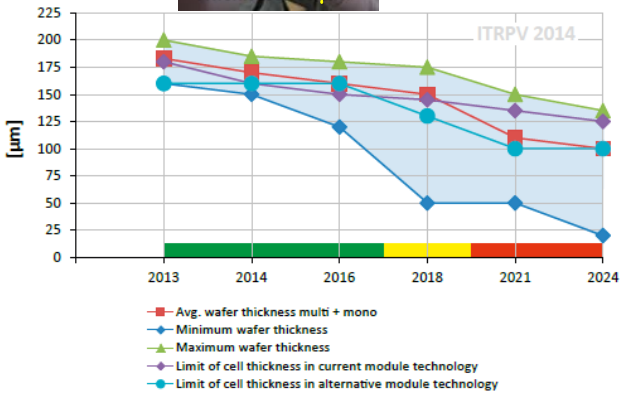
Cu In/Ga Se



IV

Si




II

VI

ZnS
CdS
CdTe

I

III

VI

CuInSe2
CuGaS2

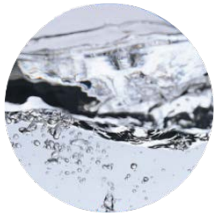
I

II

IV

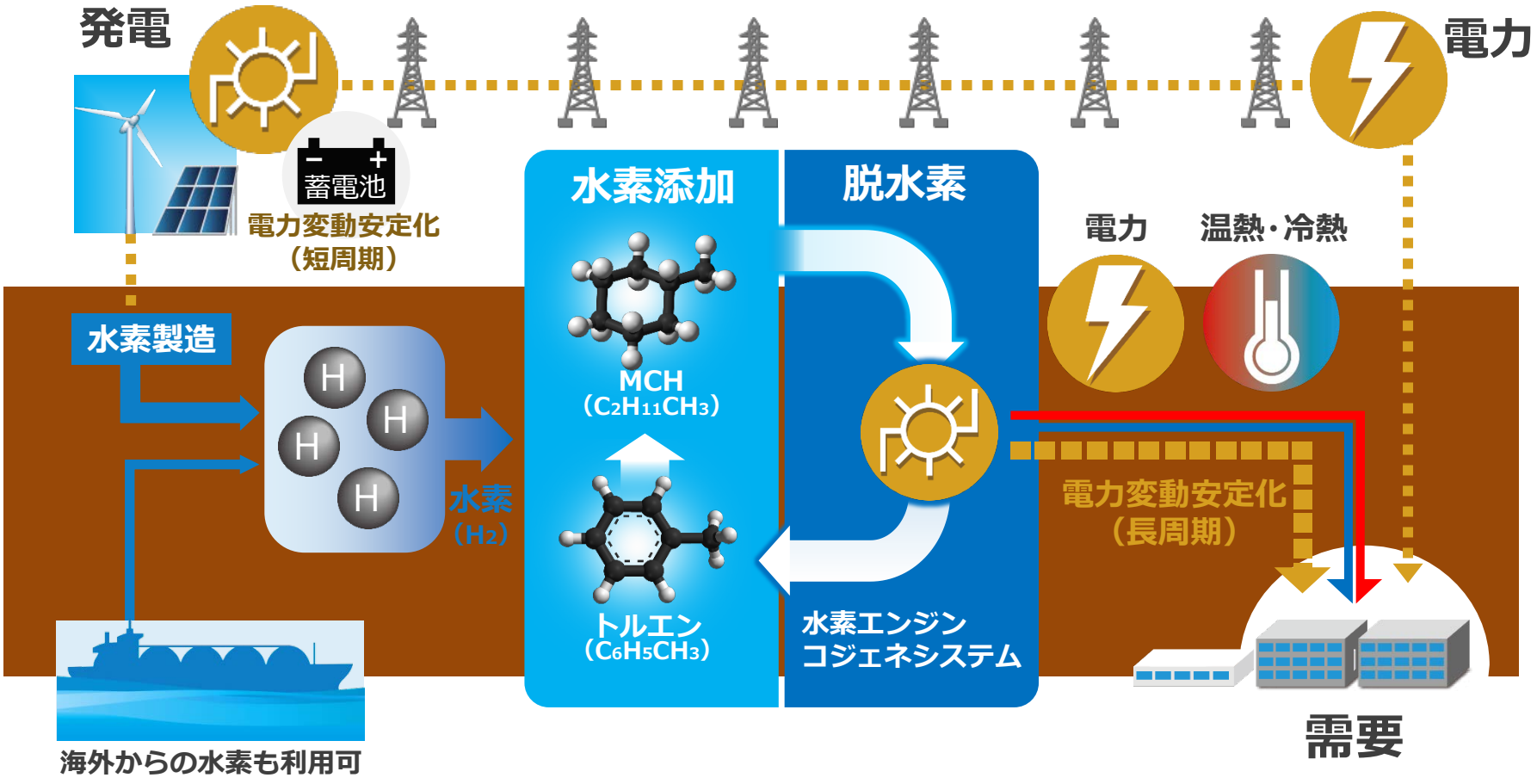
VI

CuZnSnSe2



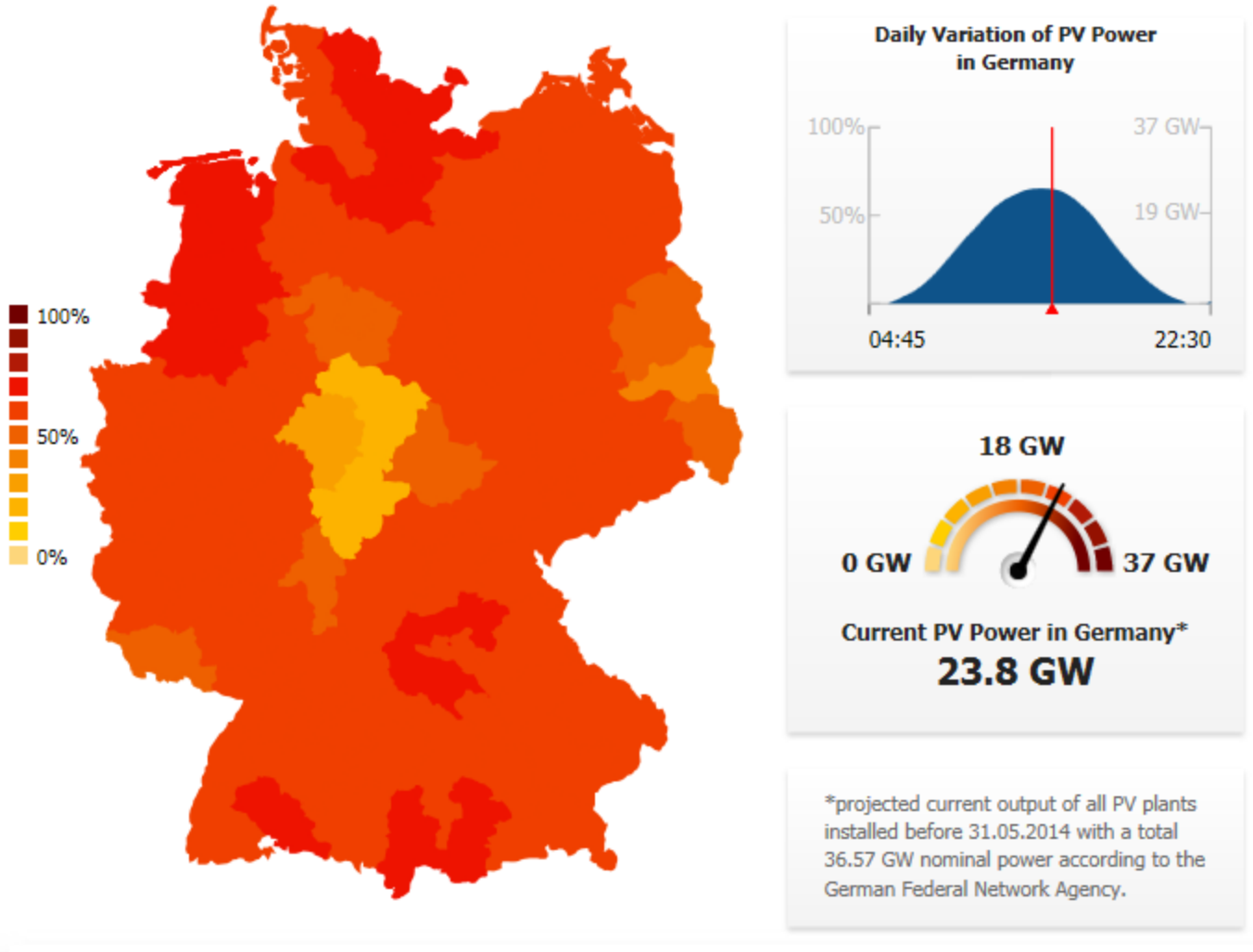
**Short term : Battery, Pumped hydro (20 GW)**
**Long term : Hydrogen**

# Hydrogen as Energy Carrier



# Real Time Monitoring

Source : SMA

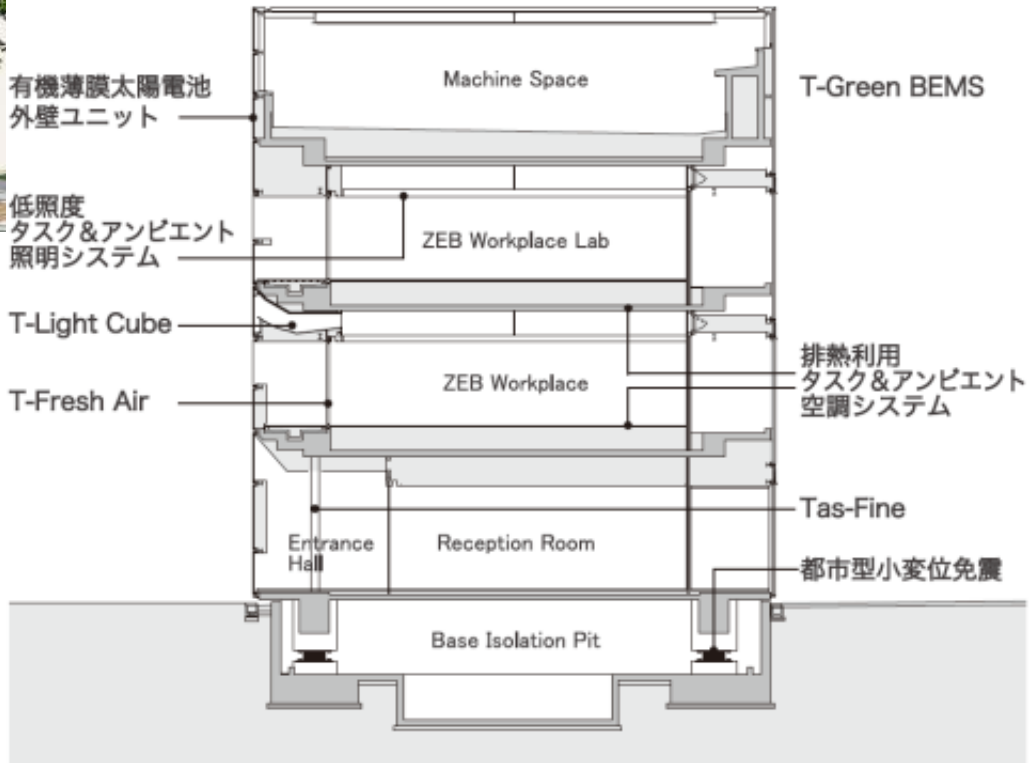


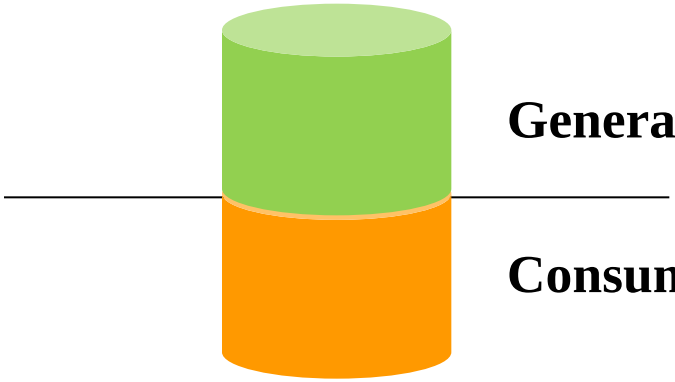

**Grid operation !**

# ZERO-Energy Building (ZEB) ; Additional Value

## Demonstration of ZEB

**~60 kW PV**
**Rooftop c-Si**
**Façade organic**




**Source: Taisei Corporation**