ACEF Deep Dive Workshop on
Distributed Energy Resources and Electric Vehicles

Least Cost Integration of DER in Small Island Grids

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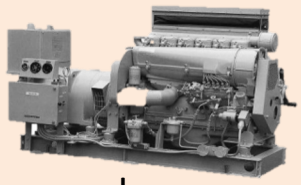
Background Information

Hybrid Islands Program

Concept of Hybrid Power Generation System (HPGS)

Optimized Diesel



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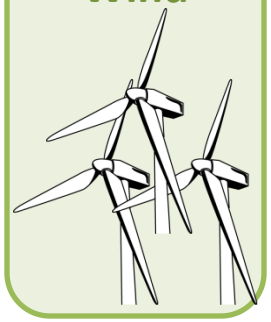
Appropriate & Economical O&M

Grid Stabilization

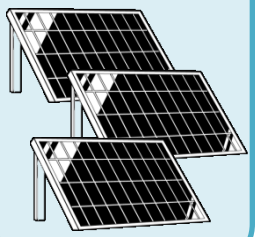
(Output restriction, Battery, EMS, etc.)

Renewable Energy

Wind



PV



Demand

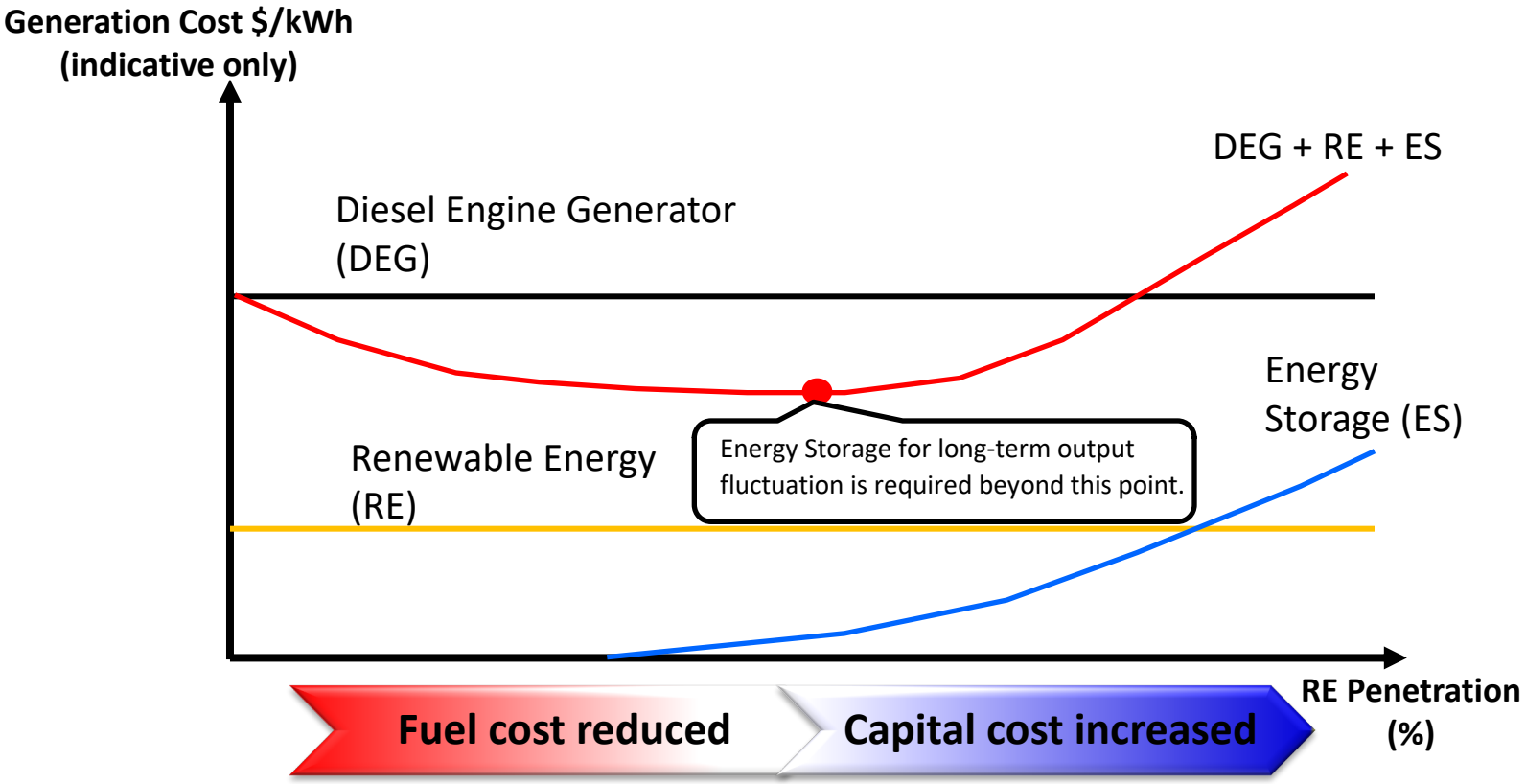
JICA's possible collaboration

- Master Plan Study on RE Introduction
- Hybrid Grid Training
- Regional Technical Cooperation
- Grant Aid for Power Infrastructure Development

for Sustainable Development...

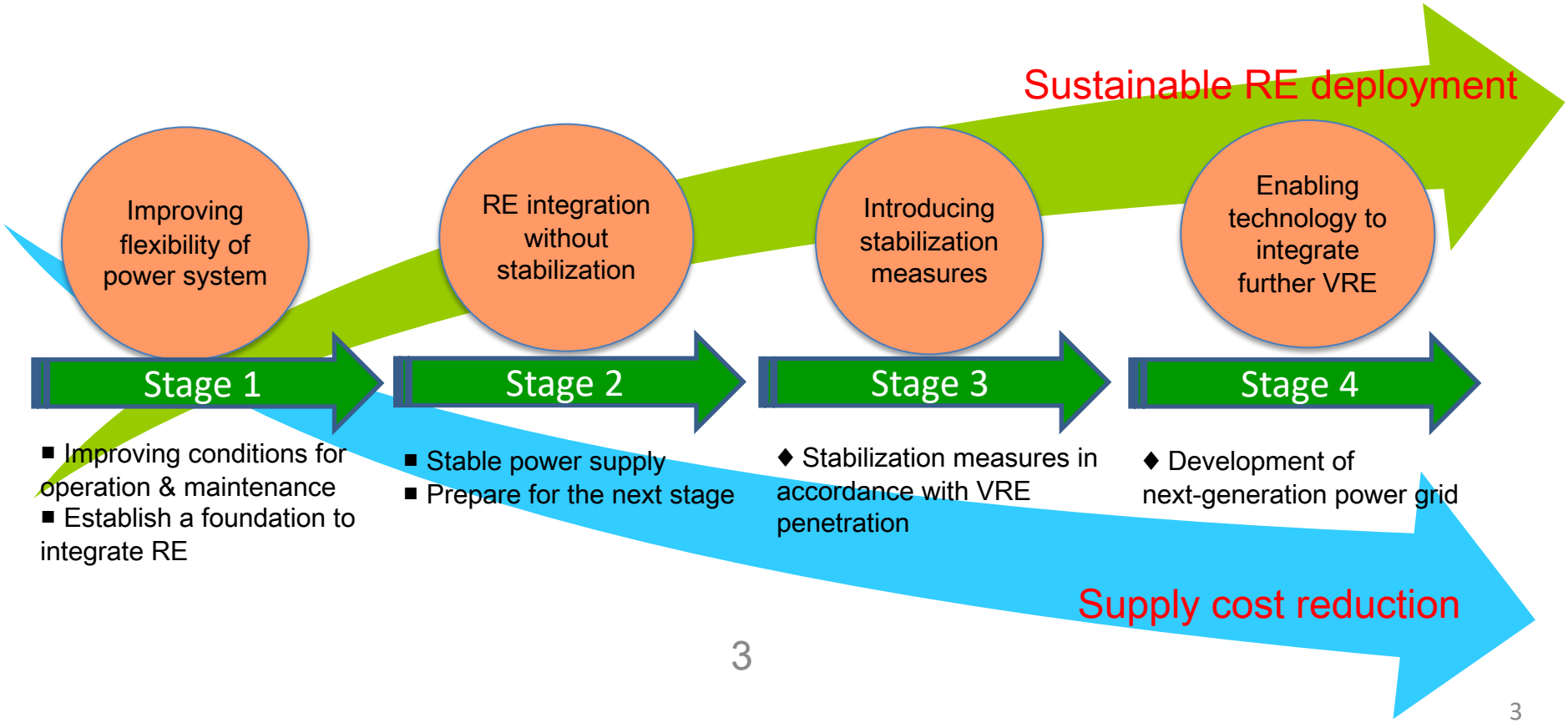
Challenge of DER integration

Total generation cost will be increased as the VRE penetration gets higher, mainly due to the incremental cost of energy storage.



Approach under Hybrid Islands Program

Step-by-step approach incorporating strategy best utilizing power system flexibility should be established to achieve higher target of VRE integration while reducing the total cost of supply.



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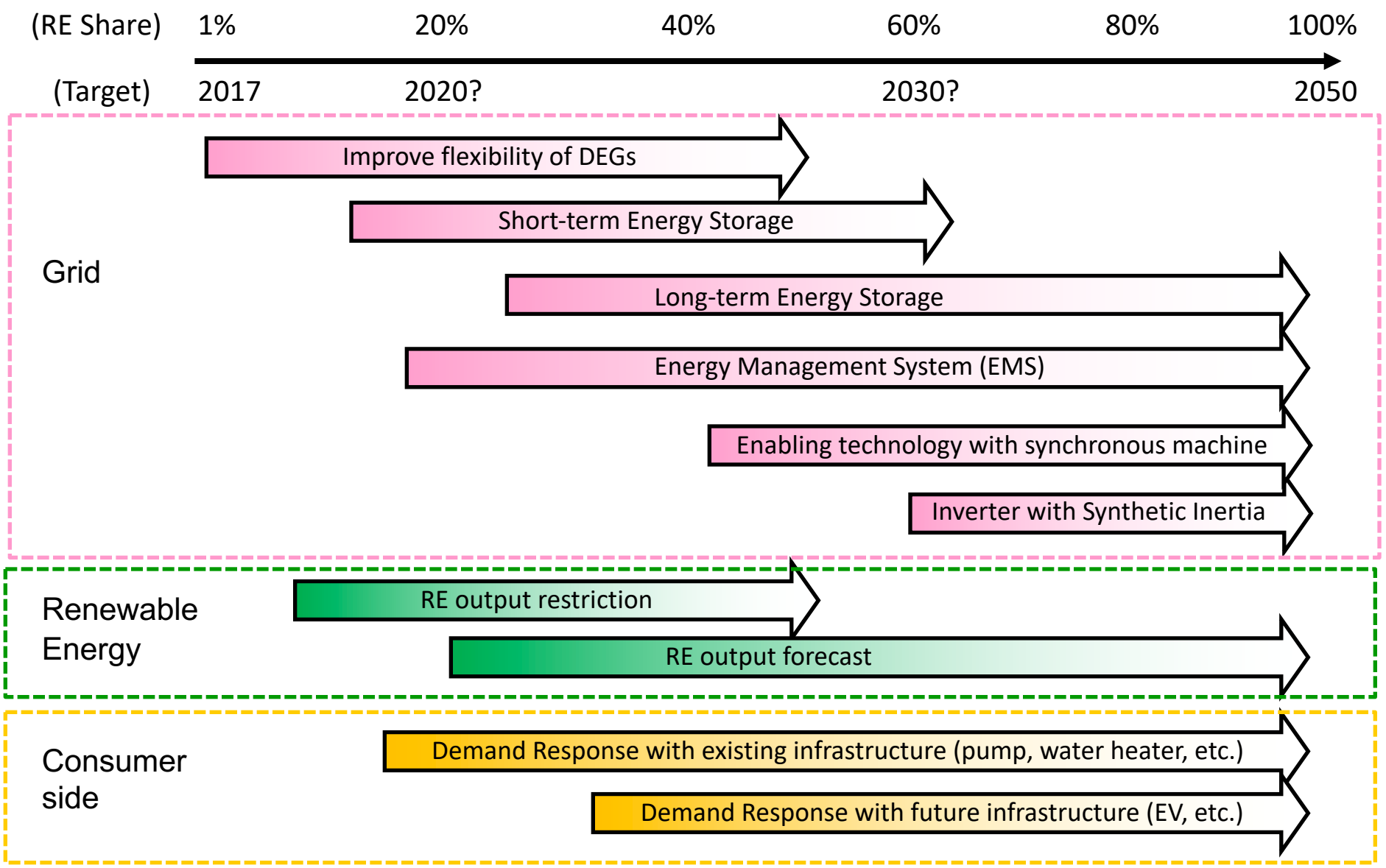
Renewable Energy Roadmap



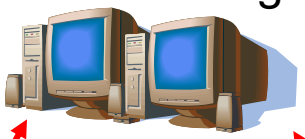
Energy Management System (EMS)

- Demand Forecast
- Economic Dispatch Control
- Frequency Control

RE Generation System

- Maximum Power Point Tracking (MPPT)

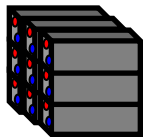
EMS for Microgrid



Output restriction & Forecast

Battery charge/discharge

Energy Storage (Short/Long-term)

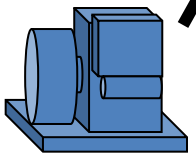


- Output fluctuation control (ΔP)
- Frequency fluctuation control (ΔF)
- Voltage / reactive power control

Control & Supervision

Demand Response

Diesel Engine Generators

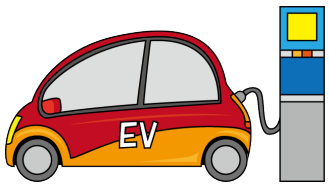


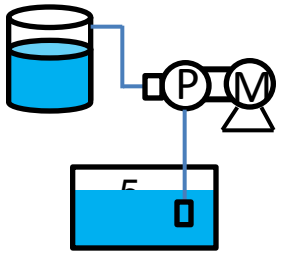
- Automatic Start/Stop
- Isochronous Control (GF/LFC)
- Optimization of unit power output & specific fuel consumption

Dispatchable Load

Ice making machine

Electric Vehicle





Water supply pump

Demand Response

(1) Dispatchable
Can be controlled in response to the request
(2) Response time
Can be controlled in short time
(3) Enough capacity
Enough capacity to accommodate RE fluctuation
(4) Opportunity
Necessary time / day of the year

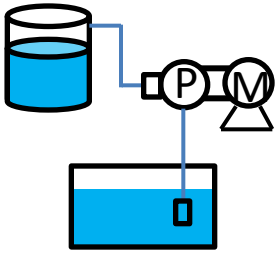
Utility

Consumer
(Dispatchable Demand)

(1) Quality & Reliability
Can keep the quality and reliability of supply
(2) Sustainability
Can avoid possible damage on the equipment
(3) Economic Incentive
Discounted tariff or TOU (Time of Use)

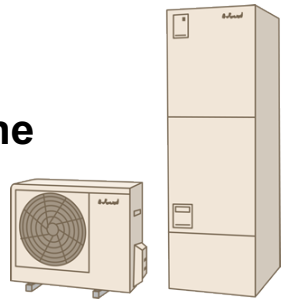
Desalination Plant

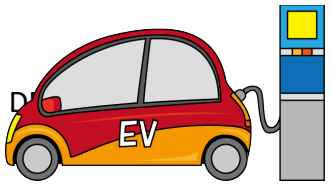
Water supply pump



Ice making machine

Heat Pump



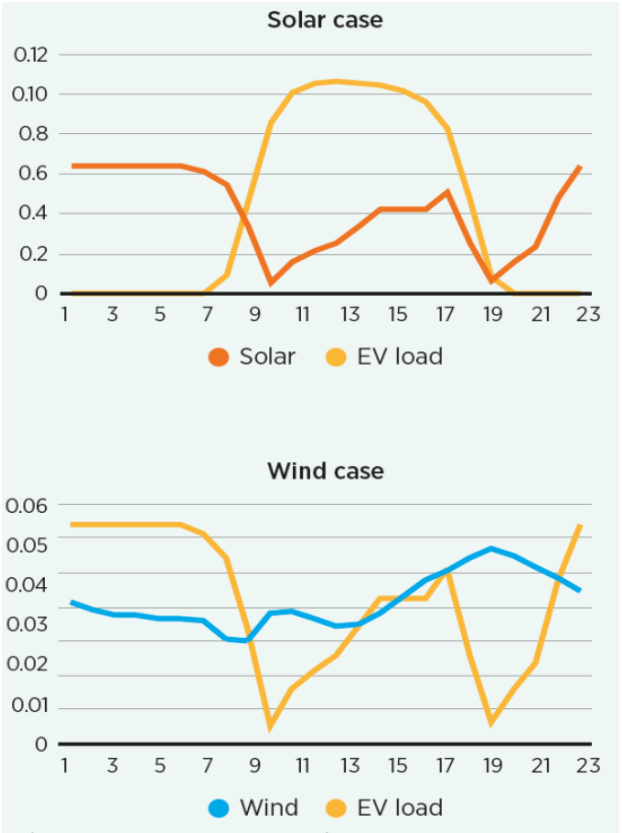


Electric Vehicle

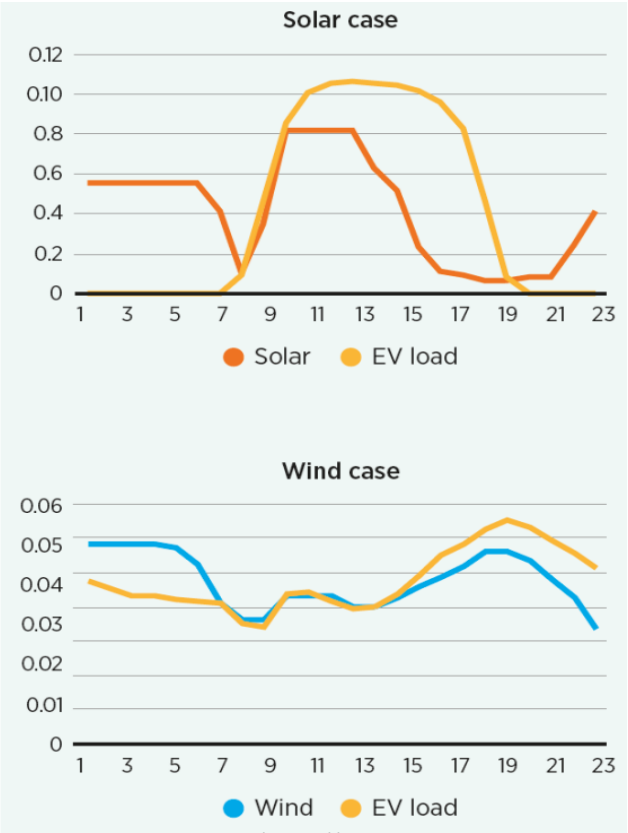
Benefit of EV integration

There is a huge potential to introduce EV as a resource for Demand Response as well as reducing GHG emission under the stage of high VRE penetration.

Normal Charging



Smart Charging



(Source: Smart Charging for Electric Vehicles, IRENA Innovation Outlook (2019))

Project Highlight : <Marshall Islands> Transition of Personnel Development to Support the EV Demonstration Experiment Project

Strategy for EV promotion

- ✓ Introduce EV with solar PV system

EV and charger at fire station


Charger & Communication system to cloud server in Japan

- **Purpose:** To find the feasibility and sustainability of promoting EV and solar PV system as a business model in small PICs
- **Pilot installation:** 3 EVs (Honda FIT), 4 charging stations with remote monitoring system from Japan
- **Lessons Learned:**
  (1) Quality of power supply (voltage, frequency) needs to be improved.
  (2) Capacity development for EV repair/ inspection shall be enhanced to ensure local maintenance system.
  (3) Environmental regulations and institutional arrangements for disposing/ recycling battery are necessary.

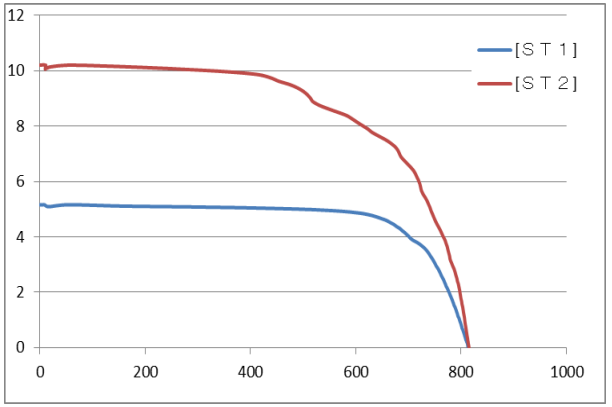
Further challenge

In some countries, less than 50% capacity of PV system is working due to inappropriate quality control for equipment and installation & maintenance works.

Observations in the Marshall Islands (Majuro)

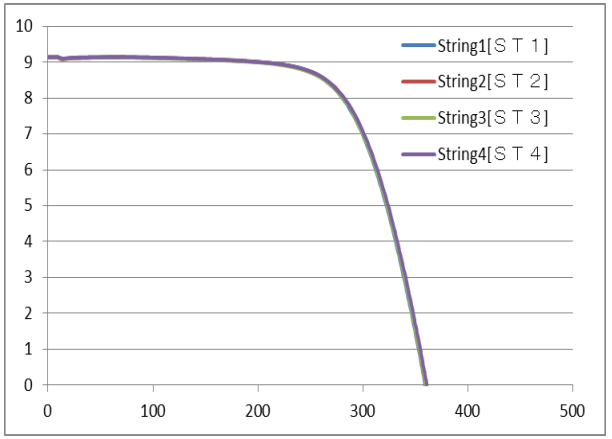
(1) PV system installed at Water Reservoir (600kW) in 2016

- Many PV modules and inverters are already out of order.



(2) PV system installed at Majuro Hospital (209kW) in 2012

- All PV modules are working with good I-V profiles.



Way Forward

- Step-by-step and holistic approach are required to realize cost-effective VRE integration in small island grids.
- Demand Response and EV will play a crucial role to reduce the cost of grid stabilization for the higher penetration of VRE integration.

Counterpart Training in Japan, The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries

THANK YOU VERY MUCH
FOR YOUR ATTENTION.