

グランド再生可能エネルギー2018 国際会議

AIST-FREA スペシャルセッション

GRAND RENEWABLE ENERGY 2018

AIST-FREA Special Session

2018/6/20 パシフィコ横浜 会議センターにて



Grand Renewable Energy 2018, AIST Special Session  
20<sup>th</sup> June 2018, Yokohama, Japan

# 再エネ分散電源の導入突破への挑戦

Increasing RE Penetration Beyond Conventional Limits  
with Advanced DER Capabilities

Fukushima Renewable Energy Institute, AIST (FREAA)

大谷 謙仁 (OTANI Kenji)



# Theme

- DER (Distributed Energy Resources)
  - Solar PV, Battery Energy Storage, EV
- Advanced Inverters (Smart Inverters)
- Testing and Certification
  - Advanced Testing: **HIL (Hardware-in-the-Loop)**
- Supporting Grids; Smart Grid
- International Collaborations



# Contents



**Smart Inverter: advanced testing and validation method,**  
by Jun Hashimoto (FREAA)



**IEC 61850 Standardization and HIL Testing in Smart Grids,**  
by Taha Selim Ustun (FREAA)



**Advanced Laboratory Testing Methods supporting Smart Grids,** by Ron Brandl (Frounhofer IEE)



**Clean Energy Transformation: The Hawaii Experience,** by Leon R. Roose (University of Hawaii)



# Countries

ranked at #1 in the world!

- **Japan**
  - PV Installations per Habitant (2016): 62 W/Hab
- **Germany**
  - PV Capacity per Habitant: 500 W/Hab
- **Hawaii, USA**
  - The most aggressive target: RE100% by 2045
  - Honolulu's PV Capacity per Habitant: 600 W/Hab

Source: IEA PVPS



# Grid support function requirements (LV)

Country	Germany	Italy	Austria	France	Spain	Europe ( $\leq 16A$ )	Europe ( $>16A$ )	U.S.	Japan
Function	2011	2012	2013	2013	2011/ 2014	2013	2014	2018	
Q control	X	X	X		N/A	X	X	X	N/A
PF control		X	P		N/A	X	X	X	N/A
Frequency control	X	X	X	X	N/A	X	X	X	N/A
Remote output control	X	X	X		N/A		X	X	P
LVRT		X			N/A		X	X	X
HVRT		X			N/A		X	X	N/A
Ref.	FGW TR3/VDE ARN 4105	CEI 0-21	TOR D4	ERDF-NOI -RES_13E	RD1699/UN E206007-1	EN 50438	CLC/TS 50549-1	IEEE1547 Full revision	JEAC 9701

X: available, P: partial available

Source: J.Hashimoto et al, Smart Inverter Functionality Testing for Battery Energy Storage Systems, Smart Grid and Renewable Energy, 2017



# FREA: Fukushima Renewable Energy Institute, AIST

## Missions

- International R&D base for renewable energy
- New industry promotion in damaged area

## Location

Koriyama, Fukushima

## Schedule

'13, Oct. organization founded  
'14, Apr. open in Koriyama

## Budget

10 billion yen for start up  
(land, buildings, equipment)  
3 billion yen/y, 400 people and more







# Aerial View of FREA







# Smart System R&D Test Platform (FREAA-G)



- Substantially expand the aforementioned FREAA facility to build the world's most advanced test facility.

## A. Grid Connection Test Bed

- Conduct required tests to secure power quality for the grid connection of distributed generations.
- Conduct various PCS tests (anti-islanding test, FRT test, etc.)
- Maximum capacity of AC simulator: 5MVA.
- Maximum capacity of EUT: 3MW.

## B. Safety Test Bed

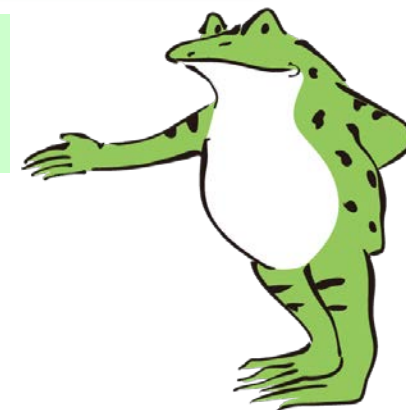
- Conduct high-temperature acceleration and heat cycle tests with PCS where real environment is simulated to evaluate long-term reliability, and also safety-related tests including surge voltage test.

## C. EMC Test Bed

- Conduct tests to measure electromagnetic radiation from PCS and to check if PCS's functions and behavior would be inhibited by external electromagnetic wave.

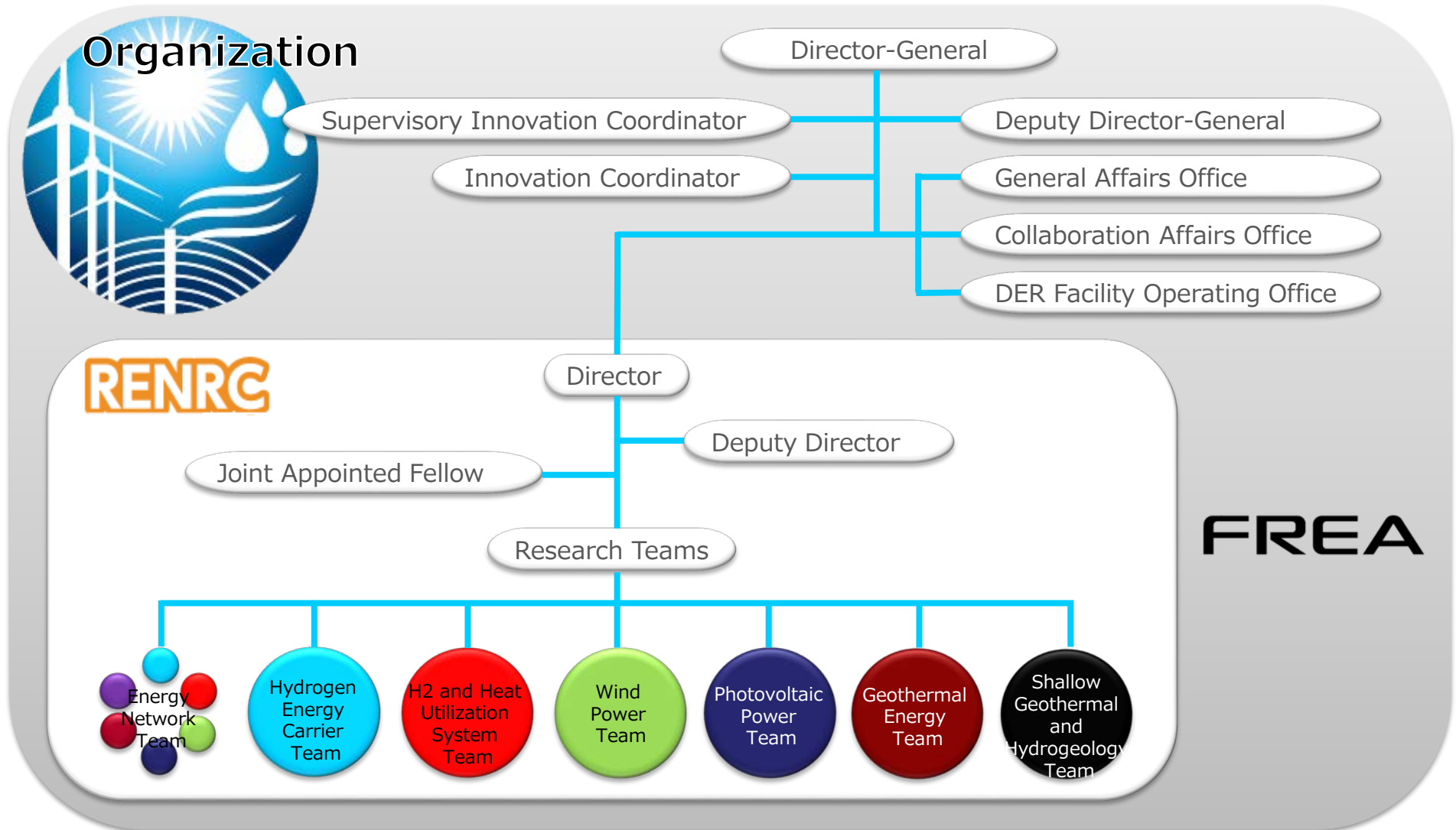
## D. System Performance Test Bed

- Evaluate different capabilities (e.g. automatic control function to maximize output depending on the weather) of distributed generations (PV, batteries, etc.) and PCS as one single system.





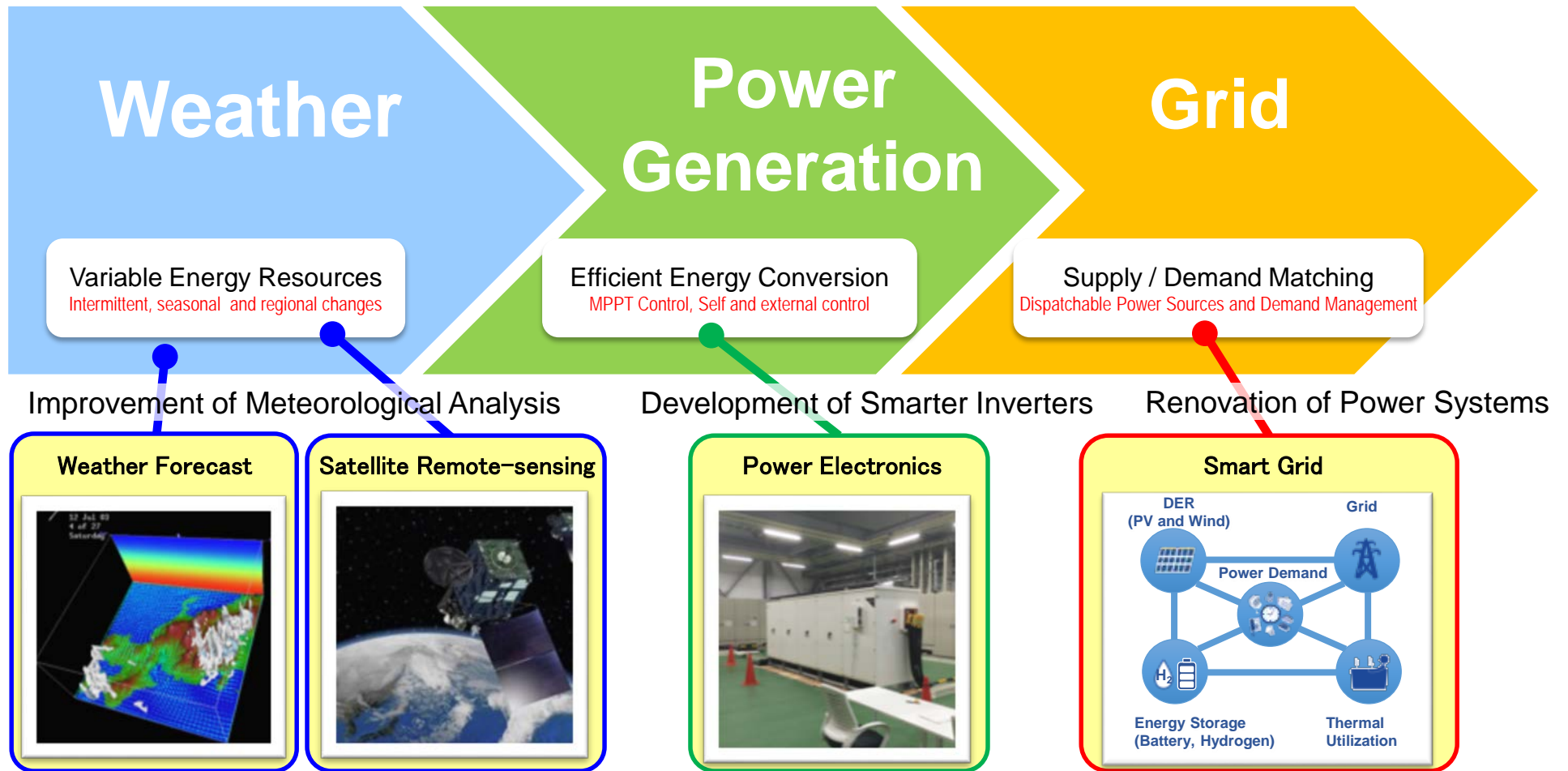
# Organization



FREA



# Research Themes for Smart Systems for High Penetration of Renewable Energy





# Energy Network Team's Research Themes

## A) Testing and Verification of DERs

- Smart Inverter Functionalities Test and Simulation
- Automated Certification Tests of Smart Inverters with Hardware-in-the-Loop Testbed

## B) Designing of Energy Systems with High Penetration of DERs

- Utilization of EVs as Dispatchable Power Sources
- Protection systems
- Communication systems (based on IEC 61850 and etc.) & cyber security

## C) Potential and Resource Assessment

- Remote sensing technologies for renewable resource assessment
- High Penetration Scenarios for Japan and Asian countries



# Energy Network Team's Long-term Targets

- To penetrate distributed energy resources (DERs) based on renewable energy without any restriction.
  - To Double Renewable DER Deployment Potentials in Existing Grids
  - 100% Renewable DER Deployment Potentials in New-build Grids
- To develop energy management technologies with DERs, consumer appliances, and energy storage systems with ICT and power electronics technologies.
- To develop and standardize a communication and control system, which realize that renewable DERs and energy storage systems will have more advanced and universal value beyond the different grid interconnection regulations of each country.
- To make a universal R&D platform in FREAA for the super-high penetration of renewable DERs all over the world.





# Enjoy this session!

