Smart Community Demonstration in NEDO

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The New Energy and Industrial Technology Development Organization (NEDO)

NEDO: Role and Smart community activity

The New Energy and Industrial Technology Development Organization (NEDO) is Japan's largest public R&D management organization for promoting the development of advanced industrial, environmental, new energy and energy conservation technologies.

Before year 2000
Grid connecting technology development for one renewable energy

Year 2000 – Year 2010
Multiple or large scale renewable grid connecting demonstration

After Year 2010
Smart community demonstration considering social needs

Results of NEDO's demonstration to Smart Community (2000-2010)

Clustered PV demonstration (Ota city)

Mega solar (Wakkanai, Hokuto))

Wind Power Stabilizing demonstration(Tomamae)

Elements of smart grid are developed

Micro Grid (Aichi, Hachinohe, Kyotango))

Power Quality management (Maebashi, Sendai))

Grid connecting battery system development

International Smart Community Demonstration（Demo～FS）（After 2010）

Lyon（France）

Zero energy building, EV car sharing and energy audit demonstration in re-developed city

Malaga（Spain）

EV charging infrastructure and driver navigation system

Turkey

Wind power fluctuation reduction by pumped hydro

Indonesia

Power quality management at industrial park

New Mexico（USA）

Micro grid demonstration in Loa Alamos and Albuquerque

Maui island（USA）

Direct control against EV, for absorbing sudden rump of renewable

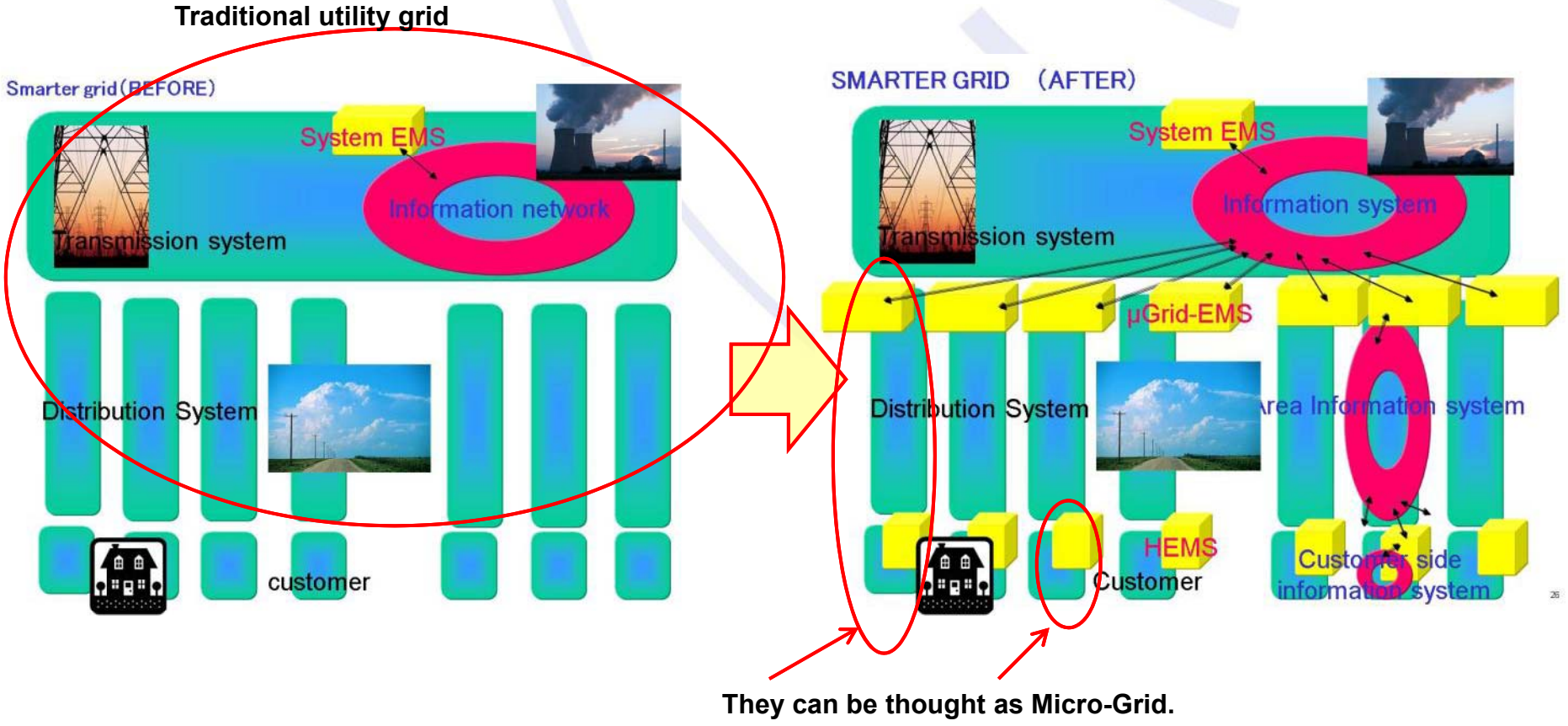
Gòngqīngchéng（China）

Introducing energy conservation and renewable energy in development plan of planned city

KEY DISCUSSION OF SMART GRID

Why Micro-grid is key element of Smart-grid

- Structure of Smart grid consists combination of Micro-grid like operating distribution system and smart customers.



Definition of Micro-Grid

- Small grid which is managed by local EMS (CEMS) for keep responsibility to balancing.

- Usually, it is connected on to larger grid. In this case, micro grid should control of tie-line power flow for keep responsibility of balancing.

- Sometime, it is operated as independent grid.

- From the view point of wide definition, each customer which is controlled by EMS (HEMS, BEMS or FEMS) may be understood as small Micro-Grid.

Countermeasure of renewable fluctuation

Project	Contents	Storage and controlled Technology	Absorbed fluctuation	Acknowled gement
Tomamae Japan	Absorbing 30MW wind power fluctuation	Redox flow battery 6MW-6MWh	Shorter fluctuation than 20 minute	
Wakkanai Japan	Absorbing 5MW solar	NAS Battery 1.5MW－10.8MWh	Short term – daily planned transmission	
Ota Japan	Rooftop PV (4kW) Voltage regulation	Lead Acid battery 6kWh	Violating voltage standard	
Los Alamos USA	Absorbing 5MW solar	NAS battery1MW& Lead acid 300kW and indirect control	Short term– long term fluctuation	
Albuquerque USA	Absorbing 0.5MW solar	Gas engine and thermal storage in building	Middle and slower fluctuation	
Maui USA	Absorbing 30～70MW Wind power ramping down	Direct control of EV and Water heater	Governor free and faster	

Micro-grid related project

Country	Utility	NEDO Microgrid	Microgrid-owner
JAPAN	Mostly integrated	Hachinohe Aichi	Microgrid owner – Demand side
USA	Wholesale deregulated (Not completely deregulated on the retail side)	New Mexico	Microgrid owner – Distributed Utility
EU	Fully deregulated (Both wholesale and retail)	Lyon (France)	Microgrid EMS is separated into two different types (regulated utilities, competitive utilities)

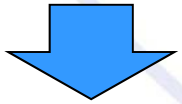
EV related demonstration in NEDO project

Project	Contents	Charger	Management system
Lyon, France	Synchronous charging by renewable energy	Mainly low speed charger	Energy balancing (for competitive energy service providers)
Malaga, Spain	Congestion management for distribution system	Mainly Rapid charger	Power flow monitoring (for regulated utility) and car navigation
Maui, USA	Frequency stabilization	Mainly low speed charger	Switching control by looking frequency on the grid
Gòngqīngchéng, CHINA	Low emission public transportation	Not fixed	Customer service and energy management

Customer side energy management

HEMS

Clustered OV demonstration in Ota.
Remote battery control was achieved by using optical network.



- High performance HEMS demo in Loa Alamos
- Integration of HEMS and BEMS in Lyon
- Cloud HEMS Technology hired in the next demonstration in Europe

NEDO SOLUTION ON ISLAND AREA ---- MAUI PROJECT

Agreement on Clean Energy Technologies at Japan-U.S. Leaders' Meeting

- Then Prime Minister Hatoyama and President Obama met in November 2009
- The two leaders agreed to clean energy technologies cooperation and issued the Fact Sheet

⇨ METI and DOE identified the initial areas for the joint activities concluded as "Clean Energy Technologies Action Plan".

Themes for Partnership

- ◆ Cooperation between National Labs
- ◆ CCS (Carbon Capture and Storage)
- ◆ Energy Efficiency
- ◆ Okinawa– Hawaii Cooperation
- ◆ Smart Grid
- ◆ Electric Vehicles
- ◆ Nuclear Energy

Fact Sheet (extract)

Establishment of a task force that will evaluate the achievements of existing clean energy projects in Okinawa and Hawaii to enable the islands to be energy independent, including micro-grid projects, and develop activities to help the two islands share experiences and knowledge with each other

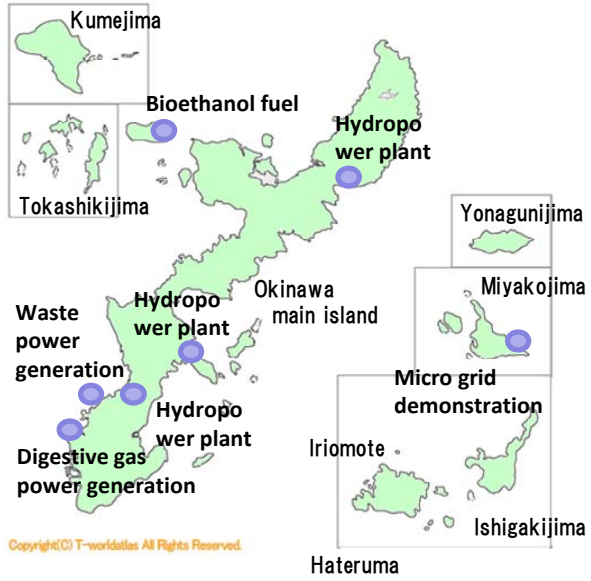
Hawaii-Okinawa Clean Energy Cooperation

Significance of cooperation

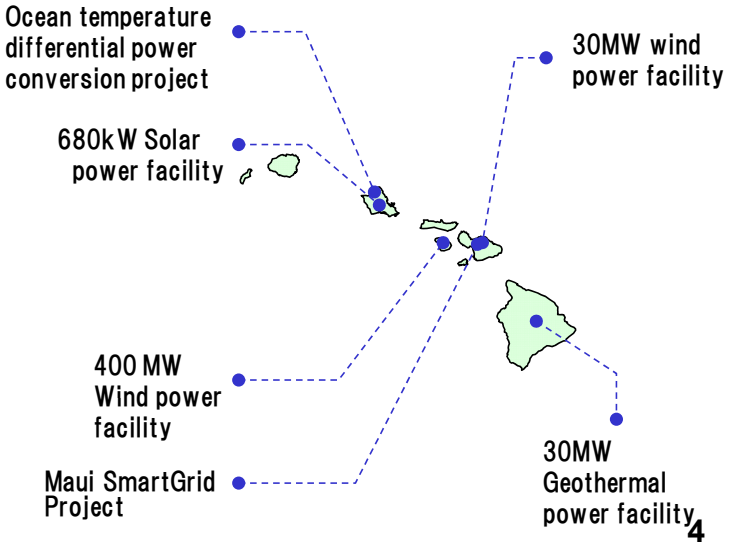
Okinawa and Hawaii shares many similarities including geographical conditions (island), climate condition (subtropical to tropical), energy structure (highly dependent to fossil fuel), proactive approach to renewable energy.

- **Maximum synergy is expected by sharing best practices of two environmentally similar areas.**
- **By installing renewable energy and promoting energy efficiency, as a model for remote islands, this cooperation could become a show case for the world.**
- **<u>Okinawa –Hawaii cooperation as a tangible Japan-U.S. cooperation</u>**

Example of activities in Okinawa



Example of activities in Hawaii



Hawaii-Okinawa Clean Energy Cooperation

●The Signing Ceremony of the Memorandum of Cooperation on the Okinawa-Hawaii Clean Energy Cooperation took place on Thursday, June 17th at Ministry of Economy, Trade and Industry.
●Signatories included Economy, Trade and Industry Minister Naoshima, U.S. Ambassador to Japan John V. Roos (on behalf of the U.S. Department of Energy), Governor of Okinawa Nakaima and Governor of Hawaii Lingle.

Outline of the demonstration

Energy Issues Seen on Islands Around the World

High Dependency on Fossil Fuel

- ***Energy Security Issues***
- ***Economic Issues (Energy cost is high)***
- ***Environmental Issues***

Solutions

As a way to address these issues,
expectations for renewable energy use are higher on islands than in other areas.

Outline of the demonstration

The State of Hawaii is carrying out activities to realize a low carbon society. In particular, it is actively introducing renewable energy.

On Maui and Hawaii, large-scale renewable energy has already been introduced.

■ Issues

- ***Surplus power***
- ***Influence on frequency***

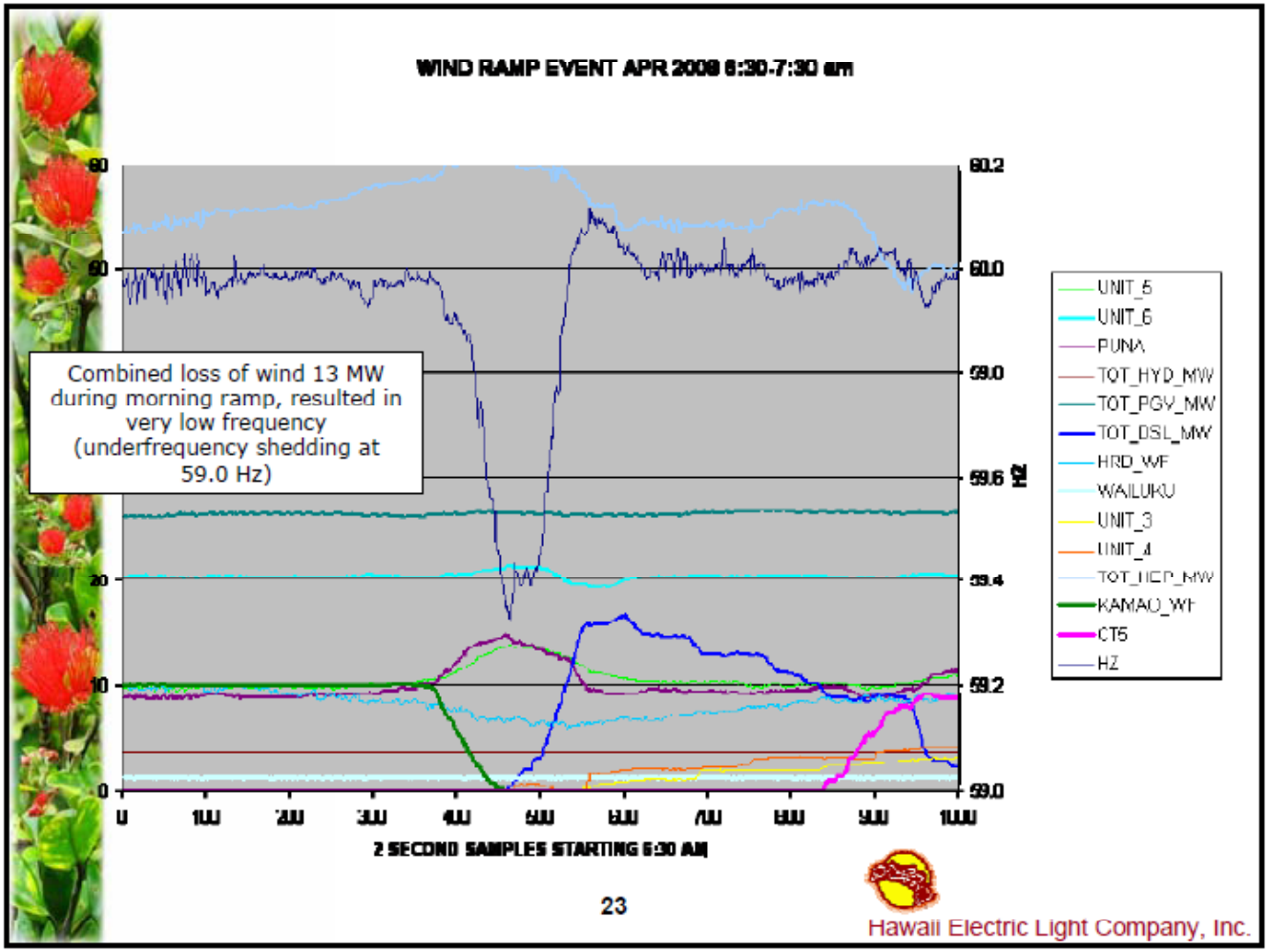
In addition, as PV systems have been steadily installed at residential houses, the *influence on distribution line voltage* also needs to be considered.

This demonstration project is designed to address a growing number of issues due to the high penetration of renewable energy by means of the effective use of technology elements.

■ Technological elements

Smart PCS for PV systems
EV and PHEV charging control
Electricity storage battery control
PV generation forecast
Demand response
Information and communications technologies

Actual frequency drop in big island



Demonstration site: Maui island

Project Overview

(I) EV Based Remote Island Smart Grid Model on Maui

- **Reducing fluctuation of frequency by rapid direct control of EV charging demand**

(II) Smart Grid Model at a Substation with One Distribution Grid Level in Kihei

- **Demonstration of DMS at distribution substation level.**
- **DMS managing direct demand control and power flow management at feeder level.**

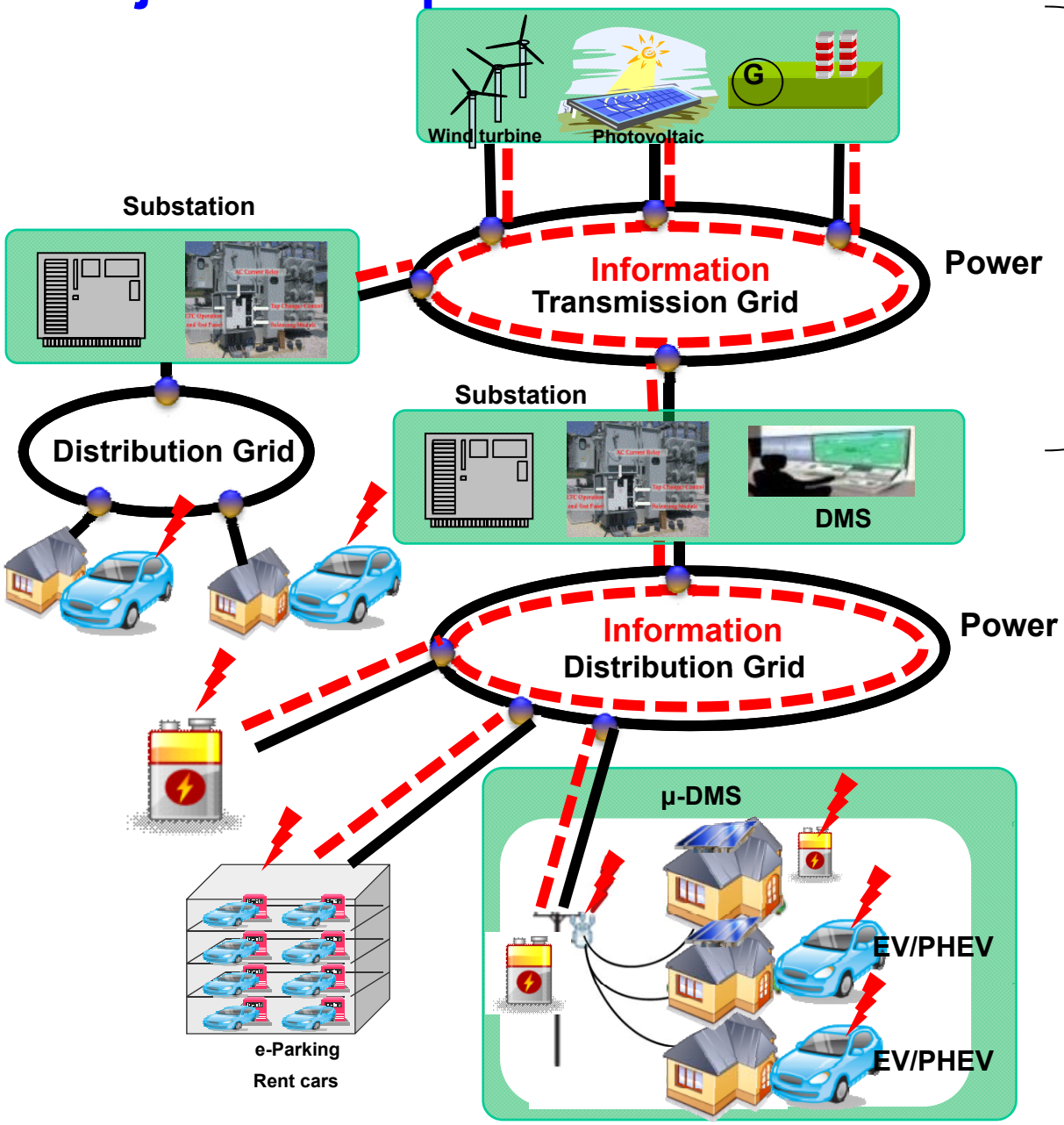
(III) Smart Grid Project for Low-voltage Transformer Level Systems

- **Micro-DMS locating at pole transformer managing flow by controlling inverter of roof top PV.**

(IV) Comprehensive Research

- **The effectiveness of smart grids developed for this collaborative project will be analyzed and evaluated.**
- **Cyber security activities will be evaluated.**
- **The economic efficiency of systems developed for the project will be evaluated.**
- **Business models for establishing a low-carbon society on a remote island will be established and assessed.**

Project Concept



Utility Operations Control Center

Task (I)
Electric Vehicle (EV) Based Remote Island Smart Grid Model on Maui

- Information on cars
- Information on traffic flow
- Information on transformers
- Control of EV charging
- Information on power generation and demand
- Information on storage batteries
- Command of discharge
- Information on users

Task (II)
Smart Grid Model at a Substation with One Distribution Grid Level

- Monitoring of feeder and transformer
- Demand response
- Control PV output and reactive power (Smart PCS)
- Information on PV generation (Smart PCS)
- Information on storage batteries
- Command of storage battery discharge and charge
- Information on users

Task (III)
Smart Grid Project for Low-voltage Transformer Level Systems

- Demand response
- Control PV output and reactive power (Smart PCS)
- Information on PV generation (Smart PCS
- Information on storage battery
- Command of storage battery discharge and charge
- Information on users

Project Framework

Japanese side

Entrustment

NEDO

Hitachi, Ltd.
- Project leader
- EV-based remote island smart grid model on Maui
- Smart grid model at a substation with one distribution grid level in Kihei
- Smart Grid Project for Low-voltage Transformer Level Systems
- Collective research on overall project

Mizuho Corporate Bank, Ltd.
- Collective research on overall project (analysis and evaluation of the effectiveness of smart grids and the economic efficiency of systems developed for the project, establishment and assessment of business models)

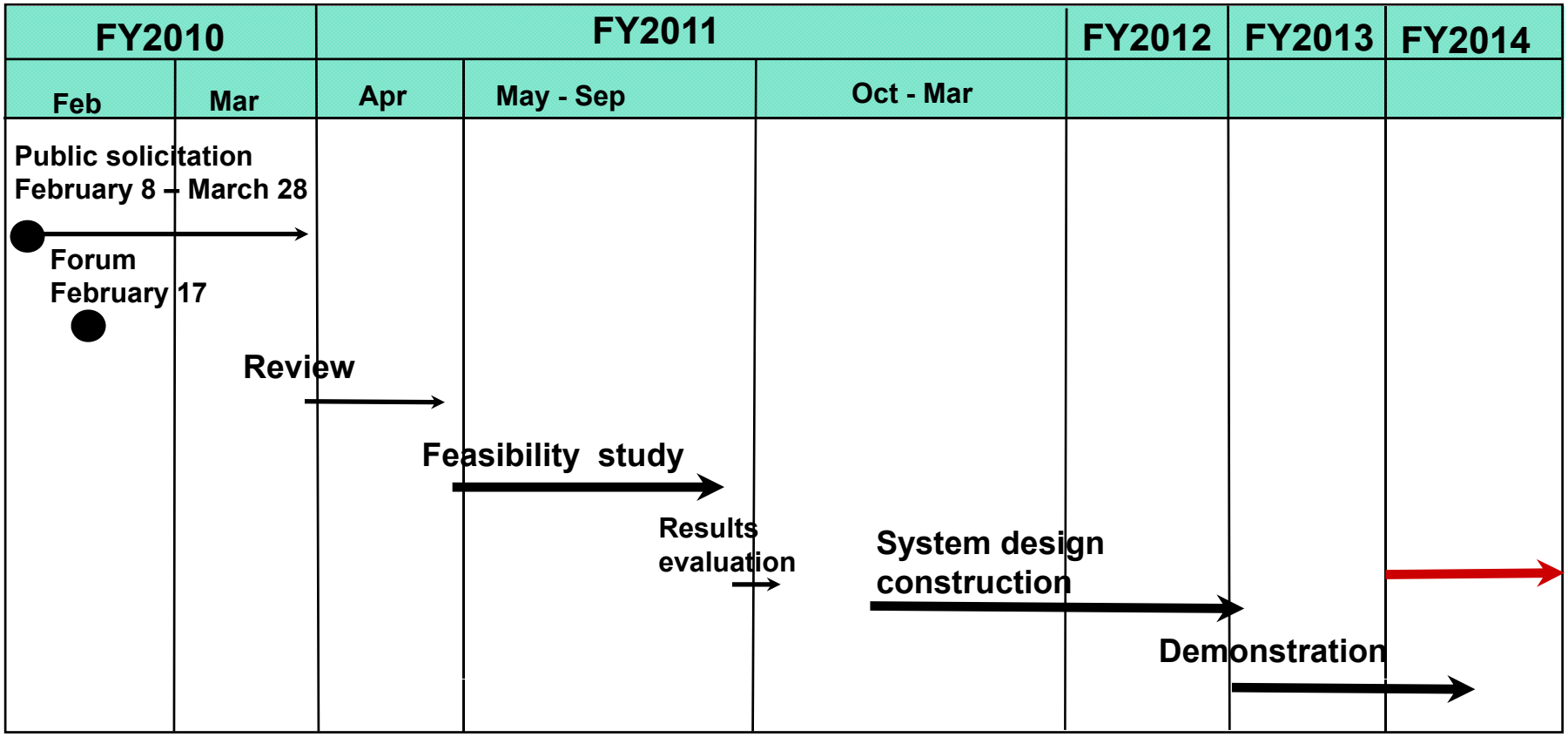
Cyber Defense Institute, Inc.
- Collective research on overall project (evaluation on cyber security)

USA side

Hawaii State (DBEDT)

HECO
HNEI
MECO
Maui County
MEDB
.....
Several US companies

Project Schedule




Thank you for your attention!!