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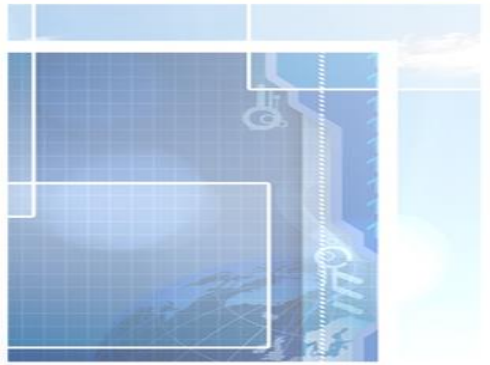


Focus & Priorities of Smart Grid solution

November 2013

Smart Grid Solution Centre EMEA
Nürnberg, Germany

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Our View on Smart Grid

Renewable Energy

Solar Power

Wind Power

Battery

Battery

Battery

Battery/system for Stabilization of Grid

Social infrastructure

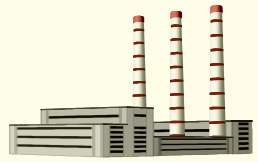
Street Lighting

Charging Stations

EV, New Transport System

Power plants

Nuclear Power Station



Thermal Power Station

Hydro Power Station & Pumped Storage

Smart Grid

µEMS
Micro Energy Management System

Commercial Grid

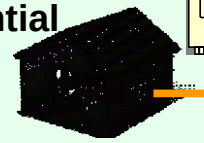
Connecting Point

Power Grid

Communication Grid

HEMS

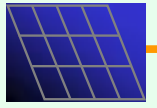
Residential



Smart meter

Battery

Home Solar Panels



EV

Home gateway

Intelligent Home Appliances

Ecocute

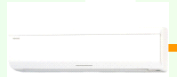
BEMS

Smart Meter

LED Lightning

- Offices
- Commercial facilities
- Apartment buildings etc.

Roof-top Solar Panels



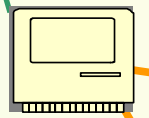
Air Conditioner

Battery

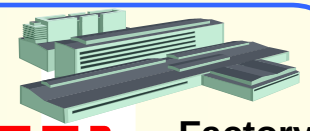
Ecocute

Energy management system (EMS)

FEMS



Smart Meter



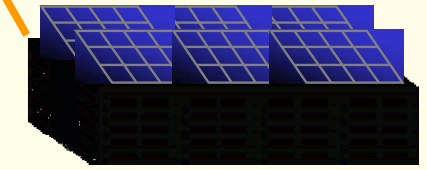
Factory

Battery

PCS

Roof-top Solar Panels

Energy management system (EMS)



What is µEMS?

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µEMS - Energy Management for Smart Grid Solutions

µEMS, the integral core of Smart Grid technology, is used to maintain the stability of power grid to which renewable energy sources are connected.

Forecasting
Renewable Generation Forecasting
Demand Forecasting

Scheduling
Generation Scheduling
Battery Scheduling

Monitoring & Controlling
Power Flow Stabilization
Fluctuation Reduction for Renewable Energy
Load Frequency Control

Benefits

Economy
Enables suppliers to reduce power generation costs and electricity customers to curtail their energy consumption

Environment
Reduce carbon footprint and impact on the environment by integrating renewable energy sources into existing power grids

Reliability
Utilize battery management systems to improve power efficiency and stability while mitigating the impact to the main grid

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BESS Solutions

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Toshiba Battery Technology

suitable for mitigation control of energy fluctuation by renewable energy (PVs / WTs)

Safety
Excellent resistance to rupture and ignition

Rapid Charging High Output
Charged within
5mins

Characteristics（Long life-cycle）
Reusable for over
6,000 times

Toshiba's SCiB™ batteries utilizes Lithium titanate for negative terminal

SCiB™(Super Charge ion Battery)

Comparison of Batteries for Grid Control

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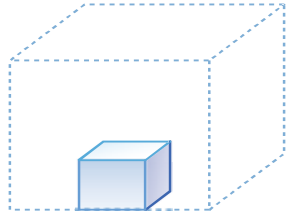
			Conventional	LTO Lithium-ion
				
	Capacity	Capacity 1000	Cycle	Capacity 6000 Cycles Cycle
Working low Temperature			0℃～	-30℃～
Charge / Discharge Performance	0.1C/3C	0.5～1C / 1～2C	1C/1～2C	3C/3C

High Input and Output

Essential requirement for BESS

Long Life

Low Temperature Operation

Rapid Recharging

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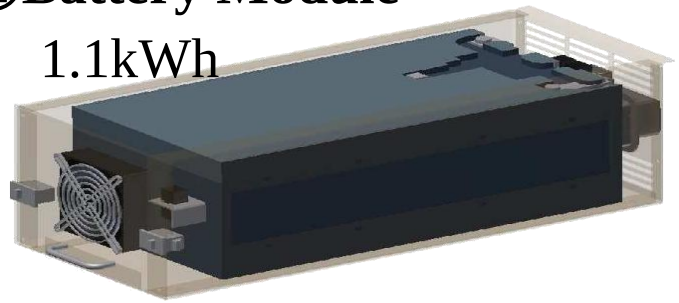
Large Battery Storage System

①Battery Cell (20Ah)

x 24

②Battery Module

1.1kWh



x 22

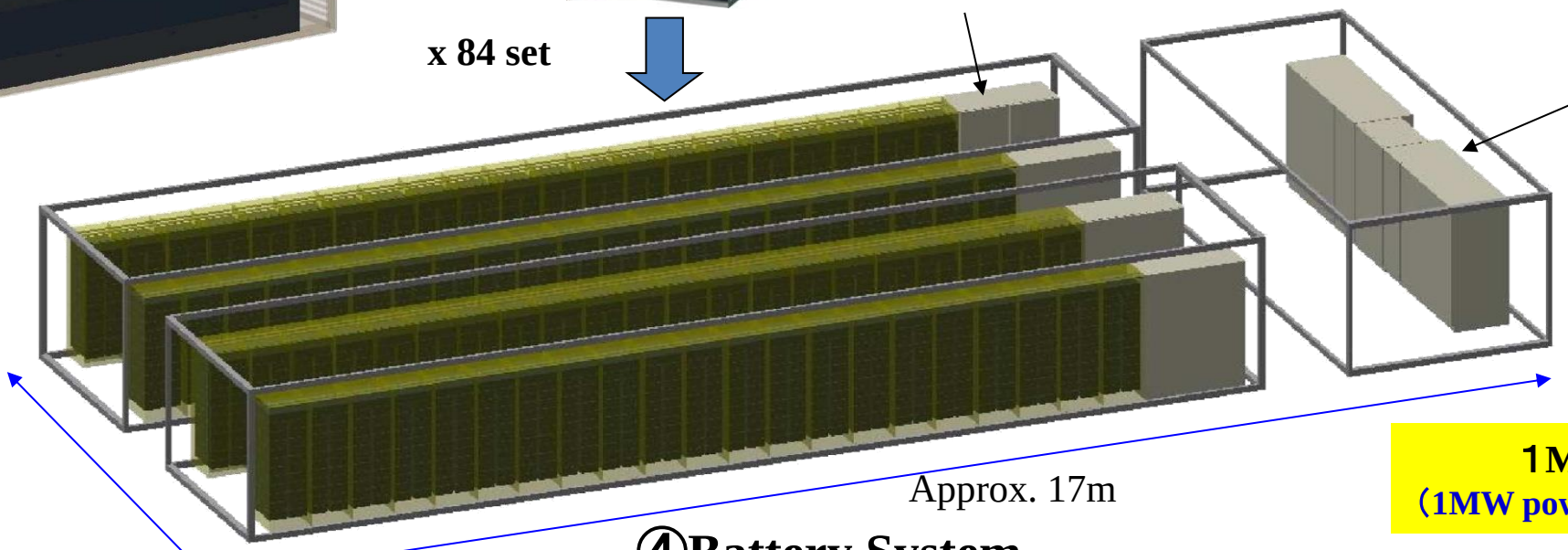
③Battery Panel

24kWh

x 84 set

⑤PCS 500kW

x 2 set



④Battery System

1MW-2MWh
(1MW power output for 2hrs)

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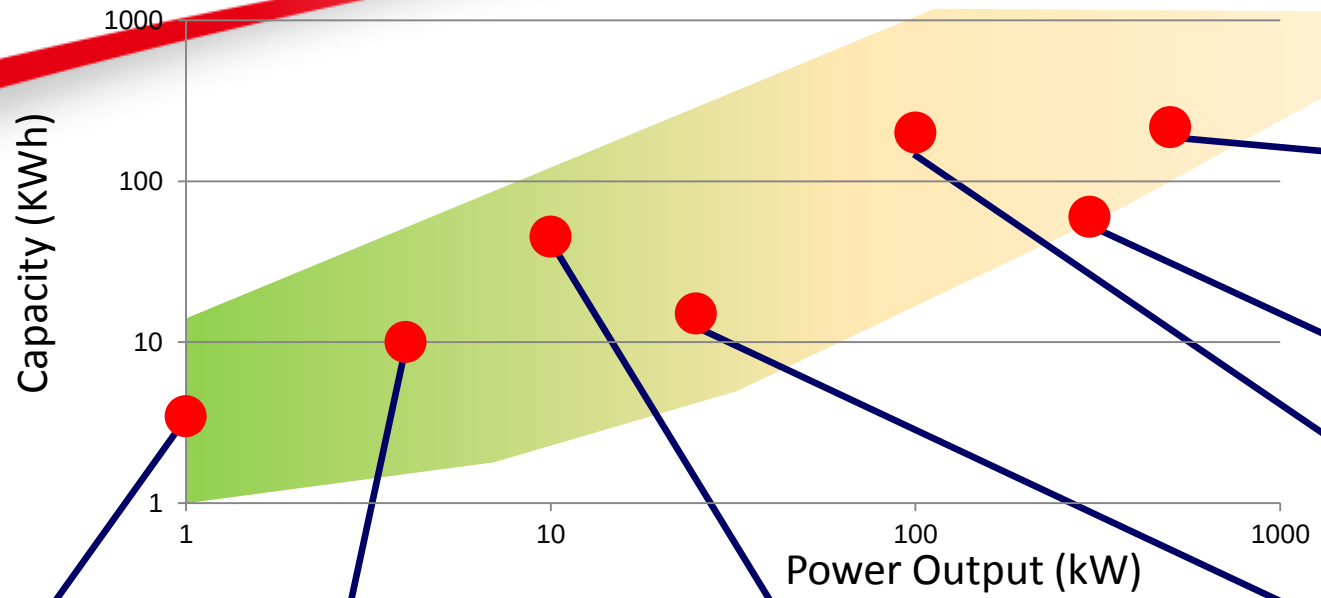
Battery Storage System Product Line-up



500kW-216kWh

300kW-60kWh

100kW-200kWh

1kW-3.45kWh

4kW-10kWh

10kW-45kWh

Battery System

25kW-15kWh

Battery System

Battery Panel

Battery output (kW) and capacity (kWh) to be chosen for customers purposes

SCiB™ Experiences in Automotive Applications

●Augst.2009：Development of Electric bus Project

※ Data source :Isuzu Motors, Ltd.

●June 2011: Official application※ in Mitsubishi new type electric vehicle

i-MiEV M

MINICAB-MiEV

※Image is from Mitsubishi Motor

● HONDA business-use electric motorcycle (EV-neo)
● EV-Neo is launched in Des.2012

●Nov.2011: Honda [Fit EV] is exhibited at Los Angeles Auto show and Tokyo Motor Show and launched in USA in summer 2012※

“EV-neo (prototype)”

Honda(Fit)（withSCiB™）

※Picture source : Honda Motor Co., Ltd.

●Sept. 2012：Application in Suzuki New type[Wagon R]

- **Mass-produced for EV**
- **Experiences in Numeral Commercial EV**
- **Passed Safety Condition of strict regulated automobile industry**

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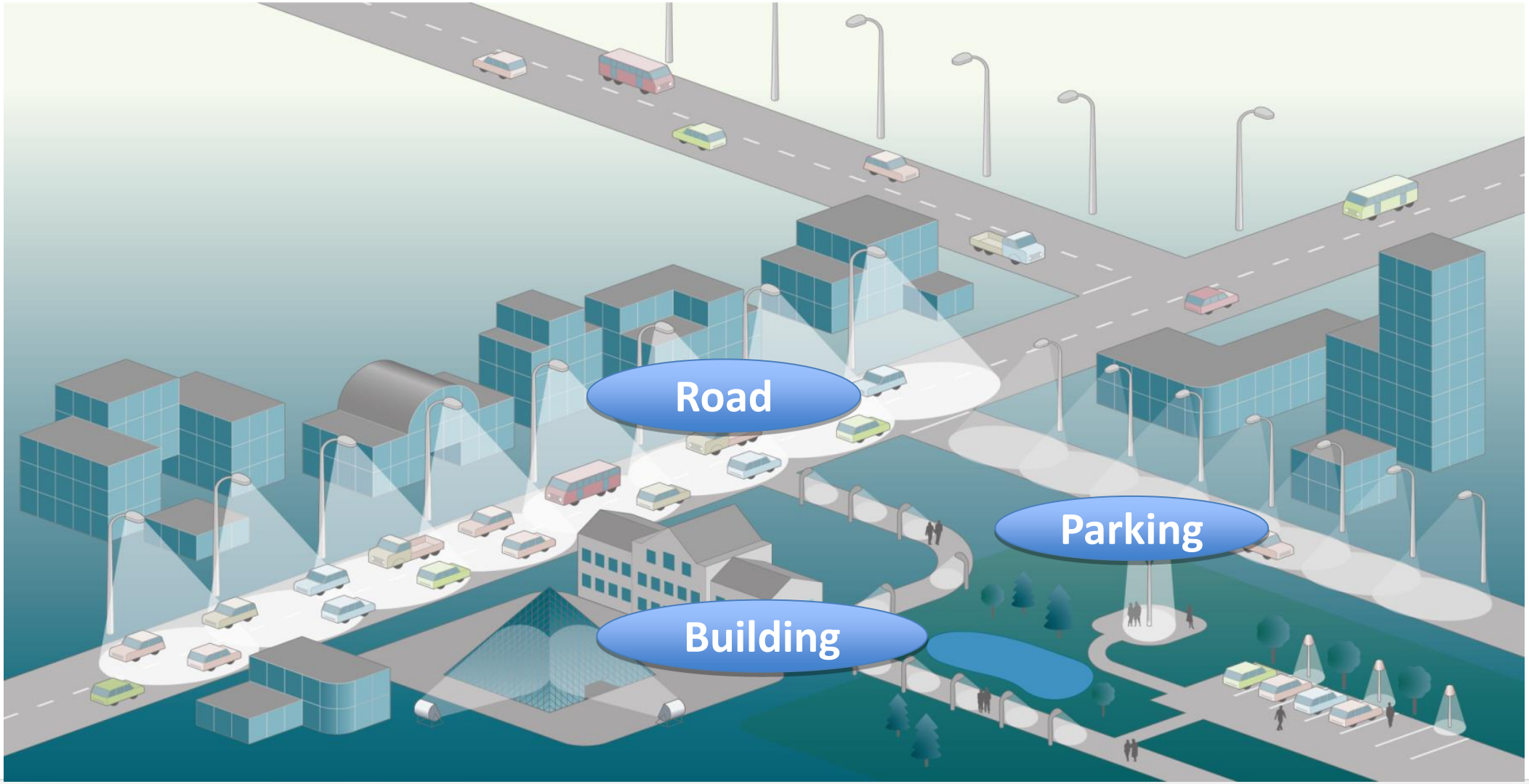
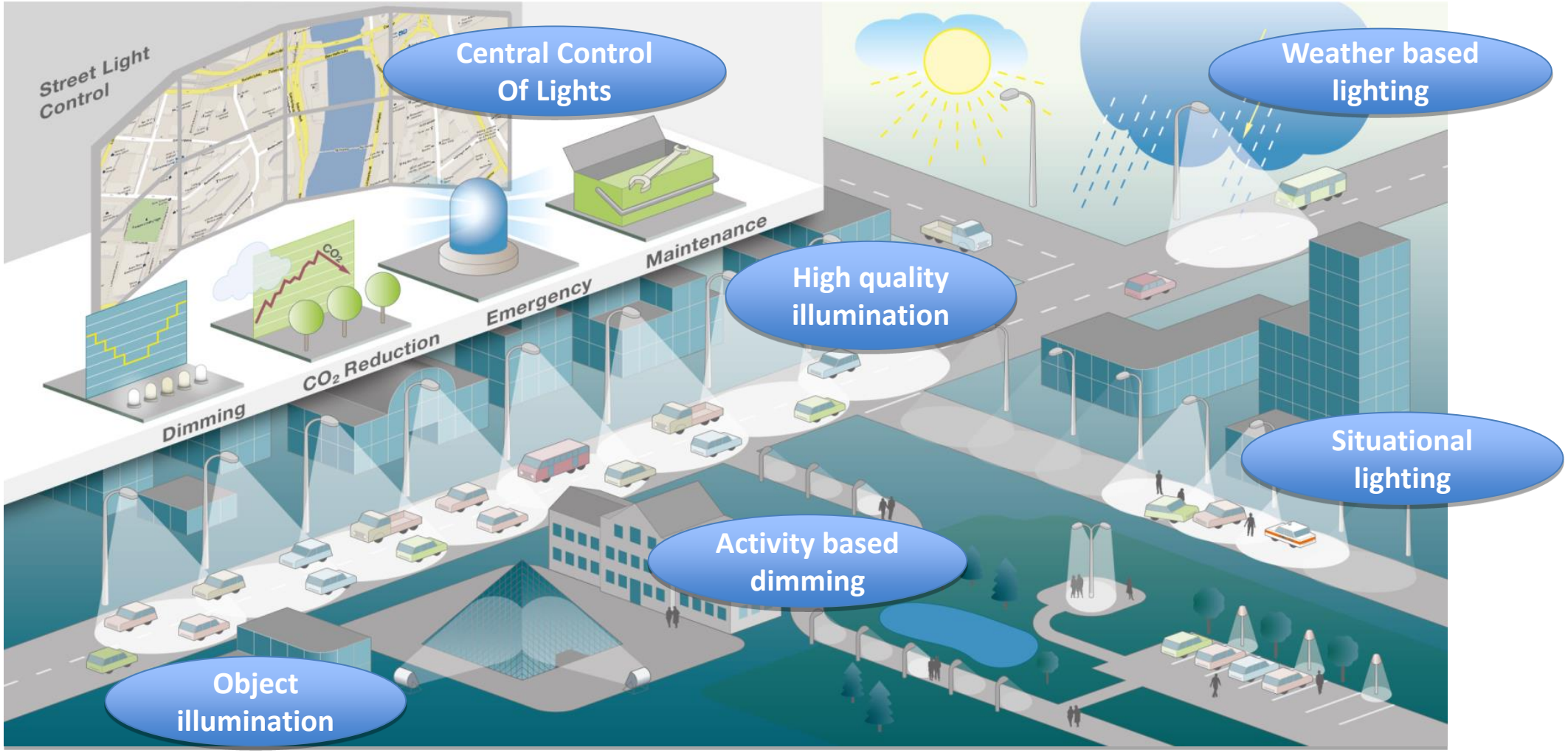
Intelligent Public Lighting Solution

Public Lighting



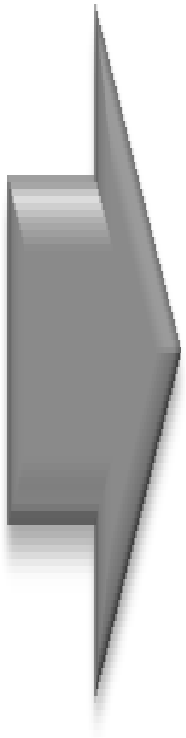
Smart public lighting solutions



Current challenges for municipalities

Challenges

- **Municipalities face budget pressure – Street light represent 30-50% of the total of energy costs**
- **EU request phase-out of Mercury Lamps**
- **Street lights emit 80 Mega ton CO_2 in Europe (3% all of emission)**
- **EU prepare regulations to limit CO_2 emission**



Solutions

- **Efficient LED technology and improved light guiding**
- **Dimming functionality based on standardized protocols**
- **Increased safety thanks to permanent illumination**
- **Reduced maintenance service due to increased life time and status information**
- **Manage the power consumption based on real-time energy pricing**

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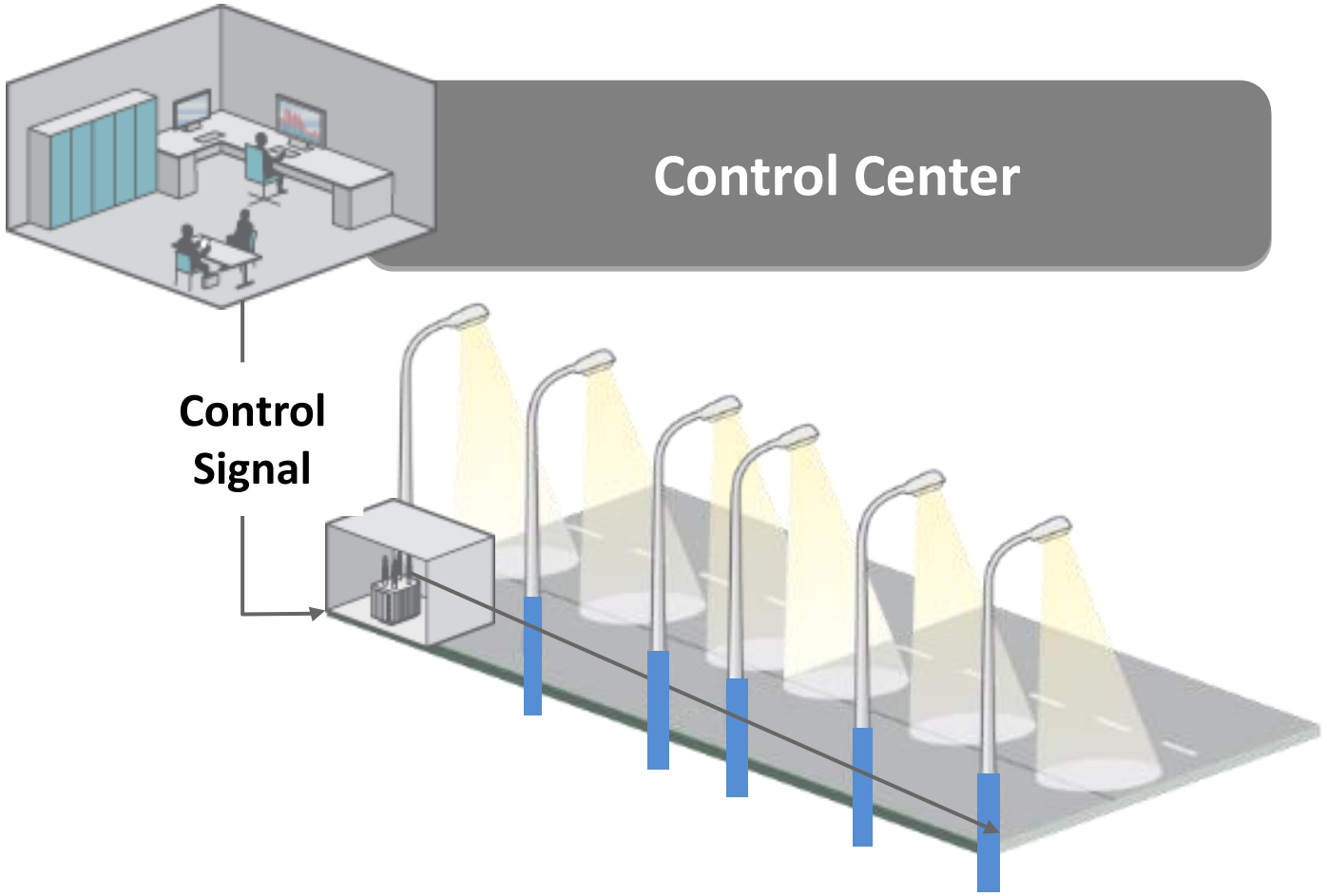
Landis+Gyr
manage energy better

LED lighting controlled by PLC or RF Mesh comms.

Central control system

Energy saving LED lights

Step dimming, individual light control



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Experience of Smart Grid with μEMS and Battery

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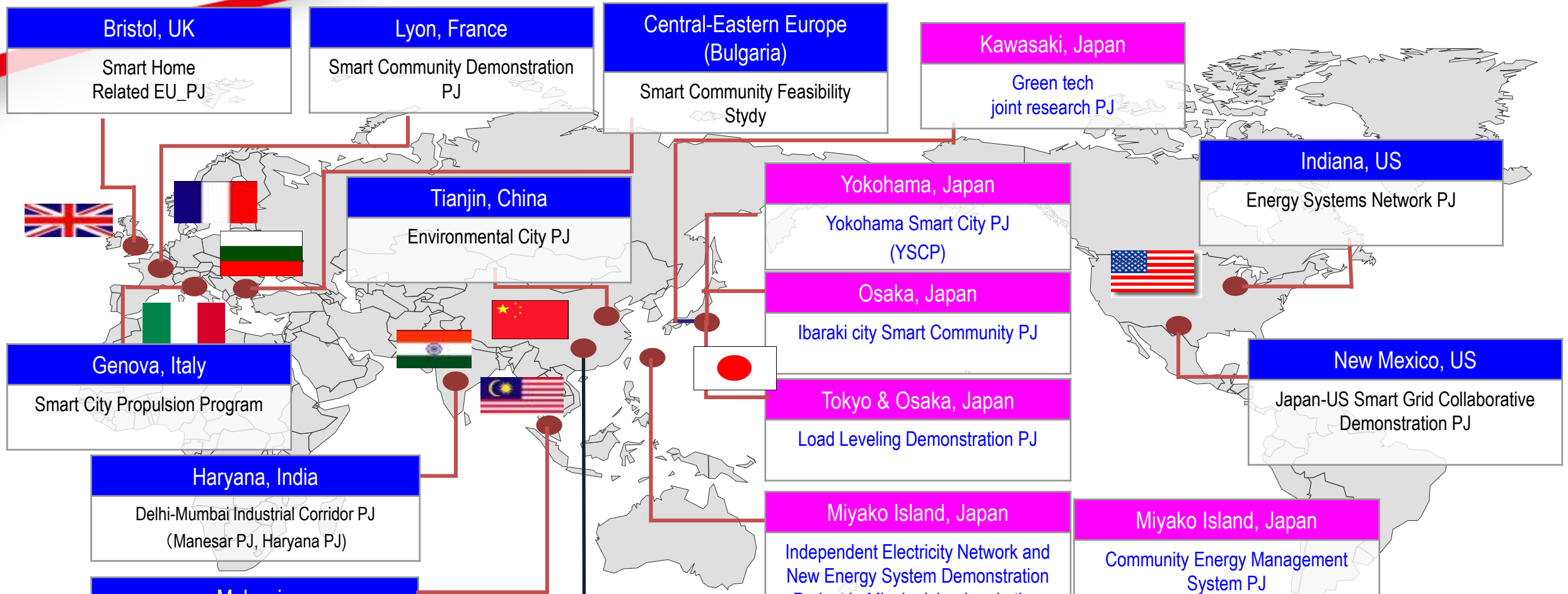
Toshiba's experiences on Smart Grid PJ



Bristol, UK
Smart Home Related EU_PJ

Lyon, France
Smart Community Demonstration PJ

Central-Eastern Europe (Bulgaria)
Smart Community Feasibility Stydy

Kawasaki, Japan
Green tech joint research PJ

Indiana, US
Energy Systems Network PJ

Tianjin, China
Environmental City PJ

Yokohama, Japan
Yokohama Smart City PJ (YSCP)

Osaka, Japan
Ibaraki city Smart Community PJ

Tokyo & Osaka, Japan
Load Leveling Demonstration PJ

New Mexico, US
Japan-US Smart Grid Collaborative Demonstration PJ

Genova, Italy
Smart City Propulsion Program

Haryana, India
Delhi-Mumbai Industrial Corridor PJ (Manesar PJ, Haryana PJ)

Miyako Island, Japan
Independent Electricity Network and New Energy System Demonstration Project in Miyako Island and other isolated islands

Miyako Island, Japan
Community Energy Management System PJ

Miyako Island, Japan
Kurima Island 100% Renewable Energy Demonstration PJ

Malaysia
Green township Concept

Gongqingcheng, China
Smart Community Technology Demonstration PJ

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PJ1: Smart Grid Research Centre

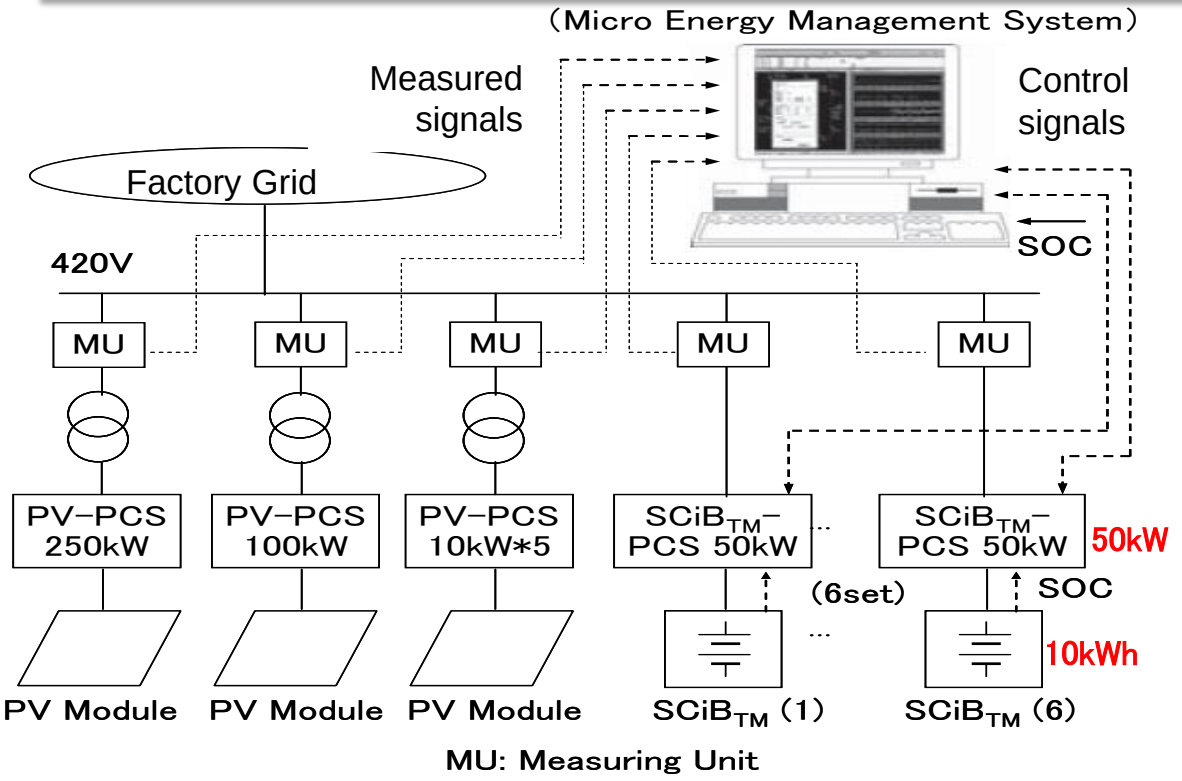
Research Facility (in Tokyo, Japan)

PCS Panel Battery Panels

4.2Ah battery cell

SCiB module

- Multiple PV generation facilities (400kW)
- High-output battery system for fluctuation suppression (300kW-60kWh)
- Micro energy management system : µEMS



Verification of smart grid control technologies and reliability of SCiB^{TM}

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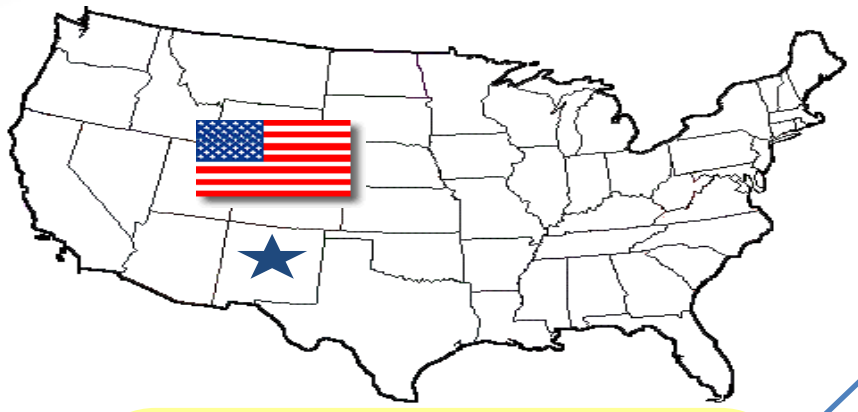
PJ2 : Japan-USA Smart Grid Pilot Project in New Mexico

A large scale Japan-US cooperative project, conducted in collaboration with New Mexico's government and US-based research organizations.



A group of 19 Japanese companies, with NEDO at its core, will participate in the two demonstration sites in Los Alamos and Albuquerque.

Toshiba is the leader of demonstration on Smart Grid project.

Demonstration on Smart Grid technology in commercial building

- Demonstration on demand-supply control, PV forecasting with large scale PV and batteries in residential area
- Demand response with demonstration house

CEO of Toshiba corporation attended this ceremony.

Demonstration sites

NEDO Funded

- Taos
- Albuquerque
- Los Alamos
- Roosevelt
- Las Cruces

Operation Started on May 17, 2012

Operation Started on Sept. 17, 2012

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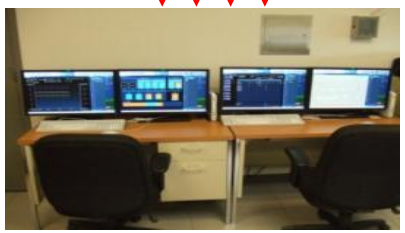
System Outline

Toshiba provided Micro Energy management system to each sites. (Key component)

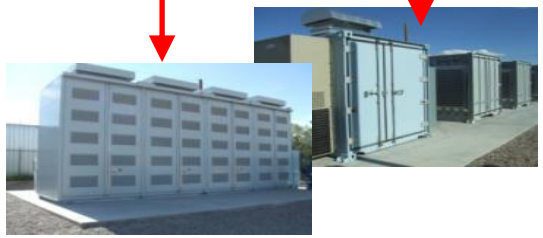
➢Smart Grid & Smart House in Los Alamos

- **Fluctuation reduction and power flow stabilization under large-scale PV**
- **Demand Response (DR) for Smart House**

Monitoring & Controlling

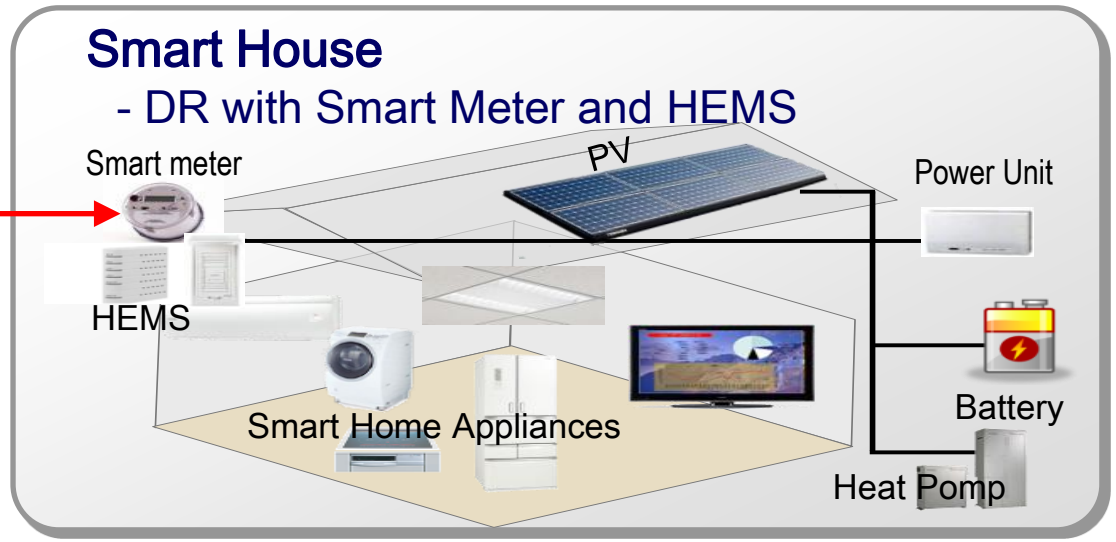


μEMS(*)



0.8MW Lead Acid Battery
1MW NAS Battery

1MW PV



(*) μEMS: Micro Energy Management System

➢Smart Building in Albuquerque

- **Islanding Operation with**
  - **PV, Gas Engine, Fuel Cell etc**
  - **Demand Response executed by μEMS(*)**

Smart Building (Mesa del Sol)

➢Collective Research

- Overall Study of Smart Grid
- Evaluation of Distributed Power Source
- Safety of Distributed Power Source
- Cyber Security
- Model Simulation

PJ3: PV/EV integration in ACEA SpA. , Italy

Objectives of the project

-Utilization of PV generated power as much as possible for EV charge
-Voltage management for main grid stability
-Trial before full-scale deployment of RES and EV in Rome

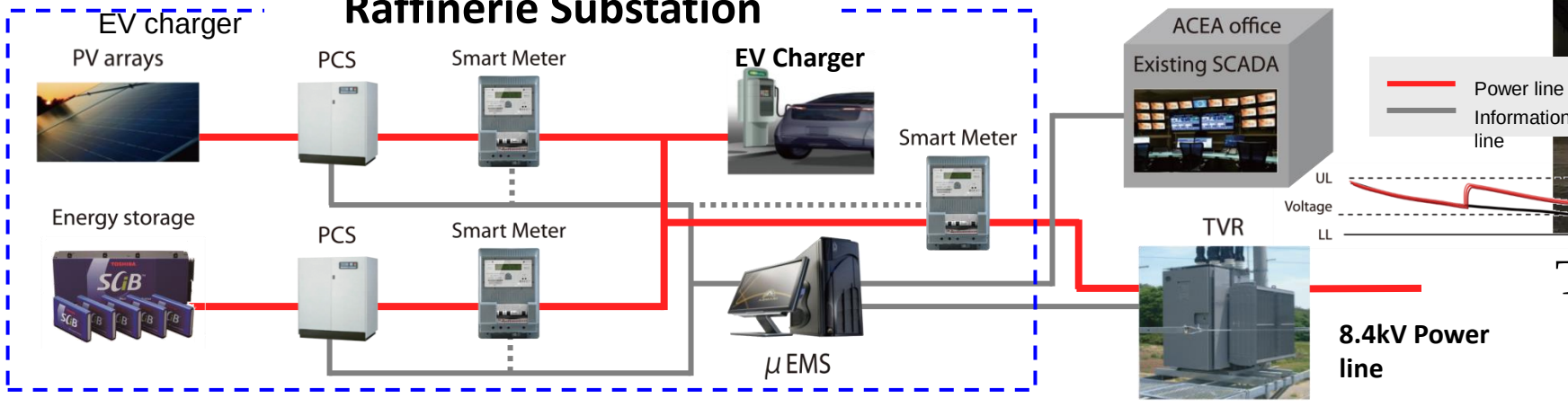
µEMS functionalities in this project

-Charge and discharge management of energy storage for efficient use of PV
-TVR operation monitoring

Battery storage system EV charging column

Installation

Transportable Container



PV = PhotoVoltaic EV = Electric Vehicle TVR = Thyristor Voltage Regulator µEMS = Micro Energy Management System PCS = Power Conditioning System

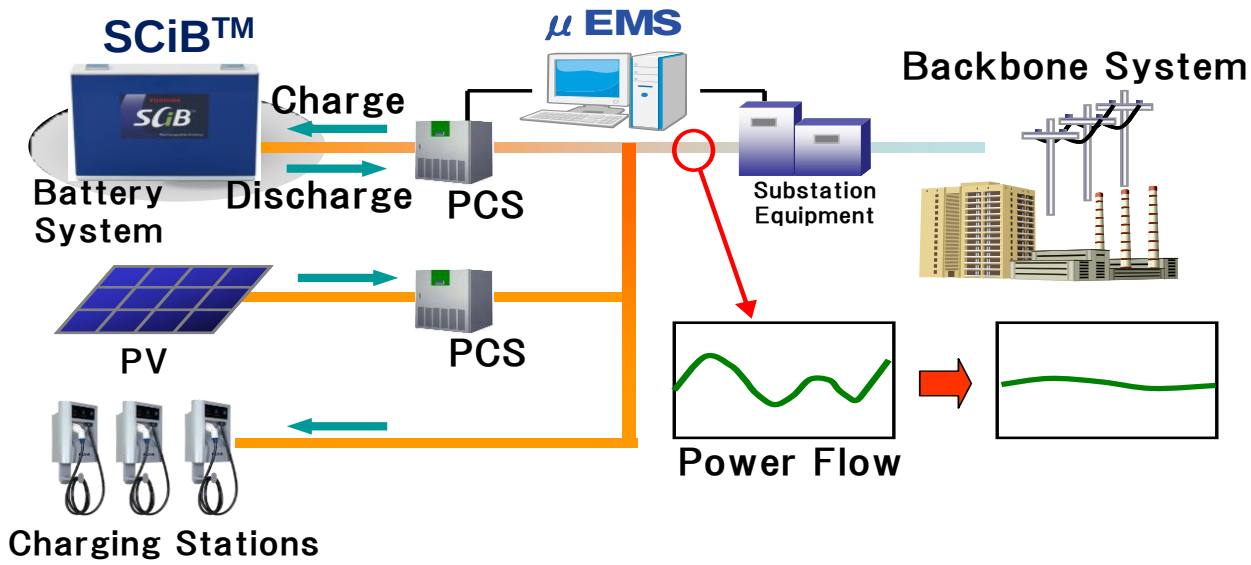
EV charging system by using power from PV generation was implemented, and the system also serves as an emergency power supply

PJ4 : PV/EV integration in Simon Mall, USA

Plug-In Ecosystem integrating PV, EV charging and BESS

Simon Mall @Clay Terrace, Indiana, USA

Project Started Feb 1st, 2013

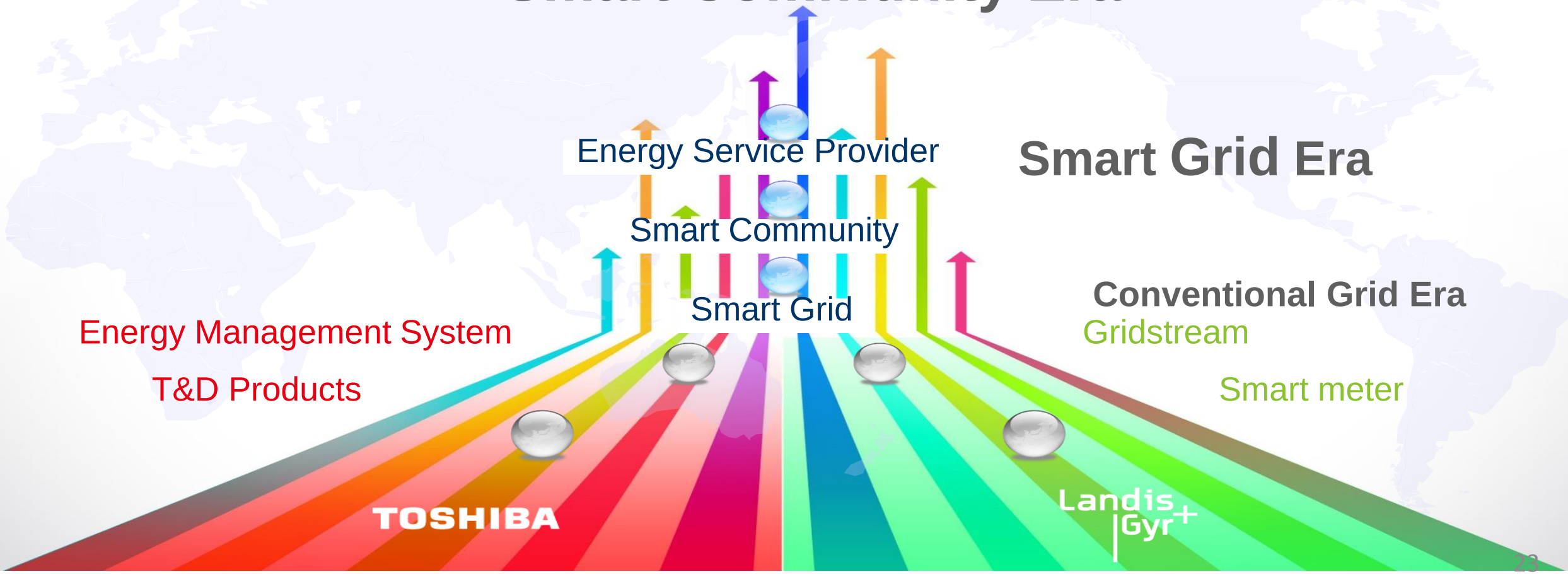


Battery Energy Storage	75kW/42kWh
PV generation system	**10kW**
Quick charger	**50kW**
Standard charger	**7.2kW x 2**

PV power can be stored in BESS and used to EVs, without drawing on the distribution grid

Duke Energy ESN ENERGY SYSTEMS NETWORK SIMON™ ITOCHU

Smart Community Era



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