TOSHIBA

Battery Energy Storage Systems for Power Grids (SCiB™)

– Toshiba's experiences and solutions –

April 2, 2025

Energy Aggregation Division

Toshiba Energy Systems & Solutions Corporation

Toshiba is …

Manufacturer of lithium-ion battery cells & modules

&

Integrator of battery energy storage systems

Toshiba Corporation (*)

(*) The business was transferred from Toshiba Infrastructure Systems & Solutions Corporation on April 1st, 2019.

Kashiwazaki Operations

SCiB™

an advanced lithium-ion battery

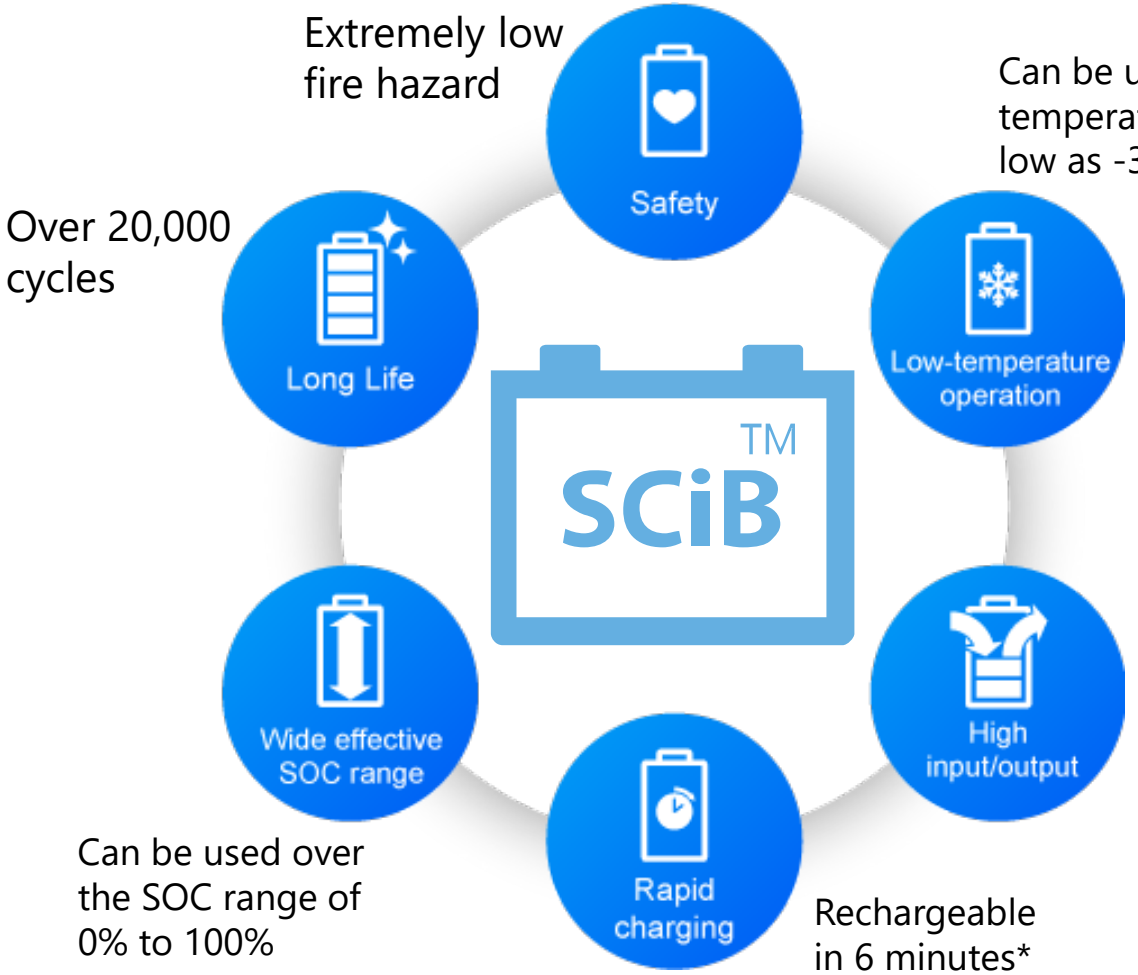
TM SCiB

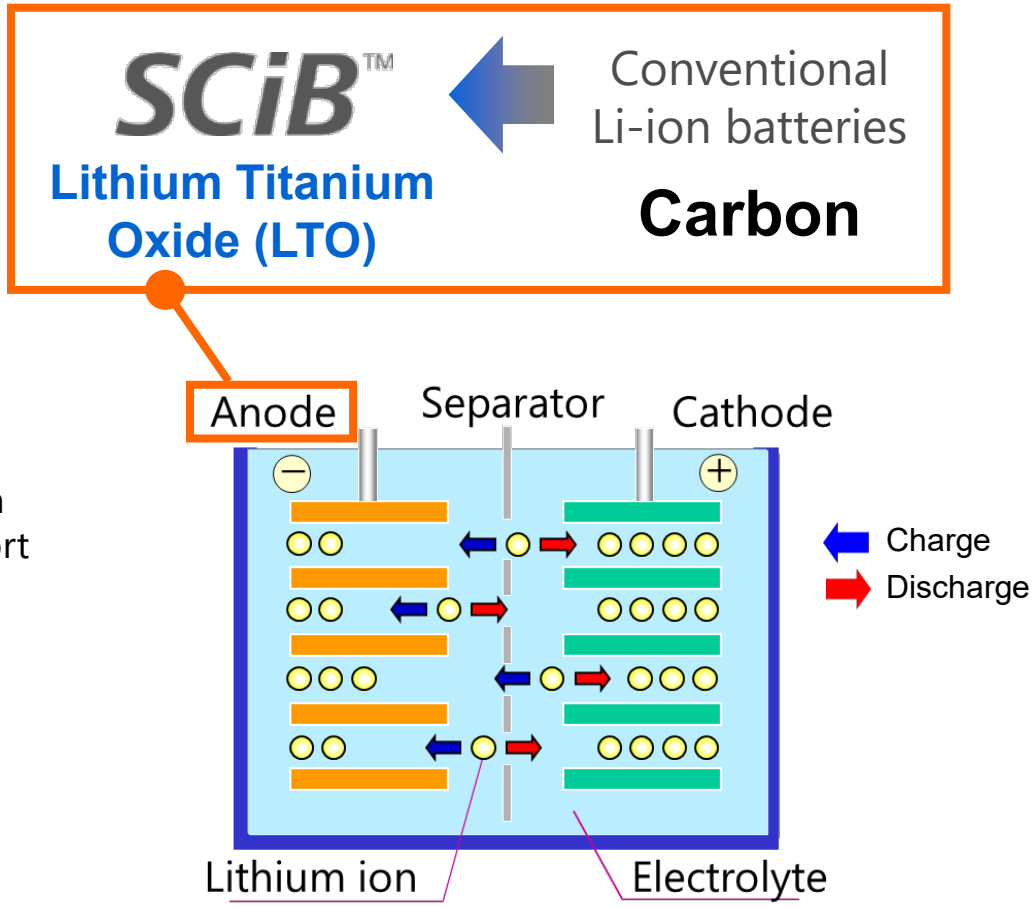
Toshiba Energy Systems & Solutions Corporation

Large-scale battery energy storage system

Toshiba's Lithium-ion Battery SCiB™

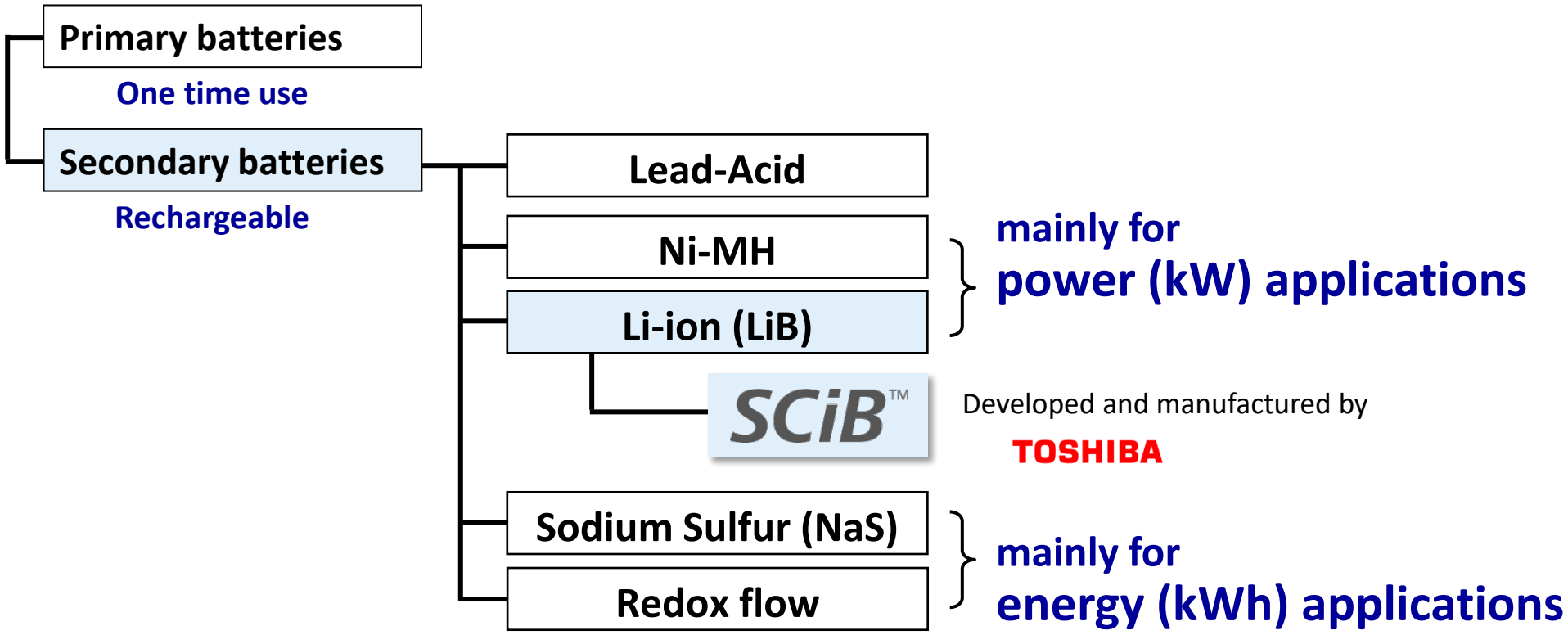
Outstanding features realized by the use of lithium titanium oxide





See more detail: https://www.global.toshiba/ww/products-solutions/battery/scib.html

Typical batteries used in power grids

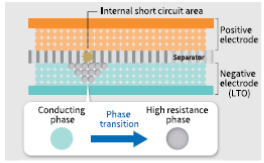


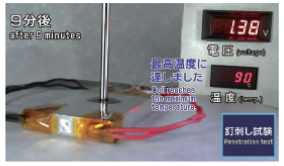
SCiB™ is a rechargeable secondary battery, a kind of lithium-ion batteries.

SCiB™ Excellent Characteristics

Safety

Low risk of fire or explosion

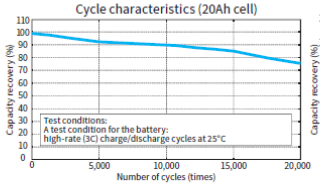


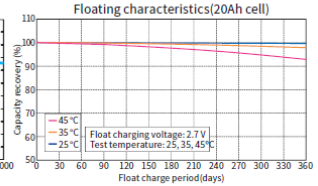


In case of an internal short circuit, the lithium titanium oxide (LTO) in the negative electrode layer of SCiB ™ phase transforms to being highly resistive, thus minimizing risk of drastic current flow that may lead to rupture, fire, or other accidents.

Long life

Cycle life of **20,000*** times or more



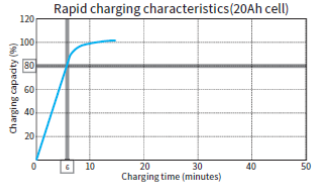


The capacity remains at 70% or more even after 20,000 times of charging/discharging. SCiB™ also has small degree of deterioration even with float charging**, making it usable for applications that keep constant voltage such as backup power supply.

*Cycle characteristics depends on cell type and usage conditions
** Float charging: Float charging means continuous constant voltage charging.

Rapid charging

Rapidly charges to about **80%** of the capacity in **6** minutes

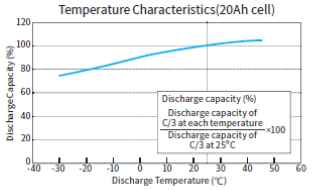


The favorable negative electrode charging characteristics provide rapid charging to about 80% of the capacity in 6 minutes.

Note: Characteristics depends on cell type and usage conditions

Performance at low temperature

Usable even at **-30**℃*

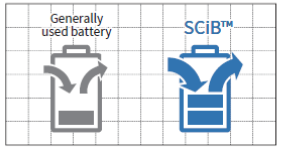


Since there is almost no lithium metal deposition even at low temperature usage, repeated charging and discharging is possible at -30℃.

*Operating temperature range depends on cell type.

High input/output

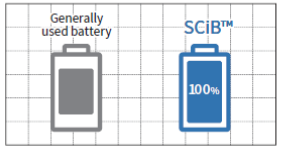
Large current
for both input and output



SCiB™ can accept large current input and output. Thus, it can store large regenerative energy generated during deceleration of railways and automobiles, and can supply large current necessary for starting the motor.

Wide effective SOC* range

Available SOC range of **0** to **100**%



SCiB™ exhibits excellent input/output characteristics over a wide SOC* range. This makes it possible to reduce the nominal battery capacity or amount of batteries necessary for a system, as compared to other batteries that have a narrower SOC range.

* SOC: State of Charge

The indicated data were measured under specific conditions. The performance varies according to the customer's condition for use.

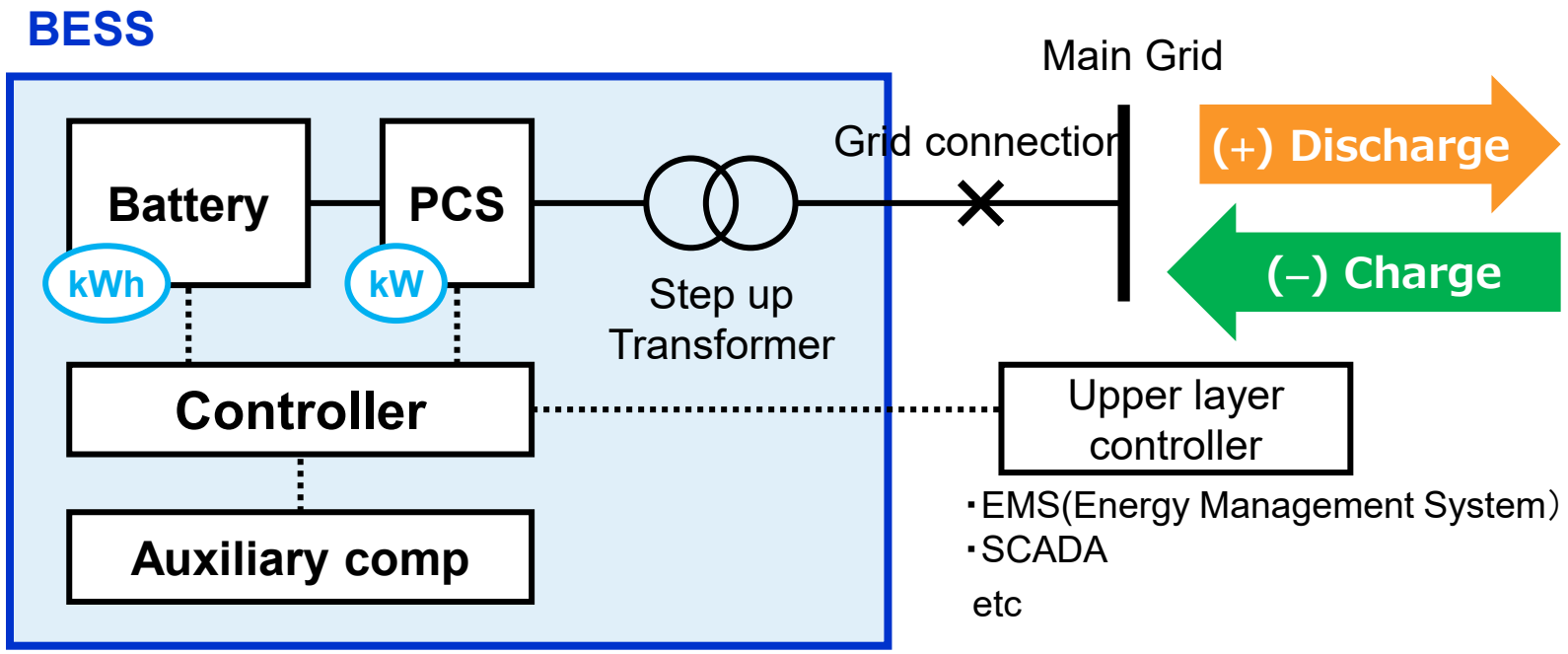
Source: Rechargeable Lithium-ion Battery SCiB™ (Brochure)

BESS using SCiB™

*BESS: Battery Energy Storage System

What is battery energy storage system (BESS)

Typical configuration of BESS



(a) Battery: Store electrical energy and charge discharge DC power
(b) PCS: Power Conditioning System (Convert energy between DC and AC)
(c) Controller: Protection and Control
(d) Auxiliary: HVAC, Fire suppression etc.

BESS assembling

Flexible Configuration in both kWh and kW to meet the application

SCiB™ Battery Cell

Battery Module

Battery Panel

kWh

BESS Controller

Battery Energy Storage System (BESS)

Containerized BESS

Power Conditioning System (PCS)

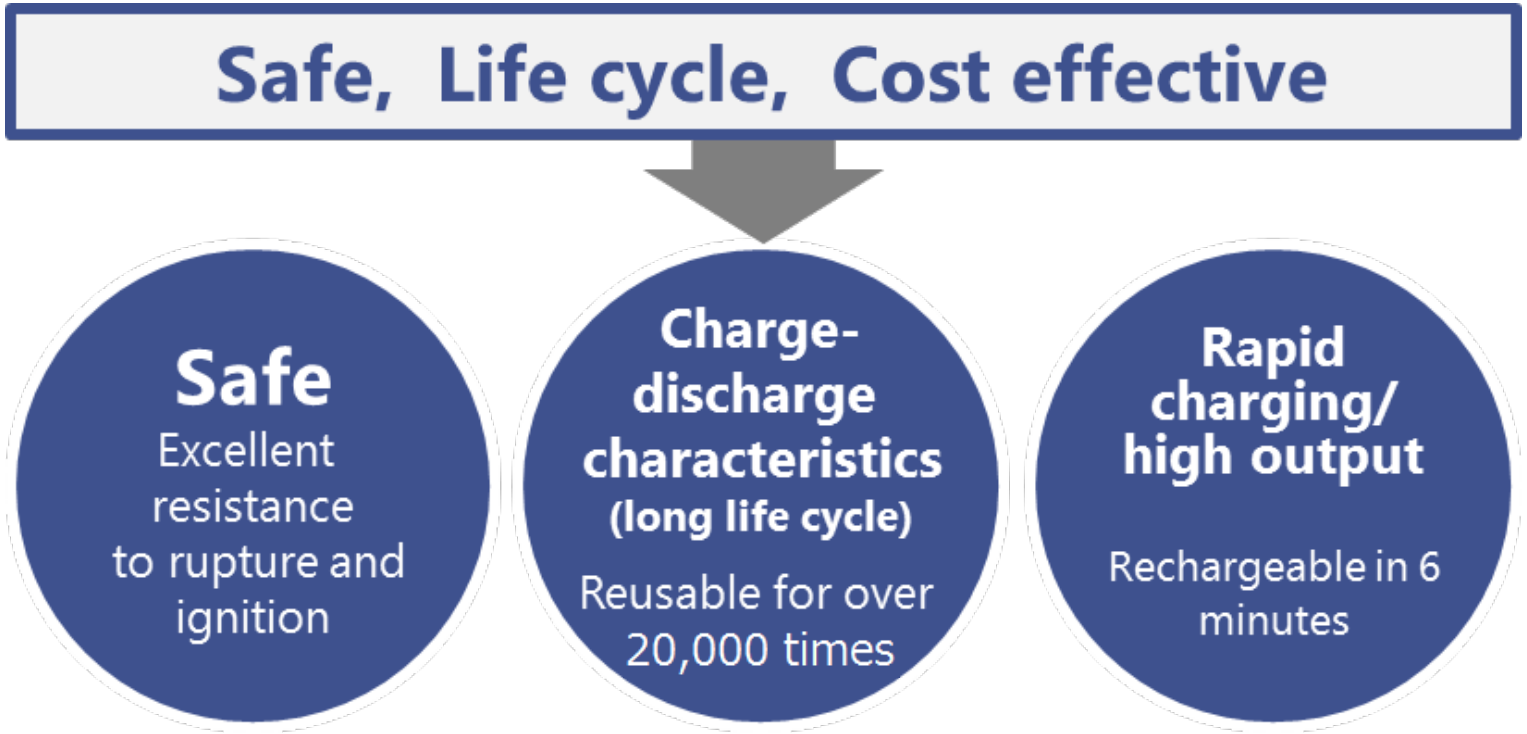
kW

Large-scale BESS

SCiB™ solutions for stationary use

Toshiba's rechargeable battery SCiB™ using Lithium Titanium Oxide in its anode.

Problems to be solved in conventional lithium ion batteries:



Suitable characteristics for grid energy storage applications

See more detail at our web site: https://www.global.toshiba/ww/products-solutions/battery/scib.html

Safety: BESS monitoring architecture ensuring safety

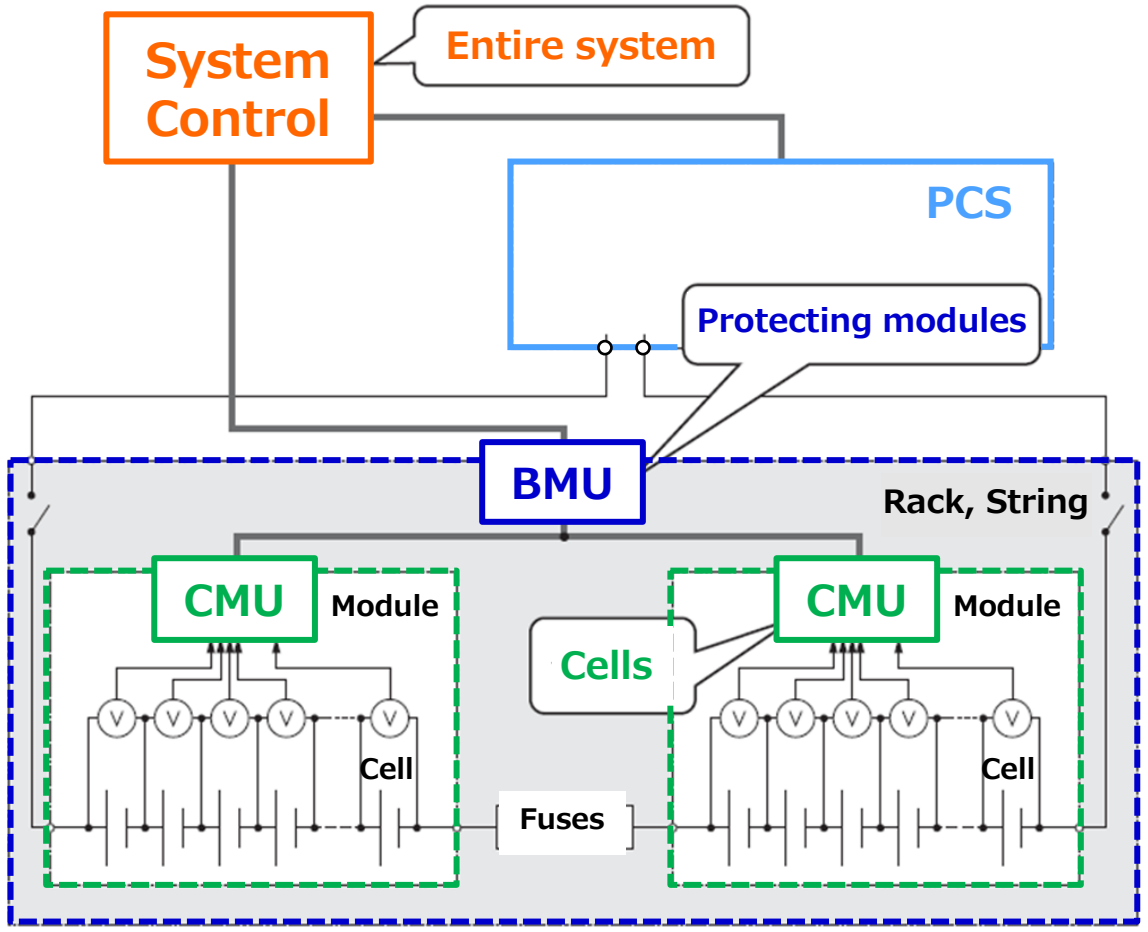
Hierarchical monitoring and protective controls to keep safe operation of the entire BESS, on top of the inherent safety of SCiB™

Hierarchical monitoring and protection control

System control
Operating range (SOC, etc.)

BMU
(Battery Management Unit)
Open contactors, Alarm

CMU
(Cell Monitoring Unit)
Temperature, voltage, etc.

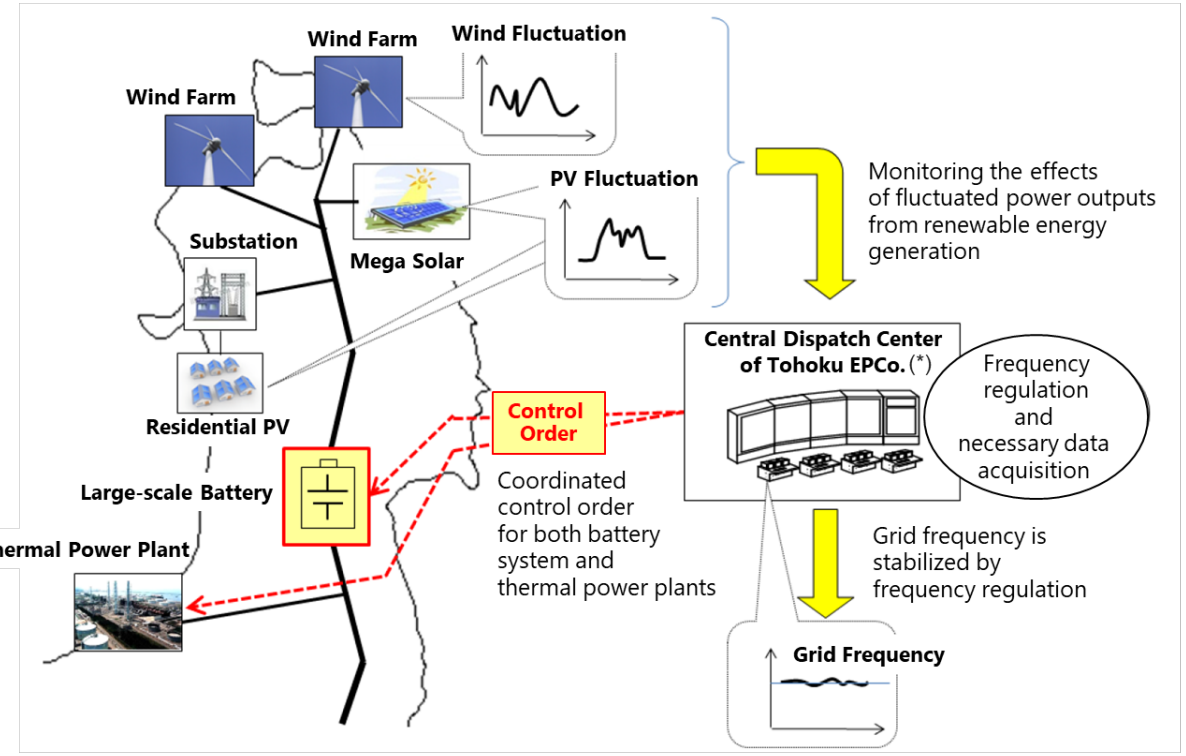


Nishi-Sendai BESS for frequency regulation

40MW/20MWh BESS for Tohoku Electric Power Network Co., Inc.(*)

(*) Tohoku Electric Power Co., Inc. at the time of installation

Control Scheme Overview:
- Frequency Regulation using Battery System

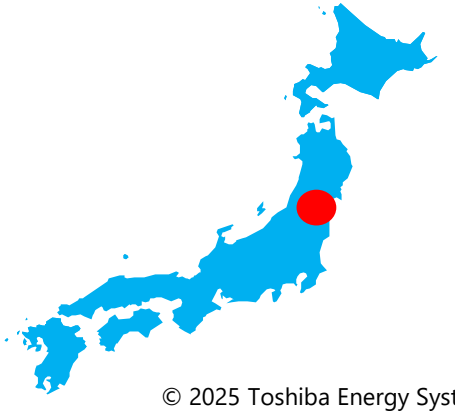


(*) Tohoku Electric Power Network Co., Inc., since April 1st, 2019

https://www.tohoku-epco.co.jp/pastnews/normal/1184472_1049.html (in Japanese)

FACTS

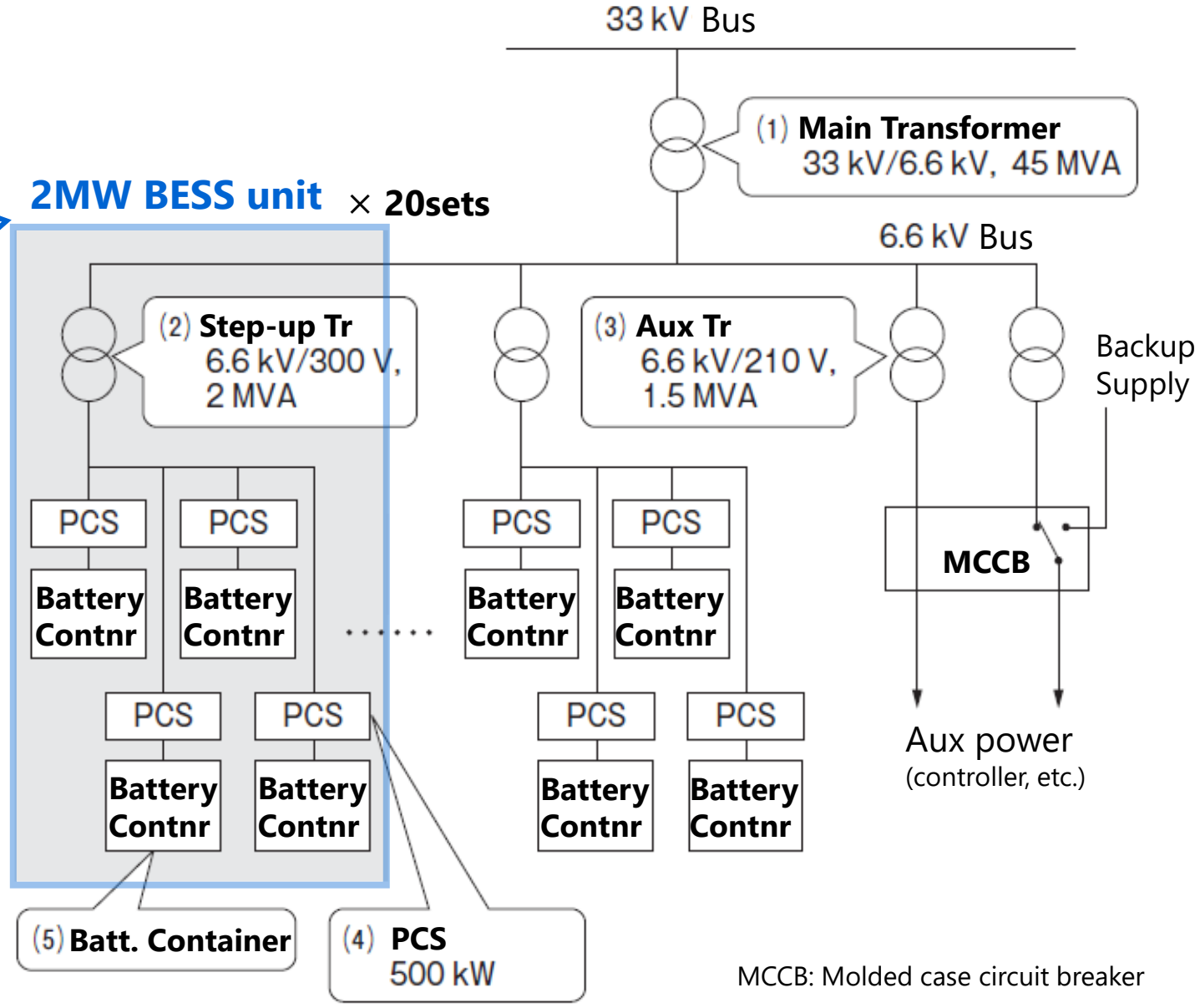
- 40MW(*)/20MWh SCiB™
  (*) short-term duty
- World largest at that time
- Support Frequency Stability
- 80 x Battery Containers
- 80 x 500kW PCS
- Operation started in Feb. 2015



Nishi-Sendai BESS for frequency regulation

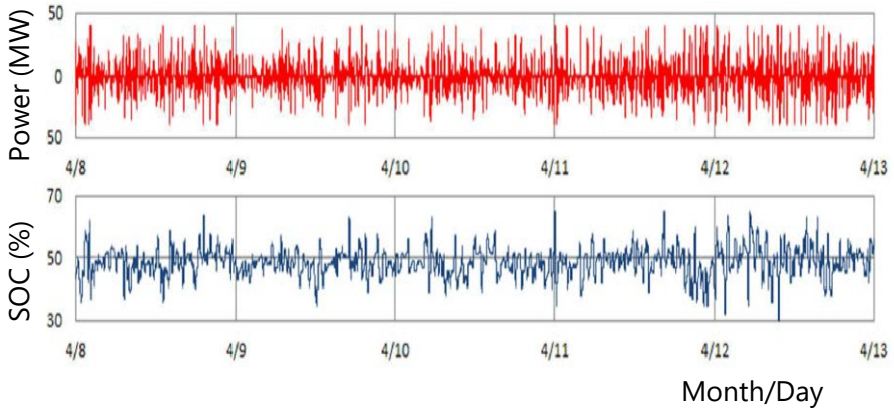
System Configuration:

20 sets of a 2MW BESS unit in parallel form Nishi-Sendai BESS with 40MW power rating



MCCB: Molded case circuit breaker

Example of Charge/discharge power at 33kV Bus (April 8-12, 2015)

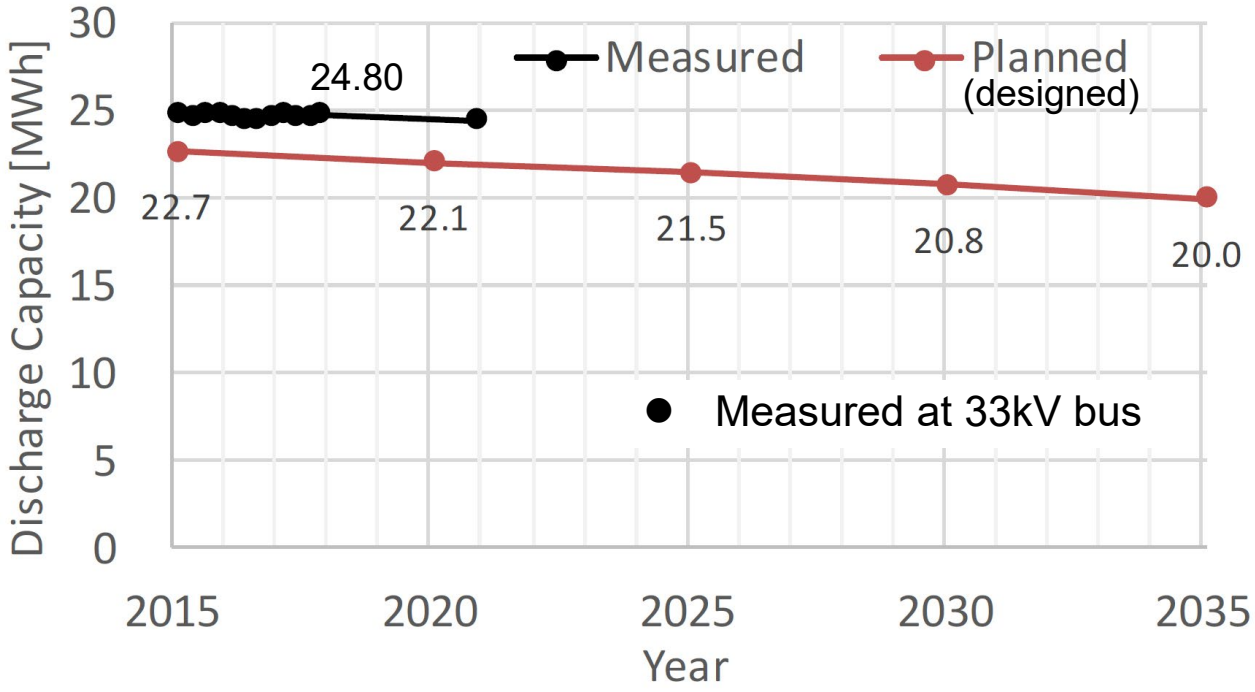


Source: Toshiba Review, Vol.70, No.9 (2015) (in Japanese)

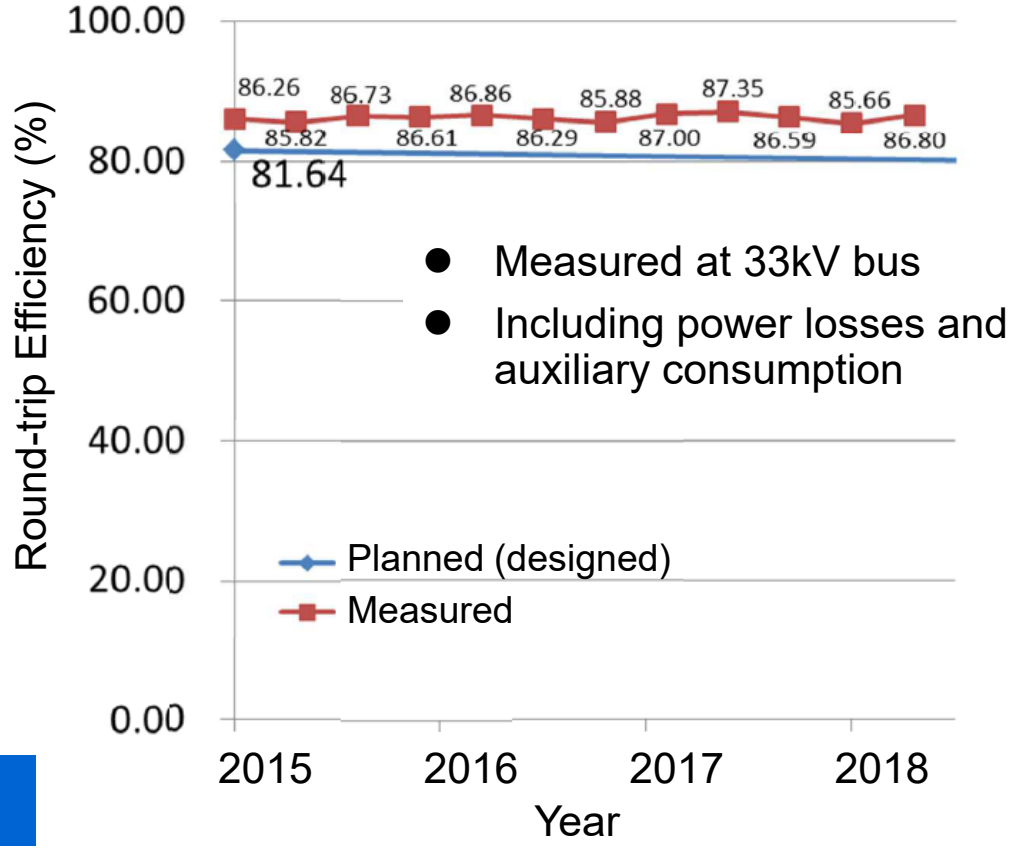
Nishi-Sendai BESS for frequency regulation

Battery performance after start of operation

Residual (Discharge) Energy Capacity



Overall Round-trip Efficiency



Performance is maintained above design values

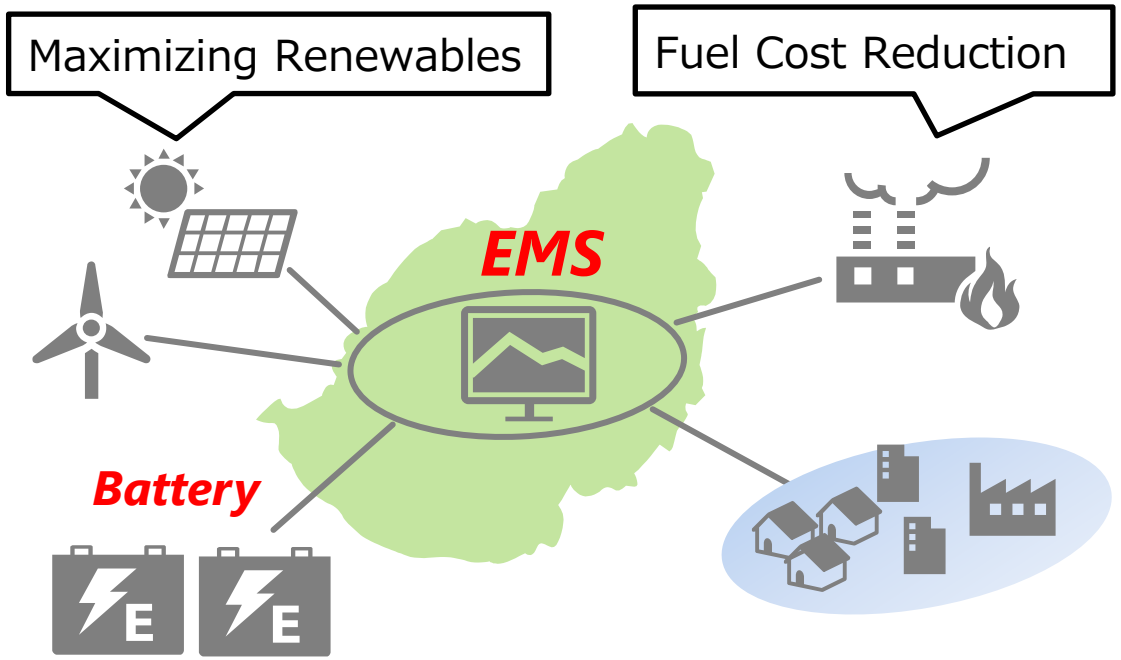
Source: (1) K.Mitsumoto, et al., CIGRE 2022 Kyoto Symposium, C000158, Apr.2022
(2) Tohoku EPCO, Final report of the demonstration results, Jan.2018

BESS with EMS* for Microgrids

*EMS: Energy Management System

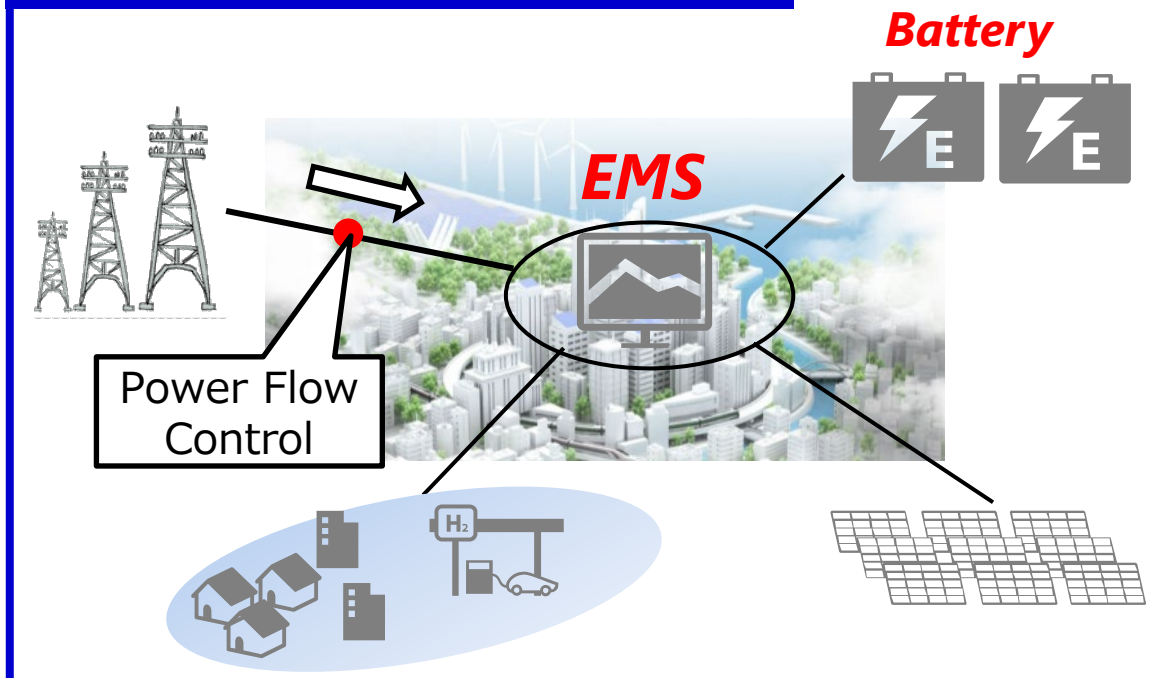
Types of Microgrids

Islanded Microgrid



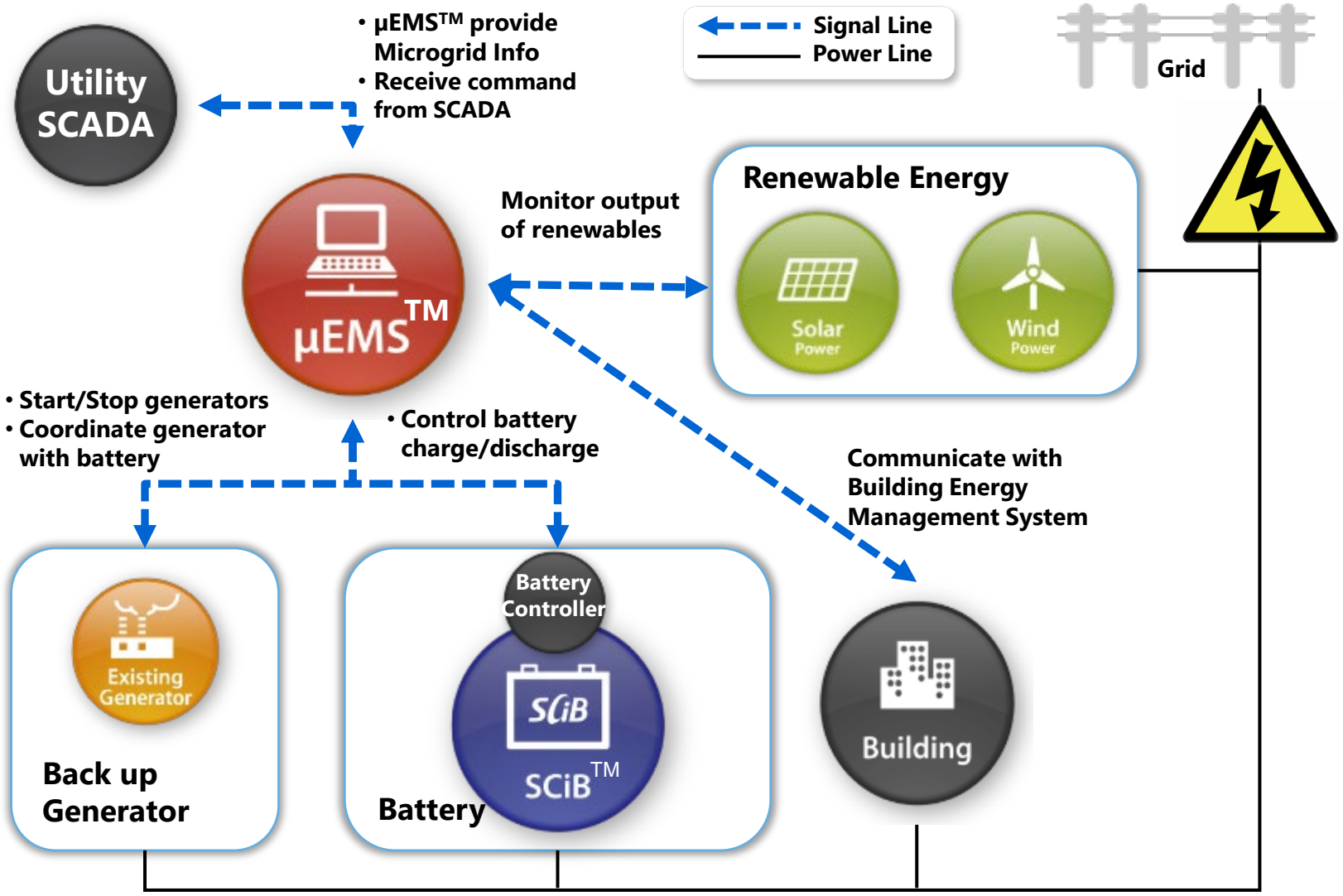
- Supply-demand balancing to keep frequency stable
- Suppress fluctuation of renewable energy output to reduce the fuel cost

Connected Microgrid



- Contributing local production for local consumption
- Islanding operation when blackout occurs (Resiliency)

Battery energy storage system (BESS) for microgrid

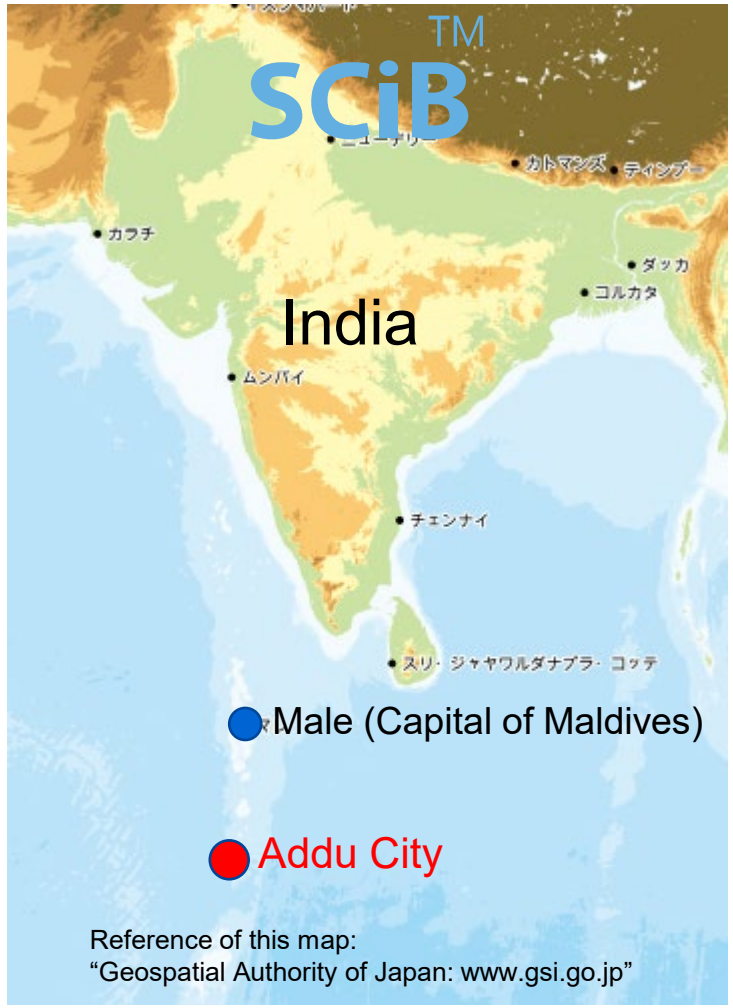


With the combination of µEMS™, BESS provides:
- **Peak shaving/cutting inside MicroGrid**
- **Reduce fluctuation from renewable sources**

In case of power outage, BESS supports MicroGrid:
- **As back up power source**
- **As Spinning reserve while waiting for back up generator to start**

Microgrid System using BESS in Addu City, Maldives

μEMS™ controls battery energy storage system and diesel generators to stabilize the grid and to reduce the fuel cost



Reference of this map:
"Geospatial Authority of Japan: www.gsi.go.jp"

μEMS™ (New)

Energy Management System for Micro-grid

- Fluctuation reduction of PV
- Economic operation of DGs

- **CO2 Reduction**
- **Fuel Cost Reduction**

Battery System (New)

1MW-336kWh Capacity

Li-ion Battery
SCiB™

Diesel Generators (DGs)

Total: 18MW Rated (15 DGs)

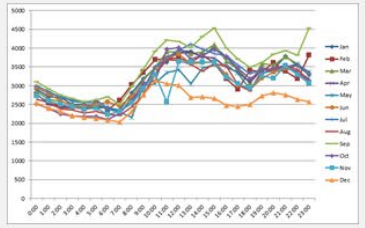
Operation Rate
40-50%

PV System

Total: 1.6MW

Load

Peak Demand: 6-7MW



https://www.toshiba-energy.com/info/info2019_0122.htm (in Japanese)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