

11th International Workshop on  
**ELECTRIC POWER CONTROL CENTERS**

**Application of Battery Systems  
to Electric Power Networks**

10 Min

**May 23, 2011**

**Dr. Hideki Hayashi,**

**General Manager – Smart Grid Technology**

**Toshiba Corporation**

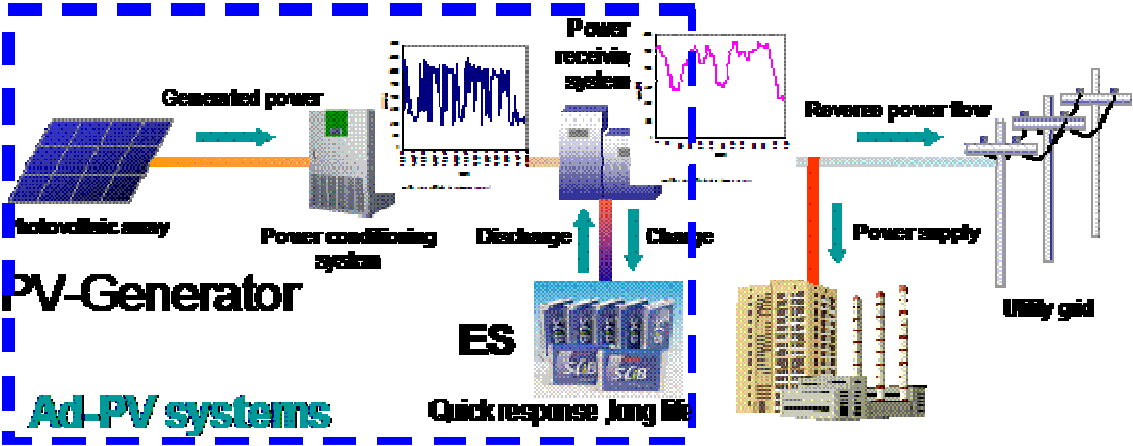
# Contents

## — Application of Battery Systems to Electric Power Networks —

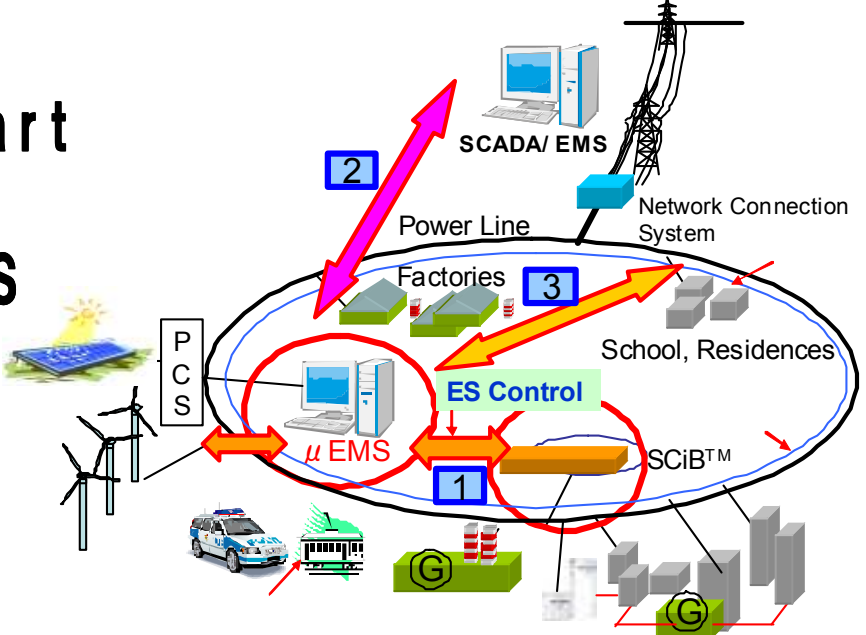
1. Renewables Integration
2. Local Approach-Advanced PV Systems
3. Battery Systems for Power Grid
4. Battery Application to Power System Control
5. Power Grid and Electro Mobility

# 1. Renewables Integration to Power Grid

(1) **Local Approach** :  
 Smart Components  
 Ex) Advanced PV System, Energy Storage Aggregation



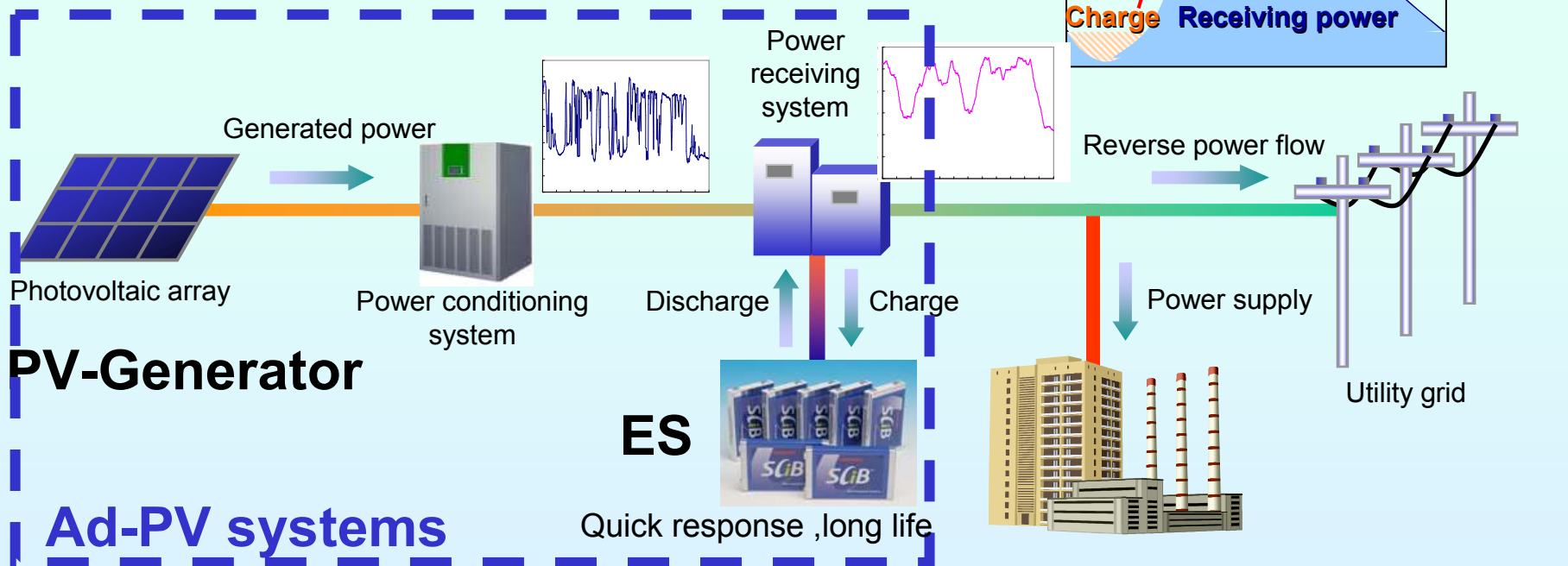
(2) **System Approach** : Smart Grid/Power System Solutions based on EMS Technology



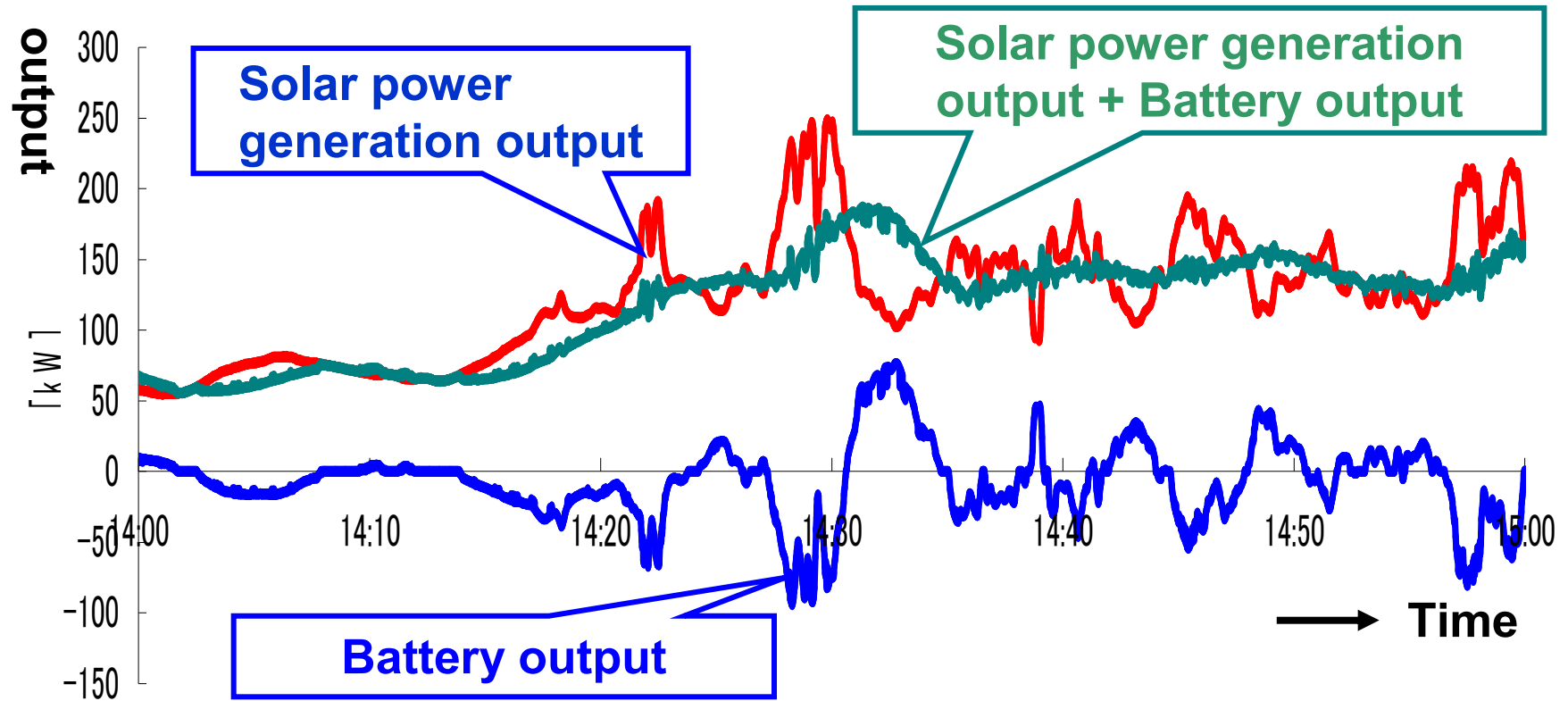
$\mu$  EMS ; Energy Management System for Micro/Smart grid

## 2. Local Approach : Advanced PV Systems — PV-Generator and Energy Storage —

1. **Reduces Fluctuation** in PV Output Power
2. Time Shift Operation such as **Demand Peak-cut**
3. Backup Power Supply (incl. Instantaneous Voltage Sag Compensation)
4. Other Options for Power System Control

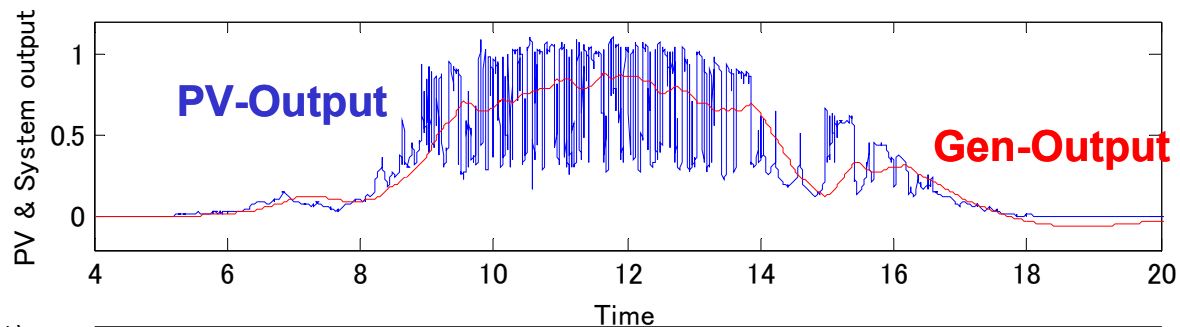


# 300 kW Actual Field Data



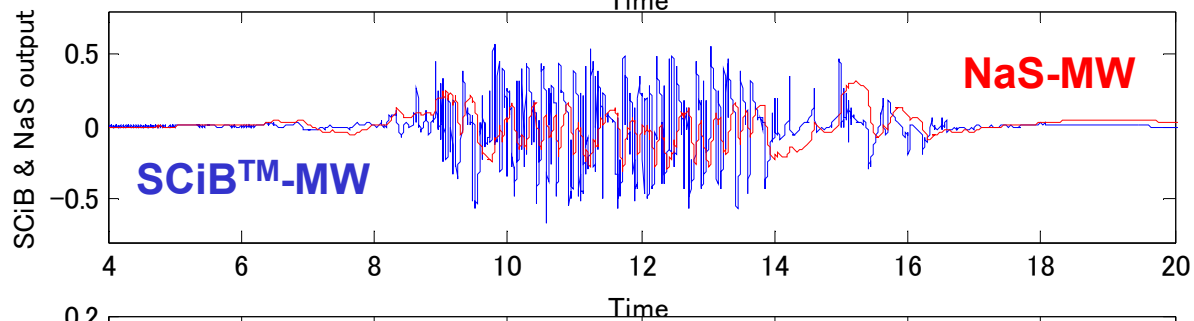
# Hybrid Control of SCiB™ & NaS(1)

## Examples on Mitigation of Power Fluctuations



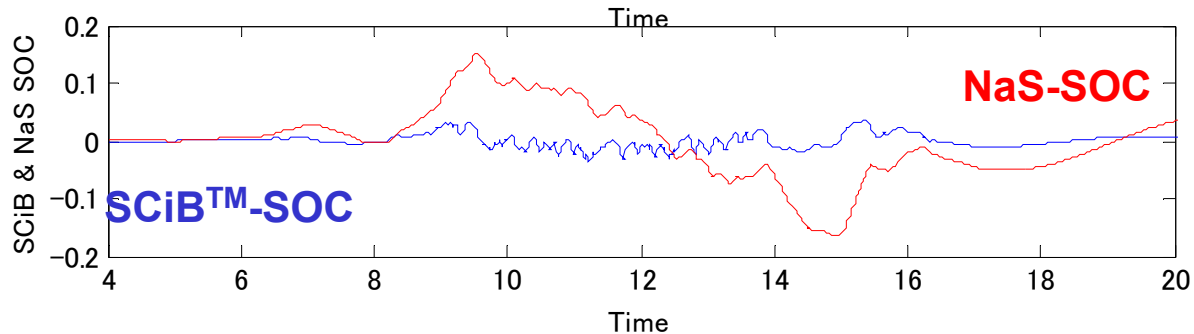
1MW PV

Cut Off 30 Min  
Component



SCiB™ 650kW

NaS 330kW

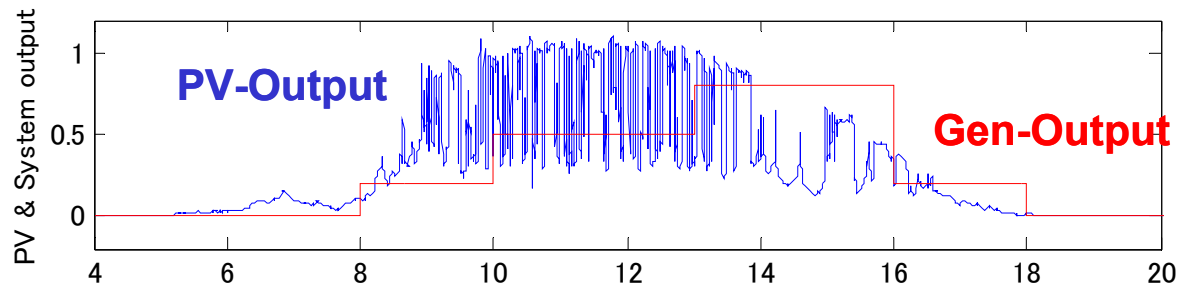


SCiB™ 40kWh

NaS 200kWh

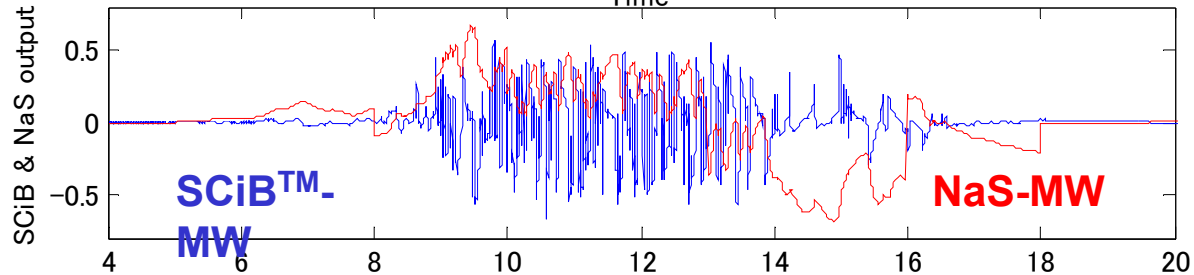
# Hybrid Control of SCiB™ & NaS(2)

## Examples on Mitigation of Planned Generation



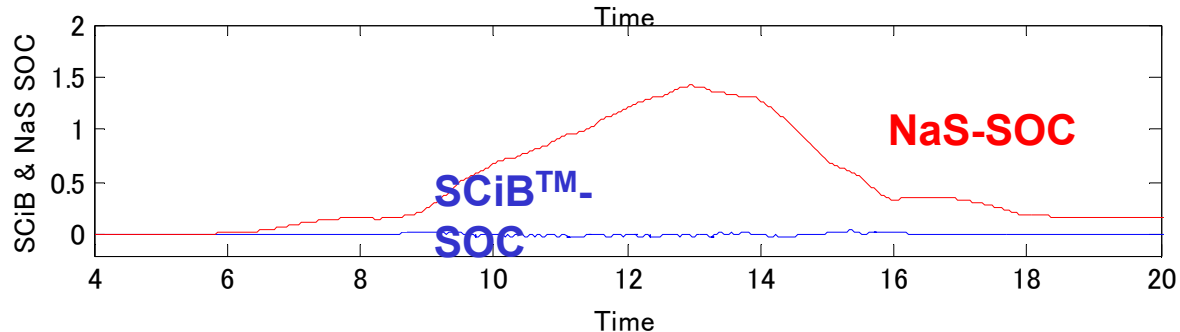
1MW PV

Max Output from 1pm to 4pm



SCiB™ 650kW

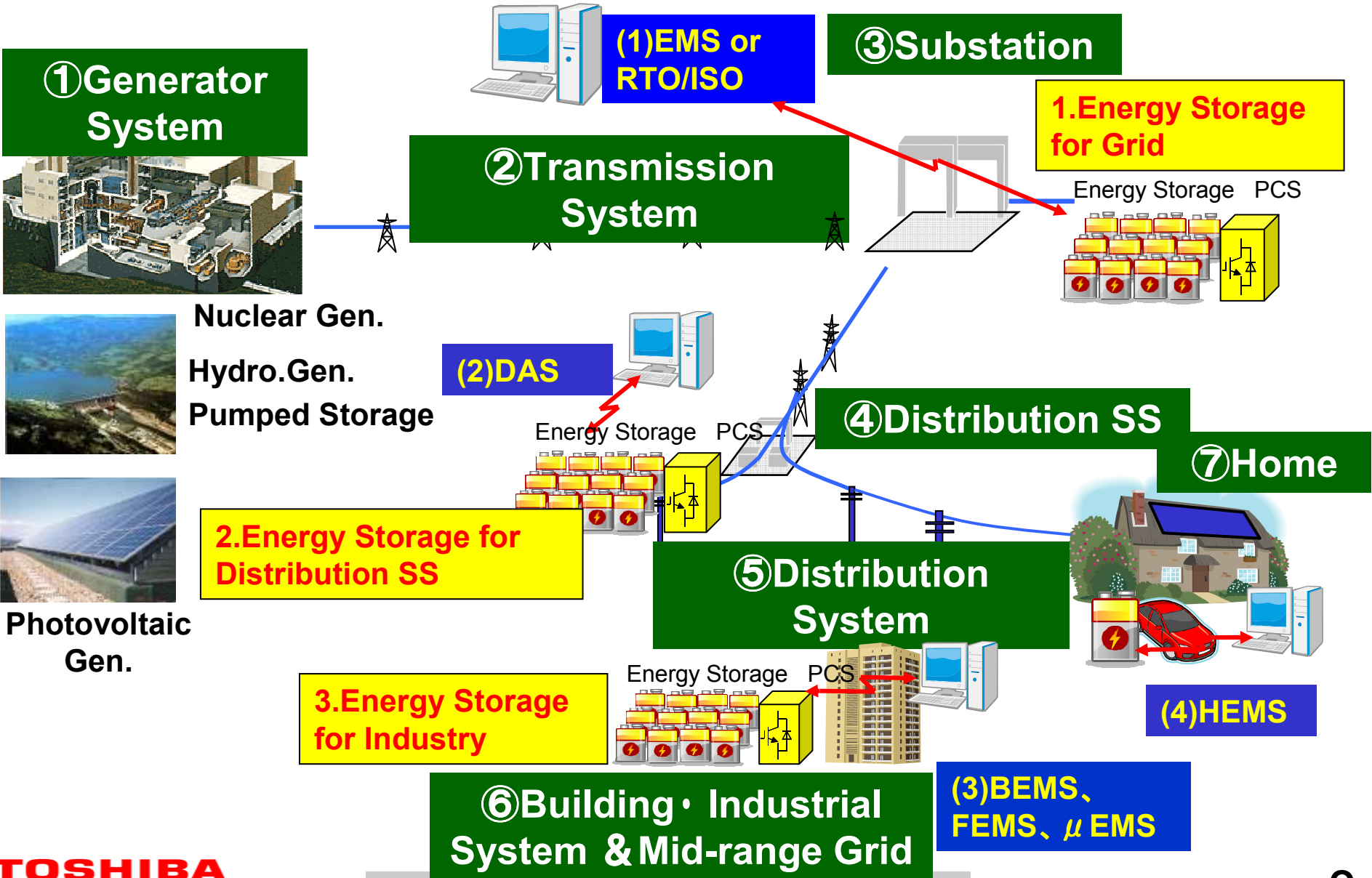
NaS 700kW



SCiB™ 40kWh

NaS 1500kWh

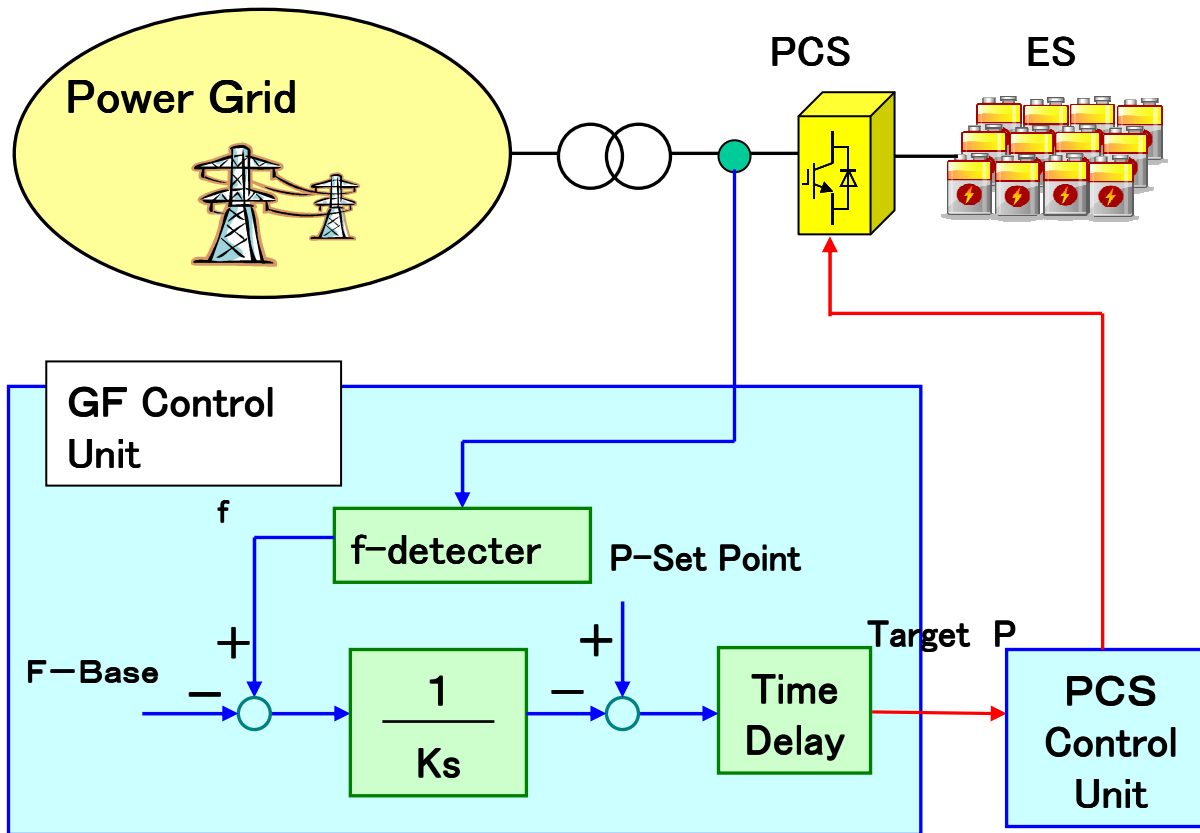
# 3. Battery Systems for Power Grid



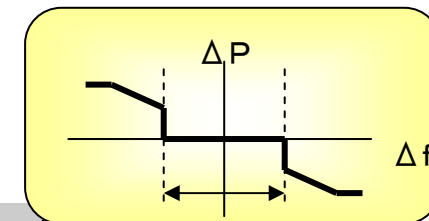
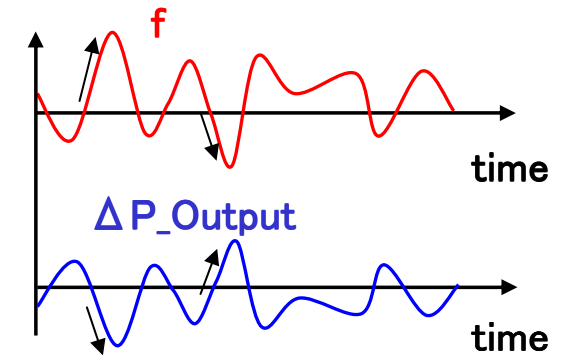
## 4. Battery Systems Application to Power System Control

1. Artificial Governor Characteristics	$\Delta P = -K \cdot \Delta f$
2. LFC Control /Fluctuation Reduction	under EMS Control
3. Peak Shift	Energy Shift
4. Voltage Control	Q-V control

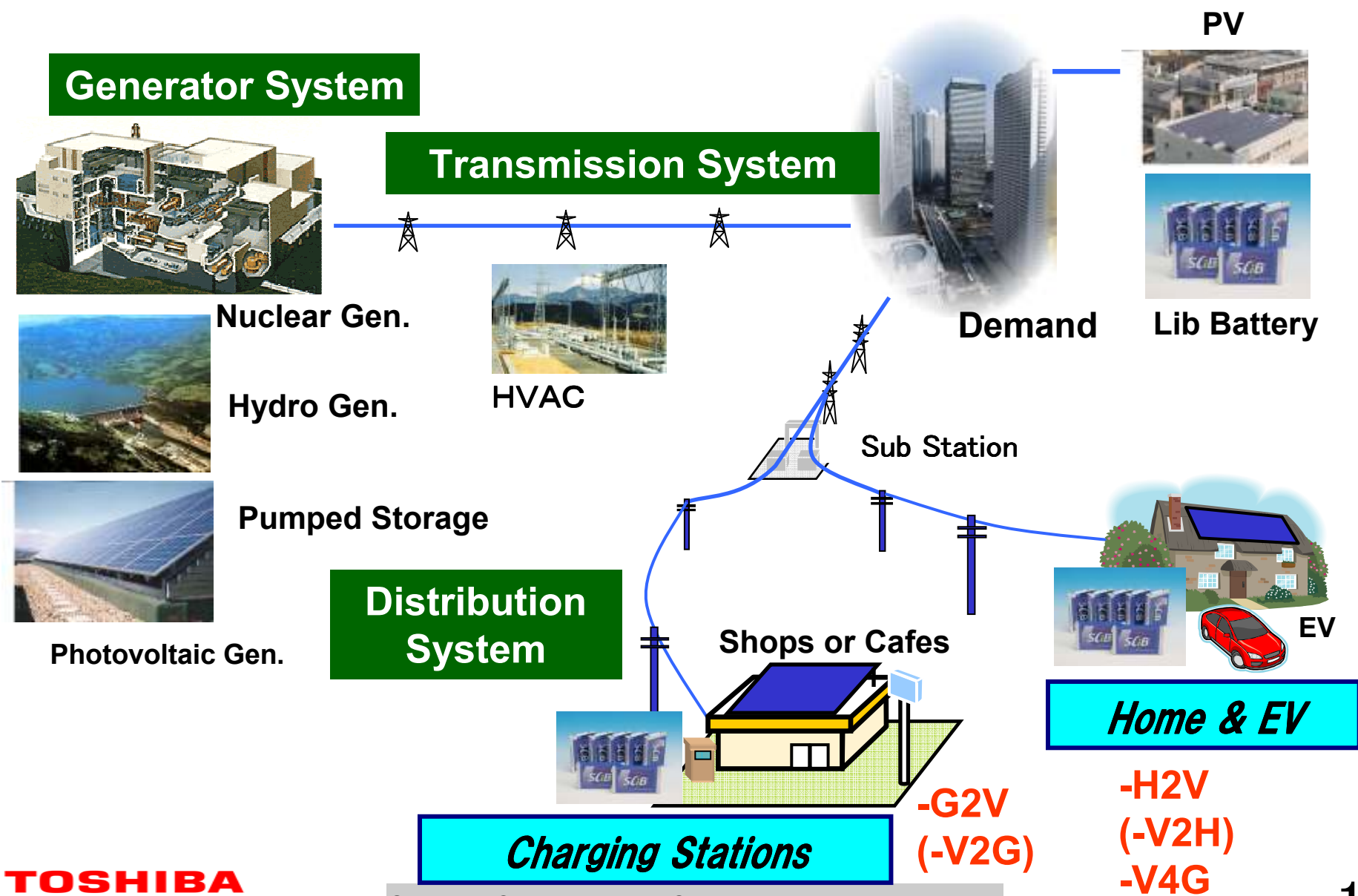
# 4.1 Artificial Governor Characteristics



- Detect  $\Delta f$  at Connected Node, then determine  $\Delta P$  according to given characteristics
- $f$  increase  $\rightarrow$  decrease P output
- $f$  decrease  $\rightarrow$  increase P output



# 5. Power Grid & Electro-Mobility



# — Application of Battery Systems to Electric Power Networks —

## 1. Ad-PV Systems : PV+Baery

## 2. Battery Systems for Power Grid; SS, Distribution SS, Industrial

## 3. Power System Control:

A-Gov., LFC, Fluctuation Reduction, Energy, V-Q

## 4. Power Grid and Electro Mobility; V4G

**Thank you for your kind attention!**



# **TOSHIBA**

**Leading Innovation >>>**

**Please Contact To Dr. Hideki Hayashi ;**

**[hideki.hayashi@toshiba.co.jp](mailto:hideki.hayashi@toshiba.co.jp)**