Asia Pacific Partnership
6th Renewable Energy and Distributed Generation
Task Force Meeting

NAS Battery Application

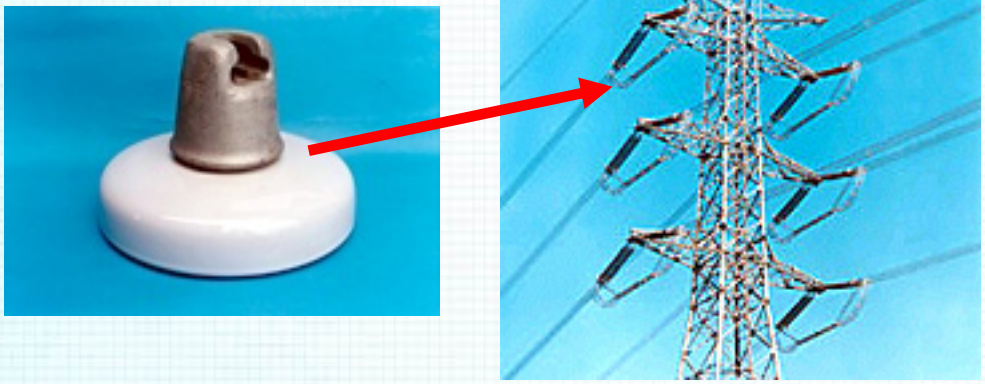
24 April 2009

Akimichi Okimoto
NGK INSULATORS, LTD.

Outline of NGK

Company Name	NGK INSULATORS, LTD.
Date of Establishment	May 5, 1919
Paid-in Capital	69,849 Million Yen
Representative Directors	Masaharu Shibata (Chairman) Shun Matsushita (President CEO) Taro Kato (Executive Vice President) Tsurayuki Okamoto Senior Vice President)
Number of Employees	2,919 (non-consolidated) 11,551 (consolidated) As of March, 2008
Consolidated Subsidiaries	54 companies As of April, 2008

NGK Power Business Group



Porcelain Insulators

Hollow Insulators

Polymer Insulators

NAS Batteries

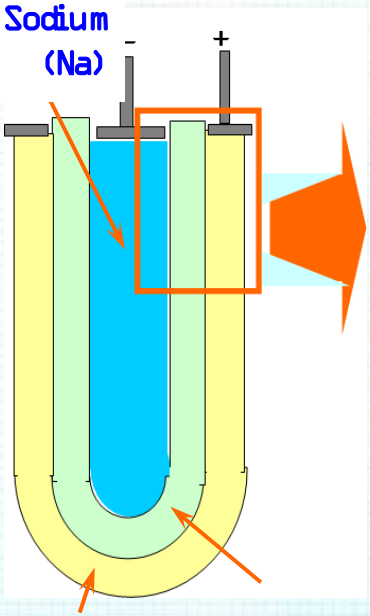
General of NAS Battery

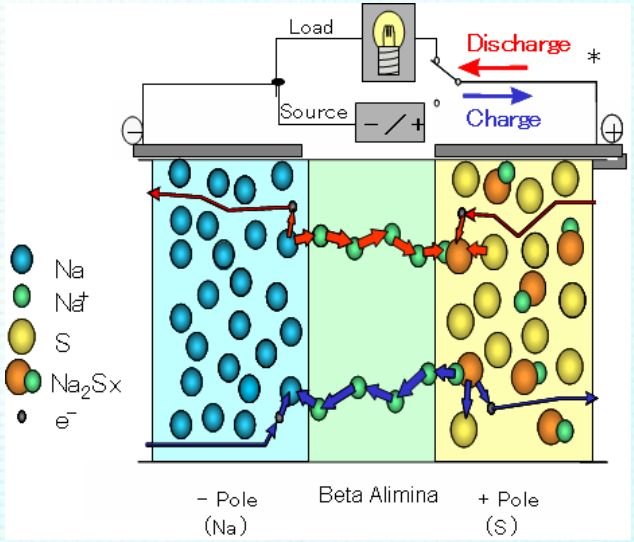
NAS Battery System
(Sodium Sulfur Battery =NaS)

1MW system (10mX3mX5mH)

Modules（50kW）

Cells





Discharging

$$2Na + xS \rightleftharpoons Na_2Sx$$

Charging

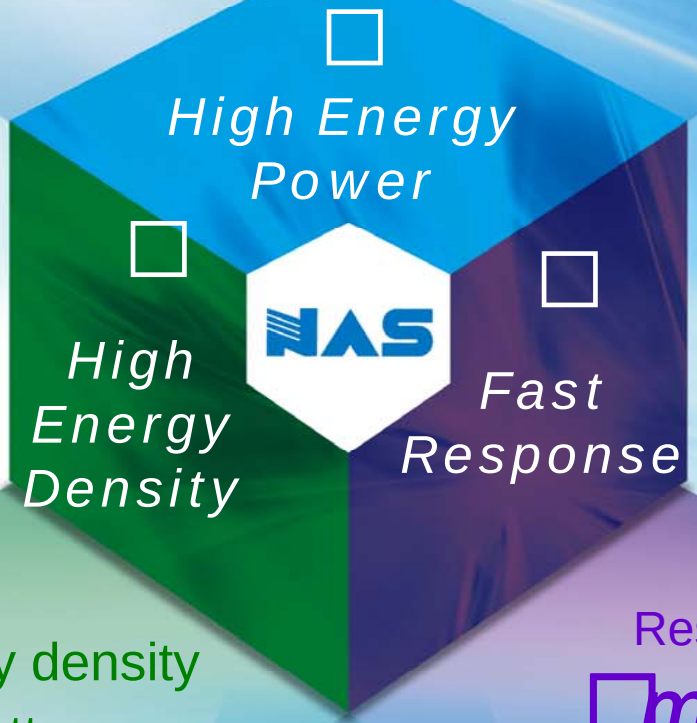
NGK's NAS Battery

8MW NAS Battery System for Hitachi Factory

Superior Function

200MW(1,200 MWh)

More than **6 hours** a day rated output



3 times energy density
Of conventional battery

1/3 space *footprint*

Response Time

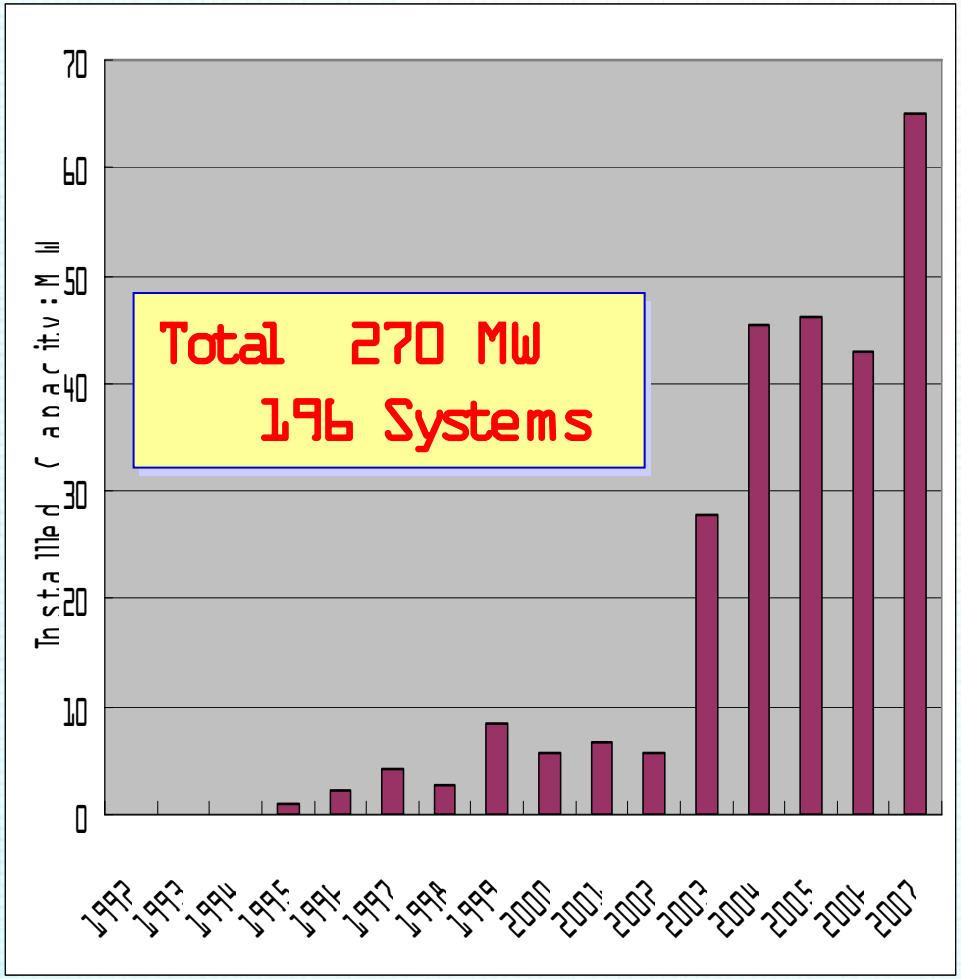
milliseconds

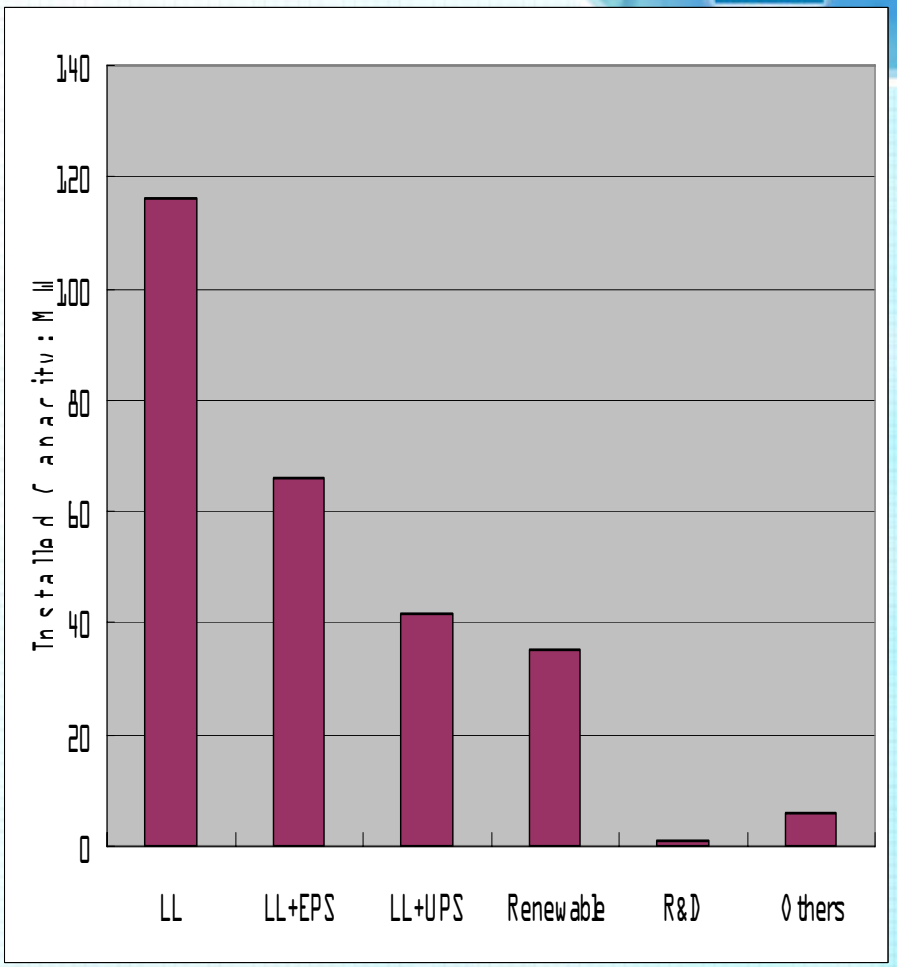
Comparison Table of Various Battery

Items \ Battery	Lead-Acid (Current)	NAS	Lithium Ion	Ni-H
Energy Density	1(Base)	3 times	3 times	2 times
Size per same kWh	100% (Base)	30%	50%	100%
Weight per same kWh	100% (Base)	20%	30%	100%
Life Cycle at standard conditions	1(Base)	5 times	3 times	2 times
Self Discharge	Yes	No	Yes	Yes
Memory Effect	No	No	No	Yes
Cost index per same kWh	1(Base)	1(Same)	5 times	3 times

Note: These data are typical values and change by the manufacturers

Installation Records



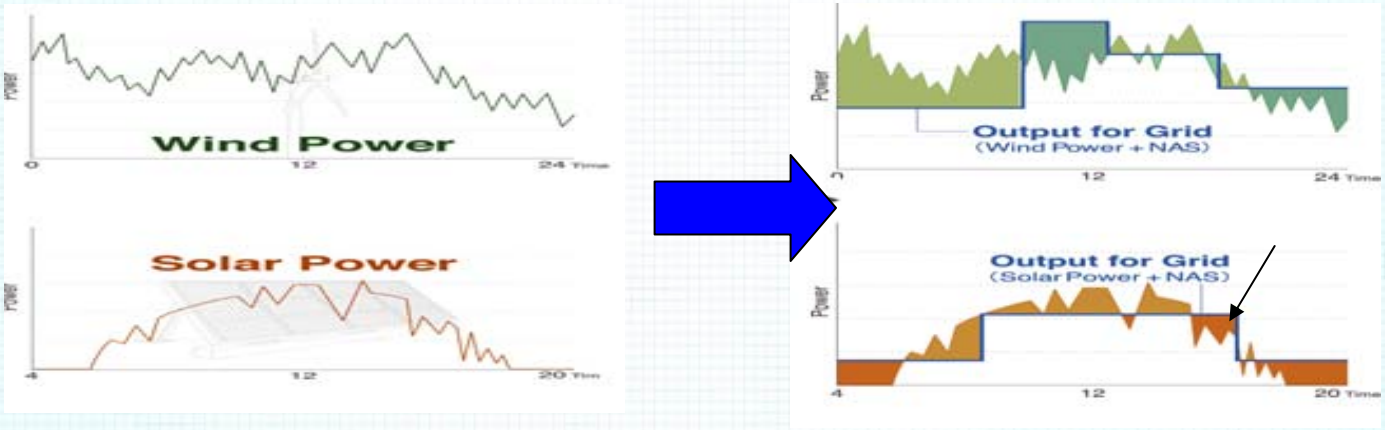


LL:Load Leveling

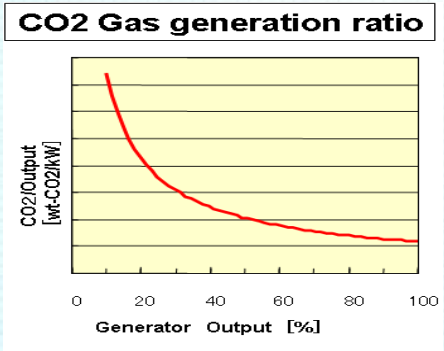
Production Capacity : 90MW(2008)→150MW(2010)

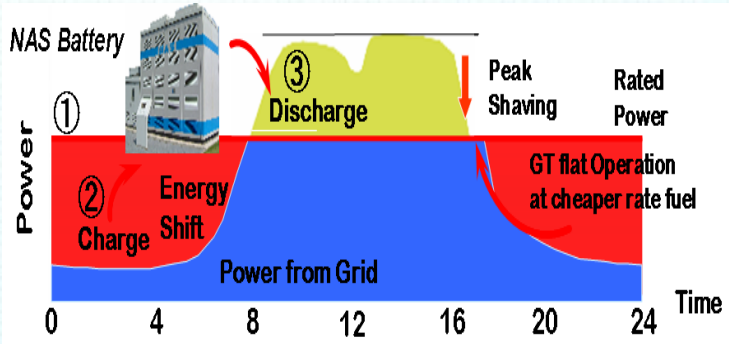
Typical NAS Battery Application

1 Stabilizing Intermittent Renewable Energy



2 Substation Application

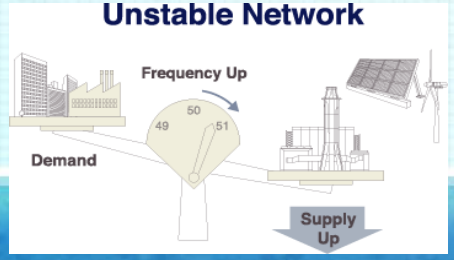


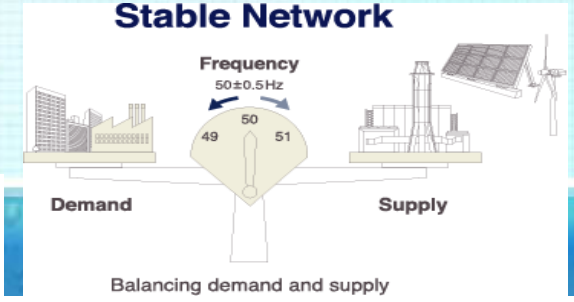


100% Turbine Operation + NAS

Minimizing
Fuel consumption
CO2 Emissions

3 Ancillary Service

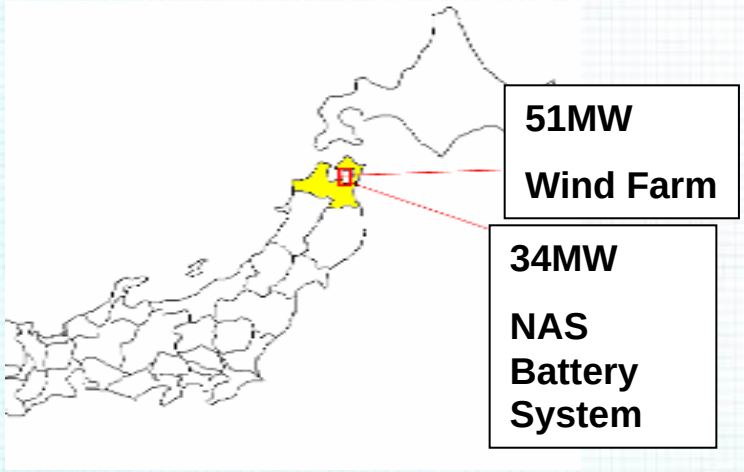




Response:10 seconds to 100%
Output : Up to 200MW

Wind Application :Rokkasho Wind Farm

34MW Battery System for 51MW Rokkasho Wind Firm

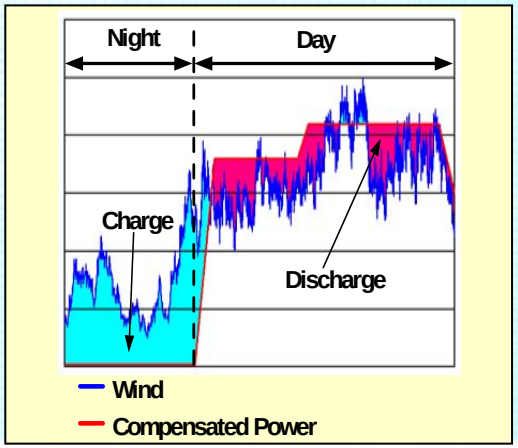


August 1,2008 : Power Supply Start to Power Company also JEPX (Japan Electric Power Trading)

2MW NAS 17sets

2MW PCS 17sets

Flat Control method



Solar Application

1.5MW NAS Battery for 5 MW Solar

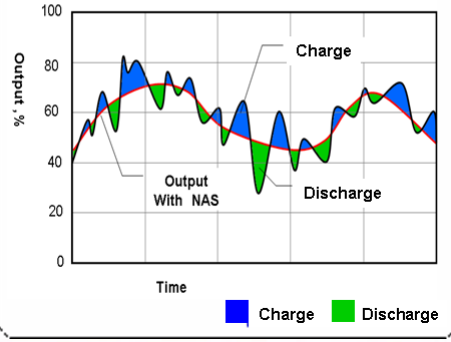
Financed by NEDO (New Energy Development Organization)

Project Size:

Solar Panel:
5MW
NAS Battery:
1.5MW

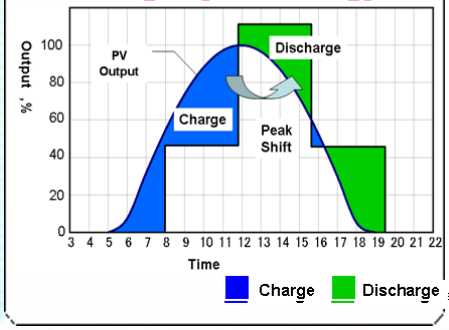
Absorb PV output fluctuation

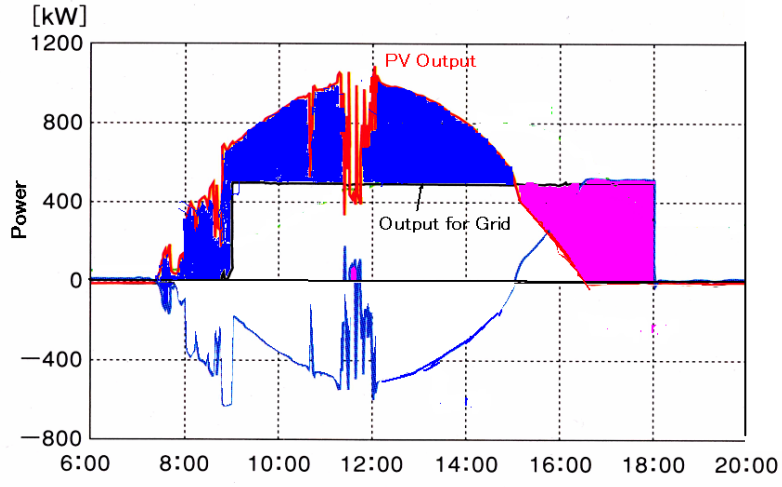
Absorption short-time fluctution of PV output



Peak Shift

Peak time discharge (Evening etc.) by Storing Day-time Energy

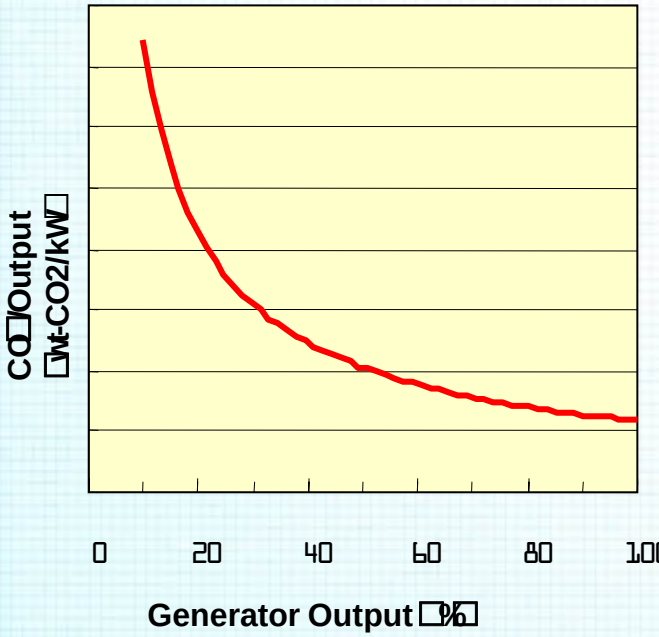


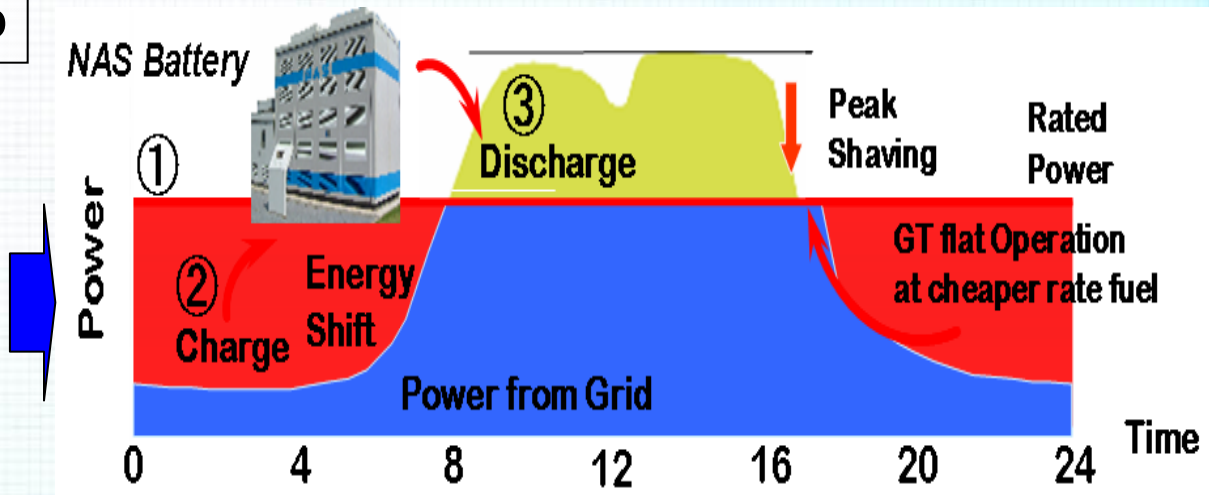


Substation Application

Use :Peak Shaving / Load Leveling

CO2 Gas generation ratio





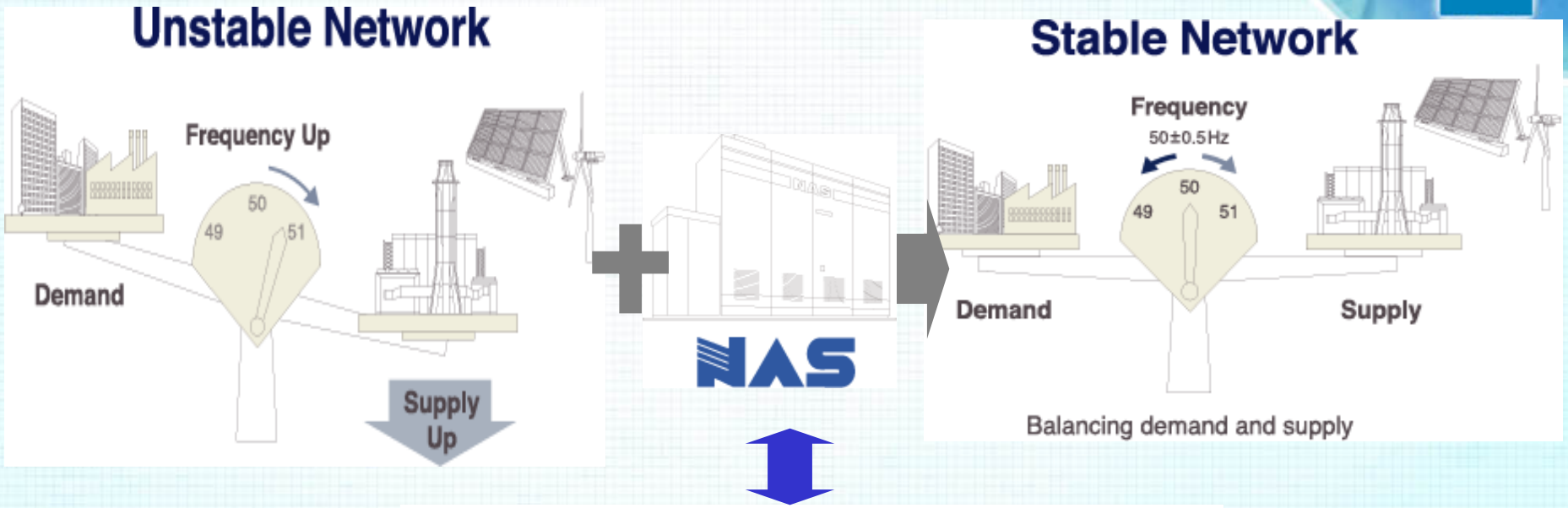
- 100 % rated operation(RO) :the most efficient and stable
- Power below 100% RO Charged to NAS
- Power above 100% RO Discharged from NAS

The most efficient and stable operation of gas turbine by hybrid NAS Battery system

Min. Fuel Consumption

Minimum CO2 Output

Ancillary Services



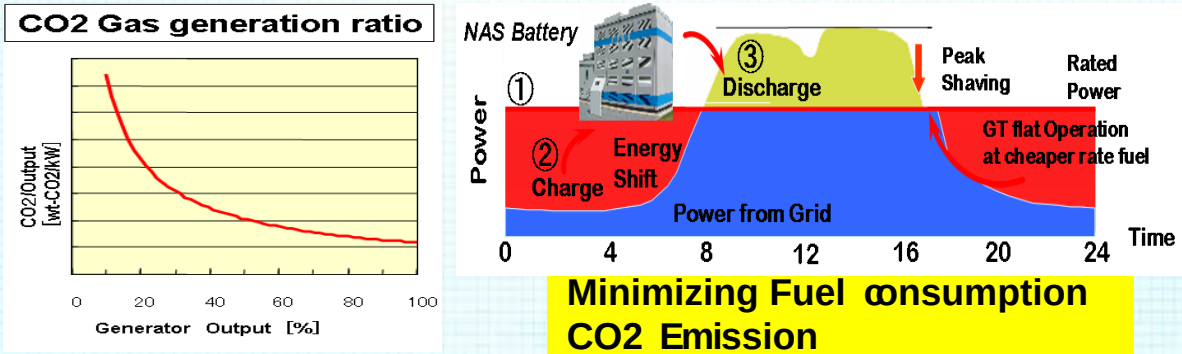
Response:10 seconds to 100%
Output : Up to 200MW

		UK	Europe (UCTE)	USA
Immediate Response		Frequency Reserve	Primary Control	**Regulation Control**
	Response Time	Continuous	Continuous	**Continuous**
Fast Response		**Fast Reserve**	**Secondary Control**	Spinning Reserve
	Response Time	**2 min**	**30 sec**	10 min
Standby Reserve		Short-Term Operating Reserve	Tertiary Control	Non-Spinning Reserve
	Response Time	20-240 min	15 min	10 min

Typical NAS Battery Application

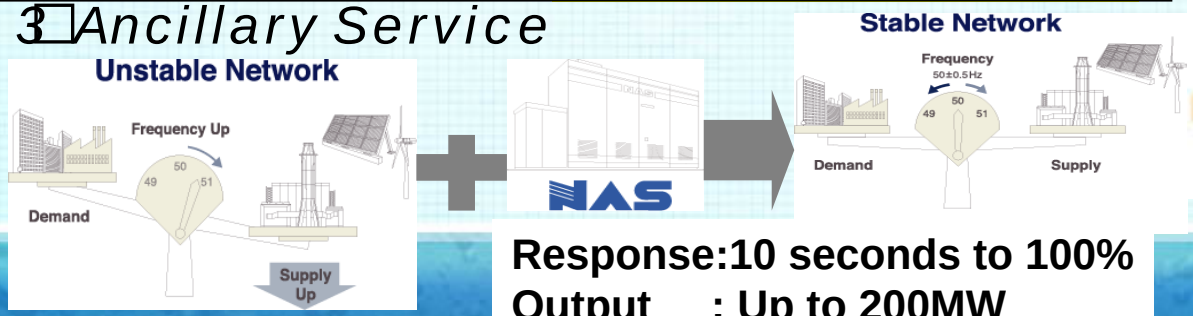
1 Stabilizing Intermittent Renewable Energy

2 Substation Application



Minimizing Fuel Consumption
CO2 Emission

3 Ancillary Service

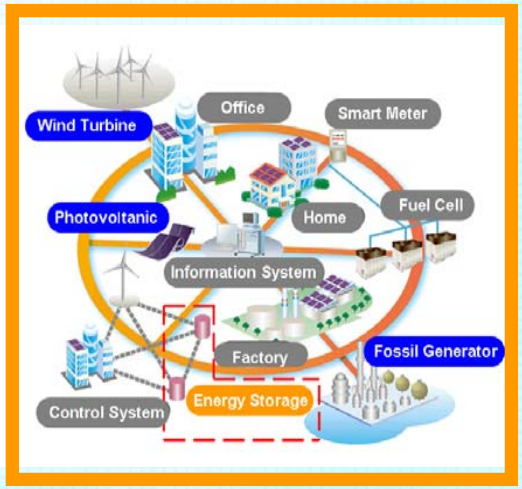


Response:10 seconds to 100%
Output : Up to 200MW

Smart Grid

Vital role for Smart Grid to stabilize all generation and grid system

MW Class Energy Storage System

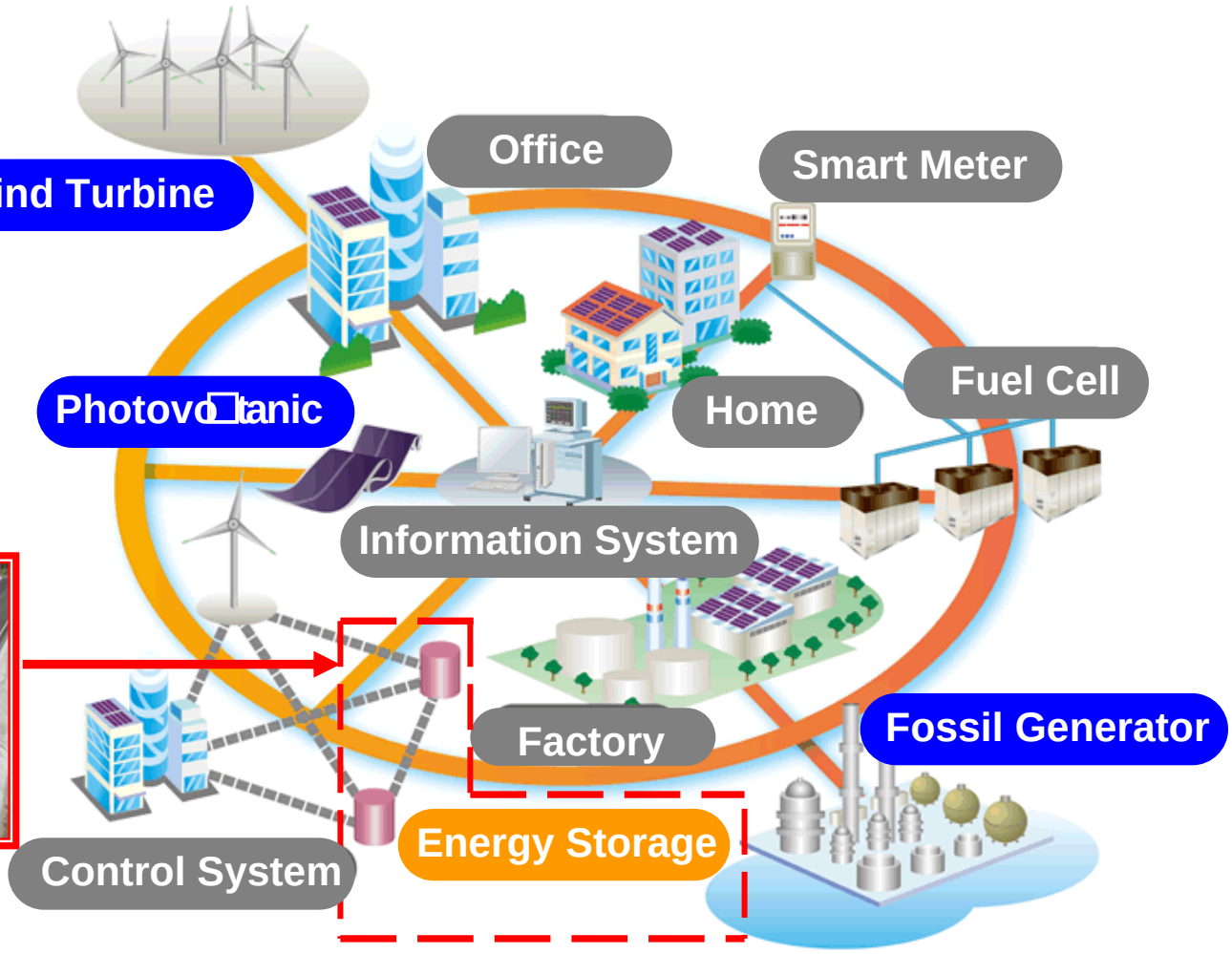


Application for SMART GRID

Smart Grid

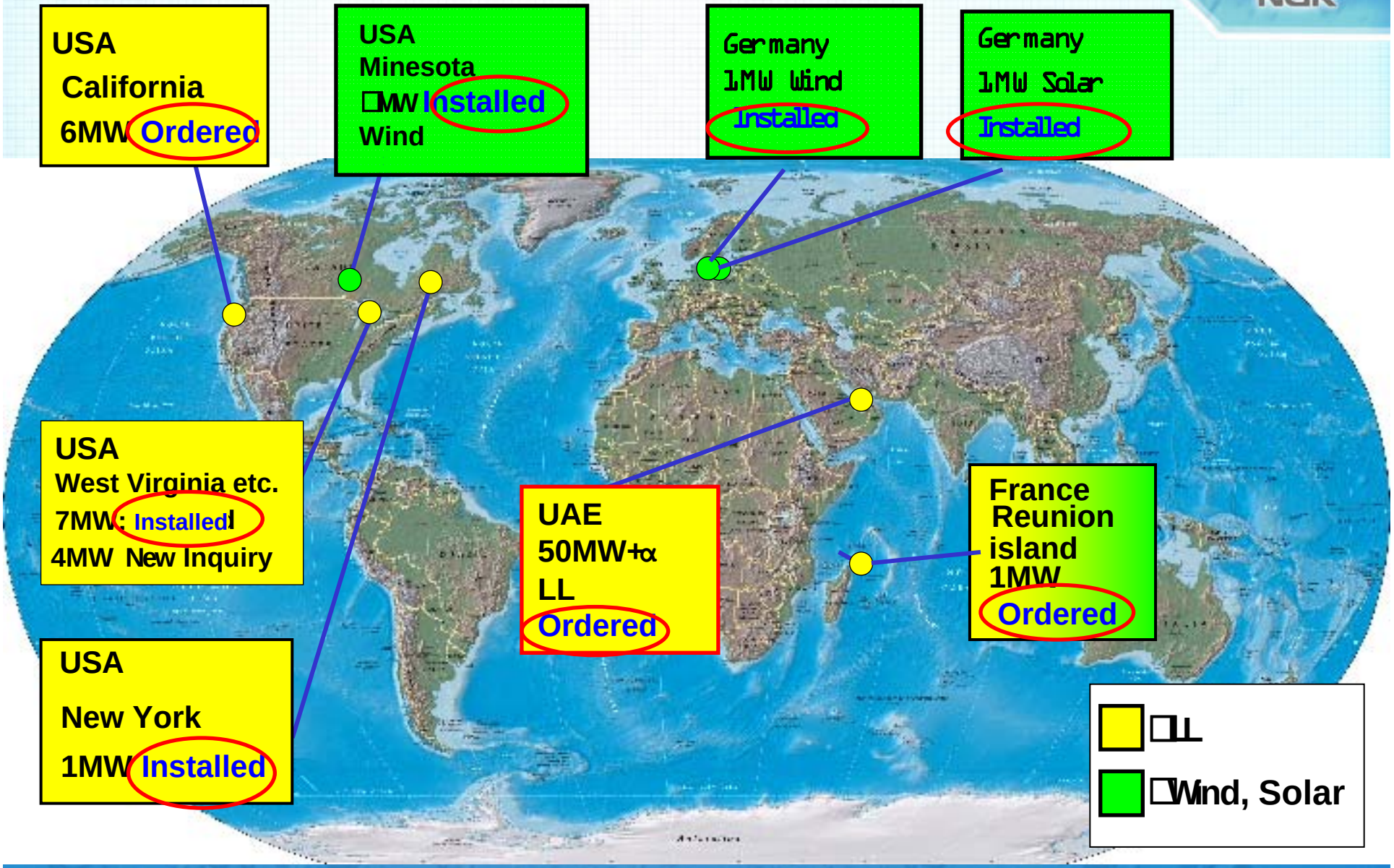
NAS system can have vital role for Smart Grid to stabilize all generation and grid system

MW Class Energy Storage System



Recent NAS Battery Business

< Installed or ordered Project >



Thank you very much!