NGK INSULATORS, LTD.

ENERGY STORAGE

NAS Sodium Sulfur Battery

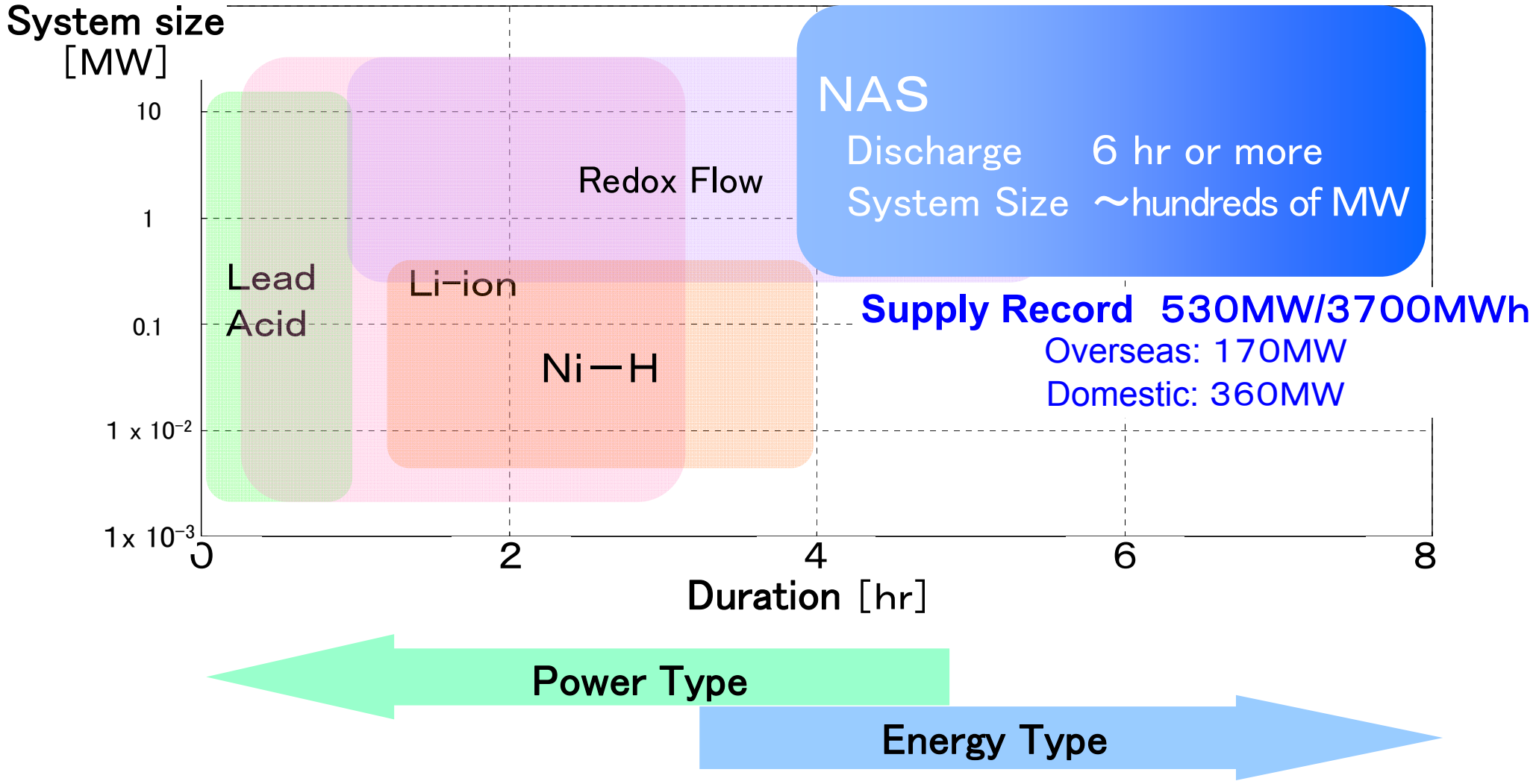
Sodium-Sulfur (NAS®) Battery

August 17 th , 2016

Comparison of Battery Technology

■ NAS battery is the most experienced and economical energy type battery.

（**Target cost of battery in 2020 is below ＄200/kWh** equal to pumped hydro supported by METI.）



Why Are Energy Type Batteries Required in India ?

Current Problems

- Shortage of generation capacity（kW/kWh）
  - Current Generation Capacity　300GW（PV + Wind 15%）
- CO_2 increase［environmental pollution］

Solution

- Introduction of huge amount of renewable energy
  - by 2022 Generation Capacity　470GW
    （**100GW PV + 70GW Wind 37%**）

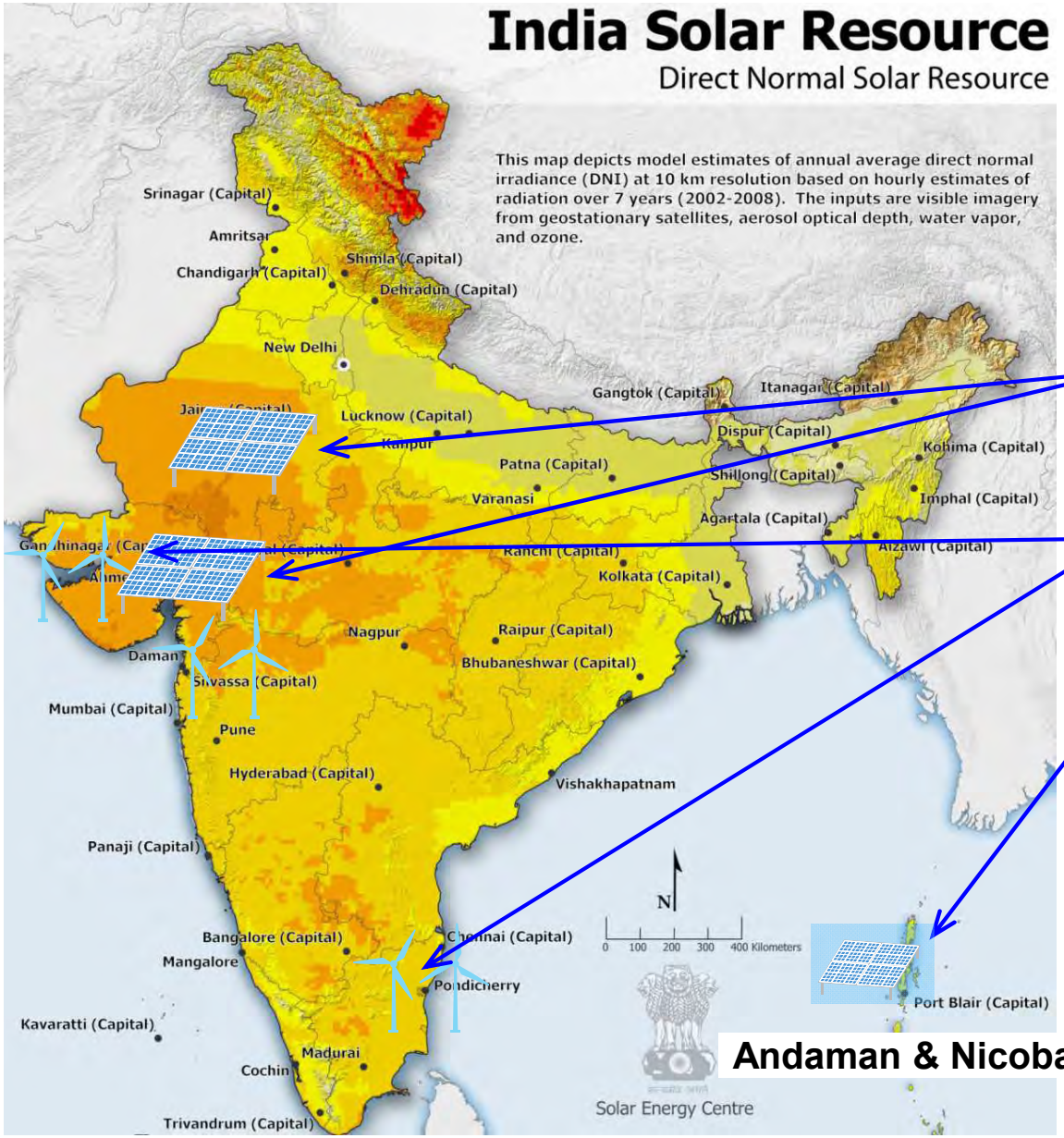
Upcoming Problems

- Difficult grid operation due to changes of climate conditions
  - Power（kW）　Unstable frequency
  - Energy（kWh）　Shortage of power supply at peak demand

Final Solution

- Energy Type Battery can solve all of them.

Overview of Future Potential Grid Problems in India



When huge PV is installed,
over-generation of PV will be anticipated.

When huge wind is installed,
imbalance of wind power will be anticipated.

When diesel generators are replaced with PV,
shortage of power during night
will be anticipated.

Source: http://sunrator.com/magazine/ntpc-plans-set-solar-project-battery-storage-andaman-nicobar/

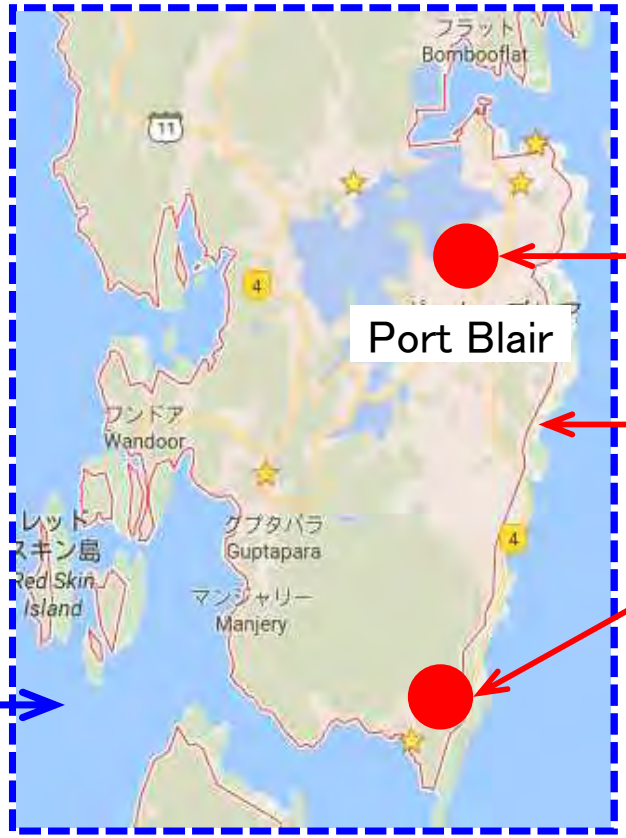
Source: http://mnre.gov.in/sec/solar-assmnt.htm

Plan of 100MW PV in Andaman & Nicobar Islands

- 100MW of PV will supply green energy but cause significant grid problems due to the limited grid capacity.
- **Energy type battery** is expected to play a vital role in solving the problems.

Andaman and Nicobar Islands

South Andaman



Kishore Nagar	30MW
Attam Pahar	20MW
Somewhere in South Andaman	32MW
Chidiya Tapu	18MW
Total	100MW

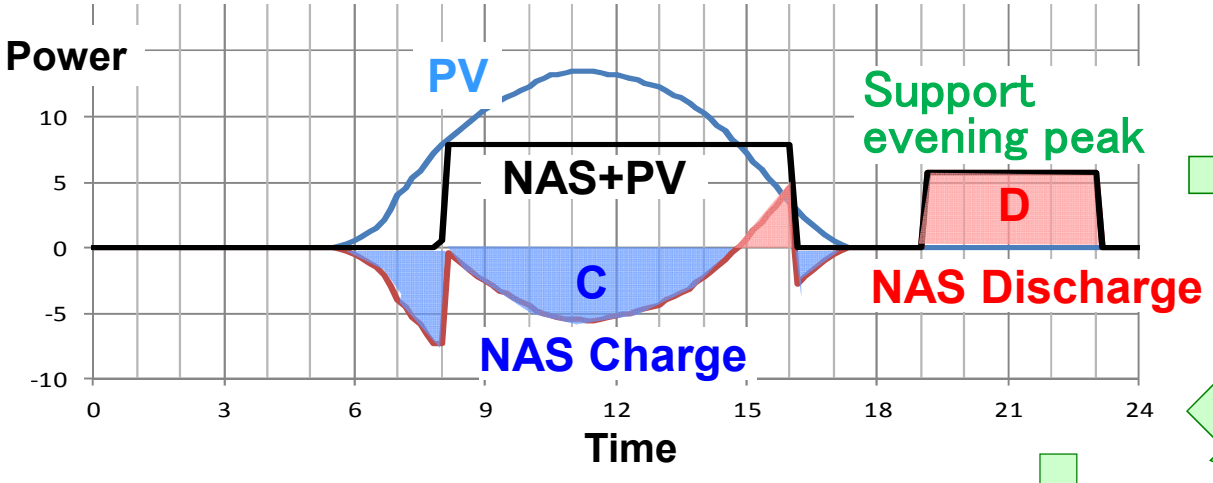
Source: http://taiyangnews.info/markets/50-mw-pv-for-andaman-nicobar/

NAS Battery Supports Evening Peak Demand in Island

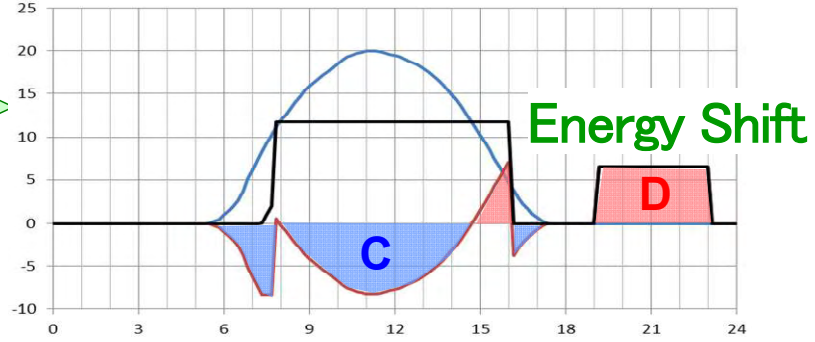
■ Supporting evening peak demand and stabilizing the grid can be achieved by suitable sized **energy type battery** under all the weather conditions.
（ **1/3 Power** against PV nominal, x **5～6hrs. Energy capacity** ）

[Simulated based on typical weather condition in an Indian island]

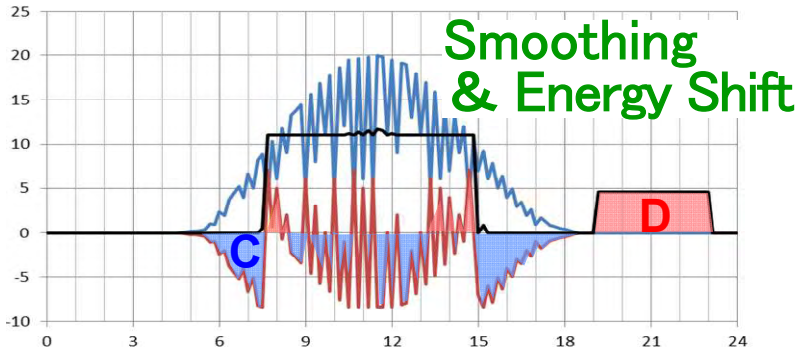
Annually average



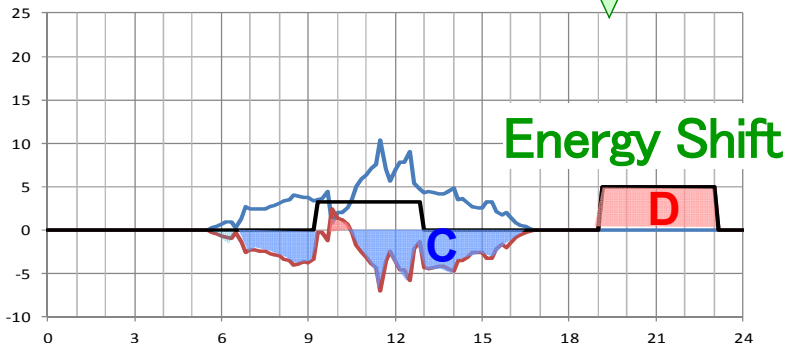
(1) Typical sunny days



(2) Typical cloudy days



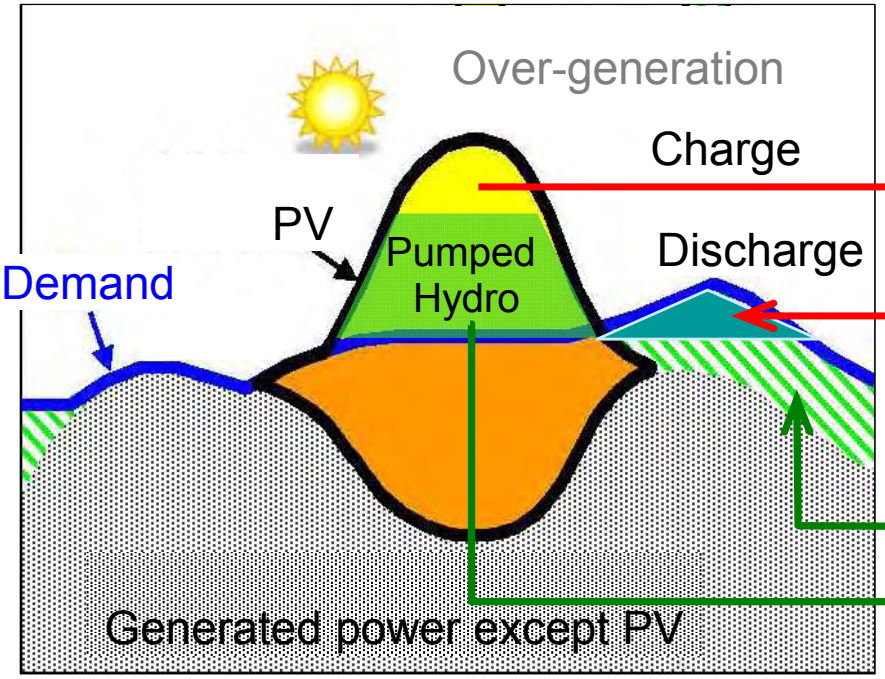
(3) Typical rainy days



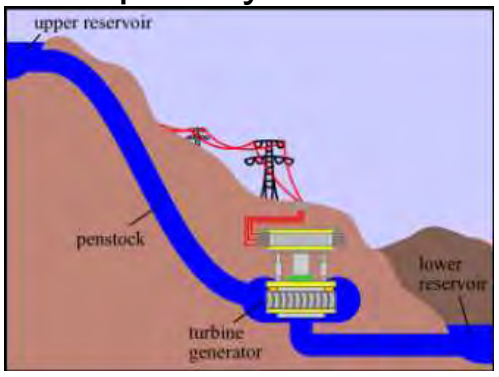
NAS Battery Solves Over-Generation of PV in Main Grid

- Huge Introduction of PV causes serious influences on system frequency and voltage.
- Imbalance of the supply and demand may lead to a **large scale blackout**.
- **NAS battery improves the supply-demand balance** of the power system by energy shift.

Buzen Battery Storage Project in Kyusyu, Japan
(Operation started from March 2016)
[Owner: Kyusyu Electric Power Company]



Pumped Hydro Station



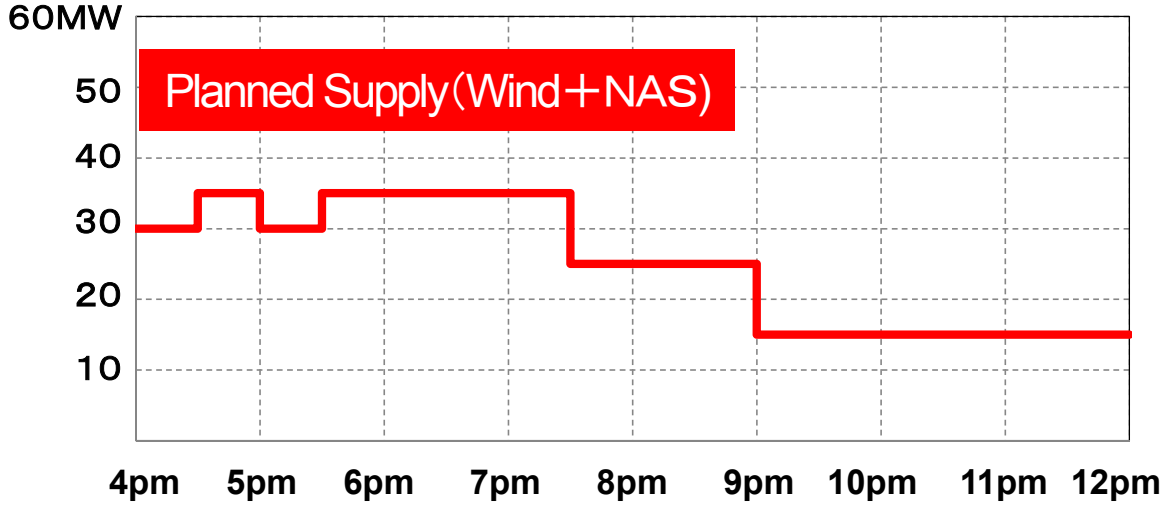
Discharge

Charge

NAS Battery Stabilizes Intermittent Wind Power

- Huge introduction of intermittent wind power causes **imbalance of supply and demand for 24h**, which needs more balancing generator.
- **NAS battery makes the wind power stable & schedulable**, more environmental friendly by load following and energy shift.

Futamata Wind Generating Station
Wind 51MW (1.5MW wind turbine × 34)



NAS Energy Storage System
34MW/224MWh (Operation started from 2008)

2MW per battery unit
× 17 battery units

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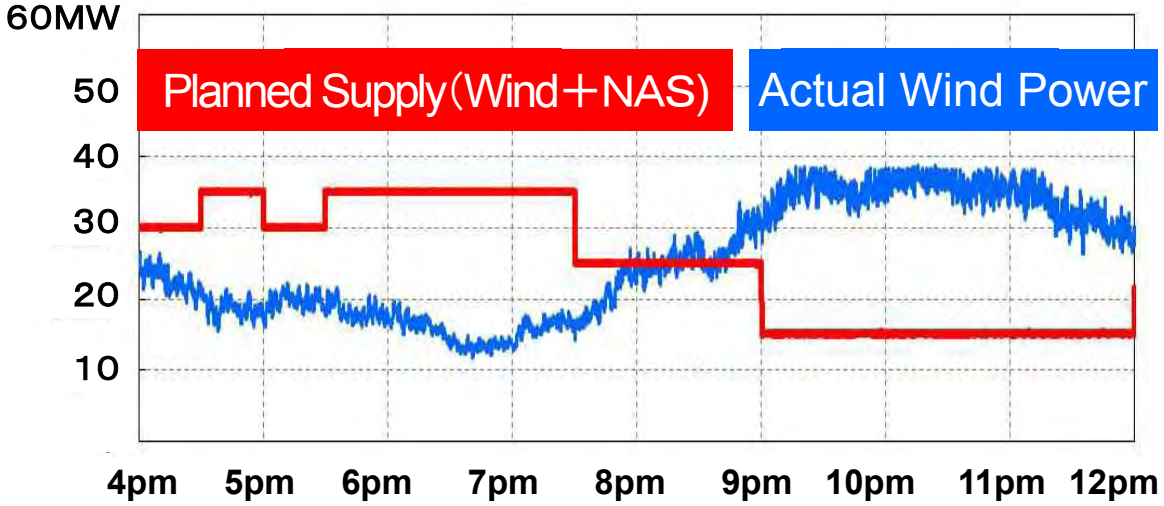

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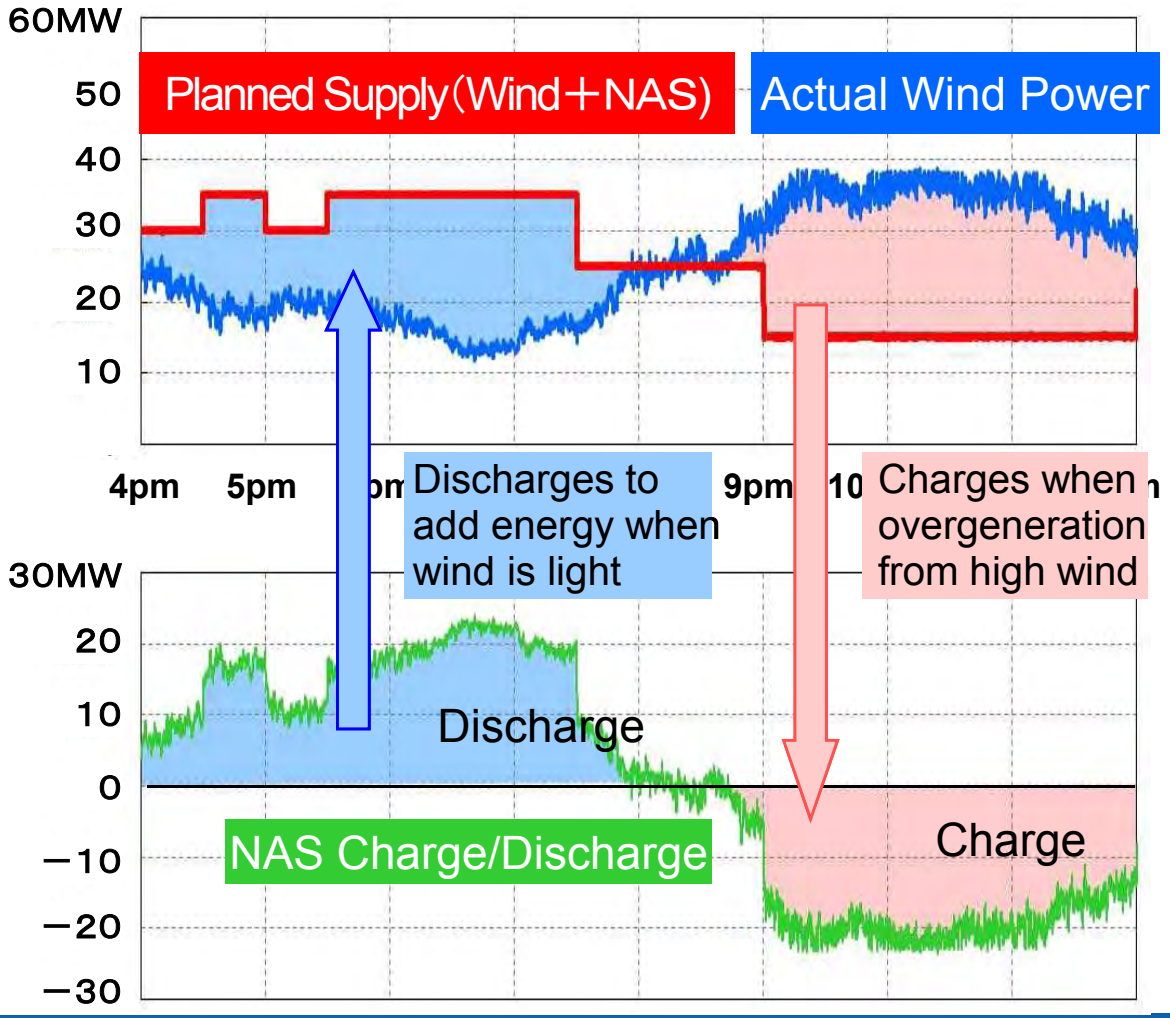

Conclusion

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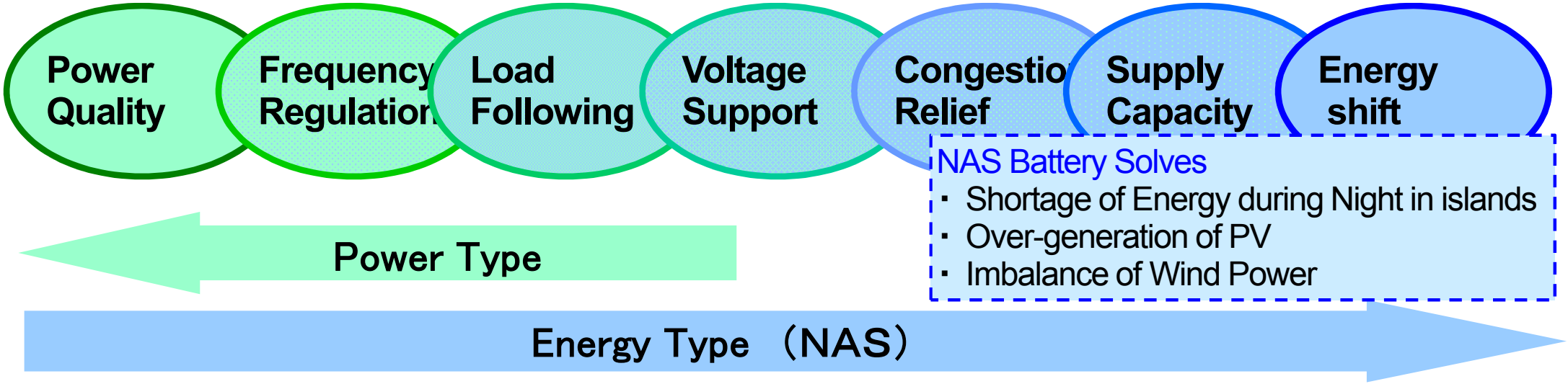
■ **NAS battery can provide effective solutions to any issues** due to huge introduction of renewable energy on transmission & distribution grids in India.



Recommendations:

1）Recognizing battery for grid application as an essential infrastructure for realizing introduction of further renewable energy and setting up a scheme to share the cost by people having the benefit.

2）Establishing regulation for grid operator to own battery.

Thank you for your time

END

URL : https://www.ngk.co.jp/nas/

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