



Expansionary Methods of Wind Installation

1. Impact of Wind Power
2. Expansionary method -- Generation Limit
3. Expansionary method – Batteries Installation
4. Expansionary method – Wind Power Forecast

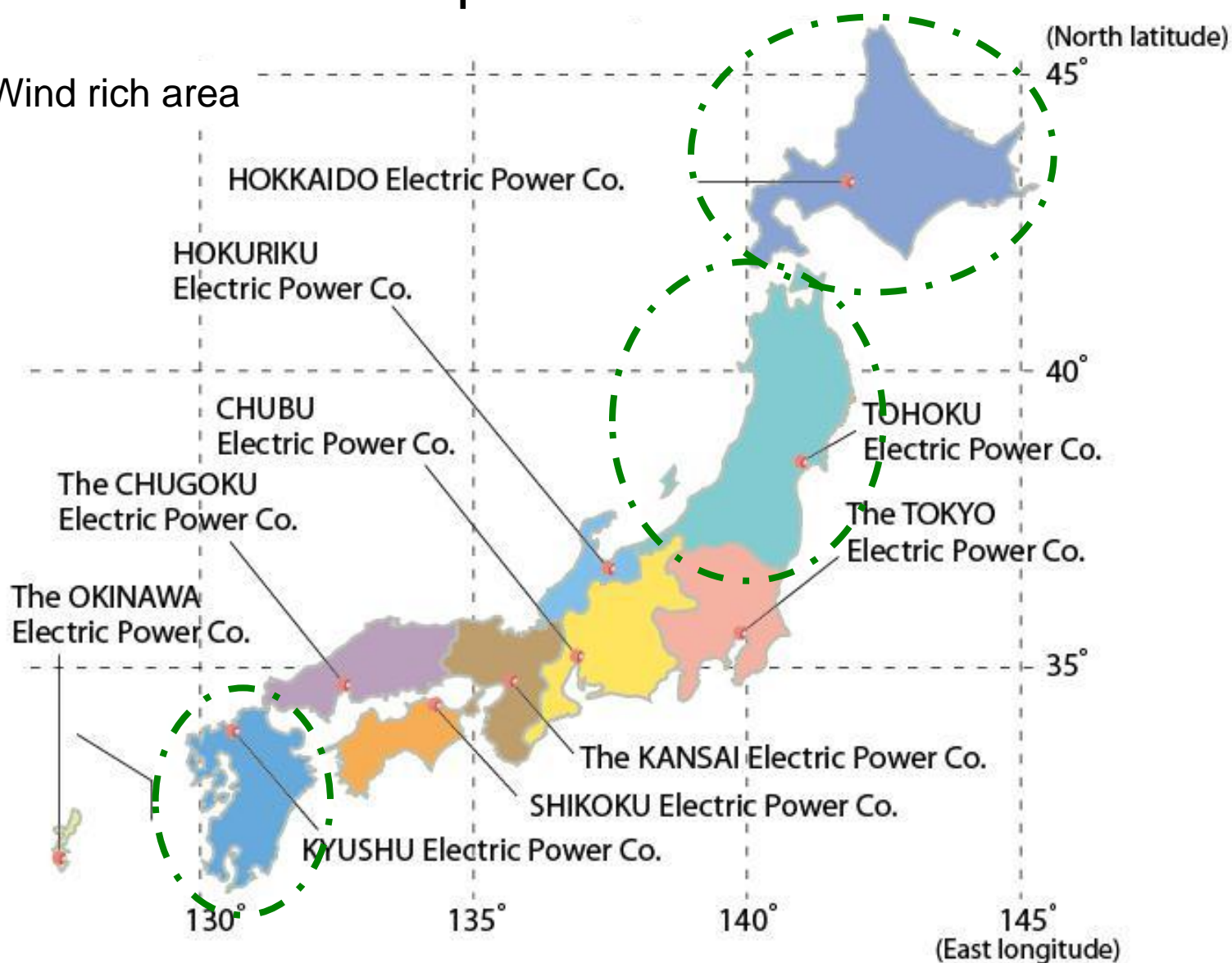
Sep 13, 2010

**MAKOTO TOYOMA
THE FEDERATION OF ELECTRIC POWER COMPANIES**

10 Electric Power Companies

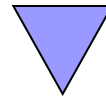


Wind rich area



Impact of Wind Power

- Generation power depends on wind situation
- There is no correlation between wind power and load
- Hard to forecast and intermittent



These features mainly result in 2 problems

- ❑ Lack of LFC(Load Frequency Control) ability
- ❑ Surplus Baseload Generation

Installation Limit for Wind power

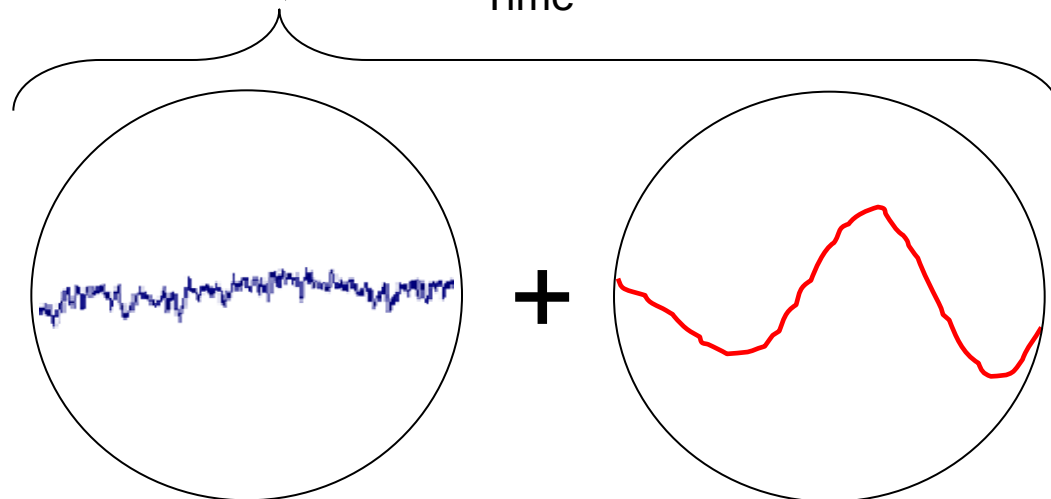
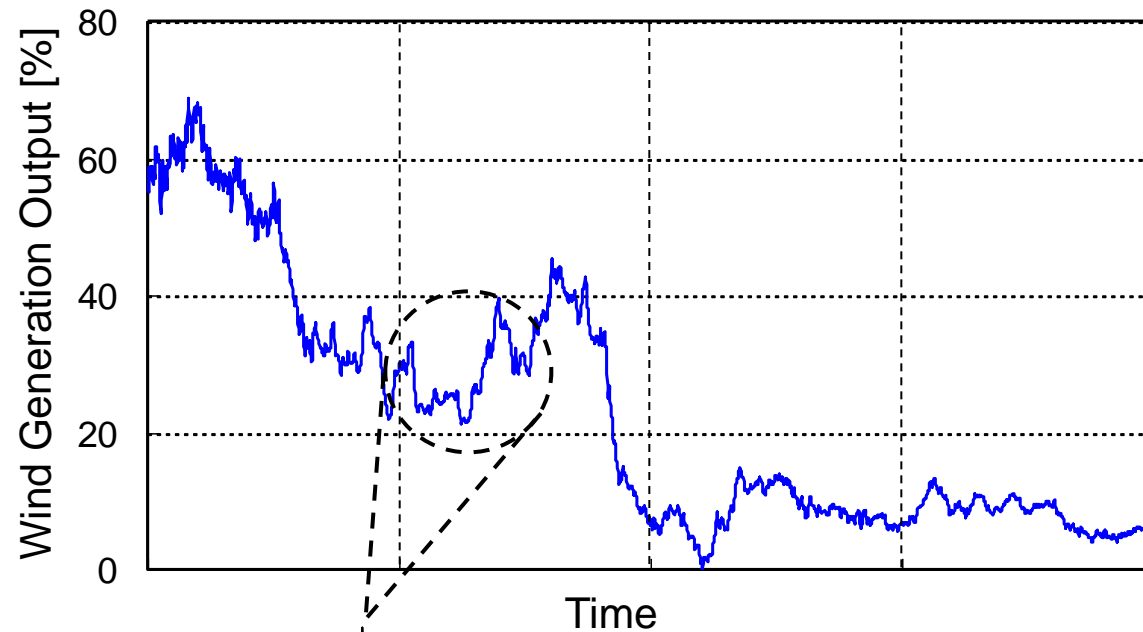
- Each utility must ensure balanced supply and demand.
- Windy areas are unevenly distributed and some areas have larger wind power capacity compared to their system.
- Strict rules are set in place for frequency and voltage.
- Difficulties in system reinforcement are caused by limitation of land use.

To ensure electricity quality, utilities limit installing wind power to gradual intervals and evaluate influence on the power system.

e.g.

- Utilities install a certain amount of capacity every year.
- Utilities limit total capacity until completing evaluation about limit enlargement.

Wind Generation Output Fluctuation



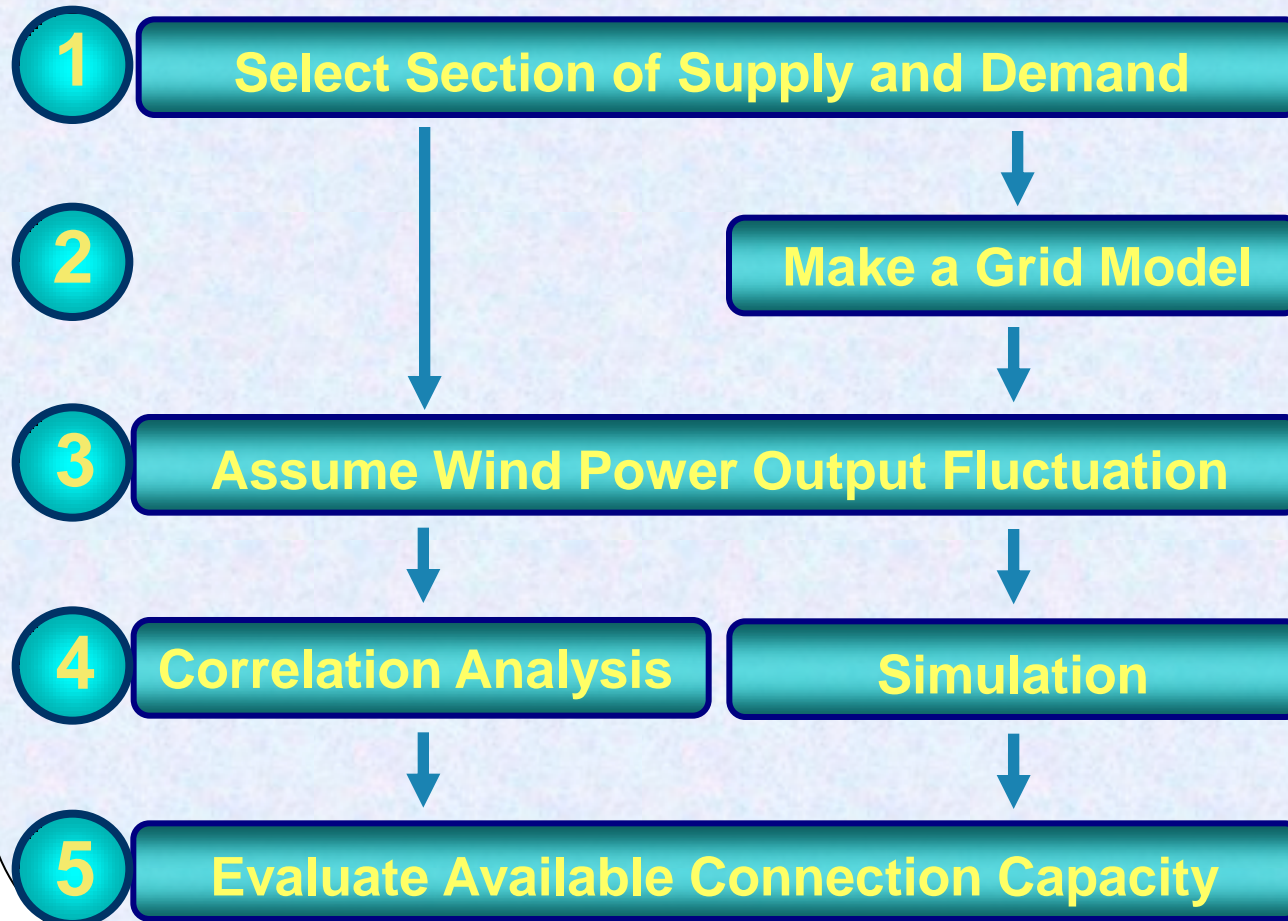
Short-term Fluctuation

Long-term Fluctuation

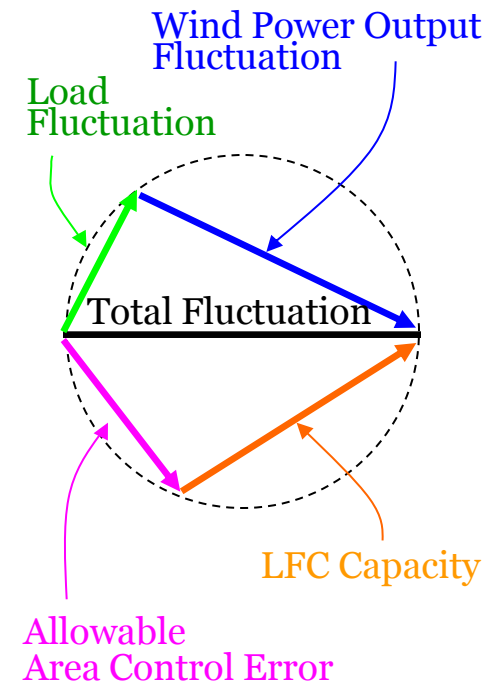
Short-term Fluctuation

Evaluation Flow

Algebraic Method or Simulation

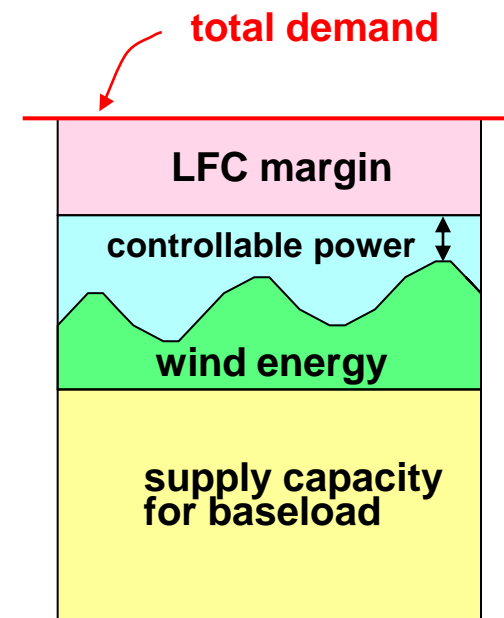
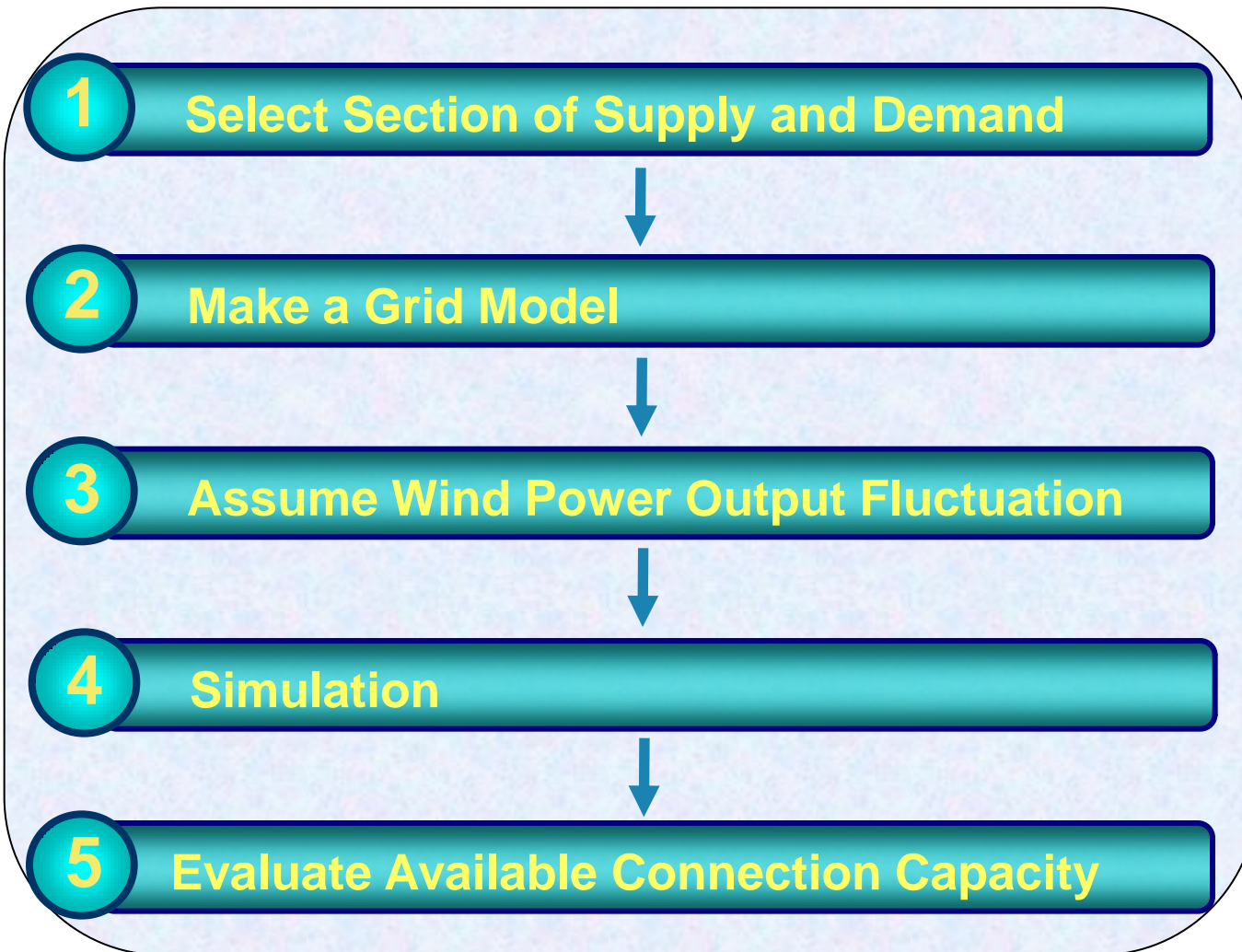


Algebraic Method



Long-term Fluctuation

Evaluation Flow



Available Connection Capacity in Japan

December 2007

Company	Available Capacity
HOKKAIDO	300MW ¹
TOHOKU	850MW ²
TOKYO	—
CHUBU	—
HOKURIKU	150MW
KANSAI	—
CHUGOKU	—
SHIKOKU	200MW
KYUSHU	700MW
OKINAWA	25MW

1: Including “ Generation-Limit-Type Capacity 50MW “

2: Including “ Battery-Installation-Type Capacity 330MW “

August 2010

Company	Available Capacity
HOKKAIDO	360MW ¹
TOHOKU	1 180MW ²
TOKYO	—
CHUBU	—
HOKURIKU	250MW ³
KANSAI	—
CHUGOKU	620MW
SHIKOKU	250MW ⁴
KYUSHU	1, 000MW
OKINAWA	25MW

1: Including “ Generation-Limit-Type Capacity 50MW “

2: Including “ Battery-Installation-Type Capacity 330MW “

3: Including “ Generation-Limit-Type Capacity 100MW “

4: Including “ Generation-Limit-Type Capacity 100MW “

Expansionary methods

In 2005, the National Sub-committee on Wind Power Installation Issues reported some expansionary methods aimed at installing wind power and while maintaining security of electricity.

Some proposed solutions

1. Generation limit
(e.g. separate wind power from grid for limited time)
2. Battery Installation
3. Wind power forecast

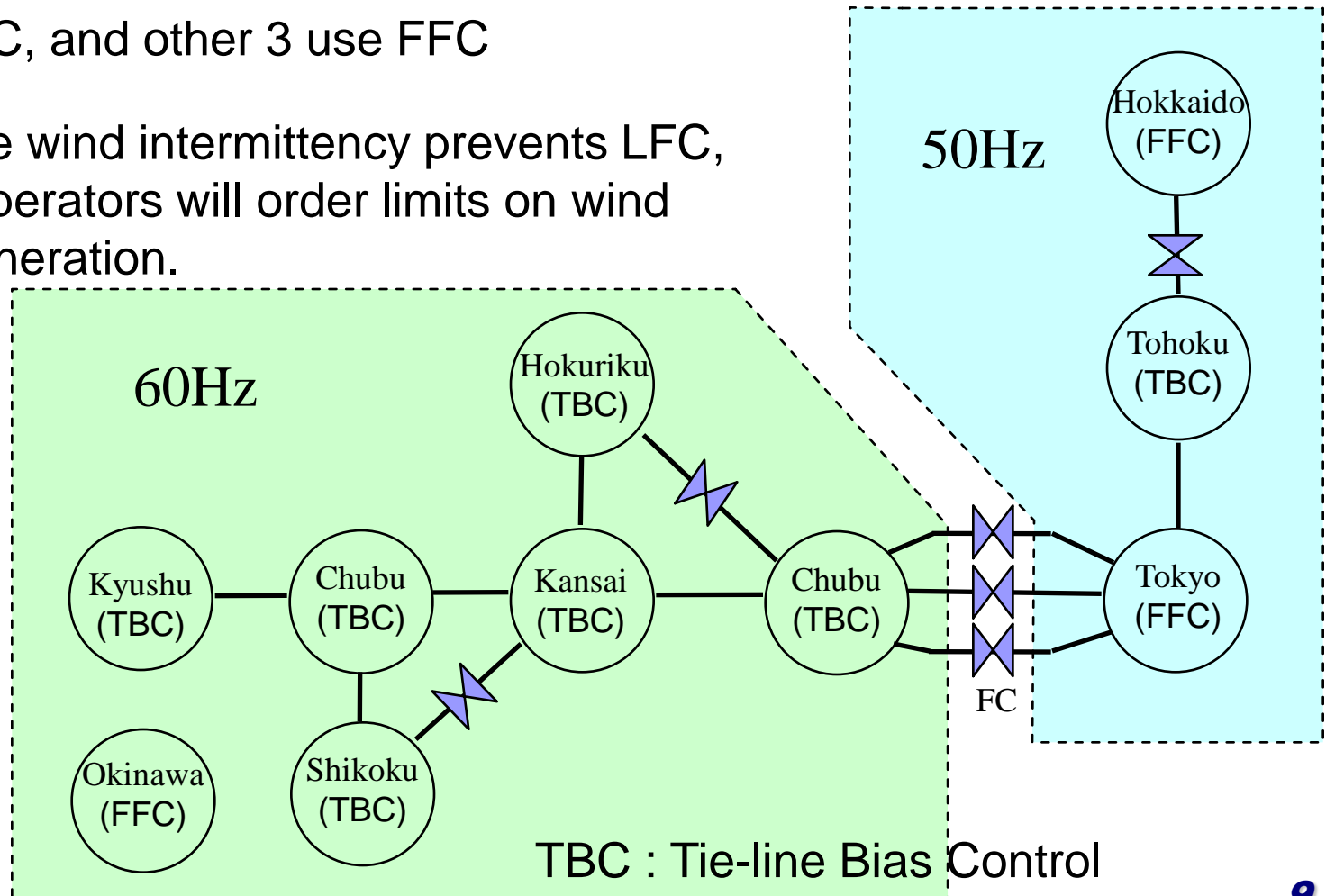


Generation limit case 1

There are 2 frequency control methods among the 10 utilities.

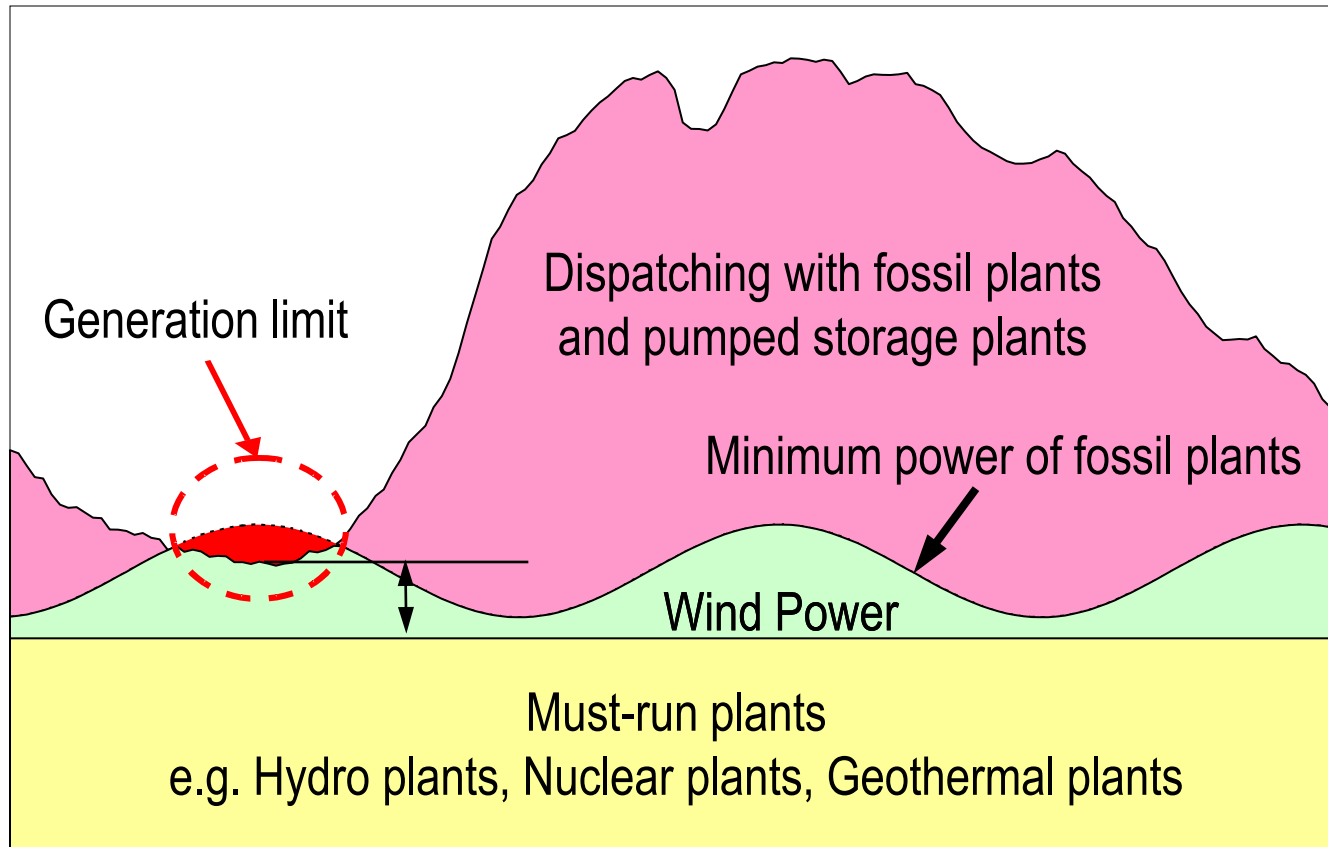
7 use TBC, and other 3 use FFC

If massive wind intermittency prevents LFC, system operators will order limits on wind power generation.



Generation limit case 2

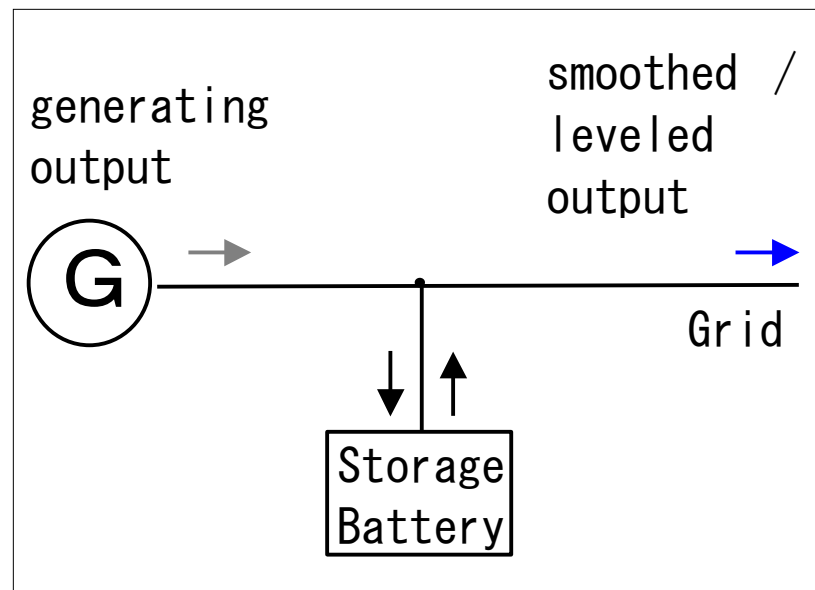
If surplus baseload generation is present, system operators will order limits on wind power generation.



Example of a Daily Load Curve

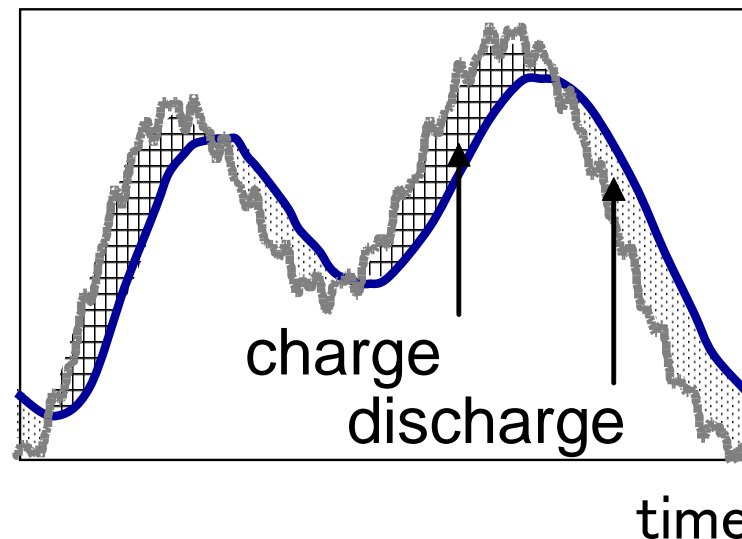
Battery Installation

1. To install more wind farms, storage batteries are effective for smoothing/leveling fluctuations.
2. Technology verification, improvement in cost-efficiency and development of governmental subsidies are necessary.
3. Limiting generation is less viable than installing batteries.



Smoothed Output Type Wind farm

- Small battery system smoothes wind power generation.
- The battery system charges generation if generation is larger than smoothed output. The system discharges output if generation is smaller than smoothed output.



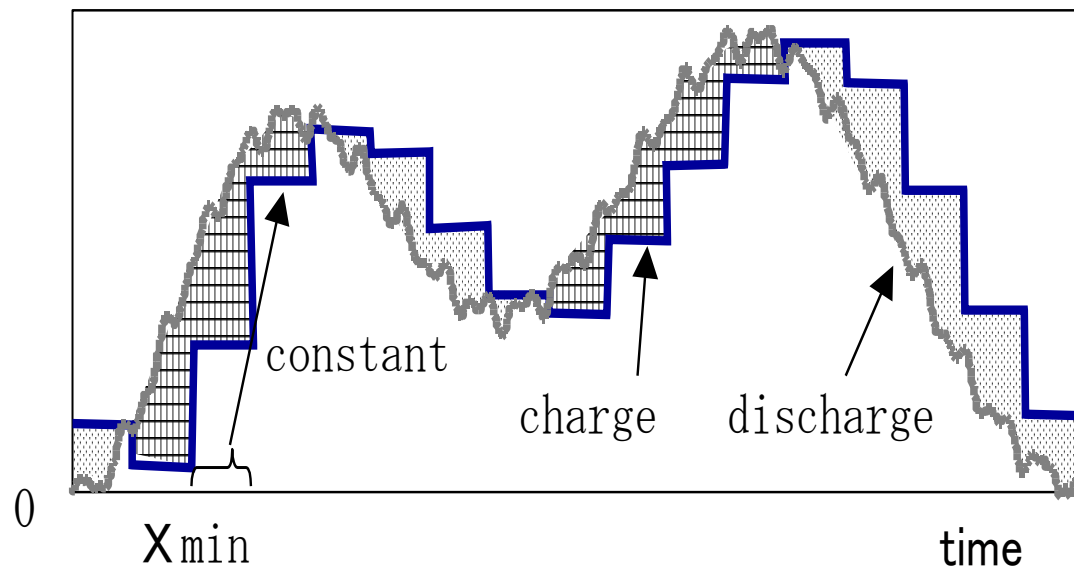
Example of Smoothed Output Type Wind farm

- 15MW Shiura windfarm is on technological verification process since Jan. 2010.
- Long life VRLA battery system (10.4MWh)
Valve Regulated Lead Acid battery



Leveled Output Type Wind farm

- Large battery system levels wind power generation.
- The battery system charges generation if generation is larger than scheduled output. The battery system discharges output if generation is smaller than scheduled output.



Example of Leveled Output Type Wind farm

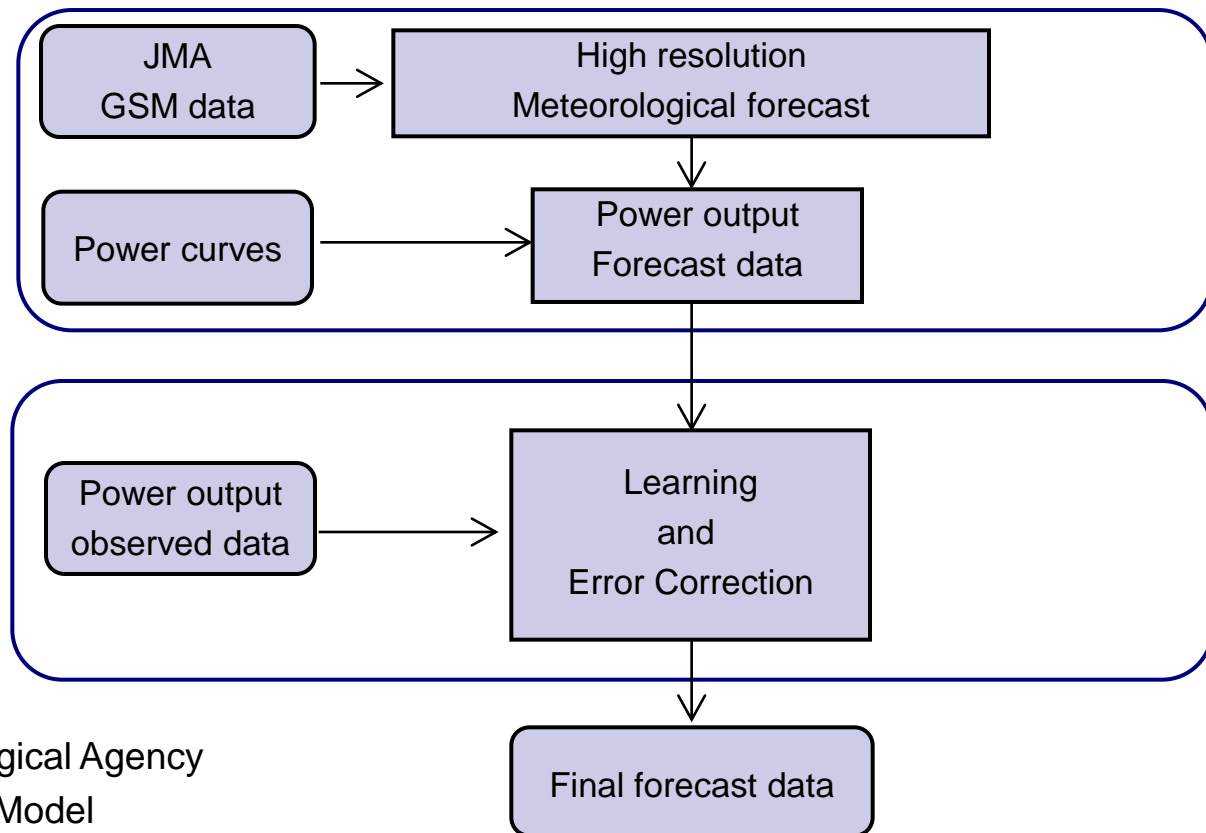
- 51MW Futamata wind farm completed technological verification process last summer and now in commercial operation.
- Sodium-sulfur battery system (245MWh)
- Wind power forecast helps scheduled generation



Wind Power Forecast

- Wind power forecasting technology is important for leveled output type wind farm

General Schematic Diagram of Wind Power Forecasting System



JMA: Japan Meteorological Agency

GSM: Global Spectral Model

Example of a wind power forecasting system

CTC Wind Power Forecasting System

■二又風力発電所
 振替
 当日・翌日予測
 週間予測
 風況急変値設定

■気象情報

天気概況
 今日・明日の天気
 週間天気予報
 天気図
 気象衛星画像
 降水情報
 アメダス実況
 専門天気図
 注意報・警報
 台風情報
 地震情報

■システム情報

情報内容
 お問い合わせ

■当日・翌日予測

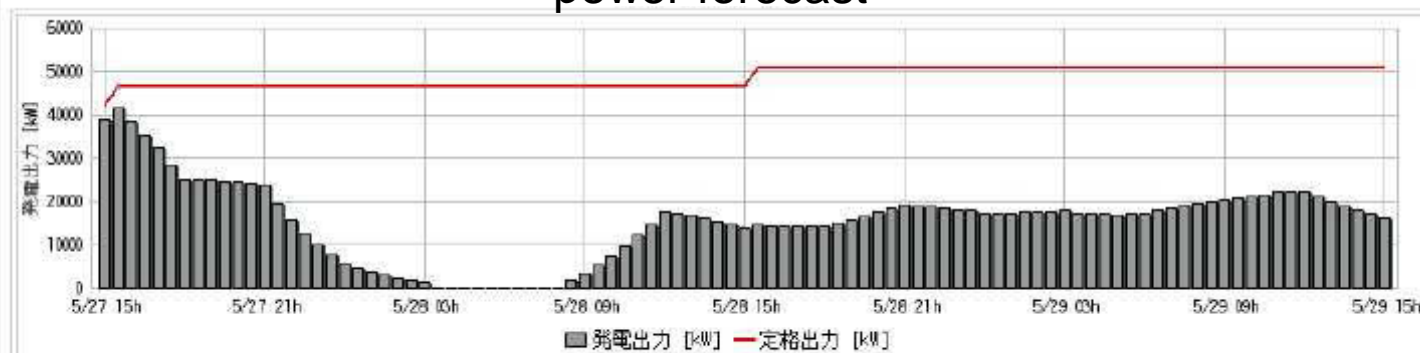
発電機 WF

予測発表時刻

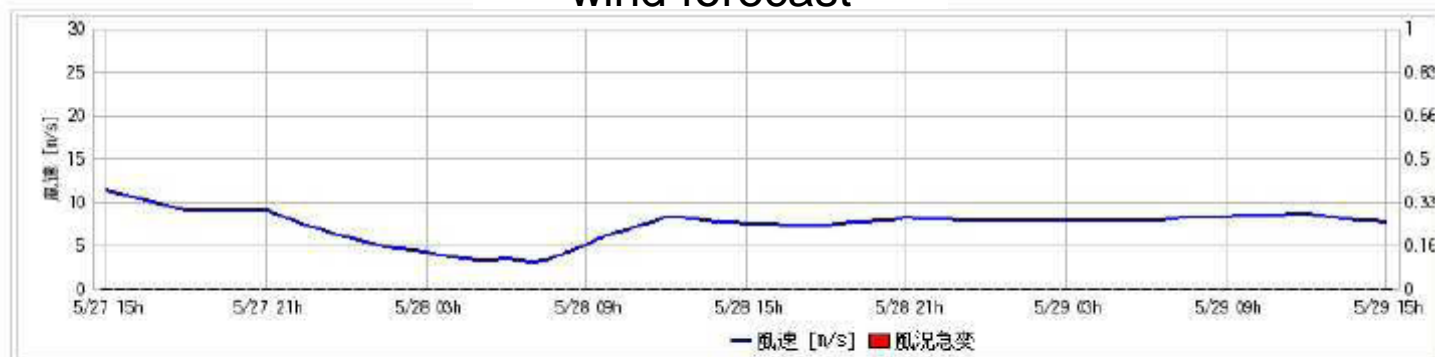
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発電機選択

power forecast



wind forecast



風向予測時系列図

Thank you for your listening

