

# Overview of Wind Power Generation (JAPAN)

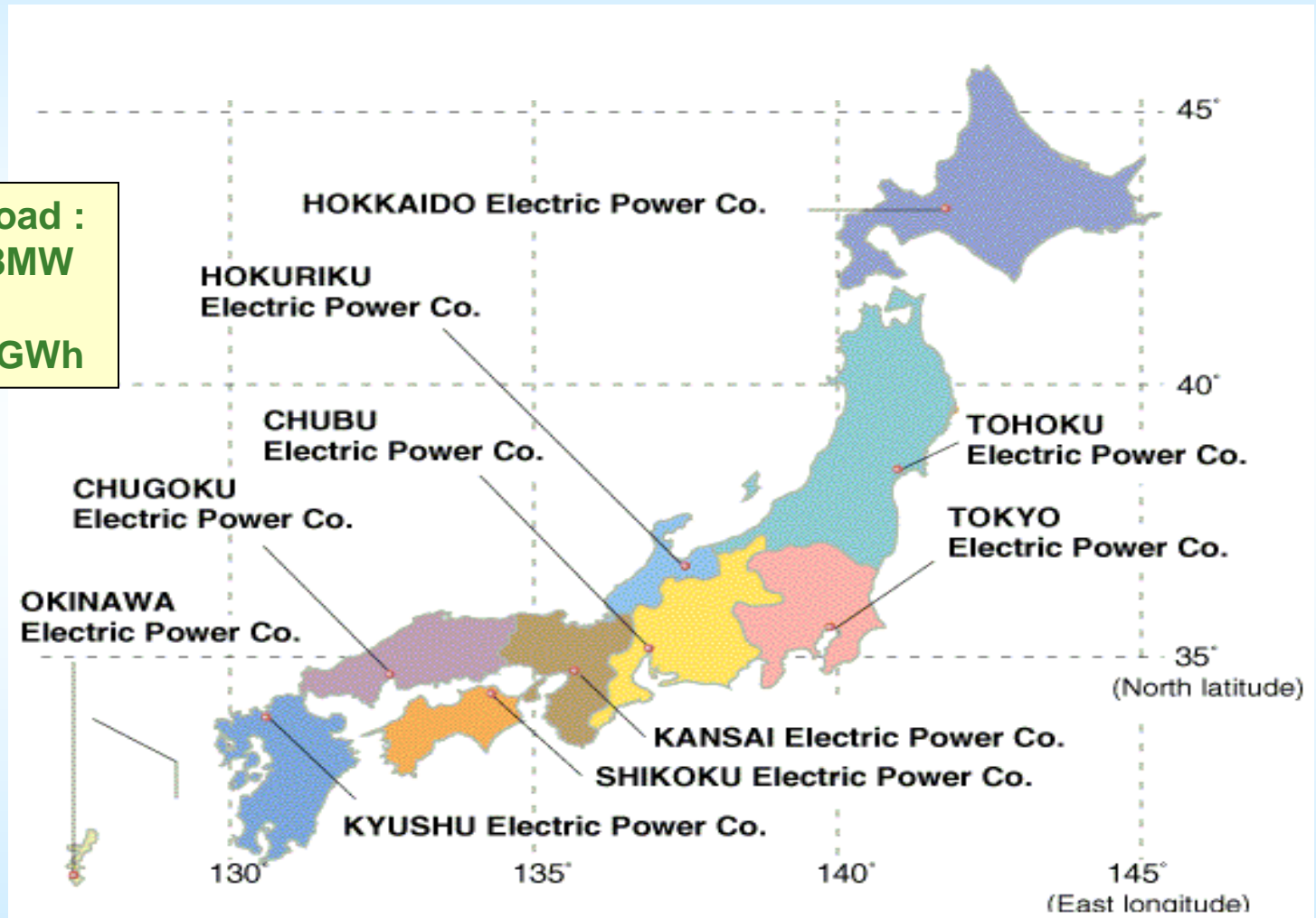
September 2010

MOTOKI UEZU  
THE FEDERATION OF ELECTRIC POWER COMPANIES

# 10 Electric Power Companies

(FY2009)

**System peak load :  
159,128MW**  
**Power sales:  
858,516GWh**



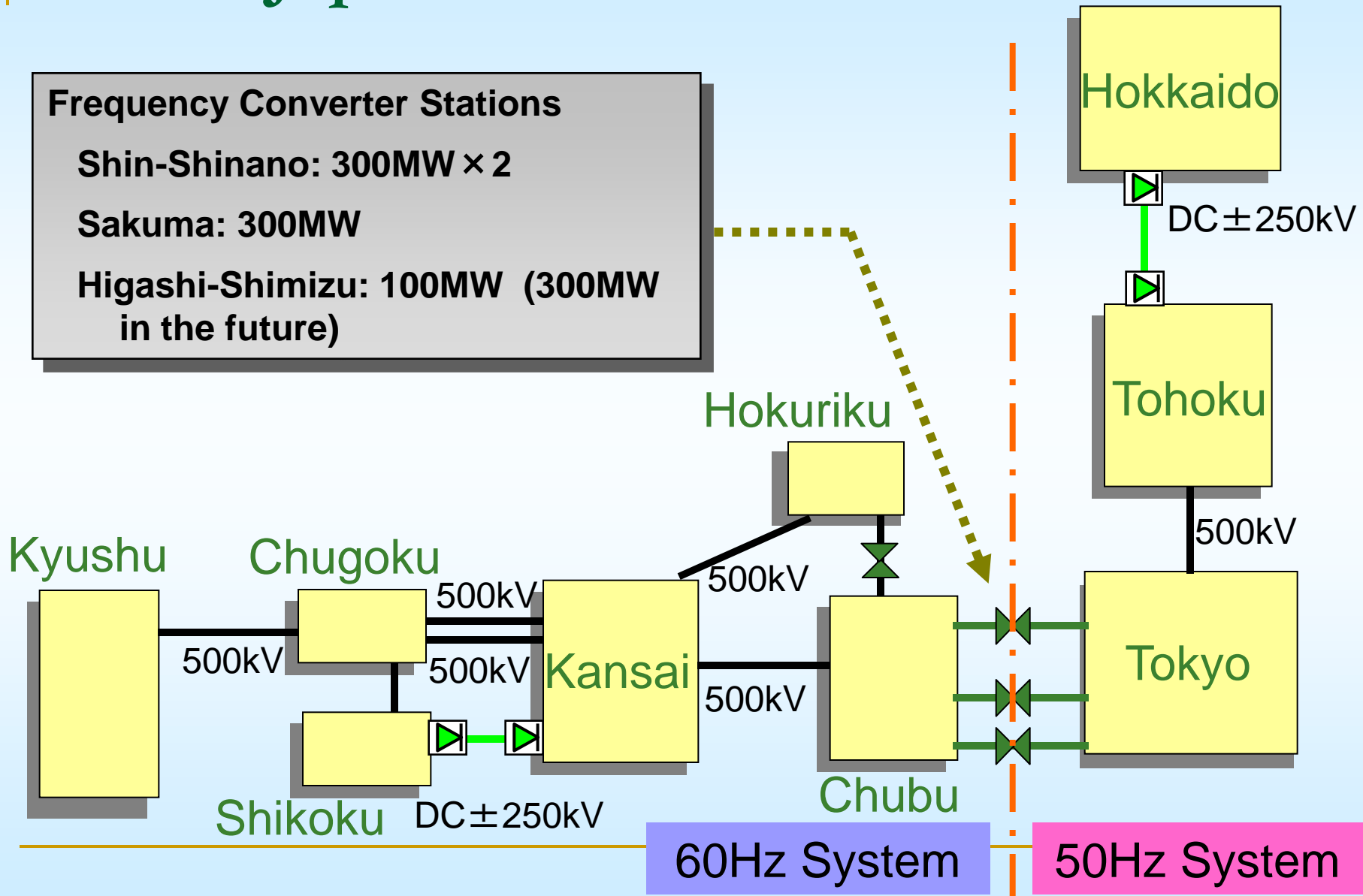
# Grid in Japan

## Frequency Converter Stations

Shin-Shinano:  $300\text{MW} \times 2$

Sakuma:  $300\text{MW}$

Higashi-Shimizu:  $100\text{MW}$  ( $300\text{MW}$  in the future)



# Outline of Power Facilities in Japan

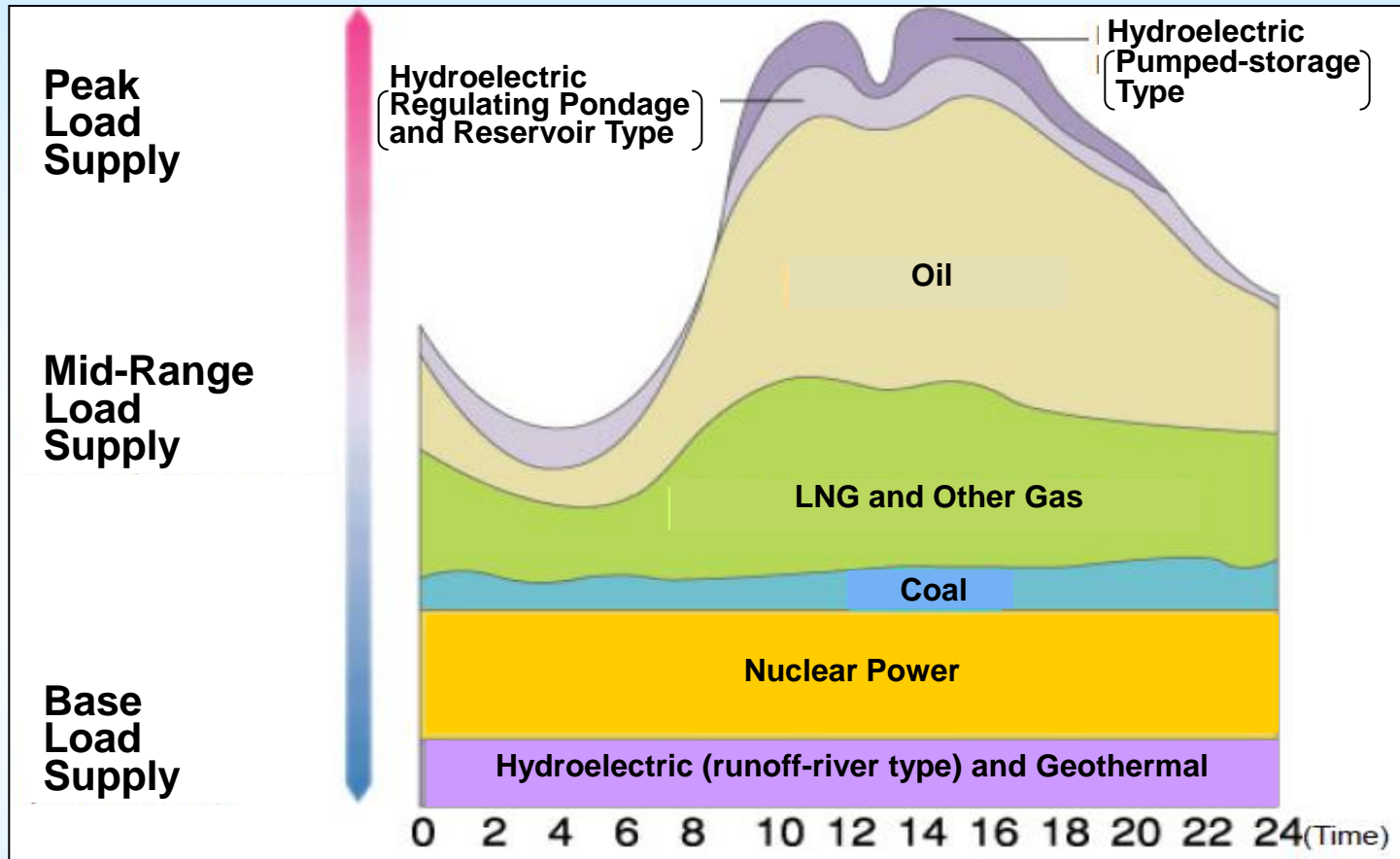
## ◇Power Plants (10 Electric Power Companies)

<Number of Plants>Installed Capacity (MW)>

Hydroelectric	1,162	34,888	(17.2%)
Geothermal	11	485	(0.2%)
Thermal			
Steam Power	83	120,083	(59.4%)
Gas Turbine	9	656	(0.3%)
Internal Combustion	68	743	(0.4%)
(Total)	160	121,482	(60.1%)
Nuclear Power	15	45,318	(22.4%)
Wind Power	4	-	(-)
Solar Cell Power	1	-	(-)
Total	1,353	202,177	(100%)

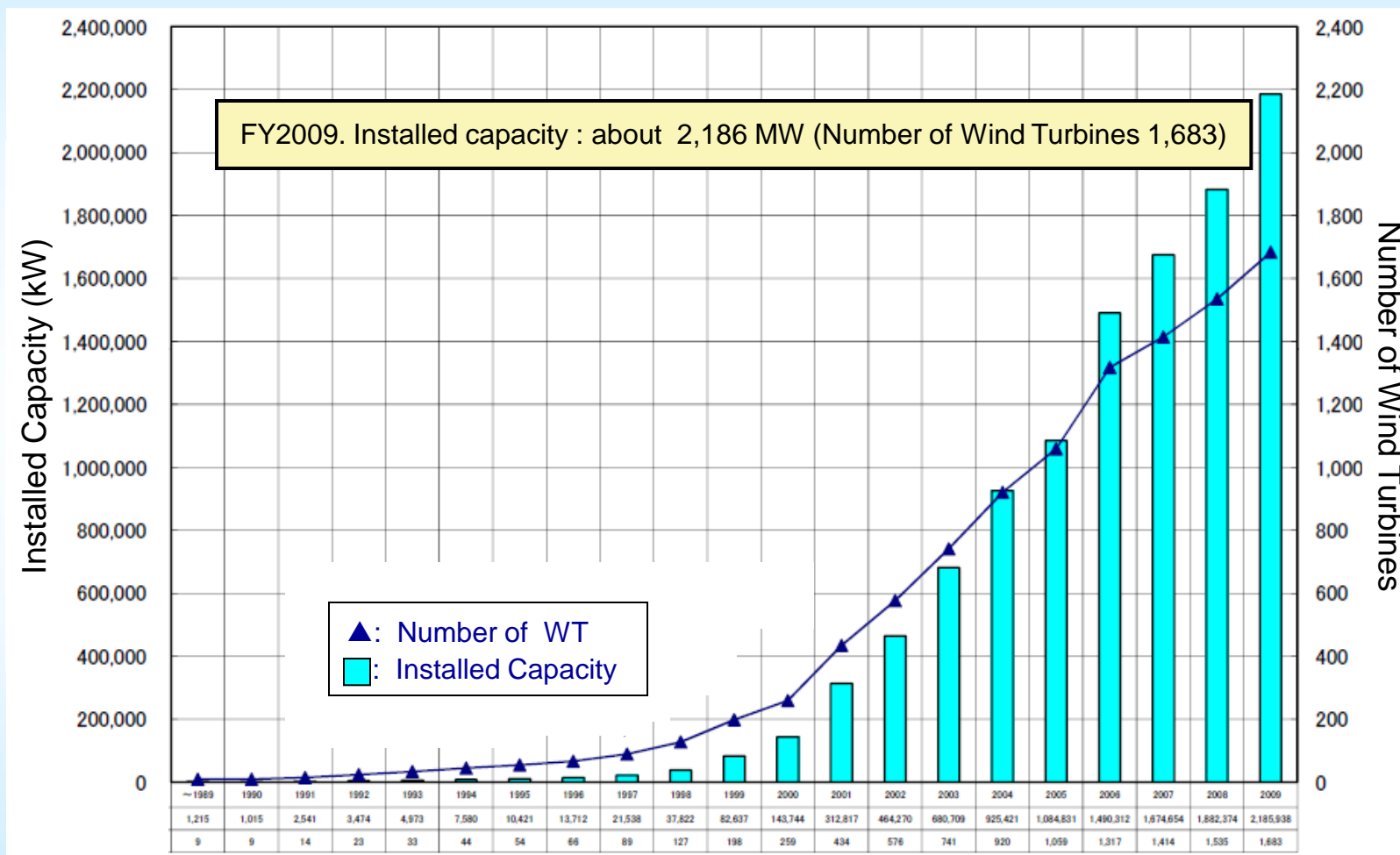


# (Example) Combination of Power Sources



Hydroelectric and nuclear power provide base load supply, while coal and LNG are major power sources for mid-range load supply. Oil-fired and pumped-storage hydroelectric power respond to peak demand variation and contribute to consistent stable supply of electricity.

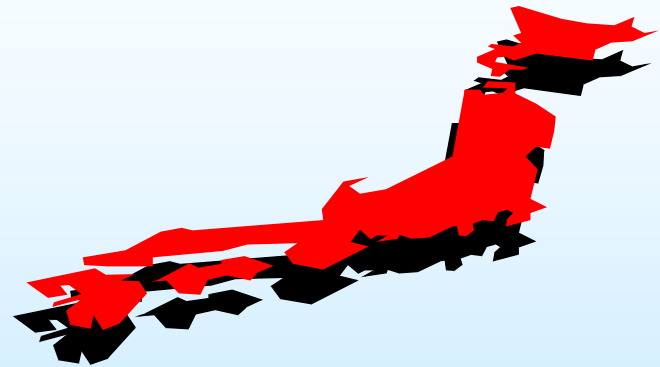
# Changes in Cumulative Installation of Wind Power Generation



(source: <http://www.nedo.go.jp>)

# Many Challenges in Japan

- Typhoon
- Lightning
- Earthquakes
- Noise Pollution
- Bird Strike
- Small Space
- Distribution Voltage
- Available Connection Capacity
- Available Transmission Capacity
- Turbulence (Complex Terrain)



# Typhoon Strike

## Typhoon #14

**Date: 11.September.2003**

**Location: Miyako Island. Okinawa Prefecture**

**Maximum Instantaneous Wind Speed: 74.1m/s**



## Tiltable Wind Turbine

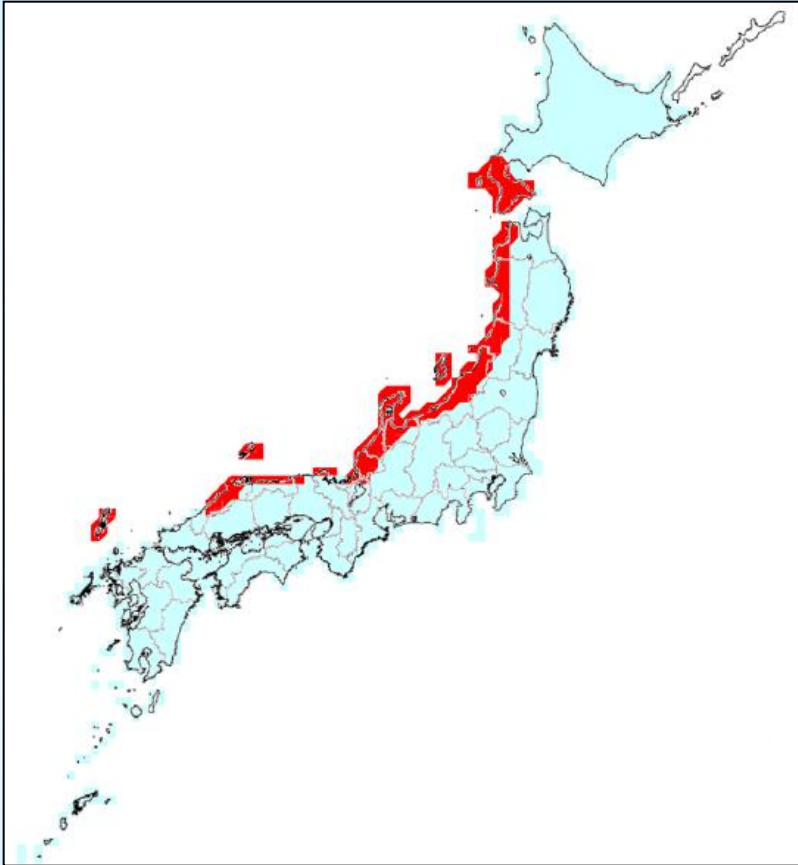
**Location : Hateruma Island. Okinawa prefecture**

### 【 Feature】

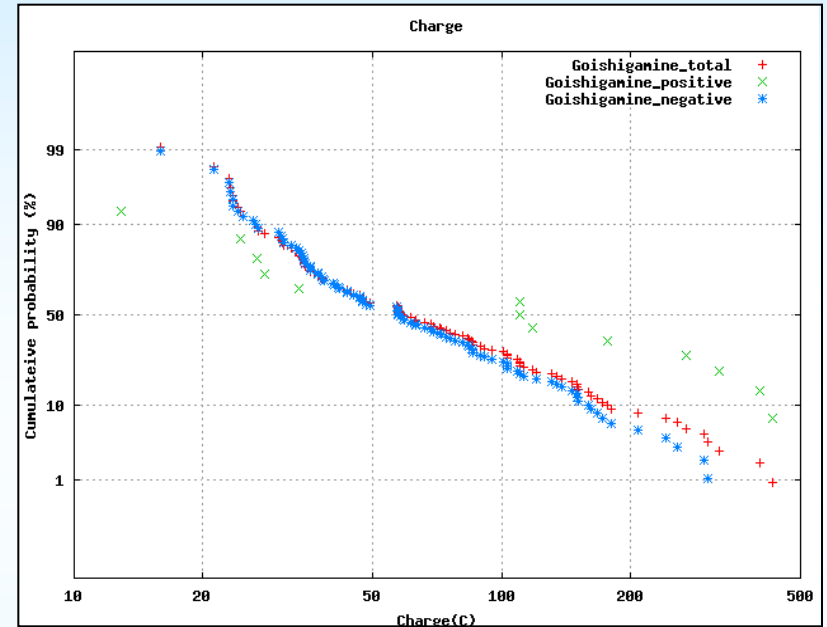
- It is possible to tilt the wind turbine to avert damage by the strong wind.
- Ground-level maintenance

(source: Okinawa Electric Power Company)

# Lightning Strike



**High Risk Area of Lightning Strikes**



**Cumulative frequency distribution of charge**

**Location: Goishigamine Wind Power Station**

**Observation period: 2004~2006**

**Result: 110 Lightning Strikes.**

**3.6% of Lightning strikes were over 300 coulombs.**

# Regulations Revision

- Technical standards had required that “wind power installations must be safe against wind pressure”, but without any clear description of what wind pressure to assume. This has been clarified to consider “extreme wind speed” and “turbulence”.
- There had not been any requirement for lightning protection, but the revised standards require wind power owners to take additional measures such as equipping receptors.

# Japanese Wind Power Generation Guidelines

In consideration of Japanese wind conditions and lightning strikes, “Japanese Wind Power Generation Guidelines” have been established.

Described as follows

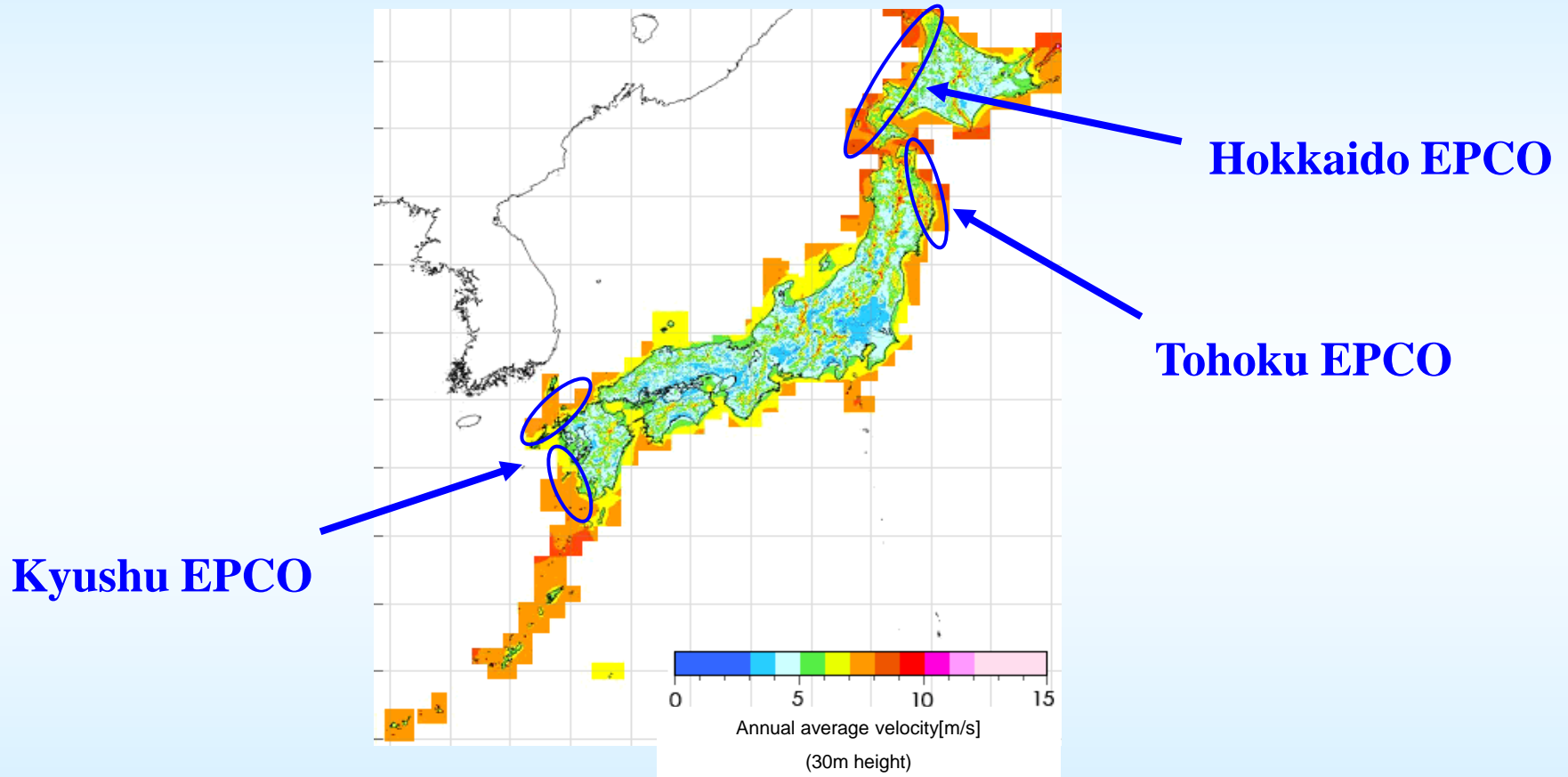
## 【Volume: Typhoon・Turbulence Measures】

- Method of understanding the assumed wind conditions
- Selection Procedure of Wind Turbine
- Useful Technical Information etc.

## 【Volume: Lightning Measures】

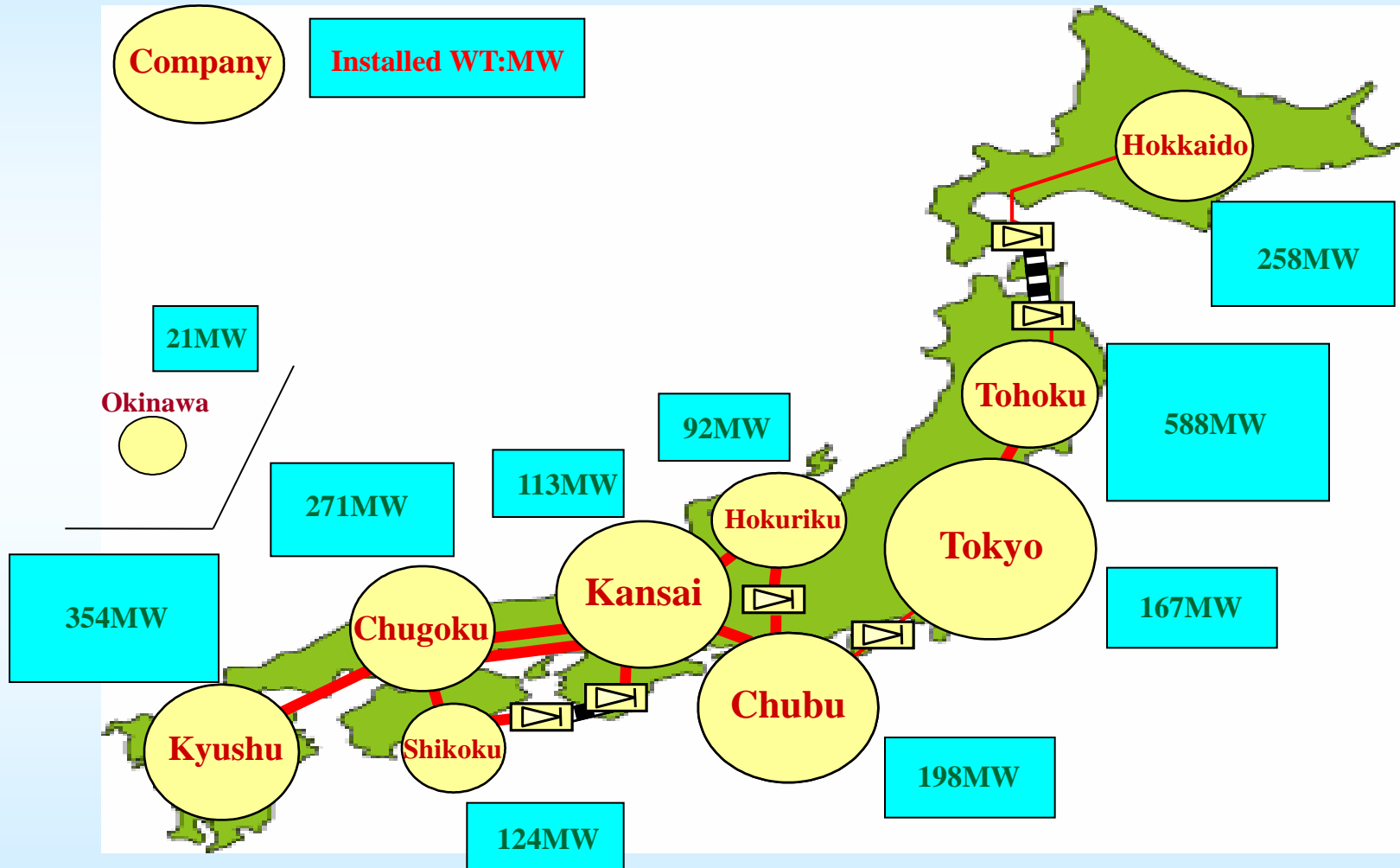
- Effective Lightning Protection System
- High Risk Area Map etc.

# Annual Average Velocity in Japan



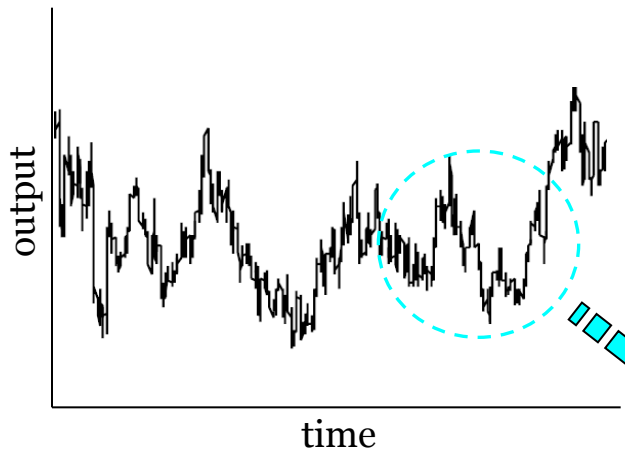
# Uneven distribution of Wind Power

(March 2010)



# Evaluation of Available Connection Capacity

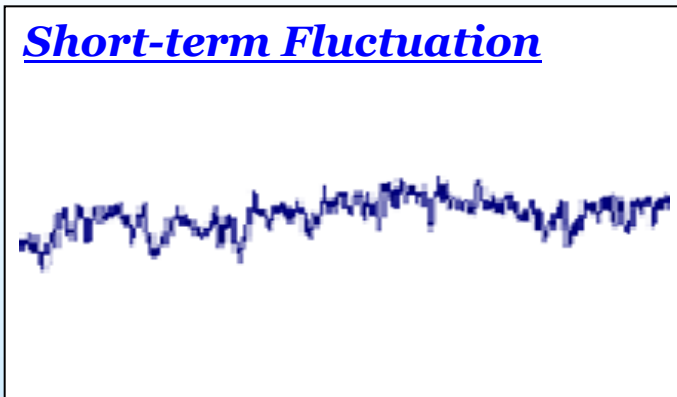
## Wind Power Output



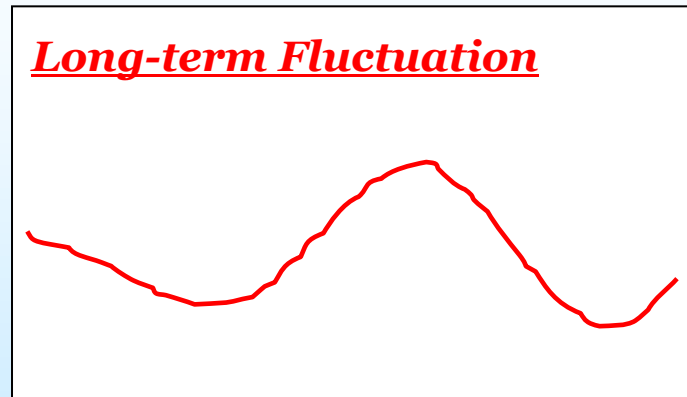
→ To keep Power Quality stable,  
Electric Utilities need to evaluate  
Available Connection Capacity.

*Bad Influence  
For  
Power Quality*

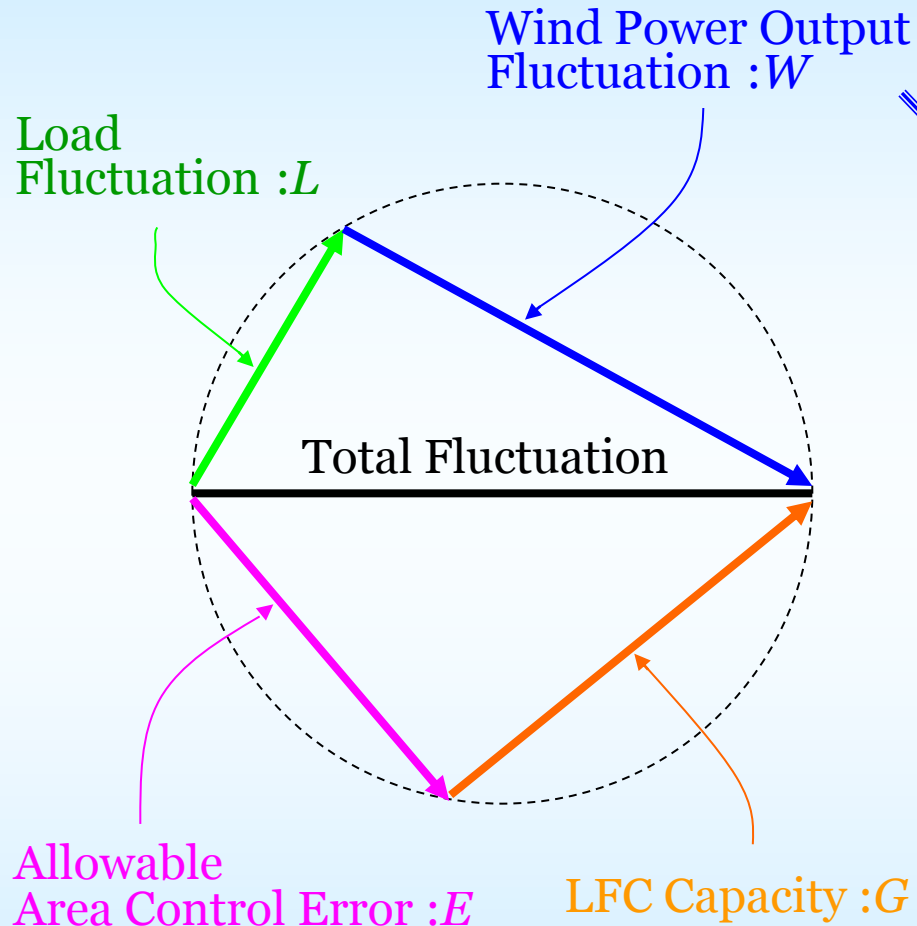
## Short-term Fluctuation



## Long-term Fluctuation



# Short-term Fluctuation



Available Connection Capacity  
of Wind Energy :  $W_{\max}$

$$W \leq \sqrt{E^2 + G^2 - L^2}$$



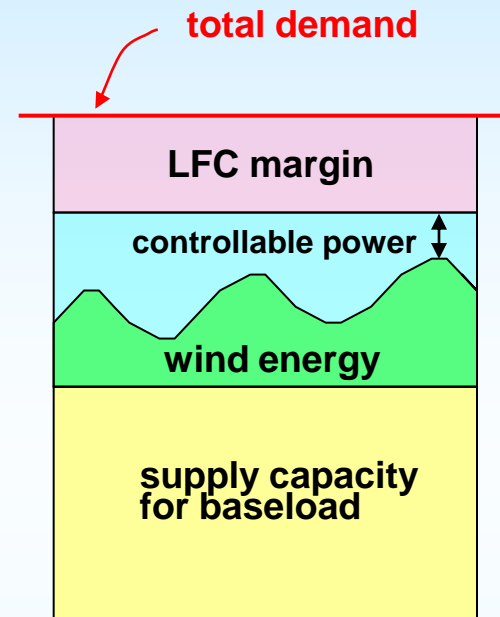
$$W_{\max} = W / R$$

R: Wind Power Output Fluctuation Rate

# Long-term Fluctuation

## Evaluation Flow

- 1 Select Section of Supply and Demand
- 2 Make a Grid Model
- 3 Assume Wind Power Output Fluctuation
- 4 Simulation
- 5 Evaluate Available Connection Capacity



# Available Connection Capacity in Japan

December 2007

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



August 2010

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

→ Electric Power Companies re-evaluate the available connection capacity step by step.

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

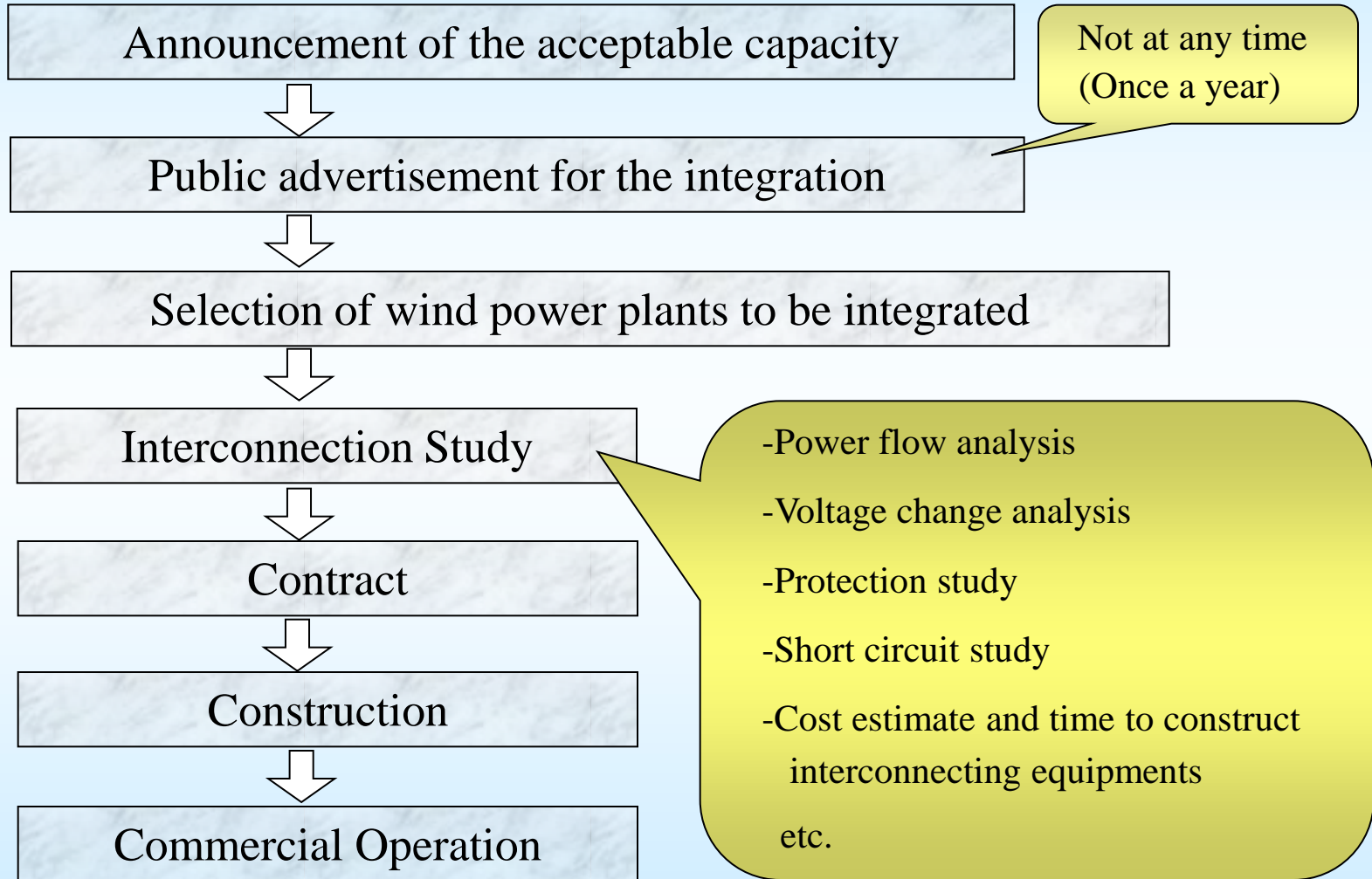
3: Including “ Generation-Limit-Type Capacity 100MW “

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

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

# The flow of integrating wind power plants

An example:



# Political Measures under Discussion

## 【Total Buyback System】

Buyback Target ... PV Generation, Wind Power Generation etc.

Buyback Price ... \ 15 ~ 20 / kWh

Buyback Period ... 15 ~ 20 years

## 【Stabilization of Power System】

Installation of the storage battery and output limitation of PV Generation and Wind Power Generation.

## 【Priority Access / Priority Load Dispatching】

Institutionalization of “priority access and load dispatching for renewable energy”.

# Thank You

