工業技術研究院
Industrial Technology
Research Institute

Addressing Grid-interconnection Issues in Order to Maximize
the Utilization of New and Renewable Energy Resources

Renewable Energy Grid Integration
Chinese Taipei's Perspective

Tom H. Lee, **Yi-Shuo Huang**
Green Energy & Environment Research Labs, ITRI

October 12, 2010, Tokyo, Japan

Current Renewable Power Utilization in Chinese Taipei

March 31, 2010	
Renewable Energy	**Installed Capacity (MW)**
Wind Power	468.2
Hydropower	1,938.9
Biomass – MSW	622.5
Biomass – Agro & Ind Waste	167.5
Biomass – Biogas	24.5
Solar PV	10.8
TOTAL	3,232.4
Rate (%)*	8.22

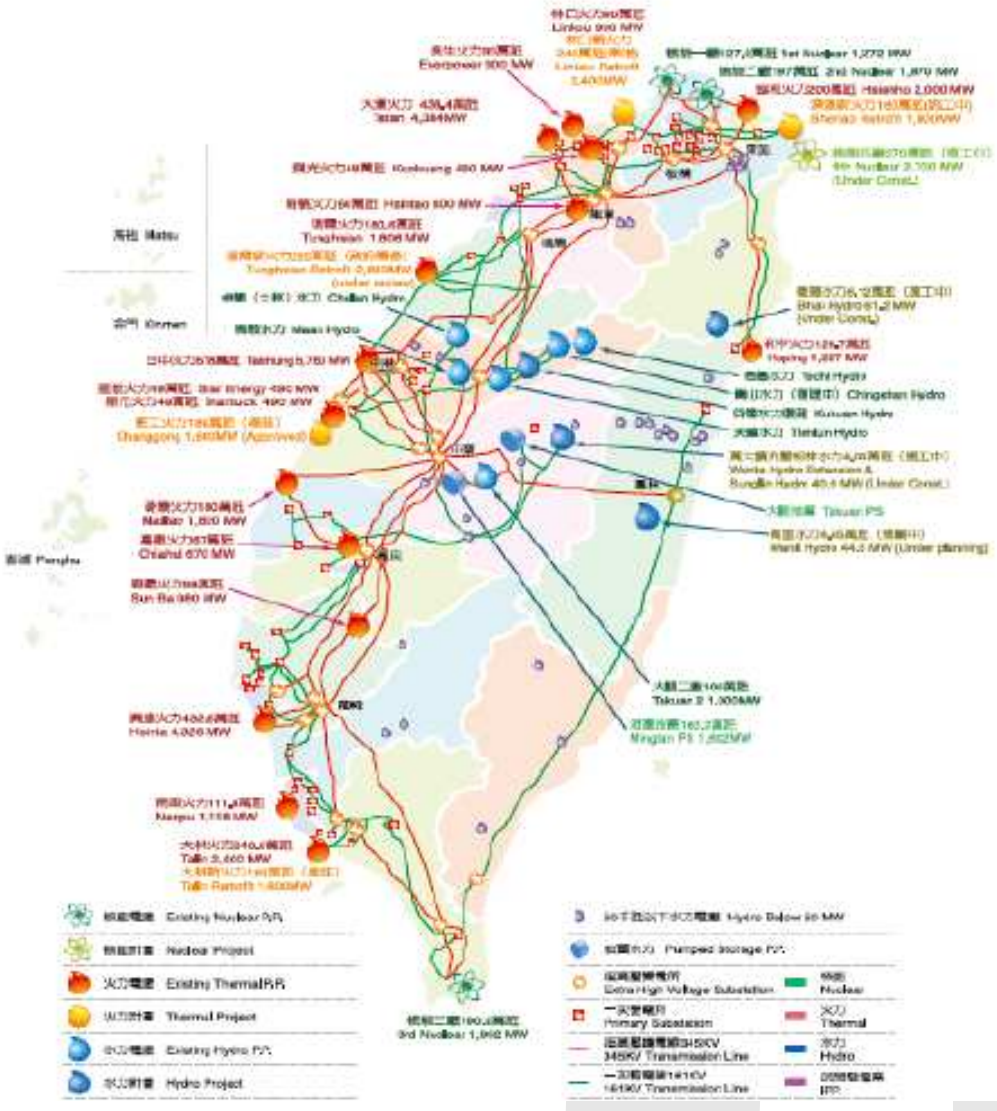
Target			
Year	2010	2015	2025
Rate (%)*	10	11	15

* contribution of RE in terms of total installed capacity

Source: BOE (2010)

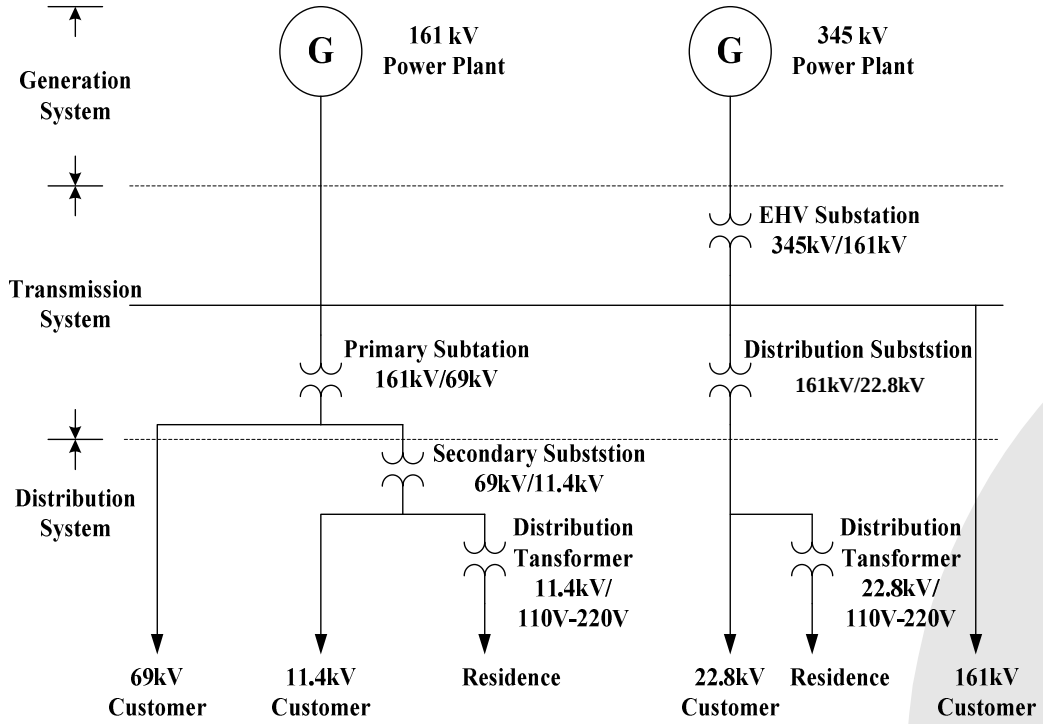
Overview of Taipower's System

- **Installed capacity ≒40.25GW**
- **Hydro (pump)**
  - 2,600 MW
- **Thermal**
  - 30,194 MW
- **Nuclear**
  - 5,144 MW
- **Renewable**
  - 2,306 MW



Transmission and Distribution Structure in Chinese Taipei

- Low Voltage (LV) system : < 600V in distribution system
- High Voltage (HV) system: 600V ~ 25kV in distribution system
- Extra High Voltage (EHV) system : > 25kV in transmission system



Regulations for Grid Integration in Chinese Taipei

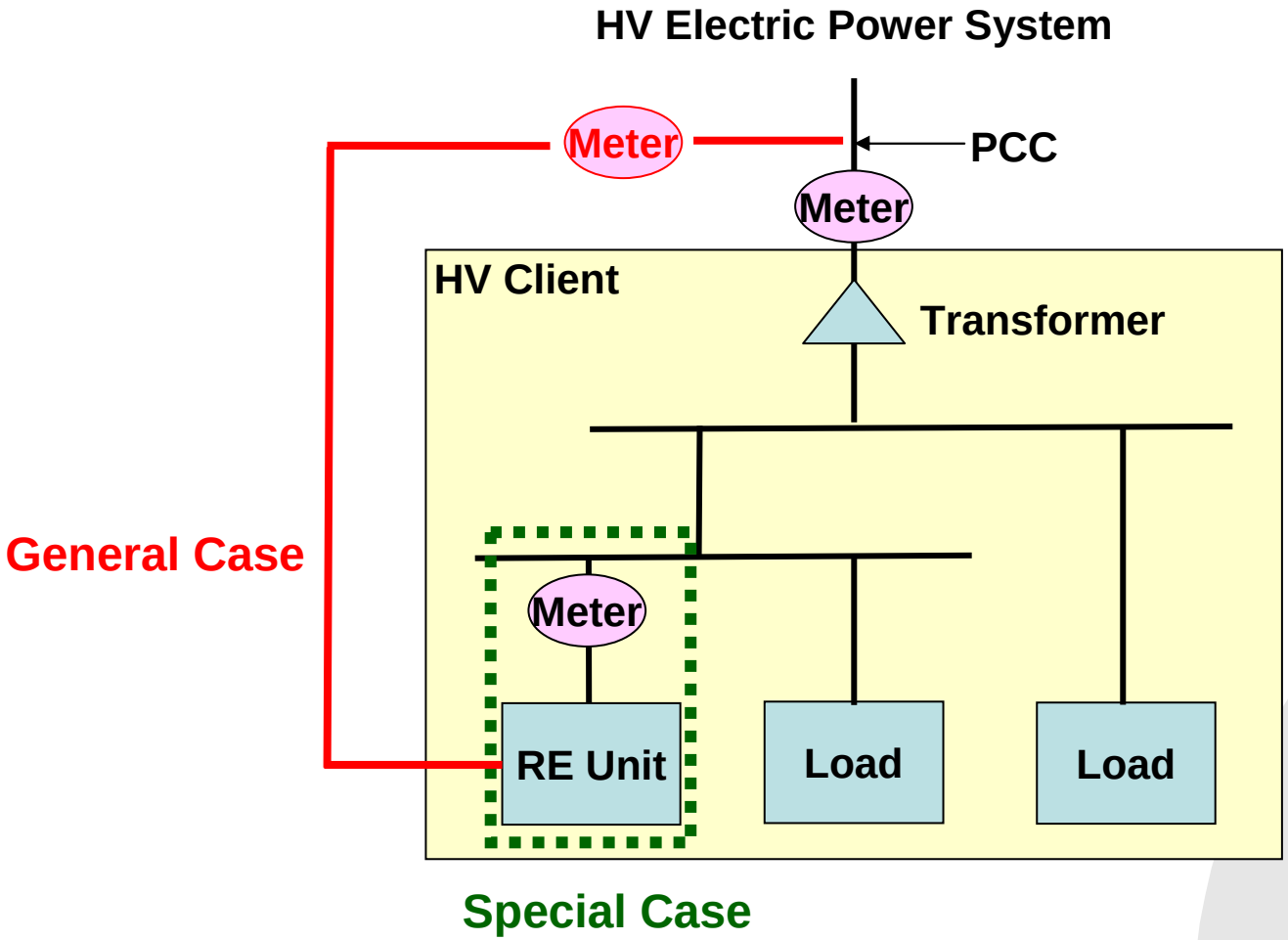
- **Renewable Energy Development Act (Jul. 8, 2009)**
- **Taipower's Renewable Energy Power System Interconnection Guideline (Dec. 31, 2009)**
- **Regulation for Identifying Renewable Energy Power Generation Equipments (Apr. 30, 2010)**
  - Type 1: RE system > 500 kW, independent power producer
  - Type 2: RE system < 500 kW, surplus power purchased by TPC
    (Net Metering)
  - Type 3: RE system < 500 kW, full sale of electricity to TPC
    (Feed-In Tariffs with 20 years contract)

Reverse Power from HV to UHV System

Renewable Energy Power System Interconnection Guideline

2002/06	2006/06	2009 (final)
Reverse power to transmission line not allowed	The maximum reverse power is limited to 10% of the rated capacity of primary transformer	The maximum reverse power is limited to 30% of the rated capacity of primary transformer (not applicable to science parks, etc.)

Special Case for Type 3 HV Customers



Interconnection Guideline - Power Quality Requirements

Short Circuit Current

Short circuit current should be less than 10 kA at Point of Common Coupling (PCC)

Voltage Fluctuation

Voltage fluctuation at PCC should be less than 2.5%

DC Injection

The RE and its interconnection system shall not inject DC current greater than 0.5% of the full rated output current at PCC , otherwise an isolation equipment is required

Interconnection Guideline - Power Quality Requirements (*con't*)

Anti-Islanding

An inverter-based interconnection system should have active and passive anti-islanding detection function.

Power Factor

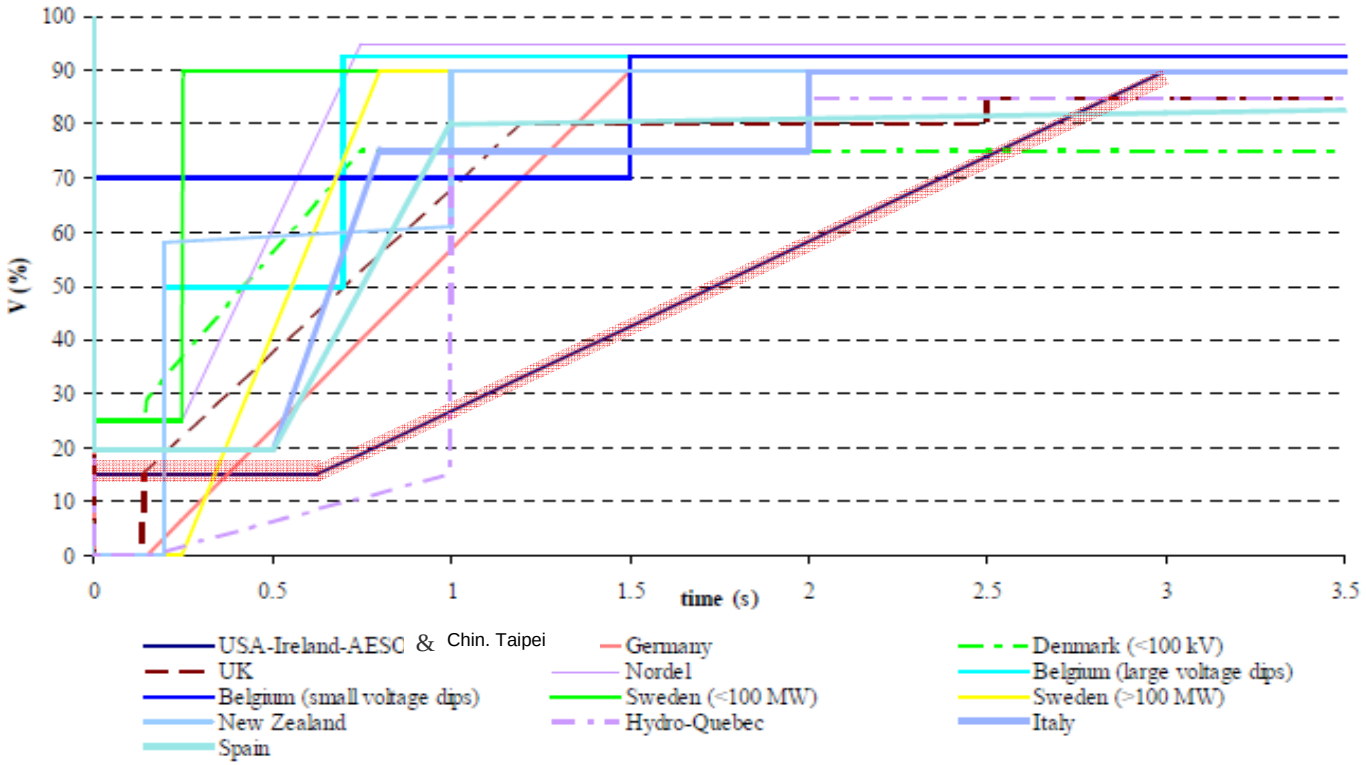
A RE generation system connected to EHV shall be capable of operating at some points within a power factor range, i.e. 0.98 leading to 0.96 lagging for a wind turbine, 0.95 leading to 0.90 lagging for others.

Total Harmonic Distortion

Total harmonic distortion should be less than 5% at Point of Common Coupling (PCC).

Wind Turbine with LVRT Function

- **Starting from 1st January 2011, wind turbines connected to the high voltage system (600V – 25 kV) or system with higher voltage should have low voltage ride through (LVRT) function.**



Remaining Issues

- **Technical Issue**
  - While renewable energy connects to the low voltage single phase distribution system, the maxmine installed capacity of the power generation equipment shall not exceed 20 kVA.

- **Non-Technical Issue**
  - The procedures for applying the renewable energy connecting to the Taipower's grid should be improved and simplified.

Smart Grid in Chinese Taipei

> Project <

Approval of Advanced Metering Infrastructure Promotion Project in June 2010

> Objectives <

- Reducing peak load
- Promoting energy conservation and AMI related industries

> Expected Benefits <

- Reducing peak load by 650 MW
- Saving 5% of electricity consumption (9.8 TWh)
- Reducing 4.39 million tonnes of CO_2 emissions

Schedule for AMI Installation

Year	2010	2011	2012	2013 ~2015	2016 ~2020
High Voltage Users	1,200	10,000	13,000	Completing the installation of 23,000 AMI users	
Low Voltage Users	300~500	10,000		1,000,000	5,000,000

Concluding Remarks

- Most contentious issues between RE installers and power company have been solved.
- The Renewable Energy Power System Interconnection Guideline has become effective since Dec. 31 2009.
- Chinese Taipei is now planning AMI and smart grid system which is essential for the development of the low carbon society.

Thank you for your attention.

Contact: htlee@itri.org.tw