EGNRET 47th Meeting

Bioenergy Applications in Chinese Taipei

Bureau of Energy
Ministry of Economic Affairs

October 10, 2016 Chinese Taipei

Outline

- Strategies of Renewable Energy Development
- Development of Bioenergy
- Concluding Remarks

Strategies of Renewable Energy Development

Renewable Energy Development (1/8)

(1) Renewable Energy Targets

- The Ministry of Economic Affairs raised the share of renewable energy generation target to 20% by 2025.

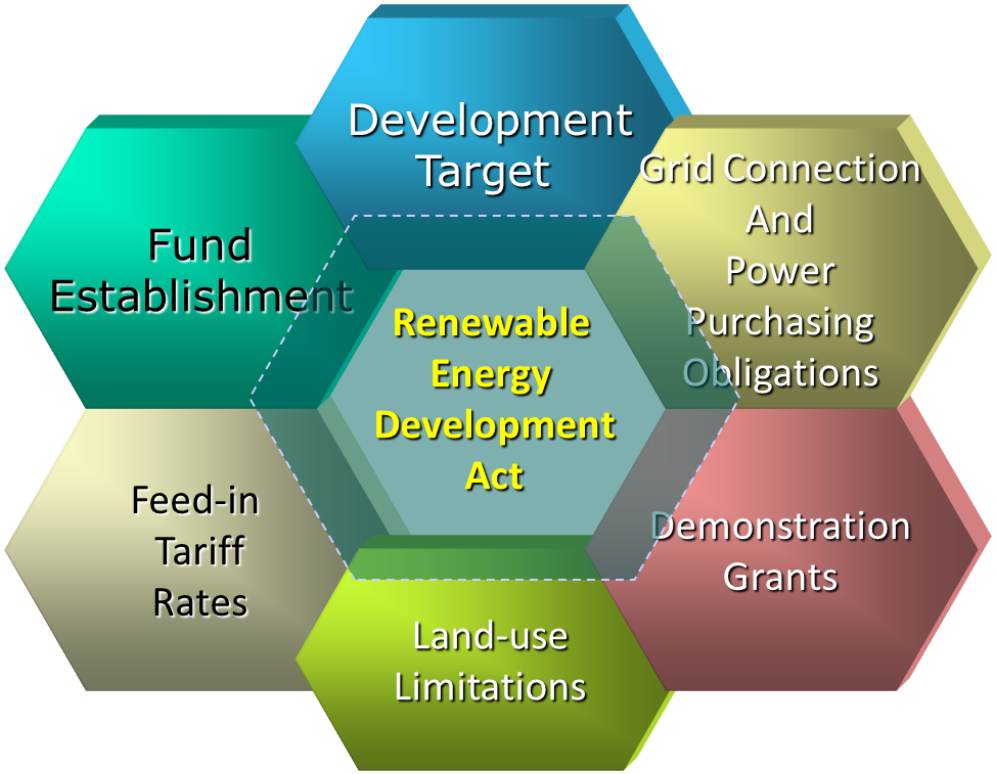
	Power Capacity (MW)			Electricity Generation (TWh)		
	2015	**2020**	**2025**	**2015**	**2020**	**2025**
Solar PV	842	6,500	20,000	11	81	250
Wind	647	1,200	1,200	16	29	29
	0	520	3,000	0	19	111
Geothermal	0	150	200	0	10	13
Biomass	741	768	813	54	56	59
Hydro Power	2,089	2,100	2,150	46	47	48
Fuel Cell	0	22.5	60	0	2	5
Total	**4,319**	**11,261**	**27,423**	**127**	**244**	**515**

Source: Bureau of Energy, Ministry of Economic Affairs, R.O.C.

Renewable Energy Development (2/8)

(2) Renewable Energy Development Act

- In order to systematically promote renewable energy, in July of 2009, Chinese Taipei promulgated the ***Renewable Energy Development Act***.
- **The core strategy of the Act is a Feed-in-Tariff system**.



Renewable Energy Development (3/8)

(3) Mechanism of Feed-in Tariffs

- Current, only Solar PV tariff rates are set on date when generating equipment installations are completed. Other technologies have tariff rates set on the Power Purchasing Agreement (PPA) signing date.
  ➔ **tariffs applied for 20 years**

  ➔ **PPA is a very important credit for banks to provide project financing**

- **announces PV capacity quota every year.** PV systems > 100 kW are subject to a bidding procedure to decide tariffs. Developers proposing higher discount rates receive the priority to get the quota.

- **The installed capacity of PV systems has been increased by more than 60 times in 5 years after the implementation of FIT.**

Renewable Energy Development (4/8)

(4) Principles of Renewable Energy Ddevelopment

- Five principles have been considered to expand our renewable energy development and maximize potentials：

1. **Subject to technological maturity and feasibility**
2. **Cost effectiveness**
3. **Development in phases**
4. **Acceptable increase in electricity price**
5. **Facilitating development of related industries**

Renewable Energy Development (5/8)

(5) Development Strategy - Solar PV

- Loosening regulation to install solar
- Increasing grid capacity to connect renewable energies
- Encouraging participation from local governments
- Strengthening public advocacy

Market

(1) Promote PV-ESCO mechanism

- Adopting PV-ESCO business model.
- providing capital financing and profits from whole-sale pricing to install PV.

(2) Advocating

- The rooftop PV has equipped on public buildings in 17 cities.
- Equipping PV on different kind of building.

Finance

(1) Establish investment environment

- Facilitating multiple financing sources
- Encouraging banks financing and providing soft loans

Environment

(1) Foster PV-friendly environment

- Simplify application processes
- Loosening bidding limitations
- Reduce application cost

(2) Strengthen public advocacy

- Communicating with public by seminar, proving solar power education, and delivering speech to community

Renewable Energy Development (6/8)

(5) Development Strategy – Wind Power

- Deployment Strategic Planning
  - **Onshore first and then offshore**
  - **On-shore: Higher potential areas first, less potential next.**
  - **Off-shore: Demonstration incentives to initiate the investment, then introduce 36 potential zones to scale up the investment, finally, zonal development with the SEA procedures to assure environmentally friendly.**
- Promotion Principles：Early start up with onshore projects, then sustainability with offshore projects
  - On-shore: assist developers in preparing and commissioning wind farms
  - Off-shore:
    - Assist demonstration projects to be delivered the contract on time.
    - Assist and remove administrative barriers in preparing and applying.
    - Support wind farm development with structure and foundations needs (such as vessel requirement, port infrastructure and grid connection)

Renewable Energy Development (7/8)

(5) Development Strategy – Offshore (1/2)

Incentive Demo Program
Investing initiative

Potential zones
offer sites、open bid

Zonal Planning
Government guidance, fostering industry growth

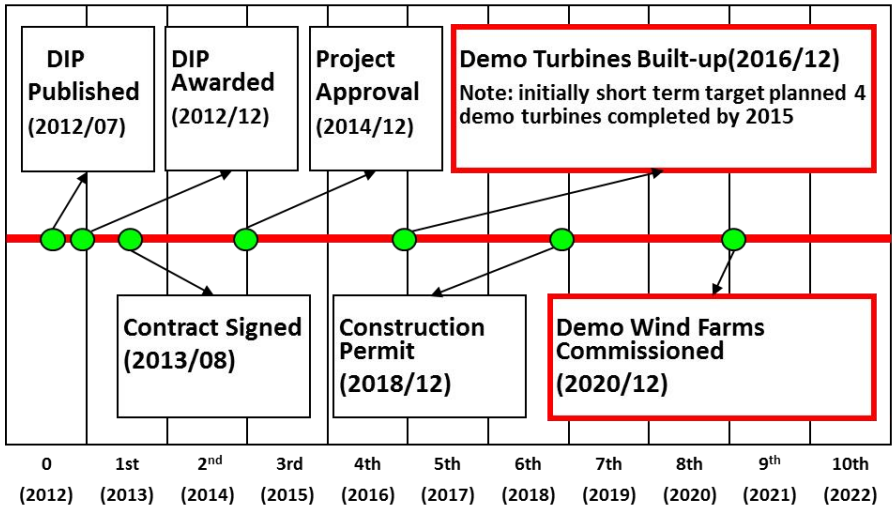
- **[Phase 1] Offshore Demonstration Incentive Program, DIP**
  - 4 demo turbines built by 2016, 3 demo farms commissioned by 2020 (2012.7.3)
  - Subside demo turbines and wind farms for bring up investment
- **[Phase 2] Directions of Zone Application for Planning, ZAP**
  - Introduce 36 potential zones for developers' reference, open for self guided investment before next zonal development phase. (2015.7.2)
  - Site EIA approval by 2017, and project preliminary permission by 2019
- **[Phase 3] Offshore Zonal Development, ZoP** (projected in 2017)
  - With sizable deploying goal helps building up domestic technologies and industries
  - Zonal Development Planning with intergovernmental consultation through the application of SEA to assure environmental sustainability
  - Share the information resources within the zonal developers to save cost

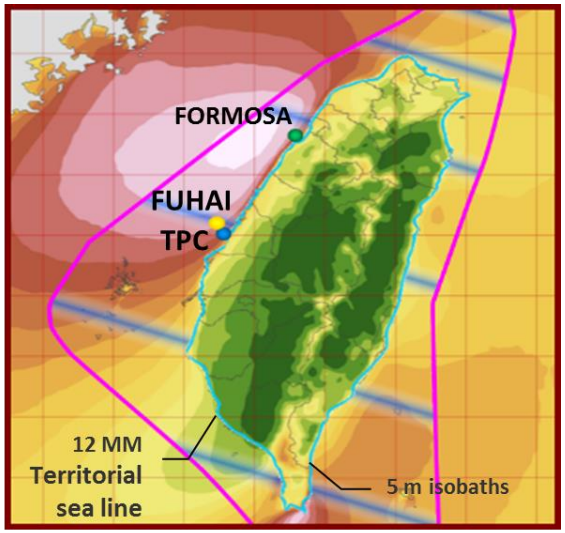
Renewable Energy Development (8/8)

(5) Development Strategy – Offshore (2/2)

Offshore Demonstration Program

- Awarded on Jan. 9 2013: Fuhai (consortium TGC, TOWSC, Century), Formosa (Swancor), TPC
- 50% subsides demo turbines' cost with no interests loan (FiT downpayment)
- Subsides the maximum loan 250 million for demo farm deployment (to be used on meteorological mast, EIA)
- A test ground for administrative, technological, financial feasibilities in scaling up future offshore wind development.





Development of Bioenergy

1. Biopower

(1) Development of domestic biofuel is of importance for Chinese Taipei, as >98% of energy is imported.

(2) Bio-power target and planning

	2016.07 : 740 MW	2025 : 813 MW
Waste	• Urban garbage: 624 MW • Industrial Waste: 5 MW	• Urban garbage: 629 MW • Industrial Waste: 21 MW
Biomass	• Biogas: 19 MW • Agricultural Waste: 92 MW	• Biogas: 30 MW • Agricultural Waste: 133 MW

Strategy

A. Promote bio-fuels from agro- and forestry-wastes.

B. Apply biomass energy in base-load power electricity and co-generation system.

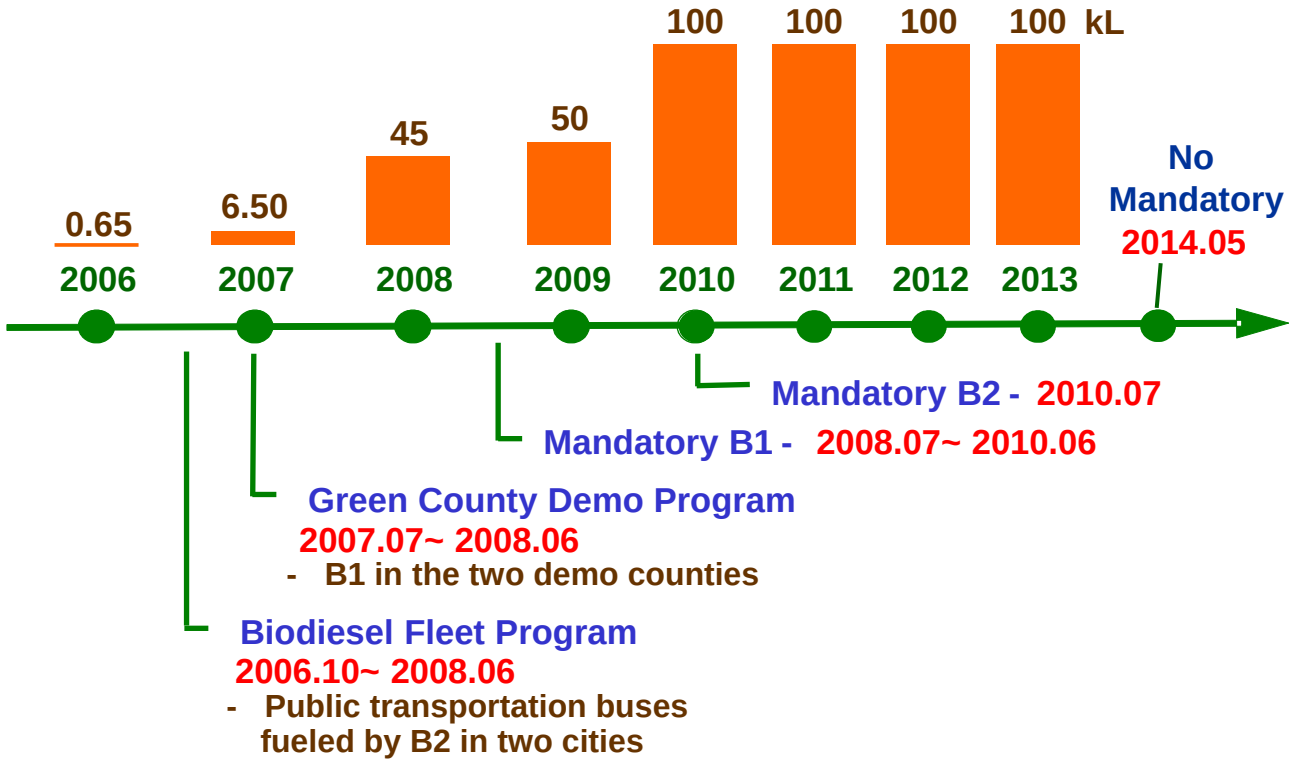
C. Produce biogas from wastewater treatment plant, a promotion of “Direction of Subsidizing Program for Biogas Power Generation System”

Biogas power plant, Municipal waste landfill, Taipei

2. Biodiesel (1/3)

(1) Biodiesel in Chinese Taipei

- 2008.7~2010.6 : B1 National implementation (Waste cooking oil as feedstock)
- 2010.6 : B2 National implementation (B100 Biodiesel demand: 100,000 kiloliter = Reduce 260,000 ton CO_2 emission)
- 2014.5.5 : Biodiesel is no longer mandated for vehicle diesel, but it will be mixed with heavy oil for industrial use.



- **Current feedstock : Waste cooking oil**
- **Sustainable feedstock**
  - ✓ Non-food
  - ✓ Environmental and ecological friendly
  - ✓ Energy effectiveness
  - ✓ Cost Competitive

2. Biodiesel (2/3)

(2) Green Bus Programs

- Kaohsiung City: 428 city buses fueled by B2 since Jan. 2007
- Chiayi County: 79 city buses fueled by B5 since Dec. 2007
- Feedstocks from soybean and recycled cooking oil
- No fuel-related incident

Source: ITRI (2008)

2. Biodiesel (3/3)

(3) Green County Program

- **B1 supplied in 297 gas stations in Taoyuan and Chiayi Counties since July 2007**
  - Sold by Chinese Petroleum Corp. and Formosa Petrochemical Corp.
  - Roughly 330,000 liters B1 were fueled by June 2008
  - No incident reported, but a few drivability concerns (power loss)

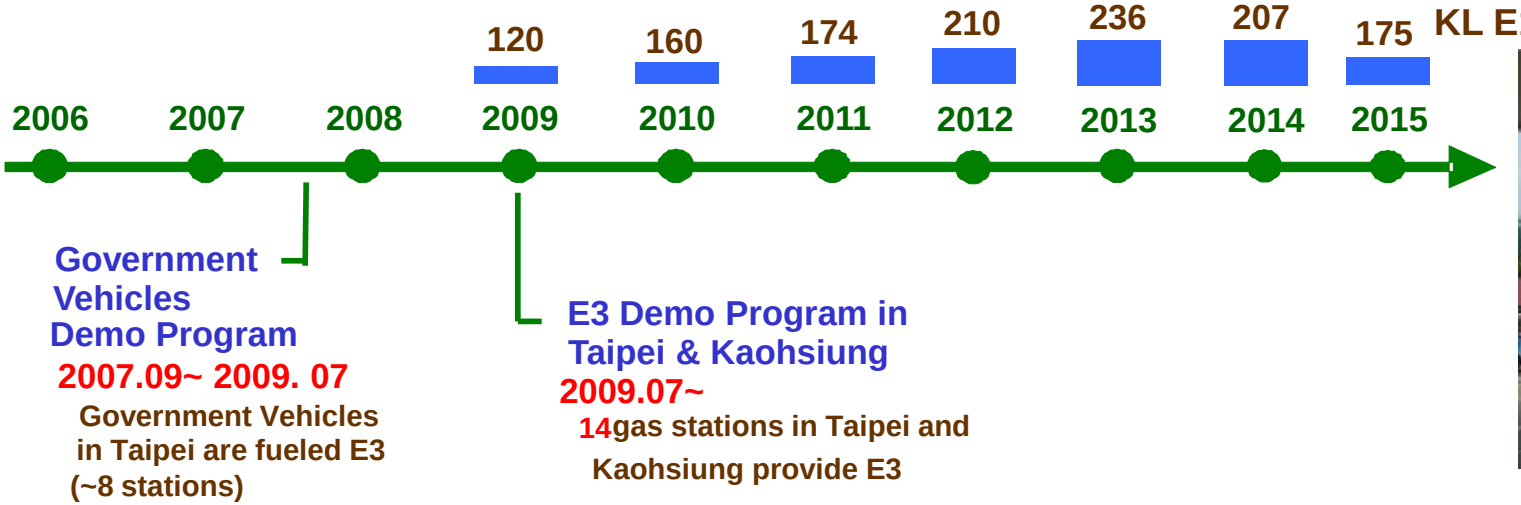
- **More than 1,500 trucks from 13 major fleet operators fueled by B1**
- **Comparison test between B5 and B0**
  - Each group consists of 4 cargo trucks
  - Total mileage of each group > 200,000 km
  - No observed difference in fuel consumption or maintenance cost

Source: BOE (2010)

3. Bioethanol

(1) E3 (3% bioethanol blended with gasoline) demo program

- Government Vehicles Demo Program during 2007~2009
  - Government vehicles in Taipei are fueled with E3
- E3 supplied in 14 gas stations in Taipei and Kaohsiung city since 2009
  - Reduced 396 ton CO_2 emission in 2015
- Future works for mandatory E3 in Chinese Taipei
  - Develop the advanced cellulosic alcohol technology
  - Consider the applicability of old vehicles



4. Prospect of Bioenergy in Chinese Taipei

Issues	Technology Needs
Feedstock Availability • Waste cooking oil: 60,000 tonne/year • Set aside land: 220,000 hectare	**Multiple Feedstocks** • Waste: Agricultural, industrial and municipal wastes • Algae cultivation • New energy crops **Advanced Processing** • Cellulose Ethanol • Bio-oil from wastes via pyrolysis process
Vehicle Suitability • B5: 35 models in total, 28 of them are suitable, the rest unknown (2001~06) • E3 vehicle: 96 models in total, 3 of them are NOT suitable (2001~06) • E3 scooter: ~12 millions scooters in total, most of them are NOT suitable	**New Formula Biofuel** • Butanol: similar to gasoline in terms of energy content, octane number and combustion parameters • Renewable alkanes via hydrogenation • Fischer-Tropsch synthesis **Flex Fuel Vehicle/Scooter** • Engine management system • Auto sensor for ethanol concentration • Emission control system

Concluding Remarks

5. Concluding Remarks

- The Government raised the share of renewable energy generation target to 20% by 2025.
- Aggressive bioenergy programs are under study in Chinese Taipei to reduce emission of CO_2, pursue sustainability of energy supply and energy resource independence.
- To facilitate renewable energy implementation, a intergovernmental body "Energy Saving and Carbon Reduction Office" has been set up under the Executive Yuan, to strengthen energy conservation and carbon reduction advocacy and communication .

Thank you for your attention