Strategy and Roadmap for PV Systems in Chinese Taipei

44th APEC EGNRET Meeting

Strategy and Roadmap for PV Systems in Chinese Taipei

Bureau of Energy
Ministry of Economic Affairs
Chinese Taipei

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Outline

- New Energy Policy of Chinese Taipei
- Renewable Energy Targets in Chinese Taipei
- PV Industry Chain in Chinese Taipei
- Financial Mechanisms for Promoting PV in Chinese Taipei
  - Mechanism of Feed-in Tariffs
  - PV Bidding Mechanism
  - PV ESCO Mechanism
- Million Solar Rooftop PVs Program
- PV Promotion Progress in Chinese Taipei
- Best Practices for PV Installation in Chinese Taipei
- Concluding Remarks
### New Energy Policy of Chinese Taipei

#### Chronology of Energy Policy Development

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011.11.03</td>
<td>President Ma announced <strong>New Energy Policy</strong> to “Steadily Reduce Nuclear Dependency, Gradually Move Towards a Nuclear-free Homeland, and Create a Low-carbon Green Energy Environment”</td>
</tr>
<tr>
<td>2010.05</td>
<td>Approval of the <strong>National Master Plan on Energy Conservation and Emission Reduction</strong></td>
</tr>
<tr>
<td>2010.01</td>
<td>Establishment of the <strong>Committee on Energy Conservation and Emission Reduction</strong></td>
</tr>
<tr>
<td>2009.07.08</td>
<td>Promulgation of <strong>Renewable Energy Development Act</strong> Amendment of <strong>Energy Management Law</strong></td>
</tr>
<tr>
<td>2009.04.15-16</td>
<td>Held the 3rd <strong>National Energy Conference</strong></td>
</tr>
<tr>
<td>2008.06.05</td>
<td>Launched <strong>Framework of Sustainable Energy Policy</strong></td>
</tr>
</tbody>
</table>
Renewable Energy Development Act

The **Renewable Energy Development Act** is the major watershed in the domestic photovoltaic power promotion policy.

1) Before promulgation of Renewable Energy Development Act, subsidy of PV generation power equipment was the main driving instrument to promote the PV power.

2) After Renewable Energy Development Act became effective, the **Feed-in-Tariff (FIT)** incentive plays the important role for the expansion of the PV power.
### Progress in PV Promotion in Chinese Taipei

<table>
<thead>
<tr>
<th>Year</th>
<th>Capacity (MWp)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>0.1</td>
<td>Solar Top &amp; Solar City Projects (2006; 1.4 MWp)</td>
</tr>
<tr>
<td>2005</td>
<td>0.3</td>
<td>Promoting PV system for emergency &amp; rescue in remote areas &amp; islands (2005; 0.98 MWp)</td>
</tr>
<tr>
<td>2006</td>
<td>0.6</td>
<td>RE Act promulgation (2009; 9.5 MWp)</td>
</tr>
<tr>
<td>2008</td>
<td>1.4</td>
<td>Million Rooftop PVs Promotion Program Launched (2012; 222.4 MWp)</td>
</tr>
<tr>
<td>2010</td>
<td>5.6</td>
<td>Million Rooftop PVs Promotion Program Launched (2012; 222.4 MWp)</td>
</tr>
<tr>
<td>2012</td>
<td>22.0</td>
<td>Million Rooftop PVs Promotion Program Launched (2012; 222.4 MWp)</td>
</tr>
<tr>
<td>2014</td>
<td>222.4</td>
<td>Million Rooftop PVs Promotion Program Launched (2012; 222.4 MWp)</td>
</tr>
<tr>
<td>2016</td>
<td>615.2</td>
<td>Million Rooftop PVs Promotion Program Launched (2012; 222.4 MWp)</td>
</tr>
</tbody>
</table>

**New Target:** 6,200 MWp by 2030
To prompt solar PV and offshore wind power, Million Solar Rooftop PVs and Thousand Wind Turbines promotion programs were approved in 2012.

- PV: 6,200 MW systems by 2030
- Wind: 1,000 turbines (450 onshore and 600 offshore) by 2030

### Aggressive RE Installation Capacity Targets

<table>
<thead>
<tr>
<th>Year</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-shore Wind</td>
<td>614</td>
<td>637</td>
<td>814</td>
<td>1,200</td>
<td>1,200</td>
<td>1,200</td>
</tr>
<tr>
<td>Off-shore Wind</td>
<td>0</td>
<td>0</td>
<td>15</td>
<td>320</td>
<td>1,520</td>
<td>3,000</td>
</tr>
<tr>
<td>Hydro Power</td>
<td>2,081</td>
<td>2,081</td>
<td>2,089</td>
<td>2,100</td>
<td>2,150</td>
<td>2,200</td>
</tr>
<tr>
<td>Solar PV</td>
<td>333</td>
<td>615</td>
<td>847</td>
<td>2,120</td>
<td>4,100</td>
<td>6,200</td>
</tr>
<tr>
<td>Geothermal</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>66</td>
<td>150</td>
<td>200</td>
</tr>
<tr>
<td>Biomass</td>
<td>741</td>
<td>741</td>
<td>745</td>
<td>768</td>
<td>813</td>
<td>950</td>
</tr>
<tr>
<td>Total</td>
<td>3,769</td>
<td>4,074</td>
<td>4,514</td>
<td>6,574</td>
<td>9,933</td>
<td>13,750</td>
</tr>
</tbody>
</table>
PV Industry Chain in Chinese Taipei

- Over 250 companies in PV industry in 2014
- A complete PV Supply Chain
- 2nd largest solar cell production in the world (~10 GW in 2014)
Renewable Energy Development Fund

Income based on expected expenses to balance revenue and expenditure

- Taipower
  - Traditional electricity
  - Renewable electricity
- Installers of self-usage power generation equipment that reaches a certain level of capacity
- Independent Power Producers, IPPs
- Power users
- Flow of Elec.
- Flow of Fund
- Flow of Fund

Generating electricity using non-renewables

Subsidies to the expense of purchasing of renewable energy equipment

Purchase of elec.

Subsidies to renewable electricity price
Mission

(1) Promote with local governments
(2) Strengthen PV System financing
(3) Public PV Promotion & Provision of advisory services
(4) Solve problems of the system installations
(5) Simplify installation processes and relative regulations
Million Rooftop PVs Promotion Program

Goal
- 6,200 MW developed by 2030
  - A. Roof-top (3,000 MW)
  - B. Ground (3,200 MW)
  Priority placed to contaminated agricultural farmlands and severe land subsidence areas, with 4% open to PV installation as the current target

Strategy
- The Feed-in Tariff as a strategy to achieve annual targets for roof-top and ground installations
- A cap quota is decided annually, while expecting large scale expansion after grid-parity is reached

Deployment Target

<table>
<thead>
<tr>
<th>Year</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>885 MW</td>
<td>2,120 MW</td>
<td>4,100 MW</td>
<td>6,200 MW</td>
</tr>
</tbody>
</table>
Financial Mechanisms for Promoting PV in Chinese Taipei

- Feed-in Tariffs
- PV Bidding
- PV ESCO
Mechanism of Feed-in Tariffs

- Tariff rates should be reviewed annually by referring to technical advancement, cost variation, goal achievement status, etc.

- Tariffs shall not be lower than the average cost for fossil-fired power of domestic power utilities.

- Currently only Solar PV tariff rates are set on the date when generating equipment installations are completed. The tariff rates for other RE technologies are set on the Power Purchasing Agreement (PPA) signing date.  
  ➡️ Applied for 20 years

- BOE announces PV capacity quota every year. **PV systems > 50 kW** are subject to a bidding procedure to decide the tariffs. Developers proposing higher discount rates receive the priority to acquire the quota.
FIT Rate for PV in 2015

Solar PV tariff rates **applied for 20 years** are set on the date when generating equipment installations are completed.

**Effective from 1 Jan. 2015 to 31 Dec. 2015**

<table>
<thead>
<tr>
<th>Type</th>
<th>Capacity (kW)</th>
<th>2015 Tariff Rates (US¢ /kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Period 1</td>
</tr>
<tr>
<td>Roof-top</td>
<td>≥ 1 ~ &lt; 20</td>
<td>21.79</td>
</tr>
<tr>
<td></td>
<td>≥ 20 ~ &lt; 100</td>
<td>18.22</td>
</tr>
<tr>
<td></td>
<td>≥ 100 ~ &lt; 500</td>
<td>17.02</td>
</tr>
<tr>
<td></td>
<td>≥ 500</td>
<td>16.49</td>
</tr>
<tr>
<td>Ground</td>
<td>≥ 1</td>
<td>15.51</td>
</tr>
</tbody>
</table>

(USD 1 ~ NTD 31.5)
Solar PV Bidding Mechanism

• Currently the **feed-in tariff** of solar PV remains relatively **high**.

• To relieve the financial pressure from the Renewable Energy Development Fund, only through the **competitive market**, the contract rate would be decreased resulting in **less expenditure** from the Fund.

• With the rapid improvement of PV technology, **PV installation prices have fallen precipitously**. The domestic demand of the PV equipment is greater than that of the deployment target.

• As a result, introducing the **bidding system** can ensure applicants **to participate fairly**. Therefore, it would **reveal the actual market value and cost**.
**Solar PV Bidding Mechanism**

- **Solar PV Bidding**
  - Installation cost evaluation
  - Bidding discount rate

- **Fair**
- **Reasonable**
- **Effective**

**Reasonable FIT Rate**
- Cost transparency
- Market value reflection

**Bidding Capacity expects to increase.**

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Deployment Target</strong></td>
<td>70</td>
<td>100</td>
<td>175</td>
<td>240</td>
<td>270</td>
</tr>
<tr>
<td><strong>Bidding</strong></td>
<td>40</td>
<td>83</td>
<td>135</td>
<td>150</td>
<td>180</td>
</tr>
<tr>
<td><strong>Non-bidding</strong></td>
<td>30</td>
<td>17</td>
<td>40</td>
<td>90</td>
<td>90</td>
</tr>
</tbody>
</table>

Unit: MW
PV Bidding Operational Process & Conditions

Bidding Operational Process

First selection: First 60% highest discount rate

Second selection: First 60% highest discount rate

Third selection: First 60% highest discount rate

Fourth band

Last selection: first 60% highest discount rate

First band

Roof

1 kW (Total Capacity)

Second band

100 kW

3rd band

500 kW

Ground

1 kW (Total Capacity)
## PV Bidding Operational Process & Conditions

### Non-bidding Conditions

<table>
<thead>
<tr>
<th>1.</th>
<th>Roof-top equipment (1kW~50kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Buildings belongs to the government or public schools</td>
</tr>
<tr>
<td>3.</td>
<td>Buildings belongs to government or public schools rent by private installers with grants by county governments.</td>
</tr>
<tr>
<td>4.</td>
<td>Government-owned enterprises</td>
</tr>
<tr>
<td>5.</td>
<td>Residential buildings (1kW~100 kW on roof)</td>
</tr>
<tr>
<td>6.</td>
<td>Remote islands</td>
</tr>
<tr>
<td>7.</td>
<td>Building-integrated photovoltaics equipment</td>
</tr>
<tr>
<td>8.</td>
<td>Land subsidence areas</td>
</tr>
<tr>
<td>9.</td>
<td>Roof-top equipment regulated by the municipal and county (city) governments under the self-government regulations</td>
</tr>
</tbody>
</table>
Cost-benefits of Solar PV bidding

1. From 2011 to 2014, the total bidding capacity was 403 MW, resulting in less expenditure from the Fund.
2. The total savings were USD 8.83 million in 2011, 17.82 million in 2012, 80.62 million in 2013, and 74.60 million in 2014, respectively.

<table>
<thead>
<tr>
<th>Year</th>
<th>Tender(s)</th>
<th>Bids</th>
<th>Capacity (MW)</th>
<th>Ratio (%)</th>
<th>Average discount rate (%)</th>
<th>Savings from the Fund (million USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>3</td>
<td>352</td>
<td>35.048</td>
<td>88.38</td>
<td>3.21</td>
<td>8.83</td>
</tr>
<tr>
<td>2012</td>
<td>7</td>
<td>335</td>
<td>83.080</td>
<td>60.11</td>
<td>3.29</td>
<td>17.82</td>
</tr>
<tr>
<td>2013</td>
<td>4</td>
<td>539</td>
<td>135.167</td>
<td>52.38</td>
<td>10.29</td>
<td>80.62</td>
</tr>
<tr>
<td>2014</td>
<td>3</td>
<td>588</td>
<td>150.060</td>
<td>60.12</td>
<td>10.08</td>
<td>74.60</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>588</td>
<td>403.355</td>
<td></td>
<td></td>
<td>181.87</td>
</tr>
</tbody>
</table>

(USD 1 ~ NTD 31.5)
Establishment of PV-ESCO Mechanism

Encouraging banks to participate in project financing and to provide soft loans to PV-ESCO players

Example Model: Zero financing burden for the site provider

- Bank
  - Finance for 80%
  - Reimburse loan principal and interest
  - Electricity selling income

- PV-ESCO / PV System company
  - Roof renting
  - System warranty and after-sales service
  - Wholesale electricity

- General residential roof system
  - During the renting period, the site provider get the rent.
  - The ownership of system after the rent expiring should be discussed by the PV-ESCO and the site provider.

Taipower Company
Achievements of PV-ESCO: Green Financing

- 16 banks now provide PV system financing support, green energy investment funds grows from USD 1.6 to 222 million from 2011 to 2013.
- USD 222 million funds could generate USD 317 million in system installation value, about 170 MW of domestic demand, and create more than USD 0.5 billion in industry chain value.
- PV-ESCO assists in installations for all buildings including solar community, public roof, solar farm, solar terminal, solar factory, solar rail, solar MRT, solar campus, etc.
- ESCO model plays an important role in Chinese Taipei PV installation. PV capacity ratio increase from 48% (2012), 63% (2013), and up to 80% (2014).
Best Practices for PV Installation in Chinese Taipei

The World’s first whale-shaped BIPV
Pingtung National Museum of Marine: 104 kWp

The World’s first spiral BIPV
Kaohsiung National Stadium: 1 MWp
Best Practices for PV Installation in Chinese Taipei

Solar Top Classic Building

Solar Wall of Lights
National Museum of Taiwan History
195 kWp

Umbrella-shaped Solar Top
Pingtung LiuDui Hakka Cultural Park
75 kWp
Best Practices for PV Installation in Chinese Taipei

Utility Scale

Kaohsiung Yong-An Power Station
4.64 MWp

Taichung Power Plant Station
1.5 MWp

Kaohsiung Luzhu HCPV Solar Farm
1 MWp

Kaohsiung Xing-Da Power Station
953 kWp
Best Practices for PV Installation in Chinese Taipei

Commercial

Location: Tainan City
Capacity: 1.3 MWp
Type: Grid-tie
Installation on Ground

Location: Pingtung County
Capacity: 1.6 MWp
Type: Grid-tie
Installation on factory rooftop
Best Practices for PV Installation in Chinese Taipei

Stand Alone (off-grid)
PV system for emergency application

Wutai Township Office, 3.2 kWp
Best Practices for PV Installation in Chinese Taipei

**Green Miracle**

- Transform the destroyed fish-farming and orchards into solar power generation after hit by the deadliest Typhoon, Morakot in 2009.
- A **23.4 MW** PV farm project, including the largest solar power plant in Chinese Taipei, has regenerated the devastated flood-hit area.

Before (2009)  
After (2014)
Concluding Remarks

- The promulgation of Renewable Energy Development Act and related regulations has paved the way for a sustainable long-term development of PV in Chinese Taipei.

- Various incentives have been issued to encourage the investment in PV in Chinese Taipei.

- The development of PV is expected to be prosperous in Chinese Taipei.

- Chinese Taipei will devote itself for the continuous growth of PV and other REs, and welcomes the international cooperation to foster the development of PV together in the global society.
Chinese Taipei, Your Best Partner!

LIGHT YOUR FUTURE

Our Global PV Projects Are Second to None.

Thank you for your attention

Contact: Dr. Chung-Hsien Chen  (ctchen2@moea.gov.tw)