Power Development in Eastern Asia

The Dramatically Changing Energy Picture in East and Southeast Asian Countries, as seen by an Electric Power Generating Company

April 15, 2015

Yoshiki Onoi

J-POWER / Electric Power Development Company, Ltd. (Tokyo)
Growth of Power Demand in Eastern Asia (1)

- Despite world economic difficulties, China and ASEAN countries have shown high growth in power demand/supply since the 1990’s up to the year 2012 as well as their economies. Japan’s economy has not shown similar growth.
- China’s growth, in particular, is outstanding in economy and electricity use.
- Although the size of ASEAN countries’ economies are not as large as China, their growth has been firm with occasional down turns due to the Asian economic crisis in the late 90’s, Lehman shock, and so on.

Total electricity generation of specific countries

Note: The figures in this graph are from statistics of IEA website.
**Growth of Power Demand in Eastern Asia (2)**

- Recent figures of electricity-GDP elasticity (2005 – 2012) compared with those in the past period (1995 – 2004) show:
  - Japan: Electricity saving is exceeding economic activities.
  - China: Electricity use is exceeding the economic growth.
  - ASEAN: Economic growth is faster than before. Electricity use follows.
  - USA: Economic growth is relatively slow. Electricity is still saved more than before.

- China and ASEAN countries are still leading in power demand growths compared to high per capita GDP countries such as USA and Japan.

**Electricity – GDP Elasticity**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GDP Growth</td>
<td>Multiplier</td>
<td>Electricity Growth</td>
<td>Multiplier</td>
<td>GDP Elasticity</td>
<td>GDP Growth</td>
<td>Multiplier</td>
<td>Electricity Growth</td>
</tr>
<tr>
<td>Japan</td>
<td>Billion USD</td>
<td>1.09</td>
<td>108</td>
<td>1.11</td>
<td>1.02</td>
<td>Billion USD</td>
<td>122</td>
<td>1.03</td>
</tr>
<tr>
<td>China</td>
<td>1,090</td>
<td>2.16</td>
<td>1,197</td>
<td>2.19</td>
<td>1.01</td>
<td>1,966</td>
<td>1.77</td>
<td>2,492</td>
</tr>
<tr>
<td>ASEAN</td>
<td>239</td>
<td>1.38</td>
<td>218</td>
<td>1.83</td>
<td>1.33</td>
<td>395</td>
<td>1.43</td>
<td>263</td>
</tr>
<tr>
<td>United States</td>
<td>3,321</td>
<td>1.36</td>
<td>593</td>
<td>1.17</td>
<td>0.86</td>
<td>1,136</td>
<td>1.09</td>
<td>-4</td>
</tr>
</tbody>
</table>

*Source: All the data in this table are from the figures in the Statistics of IEA website and/or calculated from such.*
Self-Sufficiency in Primary Energy

- Among eastern Asian countries, **China** is rapidly decreasing its self-sufficiency in primary energy.

- **Thailand** is gradually changing to a country of energy imports due to the decrease of domestic natural gas production and steady economic growth.

- **Japan** is continuing to import energy resources with a balance of LNG, coal and fuel for nuclear.

- Countries of 2\textsuperscript{nd} and 3\textsuperscript{rd} largest GDP (China and Japan) must import more despite the introduction of more renewable energy options.

- Resource rich countries like the United States and Indonesia are changing trading positions and seeking new opportunities in exports for energy markets.

*Source: By statistics from IEA website.*
## Fuel Energy Balance of Specific Countries

### Self-sufficiency of fuel energy balance

<table>
<thead>
<tr>
<th></th>
<th>Coal</th>
<th>Natural Gas</th>
<th>Crude Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>China</strong></td>
<td>98% -9.2 96%</td>
<td>100% 0</td>
<td>74% -30.9 118% +20.6 44%</td>
</tr>
<tr>
<td><strong>Indonesia</strong></td>
<td>165% +2.3 858%</td>
<td>266% +26.3 192% +32.3 176% +32.3 90%</td>
<td></td>
</tr>
<tr>
<td><strong>Thailand</strong></td>
<td>94% -0.2 30%</td>
<td>100% 0</td>
<td>74% -9.0 23% 32%</td>
</tr>
<tr>
<td><strong>Japan</strong></td>
<td>5.8% -72.2  (negligible)</td>
<td>4.3% -42.2 2.9% -102.2 0.34% -203.9 0.35%</td>
<td></td>
</tr>
<tr>
<td><strong>United States</strong></td>
<td>118% +82.1 117% +70.4</td>
<td>95% -20.1 98% -11.7 55% -351.0 47%</td>
<td></td>
</tr>
</tbody>
</table>

**Source:** Calculated by statistics from IEA website.

### Electricity sources by country (2012)

- **China**
- **Indonesia**
- **Thailand**
- **Japan**
- **United States**

**Source:** Calculated by statistics from IEA website.
## Power Mix Policies of Asian Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Supply volume and power mix policies</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>Within the total primary energy supply, by 2020, coal ratio is to be decreased to 62% or less, and natural gas will be increased to more than 10%. Nuclear energy is to be developed under strict safety policies and renewable energy will be developed up to 30GW. From 2020 new coal-fired power plants are subject to stricter regulations for energy efficiency and emissions. Energy Development Strategy Action Plan in 2004 - 2020.</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Additional capacity from 2015 to 2024 is to be 70.4 GW including 42.1GW of coal-fired generation, which will account for 63.7% of total capacity in 2024. RUPTL 2015</td>
</tr>
<tr>
<td>Thailand</td>
<td>Renewable and alternative energy will be developed by 25% until 2021. Energy supply security is taken into consideration for fuel diversification with coal fired plants. PDP2010:Rev. 3 (June 2012)</td>
</tr>
<tr>
<td>Viet Nam</td>
<td>The total capacity of 27GW in 2012 is to be increased to 75GW in 2020 and 147GW in 2030. Hydro power accounts for 48% of total capacity in 2012. Thereafter, coal-fired generation will account for 52% in 2030. 1st nuclear COD is planned in 2030. PDP7(July 2011)</td>
</tr>
<tr>
<td>Myanmar</td>
<td>1st PDP draft was reported to Myanmar government in 2013. The scenario for energy strategies is still under discussion. Total capacity of 3.6GW is to be added in 2014 with the target of 24 - 29GW in 2030. PDP Draft (July 2013)</td>
</tr>
</tbody>
</table>
Country View

China (1) More Coal, Less CO₂

• The biggest coal production country needs more coal than domestic production.

• The global share of demand and supply of coal will be decreasing in the 2030s, however.

• In 2014, President Xi Jinping addressed CO₂ reduction after 2030.

• A total capacity of 96 GW* power generation plants including 60 GW by non-fossil energy have been added in 2014.

*Estimated in June, 2014

Installed Capacity in 2014 (GW) Total=1,340 GW*

- Coal 820
- Hydro 280
- Pumped storage 23
- Nuclear 21
- Wind 93
- PV(by FIT) 29

• CO₂ intensity is decreasing due to increased efficiency of conventional thermal power plants. Future dynamic introduction of renewables is also expected to lower the CO₂ intensity per kWh.

Country View
China (2) J-Power’s Investment

Shareholding and Power Assets
- Investment in hydropower with Datang Elec., Co.
- Shareholding of an energy company “Gemeng” with Korean Electric Power Corporation (KEPCO)
- Highly efficient USC coal power plants “Hezhou” in Guan xi with Hong Kong based China Resources Power Holdings

  * USC : Ultra-Super Critical pressure condition for the boiler

- A substantial amount of coal is unloaded at ports and transported by train for 400 km to Hezhou.

Project security and financing
- Tariffs of coal thermal plants are reviewed in line with coal price from time to time. Unlike project finance, business pro forma is not committed.
- The tariff levels are tough for low efficiency plants. Better efficiency is a key factor in project security.
- Finance is provided by equity and domestic bank loans.
- Foreign direct investment is still welcomed in terms of mixing business governance by foreign companies.

J-POWER’s Investment in China
Country View
China (3) Future Development

Coal-fired power generation
- Domestic mines distribute coal across the country for regional uses while competing with each other and with imported coal.
- Coal-fired plants continue to be a dominant power source even until 2040 when less-efficient plants are replaced with more efficient ones. Only high-efficiency coal power plants, such as USC, are promoted.
- Domestic major vendors are producing modern boilers for domestic use.
- Operation and maintenance still has room to improve.

Views from foreign investment in China’s power plants
- Project financing is different from western project finance schemes with MDB/ECA under OECD rules. Debt finance is provided by domestic banks. Foreign financing contribution is not the key factor like in the case of other Asian country’s case.
- Change of regulations and tariffs are pre-conditions for equity investment.
- Managerial and technical discussions are held very earnestly as business relationships.
- Procurements of machines are available domestically except for modern gas-turbines.
Country View

China (4) Accelerate Renewables

Natural gas
• Natural gas pipelines are interconnected from the west to East Central Asia and Russia (planned). From the constraints of the gas volume however, on-site use of natural gas will be promoted for the time being. Restriction of off-shore dependence is also considered.

Tremendous renewable energy potential
• Wind energy potential distributes along the northern border and Tibet Highland.
• Solar energy potential is also observed in the same zones whereas east – south parts of the country have less potentials.

Power mix and network (grid)
• If back-up from by other types of generation and connected networks are secured, renewable energy has the great potential. Even if not, such renewable potential can be applied to small green applications. Also such renewable energy, with other infrastructures such as roads, railways, and water, can be one of drivers for new development of the corridor beyond the western border.

Gas pipeline network

Wind power potential

Solar power potential

Source: Medium-Term Gas Market Report 2014, IEA
Source: China wind energy development roadmap 2050, IEA, ERI.
Source: ERI
Country View
Japan (1) Power Supply Difficulties

• Fukushima No. 1 Plant: accident and aftermath.
  - All nuclear plants (54 units) were shut down.
  - All plants are under review by the Nuclear Regulatory Commission (NRA).
  - Alternative supply has been covered by LNG and coal thermal power generations.

• Due to the increased fuel costs for imported oil and LNG, many of coal thermal power plants, which are expected to run with relatively low and stable fuel costs, are being newly planned (more than 15GW reportedly).

• The government started to create a new power mix policy to secure investments for the sustainable supply of electricity under the three-part policy of nuclear acceptance, CO2 reduction, and minimization of power prices for industrial and domestic uses so as to meet COP 21 (Paris) in the end of 2015.
Country View
Japan (2) New Energy Mix Policy Toward COP21

- A consensus about Japan’s power mix is expected from the consideration of various factors.
- Power generators’ efforts
  - Respond to new regulations for nuclear power re-start
  - Replacement of old thermal power plants
  - Strengthen fuel procurements

<table>
<thead>
<tr>
<th></th>
<th>CO2</th>
<th>Tariff</th>
<th>Safety</th>
<th>Energy security</th>
<th>Siting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewables*</td>
<td>Positive</td>
<td>Negative</td>
<td></td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td>Nuclear</td>
<td>Positive</td>
<td>Positive</td>
<td>Cautious</td>
<td>Positive</td>
<td>Very limited</td>
</tr>
<tr>
<td>LNG</td>
<td></td>
<td></td>
<td></td>
<td>Important as</td>
<td>Seashore</td>
</tr>
<tr>
<td>Coal</td>
<td>Negative</td>
<td>Positive</td>
<td></td>
<td>mixed portfolio</td>
<td>Seashore</td>
</tr>
</tbody>
</table>

* Introduction of renewables tends to raise power grid instability. This should be carefully considered.

- New coal-fired plants with CCT
  - The most modern CCT (Clean Coal Technology) such as USC boiler shall be applied.
  - Promotion of IGCC (Integrated Gasification Combined Cycle) – Oxygen blown and air blown types
  - R&D for CCS (Carbon Capture and Storage)

- More renewable energy development, but...(next page).....

IEA’s estimates (NPS)
Country View
Japan (3) Challenge for More Renewables

• Tariff burden for renewable energy (Feed-In-Tariff)

<table>
<thead>
<tr>
<th>Off-take price (JPY/kWh)</th>
<th>FY2014</th>
<th>FY2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>- PV (&gt; 10kW)</td>
<td>32</td>
<td>29 ⇒27</td>
</tr>
<tr>
<td>- Wind power (&gt;20kW)</td>
<td>22</td>
<td>Same</td>
</tr>
<tr>
<td>- Wind power (&lt;20kW)</td>
<td>55</td>
<td>Same</td>
</tr>
</tbody>
</table>

* Approved total capacity of FiT generators is 73GW (Nov. 2014). PV shares more than 90%.
* Ref. JEPX spot price = 15.3 (average In 1,2,3Q of 2014)

• Sharing grid capacity

Kyushu Electric Power Co., Inc., a regional off taker, announced that their evaluation process for proposed solar power projects in 2014 is to be suspended. Almost 70,000 project plans were filed in only in one month. The total capacity of proposed solar projects, if all are permitted, is estimated to reach to 12.6 GW whereas the region’s current capacity is 23.1 GW.

The government formed a committee to examine the possible capacities for renewables in specific regions. The rule of allocation for various types of generations in a grid is under discussions.
Country View

Indonesia (1) World Biggest Coal Supplier

• Indonesia is the largest in ASEAN countries in population (247 millions in 2012) with a high degree of GDP growth (6.5 %, 6.3 %, 5.8 %, 2011 – 2013).

• As the world’s largest exporter of coal, the government is strategically controlling the volume and price accordingly to maximize country’s benefits. The big consumers are China, Japan, India, South Korea and Taiwan followed by Germany and UK.

• Including the largest grid of the main islands of Java and Bali, national power development will be needed to sustain further economic growth.

<table>
<thead>
<tr>
<th>Indonesian coal statistics</th>
<th>Production</th>
<th>Export</th>
<th>Domestic</th>
</tr>
</thead>
<tbody>
<tr>
<td>in millions of tons</td>
<td>2006</td>
<td>2007</td>
<td>2008</td>
</tr>
<tr>
<td>Production</td>
<td>194</td>
<td>217</td>
<td>240</td>
</tr>
<tr>
<td>Export</td>
<td>144</td>
<td>163</td>
<td>191</td>
</tr>
<tr>
<td>Domestic</td>
<td>49</td>
<td>61</td>
<td>49</td>
</tr>
</tbody>
</table>

Source: Ministry of Energy and Mineral Resources

Projected electricity generation by fuel

Source: RUPTL 2013-2022, PLN
Country View
Indonesia (2) Domestic Power Infrastructure

• To meet the expected demand, annual additional generation capacities are scheduled by PLN. Major portion of such development will be by coal fired plants.

• Development will be made by PLN and IPPs (Independent Power Producers). From the year 2018, incremental development by IPPs is largely expected in stead of PLN’s development.

• In proportion to power development, sovereign finance for PLN and project finance for IPPs will be needed in the magnitude of 125 billions USD for both players. The Indonesian government has institutionalized PPP schemes to motivate more private participation. J-Power is trying to build a high efficiency coal-fired power plant (1,000 MW x 2) under the PPP scheme with private partners.

• For such project finance, involvement of ECA (Export Credit Agency) and/or MDB (Multilateral Development Banks) is expected.

Additional generation capacity
Investment needs for power development

Source: RUPTL 2013-2022, PLN
Country View

Thailand (1) Gas Oriented Power Supply

- Domestic and Myanmar gas supply is currently made available by pipelines.
- Domestic gas production will peak in 2017. (Min. of Energy)
- LNG terminals are needed more for import.
- PTT, the dominant gas company, is securing the upstream assets of a foreign gas field.
- Fuel diversification is an urgent need regarding national energy security.

Gas pipeline network of Thailand

Production and import of natural gas

Imported (NG): 18.4%
Imported (LNG): 2.2%
Domestic 79.4%

Total: 4,509 MMSCFD in 2011

Source : PTT Annual Report 2011

Source : Energy Policy and Planning Office (EPPO)
Country View
Thailand (2) Future Power Development

- An added capacity of 55,130 MW during 2012 – 2030 is planned.

<table>
<thead>
<tr>
<th>Source: PDP2010:Revision 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>- Domestic renewable power</strong></td>
</tr>
<tr>
<td><strong>- Imported renewable power</strong></td>
</tr>
<tr>
<td><strong>- CCGT</strong></td>
</tr>
<tr>
<td><strong>- Coal - fired power</strong></td>
</tr>
<tr>
<td><strong>- Nuclear power</strong></td>
</tr>
<tr>
<td><strong>- Power import</strong></td>
</tr>
</tbody>
</table>

- Risk concerns
  - Subsidy burden
  - Uncertainty
  - More imported gas needed
  - People’s acceptance / CO2
  - Complex permit process
  - Energy security

- “.... to avoid the risk of the natural gas acquiring from sources in the western part of Thailand, in case of no natural gas supply, ..... “ (PDP2010:Revision 3)

- The Thai power grid is interconnected with adjacent countries to import electricity so far. But, in case that a surplus of generation is realized, they can export electricity outside in the future by the broader network in the region accordingly.
Growth Changes Energy Policy Dramatically

- **Energy Security**
  - Countries with higher growth rate become the countries that import more energy (fuels and electricity), securing their energy policies through an adequate portfolio of origin countries of production by the measures of mixing fuel types, and by raising self-supply sufficiency through renewables and nuclear.
  - Energy import should not depend on a single type of fuel such as pipeline gas, LNG, or coal.
  - When international financing is needed, the main sources will be under the credit cover by MDBs/ECAs.
  - China’s leading fund will also join Asian infrastructure financing.

- **Energy Efficiency**
  - **Supply efficiency**
    - High efficiency CCGT for natural gas, Clean Coal Technologies for coal, and improvements / R&D for wind and solar power are important. China is new entrant and has potential in such areas, except gas turbines.
    - To ensure the long-term reliability of a plant, qualified technical governances for operation and maintenance will be more important. Japan and South Korea may have strengths in this area.
  - **Demand efficiency**
    - More introduction of co-generation, demand-response, and efficient apparatus such as LED will be “no-regret options” for every country.
Energy Cooperation in the Region

• Change of differentiated values of each country
  China
  - The creation of large power market
  - Mass production of heavy equipment
  - Natural gas & coal exploration world wide
  - Energy networking with adjacent areas such as Indochina and corridor along the west
  - Potential financing to developing countries, etc.
  Japan and South Korea
  - Qualified technical governance in production and operation/maintenance
  - Qualified project management
  - Financing potentials by private and public sectors
  - Diversified R&D, etc.
  ASEAN countries
  - Enhancing the power market through industrial growth and amelioration of life-style
  - Improvement of regional energy usage through inter-state power grid and gas connections
  - To join natural gas explorations world wide, etc.

• These combinations of new values create next cooperation relationships.
J-POWER
Selected R&D and Engineering
Toward New Value
We achieved the world’s highest level of thermal efficiency at Isogo PS unit 2 as a result of our continuous R&D for energy efficiency improvement for decades.

Measures for improving generation efficiency
- Improve steam conditions
- Enlarge plant scale

Installed gross thermal efficiency (% based on HHV)

- Takasago (250MW x 2 Units): 566 / 538°C
- Isogo New No.2* (600MW): 600 / 620°C
- Tachibannawan (1,050MW x 2 Units): 600 / 610°C
- Matsuura No.2 (1,000MW): 593 / 593°C
- Matsuura No.1 (1,000MW): 538 / 566°C
- Itoigawa (15.6MW x 2 Units): 566 / 566°C
- Takahara No. 3 (700MW): 538 / 566°C
- Isogo New No.1* (600MW): 600 / 610°C
- Takehara No.1 (250MW): 566 / 538°C

Trends in capacity per unit
New Isogo: The world’s leading USC Coal Power Plant

Isogo Coal-Fired Power Plant
opened in 1967

New Isogo Coal-Fired Power Plant
Unit 1 opened in 2002, Unit 2 in 2009

17% of CO2 Intensity improvement

Numbers in ( ) are for Unit #1

Capacity 530MW (265MW × 2) 1200MW (600MW × 2)

SOx 60ppm 10ppm (20)
NOx 159ppm 13ppm (10)
PM 50mg/m3N 5 mg/m3N (10)

Steam Subcritical Ultra-Supercritical

Efficiency (gross HHV) 38% 43%
CO2 Intensity (Net) 100 (base) 83
Minimized SOx and NOx

- Emissions of SOx and NOx from Isogo PS is much less than those from other fossil-fuel power plants in developed countries due to the advanced DeSOx and DeNOx system.

**Synthesis of Coal, Oil, Gas Power**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>America</td>
<td>1.7</td>
<td>0.7</td>
<td>0.3</td>
<td>0.21</td>
</tr>
<tr>
<td>Canada</td>
<td>2.5</td>
<td>0.7</td>
<td>0.4</td>
<td>0.2</td>
</tr>
<tr>
<td>UK</td>
<td>1.6</td>
<td>0.9</td>
<td>0.6</td>
<td>0.01</td>
</tr>
<tr>
<td>France</td>
<td>1.6</td>
<td>0.9</td>
<td>0.4</td>
<td>0.51</td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J-POWER</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isogo</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sources:**
## J-Power’s Development of Oxygen-blown IGCC

### EAGLE project

<table>
<thead>
<tr>
<th>Year</th>
<th>Details</th>
</tr>
</thead>
</table>
| 1995 - 2014 | - Development of Japanese oxygen-blown entrained bed coal gasifier  
- Establishment of gas clean-up technology  
- Coal type expansion  
- Establishment of CO₂ capture technology (chemical absorption and physical absorption) |

### Results

- ✔ Developed coal gasifier with the world’s top-grade efficiency of gasification.  
- ✔ Cut CO₂ capture energy consumption by 30% (2 points up in power generation efficiency) compared to conventional technology (chemical absorption).

### Osaki CoolGen project (170MW-class IGCC power plant)

<table>
<thead>
<tr>
<th>Year</th>
<th>Details</th>
</tr>
</thead>
</table>
| 2009 - 2012 | ✔ Verifying reliability, economy and operation of oxygen-blown IGCC power plant for practical application.  
- Environmental assessment and feasibility study |
| 2012 - 2016 | - Design and construction |
| 2016 - 2018 | - Demonstration of IGCC |
| 2019 - 2020 | - Demonstration of IGCC & CO₂ capture |
| After 2020 | - Demonstration of IGFC & CO₂ capture |

---

* Under government support
** Under government support

In association with Chugoku Electric Co., Inc.
J-Power’s Sea-Water Pumped Storage Power Plant as a Battery for Renewable Energy

Okinawa Yambaru sea-water pumped storage power station (30MW) is the world's first pumped storage power plant using sea water.

Outline of the plant

Upper Pond
- Diameter: 252 m
- Storage: 8 hours

Penstock: FRP
Pump/Turbine: Variable speed

Underground cavern for powerhouse
- Depth: 180 m
- Width: 16 m
- Length: 40 m
J-POWER Company Profile (1) - Japan

J-POWER, established in 1952 as a semi-government owned organization under Japan’s Electric Power Development Promotion Law, has been serving electric power throughout Japan for more than 6 decades.

Generating Facilities in Japan (2014)
- Hydropower 8,556 MW
- Thermal power 8,374 MW
- Geo-thermal 15 MW
- Wind power 381 MW
- Nuclear Power 1,383 MW*

* under construction

http://www.jpower.co.jp/english/

Tagokura Hydropower Station
Isogo Thermal Power Station
Koriyama-Nunobiki Kogen Wind Farm
J-POWER Company Profile (2) - Overseas

• Since fully privatized and listed in the Tokyo Stock Exchange in 2004, J-POWER has expanded its business frontier aggressively by exploring energy related business overseas.

• Currently, J-POWER owns electric power generation assets in Japan, China, Poland, Taiwan, Thailand, Philippines, Indonesia (planned), and the United States.

In operation (7 countries & region) 36 Projects

Under construction/Planned (2 countries) 2 projects

Orange Grove Power Station (CA)
J-POWER USA Profile

- Established in 2005 as a wholly owned subsidiary of J-POWER.
- Head office in Schaumburg, IL with 30 professional staff in a wide range of disciplines: development, finance, asset management, operations and accounting.

- Assembled a high-quality and largely contracted portfolio of assets through acquisition and development: current size is approx. 2,800MW*.

  * Including Joint Venture (JV) with John Hancock Life Insurance Company

- Excellent access to capital markets and low cost financing.

J-POWER USA’s Power Generation Assets

<table>
<thead>
<tr>
<th>Project</th>
<th>State</th>
<th>COD</th>
<th>MW</th>
<th>Generation Type</th>
<th>Power Purchaser</th>
<th>Share [%]</th>
<th>Acquired Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frontier</td>
<td>TX</td>
<td>2000</td>
<td>830</td>
<td>CCGT</td>
<td>Exelon</td>
<td>31</td>
<td>2006</td>
</tr>
<tr>
<td>Elwood</td>
<td>IL</td>
<td>1997-2001</td>
<td>1,350</td>
<td>CCGT</td>
<td>Exelon Constellation</td>
<td>25</td>
<td>2007</td>
</tr>
<tr>
<td>Green Country</td>
<td>OK</td>
<td>2002</td>
<td>795</td>
<td>CCGT</td>
<td>Exelon</td>
<td>50</td>
<td>2007</td>
</tr>
<tr>
<td>Birchwood</td>
<td>VA</td>
<td>1996</td>
<td>242</td>
<td>Coal</td>
<td>VEPCO</td>
<td>50</td>
<td>2008</td>
</tr>
<tr>
<td>Fluvanna</td>
<td>VA</td>
<td>2004</td>
<td>885</td>
<td>CCGT</td>
<td>Coral Power</td>
<td>15</td>
<td>2008</td>
</tr>
<tr>
<td>Pinelawn</td>
<td>NY</td>
<td>2005</td>
<td>80</td>
<td>CCGT</td>
<td>LIPA</td>
<td>50</td>
<td>2008</td>
</tr>
<tr>
<td>Equus</td>
<td>NY</td>
<td>2004</td>
<td>48</td>
<td>GT-Simple Cycle</td>
<td>LIPA</td>
<td>50</td>
<td>(Developed)</td>
</tr>
<tr>
<td>Edgewood</td>
<td>NY</td>
<td>2002</td>
<td>80</td>
<td>GT-Simple Cycle</td>
<td>SDG&amp;E</td>
<td>50</td>
<td>2010</td>
</tr>
<tr>
<td>Shoreham</td>
<td>NY</td>
<td>2002</td>
<td>80</td>
<td>JET fuel GT</td>
<td>SDG&amp;E</td>
<td>50</td>
<td>2010</td>
</tr>
<tr>
<td>Orange Grove</td>
<td>CA</td>
<td>2010</td>
<td>96</td>
<td>GT-Simple Cycle</td>
<td>SDG&amp;E</td>
<td>50</td>
<td>(Developed)</td>
</tr>
</tbody>
</table>

www.jpowerusa.com/
Thank you