Electricity Spot Markets:
The Singapore Experience

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Vice President, Energy Market Company, Singapore
Presentation Outline

• Path to Market Liberalization
  – Background and Considerations

• NEMS: The First Few Years
  – Steps taken and Market Performance

• Looking Forward
  – Further Enhancements
Path to Market Liberalization
Geography

- 5.1 Million people
- 40km x 20km
- 2nd most densely populated nation
- 4th highest GDP per capital
## Demand Characteristics

### Demand Characteristic (2012) - Singapore

<table>
<thead>
<tr>
<th>Demand Characteristic</th>
<th>Singapore</th>
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</thead>
<tbody>
<tr>
<td>Peak Demand</td>
<td>6,386 MW</td>
</tr>
<tr>
<td>Total Annual Load</td>
<td>44,175 GWh</td>
</tr>
<tr>
<td>Projected Annual Load Growth</td>
<td>2.5-3%</td>
</tr>
<tr>
<td>Estimated distribution of load</td>
<td></td>
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<tr>
<td>Households</td>
<td>17%</td>
</tr>
<tr>
<td>Commercial and Industrial</td>
<td>83%</td>
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</tbody>
</table>
May 1963 – Public Utilities Board (PUB) formed
• Supplies water/electricity/gas to Singapore

Oct 1995 – Corporatisation of electricity/gas
• Holding company (Singapore Power) owning:
  ❖ 2 gencos (PowerSenoko, PowerSeraya)
  ❖ 1 transmission/distribution company (PowerGrid)
  ❖ 1 electricity retail company (Power Supply)
  ❖ 1 gas supply company (PowerGas)
• Temasek Holdings owning 1 genco (Tuas Power)
Vertical integration to competition

Apr 1998 – Singapore Electricity Pool
Mar 2000 – Decision to deregulate further
Apr 2001 – Further restructuring:
  • PUB restructured as water authority
  • EMA regulate electricity and gas industries
  • PSO take over system operations
  • EMC formed to operate and administer wholesale electricity market
Target Outcomes for Consumers

- **Reliable Service** (no blackouts)
- **Low Prices** (but high enough to be sustainable for gencos)
- **Fairly Predictable Bills** (no extreme price volatility)
- **Value-Added Services** (e.g. different packages to suit consumers’ needs)
Problems with Traditional Structure

Cost Pass-through/Cost-based tariffs lead to:

- Over-Investment and Excess Capacity
- Slow Adoption of Efficient Technologies
- High prices with Supernormal Profits
- Firm not given correct incentives/penalties for making optimal decisions
Reform Steps Taken

• Diffusion of Market Concentration – Break up large entities and encourage new entrants

• Non-Discriminatory Access to essential infrastructure

• Remove price and entry controls

• Set up Independent System Operator - system security without any asset ownership

• Set up Independent Regulatory Body - Regulate natural monopolistic functions

• Retail Competition - Allow consumers to choose retailers in phases
# Challenges and Response

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Singapore’s Response</th>
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</thead>
<tbody>
<tr>
<td>• Consumers exposed to true, volatile costs of supply</td>
<td>• Fixed price tariffs for smaller consumers</td>
</tr>
<tr>
<td>• Customers are not responsive to prices</td>
<td>• Implementation of price caps</td>
</tr>
<tr>
<td>• Concentrated market with few sellers</td>
<td>• Introduction of Demand response</td>
</tr>
<tr>
<td>• Certain functions remain natural monopolies</td>
<td>• Demand tend to be inelastic</td>
</tr>
<tr>
<td>• Changing market conditions</td>
<td>• Vesting Contracts to control market power</td>
</tr>
<tr>
<td></td>
<td>• Market Surveillance and Compliance by independent body and regulator</td>
</tr>
<tr>
<td></td>
<td>• Regulator to determine regulated revenue framework</td>
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<tr>
<td></td>
<td>• Dynamic framework to evolve market</td>
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## Government Intervention

<table>
<thead>
<tr>
<th>Function</th>
<th>Implications</th>
<th>Intervention</th>
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</thead>
<tbody>
<tr>
<td><strong>Generation</strong></td>
<td></td>
<td></td>
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<tr>
<td>Oligopoly</td>
<td>• Exercise localised market power (LMP)</td>
<td>• Vesting / must-run for LMP</td>
</tr>
<tr>
<td>facing inelastic demand</td>
<td>• Gaming &amp; collusion</td>
<td>• Licensing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Legislation to prohibit anti-competitive behaviour (e.g.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Electricity Act)</td>
</tr>
<tr>
<td><strong>Transmission &amp; Distribution</strong></td>
<td>• May charge high prices / Practice discrimination</td>
<td>• Regulated returns</td>
</tr>
<tr>
<td>Natural Monopoly</td>
<td>• Under-/over-investment</td>
<td>• Licensing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Set service standards and requirements</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Ensure non-discriminatory access (e.g. transmission code)</td>
</tr>
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<tr>
<td><strong>Retail</strong></td>
<td>• Retail competition may result in cherry-picking by retailers</td>
<td>• Provider of last resort, with regulated returns</td>
</tr>
<tr>
<td><strong>Customers choose retailers and vice versa</strong></td>
<td></td>
<td>• Set performance standards (e.g. code of conduct for retail electricity licensee)</td>
</tr>
</tbody>
</table>
Key Reform Principles

- **Unbundling of Key Functions** → Transmission, Generation, Retail, Market Operation, System Operation, Market Support Services

- **Separation of Contestable and Non-Contestable Businesses** → Operational separation, followed by ownership separation.

- **Contestable Businesses** → Introduce Competition in Generation and Retail

- **Non-Contestable Businesses** → Regulation of Transmission, Market Operation, System Operation, Market Support Services

- **Privatisation of Generation and Retail Assets**
NEMS: The First Few Years...
Key Features of the NEMS

- Mandatory “real-time” pool-based model
- Merit-order dispatch based on generation offer stack with no demand side bidding
- Sophisticated nodal price system to model power flow, losses and constraints
- Market Clearing Engine co-optimizes across energy and reserves
Key Features of the NEMS

- Generators paid nodal prices; Retailers pay weighted average nodal prices
- Large consumers buy from retailers at spot or negotiated fixed tariffs
- Small consumers buy from Singapore Power at regulated tariffs, supported by vesting contracts
- Vesting contracts computed by Regulator based on hypothetical cost of new entrant (fuel costs, fixed costs)
Market Concentration at Market Start

Concentrated market with 3 Generators controlling more than 80% market share

Market Share by Generator 2003/04 (based on scheduled generation)
USEP, System Demand and Offered Capacity (2004)

Episodes of price volatility
Electricity and Fuel Price Movements

2005 to 2008
- Spot price keeping pace with Tariff movements
- Both did not match sharp rise in oil prices – likely efficiency gains passed on to consumers
2009-2012
- V-shaped economic recovery drives strong electricity demand
- Spot price matching fuel prices
2013
- Capacity investments initiated in 2009/2010 comes to fruition in 2013/2014
- Excess capacity leads to fall in spot prices
Generation Mix (2003-2013)

Gradual Shift to more efficient CCGT units
NEMS Cost Benefit

- Regulator commissioned PWC to conduct Cost-Benefit Analysis of NEMS in 2006

<table>
<thead>
<tr>
<th>Item</th>
<th>2002/03*</th>
<th>2003/04*</th>
<th>2004/05*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production Cost Benefit</td>
<td>31.2</td>
<td>123.8</td>
<td>96.0</td>
<td>251.0</td>
</tr>
<tr>
<td>Economy Wide Benefit</td>
<td>-3.0</td>
<td>13.0</td>
<td>25.0</td>
<td>35.0</td>
</tr>
<tr>
<td><strong>Total Benefit</strong></td>
<td><strong>28.2</strong></td>
<td><strong>136.8</strong></td>
<td><strong>121.0</strong></td>
<td><strong>286.0</strong></td>
</tr>
<tr>
<td>NEMS Once off Costs</td>
<td>-103.1</td>
<td></td>
<td></td>
<td>-103.1</td>
</tr>
<tr>
<td>NEMS Ongoing Costs</td>
<td>-11.5</td>
<td>-28.2</td>
<td>-28.6</td>
<td>-68.3</td>
</tr>
<tr>
<td>SEP Ongoing Costs</td>
<td>1.6</td>
<td>6.2</td>
<td>6.2</td>
<td>14.0</td>
</tr>
<tr>
<td><strong>Cost Differential</strong></td>
<td>-113.0</td>
<td>-22.0</td>
<td>-22.4</td>
<td>-157.4</td>
</tr>
<tr>
<td><strong>Net Benefit</strong></td>
<td>-84.8</td>
<td>114.8</td>
<td>98.6</td>
<td>128.6</td>
</tr>
</tbody>
</table>
Looking Forward…
Singapore’s LNG terminal

- LNG terminal with initially 3.5 million tonnes per annum (Mtpa) commenced operations in May 2013
- BG as LNG aggregator with exclusive rights to import 3 Mtpa
- LNG may provide entry point to international gas pricing in the future
- EMC working with SGX on LNG marker and secondary gas market
Future Developments

• April, Oct 2014 – Increased Retail Competition, gradual rollout to consumers with monthly consumption below 4MWh

• Oct 2014 – Rollout of Electricity Futures Market by SGX

• Dec 2015 – Implementation of Demand Response Program

• Import of Electricity
Thank you