Singapore’s Electricity Industry
About the Energy Market Authority (EMA)

- Formed in 2001, EMA is the lead agency for energy matters in Singapore – a statutory board under the Ministry of Trade and Industry. In addition, EMA is the economic and technical regulator of Singapore’s electricity and gas industries.

**Mission**

*To Forge a Progressive Energy Landscape for Sustained Growth*

**Key Policy Objectives**

**A Secure Energy Supply: Power System Operation**
- Reliability
- Security
- Stability

**A Competitive Energy Market: Regulation**
- Electricity
- Gas
- District Cooling

**A Dynamic Energy Sector: Energy Planning & Development**
- Planner
- Promoter
- Development
Reform of Singapore’s Electricity Industry

- Singapore’s electricity industry had traditionally been vertically integrated and Government-owned.

- Restructuring of electricity industry began in 1995, and continued through 2000, where the government decided to press on with further liberalisation of the electricity industry and obtain the full benefits of competition.

**Key Initiatives for Restructuring:**

- Clear separation of competitive businesses (contestable) from natural monopolies (non-contestable) to ensure level playing field; and

- Open access to monopoly infrastructure.
Electricity Industry Structure

- Power Generation Companies
  - SP PowerGrid
  - SP Services
  - Electricity Retailers

- Consumers
  - Non-Contestable: < 4,000 kWh (mainly households)
  - Contestable: ≥ 4,000 kWh (Industrial/commercial users)

- Non-Contestable Sector
- Contestable Sector

- EMA
  - Industry Regulator
  - Industry Promoter & Developer
  - System Operator

- EMC
  - Wholesale Market Operator

Smart Energy, Sustainable Future
Installed capacity = 13,208 MW
Typical Daily System Demand

% OF MAXIMUM DEMAND

TIME OF DAY

WEEKDAY
SATURDAY
SUNDAY

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Monthly Peak Demand Profile

10-Year Maximum Demand (2005 - 2014)

- Peak Demand (MW)

- 6880 MW

- 2014

- 2013

- 2012

- 2011

- 2010

- 2009

- 2008

- 2007

- 2006

- 2005

- JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC

Energy Market Authority
Power System Overview

- **400kV Network**
  - Tuas Seraya
  - Senoko Seraya SembCogen KeppelCogen ExxonMobil PacificcLight
  - 6 Substations

- **230kV Network**
  - 28 Substations

- **66kV Network**
  - 117 Substations

- **22kV and 6.6kV Network**
  - ~10,000 Substations

- **Low Tension Network 400/230 Volts**
  - ~25,000 Over Ground Boxes

- **Ultra High Tension Consumer (1)**

- **Extra High Tension Consumers (~25)**

- **High Tension Consumers (~1000)**

- **Low Tension Consumers (~1.3 Million)**

- **Distributed Generators**

- **Solar PVs**

- **Jurong Shell Ular Incineration Plants (Senoko+Keppel+NEA) TMUC**
Transmission & Distribution System

Tuas & Seraya Power Stations

Other Power Stations
Senoko, Seraya, SembCogen, Keppel

400/230kV Transformers

Link to Malaysia

230/66kV Transformers

400V or 230V LV distribution network

66 kV mesh grid

22kV or 6.6kV distribution network

Each unit can support ~ 10 blocks of HDB flats, e.g Clementi Ave 2.

22kV/LV or 6.6kV/LV Transformers

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EMA/ PSO Functions

- Responsible for secure operation of the Power System
- Operates from the Power System Control Centre
- Round the clock monitoring and controlling the electricity transmission system and generators
- Oversee real-time operation of gas transmission system
- Activate contingency plans and coordinate emergency responses of gas/power licensees when the need arises
- Assess generating plants design & performance
- Assess electricity & natural gas systems development plan
1. Sanction Overhaul/Maintenance request
2. Provide Network Status, Outage Schedules & Load Forecast to EMC
3. Dispatch Generating Units according to EMC schedule
4. Sanction Startup/Shutdown of Generating Units
5. Dispatches Ancillary Services
6. Takes full control in times of Emergency
7. Provides Adequacy & Security Assessments to Market
8. Monitor & report non-compliance to dispatch instruction
Market Work Flow

- PSO produces forecast of demand for energy and reserve and sends it to the EMC
- PSO extracts current network condition and send these to EMC
- Market Participants offer Energy, Reserve and Regulation
- EMC produce Dispatch Schedule using Market IT System
- EMC sends Dispatch Schedule to PSO
- EMC publishes Dispatch Schedules
- EMC publishes Market Clearing Prices to Participants
- PSO dispatches Energy and Reserve using MCE Schedule of Energy, Reserve and Regulation
- PSO monitors compliance with dispatch instructions
- Market Assessment Unit (MAU) monitors compliance with market rules, manuals
- MSSL collects and adds up Meter Data
- EMC pays Metered Energy at the Market Price
NEMS Dispatch Schedules

- Market Outlook (MO) Schedule
- Pre-Dispatch (PD) Schedule
- Short Term Schedule (STS)
- Real Time Dispatch (RTD) Schedule

Day D-7
Day D-1
Day D
Day D
Day D

Period P-6hours
Period P

Each Period P-30min

Energy Market Authority
REGULATORY FRAMEWORK
Key Regulatory Objectives

- Level Playing Field
- Transparent rules and consistent application of rules
- Open access
- Low entry and exit barriers
Regulatory Approach

**Contestable Sector**
(Power Generation Companies and Electricity Retailers)
- Clear and transparent regulatory regime
- Rely on market signals
- Ensure level playing field
- Low barriers of entry

**Non-Contestable Sector**
(Natural Monopolies)
(Transmission/Grid Operator, Market Support Services and Wholesale Market Operator)
- Regulate revenue of monopolies
- Incentivise efficient behaviour
- Open access
Competition in Contestable Sector

• In the electricity generation and retail businesses, companies compete with one another for dispatch and customers. By keeping the market competitive, these companies should be unable to raise price at the detriment of consumers.

• However, there are three large Gencos in the electricity generation business. As such, EMA introduced the Vesting Contracts to curb the potential exercise of market power.
Mitigating Market Power

- Introduced in 2004 as a regulatory instrument to curb the potential exercise of market power by the gencos. Specifically, Vesting Contracts:
  - Commit gencos to sell a specified amount of electricity (viz. Vesting Contract level) at a specified price (viz. Vesting Price).
  - Removes incentive for gencos to withhold capacity to bid up spot prices in the wholesale electricity market.

- Vesting contract level and price reviewed every two years:
  - Vesting contract level is set based on projected demand and supply at the point of review and using a game theoretic simulation model to simulate non-collusive interactions among the gencos.
  - Vesting price is set based on the long run marginal cost (LRMC) of the most efficient generation technology that accounts for at least 25% of our system demand.
Economic Regulation of Non-Contestable Sector

- Transmission and Grid Operator, Market Support Services and Wholesale Market Operator are natural monopolies. These companies have the potential to raise price and restrict the quantity/quality of goods and services offered.

**Example: SP PowerAssets (SPPA)**

- SPPA is the entity that owns the national electricity transmission system used to transmit electricity from gencos to consumers.

- Consumers pay grid charges (also known as UOS charges) to SPPA. Consumers connected at HT and above need to contract for capacity with SPPA and pay contracted capacity charges.

- SPPA’s average grid charges are regulated by EMA and are determined under its 5-year regulatory framework.
Price-Regulation Framework

• Building Block approach

• Allowed Revenue = operating costs + depreciation + taxes + allowed return

• Incentive mechanism to incentivise efficient behaviour

• 5-year Regulatory period - Parameters are fixed during the 5-year period.
Results of Market Liberalisation

- Competition has motivated gencos to **switch from oil-fired steam plants to more cost efficient gas-fired plants**. As a result, while average oil prices in Q4 2014 are about six times higher compared to the average fuel price in 1995, electricity tariff in Q1 2015 has only risen by about 70%.
Results of Market Liberalisation

- Liberalisation of the electricity market has also seen consumers benefit from greater choice of retailers, and pricing plans. Today, around 80% of demand have retail choice, and we are working on how to let the remaining 20% also enjoy the benefits of competition.

- In the monopoly sector, regulation has also brought about lower rates, while maintaining the high performance of the grid.