

Electricity Spot Markets: The Singapore Experience

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- 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

Southeast Asia



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

Demand Characteristics

Demand Characteristic (2012)	Singapore
Peak Demand	6,386 MW
Total Annual Load	44,175GWh
Projected Annual Load Growth	2.5-3%
Estimated distribution of load	
Households	17%
Commercial and Industrial	83%

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**)
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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)



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
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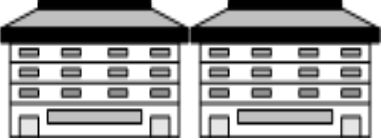
Challenges and Response

Challenges	Singapore's Response
<ul style="list-style-type: none"> • Consumers exposed to true, volatile costs of supply 	<ul style="list-style-type: none"> • Fixed price tariffs for smaller consumers • Implementation of price caps
<ul style="list-style-type: none"> • Customers are not responsive to prices 	<ul style="list-style-type: none"> • Introduction of Demand response • Demand tend to be inelastic
<ul style="list-style-type: none"> • Concentrated market with few sellers 	<ul style="list-style-type: none"> • Vesting Contracts to control market power • Market Surveillance and Compliance by independent body and regulator
<ul style="list-style-type: none"> • Certain functions remain natural monopolies 	<ul style="list-style-type: none"> • Regulator to determine regulated revenue framework
<ul style="list-style-type: none"> • Changing market conditions 	<ul style="list-style-type: none"> • Dynamic framework to evolve market

Government Intervention

Function	Implications	Intervention
<p>Generation</p>  <p>Oligopoly facing inelastic demand</p>	<ul style="list-style-type: none"> • Exercise localised market power (LMP) • Gaming & collusion 	<ul style="list-style-type: none"> • Vesting / must-run for LMP • Licensing • Legislation to prohibit anti-competitive behaviour (e.g. Electricity Act)
<p>Transmission & Distribution</p>  <p>Natural Monopoly</p>	<ul style="list-style-type: none"> • May charge high prices / Practice discrimination • Under-/over-investment 	<ul style="list-style-type: none"> • Regulated returns • Licensing • Set service standards and requirements • Ensure non-discriminatory access (e.g. transmission code)

Government Intervention

Function	Implications	Intervention
<p style="text-align: center;">Retail</p>  <p style="text-align: center;">Customers choose retailers and vice versa</p>	<ul style="list-style-type: none"> • Retail competition may result in cherry-picking by retailers 	<ul style="list-style-type: none"> • Provider of last resort, with regulated returns • Set performance standards (e.g. code of conduct for retail electricity licensee)

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

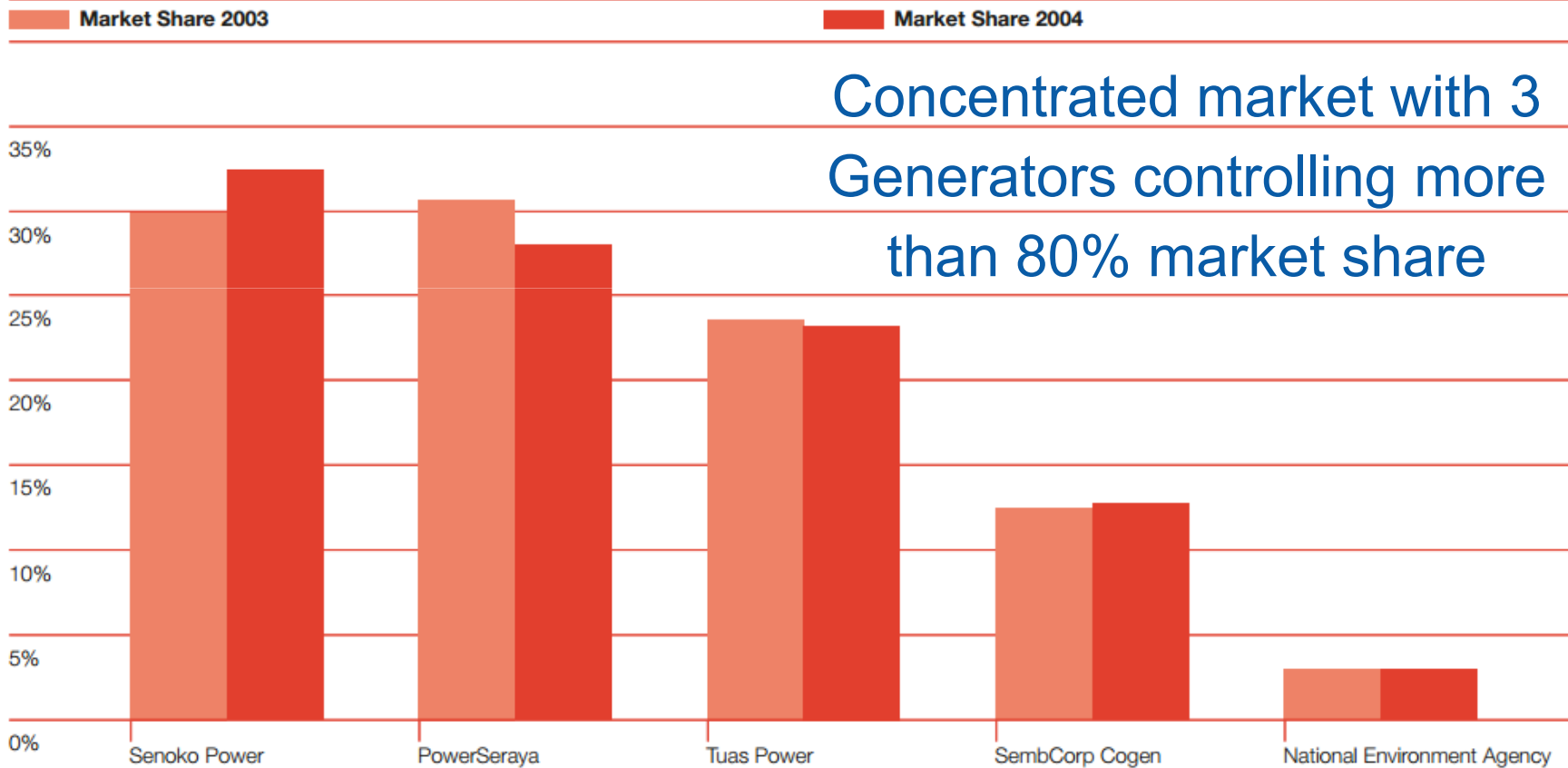
- Mandatory “real-time” pool-based model
- Merit-order dispatch based on generation offer stack with no demand side bidding
- Sophisticated nodal price system to model power flow, losses and constraints
- Market Clearing Engine co-optimizes across energy and reserves

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)

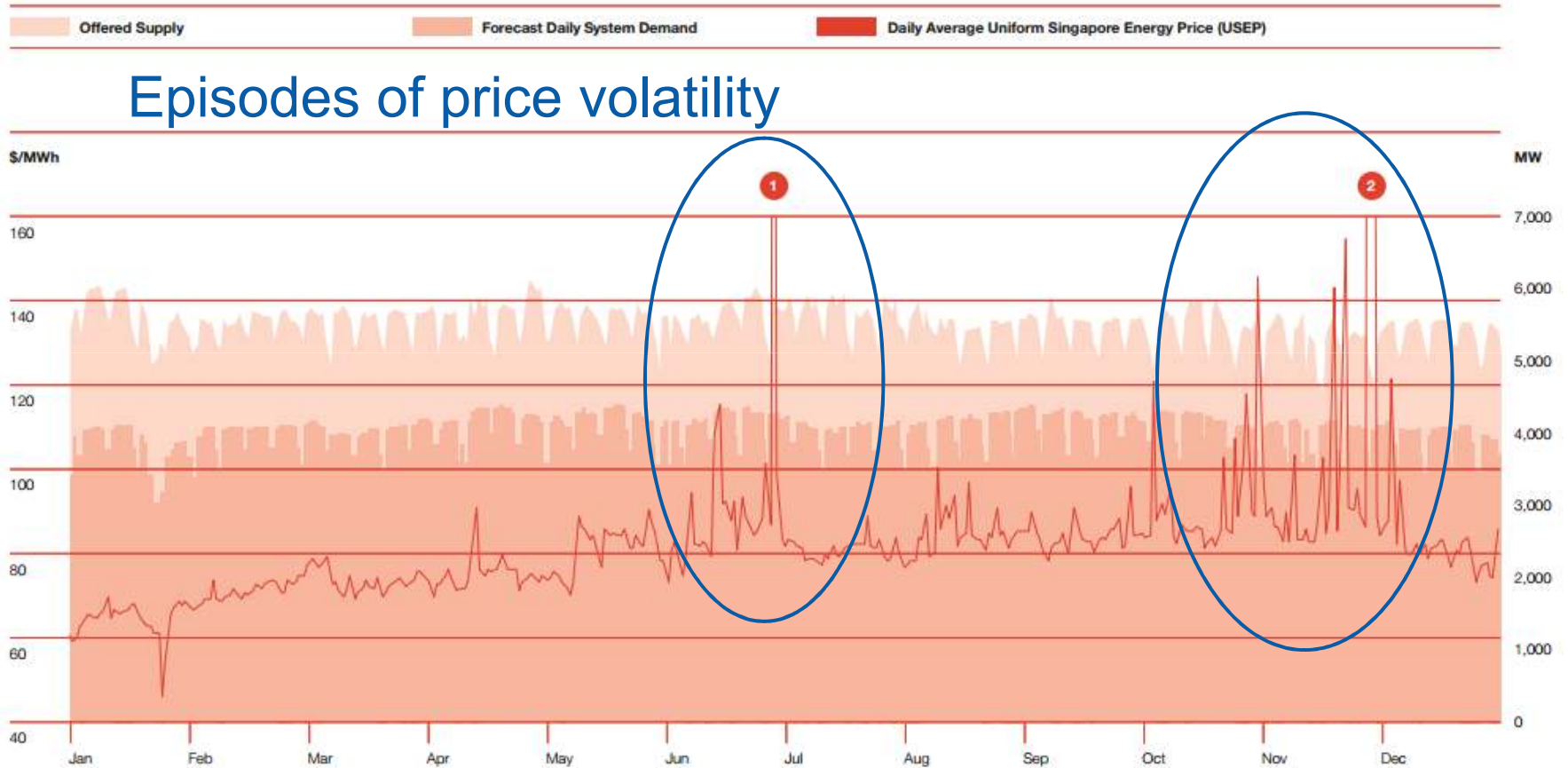
Market Concentration at Market Start

Market Share by Generator 2003/04 (based on scheduled generation)

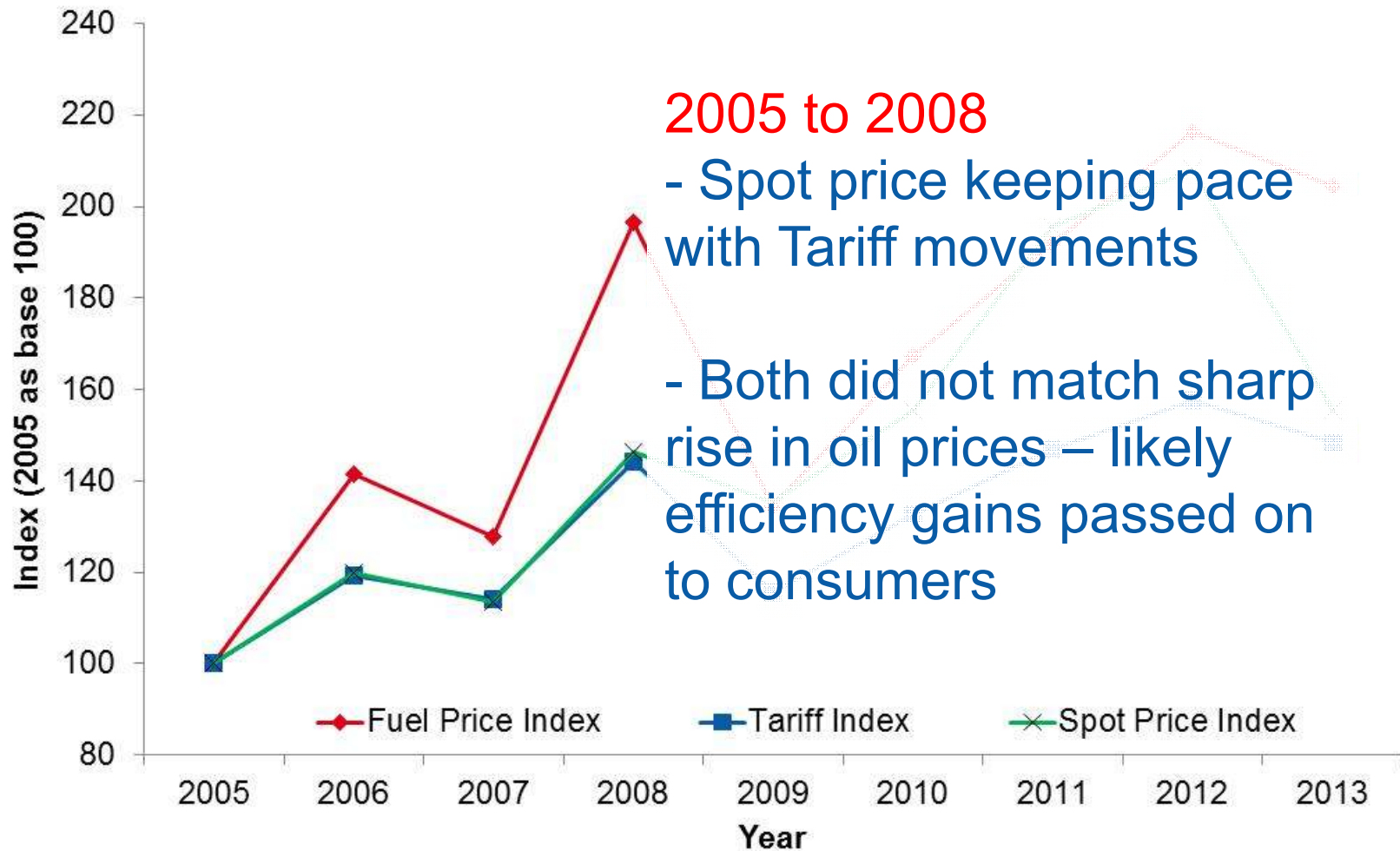


Concentrated market with 3 Generators controlling more than 80% market share

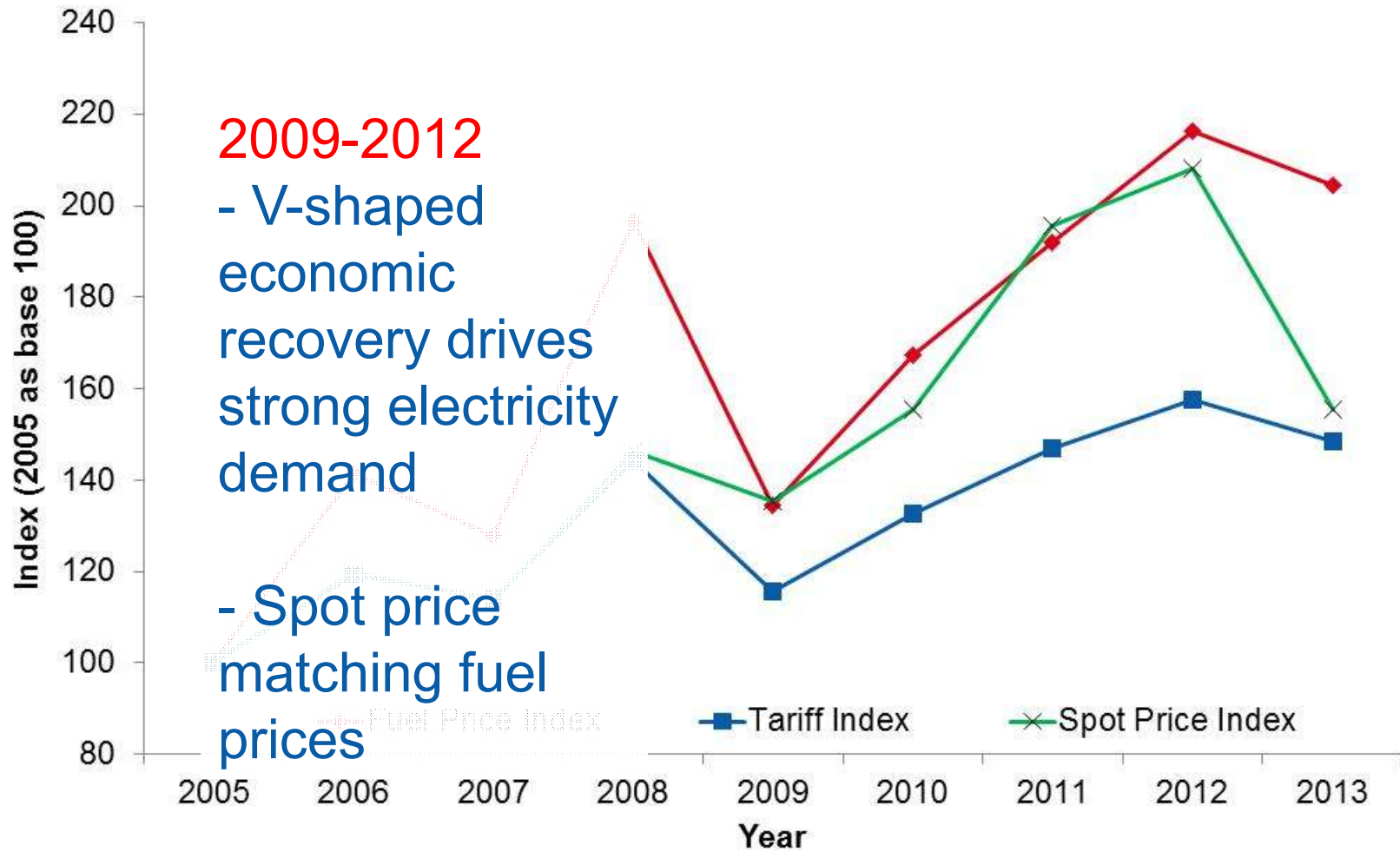
USEP, System Demand and Offered Capacity (2004)



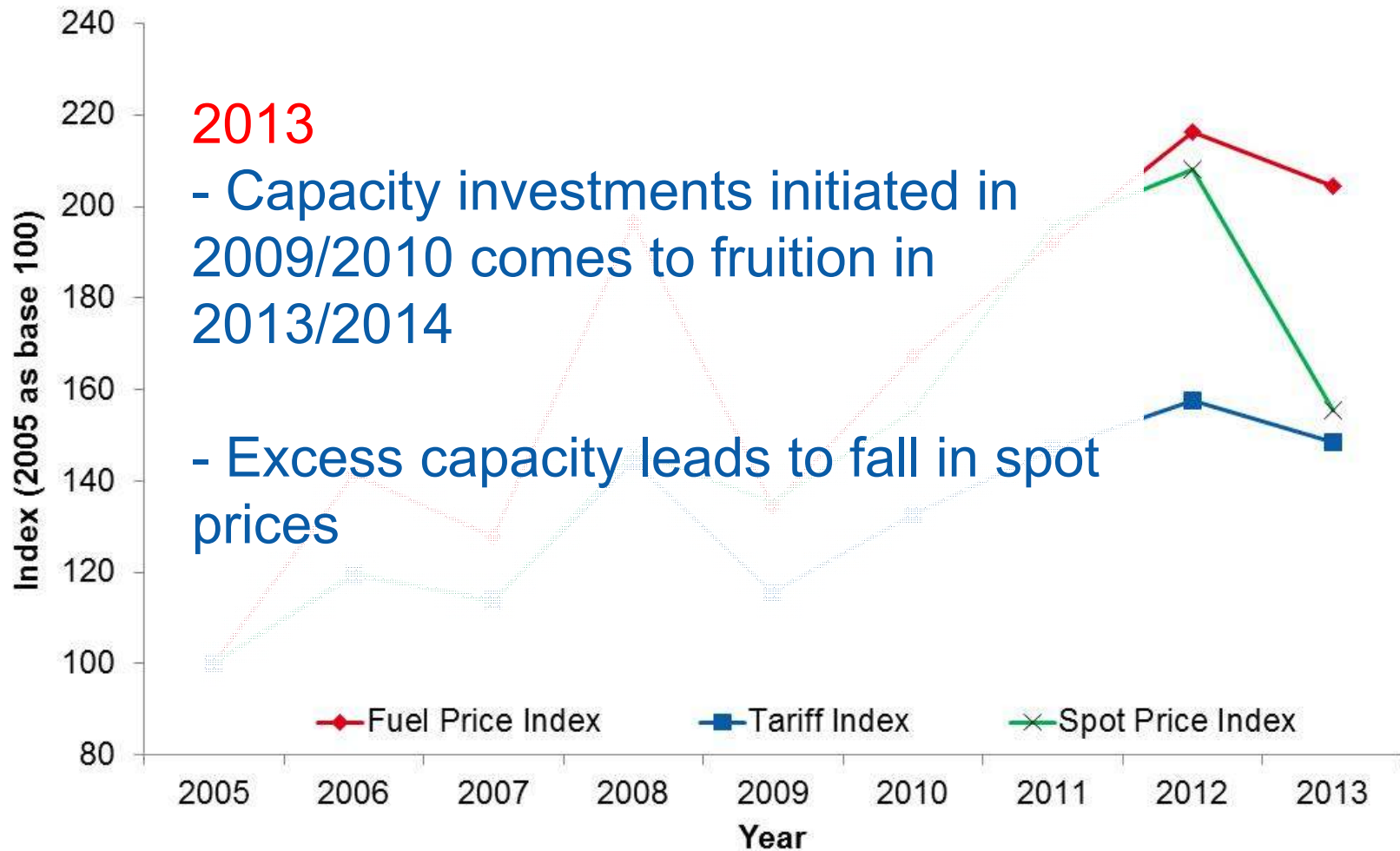
Electricity and Fuel Price Movements



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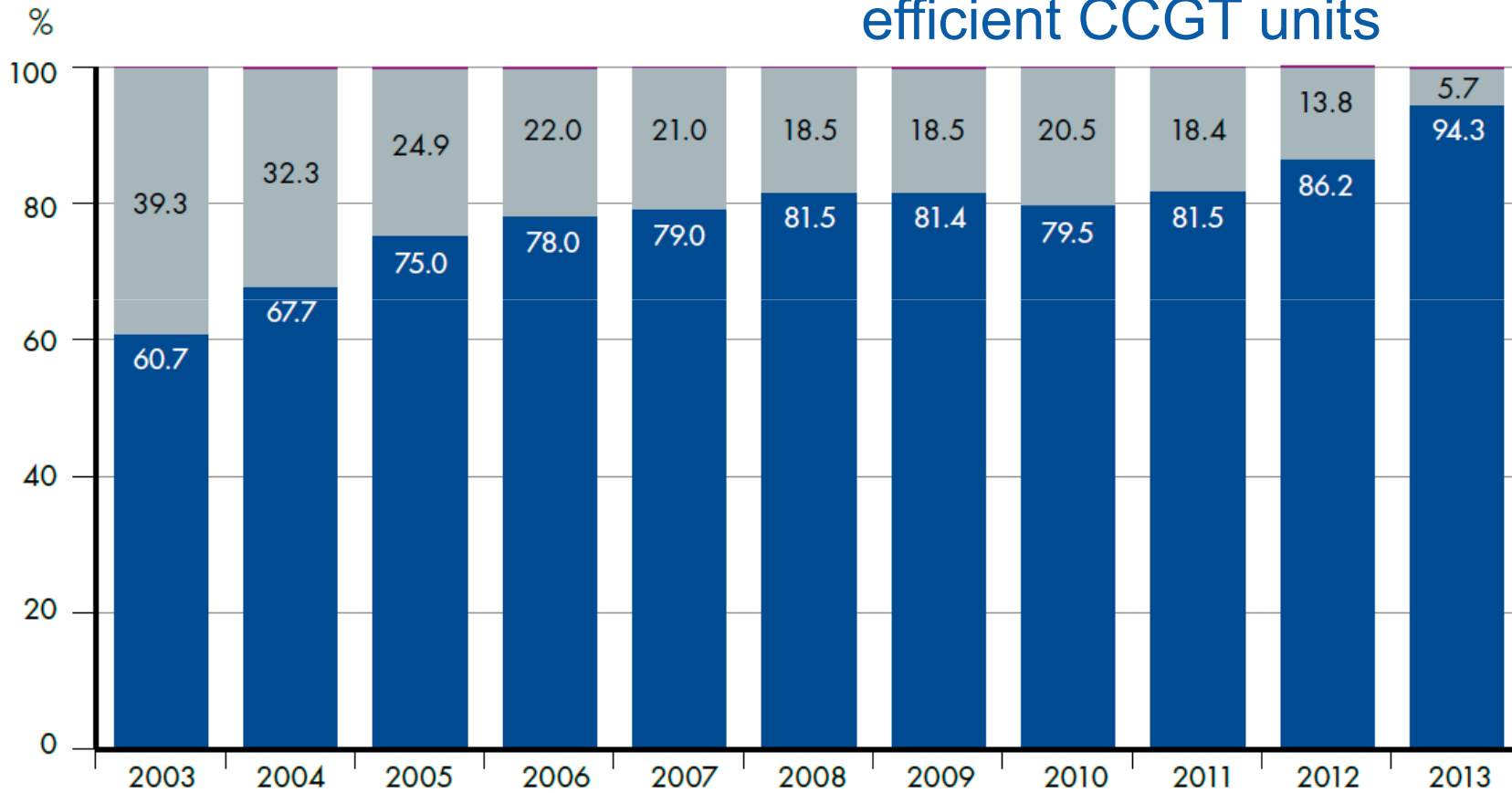
Electricity and Fuel Price Movements



Generation Mix (2003-2013)

■ CCGT/Cogen/Trigen ■ ST ■ GT

Gradual Shift to more efficient CCGT units



NEMS Cost Benefit

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

Item	2002/03*	2003/04*	2004/05*	Total
Production Cost Benefit	31.2	123.8	96.0	251.0
Economy Wide Benefit	-3.0	13.0	25.0	35.0
Total Benefit	28.2	136.8	121.0	286.0
NEMS Once off Costs	-103.1			- 103.1
NEMS Ongoing Costs	-11.5	-28.2	-28.6	- 68.3
SEP Ongoing Costs	1.6	6.2	6.2	14.0
Cost Differential	- 113.0	- 22.0	- 22.4	- 157.4
Net Benefit	- 84.8	114.8	98.6	128.6

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 market 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