

WHOLESALE ELECTRICITY MARKET REPORT

2003

nems

National
Electricity
Market of
Singapore

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The commencement of the National Electricity Market of Singapore (NEMS) on 1 January 2003 is an achievement of which Singapore can be proud. The electricity industry plays a vital role in the nation's economy. The wholesale functions of the NEMS are the principal mechanisms through which Singapore achieves competitively priced electricity and encourages efficient investment decisions.

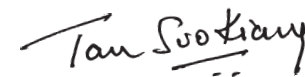
Establishing the NEMS required the cooperation and support of Singapore's entire electricity industry. The market implementation project, which began in 2001, required the creation of new organisations such as the Market Operator, the Energy Market Company (EMC), the reorganisation of existing organisations such as the Power System Operator (PSO), and changes in the way all participants approached and conducted their businesses. I wish to congratulate the industry and the Energy Market Authority for successfully launching the NEMS and thank all participants in the project for their commitment and diligence.

The first year of trading in the NEMS not only demonstrated that competitive wholesale electricity markets can deliver real benefits, but it also proved that the NEMS design is robust and that market participants respond efficiently to changes in market fundamentals. It was pleasing to observe that, even at times when the market came under stress (for example during the natural gas supply disruption in November 2003), price signals gave appropriate incentives

to generators to offer additional capacity, and, as a result, system security was not compromised.

With the opening of the NEMS, the market governance panels were also formally established. I would like to thank the members of the Rules Change Panel, the Market Surveillance and Compliance Panel, the Dispute Resolution Counsellor and the Disputes and Compensation Resolution Panel for their important contribution to the integrity and success of the market. In addition, I would like to thank my fellow members of the EMC Board and all the EMC staff for their hard work and support.

Looking ahead, the NEMS faces a number of key challenges as it continues to develop and mature. I am confident that the wholesale market structures, rules and systems that have been established are world-class and provide a robust platform for an efficient industry and ongoing evolution. It is therefore critical that any future changes to the regulatory environment, the retail electricity market and the gas market are consistent with what is now in place and supportive of the ongoing success of the NEMS.



Tan Soo Kiang
Chairman
Energy Market Company

CHAPTER

01 Introduction To The National Electricity Market Of Singapore

02 > MARKET LIBERALISATION

The opening of the National Electricity Market of Singapore (NEMS) in 2003 is the culmination of a number of structural changes to Singapore's electricity industry. Singapore's journey through liberalisation started in 1995, when industry assets began to be put on a commercial footing to facilitate competition and as a precursor for eventual privatisation. In 1998, the Singapore Electricity Pool (SEP), a day-ahead cost-based market, began operation.

The NEMS represents a progression from the SEP to what will eventually be fully competitive wholesale and retail electricity markets. The NEMS places Singapore at the forefront of an international movement to introduce market mechanisms into the electricity industry. This restructuring is viewed by many as a way of:

- ✘ attracting private investment
- ✘ increasing the efficiency of government assets
- ✘ sending accurate price signals
- ✘ encouraging innovation
- ✘ providing consumer choice

Differences between the SEP and the NEMS

	The Singapore Electricity Pool (SEP)	The National Electricity Market of Singapore (NEMS)
Trading process	<p>Generators could offer capacity only once a day.</p> <p>A day-ahead price was produced that could not be changed.</p> <p>Energy was the only product competitively traded.</p>	<p>Generators can offer capacity in real-time.</p> <p>Trading responds to real-time conditions such as load volumes and network conditions.</p> <p>Energy, reserve and regulation products are traded.</p>
Price calculation	<p>Prices were determined without considering the electricity network or power system security.</p>	<p>The market clearing engine (MCE) determines the dispatch schedule and prices considering real-time security issues.</p> <p>Energy, reserve and regulation products are co-optimised to derive the least-cost product combination.</p>

The establishment of the NEMS was a collaborative industry effort led by the Energy Market Authority (EMA). The Energy Market Authority of Singapore Act 2001 created the EMA and granted it regulatory power to oversee the restructuring initiatives. These initiatives include:

- ✘ separation of the ownership of the contestable and non-contestable parts of the industry
- ✘ establishment of a power system operator and a market operator
- ✘ establishment of a real-time wholesale market
- ✘ liberalisation of the retail market

The Power System Operator (PSO) was established in 2001 as a division within the EMA by transferring functions from the grid owner PowerGrid (now named SP PowerAssets).

The Energy Market Company Pte Ltd (EMC) was established in February 2001. EMA and The Marketplace Company Pte Ltd (M-co) signed a joint venture agreement for EMC to operate and administer the wholesale functions of the NEMS in July 2001.

The EMA took the initial lead in designing the market rules and systems and transferred them to industry participants in early 2002. The market rules were then further developed

by the EMC. This process was governed by the Pro-Tem Rules Change Panel, which considered 140 rule modifications, of which 100 were approved in the process. This ensured that the market rules were robust enough to commence operation of the NEMS.

The market systems were subjected to a rigorous programme of user-acceptance testing and trialling over a period of nine months before market start. This intensive implementation programme as well as good cooperation between industry participants, were key factors in the smooth transition on 1 January 2003 between the SEP and NEMS trading arrangements. The result was arguably the most successful wholesale electricity market implementation to date.

Corporatisation	1995	<ul style="list-style-type: none"> ✘ Electricity functions of the Public Utilities Board corporatised ✘ Singapore Power formed as a holding company
	1996	<ul style="list-style-type: none"> ✘ Pool design process begins
Singapore Electricity Pool (SEP)	1998	<ul style="list-style-type: none"> ✘ SEP commences ✘ PowerGrid is SEP administrator and power system operator ✘ Attempted sale of generator Tuas Power
	1999	<ul style="list-style-type: none"> ✘ Review of electricity industry
National Electricity Market of Singapore (NEMS)	2000	<ul style="list-style-type: none"> ✘ Decision for further reform to obtain full benefits of competition ✘ New market design process begins
	2001	<ul style="list-style-type: none"> ✘ Electricity industry legislation enacted ✘ Energy Market Authority (EMA) established as industry regulator ✘ Power System Operator (PSO) becomes a division within EMA ✘ Energy Market Company (EMC) established as NEMS wholesale market operator ✘ Initial phase of retail contestability
	2002	<ul style="list-style-type: none"> ✘ Draft market rules issued ✘ Testing and trialling of wholesale market system begins
	2003	<ul style="list-style-type: none"> ✘ NEMS wholesale market trading begins

04 INDUSTRY STRUCTURE

The participants in the National Electricity Market of Singapore (NEMS) are:

Active Generators	<ul style="list-style-type: none"> ✘ PowerSeraya Ltd ✘ Senoko Power Ltd ✘ SembCorp Cogen Pte Ltd ✘ Tuas Power Ltd ✘ National Environment Agency
Active Retailers	<ul style="list-style-type: none"> ✘ Keppel Electric Pte Ltd ✘ Seraya Energy Pte Ltd ✘ SembCorp Power Pte Ltd ✘ Senoko Energy Supply Pte Ltd ✘ Tuas Power Supply Pte Ltd
Market Operator	✘ Energy Market Company Pte Ltd (EMC)
Market Support Services Licensee	✘ SP Services Ltd
Transmission Licensee	✘ SP PowerAssets Ltd
Power System Operator	✘ Power System Operator (PSO)

The Energy Market Authority (EMA) - The Regulator

The EMA is the regulator of the electricity industry and has the ultimate responsibility for the market framework and ensuring that the interests of consumers are protected.

The Energy Market Company (EMC) - The Market Operator

EMC operates and administers the wholesale market. This role includes calculating prices, scheduling of generation, clearing and settling market transactions, and procurement of ancillary services.

The Power System Operator (PSO)

The PSO (a division of the EMA) is responsible for ensuring

the reliable supply of electricity to consumers and the secure operation of the power system. The PSO controls the dispatch of generation facilities, co-ordinates outages and power system emergency planning, and directs the operation of the high-voltage transmission system.

SP PowerAssets Ltd Transmission licensee

SP PowerAssets (formerly PowerGrid Ltd) owns and is responsible for maintaining the transmission system.

Generation licensees

All generators are licensed by the EMA, unless their facilities are less than 10 MW. All generators with facilities of

1 MW or more that are connected to the transmission system must participate in the NEMS and be registered for dispatch by the PSO.

Retail electricity licensees

Retailers that sell electricity to contestable consumers are licensed by the EMA. Retailers that are registered as market participants purchase electricity directly from the wholesale market.

Market support services licensees

SP Services Ltd provides market support services as a Market Support Services Licensee (MSSL). This service includes meter reading, meter data management and acting as a provider of last resort. In 2003, SP Services, was the only MSSL. SP Services also facilitates access to the wholesale market for contestable consumers and retailers, and is responsible for supplying electricity to all non-contestable consumers.

Consumers

Consumers are classified as being either contestable or non-contestable, depending on their electricity usage. Contestable consumers may choose to purchase electricity from a retailer, or directly from the wholesale market, or indirectly from the wholesale market through MSSL. Non-contestable consumers are supplied by the MSSL.



CHAPTER 02 Market
Structure

05 MARKET OVERVIEW

In the National Electricity Market of Singapore (NEMS) wholesale market, energy, reserve and regulation products are traded in real-time. The NEMS is a physical spot-market with other ancillary services (e.g. black-start services) procured via annual contracting.

In the spot market, offers made by generators are matched with the system demand forecast. The market clearing engine (MCE) produces the least-cost dispatch by taking into account:

- ✘ the available generation capacity
- ✘ the ability of generation capacity to respond (ramping)
- ✘ the relationship between energy production and reserve and regulation provision
- ✘ physical limitations on the flows that can occur on the transmission system
- ✘ losses that vary with the configuration of the system and power flows in the system
- ✘ constraints in relation to system security

Based on this process, the MCE determines the following spot market outcomes every half hour:

- ✘ the dispatch quantity that each generation facility is to produce;
- ✘ the reserve and regulation capacity each facility is required to maintain; and
- ✘ the corresponding wholesale spot-market prices for energy, reserve and regulation.

Energy prices – referred to as nodal prices – vary at different points on the network. The differences in nodal prices reflect the transmission losses and physical restrictions on the transmission system. This means that the true costs to the market of delivering electricity to each point on the electricity network are revealed.

This method of price determination encourages the economically efficient scheduling of generation facilities in the short term, and provides incentives to guide

investment in new power system infrastructure in the long term.

EMC uses market prices and metered demand and generation from the market support services licensee (MSSL) to settle spot-market transactions on a daily basis. Generators receive the market price for energy that is determined at their point of connection to the transmission network (injection node). Retailers pay the Uniform Singapore Energy Price (USEP) for energy, which is the weighted-average of the nodal prices at all off-take nodes.

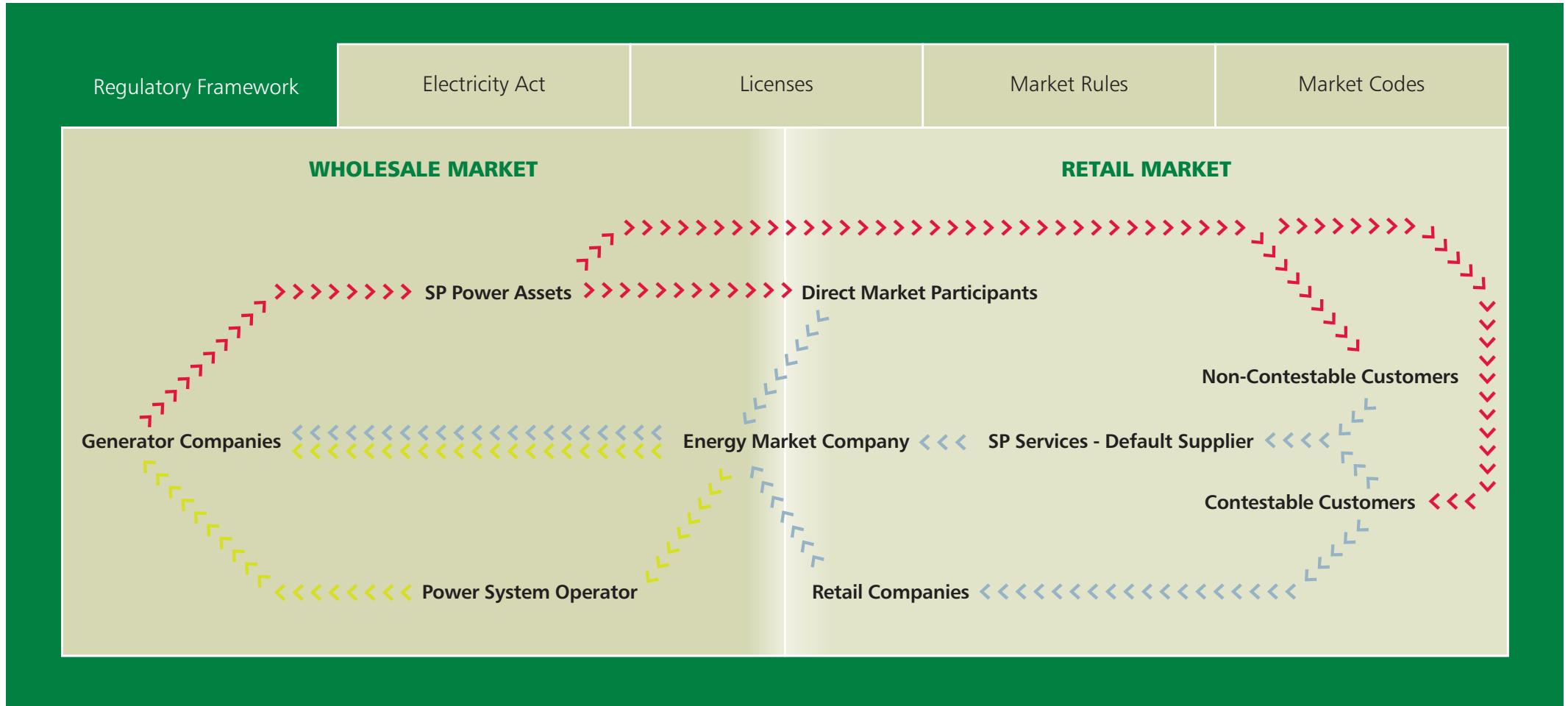
Generators pay for reserve according to how much risk they contribute to the system. Regulation is paid for by loads in proportion to their energy consumption and by dispatchable generators for up to 5MW for each trading period.

Competition is being introduced into the retail market in stages. Since July 2001, consumers with a maximum power requirement of 2MW and above have been considered 'contestable'. From June to September 2003, about 5,000 consumers with average monthly consumption of 20,000KWh and above were made contestable. Contestability means that consumers can purchase electricity from a retailer of their choice, directly from the wholesale market, or indirectly from the wholesale market via the market support services licensee.

	Purchaser	Seller
Energy	Retailers	Generators
Reserve	Generators	Generators*
Regulation	Generators and Retailers	Generators

* In 2004, retailers will be able to sell reserve capacity through the provision of interruptible load.

National Electricity Market of Singapore



>> Financial Flows >> Energy Flows >> Dispatch Information

07 MARKET FEATURES

The NEMS has a number of features that drives efficiency and makes its design truly world-class. These include:

- ✘ near real-time dispatch
- ✘ locational pricing and security-constrained dispatch
- ✘ co-optimisation of energy, reserve and regulation products

Near real-time dispatch

Dispatch quantities for generation, reserve and regulation and market prices are calculated five minutes before the start of each half-hour trading period. This ensures that the market outcomes reflect the most recent offers made by generators and the prevailing power system conditions. The result of near real-time calculation of dispatched generation quantities ensures as little intervention from the system operator as possible, and hence a minimal deviation from the competitive market solution.

Locational pricing and security constrained dispatch

The market clearing engine (MCE) models the transmission network and uses linear programming to establish demand and supply conditions at multiple locations (nodes) on the network. For each trading period, the MCE calculates the prices to be received by different generators at 33 injection nodes and prices to be paid by customers at approximately 350 withdrawal nodes. This sophisticated modelling ensures that market transactions are structured in a way that is physically feasible given the capacity and security requirements of the transmission system. It also produces locational price signals that guide infrastructure investment in the long term.

Co-optimisation of energy, reserve and regulation products

The MCE schedules generators for dispatch of the following energy-related products:

- ✘ energy (the generation of electricity)
- ✘ reserve (standby capacity that can be drawn-on when there is an unforeseen shortage of supply during the trading period. There are three classes of reserve traded – primary reserve (8-second response), secondary reserve (30-second response) and contingency reserve (10-minute response onwards)
- ✘ regulation (generation that is on stand-by to fine-tune the match between generation and load)

The scheduling of all these products is co-optimised by the MCE to ensure the most efficient supply of electricity at the lowest overall cost to Singapore.



CHAPTER 03 Market
Governance

08 > GOVERNANCE OVERVIEW

The National Electricity Market of Singapore (NEMS) wholesale market operates in accordance with the Singapore Electricity Market Rules (the Market Rules). The rule-making process is the responsibility of the Rules Change Panel (RCP). The RCP is appointed by the Energy Market Company (EMC) Board and its membership includes a cross-section of market participants and stakeholders to ensure that the interests of the various sectors of the industry are adequately represented. The rules modification process is designed to maximise both transparency and opportunities for public involvement. Rule modifications recommended by the RCP require support from the EMC Board and the Energy Market Authority (EMA).

The Market Rules require the establishment of the Market Surveillance and Compliance Panel (MSCP) and a Dispute Resolution Counsellor (DRC). The MSCP, comprising professionals independent of the market, is responsible for monitoring, investigating and reporting on the behaviour of market participants with a view to identifying inappropriate or anomalous behaviour. In circumstances where the MSCP determines that a market participant is not compliant with the Market Rules, they may issue a penalty. The MSCP also has the task of monitoring the marketplace in general, in order to detect deficiencies in the market design.

The DRC manages the dispute resolution process contained in the Market Rules and facilitates the resolution of disputes. If disputes are unresolved, arbitration is available as a last resort. A group of arbitrators has also been formed within the market for this purpose. When necessary, a Disputes and Compensation Resolution Panel can be formed from this group to conduct an arbitration. The dispute resolution process is designed to be a cost-effective way of managing disputes by avoiding the need to resort to court proceedings.

These panels play an important role in ensuring that the Market Rules accurately address operational issues, that market participants comply with these rules, and that disputes, when they arise, are dealt with swiftly and fairly.

A letter from the Chair, Rules Change Panel

The Singapore Electricity Market Rules govern the wholesale operations of the National Electricity Market of Singapore (NEMS). These rules, and the market framework they represent, are subject to constant evaluation to ensure their relevance and the ongoing efficiency of the NEMS. The Rules Change Panel (RCP) therefore holds a central role in evolving the NEMS and maintaining the market as a level playing field.

The RCP, which draws its members from across the electricity and financial communities, considers rule modification proposals submitted by electricity industry participants and other interested parties. It provides a formalised and transparent mechanism for industry members to make a contribution to the way in which the NEMS evolves. The RCP assesses rule modification proposals based on their impact on the:

- ✘ reliability and security of the power supply system
- ✘ structural and financial integrity of the NEMS
- ✘ operational integrity and efficiency of the NEMS

The RCP formed its roots as the Pro-Tem Rules Change Panel (PTRCP) that took over the rulebook governance process from the Energy Market Authority (EMA) in March 2002. The PTRCP considered 140 rule changes prior to market start. Many of the changes made during the lead-up to the opening of the market were market-start critical rule changes needed to ensure that the NEMS was able to commence on 1 January 2003. I must thank the PTRCP for their hard work and judgement, as well as the Energy Market Company's (EMC) Market Administration Department for its analytical support. The market could not have been launched without your efforts.

The RCP was appointed by the EMC Board and first met in January 2003. I am proud to highlight that in its first year of work, the Panel has had a number of substantial achievements in 2003. These include:

- ✘ considering a backlog of issues that were not considered market-start critical
- ✘ considering a number of significant rule changes such as the rules necessary to implement the interruptible

load regime within the reserve market

- ✘ establishing a Technical Working Group (TWG) responsible for assessing the evolution of the dispatch and price discovery process
- ✘ adoption of information disclosure standards
- ✘ agreeing on a rules change work plan to guide the future evolution of the NEMS framework, taking into account the views of our market participants

I wish to thank the members of the RCP and TWG for their diligence and significant contributions to the market evolution process. On behalf of the Panel, we look forward to continuing to evolve and contribute value to the NEMS.



Allan Dawson
Chairman
Rules Change Panel

Significant Market Evolution Initiatives for 2003

Interruptible Load participation in the reserve market

To ensure the reliability of power supply in real time, capacity needs to be on stand-by as reserves to manage the system security risk. Traditionally in the market, generators have been the sole reserve providers.

This rule change allows consumers to voluntarily offer their consumption into the reserve market. The interruptible load regime improves the efficiency of the market by allowing loads to compete directly with generators to provide reserve.

Removing Constraint Violation Penalties (CVP) when load is not shed

The market clearing engine (MCE) is the linear programming software used for establishing the most cost-effective dispatch and price schedules. Like all mathematical optimisation models, the MCE may at times not be able to determine a feasible solution (e.g. under an energy shortage situation). CVPs are used to flag infeasible solutions detected by the model. The resulting settlement prices reflect the CVP.

High prices that reflect imbalances in demand and supply send efficient signals to the market. However, high prices due to CVPs that are caused by modelling imperfections do not reflect the market fundamentals.

This rule change removes the effects of line CVPs when load is not actually shed, that is, when the high prices are caused

by modelling imperfections. This means that high prices will occur only when there is imbalance of demand and supply of energy in reality, sending the right economic signals and improving market efficiency.

Modifying reserve modelling in the Market Clearing Engine (MCE)

The Power System Operator (PSO) raised its concern about a system security issue where a generator might be dispatched to provide reserve at a level that was slightly higher than it is able to provide. This would mean that in the event of a significant contingency event, the actual reserves that could be provided by generators might be insufficient to prevent the frequency from falling below the acceptable limits.

This rule change enhances system security by improving the accuracy of modelling the reserve capability of generators.

Use of weighted average Market Energy Price (MEP) to replace Uniform Singapore Electricity Price (USEP) as the Vesting Contract Reference Price (VCRP)

Market participants were concerned about a shortcoming in the design of the vesting contract regime, where USEP was to be used as the VCRP. The issue was that both the generation companies and the Market Support Services Licensee (MSSL) would not settle at the hedge price for

the hedge quantity. This created a basis risk for the generation companies and subjected them to substantial adverse financial impact when the USEP was significantly higher than the spot prices.

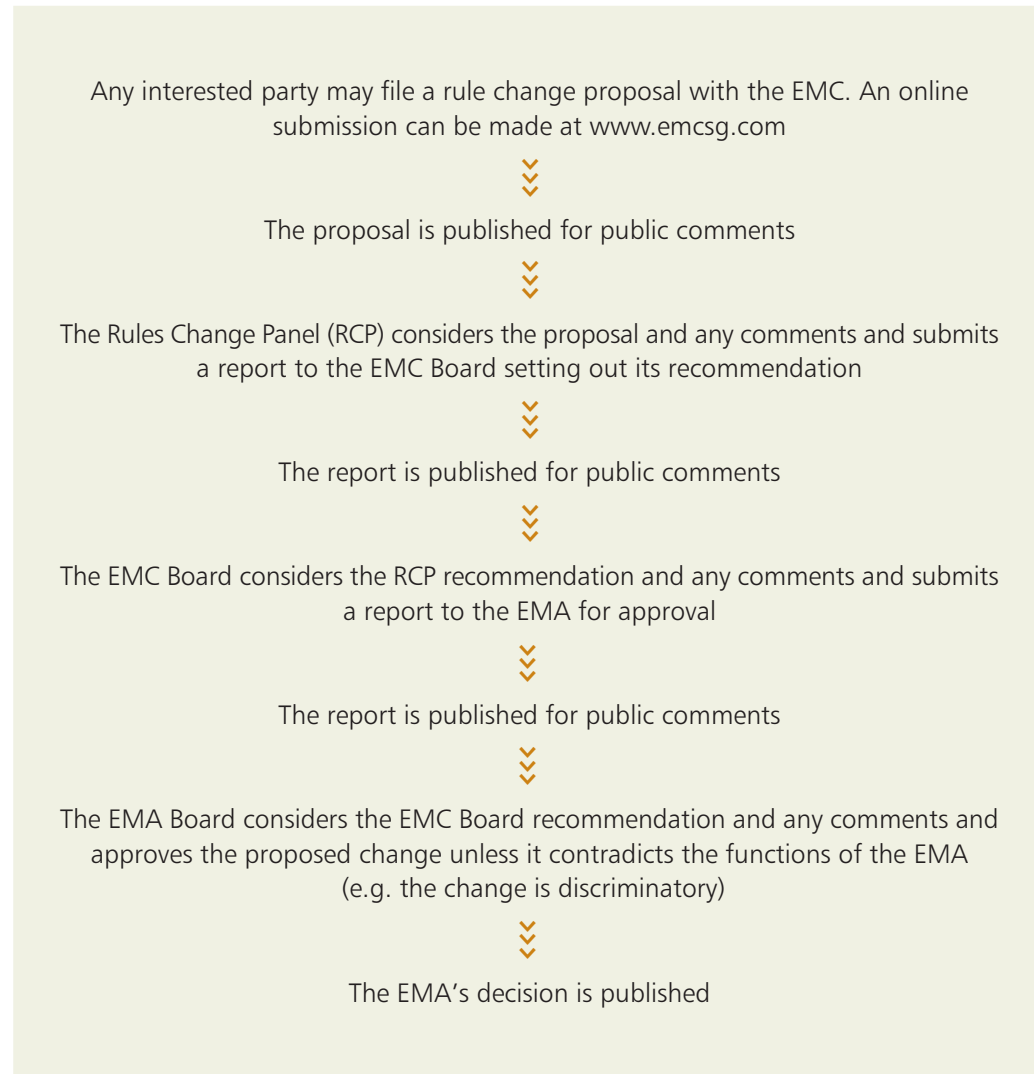
This rule change, which uses the weighted average MEP as the VCRP, ensures that both parties will settle at the hedge price and eliminates the basis risks that had concerned the generation companies.

Streamlining the rule change process

Energy Market Company (EMC) conducted a review of the rules governing the rule-change process and concluded that the current process was inefficient and should be streamlined and rationalised. It noted that, under the current rules, a rule-change proposal might be subject to a process spanning 155 business days.

This rule change improves the efficiency and robustness of the governance structure and reduces the transaction costs for all market participants.

Overview of rule change process



Panel Statistics

2002 Pro Tem Rules Change Panel	
Number of meetings	14
Number of rule change proposals considered	140
Number of rule change proposals approved	100
Approved 16 market manuals	
Reviewed EMC budget	
2003 Rule Change Panel	
Number of meetings	10
Number of rule change proposals considered	66
Number of rule change proposals approved	48
Approved 1 market manual and information disclosure policy	
Reviewed EMC budget	
2003 Technical Working Group	
Number of meetings	6
Number of rule change proposals considered	7
Number of rule change proposals approved	7

Role of the Market Surveillance and Compliance Panel

The Market Surveillance and Compliance Panel (MSCP) monitors and investigates the conduct of market players, and the structure and performance of, and activities in, the wholesale electricity market to:

- ✘ identify breaches of the market rules, any market manual or the system operation manual;
- ✘ assess whether the underlying structure of the wholesale electricity market is consistent with the efficient and fair operation of a competitive market; and
- ✘ recommend remedial actions.

The Singapore Electricity Market Rules also provide for the MSCP to assist the regulator, Energy Market Authority (EMA), in carrying out its functions under the Electricity Act in relation to prohibiting anti-competitive agreements and abuse of a dominant position. The MSCP assists the EMA by providing market information in accordance with its information requirements. Additionally, the MSCP reports to the EMA should it come across possible anti-competitive behaviour in the course of pursuing its monitoring and investigation activities.

The Market Assessment Unit (MAU) of the Energy Market Company (EMC) supports the MSCP in performing its role. MSCP members meet as a panel about once a month to review MAU reports, provide supervision and direction to the MAU and perform their monitoring and investigation functions.

A Letter from the Chair, Market Surveillance and Compliance Panel

The Market Surveillance and Compliance Panel (MSCP) was established under the Singapore Electricity Market Rules (the Market Rules) when the National Electricity Market of Singapore (NEMS) opened on 1 January 2003. The four members of the panel were appointed by the Board of Directors of the Energy Market Company (EMC).

Before market start, market players had expressed concerns regarding how stringent the enforcement of the Market Rules would be in the period immediately following market start. Taking into consideration these concerns, the MSCP informed market players that it had adopted the policy that, when considering a potential rule breach during the three months immediately after market start, it would:

- ✘ treat each case based on its merits
- ✘ take into consideration the fact that all parties were going through a learning curve
- ✘ take whatever action the rules permit if breaches of the market rules were found to have occurred in circumstances where the MSCP did not believe the person had acted reasonably or made a reasonable attempt to comply with the rules

The MSCP also indicated that, after the initial three months, it would expect market players to carry out their activities precisely in accordance with the Market Rules. In our deliberations over rule breaches in the past year, we have endeavoured to implement this policy.

To effectively carry out market monitoring, the Market Rules provide for the development of an information requirements system and criteria for evaluation. This involves developing a catalogue of the data to be collected and a catalogue of monitoring indices to be used to evaluate data collected.

Since its establishment, the MSCP has been working with the EMC's Market Assessment Unit (MAU) to develop a catalogue of

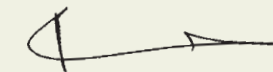
data. A draft catalogue of data was published for public consultation on 7 March 2003. Market players participated actively in this process and the MSCP published written responses to the many comments received. After two rounds of public consultation, a catalogue of data was adopted on 29 August 2003. Data collection for the catalogue began about a month later.

With the adoption of the catalogue of data, the MSCP and MAU began their review of the catalogue of monitoring indices. Since market start, several indices have been under review, with the aim of identifying those that would be appropriate for continued use. Work on the catalogue of monitoring indices continues to be underway.

The Market Rules also provide for the MSCP to prepare an annual report concerning its activities. On 12 May 2003, the MSCP issued its first report relating to the first three months of the market. The next report will cover a full year, from 1 April 2003 to 31 March 2004.

In 2003, the MSCP also put forward its first rule change proposal relating to ambiguities in the Market Rules concerning offers exceeding offer change limits.

The MSCP has had an interesting first year, given its members' varied professional backgrounds, and thus different perspectives and skills. Professor Lim Chin is an economist. Mr Lee Keh Sai has a background in power system operations. Mr TPB Menon and I are legal practitioners. We have had numerous debates over issues occurring over the past year, and the diverse views put forward have, we hope, resulted in appropriate decisions in the interests of the market.

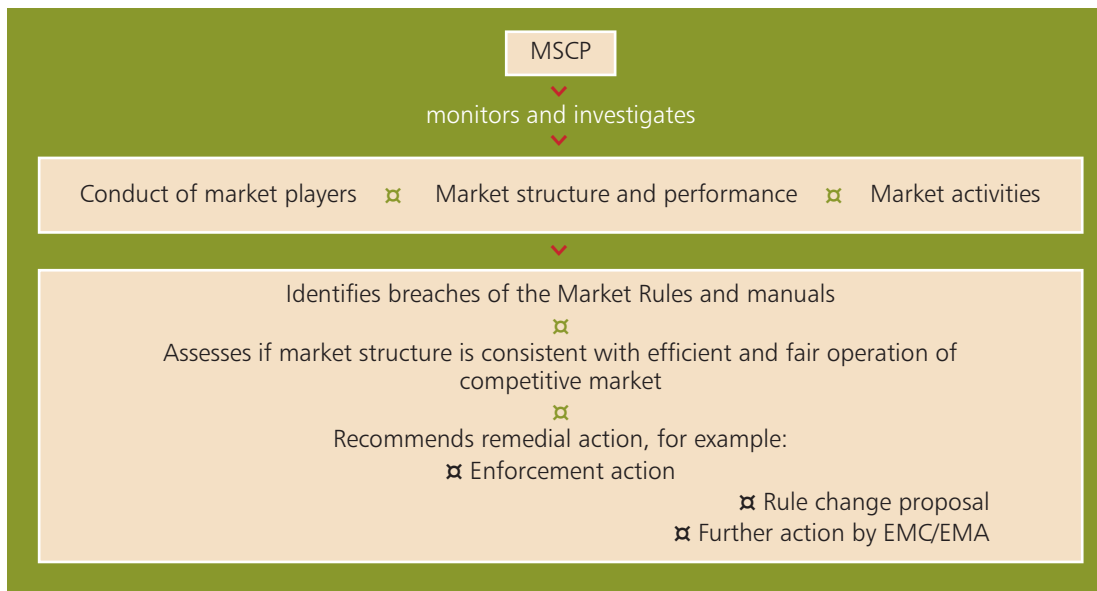


Joseph Grimberg SC
Chair
Market Surveillance and Compliance Panel

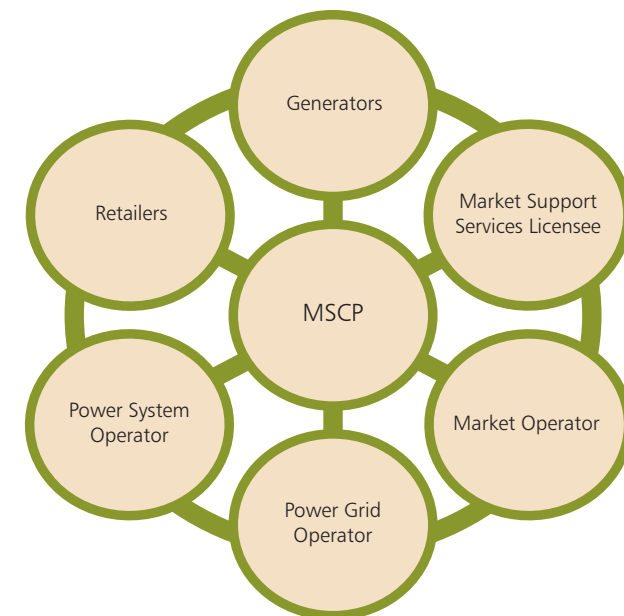
MSCP Statistics for 2003

Activity	Total number of hours spent by panel members on MSCP activities	277
	Number of referrals or complaints received	53
	Number of cases closed	21
	Number of cases where reports of determination have been published	16
	Number of offers after gate closure considered	2578
	Number of formal MSCP hearings	0
	Enforcement Action: Total financial penalties	\$50,000
	Total costs recovered from party in breach	\$14,000

Role of the MSCP



Parties under the jurisdiction of the MSCP



Role of the Dispute Resolution Counsellor and the Disputes and Compensation Resolution Panel

The Market Rules provide a process for resolving wholesale electricity market disputes. This process contemplates that disputes will be kept out of the courts, where possible. Parties are encouraged to resolve disputes on their own. However, they have access to the services of a Dispute Resolution Counsellor (DRC) who has been appointed to facilitate the resolution of disputes. Market participants may opt for mediation by the DRC. If a dispute is unresolved, arbitration is available as a last resort.

For arbitration, parties can select their own Disputes and Compensation Resolution Panel (DCRP) from a list of experienced arbitrators. Since market start, a five-member panel has been appointed for this purpose.

The Market Assessment Unit (MAU) of the EMC provides support to the dispute resolution process and institutions.

A Letter from the Dispute Resolution Counsellor

The office of the Dispute Resolution Counsellor (DRC) was established under the Singapore Electricity Market Rules. The Energy Market Company (EMC) Board appointed me to serve as DRC for the National Electricity Market of Singapore (NEMS) upon market start on 1 January 2003.

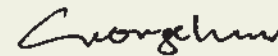
Since the launch of the market, a Disputes and Compensation Resolution Panel (DCRP) has also been established and I have appointed to this panel, five persons who are legally trained and have extensive experience in arbitration. They are Associate Professor Lawrence Boo, Mr Naresh Mahtani, Associate Professor Tan Cheng Han SC, Mr Tan Ching Tiong and Mr George Tan.

In order to provide the dispute resolution personnel with a strong overview of the market and its operations, the EMC organised an education programme at market start, acquainting us quickly with the Singapore electricity market. I continue to work with the EMC on other educational opportunities so that we continue to be fully equipped for our role.

Over the past year, I have been working with the MAU to review the dispute resolution process provided in the market rules. To guide us in our work, we have examined the dispute resolution processes used in other electricity markets and conducted a study visit last February to meet with Australian

dispute resolution personnel. I have also taken note of the changes taking place in Singapore in relation to dispute resolution. By the close of 2003, we had done extensive work on drafting a rule change proposal to provide a comprehensive approach to dispute resolution, to make the market rule provisions on dispute resolution more accessible, and to address areas in the market rules that can potentially give rise to practical problems in implementation. We expect to submit this rule change proposal to the Rules Change Panel in 2004.

My main objective as DRC in the first year was to put in place a proper process and appoint competent professionals to assist market players in resolving disputes should they arise. While there was no formal filing of any disputes last year, and the dispute resolution process has yet to be tested, the preparation undertaken in 2003 ensures that we are well equipped to assist market players when our services are called upon. With the changes that I hope to introduce, I aim to contribute to developing a dispute resolution process for market players that is comprehensive, fair and cost-effective.



George Lim
Dispute Resolution Counsellor

Dispute Resolution Process



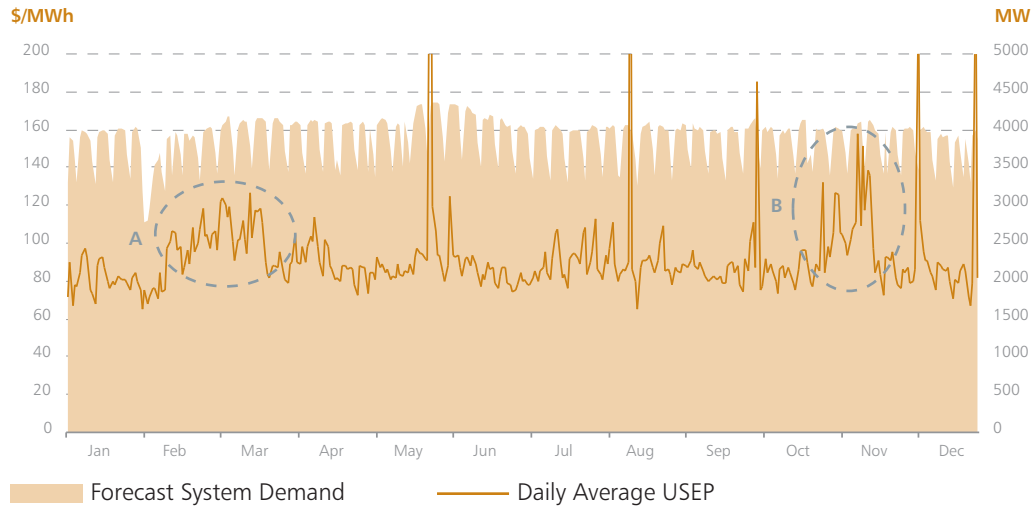
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04

Market Performance

15 ENERGY PRICES

Energy Prices - USEP vs System Demand



The Uniform Singapore Energy Price (USEP) is the quantity weighted average of prices at withdrawal nodes across Singapore in a particular trading period.

The higher than typical prices in February and March (indicated by area A) were influenced by the following:

1. Increases in system demand after the Chinese New Year holiday period.
2. Lower than typical available generation supply due to planned plant outages. In the months of February and March, an average of 1000MW of capacity was unavailable due to maintenance.
3. The system reserve requirement was also higher during this period and exerted upward pressure on prices.

The higher than typical prices from mid October to mid November (indicated by area B) were influenced by the following:

1. Lower than typical available generation supply due to planned plant outages. As was the case in February and March, an average of 1000MW of capacity was unavailable due to maintenance.
2. Gas supply from the West Natuna field in Indonesia was disrupted on 15 November and partially restored on 19 November. During this period, combined-cycle gas turbine (CCGT) capacity was either not offered into the market or was offered in at higher prices reflecting the cost of switching to diesel as an alternative fuel source. As a result, the average USEP rose to \$136/MWh.

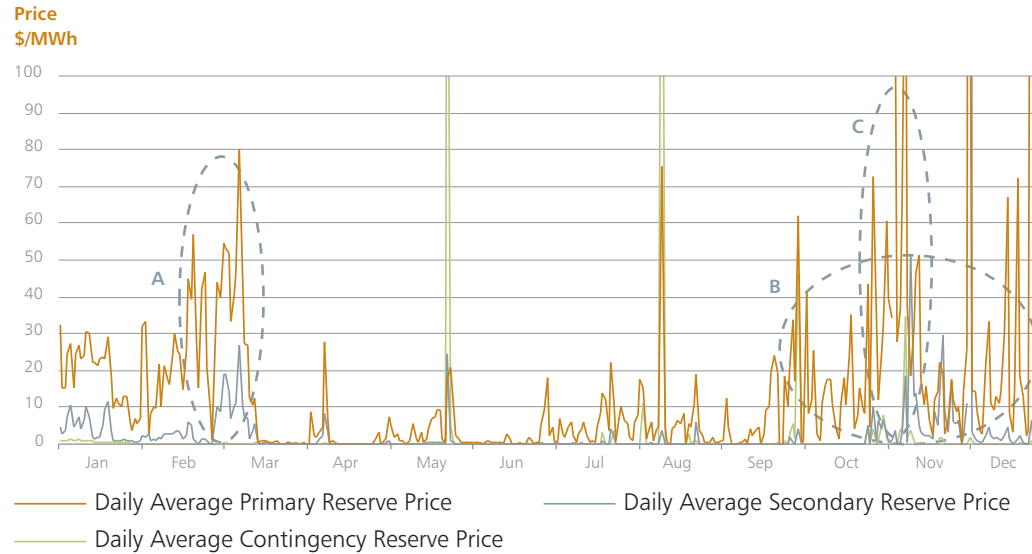
The price spikes in May, August and December were caused by either forced (unplanned) plant outages or insufficient generation offers. In 2003, energy prices reached the \$4500/MWh limit in 3 trading periods out of 17,520 trading periods in the year.

Energy Price Histogram - USEP by Trading Period for 2003



The distribution of USEP by trading period for 2003 centres on a mean of \$92.35/MWh. Energy prices were between \$50 - \$200/MWh in 98.94% of trading periods, lower than \$50/MWh in 0.18% of trading periods and greater than \$200/MWh in 0.88% of trading periods.

Reserve Prices



The primary reserve class is used to procure 8-second reserve. The average primary reserve price for 2003 was \$14.95/MWh.

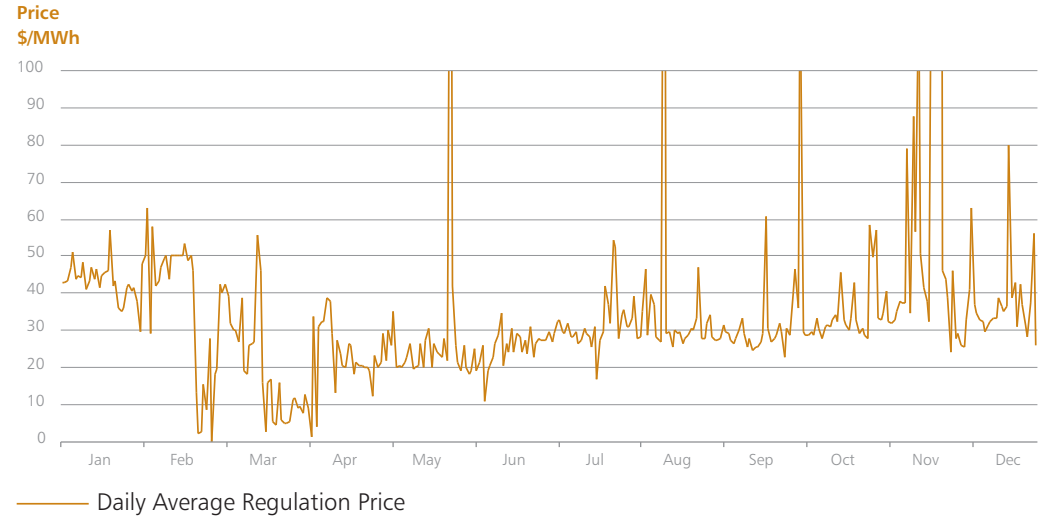
The secondary reserve class is used to procure 30-second reserve. The average secondary reserve price for 2003 was \$2.36/MWh.

The contingency reserve class is used to procure 10-minute reserve. The average contingency reserve price for 2003 was \$1.69/MWh.

Reserve prices are highly influenced by energy price trends as a result of co-optimisation. Higher than typical reserve prices were due to:

1. Higher system reserve requirements in February and March (indicated by area A).
2. A revision to the classification of reserve provider groups effective from 7 October that reduced the total level of effective reserve available in the market (indicated by area B).
3. Gas supply from the West Natuna field in Indonesia was disrupted on 15 November and partially restored on 19 November (indicated by area C). During this period there was a higher reserve requirement (between 5-7%) and lower availability of reserve capacity due to a decline in combined-cycle gas turbine (CCGT) availability.

Regulation Prices



Regulation is generation that is made available to fine-tune the match between generation and load. The regulation requirement is set by the Power System Operator (PSO) at a standard level of 100MW. The average regulation price for 2003 was \$36.44/MWh.

Regulation prices are highly influenced by energy price trends as a result of co-optimisation.

17 PRODUCT COSTS

The National Electricity Market of Singapore (NEMS) has meant a transition from the Singapore Electricity Pool (SEP) regime, where reserve costs were imputed from electricity prices, to a competitive market that establishes separate prices for energy, reserve and regulation products.

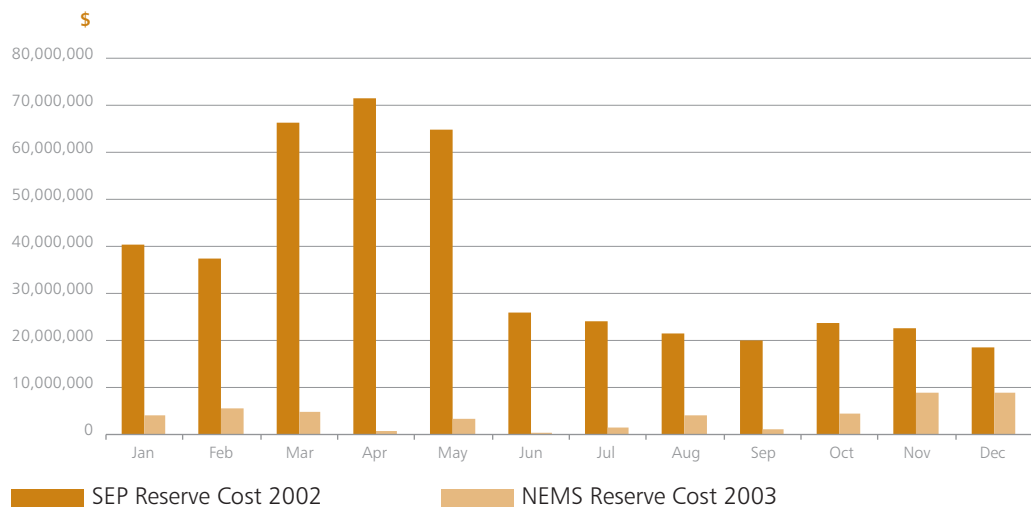
In addition, more sophisticated methods have been used to dynamically calculate the level of system reserve required and better allocate the reserve costs to those generators that contribute to system risk.

These pricing and cost allocation initiatives have dramatically reduced the daily average reserve cost from \$1.2m in the SEP to \$0.130m in the NEMS providing an annual saving of over \$390m. As the cost of reserves is covered by generators themselves, the savings are distributed amongst the generators, with generators having the larger, more efficient and newer plants benefiting the most.

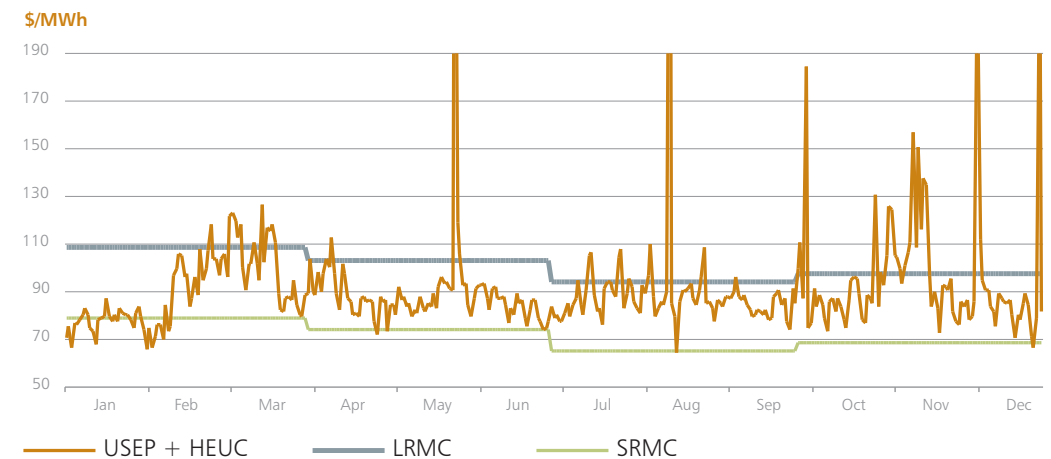
The NEMS produced energy prices that were generally between the short-run marginal cost (SRMC) and long-run marginal cost (LRMC) model benchmark established by the Energy Market Authority (EMA). The cost modelling, which estimates the marginal costs of a new combined-cycle gas turbine (CCGT) unit (the most efficient unit in the Singapore system), has been used by the EMA to determine the strike price for the vesting contract regime that was introduced on 1 January 2004. Analysis of the NEMS

wholesale energy prices over 2003 shows that, on average, they were 10 percent lower than the modelled LRMC for the same period. The EMA have indicated that regulated price caps were used in 2003 as a mechanism to manage market power held by generators and that these caps suppressed prices below the LRMC level.

Monthly Reserve Costs - Comparison between SEP and NEMS



Energy Prices and Marginal Costs of CCGT



One of the indicators of market efficiency is how responsive prices are to movements in the determinants of demand (e.g. consumer load) and supply (e.g. fuel costs).

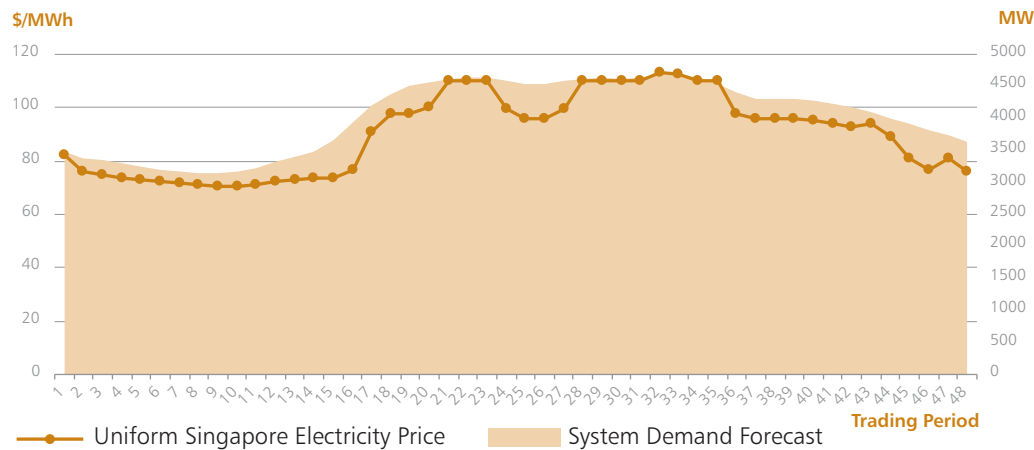
The responsiveness of the NEMS wholesale prices to changes in demand levels is illustrated by how prices change over the course of a typical trading day. It is rare for the load and price patterns to deviate from that of the typical day.

In peak load periods, the market calls upon the services of more expensive sources of

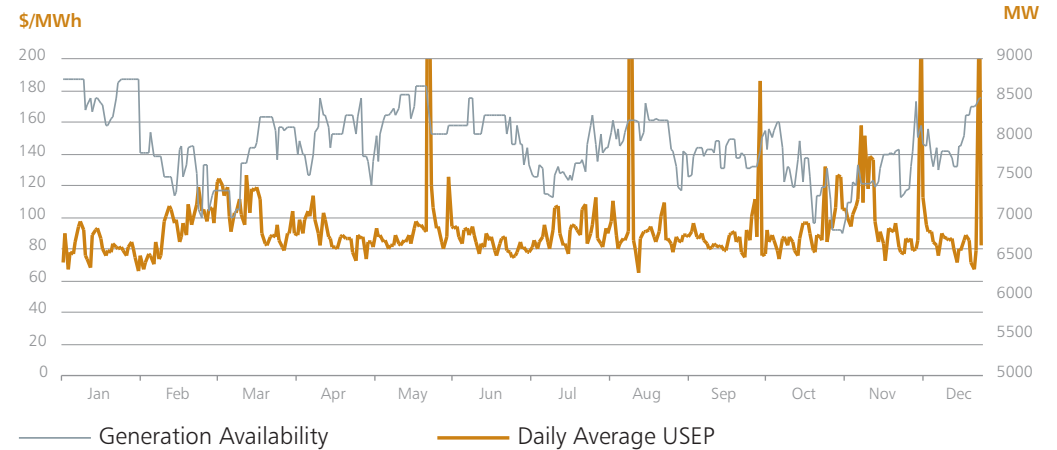
generation. The NEMS allows generators to adjust their offers to supply electricity to the market for up to four hours before the supply is required without breaching the market gate-closure provisions. This trading flexibility encourages generators to increase their offered supply quantities to take advantage of price increases associated with peaking demand. This competitively-based supply response in turn puts downward pressure on prices. Evidence of this dynamic is shown in the way the system's Uniform Singapore Electricity Price (USEP) tracks closely with trends in system demand.

Price responsiveness can also be seen when the NEMS comes under stress through a shortage in supply. In times of shortage, such as a generator outage, prices rise to solicit a supply response from other generators. A general trend can be seen where movements in USEP are inversely proportional to the availability of generation. When availability is high, USEP tends to be lower, and vice versa.

Energy Price Trend for a Typical Day (Wednesday, 24 September 2003)



Energy Prices - USEP vs Generation Availability



19 > PRICE RESPONSIVENESS

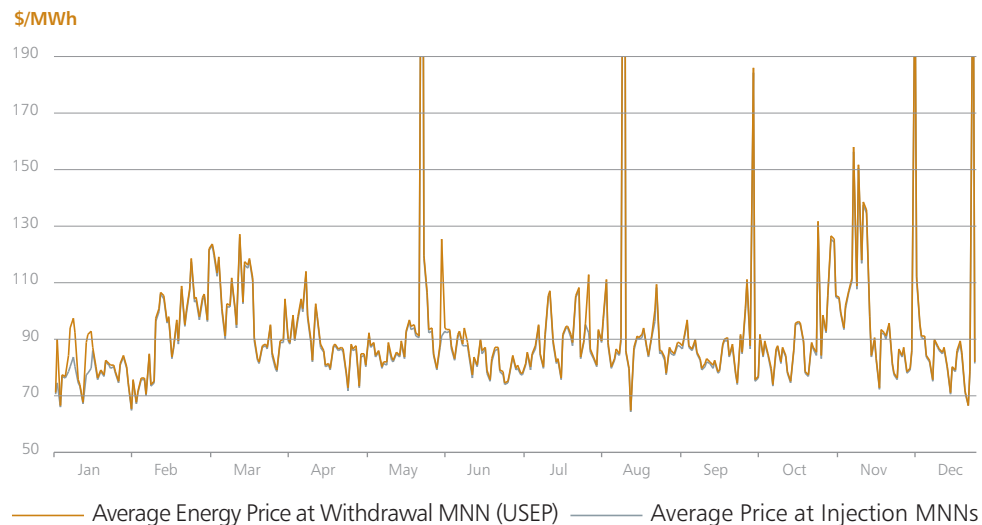
The NEMS uses a location-based model to determine a security-constrained dispatch and establish nodal prices. As a result, prices are different at different locations on the network. The differences are due to the cost of transporting electricity to different locations on the network. These transport costs arise because of transmission losses and are also occasionally influenced by line constraints. As a rule of thumb, the load point closest to a generation source will have the cheapest nodal price.

As the Singapore network is small, comprising of underground cables, a very low level of transmission losses is experienced. In addition, the Singapore network has a very robust lattice configuration and hence is generally a constraint free system. The result of this is minimal divergence of prices across the network. The comparison of average prices received by generators at injection market network nodes (MNNs) and prices paid by retailers at the withdrawal MNN, which is the Uniform Singapore Electricity Price (USEP), shows minimal divergence. In 2003, there

were no instances of physical grid congestion or load shedding. The differences between USEP and MNN prices were largely the result of real-time load shifting that was not modelled by the Market Clearing Engine (MCE). The Hourly Energy Uplift Charge (HEUC) is a settlement mechanism that distributes these congestion rentals to consumers. The Energy Market Company (EMC) and Power System Operator (PSO) are working to establish a system where load shifting can be reflected in the MCE dynamically as a way of reducing the incidence of nodal price separation.

The differences in MNN Price received by generators are largely driven by the extent of the losses at the transformer connecting the generation facility to the grid. During 2003, some generators invested in new transformers to minimise the level of losses associated with their facility and improve the MNN price received.

Differences between Energy Prices at Injection MNNs and Energy Prices at the Withdrawal MNN



Energy Prices Received by Generators



The start of the NEMS has stimulated a structural shift in the type of generation unit being run to supply electricity. Combined-cycle gas turbine generation units (CCGTs) were the dominant source of generation in 2003, whereas they were a secondary source to oil-fired steam turbine (STs) generation units in the SEP.

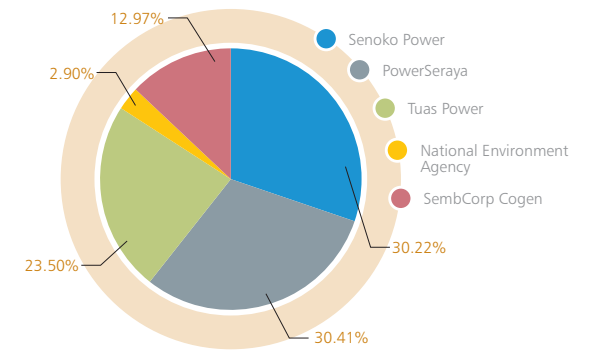
CCGTs provide superior fuel efficiency and environmental performance when compared to STs.

One of the ways the NEMS has stimulated this change is by providing generators with 'look-ahead' schedules that forecast demand and supply conditions. With this new information, generation companies are better able to tailor their supply offers to real-time power system requirements rather than having to adopt a conservative and unresponsive approach.

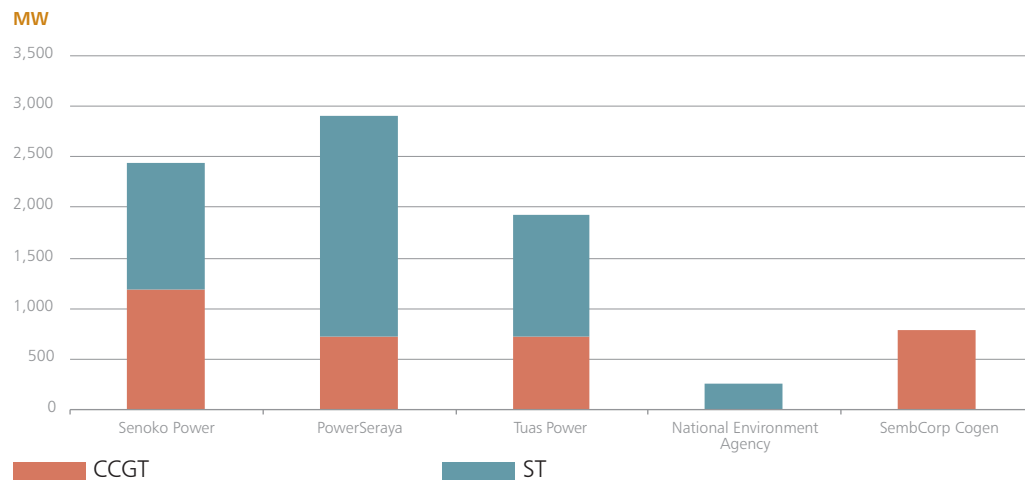
Another significant factor in the rise of CCGTs as the dominant form of generation is

enhancements in the way reserve costs are calculated and allocated. Reserve costs in the SEP were allocated in such a way that the largest generating set bore most of the cost. Reserve costs effectively increase the cost to a generator of supplying electricity. This method discouraged high capacity CCGTs from generating at efficient levels for fear of attracting disproportionately high reserve costs.

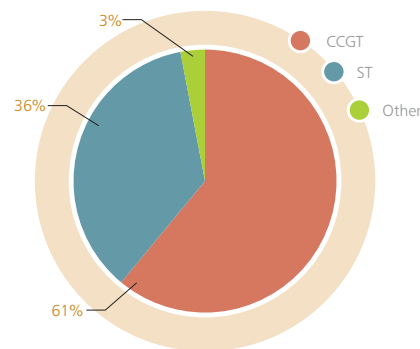
Energy Market Share - 2003 (based on scheduled generation)



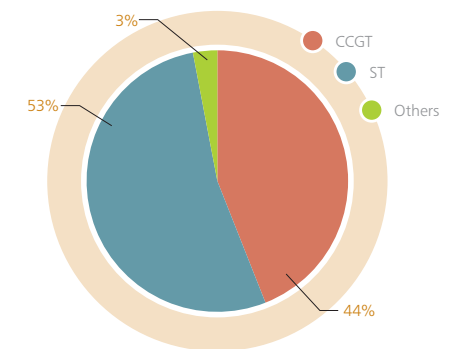
Generation - Registered Installed Capacity



Market Share by Plant Type - NEMS 2003



Market Share by Plant Type - SEP 2002



Retail contestability is being introduced into the NEMS in stages. From July 2001, the 250 largest consumers have had the freedom to choose their supplier from among the five active retailers.

By the end of 2004, 10,000 additional non-domestic consumers will be free to choose suppliers, making about 75 percent of electricity demand contestable.

Under Singapore's approach to contestability, contestable customers can choose to remain with the incumbent supplier (SP Services Ltd),

or switch to a retailer, or purchase electricity directly from the wholesale market.

To provide an impetus for customer switching, SP Services is not allowed to engage in competitive retailing and is required to base its tariffs on passing on wholesale prices plus administrative charges. Competitive retail companies can, however, entice consumers to switch by offering competitive packages and services that better suit consumer needs.

These arrangements have seen retail companies gain significant market share.

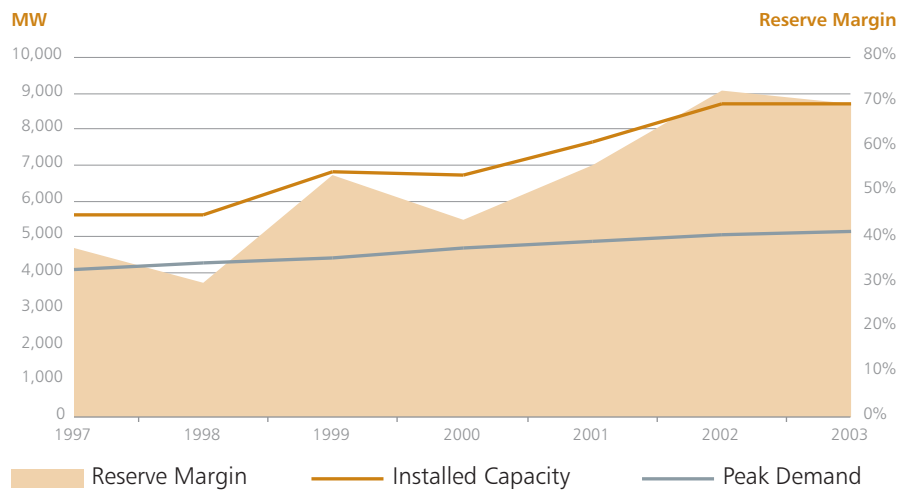
A survey carried out by the EMA in March 2002 showed that 90 percent of the first 250 contestable consumers had chosen to be supplied by competitive retailers. Of those that had switched, 80 percent reported cost savings.

The consumers that are not yet contestable continue to be serviced by SP Services, the default supplier, at regulated tariffs. The EMA is investigating how full retail competition (FRC) can be achieved so that all customers have the freedom to choose retailers and has indicated that FRC is likely to take place in 2006 or 2007.

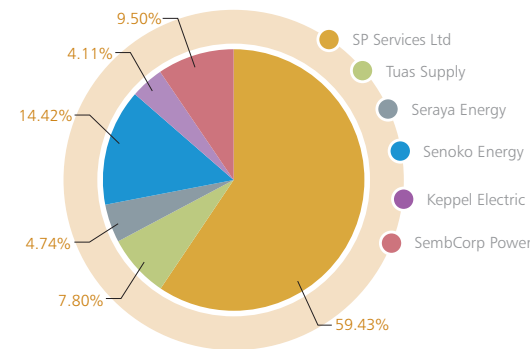
A comparison of market shares in the retail market at the beginning and end of 2003 shows two significant trends:

- ✘ the market share of SP Services is declining as more consumers become contestable and opt to be serviced by retail companies
- ✘ market shares have shifted between the five active retailers, showing active competition in the retail market.

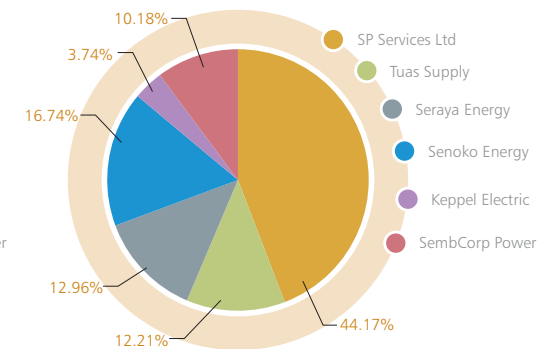
Installed Capacity and Peak Demand



Retail Market Share - 1 Jan 2003



Retail Market Share - 31 Dec 2003



The EMC is the financial clearinghouse for the wholesale market and settles the following transactions:

- ✦ energy trading
- ✦ three classes of reserve (primary, secondary and contingency)
- ✦ regulation
- ✦ bilateral contracts
- ✦ vesting contracts (introduced in January 2004)
- ✦ contracted ancillary services (black-start and fast-start services)
- ✦ fee recovery for EMC and Power System Operator (PSO) administration charges.

The settlement systems use the energy prices determined by the market clearing engine (MCE) and the metering data generated by the Market Support Services Licensee (MSSL) to settle energy transactions. Reserve and regulation transactions are settled on the basis of the price and quantities determined by the MCE.

Settlement in the wholesale market is carried out daily. Twenty days after the trading day (D+20), a debtor has to pay the EMC for transactions on trading day D. A creditor for a trading day D is paid by the EMC on day D+21.

To cover the 20-day exposure of a debtor and the time required to initiate a suspension when a market participant defaults, a market participant must provide on-going collateral (credit support) covering 30 days of trading to the EMC. This prudential cover protects the EMC and other market participants from payment defaults. EMC reviews the adequacy of prudential cover daily.

A margin call is issued when a market participant's estimated 20-day exposure (unpaid debt) reaches a value equal to or greater than 70 percent of the level of credit support currently provided by the market

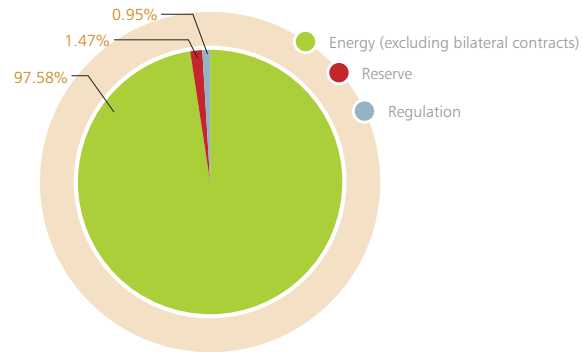
participant. When issued with a margin call, a market participant has two business days to make payment. In 2003, the market was well secured. EMC issued 12 margin calls and there were no instances of default in payment.

Settlement Timeline



23 > SETTLEMENT AND PRUDENTIAL MANAGEMENT

Market Transaction by Product 2003

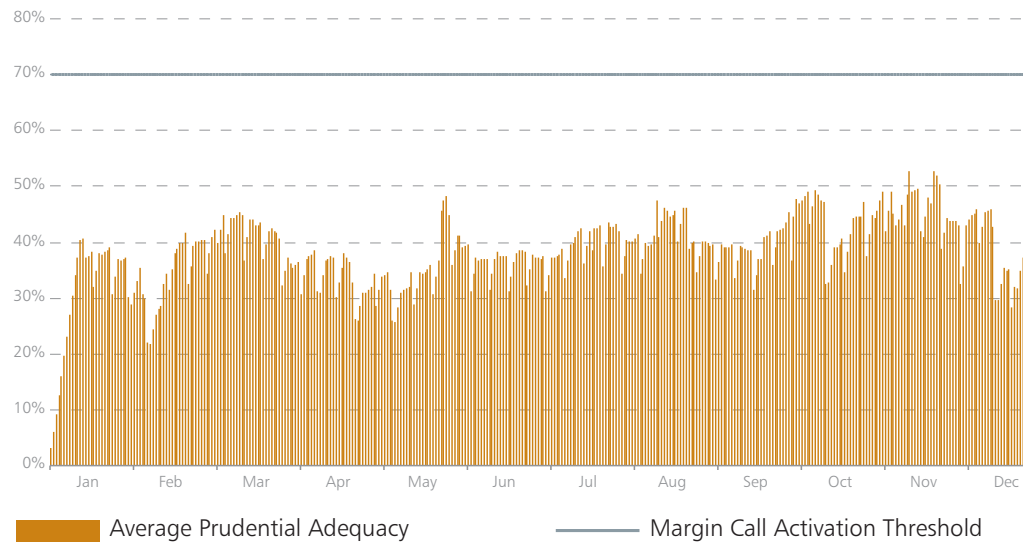


Settlement Statistics - Annual Figures for 2003

Value of total retail settlement payments	\$2,529,801,518
Total energy quantity traded	32,578,147 MWh
Settlement statements issued	9,490
Settlement errors	0
Value of credit support (daily average)	\$345,850,000
Number of margin calls	12
Instances of payment default	0
Value of bilateral contracts processed by EMC	\$979,112,325
Number of settlement re-runs	95*

* The settlement process is re-run to correct errors in metering data. The process for conducting settlement re-runs is under review and earmarked for change in 2004.

Prudential Adequacy



As required by its electricity license and the Market Rules, EMC, on behalf of and at the request of the PSO, negotiates and enters into ancillary service contracts to ensure the reliable operation of Singapore’s power system. Contracted ancillary services for 2003 were fast-start capability and black-start capability services.

To fulfil its obligations to the market, EMC undertook a process of due diligence regarding contract negotiations in 2002.

Operational requirements were determined in consultation with and as directed by the PSO. EMC procured 408 MW of fast-start services at a cost of S\$20.7M from PowerSeraya and Senoko Power, and 77.25 MW of black-start services at a cost of S\$11.0M from PowerSeraya, Senoko Power and Tuas Power for the year 2003.

‘Fast-start’ capability refers to a generation facility that is able to synchronise with the power system and begin generation at a

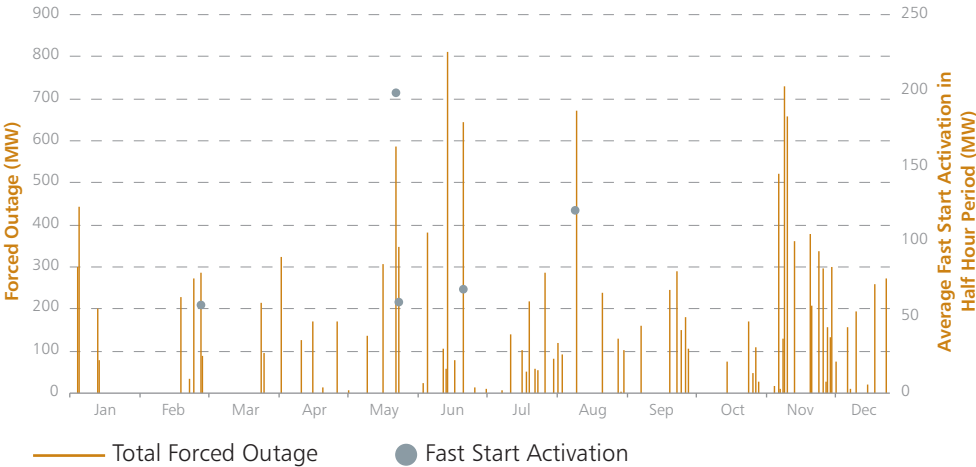
defined level within a specified time. Such generating units can usually be synchronised to the transmission system within five to ten minutes of receiving the instruction to generate. They are usually called upon when there is a shortfall of spinning reserve or during emergency operating states to restore security of the PSO-controlled system.

Black-start services ensure that there is initial generation to supply electric power for system restoration during blackouts. These initiating

generating units must be able to self-start without any off-site electric power source, and energise the station auxiliary board within 30 minutes. The black-start units must also have sufficient capacity to power auxiliary equipment and remain in stable operation for the entire process of start-up.

In 2003, there was five activations of fast-start services but there were no requirements for the initiation of black-start services.

Forced Outage and Fast Start Activation



25 > WHOLESALE MARKET FEES

The costs associated with the wholesale functions of the National Electricity Market of Singapore (NEMS) are:

Fees recovered directly from the wholesale market:

	Budget	Fee
EMC fees: 1 January 2003 – 1 March 2003	\$9.77m	\$0.61/MWh
EMC fees: 1 April 2003 – 31 March 2004	\$30.26m	\$0.47/MWh
PSO fees: 1 January 2003 – 1 March 2003	\$4.44m	\$0.28/MWh
PSO fees: 1 April 2003 – 31 March 2004	\$16.96m	\$0.26/MWh

EMC and PSO fees are recovered from both generator and retailer class market participants based on quantity of energy that they trade.

Fees recovered directly from market participants and consumers:

SP Services' Market Support Services Licensee (MSSL) fees associated with meter reading and data management	Levied on a per meter basis
SP PowerAssets' transmission charges	Levied based on actual usage

GLOSSARY

Ancillary Services

The additional services necessary to ensure the security and reliability of the power system. The ancillary services procured via the spot market are three classes of reserve and regulation. The ancillary services procured via contracting in 2003 were for black start and fast start services.

Black Start Ancillary Service

A service to ensure that there is initial generation to supply electric power for system restoration during blackouts.

Contestable Consumers

Those consumers that have the right to choose to purchase electricity from either a retail supplier, directly from the wholesale market, or indirectly from the wholesale market through the market support service licensee (SP Services Ltd).

Co-optimisation

The process used by the market clearing engine (MCE) to ensure that the cheapest mix of energy, reserve and regulation is purchased from the market to meet electricity demand in each dispatch period.

Dispatch Schedule

A schedule produced by the market clearing engine (MCE) every-half hour that is the basis for the supply of energy, reserve and regulation in the market.

Energy

The flow of real electricity.

Full Retail Competition (FRC)

A situation in the retail market where all consumers have the right to choose to purchase electricity from either a retail supplier, directly from the wholesale market, or indirectly from the wholesale market through the market support service licensee (SP Services Ltd).

Fast Start Ancillary Service

A generation facility that is able to synchronise with the power system and begin generation at a defined level within a specified time.

Load

The consumption of real electricity.

Market Clearing Engine (MCE)

The linear programme used to calculate market quantities and prices.

Nodal Pricing

A market structure in which prices are calculated at specific locations (or nodes) in the power system to reflect the demand and supply characteristics at each location. Nodal pricing is also commonly referred to as locational marginal pricing.

Non-contestable Consumers

Consumers that have not been given the right to choose to purchase electricity from either a retail supplier, directly from the wholesale market, or indirectly from the wholesale market through the market support service licensee (SP Services Ltd) and instead are supplied by SP Services Ltd at a regulated tariff.

Retail Market

The transactions between retail companies and end consumers.

Regulation

Generation that is on stand-by to fine-tune the match between generation and load.

Reserve

Standby capacity that can be drawn-on when there is an unforeseen shortage of supply.

Wholesale Market

The transactions made between generation companies and retail companies.

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