MARKET REPORT 2015

National Electricity Market of Singapore

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Dear Industry Members

We continued to see exciting developments in Singapore's power sector and in the National Electricity Market of Singapore (NEMS) in the last 12 months.

An electricity futures market was launched in 2015, allowing both generation companies and consumers to hedge their risks, and lowering the barriers of entry for new, independent retailers. Changes were also made to the Market Rules and relevant codes to make it easier for solar energy providers to participate in the NEMS.

To enhance competition in the electricity sector, the contestability threshold was lowered further in the retail market, with the aim of achieving full retail competition by 2018. In the wholesale market, preparations are underway for the Demand Response programme that will be implemented in 2016, which will give contestable consumers an additional option to reduce their electricity usage in response to high price signals.

Amidst these developments and other changes in the broader energy landscape, I am glad to note that the NEMS remains efficient and competitive.

In 2015, we welcomed six new market participants (MPs) in the NEMS. We also continued to see new investments in the market with the registration of three new facilities, which propelled the total registered capacity above the 13,000 megawatt (MW) level for the first time.

Total generation supply (which is the total amount of electricity offered in the NEMS), remained almost unchanged from the preceding year. It is important to note, however, that the supply cushion remained high at 29.3 percent, indicating an abundance of supply in the market.

Concurrently, in line with slower economic growth in 2015, the growth rate of electricity consumption fell to a four-year low of 1.7 percent, to 47.5 terawatt hours.

With abundant supply in the market, a slower rate of growth in electricity consumption and a significant drop in fuel oil price during the year, the Uniform Singapore Energy Price (USEP) (or wholesale electricity price) dropped for the third consecutive year and averaged $96 per megawatt hour (MWh) in 2015. The level of decline in the USEP – a 29.9 percent drop from 2014's average of $137/MWh – is unprecedented in the NEMS.

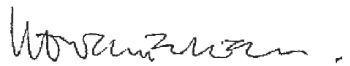
While the fall in the USEP was steep, it is significant to note that the decline is in line with prevailing market conditions. The market's efficiency is also evident in the move towards the more efficient combined-cycle gas turbine (CCGT) units in electricity generation – the market share of CCGT units in the NEMS currently stands at 97.5 percent, up from 80 percent just five years ago.

Market concentration in the NEMS continued to drop in both the generation and retail markets in 2015. This is another sign of a well-functioning competitive market.

The total market share of the three largest generation companies fell below 60 percent for the first time since the market started. In the retail market, the market share of the three largest retailers (other than SP Services which supplies to all non-contestable consumers) dropped a further 2.1 percentage points in 2015, to 39.5 percent.

The NEMS' successful evolution over the years would not have been possible without the support from our governance panels. I would like to express my appreciation to the members of the Rules Change Panel, Market Surveillance and Compliance Panel, and Dispute Resolution and Compensation Panel for their hard work and dedication, which have contributed to the NEMS' stability and efficiency.

Changes in the energy landscape in Singapore and globally will continue to pose challenges for governments and industry stakeholders. At the same time, new opportunities will emerge. I am confident that the NEMS will remain relevant in the midst of these changes, and will continue to be a role model for countries in this part of the world that are looking to the path of liberalisation for their power sectors.



Wong Meng Meng
Chairman
Energy Market Company

MARKET OVERVIEW

The opening of the National Electricity Market of Singapore (NEMS) in January 2003 was the culmination of a number of structural reforms to Singapore's electricity industry.

Singapore's journey to liberalisation started in October 1995, when industry assets were corporatised and put on a commercial footing. In 1998, the Singapore Electricity Pool, a day-ahead market, began operations. On 1 April 2001, a new legal and regulatory framework was introduced that formed the basis for a new electricity market.

The NEMS is an integral part of Singapore's overall energy policy framework which seeks to maintain a balance of the three policy objectives of economic competitiveness, energy security and environmental sustainability. The NEMS places Singapore alongside an international movement to introduce market mechanisms into the electricity industry as a way to:

- increase economic efficiency through competition;
- attract private investment;
- send accurate price signals to guide production and consumption decisions;
- encourage innovation; and
- provide consumer choice.

Market Reform Milestones

Corporatisation	1995	Electricity functions of the Public Utilities Board corporatised Singapore Power formed as a holding company
	1996	Singapore Electricity Pool (SEP) design process began
Singapore Electricity Pool (SEP)	1998	SEP commenced PowerGrid is SEP Administrator and Power System Operator (PSO)
	1999	Review of electricity industry
National Electricity Market of Singapore (NEMS)	2000	Decision for further reform to obtain full benefits of competition New market design process began
	2001	Electricity industry legislation enacted Energy Market Authority (EMA) established as industry regulator and PSO Energy Market Company (EMC) established as the NEMS wholesale market operator First phase of retail contestability
	2002	Testing and trialling of wholesale market system began
	2003	NEMS wholesale market trading began
	2004	Vesting contract regime introduced Interruptible loads (IL) began to participate in the reserves market
	2006	First wholesale market trader joined the market and commenced trading as IL provider First commercial generator since 2003 joined the market and started trading Retail contestability expanded to 75 percent of total electricity demand
	2007	Removal of the Market Registration Application Fee
	2008	Sale of Tuas Power to China Huaneng Group in March, Senoko Power to Lion Consortium in September, and PowerSeraya to YTL Power in December Embedded generators (EG) joined the market
	2009	Revised regulation price cap of $300/MWh was implemented New EGs, small generators and incineration plants joined and started trading
	2010	Vesting tender was introduced to tender out a percentage of non-contestable electricity demand to generation companies for bidding
	2012	NEMS completed ten successful years of trading
	2013	Singapore's Liquefied Natural Gas (LNG) terminal started commercial operations LNG vesting contract introduced
	2015	Electricity futures trading commenced

Singapore's electricity industry is structured to facilitate competitive wholesale and retail markets. Competitiveness is achieved by separating the ownership of the contestable parts of the industry from those with natural monopoly characteristics.

Six New Market Participants Joined the Market

The NEMS welcomed six new market participants (MPs) in 2015. Four of the new MPs are retailers while the remaining two are wholesale market traders.

KiWi Power Singapore was registered in January, making it the fourth wholesale trader for interruptible load service in the NEMS. It also marks the entry of its parent company, KiWi Power – a demand response provider in the United Kingdom – into Asia Pacific. The other wholesale trader that was registered in October is Singapore-based solar services provider, LYS Genco Beta.

In the retail market, the number of MPs grew by more than 40 percent this year. New retailers, Buri Energy and Sun Electric Power, joined the NEMS in June. Sunseap Energy, the retail arm of Sunseap Leasing, and Best Electricity Supply were registered in November and December respectively.

There are now 15 wholesale market traders and 13 retailers in the NEMS. The number of generation companies remains at 13.

Participants and Service Providers in the NEMS

Generators	ExxonMobil Asia Pacific Keppel Merlimau Cogen Keppel Seghers Tuas Waste-To-Energy Plant (Tuas DBOO Trust) National Environment Agency PacificLight Power Sembcorp Cogen	Senoko Energy Senoko Waste-to-Energy Shell Eastern Petroleum TP Utilities Tuas Power Generation Tuaspring YTL PowerSeraya
Wholesale Market Traders	Air Products Banyan Utilities CGNPC Solar-Biofuel Power (Singapore) CPvT Energy Asia Diamond Energy ECO Special Waste Management Glaxo Wellcome Manufacturing – GlaxoSmithKline Biologicals Green Power Asia	KiWi Power Singapore LYS Genco Beta MSD International GmbH (Singapore Branch) Pfizer Asia Pacific Singapore LNG Corporation Singapore Oxygen Air Liquide Sunseap Leasing
Retailers	Best Electricity Supply Buri Energy CPvT Energy Asia Diamond Energy Supply Hyflux Energy Keppel Electric PacificLight Energy	Sembcorp Power Senoko Energy Supply Seraya Energy Sun Electric Power Sunseap Energy Tuas Power Supply
Market Support Services Licensee (MSSL)	SP Services	
Market Operator	Energy Market Company	
Power System Operator (PSO)	Power System Operator	
Transmission Licensee	SP PowerAssets	

Generation Licensees

All generators with facilities of 1MW or more that are connected to the transmission system must participate in the NEMS and be registered with EMC. Generation licensees are companies with generating facilities that are 10MW or more that are connected to the transmission system and licensed by the EMA to trade in the wholesale electricity market.

Wholesale Market Traders

Wholesale market traders are generators with facilities of 1MW or more but less than 10MW that are connected to the transmission system and licensed by the EMA to trade in the wholesale electricity market. This category includes consumers that offer their own load to be interrupted, as well as companies that provide services to other consumers interested in offering their load to be interrupted.

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 Licensee – SP Services

A Market Support Services Licensee (MSSL) is authorised to provide market support services. Such services include facilitating customer transfers between retailers, meter reading and meter data management. SP Services is the only MSSL. In addition to its market support services function, SP Services also facilitates access to the NEMS for contestable consumers who have not appointed a retailer, and supplies electricity to non-contestable consumers.

Market Operator – EMC

EMC operates and administers the wholesale market. This role includes calculating prices, scheduling generation, clearing and settling market transactions, and procuring ancillary services. EMC also administers the rule change process and provides resources that support the market surveillance and compliance and dispute resolution processes.

Transmission Licensee – SP PowerAssets

SP PowerAssets owns and is responsible for maintaining the transmission system.

Power System Operator

The Power System Operator (PSO), a division of the EMA, is responsible for ensuring the security of supply of electricity to consumers. The PSO controls the dispatch of generation facilities, co-ordinates scheduled outages and power system emergency planning and directs the operation of the high-voltage transmission system.

Regulator – EMA

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

Consumers

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

The NEMS has a number of features that drive efficiency and make its design truly world class. These include:

- co-optimisation of energy, reserve and regulation products;
- security-constrained dispatch and nodal pricing; and
- near real-time dispatch.

Co-optimisation of Energy, Reserve and Regulation Products

A sophisticated process involving about 50,000 different mathematical equations is used to determine the price and quantity of the energy, regulation and reserve products traded. Integral to this process is the concept of co-optimisation, wherein the market clearing engine (MCE) considers the overall costs and requirements of all products, and then selects the optimal mix of generation and interruptible loads (IL) to supply the market.

Security-Constrained Dispatch and Nodal Pricing

To determine the prices for products traded on the wholesale market, offers made by generators and ILs are matched with the system demand forecast and system security requirements. The MCE produces a security-constrained economic dispatch by taking into account the:

- available generation capacity;
- ability of generation capacity to respond (ramping);
- relationship between the provision of energy, reserve and regulation (co-optimisation);
- power flows in the system;
- physical limitations on the flows that can occur in the transmission system;
- losses that are incurred as power is transported; and
- constraints in relation to system security.

This process is run every half-hour to determine the:

- dispatch quantity that each generation unit is to produce;
- reserve and regulation capacity that each generation unit is required to maintain;
- level of IL that is required; and
- corresponding prices for energy, reserve and regulation in the wholesale market.

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

The MCE models the transmission network and uses linear and mixed integer programming to establish demand and supply conditions at multiple locations (nodes) on the network. Modelling ensures that market transactions are structured in a way that is physically feasible given the capacity and security requirements of the transmission system. For each half-hour trading period, the MCE calculates the prices to be received by generators at the 60 injection nodes, and the prices at up to 850 withdrawal or off-take nodes[1] that are used as the basis for the price to be paid by customers. This method of price determination encourages the economically-efficient scheduling of generation facilities in the short term and provides incentives to guide new investment into the power system infrastructure in the long term.

EMC uses metered demand and generation from the MSSL and market prices to settle 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 reserves according to how much risk they contribute to the system. Regulation is paid for by retailers in proportion to their energy purchase and by dispatched generators up to a ceiling of 5 megawatt hours for each trading period.

Energy, Reserve and Regulation Products

	Description	Purchaser	Seller
Energy	Generated electricity	Retailers	Generators
Reserve	Stand-by generation capacity or IL that can be drawn upon when there is an unforeseen shortage of supply. Three classes of reserves are traded: 1) primary reserve (8-second response); 2) secondary reserve (30-second response); and 3) contingency reserve (10-minute response).	Generators	Generators, Retailers and Wholesalers
Regulation	Generation that is available to fine-tune the match between generation and load	Generators and Retailers	Generators

Near Real-Time Dispatch

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

To support near real-time dispatch, EMC produces market forecast schedules up to a week ahead of the relevant trading period. These forecast schedules increase in frequency as the trading period approaches to ensure that MPs have the information they need to adjust their trading positions prior to physical dispatch.

[1] Numbers of injection and withdrawal nodes are as of 31 December 2015.

MARKET GOVERNANCE

Governing Documents and Institutions

The Energy Market Authority (EMA) was established under the Energy Market Authority of Singapore Act 2001. The EMA is the electricity market regulator under the Electricity Act 2001 and is responsible for, among other mandates:

- creating the market framework for electricity and gas supply;
- promoting development of the electricity and gas industries;
- protecting the interests of consumers and the public;
- issuing licences; and
- advising the Government on energy policies.

Rule Change Process

The day-to-day functioning of the National Electricity Market of Singapore (NEMS) wholesale market is governed by the Singapore Electricity Market Rules.

The rule change process is the responsibility of the Rules Change Panel (RCP). Appointed by the Energy Market Company (EMC) Board, RCP members represent generators, retailers, wholesale market traders, the financial community, the Power System Operator (PSO), the Market Support Services Licensee (MSSL), the transmission licensee, electricity consumers and EMC, ensuring representation by all the key sectors of the industry.

The rule change process is designed to maximise transparency and opportunities for public involvement. Rule modifications recommended by the RCP require the support of the EMC Board and the EMA. When approving changes to the Market Rules, the EMA is required to consider whether the proposed rule modifications (i) unjustly discriminate in favour of or against a market participant (MP) or a class of MPs; or (ii) are consistent with the functions and duties of the EMA under subsection 3(3) of the Electricity Act. Each year, the RCP establishes and publishes its work plan to ensure that stakeholders remain informed about the likely evolution of the market. The work plan can be found at www.emcsg.com.

Market Surveillance and Compliance

The Market Surveillance and Compliance Panel (MSCP), comprising professionals independent of the market, is responsible for monitoring, investigating and reporting the behaviour of MPs and the structural efficiency of the market. The panel identifies market rule breaches and assesses market operations for efficiency and fairness. In circumstances in which the MSCP determines that an MP is not compliant with the Market Rules, it may take enforcement action, which may include levying a penalty. The MSCP also recommends remedial actions to mitigate any rule breaches or inefficiencies identified. The Panel produces the MSCP Annual Report, which has been published together with the NEMS Market Report since 2007.

Dispute Resolution

The Market Rules contain a process that facilitates the resolution of disputes between MPs and service providers. The dispute resolution process is designed to be a cost-effective way of resolving disputes and preserving market relationships by avoiding court proceedings. This process is managed by the Dispute Resolution Counsellor (DRC).

Dear Industry Members

As the Market Rules govern the Singapore Wholesale Electricity Market (SWEM), it is of utmost importance that they stay relevant in the continually evolving electricity landscape. The Rules Change Panel (RCP) is central to this rule change process by assessing and making decisions on proposals contributed by members of the wholesale electricity industry.

The proposals this year revolved around the improvement of existing processes, ranging from the extension of the planning horizon of the annual outage plan to the clarification on registration issues relating to commissioning generation facilities (CGFs). The Panel diligently perused such administrative proposals in order for procedures to be streamlined for the benefit of the market. For instance, the Market Rules and Manuals relating to CGFs were reviewed for consistency, and the complex procedures involving multiple service providers relating to the expiry of CGFs are now in the midst of clarification, arising from the Panel's inquiry.

With the rise of renewable energy sources due to environmental concerns and technological advancements, the power system needs to accommodate such energy sources which are usually intermittent in nature, without compromising security and reliability. In view of this, the Panel examined how the Market Rules could be updated to enable the participation of batteries in the regulation market to bolster the quantity and quality of regulation service in the SWEM.

As always, the RCP seeks to refine the market clearing engine (MCE) for more accurate scheduling and pricing of services from registered facilities. This year, the Panel uncovered a limitation of the network simplification process in removing fictional buses which could be default buses of generating units, thereby resulting in incorrect pricing. With the principle of minimising cost to achieve the maximum benefit, the Panel supported the option to revise only Energy Market Company's (EMC) internal procedures to notionally designate such fictional buses as real in the standing data. In another proposal, the Panel standardised the use of a better proxy for the output level of generation facilities at the beginning of each half-hourly period throughout the MCE, so that constraints in the MCE could be applied with more precision.

While improvements to the MCE are always sought after, their associated benefits relative to the costs would be factored into consideration by the Panel when it comes to decision-making. For instance, the extension of the stepwise approach for constraint violation penalties to line limits and ramp rates were explored for improved modelling of the physical characteristics of lines and facilities in tight supply conditions. However, the infrequency of line binding incidents and lower offered ramp rates did not justify the cost of implementation.

The attendance of RCP members at meetings is important for the concerns of all industry stakeholders to be heard in the process of market evolution and governance. I was impressed by the Panel members' willingness to set aside personal interests, and debate heartily on the need for and the type of punitive measures to be imposed on members with unsatisfactory meeting attendances.

We welcomed Henry Gan back to the Panel this year as he replaced Toh Seong Wah to represent EMC. On behalf of the Panel, I would like to express my appreciation to Toh Seong Wah for his contribution in the last three-and-a-half years.

The success of the rule change process is not solely attributed to the RCP. Let me take this opportunity to thank my Panel members, the Energy Market Authority and the EMC Board for considering the rule changes, EMC's Market Administration and Market Operation teams for collaborating on the analytical support for the proposals, and all market participants who have proactively provided comments and suggestions and contributed to a fruitful year for the RCP.

Paul Poh
Chair
Rules Change Panel

Rule Changes Supported by the RCP

The following rule changes were discussed and approved, as part of the RCP's continual efforts to guide the evolution of the wholesale electricity market.

Handling of Fictional Busbars

When the network status file shows that a generating unit is physically disconnected, the market clearing engine (MCE) will usually connect the generating unit to its designated main or alternate default busbars. This is so that all generating units will be represented as connected in the MCE's dispatch network model, so as to allow them to be scheduled in the upcoming periods.

However, in the rare situation when the PSO designates fictional buses (which are real physical connections like real busbars, but comprise short connectors between switches) as the main or alternate default busbar for a generating unit, incorrect marginal pricing problems could occur. This is because fictional buses, when they are electrically equivalent to other buses, could be removed as part of the dispatch network simplification process by the MCE.

A proposed option of notionally designating fictional buses assigned as main or alternate default busbars as real buses in the standing data was supported by the RCP unanimously. EMC amended its internal procedures through EMC's internal documents governing the dispatch network simplification process, such that the relevant buses will not be simplified as part of the process.

Clarification of Timeline for Minimum Stable Load Compensation

A previously-approved rule change enables the modelling of generation registered facilities' (GRFs) minimum stable loads (MSL), together with compensation for those that are scheduled at their MSLs. This rule change was made to clarify that the timelines for the calculation, verification and disbursement of such compensation refers to business days.

Eligibility of Energy & Reserve Offers

A proposal recommended the use of a better proxy – ExpectedStartGeneration – instead of StartGeneration to represent the output of a generator at the beginning of a dispatch period (BOP) in the MCE formulations. ExpectedStartGeneration is already used to check if a generator is eligible to provide regulation.

StartGeneration captures the output of a generator ten minutes before the BOP, potentially deviating from the generator's actual output at the BOP. ExpectedStartGeneration, on the other hand, projects the output of a generator at the BOP using its energy schedule of the prior period and physical constraints, i.e., its StartGeneration and maximum ramp rates.

It was proposed that ExpectedStartGeneration, instead of StartGeneration, be used in other constraints to represent the output of a generator at the BOP. The RCP unanimously supported this rule change which will come into effect three months after the implementation of the Demand Response (DR) scheme.

Provision of Regulation by Batteries

Currently, regulation is provided by conventional generators only via automatic generation control (AGC) in the Singapore Wholesale Electricity Market (SWEM). However, batteries are also capable of providing regulation, through charging or discharging. The small sizes of batteries allow them to change their energy output in very small resolutions, while their high ramp rates allow them to respond rapidly and accurately to regulation signals. It was, therefore, proposed that batteries be allowed to participate in the regulation market.

The proposal suggested that the existing treatment of conventional generators in regulation provision be applied to batteries. One key difference between conventional generators and batteries is the limited storage capacities of batteries. This would constrain the ability of batteries to provide regulation up or down when they are fully discharged or charged. To counter this limitation, batteries shall provide regulation via the dispatch mechanisms approved by the PSO instead of AGC. The dispatch mechanisms should ensure that the battery provides regulation continuously, without being fully discharged or charged, and prohibit it from exhibiting reverse behaviour.

The participation of batteries in the regulation market will be beneficial to the SWEM. The potential increase in quantity and quality of regulation complements the expected increase in deployment of renewable energy sources like solar energy (whose intermittency may increase the regulation requirement) by improving system security. Greater competition in the regulation market will also improve market efficiency, potentially driving regulation prices down. The RCP, by majority vote, supported the proposal which will come into effect with the DR scheme as its implementation will be aligned with other system changes taking effect for the DR scheme.

Extending Planning Horizon of Annual Outage Plan

The PSO conducts an annual exercise to coordinate the outage plans of MPs for the upcoming year, and forms the approved annual outage plan listing the outages scheduled to occur in that upcoming year.

A rule change was made to require that outage plans cover a three-year period instead of the previous one-year period, by requiring the formation of a pro forma biennial outage plan based on indicative outage plans submitted by MPs for the second and third years. The formation of the pro forma biennial outage plan will be done at the same time as that for the approved annual outage plan.

Rectification of Settlement Formula for Net Participant Settlement Credit

This rule change aimed to correct an error in the formula for calculating the Net Participant Settlement Credit.

The original formula was based on the assumption that every MP had only one settlement account. In reality, an MP can have more than one settlement account if it owns embedded generators (EGs), as each group of EGs will be assigned a unique settlement account.

The Net Participant Settlement Credit of an MP should therefore be the aggregate of settlement credits across all settlement accounts associated with that MP, and a rule change was made to reflect this. With this change, an MP will be able to see the total settlement amount across all his settlement accounts in one statement.

Registration Issues Relating to Commissioning Generation Facilities

A proposal was received for EMC to implement a check in EMC's market system to prevent any Commissioning Generation Facility (CGF) from continuing to participate in the real-time markets after the expiry of its CGF registration. Currently, MPs of CGFs whose registrations have expired are not allowed to participate in real-time markets, or cause or permit any physical service to be conveyed into, through or out of the transmission system from such CGFs. There are already provisions in the Market Rules for rule breaches to be dealt with by the Market Surveillance and Compliance Panel (MSCP).

Under the current rules, EMC already has the responsibility to ensure that expired CGFs are not scheduled for dispatch periods after the expiry date of the CGFs' registration. The proposal received, therefore, did not require a rule change. The RCP suggested instead that EMC look into setting an appropriate deadline in the Market Rules and Market Manual for the status of a CGF's registration to be confirmed, so that the relevant parties have the required lead time to proceed with the deregistration/removal of the CGF where necessary.

In addition, a review was conducted of the Market Rules on the registration of CGFs, as well as the Application Form for the Registration of CGFs contained in the Market Administration Market Manual. The review provided for generation facilities intending to be registered as generation settlement facilities to first register as CGFs if they are required to connect to the grid to undergo commissioning tests.

The RCP unanimously supported the proposed changes to the CGF registration form and consequently the generation facility registration form, which ensure that the forms are consistent with the Market Rules and the other market manuals.

Rule Changes Not Supported by the RCP

The RCP also discussed the following proposals but decided not to support them because the potential benefits did not justify the costs.

Increase in Transparency of Market Information on Transmission Congestion and Price Separation

With the recent increase in new generation capacity on Jurong Island, the excess supply has led to more frequent occurrences of transmission congestion and price separation events in the south-west block of the transmission system.

EMC thus proposed that more information on transmission constraints be provided to the industry so as to allow MPs, the PSO and the Transmission Licensee to better understand and manage transmission congestion from an economic point of view.

For example, EMC can inform the industry when a binding transmission constraint is observed in forecast schedules. After a congestion event where a price separation has occurred, EMC may also provide a quantitative analysis of the financial impact caused by transmission constraints.

The industry, however, was of the view that such information would not be useful in managing transmission constraints. Therefore, the RCP, by majority vote, decided not to support this proposal.

Extension of Stepwise Constraint Violation Penalties

Constraint violation penalties (CVPs) are costs taken into account by the MCE when a solution that simultaneously satisfies all constraints cannot be found. A previous rule change implemented stepwise CVP for reserve and regulation deficits, with increasing severity of violation incurring a higher CVP per unit of violation. This paper discussed extending the stepwise CVP approach to two other types of violations.

First, while transmission lines should usually be operated within their continuous ratings, they are also designed to allow flows up to their emergency ratings for short durations. One proposal examined the feasibility of allowing the MCE to exceed a line's continuous rating at a lower associated CVP, in order to reduce energy deficits or relieve line congestion.

Second, the MCE currently uses generators' offered ramp rates, which could be lower than their standing capabilities, in scheduling. The second proposal explored the feasibility of applying the stepwise CVP approach to ramp rate violation, with lower CVPs associated with exceeding generators' offered ramp rates, up to their standing ramp rates. This allows the MCE to schedule generators for more energy by exceeding their offered ramp rates to serve load.

Given that line binding incidents and lower offered ramp rates occur infrequently, and on account of industry feedback received, the RCP decided not to support the extension of stepwise CVPs to these two types of violations.

Attendance at Meetings by Rules Change Panel Members

In order to ensure adequate representation from all classes of stakeholders at RCP meetings, the Panel considered whether some measures should be put in place to encourage members to make more effort to attend all meetings, especially those representing service providers with only one representative.

Several options were explored, including allowing for alternative representatives and sending reminders to RCP members and the nominating organisations.

At the meeting, the Panel was of the view that RCP members are generally well aware of the importance of RCP meetings. Given that the attendance of members is already being monitored, the Panel decided that there is no urgency to introduce any additional measures at this moment.

Rule Changes Directed by the EMA

In addition to the rule changes considered by the RCP, EMC also implemented the following rule changes as directed by the EMA pursuant to Section 46(2)(b) of the Electricity Act:

Enhancements to the Regulatory Framework for Intermittent Generation Sources in NEMS

To enhance the regulatory framework for intermittent generation sources (IGS) such as solar energy, EMC implemented rule changes on 1 April 2015 to effect the EMA's key policy decisions as follows:

1) Not to subject all IGS, regardless of size, to dispatch by the PSO, as the output of IGS is dependent on weather conditions;
2) Allow contestable consumers (CCs) with embedded IGS of less than 1MWac to choose to sell their excess electricity generated through the central intermediary, the MSSL, instead of participating directly in the wholesale market; and
3) Apply 'net settlement for energy component' to all embedded IGS owned or leased by CCs to facilitate the settlement of their net generation or consumption.

Forward Sales Contract Scheme

The development of an electricity futures market, which supports the trading of 'forward' electricity products, complements both the existing wholesale and retail electricity markets. It is a platform for industry players and financial intermediaries to use financial instruments for risk management and investment activities. The outcome is a more efficient supply of electricity in the wholesale and retail markets, which will benefit industry stakeholders and electricity consumers. Given the size and structure of Singapore's market, the key challenge to the development of the electricity futures market is to ensure sufficient initial liquidity.

To ensure sufficient initial liquidity, the EMA implemented the Forward Sales Contract (FSC) Scheme and directed EMC to modify the Market Rules accordingly such that EMC will settle the FSCs as part of wholesale settlement. MPs participating in the FSC Scheme (the 'FSC Holders') are allocated forward sales quantities under FSCs, in return for their undertaking and fulfilling of certain market-making obligations in certain electricity futures contracts traded on the market operated by the Singapore Exchange Derivatives Trading Limited. These FSCs are bilateral cash-settled contracts for differences, each entered into between an FSC Holder (as a floating price payer) and the MSSL (as the fixed price payer).

Implementation of Automatic Penalty Scheme

In 2011, the EMA made the decision to impose financial penalties automatically on all GRFs that have deviated from their dispatch schedules by more than 10MW, unless the deviation occurs under circumstances beyond the control of the MP.

Under this scheme, the MSCP does not need to conduct investigation into such straightforward deviation cases before a penalty can be imposed on deviating generators. Instead, a financial penalty will be imposed by EMC directly and collected within 20 days, similar to the current settlement cycle. If the non-compliance was to avoid endangering safety of personnel, damaging equipment or violating laws, an MP is still allowed to appeal to the MSCP for waiver of penalty afterwards.

With this scheme, GRFs would be incentivised to comply with their schedules, which would in turn enhance system security.

Dear Industry Members

Dispute Resolution and Compensation Panel

The Dispute Resolution and Compensation Panel (DRCP) was established under the Market Rules to provide dedicated dispute resolution services to the NEMS when required.

DMS Contacts

Pursuant to the Market Rules, each market entity has nominated at least one Dispute Management System (DMS) contact to be the first point of engagement in the event of a dispute.

The current DMS contacts are:

1. Air Products - Shawn Zhang
2. Air Products - Tang Siew Wai
3. Best Electricity Supply - Terence Neo
4. Buri Energy - Nerine Teo
5. CGNPC Solar Biofuel Power (Singapore) - Nelson Ong
6. CGNPC Solar Biofuel Power (Singapore) - Zhang Hua
7. CPvT Energy Asia - Jeffrey Ng
8. CPvT Energy Asia - Vijay Sirse
9. Diamond Energy Supply - Laurence Kwan
10. ECO Special Waste Management - Ethiraj Thirumalai
11. ECO Special Waste Management - Vincent Tang
12. Energy Market Company - Tan Phaik Kim
13. ExxonMobil Asia Pacific - Elaine Lee
14. GlaxoSmithKline Biologicals - Chew Siou Ping
15. GlaxoSmithKline Biologicals - Wong Joon Jee
16. Green Power Asia - Daniel Ma
17. Hyflux Energy - Cindy Lim
18. Hyflux Energy - Ng Soo Yong
19. Keppel Electric - Joelyn Wong
20. Keppel Electric - Nicholas Tan
21. Keppel Merlimau Cogen - Sean Chan
22. Keppel Merlimau Cogen - Tini Mulyawati
23. LYS Genco Beta - Jonathan Chong
24. National Environment Agency - Siew Weng Soon
25. National Environment Agency - Teresa Tan
26. PacificLight Energy - Teo Chin Hau
27. PacificLight Power - Calvin Tan
28. PacificLight Power - Linda Wen
29. Pfizer Asia Pacific - Lee Chin Hoo
30. Pfizer Asia Pacific - Tan Meng Tong
31. Power System Operator - Agnes Tan
32. Power System Operator - Loh Poh Soon
33. Sembcorp Cogen - Ang Geok Chuan
34. Sembcorp Cogen - Agnes Low
35. Sembcorp Power - H C Chew
36. Senoko Energy - Luke Peacocke
37. Senoko Energy - Poo Siok Yin
38. Senoko Energy Supply - Eu Pui Sun
39. Senoko Energy Supply - Michelle Lim
40. Seraya Energy - Daniel Lee
41. Seraya Energy - Elaine Syn
42. Shell Eastern Petroleum - Pak-Juan Koe
43. Singapore LNG Corporation - Lam Zheng Xin
44. Singapore LNG Corporation - Vincent Lam
45. Singapore Oxygen Air Liquide - Lim Yong Yi
46. SP PowerAssets - Chan Hung Kwan
47. SP PowerAssets - Ong Sheau Chin
48. SP Services - Budiman Roesli
49. SP Services - Lawrence Lee
50. Tuas Power Generation - Priscilla Chua
51. Tuas Power Supply - Jazz Feng
52. Tuaspring - Calvin Quek
53. Tuaspring - Chin Shi En
54. YTL PowerSeraya - Jonathan Chew
55. YTL PowerSeraya - Mark New Yuzhe

DRCP Members

The DRCP members are:

Mediation Panel

1. Chandra Mohan
2. Daniel John
3. Danny McFadden
4. Geoff Sharp
5. Associate Professor Joel Lee
6. Associate Professor Lim Lei Theng
7. Dr Peter Adler
8. Robert Yu
9. Shirli Kirschner

Arbitration Panel

1. Ang Cheng Hock, Senior Counsel
2. Ben Giaretta
3. Chelva Rajah, Senior Counsel
4. Giam Chin Toon, Senior Counsel
5. Gregory Thorpe
6. Harry Elias, Senior Counsel
7. Kenneth Tan, Senior Counsel
8. Professor Lawrence Boo
9. N Sreenivasan, Senior Counsel
10. Naresh Mahtani
11. Philip Jeyaretnam, Senior Counsel
12. Phillip Harris
13. Raymond Chan
14. Dr Robert Gaitskell, Queen's Counsel
15. Tan Chee Meng, Senior Counsel
16. Professor Tan Cheng Han, Senior Counsel

Conclusion

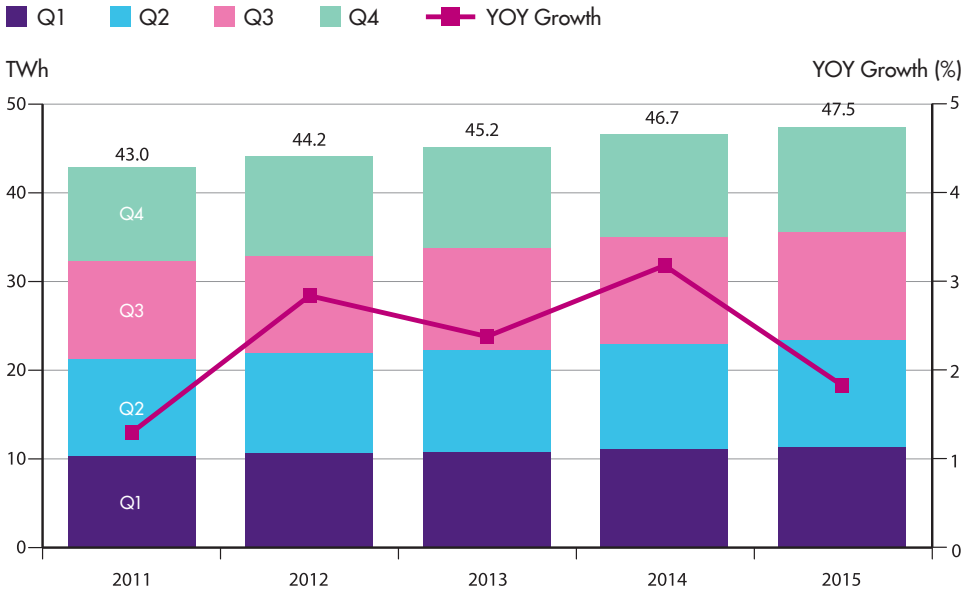
For the past year, no disputes were filed with me.

I thank the DRCP members and DMS contacts for their contributions, and look forward to continuing to support the dispute resolution needs of all NEMS market entities in the coming year.

George Lim
Senior Counsel
Dispute Resolution Counsellor

MARKET PERFORMANCE

Annual Electricity Consumption 2011 – 2015



Year-on-year growth in electricity consumption falls to a four-year low

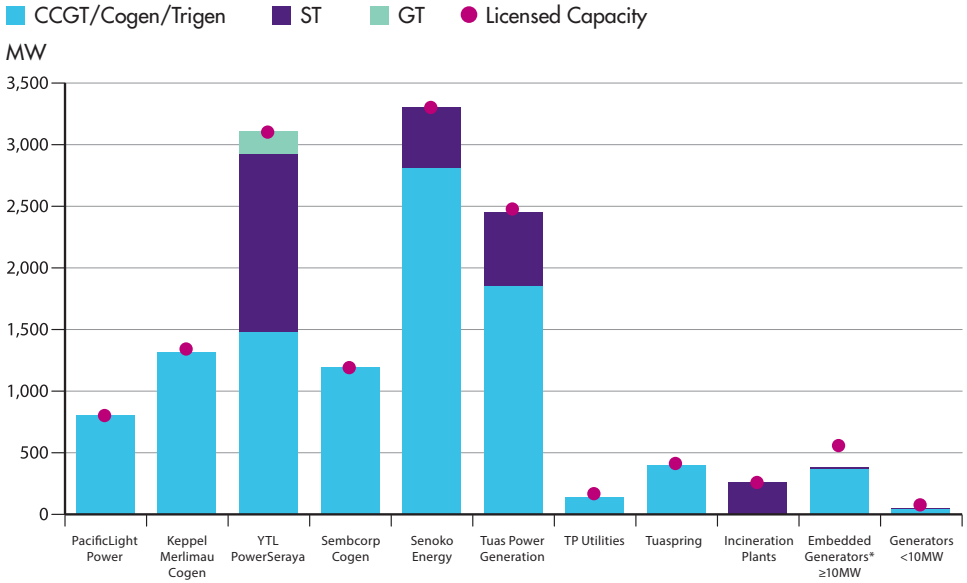
Electricity purchased by market participants (MPs) is settled using electricity consumption data provided by the Market Support Services Licensee (MSSL).

In line with the slower growth in Singapore's economy in 2015 of 2.0 percent[2] (down from 3.3 percent in 2014), the year-on-year (YOY) growth in electricity consumption fell to a four-year low of 1.7 percent in 2015, to 47.5 terawatt hours (TWh).

Compared to the same periods in 2014, all quarters in 2015 saw higher YOY electricity consumption. The largest increase was in the last quarter, when electricity consumption rose by 2.8 percent. The smallest increase was registered in the second quarter, at 1.0 percent.

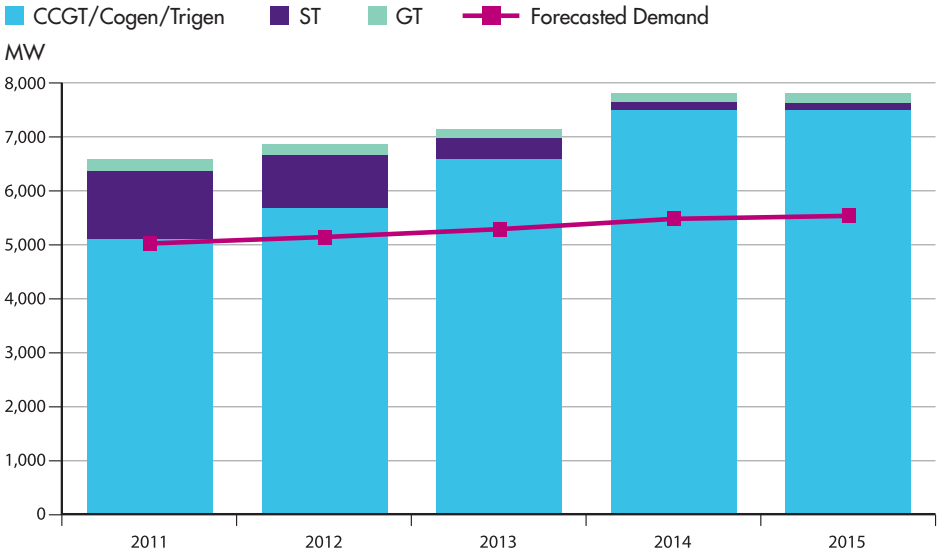
[2] Based on the Singapore Ministry of Trade and Industry press release on 24 February 2016: *MTI Maintains 2016 GDP Growth Forecast at 1.0 to 3.0 Per Cent.*

Generation Capacity as of 31 December 2015: Registered Versus Licensed



*Embedded generators exclude TP Utilities

Annual Generation Supply by Plant Type 2011 – 2015



Licensed capacity falls while registered capacity increases

Total licensed capacity in the National Electricity Market of Singapore (NEMS) fell by 2.7 percent to 13,670 megawatts (MW) in 2015, from 14,053MW in 2014. During the year, Sembcorp Cogen's fourth generator with a capacity of 500MW was removed[3]. On the other hand, the number of smaller generators with capacity below 10MW increased 43.0 percent, bringing the total licensed capacity of such generators to 75MW.

Registered capacity grew 3.6 percent to 13,349MW in 2015 with the addition of Tuaspring's first generation facility of 395.7MW.

The increase in registered capacity and decrease in licensed capacity narrowed the gap between the two. The proportion of total registered capacity to total licensed capacity stood at 97.7 percent in 2015, an increase from 2014's 91.7 percent.

Out of the total registered capacity, the proportion of CCGT/cogen/trigen registered capacity grew from 76.8 percent in 2014 to 77.6 percent in 2015.

CCGT/cogen/trigen = Combined-cycle gas turbine/ cogeneration/trigeneration (combined category)
ST = Steam turbine
GT = Gas turbine
Embedded generators (EG) = Generation units that generate electricity to their onsite load principally for self-consumption.

[3] Source: Energy Market Authority website.

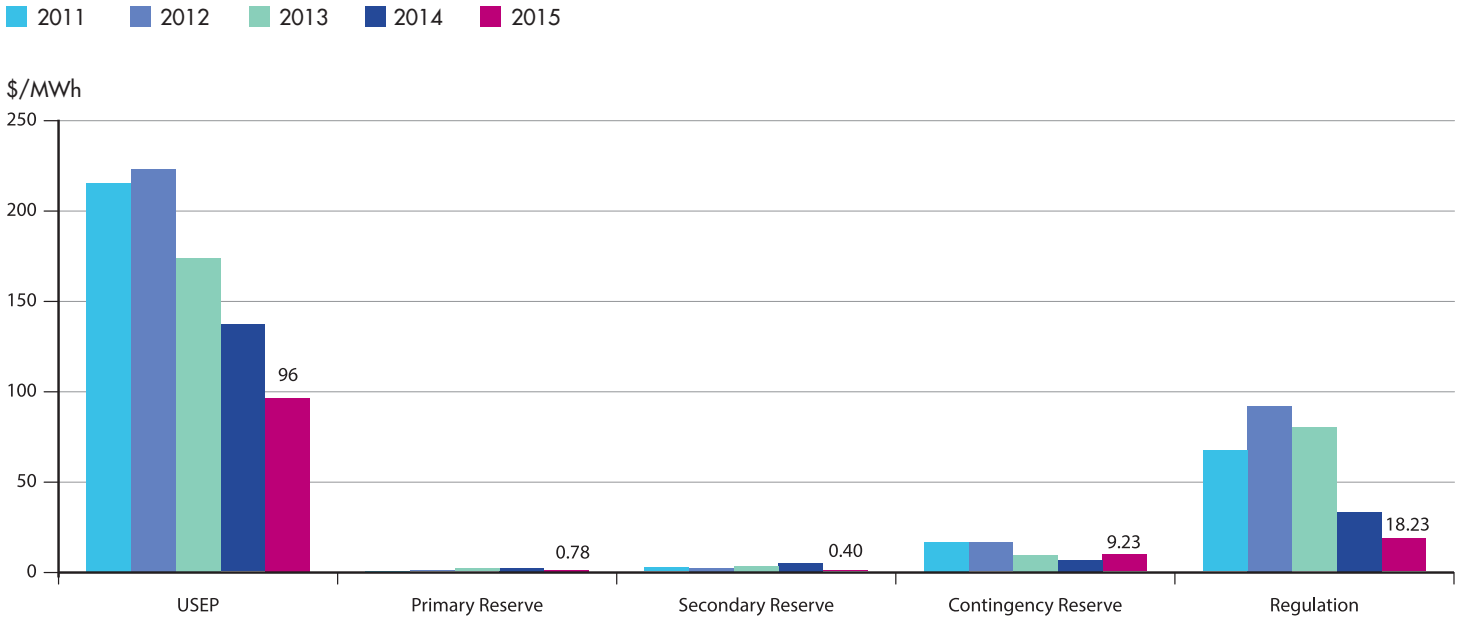
Supply maintains at the same level as 2014

CCGT/cogen/trigen supply decreased marginally by 0.1 percent in 2015. Since the start of the market, this is the second instance where CCGT/cogen/trigen supply saw a YOY drop. The first instance was in 2009. CCGT/cogen/trigen supply continued to stay above forecasted demand in 2015 by a margin of 35.5 percent, a 1.5 percent drop from the level seen in 2014.

The slight dip in CCGT/cogen/trigen supply was balanced by the marginal increase in ST and GT supply. After recording the lowest level in 2014 since the start of the market, ST supply increased 1.6 percent in 2015. GT supply was 1.3 percent higher in 2015.

The annual generation supply in 2015 was 7,834MW, similar to the level seen in 2014. This is the third consecutive year since 2013 that the annual generation supply has stayed above the 7,000MW mark.

Annual USEP and Ancillary Prices 2011 – 2015



Most prices, including USEP, fall in 2015

Market prices for energy, reserve and regulation are calculated five minutes before the start of each half-hour trading period. This ensures that the prices reflect the prevailing power system conditions and the most recent offers made by generators.

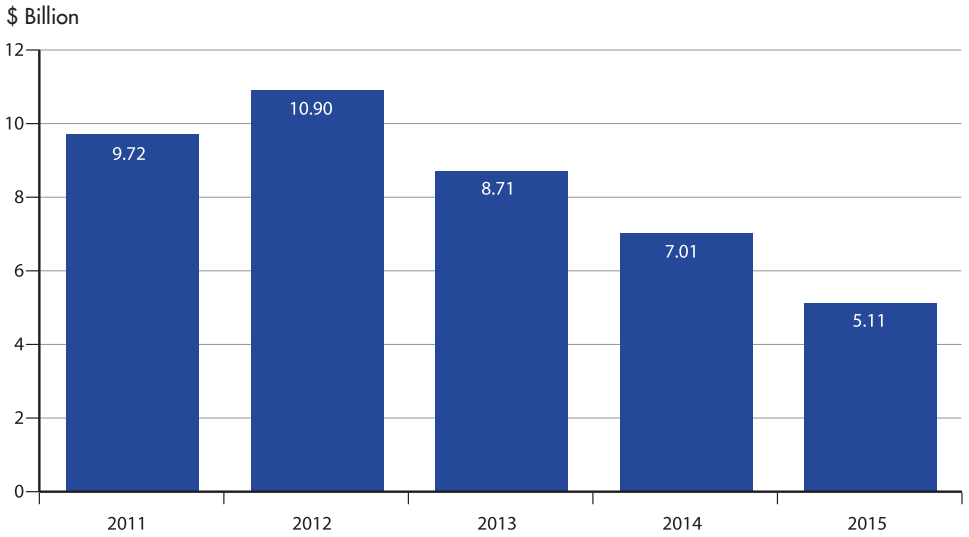
The annual average Uniform Singapore Energy Price (USEP) fell from $137 per megawatt hour (MWh) in 2014 to $96/MWh in 2015. This is the third lowest level since the market started, the lowest being $82/MWh registered in 2004. The YOY drop of 29.9 percent is unprecedented. The low USEP was in line with the decline in fuel oil[4] price, which dropped 47.3 percent from 2014 to USD302 per metric tonne (MT) in 2015.

On the back of cheaper offers and lower requirement in 2015, primary and secondary reserve prices fell to $0.78/MWh and $0.40/MWh respectively. On the other hand, contingency reserve price rose from $6.20/MWh in 2014 to $9.23/MWh in 2015 due to higher requirement.

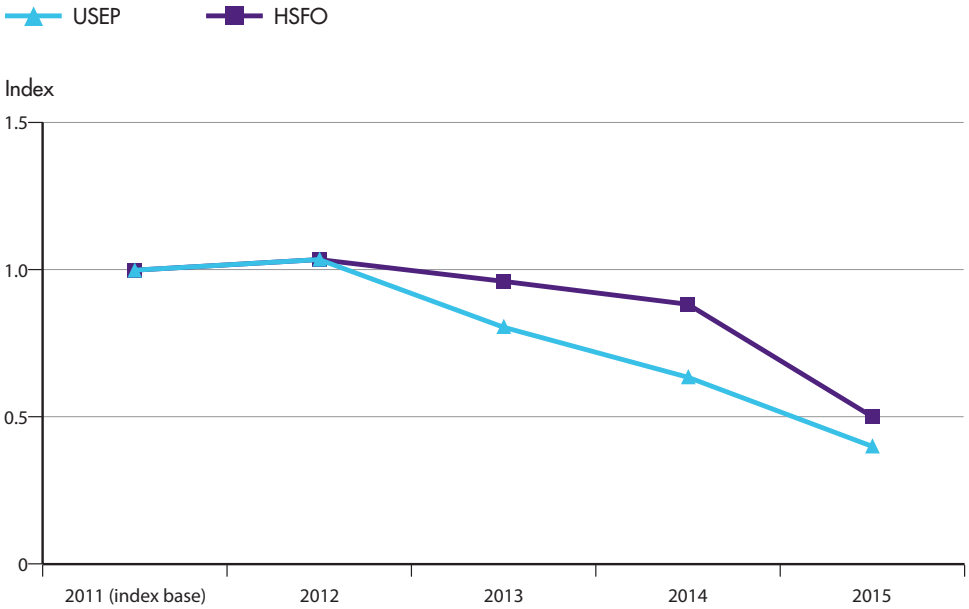
Regulation price plunged to a record low of $18.23/MWh in 2015, a 42.1 percent dip from the record level of $31.47/MWh set in 2008. The lower regulation price was in spite of the new regulation requirement which was revised up to 126MW from 1 February 2015.

[4] Based on HSFO 180 CST price which is used as a proxy for fuel price.

Annual Value of Products Traded 2011 – 2015



Annual USEP and Fuel Price (HSFO) Movements 2011 – 2015



Annual value of products traded declines for third consecutive year and registers a ten-year low

The value of products traded shows the transacted value for all products traded in the NEMS: energy, reserves and regulation. EMC uses the metered demand and generation data from the MSSL as well as market prices in the NEMS to settle market transactions on a daily basis.

The annual value of products traded shrunk to a ten-year low in 2015 to $5.11 billion. With more MPs joining the market, competition in the NEMS intensified and energy prices fell. This contributed to the drop in the annual value of products traded by the 13 generation companies, 15 wholesale market traders and 13 retailers in the NEMS in 2015.

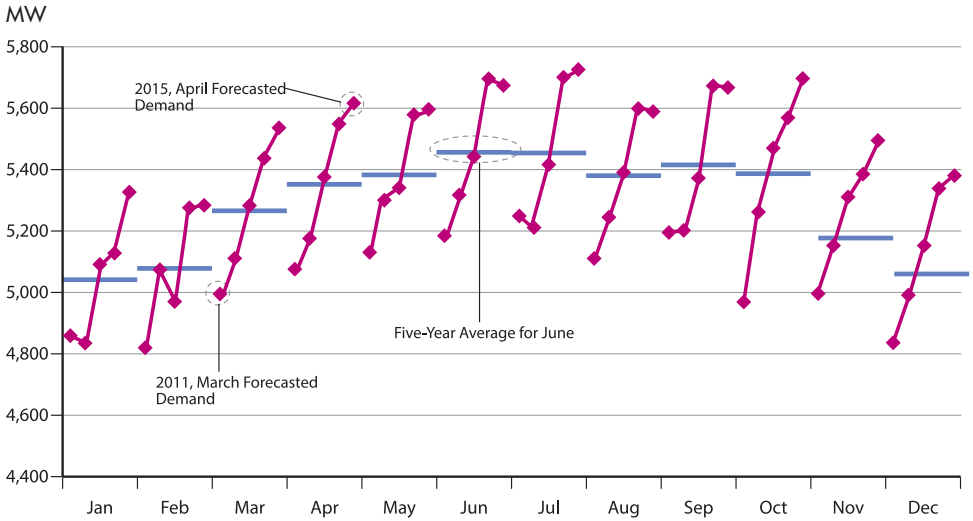
Compared to 2014, the annual value of products traded fell by 27.0 percent in 2015. This can largely be attributed to the fall in the energy and regulation markets, by 27.0 and 0.1 percent respectively. The reserves market grew marginally by 0.1 percent.

USEP and fuel price indices[5] converge in 2015

The intense competition in the electricity market drove the USEP index down for the third consecutive year, causing it to fall below 0.5 in 2015. The fuel price index has also dropped for three consecutive years. The difference is that the pace of decline for the latter was accelerated by an oversupply in the fuel oil market in 2015 which pushed the index down to 0.5. The gap between the USEP and fuel price indices narrowed in 2015.

[5] The index is computed using 2011 as the index base. Therefore, the USEP index in 2011 is 1, while the USEP index in 2012 is 1.03 (computed using the 2012 USEP of $222/MWh divided by the 2011 USEP of $215/MWh).

Monthly Forecasted Demand 2011 – 2015



Forecasted demand grows in most months except June, August and September

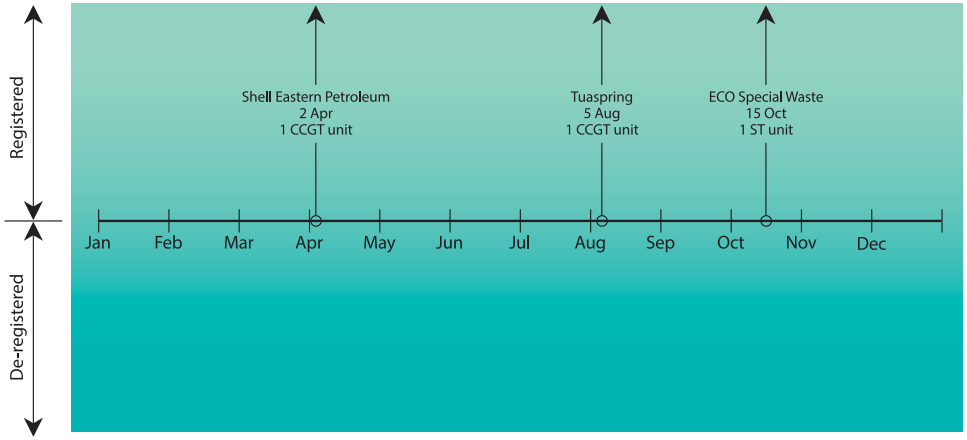
Forecasted demand is the projected electricity consumption in the NEMS. The forecast is provided in real-time by the Power System Operator (PSO) and is a key component in determining the USEP.

Comparing YOY, demand was stronger in nine out of 12 months. Apart from January when the Chinese New Year public holidays could have influenced the YOY growth rate, October 2015 saw the highest monthly YOY growth rate of 2.3 percent. In 2014, the highest monthly YOY growth rate of 5.6 percent occurred in September.

The highest monthly average forecasted demand in 2014 was registered in July at 5,700MW. Likewise in 2015, the highest monthly average forecasted demand occurred in July at 5,725MW. The peak half-hourly forecasted demand was recorded on Period 29 of 4 June at 6,696MW. This was significantly lower than the highest half-hourly forecasted demand seen in 2014 on Period 29 of 7 May at 6,850MW.

Overall, the forecasted demand rose by 1.0 percent in 2015 from 5,493MW in 2014.

Generation Facilities Registered and De-registered in 2015



Registered capacity surpasses 13,000MW in 2015

The total registered capacity in the NEMS as of 31 December 2015 was 13,349MW. Two new CCGT generation facilities with a total capacity of 463.5MW and a new ST generation facility of 1.5MW were registered in the year. Together, they brought about a 3.6 percent increase in the total registered capacity.

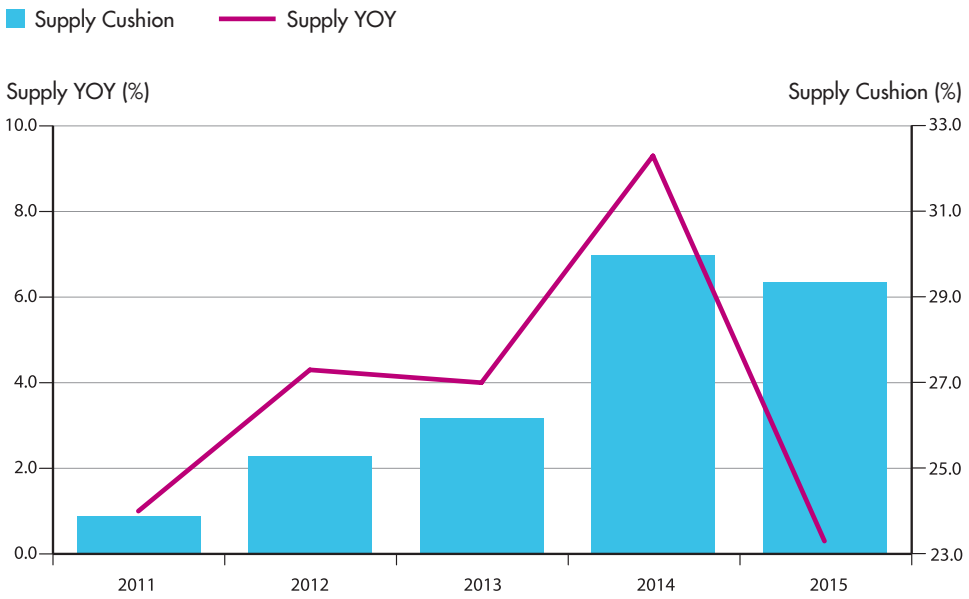
The entrants to the market consisted of:

Market Participant	Generation Type	Registered Capacity
Shell Eastern Petroleum	1 CCGT unit	67.8MW
Tuaspring	1 CCGT unit	395.7MW
ECO Special Waste Management	1 ST unit	1.5MW

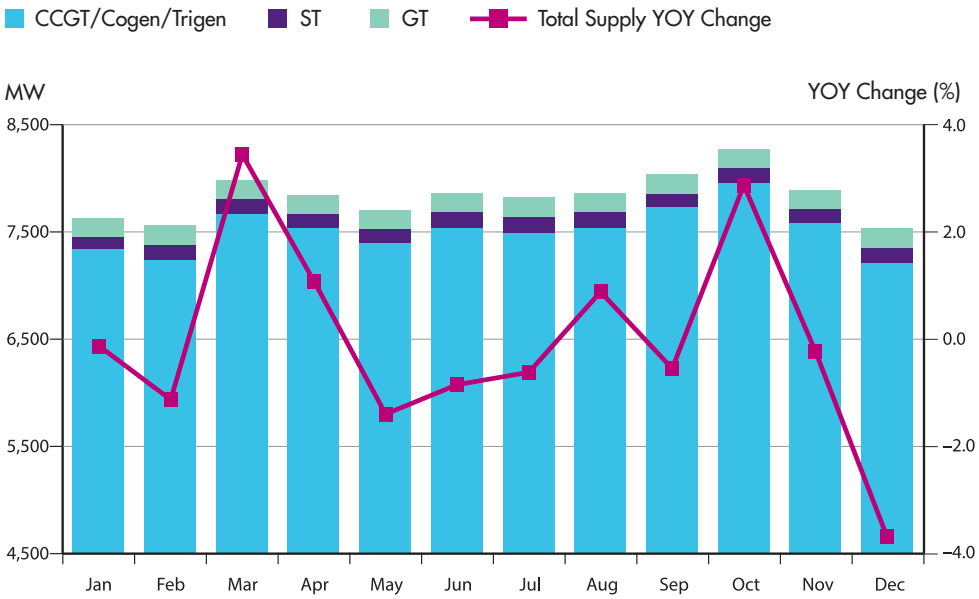
No facilities were de-registered or de-rated in 2015.

Of the registered capacity in 2015, 77.6 percent or 10,356MW belonged to the CCGT/cogen/trigen category. The total number of generation facilities registered as of 31 December 2015 was 59.

Supply Cushion Stays Close to 30.0 percent in 2015



Monthly Supply by Plant Type 2015



Supply cushion in 2015 remains strong despite a slight dip from 2014's level

Supply cushion measures the percentage of total generation supply that is available after matching off forecasted demand. It is calculated by subtracting forecasted demand from total supply, over total supply. If both total supply and forecasted demand rise in tandem, the supply cushion would then remain constant.

In 2015, the forecasted demand increased at a faster rate than total supply, which resulted in a slight dip in the supply cushion to 29.3 percent. This is the second highest level of supply cushion since the market started, after 2014's 30.0 percent. Despite a slower supply growth in 2015, the supply cushion was still significantly higher than the years preceding 2014.

Total supply remains unchanged despite most months recording negative YOY growth

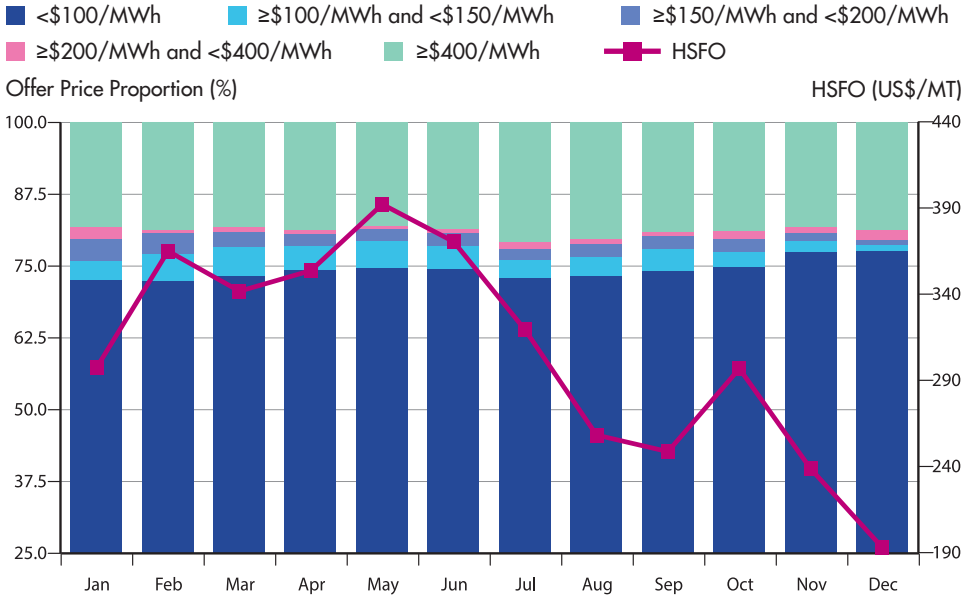
In 2015, eight out of 12 months registered negative YOY growth for supply. However, total supply remained unchanged as the months with positive growth overshadowed those with negative growth. The highest positive YOY supply growth registered was 3.5 percent in March due to greater CCGT offer availability, while the largest YOY supply drop registered was 3.7 percent in December as a result of higher CCGT maintenance.

The more efficient and economical CCGT continued to remain in dominance with a 95.9 percent share of the total supply, similar to the level in 2014. For all months in 2015, the proportion of CCGT supply to total supply was above 95.5 percent.

The trend of negative YOY growth for ST supply reversed in 2015, as most months saw positive YOY growth ranging from 0.2 percent to as high as 18.3 percent. ST supply made up 1.8 percent of total supply, a 0.1 percent increase from 2014.

The peak monthly supply at 8,274MW in October was the highest level seen since the market started. Both 2014 and 2015 saw total supply surpassing the 8,000MW level for the months of September and October.

Monthly Energy Offer Price Proportion and HSFO Price 2015



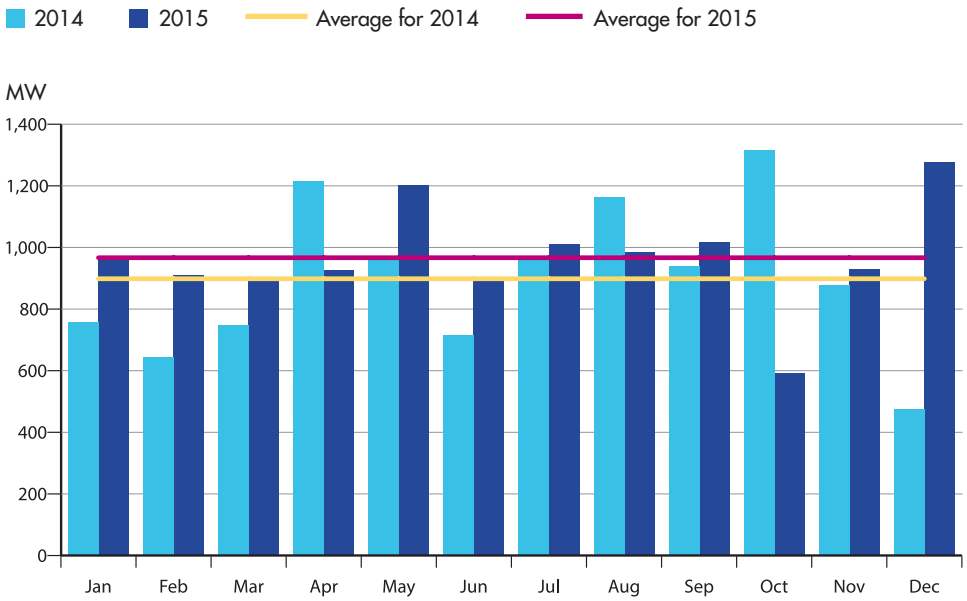
Energy offer price shifts to lower price bands as fuel oil price[6] trends down

Throughout 2015, energy offer prices in the lower price band (below $100/MWh) increased by between 6.6 percent and 19.5 percent. The percentage of energy offers priced below $100/MWh averaged 74.3 percent, up from 60.4 percent in 2014.

Lower fuel oil prices tend to shift energy offer prices into the lower price bands. This correlation was evident in December – when the HSFO price fell to the year-low of USD193/MT, the proportion of energy offers in the lower price band increased to 77.6 percent. Annually, the HSFO price averaged USD302/MT in 2015.

[6] Based on HSFO 180 CST price which is used as a proxy for fuel price.

Monthly Generation Maintenance 2014 Versus 2015



Generation maintenance at a three-year high in 2015

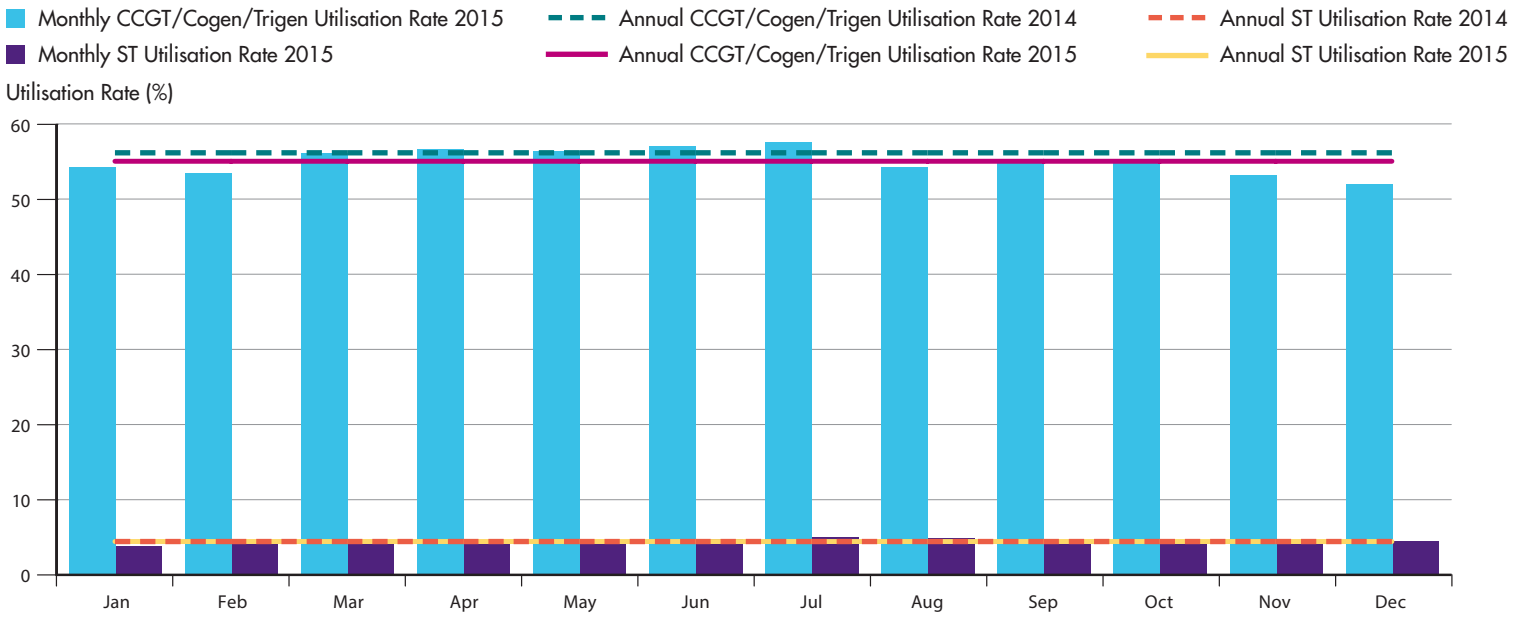
Annual average generation maintenance levels[7] rose by 6.1 percent or 68.2MW in 2015 and averaged 944MW. Generation maintenance levels increased in all months except April, August and October. December 2015 registered the highest level of generation maintenance at 1,276MW with a minimum of three generation units out on maintenance every day.

The standard deviation of monthly generation maintenance decreased from 248MW in 2014 to 168MW in 2015. The monthly generation maintenance level ranged from 593MW to 1,276MW in 2015, compared to the wider range of between 475MW and 1,317MW in 2014.

The average ratio of generation maintenance to registered capacity rebounded from 7.0 percent in 2014 to 7.1 percent this year.

[7] Generation maintenance levels are calculated based on the Annual Generator Outage Programme (AGOP) provided by the PSO.

Monthly Utilisation Rate by Plant Type 2015



Utilisation rate for CCGT/cogen/trigen plant types dips slightly while that of ST plant type remains unchanged

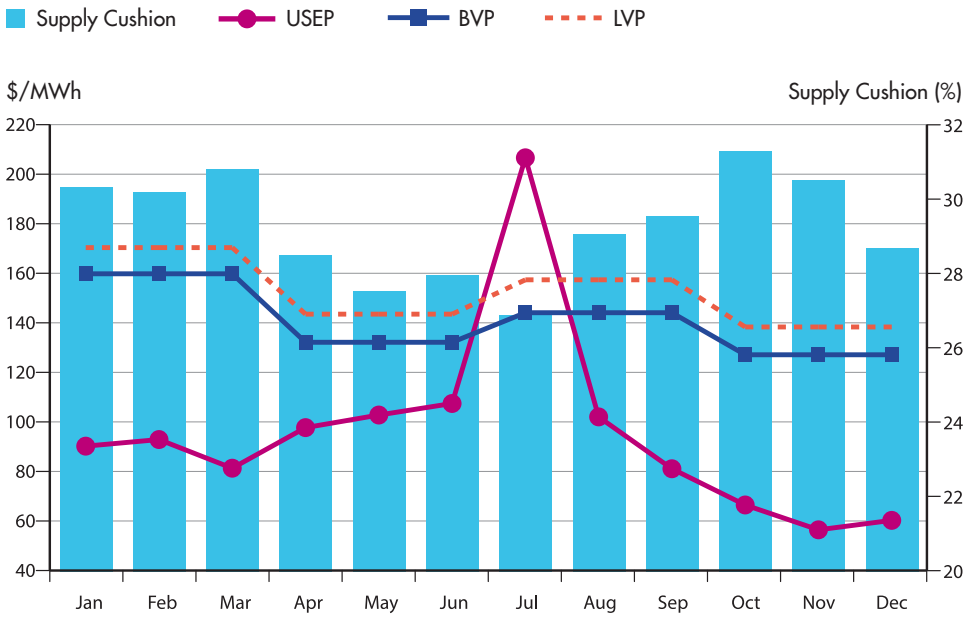
The utilisation rate measures the scheduled energy as a percentage of registered capacity.

In 2015, the monthly CCGT/cogen/trigen utilisation rate reached the highest level in July at 57.6 percent, and the lowest level in December at 52.0 percent. The CCGT/cogen/trigen utilisation rate trended higher from March to July, and was lower at the beginning and at end of the year. In November and December, the drop in the CCGT/cogen/trigen utilisation rate resulted from the easing of the forecasted demand at year-end. Compared to 2014, the monthly utilisation rate in 2015 was slightly more irregular and spanned a wider range between 52.0 percent and 57.6 percent (2014's range was between 54.3 percent and 57.9 percent).

Overall, the utilisation rate for CCGT/cogen/trigen dipped marginally from 56.2 percent in 2014 to 55.1 percent in 2015. The decline in the utilisation rate is consistent with the commissioning activities of new CCGT/cogen/trigen units entering the market in 2015.

The monthly ST utilisation rate ranged between 3.9 percent and 5.0 percent, with July registering the highest utilisation rate. The annual ST utilisation rate was similar to that of 2014 at 4.5 percent.

Monthly USEP, BVP, LVP and Supply Cushion 2015



USEP stays below BVP and LVP benchmarks for all months except July

Starting from the third quarter of 2013, the LNG Vesting Price (LVP) and Balance Vesting Price (BVP) replaced the Vesting Contract Hedge Price (VCHP) as benchmarks against the USEP.

A certain percentage of the total allocated vesting quantity is pegged to LNG, i.e., Total Allocated Vesting Quantity = LNG Vesting Quantity (pegged to LNG) + Balance Vesting Quantity (pegged to piped natural gas). Correspondingly, the LVP is the price for the LNG Vesting Quantity allocated, while BVP is the price for the Balance Vesting Quantity allocated.

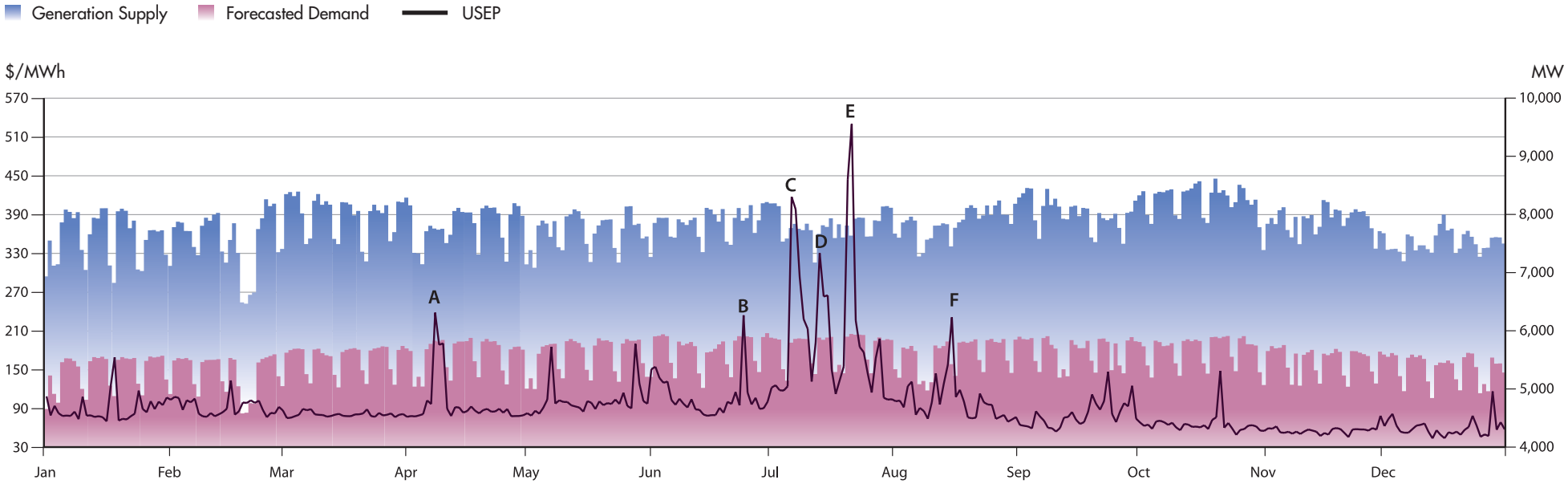
Compared to 2014 in which the monthly average USEP ranged between $93/MWh and $156/MWh, 2015 displayed a more volatile trend as the monthly average USEP varied between $57/MWh and $207/MWh. The monthly average USEP of $57/MWh was registered in November and it is the lowest monthly level since the market started.

Apart from July, all months saw the USEP registering below the BVP[8] at a discount of at least 22.9 percent. The largest gap between the USEP and the BVP was observed in November, when the BVP more than doubled the USEP. The annual average BVP of $141.19/MWh in 2015 was 32.1 percent higher than the USEP.

The supply cushion started off strongly in 2015, maintaining an average of 30.0 percent for the first three months. It dropped to an average of 28.2 percent from April to September, and bounced back to an average of 30.2 percent for the last three months. The weaker supply cushion seen in the second quarter (Q2) of 2015 was a result of the forecasted demand increasing at a faster rate than the total supply – forecasted demand increased by 4.6 percent in Q2 compared to total supply which increased by 1.0 percent. In addition, the maintenance level in Q2 was also higher at 1,101MW (all other quarters saw maintenance levels below 1,000MW).

[8] Average BVP in 2015 was $141.19/MWh; average LVP in 2015 was $152.80/MWh.

Daily USEP, Forecasted Demand and Generation Supply 2015



There was higher volatility in the daily USEP in 2015, with price spikes (higher than $210/MWh) concentrating largely in July. The key observations on some of the daily spikes in the USEP in 2015 are as follows:

Point A:

On 8 April, the daily USEP averaged $239/MWh. Two CCGT facilities were on unplanned maintenance while an Embedded Generation (EG) facility was on planned maintenance (total CCGT capacity unavailable[9] was 885MW or 6.8 percent of total registered capacity). The lower available CCGT capacity coupled with higher forecasted demand caused the supply cushion to fall below 20.0 percent from Period 20 to Period 24, Period 26 to Period 36 and Period 40 to Period 43. In particular, the USEP spiked above $800/MWh in Periods 28, 29, 32 and 33 when the supply cushion dipped below 18.7 percent. Contingency reserve violation ranging from 7MW to 26MW was recorded in Periods 40, 42 and 43 and GT was scheduled for a total of eight periods (Periods 17 to 24). The violation was the result of the implementation of Stepwise Constraint Violation Penalty (CVP) whereby the market clearing engine (MCE) would choose to 'violate' reserve requirements if the cost of violating them is less than that of scheduling more expensive offers in the market, thereby lowering overall cost to the market.

A security constraint limit of 1,450MW, applied to four lines between Jurong Pier and the Upper Jurong/Tuas area, reached its limit in Periods 21 to 24, Periods 28 and 29, and Periods 32 and 33.

Point B:

On 24 June, the daily USEP averaged $235/MWh. A CCGT forced outage in Period 15, along with one other CCGT facility being on unplanned maintenance (total CCGT capacity unavailable was 770MW or 7.7 percent of total registered capacity), dampened supply availability. Forecasted demand strengthened from Period 16, when it increased by 303MW from Period 15's 5,504MW and climbed at an average of about 155MW per period until it reached the day's peak of 6,651MW in Period 29. In the same time frame, the supply cushion fell from 31.7 percent in Period 15 to levels below 20.0 percent. Only in Period 36 did the supply cushion climb back above 20.0 percent. There was no interruptible load (IL) activation but two GT facilities were scheduled for 14 periods each (Periods 21 to 34). Contingency reserve violation ranging between 5MW and 39MW was also recorded in Period 20, and from Period 28 to Period 32.

Point C:

On 6 July, two CCGT facilities on unplanned maintenance and one other CCGT facility on planned maintenance dragged supply lower (total CCGT capacity unavailable was 1,131MW or 8.7 percent of total registered capacity). The lower CCGT offers coupled with offer changes caused the supply cushion to fall below 20.0 percent from Period 18 to Period 34. In response, the USEP rose from $161/MWh in Period 17 to a peak of $1,232/MWh in Period 22 when the supply cushion dropped to 14.3 percent. One GT facility was scheduled for seven periods (Periods 20 to 26) and another GT facility was scheduled for four periods (Periods 21 to 24). There were 16 periods that day when the USEP rose above $500/MWh. The daily average USEP was $418/MWh.

The security constraint limit of 1,450MW applied to four lines between Jurong Pier and the Upper Jurong/Tuas area also reached its limit in Periods 21 to 23, and Periods 25 and 26. The USEP varied from $72/MWh to $1,232/MWh for the day.

Point D:

On 13 July, two CCGT facilities were on unplanned maintenance and another CCGT facility was on planned maintenance. Separately, there was an ST facility forced outage in Period 3. The higher demand coupled with the above conditions propelled the USEP to $488/MWh in Period 19. The USEP remained above $500/MWh for the next 15 periods. The supply cushion also fell from 20.3 percent in Period 17 to 18.9 percent in the following period, and it stayed below 20.0 percent until Period 35.

The security constraint limit of 1,450MW, applied to four lines between Jurong Pier and the Upper Jurong/Tuas area, also reached its limit in Period 24. The USEP for the day averaged $331/MWh.

Point E:

On 21 July, the average daily USEP reached $531/MWh, the highest level in 2015. There were 20 periods (Periods 17 to 35 and Period 39) when the USEP rose above $500/MWh. A GT facility was scheduled for 16 periods (Periods 21 to 36) and another GT facility was scheduled for 11 periods (Periods 21 to 33 and Period 36) when the supply cushion was 19.0 percent or less.

One CCGT facility was on planned maintenance while another CCGT facility was on unplanned maintenance. When a CCGT facility experienced forced outage in Period 25 (total CCGT capacity unavailable was 1,144MW or 8.8 percent of total registered capacity), it resulted in lower CCGT supply. In addition, the security constraint limit of 1,450MW applied to four lines between Jurong Pier and the Upper Jurong/Tuas area reached its limit in Periods 17 and 18, and from Periods 21 to 35.

Contingency reserve violation ranging from 1MW to 35MW was recorded in Period 18, Periods 21 to 23, and Periods 34 to 35. The combination of the above mentioned factors, coupled with higher demand and offer changes on 21 July, propelled the USEP to above $1,000/MWh for 11 periods (Periods 21 and 22, and Periods 26 to 34). The USEP ranged between $96/MWh and $1,328/MWh for the day.

Point F:

On 15 August, the daily USEP averaged $232/MWh. One CCGT facility was on planned maintenance and another CCGT facility was on unplanned maintenance. In addition, two EG facilities were on unplanned maintenance (total CCGT capacity unavailable was 842MW or 8.1 percent of total registered capacity). The lower available CCGT capacity coupled with higher forecasted demand caused the supply cushion to fall below 20.0 percent from Period 20 to Period 23. The lower supply cushion led to a spike in the USEP which rose above $800/MWh for these four periods. Contingency reserve violation ranging from 4MW to 28MW was recorded in Periods 20 to 22 and GT was scheduled for a total of eight periods (Periods 19 to 26). The security constraint limit of 1,450MW, applied to four lines between Jurong Pier and the Upper Jurong/Tuas area, also reached its limit in Periods 19 to 22, Period 29 and Period 43.

[9] EG facility is categorised under the CCGT/cogen /trigen combined category for the calculation of *total CCGT capacity unavailable*.

Summary of Security Constraints in 2015

Security Constraint	Affected Region	Limit	Start Date	Expiry Date
1	Three lines between Jurong Island and Tembusu	1,150MW	24 April 2014	31 December 2018
2	Four lines between Jurong Pier and Upper Jurong/Tuas	1,450MW	4 July 2014	3 September 2015
3	Three transformers in the North block	1,150MW	4 September 2015	31 December 2016
4	Three lines between Ayer Rajah and the North block	460MW	3 September 2015	31 December 2020

Application of security constraints in 2015

In light of the reliability of the grid and system security, the PSO continued to implement security constraints in 2015. Apart from the security constraints that were applied to the South-West Block of the transmission grid from 2013 to 2015, new security constraints were applied to the North-West Block in 2015.

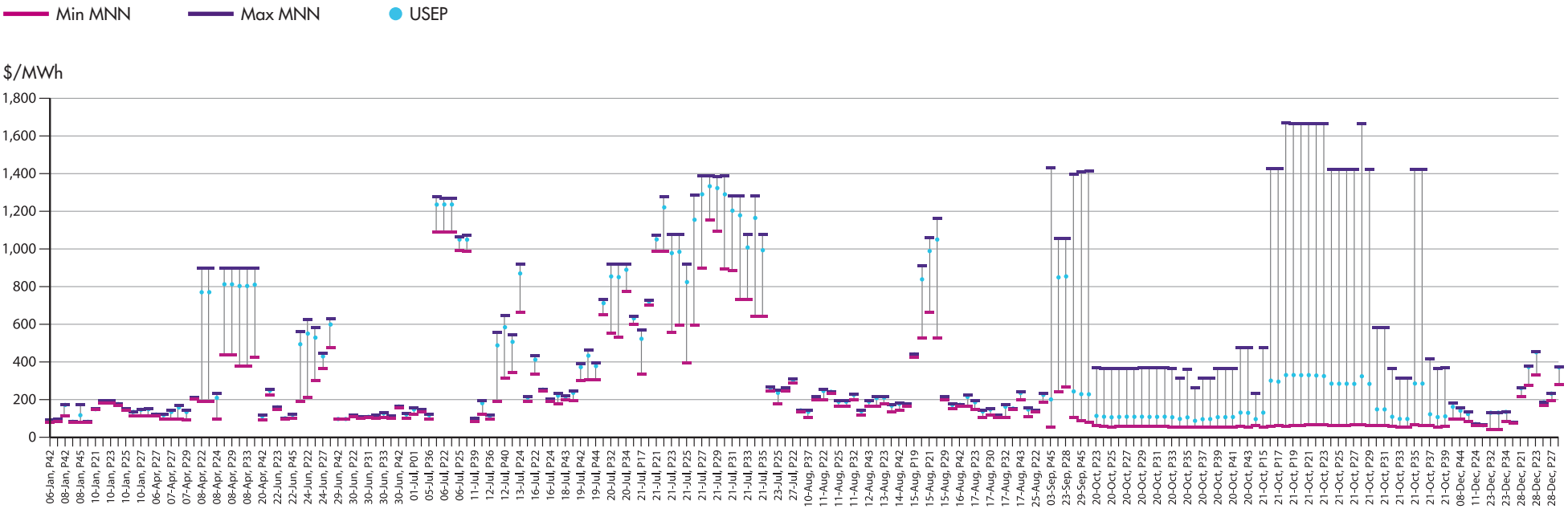
Security constraints were applied throughout the year in 2015, compared to just 12,071 periods (or 69% of the year) in 2014. In 2015, security constraint binding occurred for a total of 200 periods. This was almost four times the number of periods with security constraint binding in 2014 (55 periods).

The first security constraint which commenced on 24 April 2014 consisted of a 1,150MW limit on three lines in the Jurong Island area (Security Constraint 1). This security constraint will be in place until Period 48 on 31 December 2018. The second security constraint with a limit of 1,450MW was applied on 4 July 2014 on four different lines between Jurong Pier and the Upper Jurong/Tuas area (Security Constraint 2). It expired on Period 48, 3 September 2015.

A third security constraint on three transformers with a limit of 1,150MW that was applied since Period 1, 4 September 2015 will expire on 31 December 2016. Lastly, a fourth security constraint with a limit of 460MW was imposed on Period 28, 3 September 2015 between Ayer Rajah and the North block of the transmission grid. This will expire on 31 December 2020.

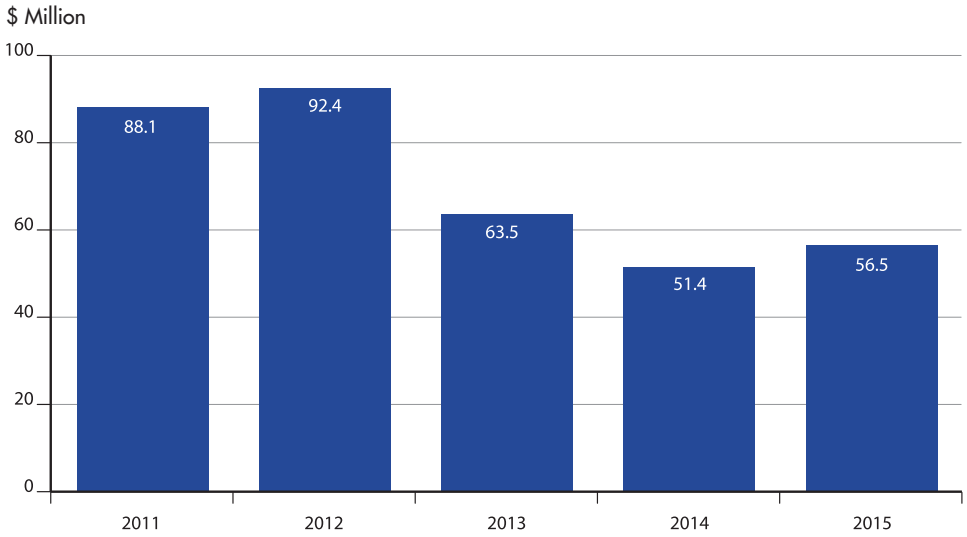
Periodically, whenever any of the affected transmission lines or transformers was on scheduled maintenance, the PSO modified these four security constraints by adjusting the limits or changing the number of lines within the constraint, or both.

Security Constraint Binding Periods with Minimum and Maximum MNN Prices and USEP



Typically, the difference between the minimum and maximum Market Network Nodal (MNN) prices is less than $10/MWh, but this widens when the security constraint limit is reached. In 2015, there was greater volatility in the MNN prices – there was a total of 20 periods when the difference between the maximum and minimum MNN prices exceeded $1,000/MWh. The chart above shows the periods in 2015 when security constraint binding took place, and the associated minimum and maximum MNN prices and USEP.

Annual Reserve Payment 2011 – 2015



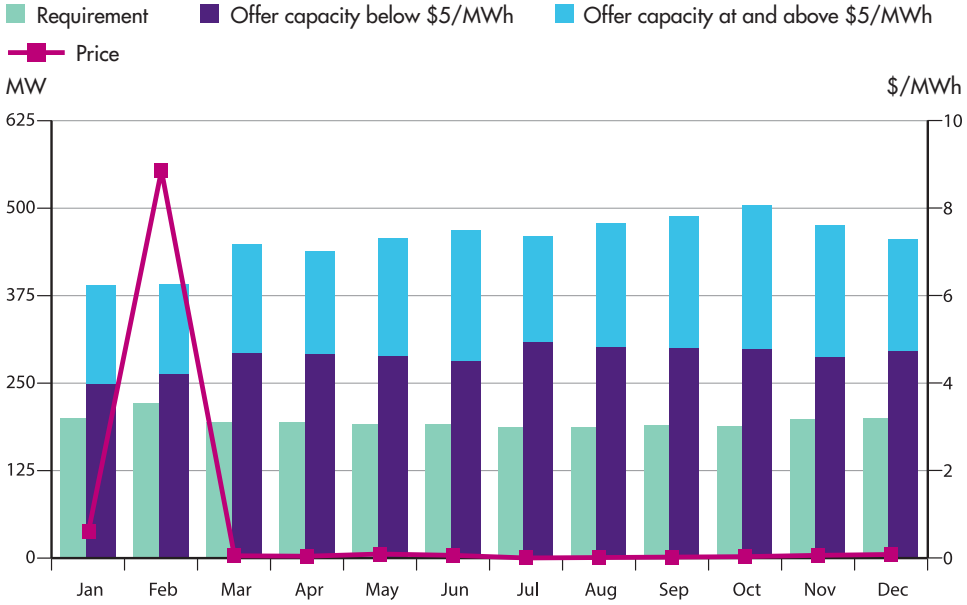
Annual reserve payment edges up after two consecutive years of negative growth

Reserves serve as a backup in the electricity market for unexpected outages caused by generators tripping. The amount of reserves required is determined by the amount needed should the largest on-line generator trip. In the NEMS, three reserve products are traded: primary, secondary and contingency reserves. Each reserve has its own price and response time, the latter being eight seconds for primary reserve, 30 seconds for secondary reserve and 10 minutes for contingency reserve. The generators bear the cost of providing the reserves.

The reserve payment in 2015 increased 9.9 percent from 2014, to a total of $56.5 million. The main driver for the increase in reserve cost was the increase in contingency reserve price as well as its requirement, which outweighed the decline in primary and secondary reserve prices. In 2015, contingency reserve price rose by 49.0 percent and its requirement increased by 1.2 percent.

The largest reserve payments were made in the months of May, June and July. The July payment of $8.3 million accounted for 14.8 percent of the total annual reserve payments, and was due to the contingency reserve price hitting its peak monthly level for the year at $17.02/MWh. Likewise, May and June's contingency reserve prices at $15.59/MWh and $15.14/MWh respectively – which were the next two highest levels in 2015 – contributed to the large reserve payments in those months.

Monthly Primary Reserve Price, Requirement and Supply 2015



Primary reserve price drops along with the dip in reserve requirement and cheaper offers

Apart from February when it spiked to $8.87/MWh, the monthly primary reserve price stayed below $0.70/MWh in 2015. The annual average primary reserve price was $0.78/MWh in 2015. The main drivers of the lower primary reserve prices seen in most months were lower primary reserve requirements, greater offer availability and a shift of offers to the less expensive price band.

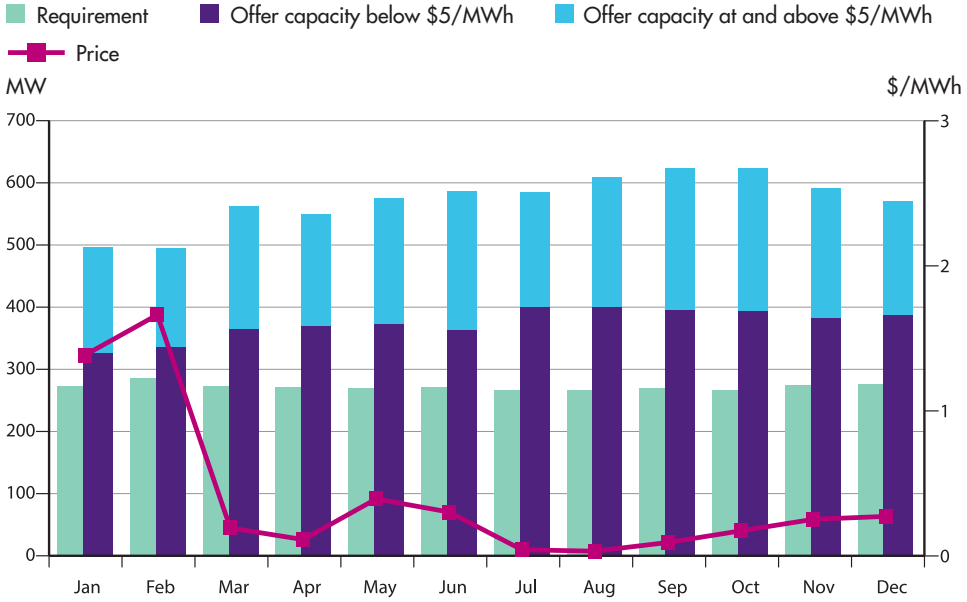
The annual average primary reserve requirement remained unchanged in 2015 at 195MW. Primary reserve offers, however, were 12.3 percent higher. Primary reserve offers in the price tranche below $5.00/MWh increased 19.1 percent in 2015 to average 288MW.

The primary reserve price spike in February was due to a planned intertie disconnection between Singapore and Malaysia. Under this circumstance, a higher level of primary reserve was required to be cleared in accordance with the Market Rules. Primary reserve requirement rose to an average of 221MW in February, which was 15.1 percent higher than the 192MW seen in a typical month. Furthermore, tight supply in February resulted in primary reserve shortfalls on 2 and 3 February. On 2 February, primary reserve shortfall totalling 133MW occurred for three periods (Periods 28 to 30); on 3 February, primary reserve shortfall totalling 4MW occurred for two periods (Periods 28 and 29).

There were no changes to the Risk Adjustment Factor (RAF)[10] in 2015. It was set at 1.0 for primary reserve.

[10] There is an RAF for each class of reserve in the NEMS. The RAF is multiplied by the raw reserve requirement to arrive at the final reserve requirement that is cleared by the market clearing engine (MCE). The PSO may amend the RAF for any reserve class temporarily if it foresees power system conditions that may warrant a higher reserve requirement than usual.

Monthly Secondary Reserve Price, Requirement and Supply 2015



Secondary reserve price stays below $2.00/MWh

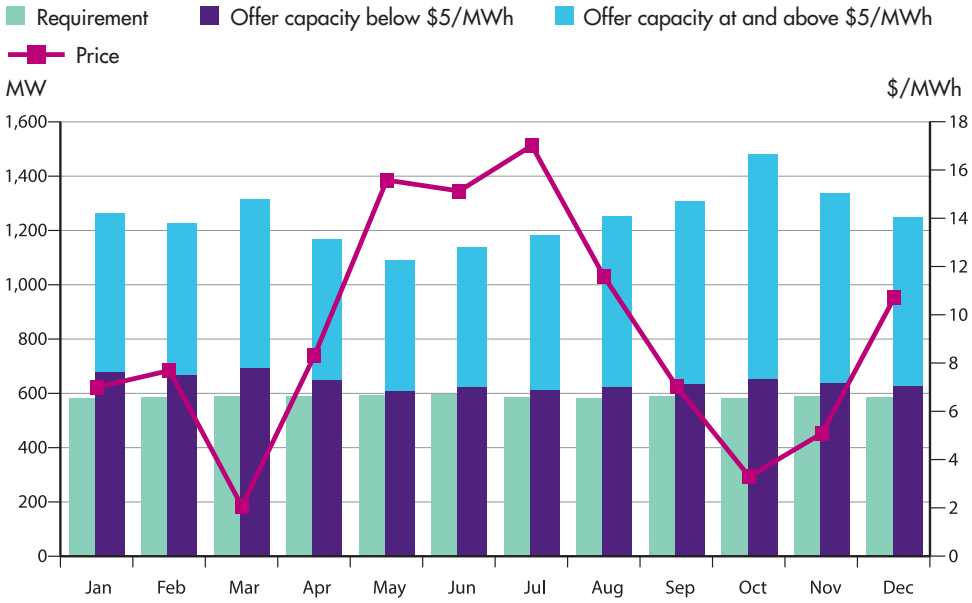
The monthly secondary reserve price stayed below $2.00/MWh throughout the year and averaged $0.40/MWh in 2015. The secondary reserve requirement fell by a marginal 0.3 percent and averaged 272MW. The lowest secondary reserve requirement was observed in August at 266MW and the peak secondary reserve requirement was observed in February at 285MW. Coincidentally, the peak secondary reserve requirement in 2014 was also 285MW and also occurred in February. Secondary reserve offers were higher by 11.4 percent, with offers priced below $5.00/MWh expanding by 23.9 percent.

The planned intertie disconnection in February affected both primary and secondary reserves, causing a jump in the secondary reserve requirement to a monthly average of 285MW. This resulted in the highest monthly secondary reserve price for the year at $1.66/MWh. In February, the secondary reserve offers in excess of the reserve requirement was the lowest for the year at 17.6 percent.

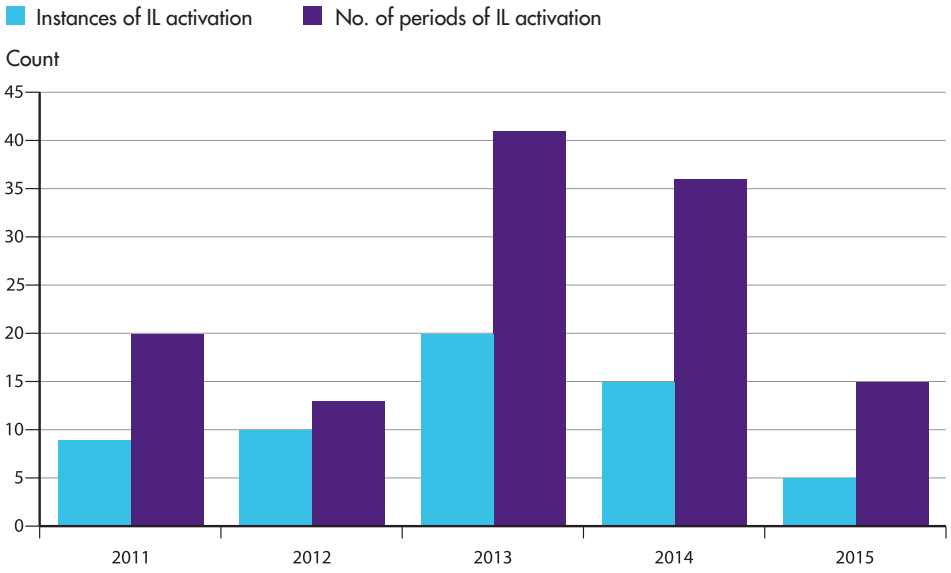
The amount of offers in the price tranche below $5.00/MWh exceeded the reserve requirement in all months in 2015 by between 19.0 percent and 50.3 percent.

There were no changes to the RAF in 2015. It was set at 1.0 for secondary reserve.

Monthly Contingency Reserve Price, Requirement and Supply 2015



Annual Interruptible Load (IL) Activations for Contingency Reserve Market 2011 – 2015



Contingency reserve price rises as offers swing to more expensive price tranches

The monthly contingency reserve price stayed below $12.00/MWh for most months in 2015 and averaged at $9.23/MWh. For the months of May, June and July, contingency reserve prices spiked above $15.00/MWh to register at $15.59/MWh, $15.14/MWh and $17.02/MWh respectively.

In May, sporadic periods of tight supply conditions that caused the contingency reserve price to spike above $100.00/MWh contributed to the higher price. Similarly, the contingency reserve price jumped up in July due to periods of tight supply conditions which placed pressure on prices. In June, the highest requirement for the year accompanied by weaker reserve supply drove the contingency reserve price to $15.14/MWh.

Unlike the declines in primary and secondary reserve requirements, the contingency reserve requirement increased by 1.2 percent to 588MW in 2015.

Overall, a 9.0 percent drop in the contingency reserve offers priced below $5.00/MWh led to an increase in the monthly contingency reserve price in 2015 to $9.22/MWh, up from $6.20/MWh in 2014.

There were no changes to the RAF in 2015. It was set at 1.5 for contingency reserve.

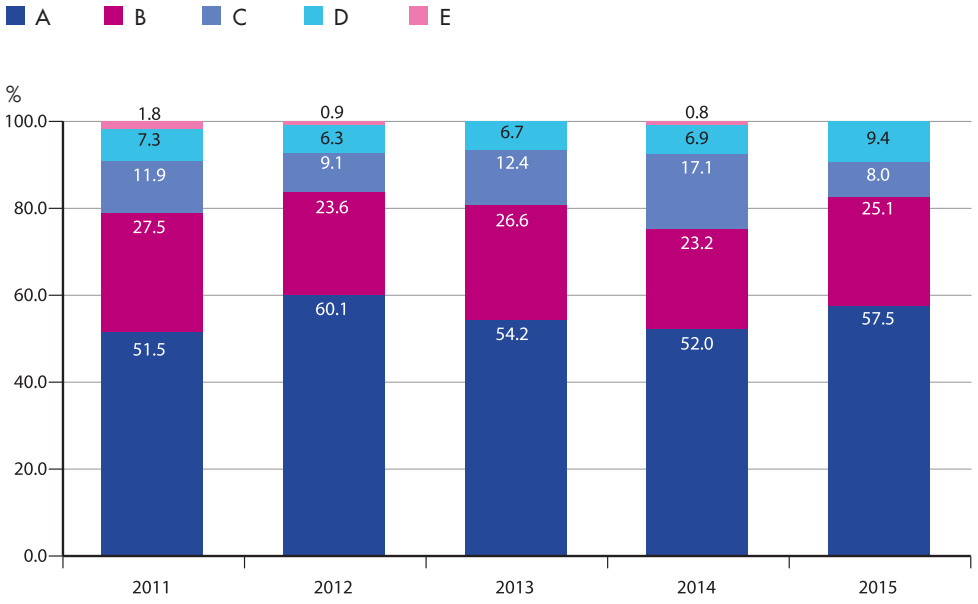
Number of periods of IL activation declines by more than half; instances of IL activation drop by one-third

As of 31 December 2015, the total registered capacity for IL remained the same as 2014 at 23.2MW for primary and secondary reserves. For contingency reserve, four new IL facilities were registered with the NEMS in 2015, contributing another 8MW to the pool and raising the total registered capacity from 25.2MW in 2014 to 33.2MW in 2015.

For primary reserve, IL was activated for the first time since the market started on 21 May 2015 for Period 29. In the same period, IL was activated for secondary reserve as well. The last time IL was activated for secondary reserve was in 2011.

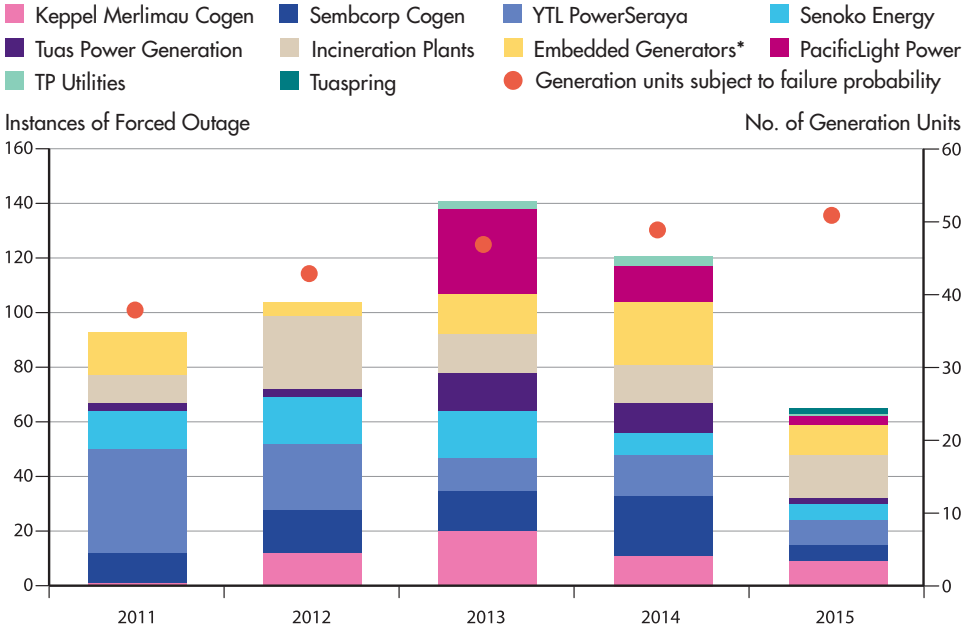
The number of IL activations for contingency reserve in 2015 dropped to a nine-year low of five, while the number of periods when IL was activated was 15. May had the highest concentration of IL activations by number of periods, with one instance of IL activation lasting for nine straight periods.

Reserve Provider Group Effectiveness for Primary and Secondary Reserve Classes (Aggregate) 2011 – 2015



Statistics exclude IL providers.
Note: The percentages in this chart may not add up to 100% due to rounding.

Annual Forced Outages by Generation Companies 2011 – 2015



The number of generation units refers to the number of generation units registered in the NEMS which are subject to reserve responsibility share.
*Embedded generators exclude TP Utilities

Improved ratings for reserve providers

Reserve providers in the NEMS are classified into five groups, with Group A reflecting reserve providers with the highest level of responsiveness and Group E reflecting those with the lowest level of responsiveness. A higher level of responsiveness attracts a higher proportion of reserve price.

The overall performance of reserve providers improved in 2015, with those from Group C shifting mostly to Groups A and B. This pushed the total percentage of reserve providers in Groups A and B up to 82.6 percent, the second highest level since the market started. The percentage of reserve providers in Group A rebounded from 52.0 percent in 2014 to 57.5 percent in 2015, after a two-year decline since 2013. Likewise, the percentage of reserve providers in Group B improved from 23.2 percent in 2014 to 25.1 percent in 2015. Unlike 2014 when 0.8 percent of reserve providers were categorised in Group E, no reserve providers fell into the Group E category in 2015. The only other year when there were no reserve providers in Group E was in 2013.

All contingency reserve providers were classified in Group A.

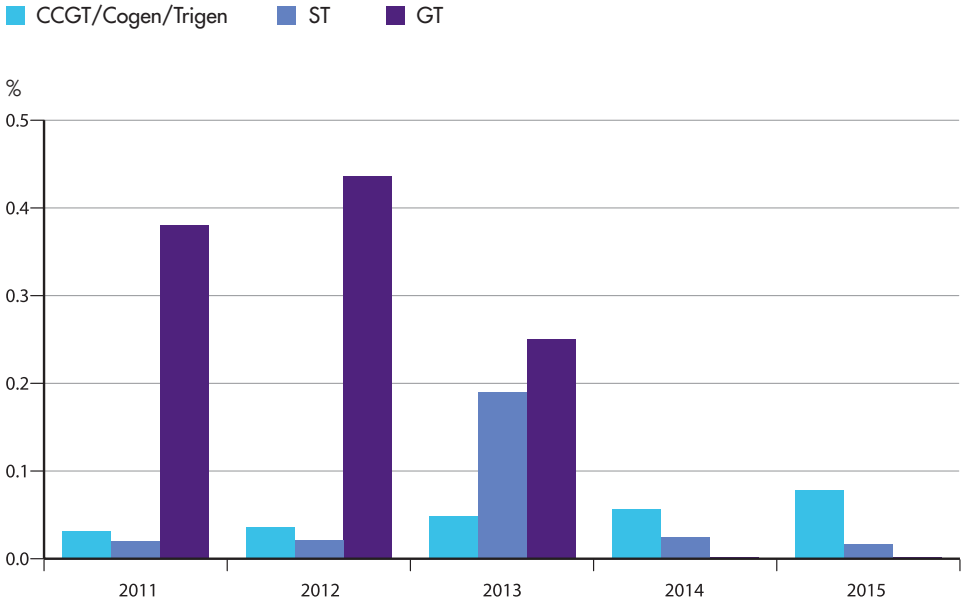
Number of forced outages dips to record low

There were 65 forced outages[11] in 2015, the lowest number since the NEMS began. The number of forced outages seen in 2015 was a drastic drop from the 121 outages seen in 2014.

The number of forced outages incurred by all generation facilities fell across the board, leading to the overall decline in the number of forced outages in 2015.

[11] With effect from 17 November 2015, partial forced outages of generation facilities were excluded in the failure of probability (FOP) calculation.

Average Failure Probability by Year 2011 – 2015



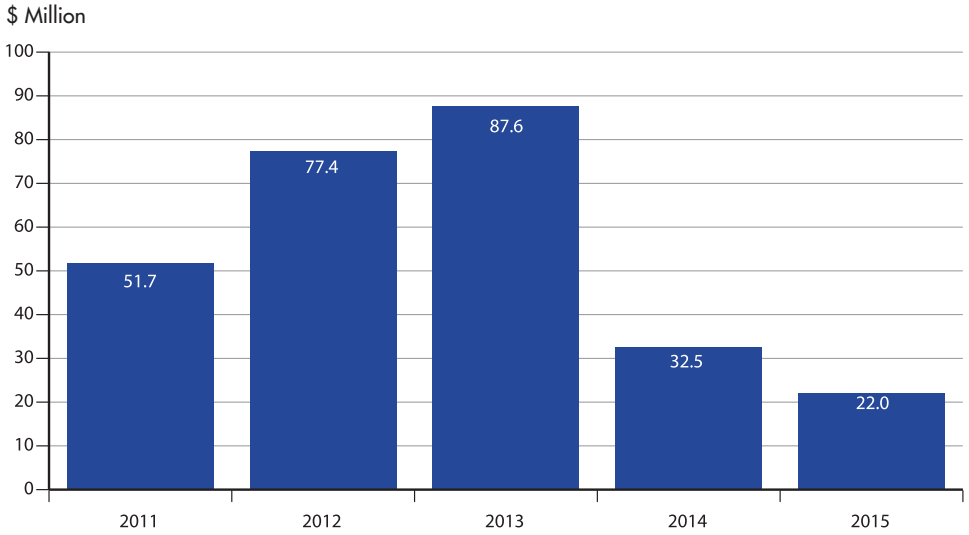
Reliability of CCGT/cogen/trigen facilities deteriorates due to increased tripping from Q2 2015

The average failure probability for a Generation Registered Facility (GRF) is the probability that after being dispatched by the PSO for a settlement interval, the GRF will cease operating, disconnect from the transmission system, or both, during that settlement interval, even if no other GRF fails. A generation facility with a lower failure probability will be allocated less reserve cost compared to one with a higher failure probability.

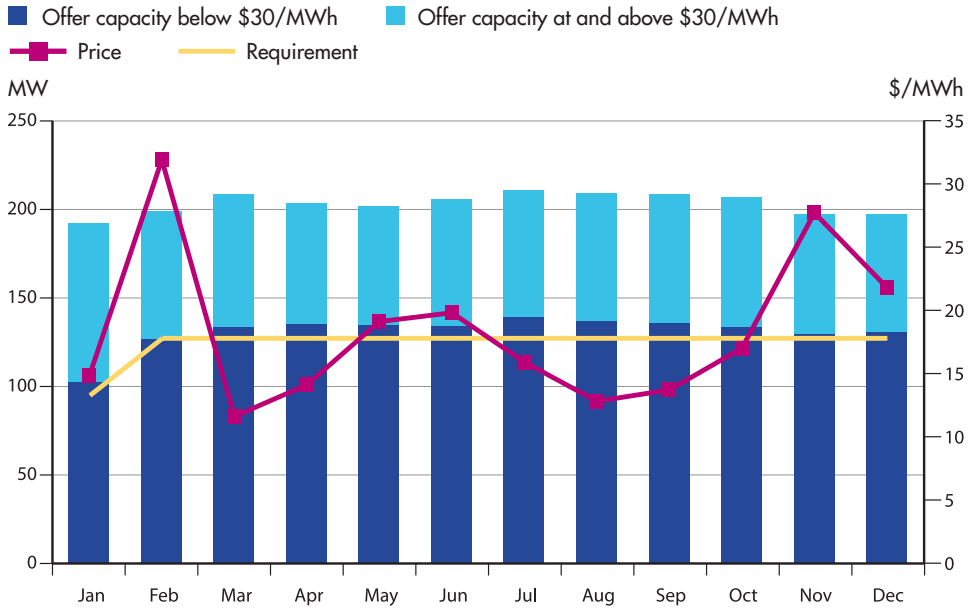
In 2015, the average failure probabilities for CCGT/cogen/trigen, ST and GT facilities were 0.078 percent, 0.017 percent and 0.001 percent respectively. Compared to 2014, the failure probability of the CCGT/cogen/trigen category increased while that of the ST category decreased. The failure probability of GT facilities remained the same.

The increase in the failure probability for the CCGT/cogen/trigen category was partly due to the lag factor in the failure probability formula. The failure probability in 2015 covered the recurrent data from September 2014 to August 2015, and this resulted in the overall poorer performance in the CCGT/cogen/trigen category. Another factor that contributed to the increase was the commissioning activities in 2015.

Annual Regulation Payment 2011 – 2015



Monthly Regulation Price, Requirement and Supply



Regulation payment at lowest level since market started

The regulation payment fell 32.4 percent in 2015 to a total of $22.0 million, the lowest level since the start of the market. The decrease was caused by the bulk of regulation offers shifting into the less expensive price tranche, which outweighed the increase in regulation requirement.

The largest regulation payment was made in February at $2.9 million. This was 45.9 percent lower than the largest regulation payment collected in 2014. In 2014, there were eight months for which regulation payment exceeded $2 million; this year, there were only three such months – February, November and December. The largest regulation payment made in February was consistent with the higher regulation requirement which came into effect from 1 February 2015. For the period 1 February 2014 to 31 January 2015, the average reserve requirement was 94MW. This was revised up to 126MW from 1 February 2015.

Regulation price stays below $35/MWh throughout the year

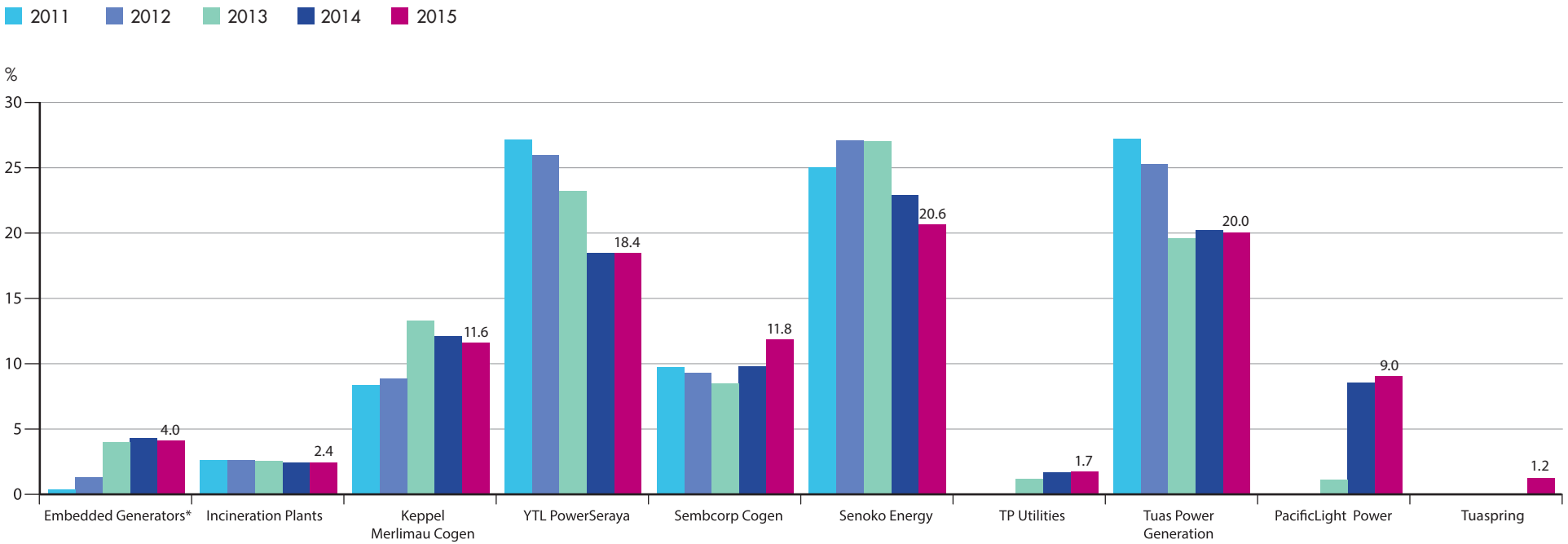
Regulation price continued to spiral downwards in 2015, dropping 44.8 percent to $18.23/MWh. This is the lowest level seen since the market started. Apart from February, November and December, all other months saw regulation prices below $20.00/MWh. Lower volatility was displayed in 2015 as the regulation price spanned from $11.63/MWh in March to $31.89/MWh in February. The peak monthly regulation price in 2015 was 44.6 percent lower compared to 2014.

In February, regulation price peaked for the year at $31.89/MWh on the back of higher requirement and lower available offers from the market. In November and December, the shift of regulation offers towards the more expensive offers[12] drove regulation price up to $27.66/MWh and $21.77/MWh respectively.

Overall, the regulation price in 2015 declined despite a 28.9 percent increase in the regulation requirement. This was due to an increase in the regulation supply, and a shifting of the offers to relatively cheaper price tranches.

[12] Higher proportion of offers in the price tranche above $30/MWh.

Annual Market Share by Generation Company 2011 – 2015 (Based on Scheduled Generation)



*Embedded generators exclude TP Utilities

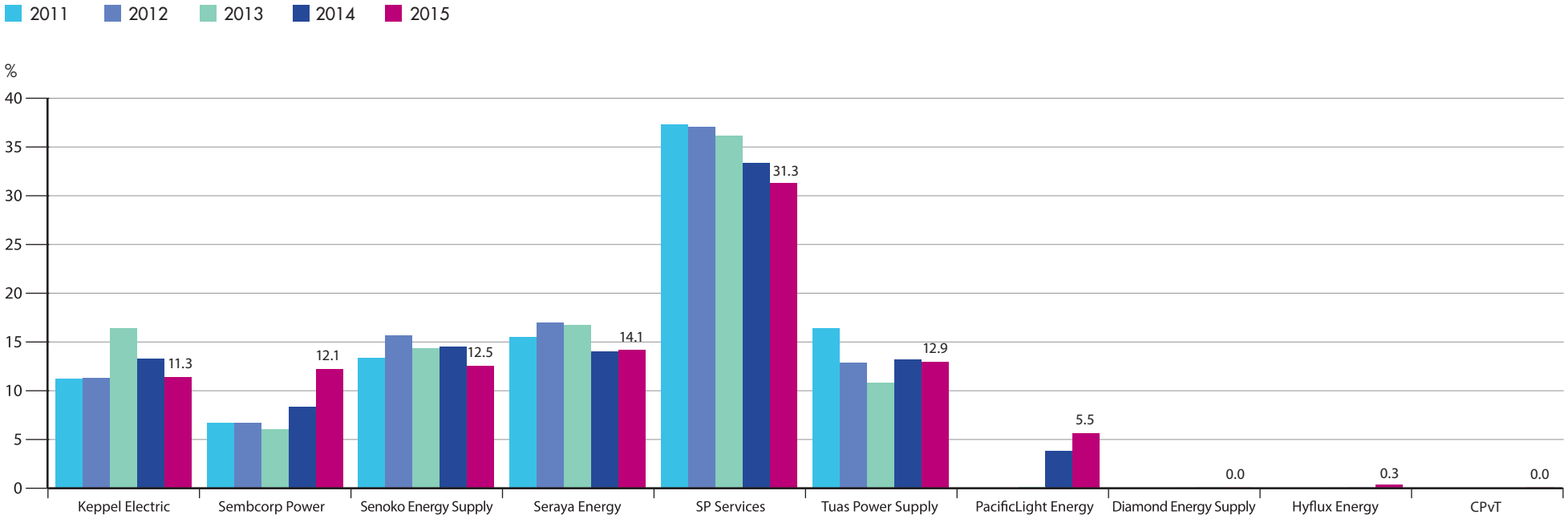
Smaller generation companies continue to gain strength

In 2015, the market share of two out of the three leading generation companies continued to drop with greater competition from existing and new, smaller MPs. Senoko Energy's market share fell by the most, dropping from 22.9 percent in 2014 to 20.6 percent in 2015. This was followed by Tuas Power Generation whose market share fell by 0.2 percent. YTL PowerSeraya's market share remained the same as 2014. The joint market share of the three largest generation companies (YTL PowerSeraya, Tuas Power Generation and Senoko Energy) fell below 60.0 percent to 59.0 percent in 2015.

On the other hand, the top gainer in 2015 was Sembcorp Cogen whose market share improved by 2.1 percent to 11.8 percent. Apart from Sembcorp Cogen, PacificLight Power and TP Utilities also saw an expansion of their market share from 8.5 percent and 1.6 percent in 2014, to 9.0 percent and 1.7 percent in 2015 respectively.

Tuaspring participated in the NEMS with its first generation facility in August 2015, gaining 1.2 percent of the total market share. The commissioning of the unit is still ongoing and is expected to be completed by end February 2016. For the first time since 2011, the market share held by embedded generators edged down 0.2 percent, from 4.2 percent in 2014 to 4.0 percent in 2015. This drop was in spite of the inclusion of two new generation facilities in 2015.

Annual Market Share of Market Support Services Licensee and Retailers 2011 – 2015 (Based on Withdrawal Energy Quantity)



Competition between retailers intensifies with new entrants

SP Services recorded the largest contraction in its retail market share, which dropped 2.0 percent from the previous year to 31.3 percent in 2015. Following closely behind were Senoko Energy and Keppel Electric whose retail market share fell from 14.4 percent and 13.2 percent in 2014, to 12.5 percent and 11.4 percent respectively this year.

In 2015, Sembcorp Power's market share boosted 3.8 percent to record a positive growth for the third consecutive year. PacificLight Energy's market share showed a gain of 1.8 percent along with a new entrant, Hyflux Energy, which acquired 0.3 percent of the retail market share.

The drop in SP Services' retail market share is consistent with the move towards full retail contestability, which has progressively given more consumers the flexibility to choose their electricity retailers.

Energy Market Company (EMC) is the financial clearing house for the wholesale market and settles the following transactions:

- energy;
- ancillary market products – three classes of reserve (primary, secondary and contingency) and regulation;
- bilateral and vesting contracts;
- uplift charges;
- financial adjustments;
- fee recovery of EMC and the PSO administration costs; and
- contracted ancillary services not provided through the ancillary market (black-start services).

The market is well-secured. To cover the exposure of a debtor and the time required to manage a default, all retailers must provide on-going collateral to EMC. This credit support protects EMC and other MPs from payment defaults. EMC reviews the risk exposure of MPs on a daily basis.

A margin call is issued when a retailer's estimated exposure reaches a value equal to or greater than 70 percent of the level of its credit support. In 2015, EMC issued a total of 18 margin calls.

In 2015, the value of total retail settlement payments (net of bilateral offsets) was $2.40 billion and the value of credit support on 31 December 2015 was $336.2 million.

Contracted Ancillary Services 1 April 2015 to 31 March 2016

Contract Period	Cost of Ancillary Services	Total MW Contracted
1 April 2015 to 31 March 2016	$15,039,147.89	88.848

In addition to the co-optimised energy, reserve and regulation markets, EMC negotiates and enters into ancillary services contracts on behalf of the PSO, to ensure the reliable operation of Singapore's power system. If these services are unable to be procured competitively, for example, due to a limited number of available suppliers, their prices are regulated.

From 1 April 2015 to 31 March 2016, the only contracted service required was black-start capability. Black-start service ensures that there is initial generation to supply electric power for system restoration following a complete blackout.

Based on the PSO's operational requirements, EMC procured 88.848MW of black-start services at a cost of $15.04 million. The capability was sourced from YTL PowerSeraya, Senoko Energy, Tuas Power Generation and Keppel Merlimau Cogen.

The costs associated with the wholesale functions of the NEMS are recovered directly from the wholesale market.

EMC and PSO fees are recovered from both generator and retailer class MPs in proportion to the quantity of energy that they trade.

EMC Budgeted Net Fees – 1 July 2015 to 30 June 2016

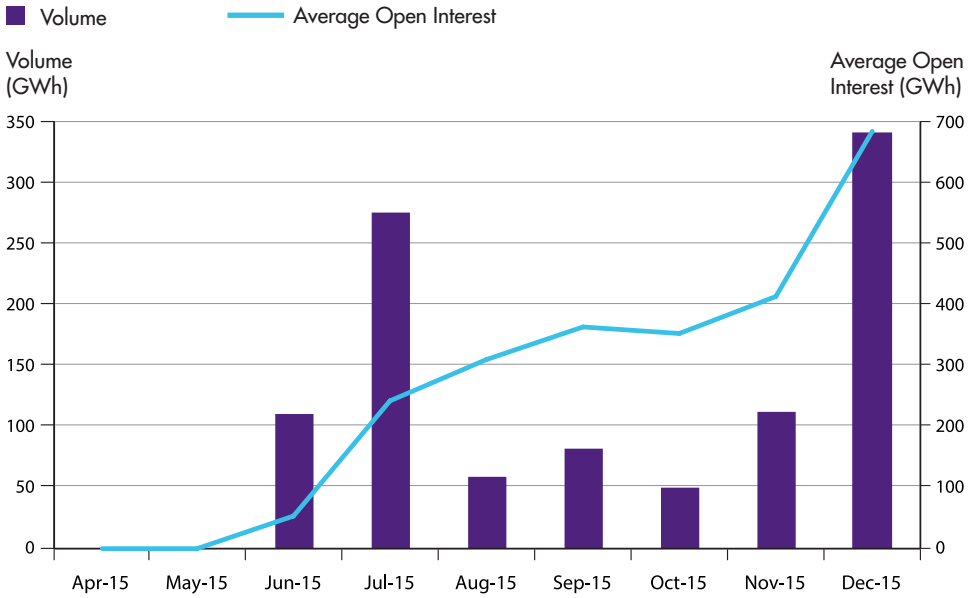
Period	1 July 2015 to 31 March 2016	1 April 2016 to 30 June 2016
EMC Fee per MWh ($/MWh)	0.2615	0.2530
Budgeted Volume (MW)	70,000	23,641
Budgeted Net Fees ($'000)	18,305	5,981
Total Budgeted Net Fees ($'000)	24,286	

PSO Net Fees – 1 April 2015 to 31 March 2016

	Total Fees ($'000)
PSO Net Fees	21,954

ADDITIONAL INFORMATION

Volume and Average Open Interest of Electricity Futures



The beginning of a new era for NEMS: Electricity futures market

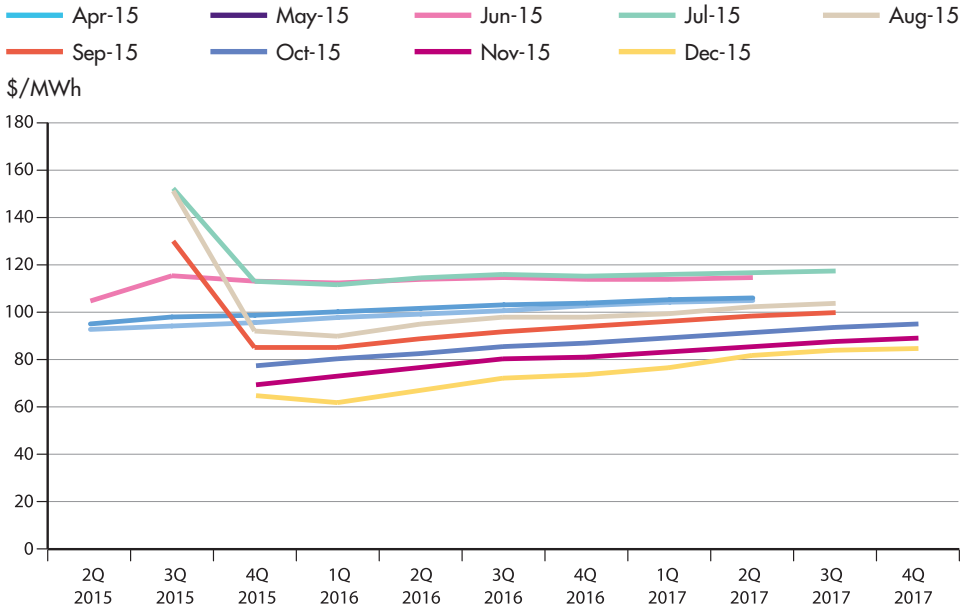
Electricity futures provide market participants (MPs) in the National Electricity Market of Singapore (NEMS) with a standardised risk management tool to manage price risks. Companies can use electricity futures as a hedging tool to cope with short-term fluctuations in the spot market. The volume of electricity futures in the chart indicates the total amount of trades in gigawatt hours (GWh), while the average open interest of the electricity futures indicates the average value of trades that were not delivered and closed (also in GWh[13]).

Electricity futures were traded for the first time in June 2015, with a total volume of 100 lots or 110.21GWh for the month. Average open interest stood at 52.46GWh in June. Electricity futures trading continued to grow, with December volumes registering multiple record highs. On 1 December, the daily trading volume hit a record high of 78 lots, breaking the previous daily records of 60 lots on 26 November and 39 lots on 1 July. The first week of December also saw a record weekly high of 164 lots, more than double the previous weekly high of 74 lots set in July. In line with this, December volume also hit a record high of 312 lots, surpassing the previous record of 250 lots in July when the wholesale electricity market experienced a month of volatile Uniform Singapore Energy Price (USEP). The average open interest for the month also expanded strongly to 683.89GWh.

Electricity futures closed the year with a total trading volume of 933 lots or 1,025.40GWh.

[13] The trading unit shall be one lot which is the amount of electrical energy (expressed as megawatt hours or MWh) generated during the base load period over each contract quarter, at a rate of one-half (0.5) of a megawatt (MW).

Monthly Average of Daily Settlement Price



The Daily Settlement Price (DSP) is the price at which an open electricity futures position is marked to market or revalued at the end of the day for each contract quarter. It also reflects the market's views of the USEP in the forthcoming quarters at that point in time.

The monthly average of the DSP showed a steady climb for each quarter and settled mainly below $120/MWh, except for the third quarter of 2015. There was an upsurge in the daily settlement price for the third quarter of 2015, particularly between the months of June and September 2015. This was in line with the surge in the USEP, especially in the month of July.

ancillary services
The additional services necessary to ensure the security and reliability of the power system. The ancillary services traded competitively on the wholesale market are regulation and the three classes of reserve. The black-start ancillary service is contracted by Energy Market Company (EMC) on behalf of the Power System Operator (PSO) on an annual basis.

balance vesting price
This refers to the price for the balance vesting quantity allocated.

balance vesting quantity
With the start of the Liquefied Natural Gas (LNG) Vesting Scheme in the third quarter of 2013, a certain percentage of the total allocated vesting quantity is pegged to LNG. The remaining percentage pegged to piped natural gas is known as balance vesting quantity.

black-start ancillary service
A service to ensure that there is initial generation for system restoration following a complete blackout.

contestable consumers
Consumers that have the right to choose to purchase electricity from a retail supplier, directly from the wholesale market, or indirectly from the wholesale market through the Market Support Services Licensee (MSSL), SP Services. Consumers qualify to be contestable based on their level of electricity consumption.

co-optimisation
The process used by the market clearing engine (MCE) to ensure that the most inexpensive 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 MCE every half-hour that is the basis for the supply of energy, reserve and regulation in the market.

embedded generators (EG)
Generation units that generate electricity to their onsite load principally for self consumption.

energy
The flow of electricity.

gigawatt (GW)
A measure of electrical power equivalent to one thousand megawatts. Gigawatt hour (GWh) represents the number of gigawatts produced or consumed in an hour.

interruptible load (IL)
A contestable consumer of electricity that participates in the wholesale market and allows its supply of electricity to be interrupted in the event of a system disturbance in exchange for reserve payment.

licensed capacity
This denotes the capacity of a facility licensed by the Energy Market Authority (EMA).

lng vesting price
This refers to the price for the LNG vesting quantity allocated.

lng vesting quantity
With the start of the LNG Vesting Scheme in the third quarter of 2013, a certain percentage of the total allocated vesting quantity is pegged to LNG. This is known as the LNG vesting quantity.

load
The consumption of electricity.

market clearing engine (MCE)
The linear programme computer application used to calculate the spot market quantities and prices.

market participant (MP)
A person who has an electricity licence issued by the EMA and has been registered with EMC as a market participant.

megawatt (MW)
A measure of electrical power equivalent to one million watts. Megawatt hour (MWh) represents the number of megawatts produced or consumed in an hour.

metered demand
Metered demand is the electricity consumption which is proxied by the withdrawal energy quantity (WEQ).

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 of each location. Nodal pricing is also commonly referred to as locational marginal pricing.

non-contestable consumers
Consumers that are supplied by the MSSL, SP Services, at a regulated tariff. These consumers 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 MSSL, SP Services.

registered capacity
This denotes the capacity of a facility registered with the National Electricity Market of Singapore (NEMS). Registered capacity may differ from licensed capacity.

regulation
Generation that is on standby to fine-tune the match between generation and load.

reserve
Stand-by generation capacity or interruptible load that can be drawn upon when there is an unforeseen disruption of supply.

retail market
The transactions made between retail companies and end consumers.

supply cushion
The supply cushion measures the percentage of total supply available after matching off demand.

terawatt (TW)
A measure of electrical power equivalent to one million megawatts. Terawatt hour (TWh) represents the number of terawatts produced or consumed in an hour.

uniform singapore energy price (USEP)
The USEP is the weighted-average of the nodal prices at all off-take nodes.

vesting contract
A vesting contract is a regulatory instrument imposed on some generators by the EMA, with the objective of mitigating the potential exercise of market power when the supply side of the industry is concentrated among a small number of generators. A vesting contract requires these generators to produce a specified quantity of electricity (vesting contract level) at a specified price (vesting contract hedge price).

vesting contract hedge price (VCHP)
The VCHP is calculated by the MSSL every three months. It is determined using the long-run marginal cost (LRMC) of the most efficient generation technology in the Singapore power system, i.e., the combined-cycle gas turbine (CCGT). EMC's settlement system uses the VCHP to settle the vesting quantity between the MSSL and the generation companies. With the introduction of LNG into the generation mix, the VCHP has been replaced by 'LNG vesting price' and 'balance vesting price' from July 2013.

withdrawal energy quantity (WEQ)
Withdrawal energy quantity (in MWh) refers to the amount of electricity withdrawn by load facilities. It is provided by the MSSL.

wholesale market
The transactions made between generation companies and retail companies.

Generator Licensees	ExxonMobil Asia Pacific	www.exxonmobil.com.sg
	Keppel Merlimau Cogen	www.kepinfra.com
	Keppel Seghers Tuas Waste-To-Energy Plant (in its capacity as Trustee of Tuas DBOO Trust)	www.keppelseghers.com
	National Environment Agency	www.nea.gov.sg
	PacificLight Power	www.pacificlight.com.sg
	Sembcorp Cogen	www.sembcorp.com
	Senoko Energy	www.senokoenergy.com.sg
	Senoko Waste-To-Energy (in its capacity as Trustee of Senoko Trust)	www.kepinfra.com
	Shell Eastern Petroleum	www.shell.com.sg
	TP Utilities	www.tputilities.com.sg
	Tuas Power Generation	www.tuaspower.com.sg
	Tuaspring	www.hyflux.com
	YTL PowerSeraya	www.ytlpowerseraya.com
Retailer Licensees	Best Electricity Supply	www.bestelectricity.com.sg
	Buri Energy	www.burienergy.com
	CPvT Energy Asia	www.cpvtenergy.com
	Diamond Energy Supply	www.diamond-energy.com.sg
	Hyflux Energy	www.hyfluxenergy.com
	Keppel Electric	www.keppelelectric.com
	PacificLight Energy	www.pacificlight.com.sg
	Sembcorp Power	www.sembcorp.com
	Senoko Energy Supply	www.senokoenergy.com.sg
	Seraya Energy	www.serayaenergy.com.sg
	Sun Electric Power	www.sunelectric.com.sg
	Sunseap Energy	www.sunseap.com
	Tuas Power Supply	www.tpsupply.com.sg

Wholesale Market Traders	Air Products Singapore	www.airproducts.com.sg
	Banyan Utilities	
	CGNPC Solar-Biofuel Power (Singapore)	www.cgnsedc.com.cn
	CPvT Energy Asia	www.cpvtenergy.com
	Diamond Energy	www.diamond-energy.com.sg
	ECO Special Waste Management	www.eco.com.sg
	Glaxo Wellcome Manufacturing– GlaxoSmithKline Biologicals	www.gsk.com
	Green Power Asia	www.greenpowerasia.com
	KiWi Power Singapore	www.kiwipowered.com
	LYS Genco Beta	www.lysenergy.com
	MSD International GmbH (Singapore Branch)	www.msd-singapore.com
	Pfizer Asia Pacific	www.pfizer.com.sg
	Singapore LNG Corporation	www.slng.com.sg
	Singapore Oxygen Air Liquide	www.soxal.com
	Sunseap Leasing	www.sunseap-leasing.com
Market Operator	Energy Market Company	www.emcsg.com
Market Support Services Licensee	SP Services	www.spservices.com.sg
Power System Operator	Power System Operator	www.ema.gov.sg
Transmission Licensee	SP PowerAssets	www.sppowerassets.com.sg

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