Smart Energy, Sustainable Future

SINGAPORE ELECTRICITY MARKET OUTLOOK

(SEMO) 2017

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Second Edition

ENERGY MARKET AUTHORITY
991G ALEXANDRA ROAD
#01-29
SINGAPORE 119975
www.ema.gov.sg

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SECTION 1 INTRODUCTION

1.1 In Singapore's liberalised market environment, power generation investments are commercially driven. Prices in the electricity market send signals to investors to make investment decisions with respect to the timing of new plantings, as well as the amount of capacity and the type of technology. For such a market-based approach to work well, it is important that there should be adequate and quality information for investors when they make their investment decisions. This is especially so for the power sector, considering the high capital cost and significant lead time required for power generation planting.

1.2 The Energy Market Authority (EMA) continually seeks to work with the industry to ensure a conducive environment for power generation investments. A public consultation paper was launched in October 2015 to seek feedback on initiatives and enhancements to prepare for future power generation investments in Singapore. This led to the publication of the EMA's Final Determination paper "Preparing for Future Power Generation Investments in Singapore" (29 July 2016) [1], wherein EMA indicated that it will henceforth be releasing an annual information package to improve visibility on the longer term outlook of the energy landscape in Singapore. The EMA launched the inaugural Singapore Electricity Market Outlook (SEMO) [2] on 24 October 2016, which provided more forward-looking information such as the projected supply and demand conditions to facilitate power generation investment decisions, and included a special section on Solar Photovoltaic.

1.3 In this second edition, the EMA continues to provide the projected supply and demand conditions in Singapore, complementing existing publications such as the Singapore Energy Statistics. It also features a special section on the Electricity Futures Market, produced in partnership with the Singapore Exchange (SGX). The Electricity Futures Market is particularly relevant in facilitating investment decisions amongst industry players and serves as an additional hedging tool.

1.4 The EMA welcomes feedback on information that may be useful to include for future editions to enhance visibility on the longer term outlook of the energy landscape in Singapore, and to support future power generation investments.

[1] More information on the initiatives can be found in the Final Determination paper "Preparing for Future Power Generation Investments in Singapore", published on 29 July 2016 https://www.ema.gov.sg/cmsmedia/Determination_Paper_%20Preparing_for_Future_Power_Generation_Investments_Final_29_Jul.pdf

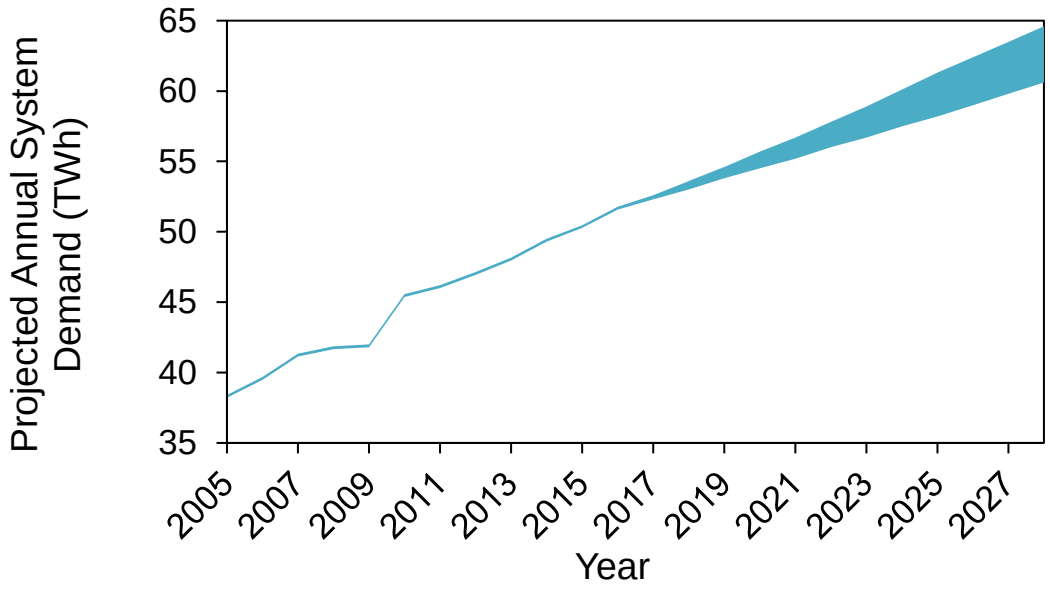
[2] The information that is put out is intended to be indicative and non-binding, and is dependent on factors such as, policy considerations, the broader macroeconomic climate, and prevailing assumptions and projections.

SECTION 2 ELECTRICITY DEMAND OUTLOOK

2.1 Singapore's system demand[3] has increased from about 39 TWh in 2006 to about 52 TWh in 2016 at a compound annual growth rate (CAGR)[4] of 2.7%. System peak demand grew from 5,624 MW to 7,149 MW over the same period at a CAGR of 2.4%.

2.2 The annual system demand and system peak demand are projected to grow at a CAGR of 1.3 – 1.9% from 2018 to 2028 (see Figures 1 and 2). This takes into account various factors, including changes to population and temperature, and projected Gross Domestic Product (GDP) growth rates.

Figure 1: Projected Annual System Demand

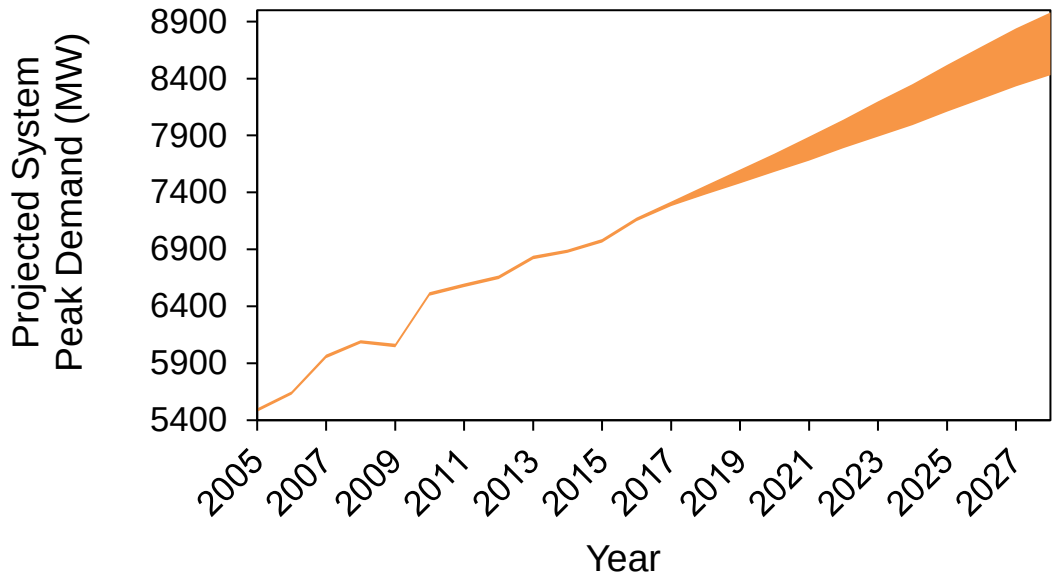


Year	Projected Annual System Demand (GWh)
2018	53,000 – 53,600
2019	53,800 – 54,600
2020	54,500 – 55,700
2021	55,200 – 56,700
2022	56,000 – 57,800
2023	56,700 – 58,900
2024	57,500 – 60,100
2025	58,200 – 61,300
2026	59,000 – 62,400
2027	59,800 – 63,500
2028	60,600 – 64,600

[3] System demand refers to gross electricity generation required to meet electricity consumed by all consumers, including autoproducers with their own generation and consumers with solar generation.

[4] The CAGR is calculated using 2006 figures as the base year.

Figure 2: Projected System Peak Demand

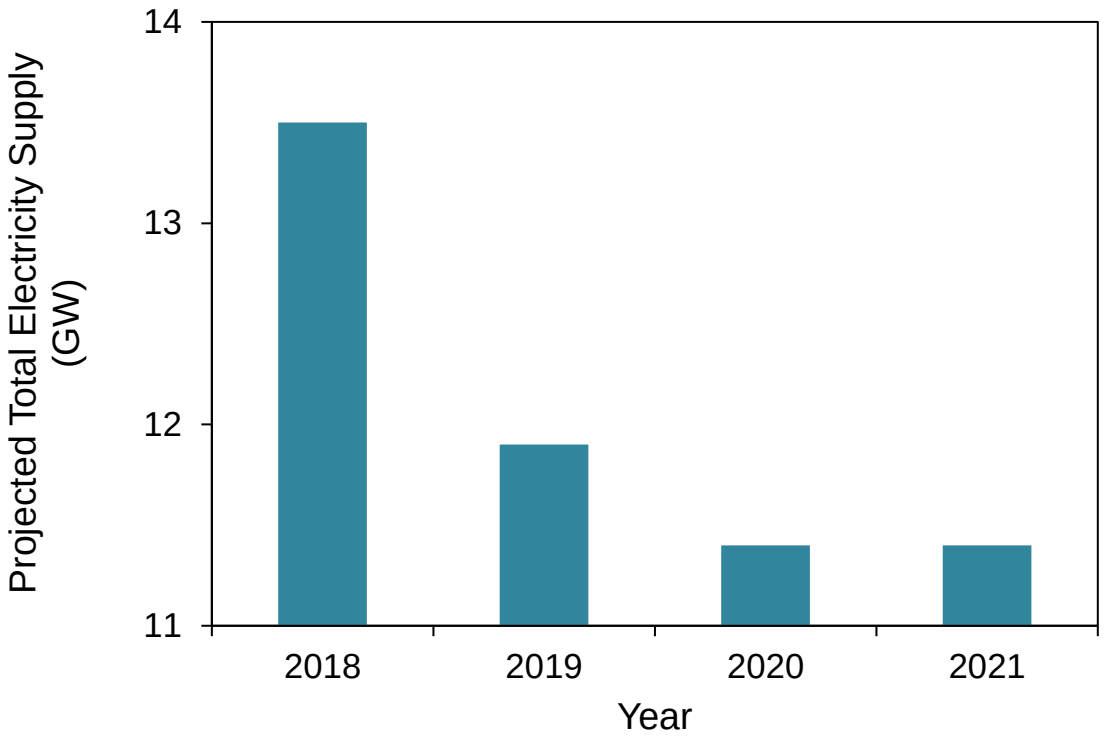


Year	Projected System Peak Demand (MW)
2018	7,380 – 7,460
2019	7,480 – 7,600
2020	7,580 – 7,740
2021	7,680 – 7,890
2022	7,790 – 8,040
2023	7,890 – 8,200
2024	7,990 – 8,350
2025	8,110 – 8,520
2026	8,220 – 8.680
2027	8,330 – 8,840
2028	8,430 – 8,980

SECTION 3 ELECTRICITY SUPPLY OUTLOOK

3.1 Based on the submissions received from generation licensees, the projected total electricity supply over the next 4 years is indicated in Figure 3. The reduction in capacity is primarily due to retirement of steam plants.

Figure 3: Projected Total Electricity Supply (Capacity) (2018-2021)



	Projected Total Electricity Supply (Capacity) (MW)[5]	Change(s) in Capacity (MW)
2018	13,500	0[6]
2019	11,900	-1600 (Retirement)
2020	11,400	-500 (Retirement)
2021	11,400	0

3.2 Based on the above projected electricity demand and supply, the reserve margin over the next 4 years is expected to remain above 30%[7] (as shown in Figure 4[8]).

[5] This is based on the projected total electricity supply (capacity) as at end of the calendar year. The projections have been rounded off.

[6] The projected total electricity supply (capacity) by end 2017 is 13,500 MW.

[7] In Singapore, the minimum reserve margin has been set at 30% to ensure system security is maintained.

[8] The reserve margin is a system-wide indicator. Potential investors should also consider any potential localised transmission constraints. More information on the development of Singapore's Transmission Network can be found in the Information Paper "Developments in the Singapore Electricity Transmission Network": https://www.ema.gov.sg/cmsmedia/Licensees/Electricity-Policy-Papers/Developments_in_the_Singapore_Electricity_Transmission_Network_05042011.pdf

The reserve margin is calculated (see formula in Figure 5) using the upper bound of projected system peak demand numbers from Figure 2 and the projected total electricity supply numbers from Figure 3.

Figure 4: Projected Reserve Margins (2018-2021)

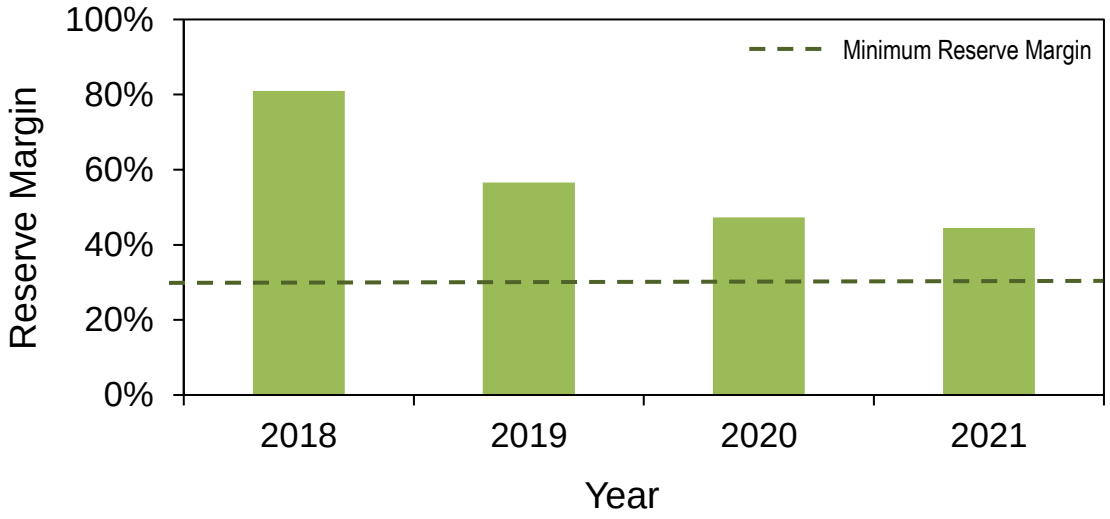


Figure 5: Reserve Margin Formula

$$\text{Reserve Margin} = \frac{\text{Total Electricity Supply (Capacity)} - \text{System Peak Demand}}{\text{System Peak Demand}} \times 100\%$$

SECTION 4 SPECIAL TOPIC: ELECTRICITY FUTURES MARKET

Overview of Electricity Futures Market

4.1 Since the liberalisation of the market in 2001, EMA has been taking steps to develop the Singapore electricity market to promote a more competitive and sustainable energy landscape. The development of an electricity futures market complements both the existing wholesale and retail electricity markets, by providing a platform for efficient trading to manage volatility and mitigate risks. In April 2015, the EMA, in partnership with the Singapore Exchange (SGX) and the electricity industry, launched the electricity futures market.

4.2 The electricity futures market provides various benefits for the industry. Firstly, electricity generators may better manage their commercial and operational risks, such as plant outages, by hedging in the futures market. Secondly, the electricity futures market facilitates the entry of independent retailers (without generation assets) by providing an additional option for them to secure fixed price contracts, which encourages enhanced retail competition. Lastly, consumers benefit from this enhanced competition via downward pressure on prices and new retail products in the market.

The definitions of common terms used in the electricity futures market are listed below:

- A **futures contract** is a standardised contract between two counterparties, generally made on a futures exchange, to buy or sell a commodity or financial instrument of standardised quantity and quality for a price agreed today with delivery or settlement occurring at a future date.
- A buyer of a futures contract is said to be "**long"** and a seller of a futures contract is said to be "**short**".
- The difference between the futures price and the spot price is called the "basis". **Basis risk** is the primary risk associated with futures contracts when the futures price and the spot price do not converge at maturity.
- **Hedging** is the buying or selling of a derivative to offset the risk of a physical position to allow a known profit to be locked in ahead of time.
- **Contango** is a term used to describe a market situation when the futures price is higher than the spot price. **Backwardation** is a term used to describe a market situation when the futures price is lower than the spot price.
- **Volume** refers to the number of contracts (or "lots") traded in a period of time.
- **Open interest** refers to the number of outstanding contracts that are "open" (i.e. not closed or yet to be settled) at any point in time. A large open interest indicates more activity and liquidity for the contract.

4.3 The electricity futures market can help balance the short-term fluctuations in the spot market. In the Singapore electricity spot market, electricity generation and consumption balance every half-hour and prices may fluctuate rapidly depending on market conditions. Futures contracts pay out or require payment when spot prices deviate from the agreed price of the futures contracts. This combination of spot prices and futures payments provides stable prices for electricity generators, retailers and consumers.

4.4 Figure 6 illustrates how different stakeholders can use electricity futures to hedge their respective price risks. During periods of falling electricity prices, generators can choose to sell electricity futures to ensure revenue certainty. Correspondingly, during periods of rising electricity prices, retailers and consumers can choose to buy electricity futures to ensure their price certainty.

Figure 6: Illustration on different stakeholders using electricity futures to hedge[9]

	Generator	Retailer/Consumer
Electricity Spot Market - Market rises - Market falls	Sell electricity at a future date Profit **INCREASES** Profit **DECREASES**	Buy electricity at a future date Profit **DECREASES** Profit **INCREASES**
Electricity Futures Market - Market rises - Market falls	Sell futures (short position) Profit **DECREASES** Profit **INCREASES**	Buy futures (long position) Profit **INCREASES** Profit **DECREASES**
Net position	**Flat** – profit or loss on the spot market are offset by profit or loss on the futures market	**Flat** – profit or loss on the spot market are offset by profit or loss on the futures market

4.5 There are 2 different types of products[10] being traded in the Singapore electricity futures market. The quarterly base load futures (product code: EF) began trading in April 2015 and allow stakeholders to trade contracts for 9 consecutive contract quarters (i.e. March, June, September and December), starting with the current quarter. The monthly base load futures (product code: EE) began trading in April 2017 and allow stakeholders to trade contracts for 4 to 6 consecutive months, starting with the current month[11].

Futures Market Statistics

4.6 As of 1 October 2017, the total volume traded in the electricity futures market is 4,744 lots (5,196 GWh), while the open interest was 1,010 lots (1,107 GWh). Based on the daily settlement prices as shown in Figure 8(b) below, the market is currently in contango[12]. Figure 7 provides an illustration on how volume and open interest figures are computed.

[9] Movements in profits are relative to stakeholders' daily mark-to-market positions.

[10] For detailed contract specifications, please refer to http://www.sgx.com/commodities/electricity

[11] The number of contracts varies depending on the month, based on quarters ending on the last day of March, June, September and December. For example, MMs are required to put up 6 contracts in April 2017 (April to September 2017) but 5 contracts in May 2017 (May to September 2017).

[12] Please refer to http://www.sgx.com/wps/portal/sgxweb/home/products/derivatives/about-derivatives/knowledge-centre#Electricity for past electricity market reports by SGX

Figure 7: Illustration on Volume and Open Interest (Source: SGX)

Date	Trading Activity	Volume	Net Positions: Long (+) / Short (-)					Total Long	Total Short	Open Interest
			A	B	C	D	E			
T	A buys 10 lots B sells 10 lots	10	+10	-10				10	10	10
T+1	C buys 50 lots D sells 50 lots	50	+10	-10	+50	-50		60	60	60
T+2	A sells 10 lots D buys 10 lots	10		-10	+50	-40		50	50	50
T+3	E buys 50 lots C sells 50 lots	50		-10		-40	+50	50	50	50
	Total as of T+3	120								50

Figure 8: Electricity Futures Statistics as of 1 Oct 2017 (Source: SGX)

Figure 8(a): EF Volume and Open Interest (OI)

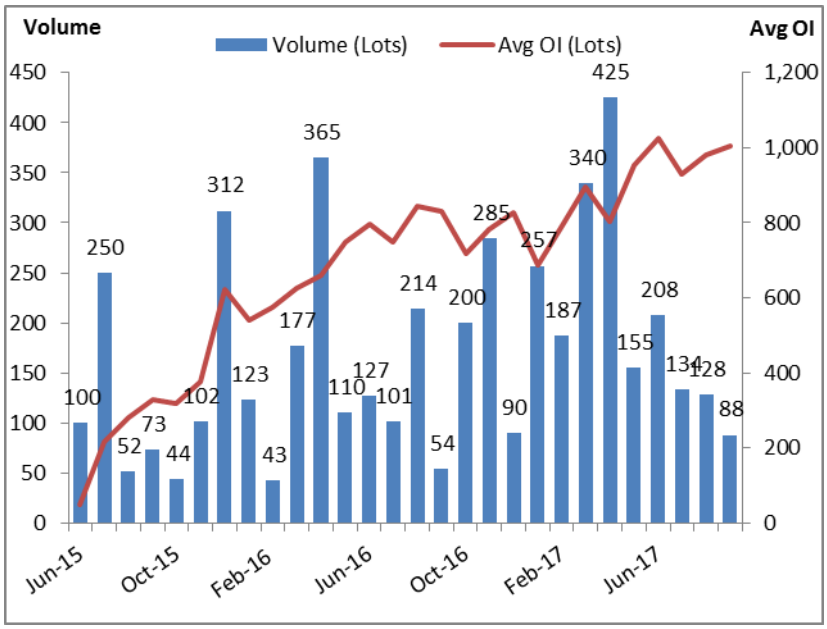


Figure 8(b): EF Daily Settlement Price (DSP)

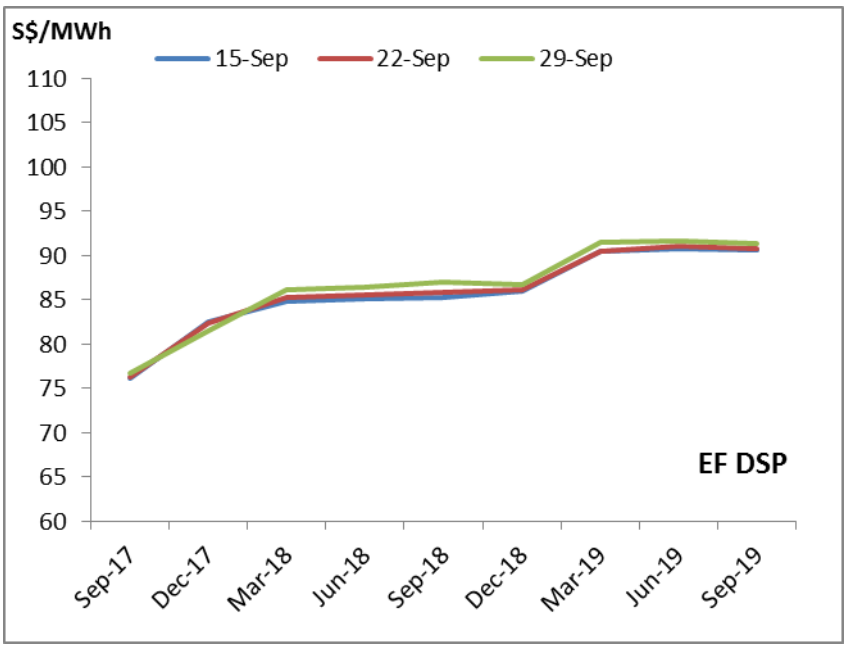
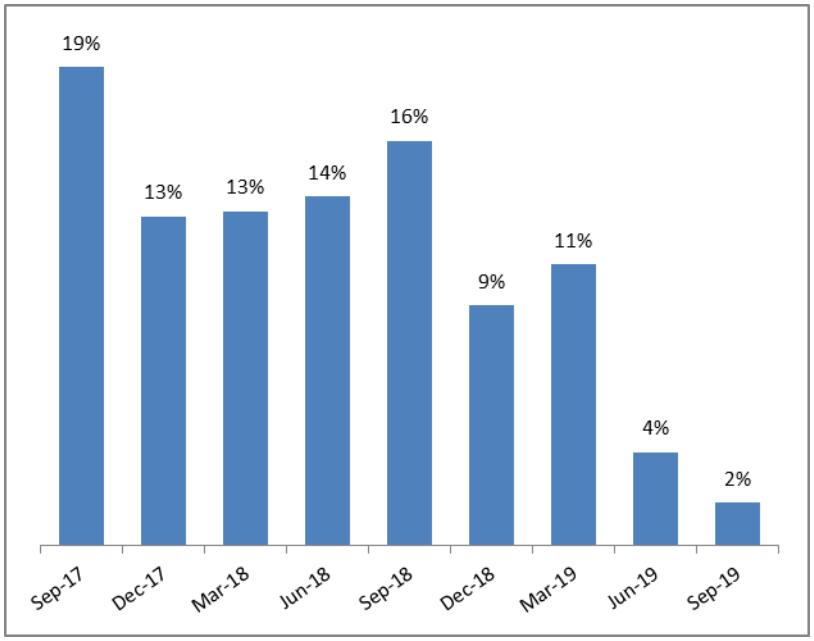


Figure 8(c): EF Open Interest Mix by Contract



How to Participate in the Electricity Futures Market

4.7 To trade electricity futures, SGX requires market participants to open a futures trading account with an SGX Clearing Member. Please approach one of the SGX Clearing Members[13] on their account opening process and requirements.

4.8 Interested parties will also need to deposit acceptable margin collaterals[14] before they can start trading. Definitions for some of the terms relating to margin requirements include the following:

- **Initial Margin**: amount of funds and/or acceptable collaterals required before initiating a new trade in a futures contract
- **Maintenance Margin**: minimum amount of funds and/or acceptable collaterals required to be maintained in an account for each outstanding contract or open position
- **Daily Mark-to-Market**: daily revaluation of open position to the daily settlement price and settlement of unrealised gains/losses arising from this mark-to-market process
- **Margin Call**: call for additional margins if the margin balance in an account falls below the prescribed maintenance margin level after the daily mark-to-market of position

4.9 Figure 9 provides an illustrative example of SGX's margin requirements.

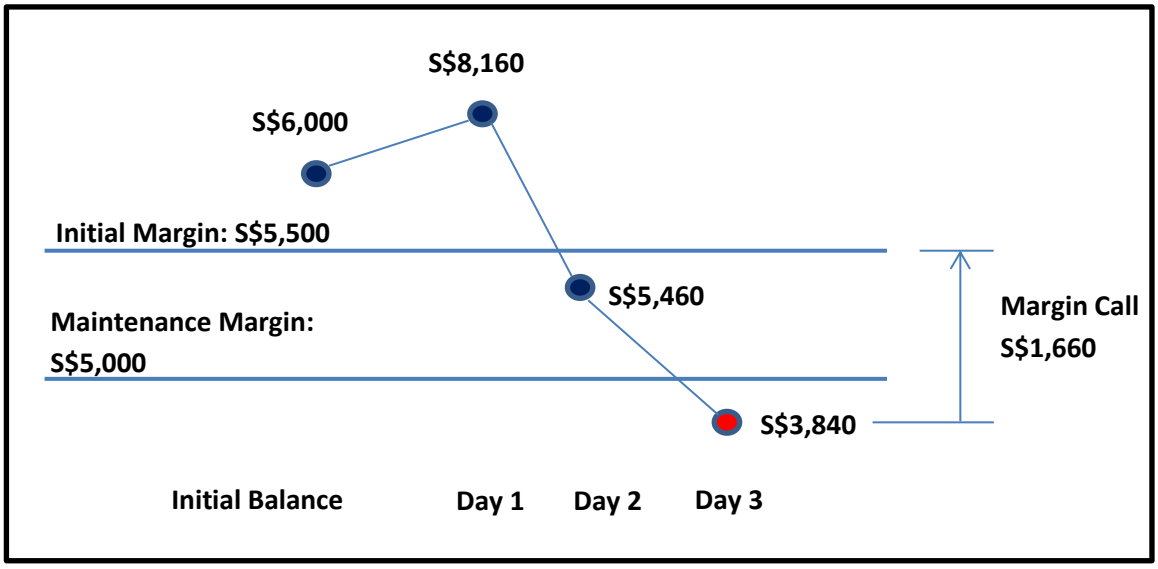
Figure 9: Illustration of SGX electricity futures margining system

Trader buys 1 lot of current contract quarter (assume contract size is 1,080 MWh) of SGX quarterly base load electricity futures at S$80/MWh. Initial Margin (IM) and Maintenance Margin (MM) for this contract are S$5,500 and S$5,000 respectively. Trader has an initial account balance of S$6,000.

	Day 1	Day 2	Day 3
Beginning Account Balance	$6,000	$8,160	$5,460
Daily Settlement Price (DSP)	$82/MWh (↑**$2.00**)	$79.50/MWh (↓**$2.50**)	$78/MWh (↓**$1.50**)
Unrealised gains/losses	$(82-80) x 1,080 MWh = **$2,160**	$(79.50-82) x 1,080 MWh = **- $2,700**	$(78-79.50) x 1,080 MWh = **-$1,620**
Account Balance After Daily Mark-to Market	$6,000 + $2,160 = $8,160	$8,160 - $2,700 = $5,460	$5,460 - $1,620 = $3,840
Margin Call	No ($8,160 > $5,000)	No ($5,460 > $5,000)	Yes ($3,840 < $5,000)
Top-up Amount	**-**	**-**	**$1,660**

[13] Please refer to http://www.sgx.com/wps/portal/sgxweb/home/regulation/members/members_firm_list for full list of SGX clearing members.

[14] Please speak with the clearing members on their list of acceptable margin collaterals.


S$8,160
S$6,000
Initial Margin: S$5,500
S$5,460
Maintenance Margin:
S$5,000
Margin Call
S$1,660
S$3,840
Initial Balance
Day 1
Day 2
Day 3

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