EMA'S PROCEDURES FOR CALCULATING THE COMPONENTS OF THE VESTING CONTRACTS

Energy Market Authority

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Version 2.8

Document History

Version Number	Version Date	Summary of Changes
1.0	April 2005	-
1.1	March 2009	Changes to the formulas for calculating HSFO fuel price in Section 3.7 and 3.8
1.2	Jun 2009	Clarification to the HSFO fuel price used in Section 3.7
1.3	October 2009	Changes to include tender of the non-contestable load
1.4	December 2009	Changes to the source to obtain the exchange rate in Section 3.8
1.5	April 2010	Changes to include the LNG Vesting Scheme
1.6	September 2010	Changes to the Tariff Reference Price formulas in Section 3.9
1.7	March 2011	Change to Load Forecasting Methodology in Section 3.2, inclusion of Appendix 1 and update to document
1.8	October 2012	Change to LRMC Scale Factor Indices and update to document
1.9	June 2013	Changes to the calculation of the Fuel Cost
2.0	Sept 2013	Refinement to the Claw Back Mechanism for the LNG Vesting Scheme and update to Figure 3.2b
2.1	Dec 2013	Refinement to the Claw Back Mechanism for the LNG Vesting Scheme
2.2	Mar 2015	Refinement to the Determination of Fuel Cost in LRMC
2.3	Sep 2015	Refinement to the PNS formula and the Load Forecast Methodology
2.4	Jun 2018	Consequential update to PNS formula due to availability of data arising from load profiling for contestable residential consumers, specifically to stagger the settlement adjustment period for PNS by three (instead of two) months
2.5	Aug 2018	Update in respect of Load Forecasting Methodology in Section 3.2 and Appendix 1, and Generation Installed Capacity in Section 3.3
2.6	Nov 2018	Added parameters 24a and 24b in Section 2.3
2.7	Jul 2019	Update of Load Forecasting Methodology in Appendix 1
2.8	Apr 2020	Update to LRMC Scale Factor Indices and removal of TRP

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1. INTRODUCTION

The Energy Market Authority ("EMA" or the "Authority") implemented Vesting Contracts[1] on 1 January 2004 as a regulatory instrument to mitigate the exercise of market power by the generation companies ("Gencos"). Vesting Contracts commit the Gencos to sell a specified amount of electricity (viz. the Vesting Contract level) at a specified price (viz. the Vesting Contract price). This removes the incentives for Gencos to exercise their market power by withholding their generation capacity to push up spot prices in the wholesale electricity market. Vesting Contracts are allocated only to the Gencos[2] that had made their planting decisions before the decision was made in 2001 to implement Vesting Contracts.

Starting from 2nd quarter 2010, to introduce competitive pricing for the setting of the non-contestable tariff, EMA will tender out portions of the non-contestable load ("Tender Vesting Quantity") for Gencos to bid on a competitive basis. The awarded tender price, ("Tender Vesting Price") will be used together with the Allocated Vesting Price for the setting of the tariff for the non-contestable consumers. The amount put up for tender will be determined by EMA. The Allocated Vesting Price will be used for the remaining portion of the Vesting Contract.

To encourage the uptake of regasified Liquefied Natural Gas (LNG), the Authority implemented the LNG Vesting Scheme that upon the completion of the LNG Terminal in May 2013. The LNG Vesting Scheme shall be in force for 10 years starting from the first complete quarter after the Commercial Operations Date of the Singapore LNG Terminal. Vesting Contract holders who qualify for the LNG Vesting Scheme are allocated a specified amount of LNG Vesting Quantities based on the regasified LNG Vesting Price as determined by the Authority.

This paper outlines procedures and/or methods for determining the values of those components of Vesting Contracts nominated to be provided by the Authority within the Market Rules, Codes of Practice and Vesting Contracts, including the values of:

- Allocated Vesting Price using Long Run Marginal Cost ("LRMC")
- Tender Vesting Price using the winning tender price(s)
- Day Profiles
- Electricity Consumption Forecast
- Vesting Contract Data
- Variable Hedge Proportion for Electricity Consumption and Payment Reference Price (VHP & PRP)
- Generation Installed Capacity
- Adjustment for over/under recovery
- LRMC Scaling Factors

[1] http://www.ema.gov.sg/ema_cms/page/91/id:134/

[2] These Gencos are Senoko Energy, PowerSeraya, Tuas Power Generation, SembCorp Cogen, Keppel Merlimau Cogen and Island Power Company.

2. LRMC PROCEDURES

2.1 INTRODUCTION

The Allocated Vesting Price approximates the long run marginal cost ("LRMC") of a theoretical new entrant that uses the most economic generation technology in operation in Singapore and contributes to more than 25% of total demand. This section outlines the procedures for determining the various components of the LRMC.

The underlying concept of the LRMC is to find the average price at which the **most efficiently configured generation facility with the most economic generation technology** in operation in Singapore will cover its variable and fixed costs and provide reasonable return to investors. The plant to be used for this purpose is to be based on a theoretical generation station with the most economic plant portfolio (for existing CCGT technology, this consists of 2 to 4 units of 370MW plants). The profile of the most economic power plants is as follows:

- Utilises the most economic generation technology available and operational within Singapore at the time. This most economic generation technology would have contributed to more than 25% of total demand at that time,

- The generation company is assumed to operate as many of the units of the technology necessary to achieve the normal economies of scale for that technology.

- The plants are assumed to be built adjacent to one another to gain infrastructure economies of scale.

- The plants are assumed to share common facilities such as land, buildings, fuel supply connections and transmission access. The cost of any common facilities should be prorated evenly to each of the plants.

- The plants are assumed to have a common corporate overhead structure to minimise costs. Any common overhead costs should be prorated evenly to each of the plants.

In estimating the LRMC and the underlying parameters, there are invariably many elements of judgement such that the LRMC and the underlying parameters cannot be determined with a high level of precision. In different markets, there are a variety of views about the value of LRMC. This variation in views reflects legitimate differences in the opinions of experts about the underlying parameters and can result in significantly different outcomes for the calculation. The parties to each Vesting Contract would typically be the market support services licensee (the "Issuer") and a generation licensee (the "Holder"). The clause in the Vesting Contract that limits the liability of the Issuer is:

Clause 3.7 *Acknowledgement of the need for judgement and Binding Nature of Calculations*

The Holder acknowledges and agrees that the calculation of Hedge Quantities and of associated Hedge Prices pursuant to clauses 3.4 and 3.5 involves the exercise of judgement by the Issuer. The Holder therefore agrees that it will be bound by any such calculation and any such calculation shall not be revised pursuant to any dispute process unless the Issuer in making the calculation:

(a) has acted otherwise than in good faith;
(b) has exercised judgement in effecting such calculation in a manner that is in error; or

(c) has exercised judgement in effecting such calculation in a manner that is significantly different from the manner in which such judgement has previously been exercised by the Issuer and no reasonable justification exists for such difference.

2.2 PROCEDURES FOR ESTIMATING LRMC PARAMETERS AND THE ALLOCATED VESTING PRICE

The following procedures will be used by the Authority for estimating parameters and making other valuations for determining the value of LRMC.

- The Authority will provide the methodology for calculating the Allocated Vesting Price and determine the first set of LRMC parameters (base parameters) that will apply at the start of the vesting regime.

- The Authority will conduct a review of the LRMC base parameters once every 24 months (for the first quarter of the calendar year), and at other times as it considers necessary, and may modify the values of currently used parameters.

- The Authority will base the LRMC calculation on CCGT technology with such updated values as shall be appropriate unless a more economic generating technology, which has contributed to more than 25% of total demand, is in use in Singapore at that relevant time.

- Between the reviews of the LRMC base parameters, the Authority will adjust the Allocated Vesting Price using indices that correct the relevant components of the LRMC calculation.

2.2.1 Procedures for estimating the parameters of LRMC

The Authority will be responsible for determining the LRMC calculations and parameters. The procedures are as follows.

In determining the parameters, the Authority will:

- Make an initial determination, seeking any expert advice as it considers appropriate,

- Communicate the estimates of all parameters to Vesting Contract holders for comment,

- On receiving the comments of the Vesting Contract holders, the Authority will make a final determination, seeking any further expert advice as it considers appropriate.

This Allocated Vesting Price will be updated by applying the adjustment indices every quarter in between each review of the LRMC base parameters using procedures outlined in Section 3.7 and 3.8.

The Authority will, however, reserve the right to revalue the LRMC parameters (and Allocated Vesting Price) at any other time where it considers that special circumstances have arisen that, in its opinion, substantially invalidate the previous LRMC calculation. In such circumstances, the Authority will consult all Vesting Contract holders at least 3 months in advance of the new valuation taking effect, giving its reasons for deciding to make the revaluation. The Authority will take into account the comments of the Vesting Contract holders and may take any other advice as it thinks fit in making its final decision. The decision of the Authority will be final.

The Authority will, if it considers it necessary, call upon the opinions of experts in determining the LRMC calculation. These opinions may be obtained as seen fit by the Authority, including by using the formal procedure set out below. This procedure for seeking expert opinion is not mandatory and may be substituted by the Authority with other arrangements considered appropriate given the circumstances prevailing at the relevant time[3]. This procedure uses panels of experts to advise the Authority on the parameter values. This procedure may be particularly appropriate for those parameters where a general consensus of the Vesting Contract holders cannot be achieved.

2.2.2 Formal Procedure using Panels of Experts

Since the opinions of experts can vary, in relation to the parameters for which the Authority may seek an expert opinion, the Authority intends to obtain such expert opinions from a number of industry-based experts. Different experts may be required to estimate different parameters, depending on their respective expertise. Three different categories of expertise may be required to estimate the parameters, as follows:

1. Engineering and power systems: comprising engineering experts with international experience and established credentials in the Asian region in electricity plant purchase, installation, operation and valuation.

2. Finance: comprising finance experts from international merchant banking companies with expertise in investment in electricity power plants and knowledge of the Singaporean economy and electricity system.

3. Real estate: comprising Singapore-registered real estate valuers.

Since the opinion of a single expert may not give a sufficiently representative view, the Authority intends that in each category, a panel of three experts be appointed.
Where any parameter is to be determined by a panel of experts appointed by the Authority, the following procedure will be adopted:

1. The Authority will, as it deems necessary, select up to three panels comprising of three experts each, based on each of the categories described above.

2. For each applicable category, one expert will be chosen as the lead expert.

3. Panel members will normally be appointed for a period of approximately 4 years to cover two consecutive LRMC revaluations and seven quarterly adjustments subsequent to the quarter covered by the initial LRMC valuations.

4. The Authority will present the experts with a statement of the requirements for the valuations or estimation of the parameters assigned to them.

5. Each expert will independently develop their estimate of the parameter values and present it to the lead expert in his respective category.

6. Each lead expert will collate the results of his respective category and send the collated results to each member of his respective panel and all holders of Vesting Contracts for their comment.

7. Each lead expert will thereafter present a written report:

[3] An example of a circumstance that may give rise to a substitution of procedure is the existence of recent and applicable data from an actual new plant or entrant in Singapore.

- summarizing the estimates of each expert in his category and the comments received from the panel and holders of Vesting Contracts, and
- presenting a single final estimate for each parameter.

8. The Authority will, in its discretion, accept such single final estimate for each parameter, which will be final.

9. The Authority will apply these final parameter estimates and valuations to the LRMC calculation. The estimate of the LRMC produced by the calculation will be the base Allocated Vesting Price.

2.3 DESCRIPTION AND METHOD OF DETERMINING LRMC PARAMETERS

No.	Parameter	Description	Method of Determination
1	Determination Date	Date on which the calculations of the LRMC, which is to apply at the Application Date, are deemed to be made.	Determined by EMA.
2	Base Month	Cut-off month for data used in determination of the LRMC base parameters. For the following base parameters which tend to be volatile in nature, the data to be used for estimating each of them shall be based on averaging over a three-month period leading up to and including the Base Month: 1. Exchange rate denominated in foreign currencies into Singapore dollars; 2. Diesel price to calculate cost of carrying backup fuel; 3. Debt premium to calculate cost of debt; and 4. MAS Core Inflation Index.	Determined by EMA
3	Application Date	Period for which the LRMC is to apply.	Determined by EMA.
4	Current Year	Year in which the Application Date falls.	Determined by EMA.
5	Exchange Rate ($US per $Sing)	The exchange rate is that as determined under Section 3.7.	Determined by EMA (in consultation with finance experts)
6	Economic capacity of the most economic technology in operation in Singapore (MW)	The size of the most thermally efficient unit taking into account the requirements of the Singapore system, including the	Determined by EMA (in consultation with the engineering and power systems experts)

No.	Parameter	Description	Method of Determination
		need to provide for contingency reserve to cover the outage of the unit and the fuel quantities available. It is acknowledged that this value may depend on the manufacturer. (For CCGT technology the size of the unit is expected to be around 370MW.)	
7	Capital cost of the plant identified in item 6 ($US/kW)	Capital cost includes the purchase and delivery cost of the plant in a state suitable for installation in Singapore and all associated equipment but excludes switch gears, fuel tanks, transmission and fuel connections, land, buildings and site development included in item 8. Where more than one unit is expected to be installed that will share any equipment, the costs of the shared equipment should be prorated evenly to each of the units.	Determined by EMA (and in consultation with the engineering and power systems experts)
8	Land, infrastructure and development cost of the plant identified in item 6 ($Sing million)	Where more than one unit is expected to be installed that will share any equipment or facilities, the costs of the shared equipment or facilities should be prorated evenly to each of the units. These costs should include all capital, development and installation costs (excluding all costs included in the capital cost of plant included in item 7 and financing costs during the build period). These costs should include the following specific items: • Acquisition costs of sufficient land to accommodate the plant defined above in item 6 (alternatively land may be included as annual rental cost under Fixed Annual Running Costs) • Site development • Buildings and facilities • Connections to gas pipelines • Switchgear and connections to transmission • Emergency fuel facilities • Project management and consultancy	Determined by EMA, (a) In consultation with the engineering and power systems experts in relation to the following values: • size of site required • site development • buildings and facilities • connections to pipelines • switchgear connections to transmission • emergency fuel facilities • project management and consultancy; and (b) In consultation with the real estate experts in relation to land value.

No.	Parameter	Description	Method of Determination
9a	HSFO 180 CST Oil Price (US$/MT)	The HSFO 180 CST Oil Price is that as determined in Section 3.7.1	Determined by EMA.
9b	Brent Index Price (US$/bbl)	The Brent Index is that as determined in Section 3.7.2	Determined by EMA.
10a	Gas Price ($Sing/GJ)	The current most economic generating technology in Singapore uses natural gas. This is calculated using the weighted average price of gas used for commercial power generation, determined by EMA in accordance with Section 3.7.	Determined by EMA.
10b	LNG Price ($Sing/GJ)	This is the Singapore regasified LNG price as determined by the Authority. The LNG Price is used in place of 10a for the LNG Vesting Quantities under the LNG Vesting Scheme. The LNG Price includes: • the LNG hydrocarbon charge • any fees or charges imposed by the Authority on the imported gas • the LNG terminal tariff • the average gas pipeline transportation tariff applicable to regasified LNG users • the LNG Aggregator's margin • the cost of Lost and Unaccounted For Gas (LUFG)	Determined by EMA.
11	HHV Heat Rate of the plant identified in item 6 (Btu/kWh)	The high heat value heat rate of the plant specified under item 6 that is expected to actually be achieved, taking into account any improvement or degradation in efficiency from installation in Singapore and other reasonable factors.	Determined by EMA (in consultation with the engineering and power systems experts)
12	Build duration of the plant identified in item 6 (years)	The time from the commencement of the major cost of development and installation being incurred up to the time of plant commissioning. This parameter is used to calculate the financing cost over the duration of the building period and assumes that the development costs are incurred evenly across this period. The build duration should be	Determined by EMA (in consultation with the engineering and power systems experts)

No.	Parameter	Description	Method of Determination
		specified to reflect this use and meaning as opposed to the actual time from the commencement of site development to the time of plant commissioning.	
13	Economic lifetime of the plant identified in item 6 (years)	The expected time from commissioning to decommissioning of the plant. This number is used to amortise the capital cost of the plant, and of installation and development.	Determined by EMA (in consultation with the engineering and power systems experts)
14	Average expected utilisation factor of the plant identified in item 6, i.e. average generation level as a percentage of capacity (%)	The utilisation factor is the expected annual proportion of plant capacity that will be used for supplying energy for sale. It should exclude station usage, expected maintenance and forced outages and the expected time spent providing reserve capacity. The determination of the factor should assume that the plant is efficiently base-loaded.	Determined by EMA (in consultation with the engineering and power systems experts)
15	Fixed annual running cost of the plant identified in item 6 ($Sing)	These costs are the fixed operating and overhead costs that are incurred in having the plant available for supplying energy and reserves but which are not dependent on the quantity of energy supplied. It is acknowledged that some costs are not easily classified as fixed or variable. The costs expected to be included in this parameter are: • Operating labour cost – it is expected that the plant will be running for three shifts per day and seven days per week so all operating labour cost is likely to be a fixed annual cost • Direct overhaul and maintenance cost, with any semi-variable costs treated as annual fixed costs • Generating license • Insurance • Property tax • Costs of emergency fuel • Other charges • Other overhead costs	(a) Determined by EMA, in consultation with engineering and power systems experts in relation to the following values: • Operating labour • Direct overhaul and maintenance cost • Costs of emergency fuel • Other overhead costs; and (b) Determined solely by EMA • Generating license • Insurance • Property tax • Other charges

No.	Parameter	Description	Method of Determination
16	Variable non-fuel cost of the plant identified in item 6 ($Sing/MWh)	Any costs, other than fuel costs, that vary with the level of energy output for a base-load plant and are not covered by item 15.	Determined by EMA (in consultation with the engineering and power systems experts)
17	Proportion of debt to assets	The proportion of debt to total assets. It is an estimate of the industry standard ratio for private sector generators in an economic environment similar to Singapore.	Determined by EMA (in consultation with the finance experts)
18	Risk free Rate (%)	The risk-free rate in Singapore shall be determined as the average of the daily closing yield on a default-free bond issued by the local government	Determined by EMA (in consultation with the finance experts)
19	Cost of Debt (%)	Risk-free rate plus a premium as determined by the Authority.	Determined by EMA (in consultation with the finance experts)
20	Market Risk Premium (%)	The market risk premium represents the additional return over investing in risk-free securities that an investor will demand for investing in electricity generators in Singapore, as determined by the Authority.	Determined by EMA (in consultation with the finance experts)
21	Beta	Parameter for scaling the market risk premium for calculating the cost of equity as determined by the Authority. Beta is a measure of the expected volatility of the returns on a project relative to the returns on the market, that is, the systematic risk of the project.	Determined by EMA (in consultation with the finance experts)
22	Tax rate (%)	Corporate tax rate applicable to generating companies in Singapore at the Base Month.	Determined by EMA.
23	Cost of equity (%)	The return of equity is calculated as item 18 + (item 20)(item 21).	Calculated by EMA (in consultation with the finance experts)
24a	Carbon price (SGD/tonne $CO_{2\text{-}e}$)[4]	Carbon price for the emissions of greenhouse gas	Determined by EMA in accordance with the Carbon Pricing Act
24b	Carbon emission factor (tonnes $CO_{2\text{-}e}$/GJ)[4]	Carbon emissions factor for the fuels used by the plant	Determined by EMA in accordance with the International Panel on Climate Change (“IPCC”) 2006

[4] These parameters will be introduced with effect from 1 Jan 2019.

2.4 PROCEDURES FOR ALLOCATION OF TENDER VESTING QUANTITIES AND THE TENDER VESTING PRICE

The following procedures will be used by the Authority to obtain the tender vesting price:

- To introduce competitive pricing to the electricity tariff for non-contestable consumers, EMA may choose to put up a portion of the Vesting Contracts of between 3 to 12% of the total electricity consumption for tender. All holders of the Vesting Contracts with available generation installed capacity and have signed the necessary supplemental agreements are eligible for the tender. The Tender Vesting Quantities and the tenure of the tender contract shall be determined by EMA.

- The winner(s) of the tender(s) shall be contracted with the Tender Vesting Quantities at the Tender Vesting Price as determined in the outcome of the tender(s) for the tenure of the tender contract. The sum of the Tender Vesting Quantities and the Allocated Vesting Quantities will make up the total Vesting Quantities.

- In an event that a portion of the tender was unawarded, EMA will determine the methodology of how these unawarded quantities are to be allocated.

- The tender contract will have a provision for planned maintenance of up to a specified number of days for the duration of the contract, during which the winner(s) of the tender(s) can be relieved of its Tender Vesting Quantities[5]. The winner(s) of the tender(s) wishing to exercise this option will have to obtain prior approval from the Power System Operator (PSO) for the planned maintenance dates. The winner(s) of the tender(s) shall then inform the Authority of the dates, in periods of 1 day, that it wishes to be relieved of its Tender Vesting Quantities at the same time that it submits its generation installed capacity for the determination of the Allocated Vesting Quantities for the following quarter.

- During the period where the winner(s) of the tender(s) is relieved of its Tender Vesting Quantities, the MSSL will buy the equivalent amount of electricity from the wholesale electricity market at the Uniform Singapore Electricity Price (USEP) to supply to non-contestable consumers. The difference between the USEP and the Tender Vesting Price will be taken into account for the calculation of the electricity tariff for non-contestable consumers in the following quarter.

[5] No relief will be given for unplanned outages.

3. PROCEDURES FOR DETERMINING OTHER DATA FOR ALLOCATED VESTING PRICES, ALLOCATED VESTING QUANTITIES AND TENDER VESTING QUANTITIES

The following procedures will be used by the Authority (or by the market support services licensee (the "MSSL") on the Authority's behalf) for estimating other data on a quarterly basis, for which the Authority is responsible, for use in the determination of both price and quantity for Vesting Contracts, other than the determination of the Allocated Vesting Price already discussed in section 2 above.

3.1 DAY PROFILES

The MSSL shall, on behalf of the Authority, calculate the values of the day profile [Period_Type (Day_Type, Period)] for the purposes of calculating the contract Allocated Vesting Quantities and Tender Vesting Quantities as stated in Schedule B of the Vesting Contract in accordance with the following procedure:

- divide the week into three representative day-types: (a) Sundays and public holidays, (b) Saturday, and (c) all other days (week-days).

- every two years or such other time corresponding to a re-estimate of the LRMC value: for each day-type, allocate each half-hourly period into one of three period-types: (a) peak, (b) shoulder and (c) off peak. There will be only three classifications which will be applicable to all three day-types (as opposed to separate categories for each day-type).

- these peak, shoulder and off peak classifications will be calculated from actual data derived over the previous 12-month period concluding 3 months before the commencement of the application of the profiles[6]. This will normally be the 12 month period from 1 October to 30 September. The actual data used could be, at the Authority discretion's, either[7]:

  - An "aggregated day" of each day type (being the average electricity consumption of each half hour over all days of that day-type in the 12-month period), or;

  - A "representative day" of each day type (which could come from a "representative week")

- The classifications will then be made as follows:

  - Peak periods will be the 1/3rd of half-hours with the highest average electricity consumption for all day-types

  - Off peak period will be the 1/3rd of half-hours with the lowest average electricity consumption for all day-types.

  - Shoulder will be the remaining 1/3rd of half-hours for all day-types.

- The Authority will have the discretion to re-classify any half-hour periods into alternate period classes if they are close in electricity consumption value to the alternative

[6] If the first quarter of vesting commencement is less than twelve months after market starts, then the available data can be extrapolated to determine the classification of the day profiles.
[7] The Authority will use "aggregated day".

classification and if such reclassification simplifies the total allocation schedule. Examples of this are:

- Making a set of half-hour periods into a contiguous classification (eg. removing a one or two shoulder half-hour from the middle of a run of peak half-hours) or;

- Eliminating a classification from a day-type (eg removing a single peak period from a Saturday)

A sample of the format and data type is provided in Figure 3.1.

Period_Type(Day_Type, Period) (Updated at irregular intervals)											
Day_Type	**Period**										
	1	2	…	16	17	…	20	21	…	47	48
Weekday	Off Peak	Off Peak		Shoulder	Shoulder		Peak	Peak		Shoulder	Off Peak
Saturday	Off Peak	Off Peak		Shoulder	Shoulder		Peak	Peak		Off Peak	Off Peak
Sunday/Holiday	Off Peak	Off Peak		Off Peak	Off Peak		Off Peak	Off Peak		Off Peak	Off Peak

Figure 3.1 Day Profile (SAMPLE ONLY)

3.2 METHODOLOGY TO FORECAST ELECTRICITY CONSUMPTION FOR CALCULATING VESTING CONTRACT QUANTITIES

The MSSL shall use the methodology as set out in Appendix 1 to forecast electricity consumption for the purpose of calculating the Vesting Contract Quantities.[8]

3.3 GENERATION INSTALLED CAPACITY

Each Vesting Contract Holder shall notify the Authority in writing at least three (3) months prior to the commencement of the next quarter of any planned changes during the quarter of the Holder's generation installed capacity resulting from all or part of its generation plants being brought into or taken out of normal operation during the quarter. If notified as such by the Holder, the Authority shall take into account the planned changes, with the exception of planned changes in respect of steam turbine generation plants, to determine the Holder's generation installed capacity (Installed_Capacity [Company, Station]) for the purpose of allocating the Allocated Vesting Quantity to the Holder by MSSL.

The Authority will determine the Vesting Contract Holder's generation installed capacity (Installed_Capacity [Company, Station]) based on the standing data (including revisions thereof) approved by the Power System Operation Division of the Authority (PSO) with respect to the relevant generation plants, with the exception of steam turbine generation plants for which the standing data as at 1 August 2018 will be used as the basis. The Holder's generation installed capacity that is unavailable for a period of more than six consecutive months overlapping with the Hedge Quarter 'Q', with the exception of steam turbine generation plants, will not be considered for allocating the Allocated Vesting Quantity by MSSL to the Holder for that quarter.

The Authority may decide to use a lower amount than the standing data, in which case the Authority will inform the generating company and give that company an opportunity to comment on the figure to be used by the Authority. The Authority will take into account the comments of the generating company and may take any other advice it thinks fit in making its final decision. The decision of the Authority will be final.

[8] The forecasting methodology in Appendix 1 shall apply for Hedge Quarter 'Q4 2011' and onwards.

3.4 VESTING CONTRACT DATA

The Authority will determine for each period-type the Vesting Contract level [Contract_Level (Day_Type, Period_Type)] that reflects the percentage of electricity consumption in that period-type that will be subject to Vesting Contracts. The Vesting Contract level for each period-type will be the same for all day-types. This will be determined by the Authority as follows:

- The Authority will determine and publish the total average Vesting Contract level as a percentage of electricity consumption.
- The Authority will determine and publish the total average contract level as a percentage of consumer load to be contracted at the Allocated Vesting Price.

- The Authority will determine and publish the Tender Vesting Contract level as a percentage of electricity consumption to be contracted at the Tender Vesting Price.

- The Authority will determine and publish period weighting factors that apportion the average Vesting Contract level to peak, shoulder and off-peak periods.

- The Authority will determine the LNG Vesting Quantities that each Holder qualifies under the LNG Vesting Scheme.

3.4.1 Annual Contract Level and Roll-back

To achieve the objective of effectively curbing the potential exercise of market power by the Gencos, the Authority will, in consultation with the industry, review and reset the Vesting Contract level every two years based on supply and demand projections at the point of review. While the long-term plan is to reduce the Vesting Contract level over time, such reduction is contingent on the dilution of Gencos' market power in the generation market.

The Authority will use an analytical model, preferably a market gaming model, to derive the overall expected annual market prices for different contract levels (as a percentage of annual load). These will be derived from the weighted average expected annual market prices for each period type. More specifically, the Authority will use the model to simulate non-collusive interactions amongst the Gencos and determine the Vesting Contract level to effectively control the Gencos' market power. Specifically, the model estimates the Vesting Contract level required to remove the Gencos' incentives to withhold capacity to raise the spot prices in the wholesale electricity market above a certain target price. The Vesting Contract level is set to target the long run marginal cost ("LRMC") of a theoretical new entrant using the most economic generation technology in Singapore contributing more than 25% of total demand. This mimics the outcome of a competitive market over the long-run and ensures appropriate price signals remain for investors to plant new and efficient generation capacity to meet demand growth. The total average Vesting Contract level will be chosen taking into account the following factors:

- The expected LRMC of a theoretical new entrant using the most economic generation technology in Singapore contributing more than 25% of the total demand,

- Supply and demand projections at the point of review,

- The robustness of different contract levels to data uncertainty,

- The likely data scenarios including the range of plant configurations that may exist,

- The transition away from Vesting Contracts by use of, if possible, a monotonic rollback schedule and thus avoidance of fluctuations in the Vesting Contract level percentage from year to year.

The Authority will use its discretion to balance these and other relevant factors in choosing the Vesting Contract levels and consequential rollback schedule, in particular taking into account the key regulatory objective to effectively curb the potential exercise of market power of the Gencos.

The rollback schedule announced by the Authority at the commencement of the Vesting Contract regime in 2004 shall form the minimum or floor rollback schedule (i.e. the Vesting Contract level determined by the Authority for a given year shall not be lower than the level specified in the schedule for that year). This schedule may potentially be extended in relation to both the total contract coverage and the duration of the vesting regime, based on information assessed at 2-yearly intervals or at other times in exceptional circumstances.

For each year, the rollback of Vesting Contract level will be determined by the Authority as either:

- The Vesting Contract level in the previously announced rollback schedule, or

- Where the Authority believes that exceptional circumstances prevail requiring the actual Vesting Contract level to differ from the corresponding level in the previously announced roll-back schedule, it may recalculate the rollback of Vesting Contract level in the same manner as in the 2-year review cycle. For avoidance of doubt, the actual Vesting Contract level need not necessarily decline year on year. If the Authority makes this determination, it must consult with all Vesting Contract Holders at least 3 months in advance of the recalculation taking effect, giving its reasons for deciding to make the recalculation and the proposed revised average Vesting Contract levels. The Authority will take into account the comments of the Vesting Contract Holders and may take any other advice it thinks fit in making its final decision. The decision of the Authority will be final.

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Coverage	65%	50%	50%	50%	50%	40%	40%	40%	40%	40%

Figure 3.2a Minimum/Floor Rollback schedule (established prior to 2004)

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	1H 2013 (Jan – Jun)	2H 2013 (Jul – Dec)	2014
Coverage	65%	65%	65%	55%[9]	55%	55%	55%	60%	55%	55%	50%	40%

Figure 3.2b Actual Vesting Contract levels

If the Authority decides to rollback the Vesting Contract level, Holders who are allocated LNG Vesting Quantities under the LNG Vesting Scheme shall retain their LNG Vesting Quantities until the termination of the LNG Vesting Scheme regardless of the Vesting Contract level under the rollback schedule.

3.4.2 Period Weighting Factors

The MSSL will, on behalf of the Authority, use the following steps to determine the period weighting factors:

[9] Vesting Contracts level was reduced to 55% in Jul 2007.

- The shoulder period weighting factor will be set to “1”

- The Authority will determine a peak period weighting factor for each day type (greater than unity) to be applied to the total average contract level required to calculate the contracting level in the peak periods. This factor will be chosen so as to bring the market power in the peak period to within an acceptable range of that in the shoulder period.

- The Authority, in determining the peak period weighting factor will use an analytical model, preferably a market gaming model, to derive expected annual market prices in each period type for different peak period weighting factors (and their consequential off-peak weighting factors, as explained below). A weighting factor will be chosen to achieve similar expected prices across the three period types. Since it may not be possible to achieve exactly equal prices from the model, and given the uncertainty of future data assumed in the model, the Authority will use its discretion to choose a peak period weighting factor that will approximately achieve these objectives. If an alternative market power model is used, then another measure of equal market power across the periods may be substituted for the measure specified here.

- The peak period weighting factor shall be revised in conjunction with the review of the roll-back schedule.

    - The revision may be based either on a predetermined factor for that year or it may be recalculated by the Authority.

    - Where the Authority chooses to recalculate the peak period weighting factor, it must consult with all Vesting Contract Holders at least 3 months in advance of the recalculation taking effect, giving its reasons for deciding to make the recalculation and the proposed revised peak period weighting factor. The Authority will take into account the comments of the Vesting Contract Holders and may take any other advice it thinks fit in making its final decision. The decision of the Authority will be final.

- The contract levels for each period-type, being the percentage of that period’s electricity consumption, will be specified as follows:

    - The peak contract level equals the total average contracting percentage multiplied by the peak period weighting factor.

    - The shoulder contract level equals the total average contracting percentage.

    - The off-peak contract level is calculated as follows:

        · the peak contract level multiplied by the electricity consumption during the peak periods *plus*

        · the shoulder contract level multiplied by the electricity consumption during the shoulder periods *plus*

        · the off peak contract level multiplied by the electricity consumption during the off peak periods *equals*
        · the total average contract level multiplied by the total electricity consumption

A sample of the form and nature of this data is provided in Figure 3.3.

Contract_Level (Day_Type, Period_Type) (Updated Quarterly)			
Period_Type	**Day_Type**		
	Weekday	**Saturday**	**Sunday/Holiday**
Peak Period	72%	72%	72%
Shoulder Period	65%	65%	65%
Off-Peak Period	50%	50%	50%

Figure 3.3 Contract Level Data (SAMPLE ONLY)

3.4.3 LNG Vesting Scheme

The LNG Vesting Scheme assumes that the generation technology for the LNG Vesting Quantities will use regasified LNG as the primary source of fuel[10]. From the onset, the Authority shall determine the Annual LNG Vesting Quantities ("ALVQ") to each eligible Holder for the term of the LNG Vesting Scheme. The Holder shall use for power generation in each calendar year, equivalent[11] regasified LNG quantities that are no less than the ALVQ in the calendar year, unless it has obtained prior written approval from the Authority.

The regasified LNG quantities which BG Singapore Gas Marketing Pte Ltd ("BGSGM") supplied to, and invoiced, the Holder in each calendar year shall be deemed as the Holder's LNG usage quantities for the purpose of calculating the Holder's equivalent LNG usage quantities ("ELUQ") for the calendar year.

The Holder shall submit to the Authority a statement of its LNG usage quantities for each calendar year no later than the Business Day on or following 15 March (whichever is earlier) of the following calendar year. Such statement shall be in the form of a letter from BGSGM to the Holder, stating the invoiced quantities with a breakdown of the actual LNG usage quantities and any shortfall LNG quantities below the Holder's Take or Pay ("TOP") obligations (or any LNG quantities drawn down from the banked LNG). Each Holder is also required to submit a declaration to the Authority stating that the invoiced quantity from BGSGM had been used solely for power generation.

In respect of each calendar year, the Authority shall determine the Shortfall LNG Vesting Quantities ("SLVQ") of the Holder 'i' as follows:

If $ELUQ_i \geq ALVQ_i$, $SLVQ_i = 0$; and
If $ELUQ_i < ALVQ_i$, $SLVQ_i = ALVQ_i - ELUQ_i$.

The SLVQ incurred by the Holder 'i' in each calendar year shall be used to reduce the LNG Vesting Quantities ("LVQ") to be allocated to the Holder 'i' over a period of twelve months starting from July in the subsequent calendar year. More specifically, the Holder's LVQ shall be calculated as follows:

For the months July to December in calendar year 'x', the LVQ for half-hour period '*h*' to Holder '*i*',

$$LVQ_i^h = \frac{ALVQ\ allocated\ at\ onset_i}{No.of\ days\ in\ year\ 'x' \times 48\ periods} - \frac{SLVQ\ in\ year\ 'x-1'_i}{(No.of\ days\ from\ Jul\ to\ Dec\ in\ year\ 'x'\ and\ from\ Jan\ to\ Jun\ in\ year\ 'x+1') \times 48\ periods}$$

[10]Should the economic generating technology which contributed to more than 25% of the total demand no longer use natural gas as the primary source of fuel, the Authority shall review the setting of the LNG Vesting Price in consultation with the Holders of LNG Vesting Quantities.

[11] 7,085 Btu of regasified LNG is equivalent to 1 kWh of LNG vesting quantities.

For the months January to June in calendar year 'x+1', the LVQ for half-hour period '*h*' to Holder '*i*',

$$LVQ_i^h = \frac{ALVQ\ allocated\ at\ onset_i}{No.of\ days\ in\ year\ 'x+1' \times 48 periods} - \frac{SLVQ\ in\ year\ 'x-1'_i}{(No.of\ days\ from\ Jul\ to\ Dec\ in\ year\ 'x'\ and\ from\ Jan\ to\ Jun\ in\ year\ 'x+1') \times 48 periods}$$

The Balance Vesting Quantity ("BVQ") for each half-hour period 'h' to Holder 'i' that qualify for the LNG Vesting Scheme,
$BVQ^h_i = \max(0, PAVQ_i^h - LVQ_i^h)$

where:

LVQ_i^h	is the total LNG Vesting Quantity for half-hour period 'h' to Holder 'i'; and
$PAVQ_i^h$	is the total preliminary Allocated Vesting Quantity for half-hour period 'h' for Holder 'i' as determined by the Issuer based on Sections 3.2, 3.3, 3.4.1 and 3.4.2.

In the event where a Holder, without the prior written approval of EMA, (i) on-sold any amount of LNG corresponding to the LNG Vesting Quantity allocated to the Holder under the LNG Vesting Scheme and/or (ii) on-sold any amount of PNG that has an effect of reducing the Holder's total contracted amount of PNG prior to the signing of the LNG Gas Sales Agreement, the Authority may suspend the Holder's eligibility to the LNG Vesting Scheme and/or impose a financial penalty on the Holder.

Upon the termination of, or suspension of the Holder's eligibility to, the LNG Vesting Scheme, the Holder will need to make payment in respect of any outstanding SLVQ ("O_SLVQ") that the Holder 'i' has incurred in period 'T' (i.e. the Holder's SLVQ not offset by the Holder's ELUQ prior to the termination or suspension), determined as follows:

$\text{Max}\ [\ 0, \sum_h^T \{O\_SLVQ_i^h \times (LVP_i^h - BVP_i^h)\}]$

where:

- $\sum_h^T$ is the sum over all corresponding half-hour periods 'h' in period 'T'
- T is the corresponding period over which O_SLVQ was incurred by Holder 'i'
- LVP_i^h is the LNG Vesting Price for half-hour period 'h' to Holder 'i'
- BVP_i^h is the Balance Vesting Price for half-hour period 'h' to Holder 'i'
    - Note: In the case where there is no BVQ attributable to the Holder in the period prior to the suspension or termination, the Vesting Contract Reference Price ("VCRP") or weighted average Market Energy Price that is used to allocate any Vesting Contract Settlement Credit or Debit to the Holder 'i' for half-hour period 'h' as specified under the Market Rules will be used instead of BVP. Accordingly, the portion of O_SLVQ which the Holder is eligible for BVQ allocation will be settled using BVP as the reference price, and any remaining portion of O_SLVQ will be settled using the Holder's VCRP as the reference price.

- $O\_SLVQ_i^h$ is the O_SLVQ incurred by the Holder 'i' for half-hour period 'h', determined as follows:

$$O\_SLVQ_i^h = \frac{O\_SLVQ_i}{Total\ No.of\ half-hour\ periods\ in\ period\ 'T'}$$

The Authority will inform the Holder of the total amount payable by the Holder with respect to any O_SLVQ incurred by the Holder 10 Business Days after the receipt of the Holder's statement of its LNG usage quantities. The Holder shall thereafter promptly make payment through the Market Company to MSSL 10 Business Days after the receipt of the letter from the Authority.

3.5 VARIABLE HEDGE PROPORTION FOR CONTESTABLE CONSUMERS AND PAYMENT REFERENCE PRICE (VHP & PRP)

The Authority shall provide the methodology for calculating the values of the variable hedge proportion [VHP_h] for contestable consumers (CC) and the corresponding Payment Reference Price [PRP_Q] to the MSSL for the purposes of settling Allocated Vesting Quantities in accordance with the Market Support Services Code (the "MSS Code"). This methodology is detailed below.

The Vesting Contract regime calls for the Tender Vesting Quantity to be allocated to the non-contestable consumers (NCC) entirely. The Allocated Vesting Quantity would be first allocated to the remaining electricity consumption of NCC not covered by the Tender Vesting Quantity, with any remaining Allocated Vesting Quantity being distributed on an equal proportion basis to all CC. The methodology for calculating the proportion of Allocated Vesting Quantity to be allocated to CC (VHP) and the associated Payment Reference Price (PRP) for these Allocated Vesting Quantities is provided below in this section.

3.5.1 Determination of VHP for Contestable Consumers

The MSSL will, using a methodology provided by the Authority, calculate the value of VHP_h required by its settlements system for each quarter. That methodology is defined below in this section.

Section 6.1 of the MSS Code, defines the methodology used for settling Vesting Contract Credits (VCC) with CC. Specifically it provides the equation replicated below whereby the VCC for consumer 'r' in billing period 'B' as being calculated as[12]:

$$VCC_B^r = \left[\sum_h^B \left(VCRP_h^k - PRP_Q \right) \bullet TLF^r \bullet \left[E_h^{nm,r} \bullet VHP_h \right] \right] \text{ or zero if } E_h^{nm,r} \text{ is negative}$$

Where:

$E_h^{nm,r}$ is the energy in kWh measured in half-hour 'h' at the meter or meters measuring consumer 'r''s net withdrawal of energy from the transmission system or the internal electricity system of the building.

VHP_h is the proportion of the consumers energy withdrawal to be covered by Vesting Contract as calculated using the methodology provided in this section.

$VCRP_h^k$

[12]This is a replication of equation 6.1(c) from the MSS Code.

is the Vesting Contract Reference Price for half hour 'h' for the settlement account associated with the MSSL counterparty calculated in accordance to the applicable provisions of Chapter 7 of the Market Rules.

For each representative day and for each representative period, the total contracted generation over the quarter is MWh_CONTRACT [Day_Type, Period_Type] where

MWh_CONTRACT [Day_Type, Period_Type]
= TENDER_VEST_QTY [Day_Type, Period_Type] + ALLOCATED_VEST_QTY [Day_Type, Period_Type]

The MSSL is fully hedging NCC who are expected to consume FORECAST_NCC_LOAD [Day_Type, Period_Type]. REP_NCC_LOAD [Day_Type, Period_Type] is the forecasted total electricity consumption for the NCCcorresponding to the day type and period type over the quarter.

FORECAST_TOTAL_LOAD [Day_Type, Period_Type] is the forecasted total electricity consumption of all consumers for the corresponding day-type and period-type over the quarter FORECAST_CC_LOAD [Day_Type, Period_Type] is the forecasted total electricity consumption of all CC for the corresponding day-type and period-type over the quarter.
The methodology for forecasting total electricity consumption of all consumers and of CC and NCC separately is set out in Appendix 1 and in particular Tables 4.2, 5.2 and 6 respectively therein.

After the NCC have been covered, the total amount of Allocated Vesting Quantity that needs to be distributed amongst the CC for a given day-type and period-type is:

Z[Day_Type,Period_Type]
= MWh_CONTRACT[Day_Type, Period_Type]-
FORECAST_NCC_LOAD[Day_Type, Period_Type]

It is possible that Z will be negative for some representative day/periods. This has to be corrected to prevent the allocation of negative Allocated Vesting Quantities. To correct this, the following calculation must be made:

CONTRACT_CC_LOAD [Day_Type, Period_Type]
=Max (0, Z [Day_Type, Period_Type])

Thus, all negative values of Allocated Vesting Quantities are set to zero (Refer to Figure 3.4).

CONTRACT_CC_LOAD [Day_Type, Period_type] (Updated Quarterly)			
Period_Type	**Day_Type**		
	Weekday	**Saturday**	**Sunday/Holiday**
Peak Period	1500 MWh	560 MWh	N/A
Shoulder Period	1800 MWh	780 MWh	500 MWh
Off-Peak Period	150 MWh	100 MWh	0 MWh

Figure 3.4 Total Contract Cover available for CC's (sample)

All CC are allocated vesting cover on an equal proportion basis of their actual net withdrawals from the grid. This portion will vary by day-type and period type in order to balance payment to/from loads with that of generators. The value of VHP [Day_Type, Period_Type] is calculated thus:

VHP [Day_Type, Period_Type] =

CONTRACT_CC_LOAD [Day_Type, Period_Type] / FORECAST_CC_LOAD [Day_Type, Period_Type]

CC will be provided with the information shown in the sample table in Figure 3.5. The table Period_Type (Day_Type, Period) will also be provided to them, to ensure that they are aware of the definitions of the periods.

VHP [Day_Type, Period_type] (Updated Quarterly)			
Period_Type	**Day_Type**		
	Weekday	**Saturday**	**Sunday/Holiday**
Peak Period	0.58	0.58	N/A
Shoulder Period	0.55	0.40	0.35
Off-Peak Period	0.20	0.20	0.00

Figure 3.5 VHP Data (SAMPLE ONLY)

The value of VHP [Day_Type, Period_Type] is then converted across the VHP_h as required by the MSSL systems, by creating a table containing a discrete VHP value for each half hour of the quarter by cross referencing the VHP [Day_Type, Period_Type] data with the data contained in Period_Types [Day_Type, Period].

3.5.2 Determination of the Allocated Vesting Price for MSSL

The Allocated Vesting Price for each quarter to the MSSL would be the weighted average of the Balance Vesting Price, Tender Vesting Price and the LNG Vesting price based on the Balance Vesting Quantities, Tender Vesting Quantities and LNG Vesting Quantities to each Holder for the quarter by the following formula:

$$AVP_Q^k = \frac{\sum_i^Q \left(BVP_Q \times BVQ_h^i + BVP_Q \times TVQ_h^i + BVP_Q \times MQ_h^i + LVP_Q \times LVQ_h^i \right)}{\sum_i^Q \left(BVQ_h^i + TVQ_h^i + MQ_h^i + LVQ_h^i \right)}$$

Where

AVP_Q^k	is the Allocated Vesting Price applicable for the MSSL counterparty 'k' for the quarter'Q' where the Allocated Vesting Price is the weighted average of the Balance Vesting Price and LNG Vesting Price of all the half-hourly periods in the quarter
BVP_Q	is the Balance Vesting Price for the quarter
BVQ_h^i	is the total Balance Vesting Quantity for half hour period 'h' to Holder 'i'
TVQ_h^i	is the total Tender Vesting Quantity for half hour period 'h' to Holder 'i'
MQ_h^i	is the total relief from Tender Vesting Quantity for half hour period 'h' to Holder 'i'
LVP_Q	is the LNG Vesting Price for the quarter
LVQ_h^i	is the total LNG Vesting Quantity for half hour period 'h' to Holder 'i'

3.5.3 Determination of Payment Reference Price (PRP_Q)

The Payment Reference Price (PRP) to be charged to CC for hedging purposes for quarter Q is:

$PRP_Q = AVP_Q^k + (PREVIOUS\_NET\_SHORTFALL/TCQ_Q)$,

Where

TCQ[13] is the total contract quantity for quarter Q.

3.6 ADJUSTMENT FOR OVER/UNDER RECOVERY

The contract price to apply to loads in each quarter will cover the expected cost of the contracts allocated to generators and also include an adjustment to account (in S$) for the shortfall or surplus in the previous quarter between the amount paid by Vesting Contract consumers and the amount paid to Vesting Contract generators. The shortfall or surplus arises because Allocated Vesting Quantities are determined before the quarter commences based on expected electricity consumption data, whereas contracts are settled on actual electricity consumption data.

The current quarter will end the day before the new quarter begins, and settlement for the last day of the current quarter will not be finalised until about a week after the new quarter begins. Consequently, it is necessary to stagger the period in which the MSSL measures the surplus/shortfall relative to the actual 3-month periods.

The Authority intends that the settlement adjustment period be staggered by three months. Thus for contracts that apply in the January to March quarter, the settlement adjustment will be based on the cumulative surplus or shortfall that the MSSL experienced in the months of July, August and September in the previous year.

The PREVIOUS_NET_SHORTFALL for the period y to be recovered in quarter (x +1) is defined as:

$$(PNS_{x+1}) = \left\{ \sum_{h}^{y} [\,(VHP_h^{NCC}\ X\ Q_h^{NCC} + VHP_h^{CC}\ X\ Q_h^{CC})\ x\ (VCRP_h^k - AVP_h^k)] - LVQ_h^G\ x\ (VCRP_h^k - LVP_h^k) \right.$$
$$\left. - (BVQ_h^G - TVQ_h^G + MQ_h^G)x\ (VCRP_h^k - BVP_h^k) \right\} + OUR_{x+1}$$

Where

x means the current quarter

y means quarter x staggered back by 3 months

Q_h^{TC} means the total quantity of electricity used by all consumers 'TC' in the Singapore electricity market during the half-hour 'h'

Q_h^{CC} means the total quantity of electricity used by all contestable consumers 'CC' in the Singapore electricity market during the half-hour 'h'

[13] Total contract quantity is the sum of the Balance Vesting, LNG Vesting and Tender Vesting Quantities.

Q_h^{NCC} means the total quantity of electricity used by all non-contestable consumers in the Singapore electricity market during the half hour 'h' : Q_h^{TC} - Q_h^{CC}

VHP_h^{CC} means the percentage of electricity consumption for contestable consumers covered under Vesting Contract for the half-hour 'h'

$$VHP_h{}^{CC} = \frac{\max(Total\ Contracted\ Quantity - FORECAST\_NCC\_LOAD, 0)}{FORECAST\_CC\_LOAD}$$

VHP_h^{NCC} means the percentage of electricity consumption for non-contestable consumers covered under Vesting Contract for the half-hour 'h':

$$VHP_h^{NCC} = \frac{\min(FORECAST\_NCC\_LOAD,\ Total\ Contracted\ Quantity)}{FORECAST\_NCC\_LOAD}$$

$VCRP_h^k$ is the Vesting Contract Reference Price for half hour 'h' for the settlement account associated with the MSSL counterparty 'k' calculated in accordance to the applicable provisions of Chapter 7 of the Market Rules.

AVP_h^k is the Allocated Vesting Price applicable for the MSSL counterparty 'k' for the half-hour period 'h' where the Allocated Vesting Price is the weighted average of the Balance Vesting Price and the LNG Vesting Price.

BVP_h^k is the Balance Vesting Price for half hour period 'h'

BVQ_h^G is the total Balance Vesting Quantity which the generation companies 'G' have committed to produce for half hour period 'h'

TVQ_h^G is the total Tender Vesting Quantity which the generation companies 'G' have committed to produce for half hour period 'h'

MQ_h^G is the total relief from Tender Vesting Quantity which the generation companies 'G' have committed to produce for half hour period 'h'

LVP_h^k is the LNG Vesting Price for half hour period 'h'

LVQ_h^G is the total LNG Vesting Quantity which the generation companies 'G' have committed to produce for half hour period 'h'

OUR_{x+1} means the over-under recovery of the previous net shortfall for quarter y –2 (collected in quarter x-1) to be recovered in quarter (x +1):

$$OUR_{x+1} = PNS_{x-1} - \left[\sum_{h}^{x-1}(PRP_h - AVP_h^k)\right] X\left(VHP_h^{NCC}\ X\ Q_h^{NCC} + VHP_h^{CC}\ X\ Q_h^{CC}\right)]$$

Where

PNS_{x-1} means previous net shortfall for the period y –2 to be recovered in quarter x-1

PRP_h means the Payment Reference Price for quarter x-1 for half hour 'h'

Note: Due to constraints of data availability, the settlement adjustment period (y) will be staggered back by three months from the current quarter (x).

3.7 DETERMINATION OF FUEL COST IN LRMC

In calculating the Balance Vesting Price for each quarter, the Authority will determine the Gas Price ($Sing/GJ) for the quarter using the weighted average gas price under the gas supply contracts (both PNG and regasified LNG) for commercial power generation or any other method as determined by the Authority and announced to the gas industry. The gas supply contracts shall exclude the following:

a. regasified LNG in relation to the LNG vesting scheme;
b. gas supply for non-commercial power generation or industrial use;
c. LNG spot cargo and Short Term Annual Quantities ("STAQ"),
d. LNG for commissioning the LNG terminal; and
e. any gas contract with annual contracted quantity of less than 60, 000 tonnes per annum.

To facilitate gencos' hedging activities, EMA will only consider the relevant contracts:

i. Commencing no later than 15th Dec of year 'Y'; and
ii. Covering at least 6 months during the period from the beginning of Q2 of year 'Y+1' till the end of Q1 of year 'Y+2'.

The proportion will be fixed from the beginning of Q2 of year 'Y+1' till the end of Q1 of year 'Y+2'.

The LNG Vesting Price shall be calculated using the LNG Price ($Sing/GJ) in place of the Gas Price for the LNG Vesting Quantities only. The LNG terminal tariff, the average gas pipeline transportation tariff applicable to regasified LNG users, the LNG Aggregator's margin, the cost of the LUFG and any fees or charges imposed by the Authority on the imported gas are added to the LNG Hydrocarbon Charge to determine the LNG Price.

In calculating the LNG Vesting Price for each quarter, the Authority will determine the LNG Hydrocarbon Charge, using the Brent Index Price and the spot exchange rate determined in Section 3.7.2.

3.7.1 HSFO 180 CST Oil Price (US$/MT)

The HSFO 180 CST Oil Price (US$/MT) for the quarter is the average price of the quarterly forward fuel oil swaps, published by Platts for every business day in the preceding quarter, up to the 15th calendar day of the 3rd month in the preceding quarter (the "Period") for the quarter for which the Balance Vesting Price is to be calculated[14] and the forward exchange rate (US$/S$) for the quarter is the average of the 3-month forward exchange rate (US$/S$) quoted by Bloomberg Generic (BGN) at New York 17:00 for the same Period.

In calculating the average price of the quarterly forward fuel oil swaps, the Authority will determine it by taking the midpoint of the published values of AAHDD00 FO 180 S'pore Swap 1-Qr by Platts for each day in the Period.

[14] This will be based on available price data published by Platts as at 10:00am on the first business day following the 15th calendar day of the 3rd month in the preceding quarter. For example, in calculating LRMC for 3rd quarter, the Authority will use the prices of the 3Q forward fuel oil swaps of each business day from 1st April to 15th June.

In calculating the average 3-month forward exchange rate, the Authority will:

(i) use the historical *ask price* in <SGD Curncy HP> and (SD3M Curncy HP> for every business day in the Period to get the daily outright 3-month (US$/S$) forward ask rate for every business day.

(ii) Take the average of the daily outright 3-month forward ask rates.

3.7.2 Brent Index Price (US$/bbl)

The Brent Index Price (US$/bbl) for the quarter is the average price of Dated Brent, published by Platts for every business day in the Period defined in Section 3.7.1, and the spot exchange rate (US$/S$) for the quarter is the average of the spot exchange rate quoted by Bloomberg Generic (BGN) at New York 17:00 for the same Period.

In calculating the average price for the Brent Index Price and spot exchange rate, the Authority will:

(i) Take the midpoint of the published values of Platts Dated Brent PCAAS00 for each day in the Period

(ii) Calculate the average of the daily prices in (i)

(iii) Take the historical *ask price* in <SGD Curncy HP> for every business day in the Period.

(iv) Calculate the average of the daily spot ask rates in (iii)

3.8 LRMC SCALE FACTOR INDICES

LRMC adjustment indices will be determined each year for scaling the Allocated Vesting Price in accordance with Schedule C of the Vesting Contracts. These indices will be determined from estimates of the parameters in Schedule C, using the methodology stated in Schedule C.

The Authority shall, for the purposes of enabling the MSSL to calculate the Allocated Vesting Price, issue the MSSL with the LRMC Scale Factor Indices as defined in Schedule C of the Vesting Contract, in accordance with the procedures defined below in this section.

The indices to be calculated are:

A. *CAPITAL COST INDEX:*

The capital cost index shall be specified by the Authority to reflect the capital cost for the current year relative to the Base quarter. This index has two components, namely:

- Changes in the cost of acquiring and building a new plant, and

- Exchange rate movements on the cost of a new plant.

The Capital cost index = CI

Where

CI is the index of cost changes

For CI, the capital cost will be updated in between the reviews of the LRMC base parameters every 24 months as determined by the EMA.

B. OVERHEAD COST INDEX:

The overhead cost index is largely an inflation index to be specified by the Authority to reflect the overhead cost for the current year relative to the Base quarter. The MAS Core Inflation rate would more accurately reflect the overhead cost of running a power plant and is shown to be a better predictor of longer-term inflation in general, compared to the overall CPI inflation.

The Overhead cost index is calculated as follows:

- Take the MAS Core Inflation from the Monetary Authority of Singapore for the Base date: $MASCI_B$

- Find the mid-point of the latest projected range of the MAS Core Inflation Rate for the year t+1 from the Monetary Authority of Singapore that is available as at 1st December of year t: $MASCIR_{t+1}$ and the MAS Core Inflation for the period in the determination year t which corresponds to the period used in the determination of the Base MAS Core Inflation (March to May): $MASCI_t$, where the MAS Core Inflation for the period is calculated as the simple average of the MAS Core Inflation for each month in that period.

- Calculate the projected MAS Core Inflation for year t+1

$MASCI_{t+1} = MASCI_t * (1 + MASCIR_{t+1})$

- The Overhead cost index for the next quarter equals $MASCI_{t+1}/MASCI_B$.

3.9 HEDGE LIMITS

For the purposes of calculating the Hedge Limits as defined in the Vesting Contract, the Authority shall provide to the MSSL the following methodology for the determination of the maximum Vesting Quantity entitled or required to be held by the Vesting Contract Holder or counterparty:

Hedge Limit = Total Generation Installed Capacity

The MSSL shall, limit the total Vesting Quantity for each Vesting Contract Holder to the Vesting Contract Holder's total generation installed capacity when the total Vesting Quantity is more than the Vesting Contract Holder's total generation installed capacity.

3.10 ADJUSTMENT FOR FORCE MAJEURE EVENTS

Where a Vesting Contract Holder is affected by a Force Majeure Adjustment Event as defined in the Vesting Contract, the MSSL shall adjust the total Vesting Quantities for the affected Vesting Contract Holder that would otherwise apply for the period during which the Force Majeure Adjustment Event is in effect on a pro rata basis by an amount that reflects the degree to which the Vesting Contract Holder is affected by the Force Majeure Adjustment Event.

3.11 CONSULTATIVE PROCESS

The Authority reserves its rights to modify the procedures and/or methods for determining the data for Vesting prices and Vesting Quantities and/or the allocation of total Vesting Quantities at any time other than the relevant times stated, where it considers that special circumstances have arisen that, in its opinion, substantially invalidate the previous procedures and/or methods for determining the components of the Vesting Contract. In such circumstances, the Authority shall consult all Vesting Contract holders at least 3 months in advance of the change taking effect, giving its reasons for deciding to make the change. The Authority shall take into account the comments of the Vesting Contract holders and may take any other advice as it thinks fit in making its final decision. The decision of the Authority shall be final.

4. APPENDIX 1: METHODOLOGY TO FORECAST ELECTRICITY CONSUMPTION FOR CALCULATING VESTING CONTRACT QUANTITIES

1.1 Electricity consumption is highly correlated[15] with economic growth. Linear regression analysis is used to model the quantitative relationship between quarterly electricity consumption (MWh) [Qtr_Load] and quarterly real GDP (S$ Million) for Singapore [Qtr_GDP] based on the historical time series of quarterly data since 2004 (refer to Equation 1). The coefficients a_0 , a_1, γ_1, γ_2, and γ_3 of the regression model will be updated each quarter to incorporate the latest available historical data.

$$\text{Qtr\_Load} = a_0 + a_1 \text{Qtr\_GDP} + \gamma_1 D_1 + \gamma_2 D_2 + \gamma_3 D_3 \quad \text{- Equation 1}$$

where:

- Qtr_Load means the historical time series of quarterly electricity consumption (MWh) from SP Services for the period Q1 2004 up to the quarter *'Q-2' (i.e. the quarter ending three months prior to the Hedge Quarter 'Q')*. This takes into account metering adjustments that occurs within D+10 business days[16] and excludes consumption by embedded generation.

  For example, for the Hedge Quarter 'Q2 2011', the historical time series of quarterly electricity consumption (MWh) will be from Q1 2004 up to Q4 2010.

  The quarterly electricity consumption (MWh) data from SP Services is available fifteen (15) days after the end of the quarter. SP Services will provide the quarterly electricity consumption (MWh) for the quarter 'Q-2' to EMA not later than fifteen (15) days (or the following Business Day) after the end of the quarter 'Q-2' e.g. the quarterly electricity consumption (MWh) data for Q4 2010 used for the computation of the Vesting Contract quantities for the Hedge Quarter 'Q2 2011' will be provided to EMA not later than 17 January 2011.

- Qtr_GDP means the historical time series of the quarterly real GDP (S$ Million) for the Singapore Economy from the Ministry of Trade and Industry (MTI) for the period Q1 2004 up to the quarter 'Q-2' retrieved via the SingStat Time Series Online System from the Singapore Department of Statistics' web-based time series retrieval system. For example, for the Hedge Quarter 'Q2 2011', the historical time series of quarterly real GDP (S$ Million) will be from Q1 2004 up to Q4 2010.

  The quarterly real GDP (S$ Million) for the quarter 'Q-2' will be based on the advance real GDP estimate (%)[17] released by MTI[18] not later than two weeks after the end of the quarter 'Q-2'. If information on the advance real GDP Estimate is not available, this would be

[15] The correlation of historical quarterly electricity consumption (MWh) and quarterly real GDP (S$ Million) for the period Q1 2004 up to Q4 2010 is about 95%.
[16] D refers to Trading Day. For example, for Trading Day 1 Sep 2010, meter adjustments that occur within D+10 Business Days will be taken into account.
[17] MTI publishes its Advance GDP Estimate in the form of year-on-year real GDP growth rate.
[18] If information is not available from MTI, this would be based on the latest available data released by the Monetary Authority of Singapore, from the Survey of Professional Forecasters, as of 15th of the first month of the quarter preceding each Hedge Quarter.

based on the latest available data released by the Monetary Authority of Singapore, from the Survey of Professional Forecasters, as of 15th of the first month of the quarter preceding each Hedge Quarter.

Quarterly real GDP (S$ Million) for the quarter 'Q-2'
= (1 + Advance real GDP Estimate (%) for the quarter 'Q-2') × real GDP (S$ Million) for the same quarter as the quarter 'Q-2' in the previous year published by MTI in the Economic Survey of Singapore.

For example, for the Hedge Quarter 'Q2 2011', the quarterly real GDP (S$ Million) for Q4 2010
= (1 + Advance real GDP Estimate (%) for Q4 2010) × real GDP (S$ Million) for Q4 2009.

- D_1, D_2 & D_3 — Each denotes a seasonal dummy variable representing a calendar quarter. Specifically, D_1, D_2 and D_3 represent Q1, Q2 and Q3 respectively, taking on the value of '1' for their corresponding quarter, and '0' otherwise. For example, in hedge quarter Q1, D_1 will be assigned a value of '1', and '0' for D_2 and D_3. There is no dummy variable for Q4 as it is the control dummy. The control dummy, if included together with the other three dummy variables for Q1, Q2 and Q3, will result in multi-collinearity which will render any statistical inferences on the data unreliable.

1.2 EMA will update the historical time series of data for quarterly real GDP (S$ Million) whenever there are revisions published by MTI to the historical data. The cut-off date for updating the historical time series of quarterly real GDP data will be the latest available data as of 15th of the first month of the quarter preceding each Hedge Quarter.

1.3 Table 1 sets out the source and cut-off date for updating the historical time series of quarterly real GDP data for each Hedge Quarter 'Q'.

Table 1: Source and Cut-off Date for Updating Historical Quarterly Real GDP (S$ Million), Qtr_GDP

Hedge Quarter 'Q' for Year 'Y'	**Vesting Contract Quantities** [General cut-off date: not later than ten (10) days before the beginning of the second month of the quarter preceding the Hedge Quarter 'Q']	**Source and cut-off Date for updating historical time series of quarterly real GDP (S$ Million), Qtr_GDP** [General cut-off date: Latest available data as of 15th of the first month of the quarter preceding each Hedge Quarter
Q1 for Year 'Y'	Not Later than 21 Oct of Year 'Y-1'	Update of quarterly real GDP (S$ Million) from Q1 2004 up to Q3 of the Year 'Y-1'. Cut-off date • Latest available data as of 15 Oct of Year 'Y-1' Source

Hedge Quarter 'Q' for Year 'Y'	**Vesting Contract Quantities** [General cut-off date: not later than ten (10) days before the beginning of the second month of the quarter preceding the Hedge Quarter 'Q']	**Source and cut-off Date for updating historical time series of quarterly real GDP (S$ Million), Qtr_GDP** [General cut-off date: Latest available data as of 15th of the first month of the quarter preceding each Hedge Quarter
		• Q1 2004 to Q2 of Year 'Y-1': Data from the Economic Survey of Singapore for Q2 of Year 'Y-1' released by MTI not later than eight weeks after the end of Q2 of Year 'Y-1' and retrieved via the SingStat Time Series Online System from the Singapore Department of Statistics' web-based time series retrieval system. • Q3 of Year 'Y-1': Data from (i) MTI Press Release on Advance real GDP Estimate for Q3 for Year 'Y-1' not later than two weeks after the end of Q3 of Year 'Y-1', and (ii) Economic Survey of Singapore for Q2 of Year 'Y-1' released by MTI not later than eight weeks after the end of Q2 of Year 'Y-1' . • If information on the Advance real GDP Estimate is not available, this would be based on the latest available data released by the Monetary Authority of Singapore, from the Survey of Professional Forecasters, as of 15th of the first month of the quarter preceding each Hedge Quarter E.g. for the Hedge Quarter 'Q1 2011': Data for Q1 2004 up to Q3 2010 is from (i) Economic Survey of Singapore for Q2 2010 released by MTI in Aug 2010 and (ii) MTI Press Release on Advance real GDP Estimate for Q3 2010 in mid-Oct 2010.
Q2 for Year 'Y'	Not Later than 21 Jan of Year 'Y'	Update of quarterly real GDP (S$ Million) from Q1 2004 up to Q4 of Year 'Y-1'. <u>Cut-off date</u> • Latest available data as of 15 Jan of Year 'Y' <u>Source</u> • Q1 2004 up to Q3 of Year 'Y-1': Data from the Economic Survey of Singapore for Q3 of Year 'Y-1' released by MTI not later than eight weeks after the end of Q3 of Year 'Y-1' and retrieved via the SingStat Time Series Online System from the Singapore Department of Statistics' web-based time series retrieval system. • Q4 of Year 'Y-1': Data from (i) MTI Press Release on Advance real GDP Estimate for Q4 of Year 'Y-1' not later than two weeks after the end of Q4 of Year 'Y-1', and (ii) Economic Survey of Singapore for Q3 of Year 'Y-1' released by MTI not later than eight weeks after the end of Q3 of Year 'Y-1'. • If information on the Advance real GDP Estimate is not available, this would be based on the latest available data released by the Monetary Authority of Singapore, from the Survey of Professional Forecasters, as of 15th of the first month of the quarter preceding each Hedge Quarter.

Hedge Quarter 'Q' for Year 'Y'	**Vesting Contract Quantities** [General cut-off date: not later than ten (10) days before the beginning of the second month of the quarter preceding the Hedge Quarter 'Q']	**Source and cut-off Date for updating historical time series of quarterly real GDP (S$ Million), Qtr_GDP** [General cut-off date: Latest available data as of 15th of the first month of the quarter preceding each Hedge Quarter
		E.g. for the Hedge Quarter 'Q2 2011': Data for Q1 2004 up to Q4 2010 is from (i) Economic Survey of Singapore for Q3 2010 released by MTI in Nov 2010 and (ii) MTI Release on Advance real GDP Estimate for Q4 2010 in mid-Jan 2011.
Q3 for Year 'Y'	Not Later than 21 Apr of Year 'Y'	Update of quarterly real GDP (S$ Million) from Q1 2004 up to Q1 of Year 'Y'. <u>Cut-off date</u> • Latest available data as of 15 Apr of Year 'Y' <u>Source</u> • Q1 2004 up to Q4 of Year 'Y-1': Data from the Economic Survey of Singapore for Q4 of Year 'Y-1' released by MTI not later than eight weeks after the end of Q4 of Year 'Y-1' and retrieved via the SingStat Time Series Online System from the Singapore Department of Statistics' web-based time series retrieval system. • Q1 of Year 'Y': Data from (i) MTI Press Release on Advance real GDP Estimate for Q1 of Year 'Y' not later than two weeks after the end of Q1 of Year 'Y', and (ii) Economic Survey of Singapore for Q4 of Year 'Y-1' released by MTI not later than eight weeks after the end of Q4 of Year 'Y-1'. • If information on the Advance real GDP Estimate is not available, this would be based on the latest available data released by the Monetary Authority of Singapore, from the Survey of Professional Forecasters, as of 15th of the first month of the quarter preceding each Hedge Quarter. E.g. for the Hedge Quarter 'Q3 2011': Data for Q1 2004 up to Q1 2011 is from (i) Economic Survey of Singapore 2010 released by MTI in Feb 2011 and (ii) MTI Press Release on Advance real GDP Estimate for Q1 2011 in mid-Apr 2011.
Q4 for Year 'Y'	Not Later than 21 Jul of Year 'Y'	Update of quarterly real GDP (S$ Million) from Q1 2004 up to Q2 of Year 'Y' <u>Cut-off date</u> • Latest available data as of 15 Jul of Year 'Y' <u>Source</u>

Hedge Quarter 'Q' for Year 'Y'	**Vesting Contract Quantities** [General cut-off date: not later than ten (10) days before the beginning of the second month of the quarter preceding the Hedge Quarter 'Q']	**Source and cut-off Date for updating historical time series of quarterly real GDP (S$ Million), Qtr_GDP** [General cut-off date: Latest available data as of 15th of the first month of the quarter preceding each Hedge Quarter
		• Q1 2004 up to Q1 of Year 'Y': Data from the Economic Survey of Singapore for Q1 of Year 'Y' released by MTI not later than eight weeks after the end of Q1 of Year 'Y' and retrieved via the SingStat Time Series Online System from the Singapore Department of Statistics' web-based time series retrieval system. • Q2 of Year 'Y': Data from (i) MTI Press Release on Advance real GDP Estimate for Q2 of Year 'Y' not later than two weeks after the end of Q2 of Year 'Y', and (ii) Economic Survey of Singapore for Q1 of Year 'Y' released by MTI not later than eight weeks after the end of Q1 of Year 'Y'. • In the event where the Advance real GDP Estimate is not available, this would be based on the latest available data released by the Monetary Authority of Singapore, from the Survey of Professional Forecasters, as of 15th of the first month of the quarter preceding each Hedge Quarter. E.g. for the Hedge Quarter 'Q4 2011': Data for Q1 2004 up to Q2 2011 is from (i) Economic Survey of Singapore for Q1 2011 released by MTI in May 2011 and (ii) MTI Press Release on Advance real GDP Estimate for Q2 2011 in mid-Jul 2011

1.4 The forecasted total electricity consumption (MWh) for the quarter under review 'Q' [For_Load^Q] is computed based on Equation 2:

$$For\_Load^Q = a_0 + a_1 For\_GDP^Q + \gamma_1 D_1 + \gamma_2 D_2 + \gamma_3 D_3 \quad \text{- Equation 2}$$

where:

- For_Load^Q means the forecasted total electricity consumption (MWh) for the Hedge Quarter 'Q' in Year 'Y';
- a_0 from Equation 1;
- a_1 from Equation 1;
- For_GDP^Q means the forecasted quarterly real GDP (S$ Million) for the Hedge Quarter 'Q' and is determined according to Equation 3.
- $\gamma_1, \gamma_2, \gamma_3$ from Equation 1;

- D_1 , D_2 & D_3 — Each denotes a seasonal dummy variable representing a calendar quarter. Specifically, D1, D2 and D3 represent Q1, Q2 and Q3 respectively taking on the value of '1' for their corresponding quarter, and '0' otherwise. For example, in hedge quarter Q1, D1 will be assigned a value of '1', and '0' for D2 and D3.

$For\_GDP^{Q} = His\_GDP^{Q,\,Y-1} \times (1 + For\_GDP\_Growth^{Q})$ - Equation 3

where:

- $His\_GDP^{Q,\,Y-1}$ — means the quarterly real GDP (S$ Million) for the same quarter as Hedge Quarter 'Q' in Year 'Y-1'.

  Source and cut-off date
  Latest available data as of 15th of the first month of the quarter preceding each Hedge Quarter from the Economic Survey of Singapore released by MTI.

- $For\_GDP\_Growth^{Q}$ — means the forecasted quarterly real GDP growth (%), for Hedge Quarter 'Q' in Year 'Y'.

  Source and cut-off date
  Latest available data from the Survey of Professional Forecasters released by the Monetary Authority of Singapore, as of 15th of the first month of the quarter preceding each Hedge Quarter

  Note: For Hedge Quarter Q1 of Year 'Y', the annual GDP forecast for Year 'Y' will be used as a proxy for the quarterly real GDP forecast.

The forecasted electricity consumption of non-contestable consumers [$For\_Load^{Q}_{NCC}$] and of contestable consumers [$For\_Load^{Q}_{CC}$] for the Hedge Quarter 'Q' will be calculated according to Equations 4 and 5.

$\mathbf{For\_Load^{Q}_{cc} = His\_Qtr\_CC\_Con_{Q-2} \times For\_Load^{Q}}$	-	**Equation 4**
$\mathbf{For\_Load^{Q}_{NCC} = For\_Load^{Q} - For\_Load^{Q}_{cc}}$	-	**Equation 5**

where:

- $For\_Load^{Q}_{cc}$ means the forecasted electricity consumption of contestable consumers (MWh) for the Hedge Quarter 'Q' in Year 'Y'.

- $For\_Load^{Q}_{NCC}$ means the forecasted electricity consumption of non-contestable consumers (MWh) for the Hedge Quarter 'Q' in Year 'Y'.

- $His\_Qtr\_CC\_Con_{Q-2}$ means the percentage contribution of the electricity consumption of contestable consumers (MWh) to the total electricity consumption (MWh) of both contestable and non-contestable consumers, for the most recent quarter available i.e. Quarter 'Q-2' for Hedge Quarter 'Q'.

  Source

  The quarterly total electricity consumption (MWh) data from SP Services is available fifteen (15) days after the end of the quarter. SP Services will provide the quarterly total electricity consumption (MWh) for the quarter 'Q-2' to EMA not later than fifteen (15) days (or the following Business Day) after the end of the quarter 'Q-2' e.g. the quarterly total electricity consumption (MWh) data for Q4 2010 used for the computation of the Vesting Contract quantities for the Hedge Quarter 'Q2 2011' will be provided to EMA not later than 17 January 2011.

  With Open Electricity Market (OEM), electricity consumption data for residential contestable consumers will be determined under Static Residential Load Profile (SRLP), and will require 75 calendar days to be finalised.

- For_Load^{Q} means the forecasted total electricity consumption (MWh) for the Hedge Quarter 'Q' obtained from Equation 2.

1.5 SP Services will profile the forecasted quarterly electricity consumption of non-contestable consumers [$For\_Load^{Q}_{NCC}$] and contestable consumers [$For\_Load^{Q}_{CC}$] by period type (Peak, Off-Peak and Shoulder)[19] and day type (Sunday/Public Holiday, Saturday and Weekday) for the Hedge Quarter 'Q'.

1.6 The methodology for profiling is illustrated using the Hedge Quarter 'Q2 2011' as an example, is set out below:

a. Forecast of Quarterly Total Electricity Consumption and Day Profile for Hedge Quarter 'Q2 2011'

Table 3.1: Forecast of Quarterly Total Electricity Consumption (MWh) for the Hedge Quarter 'Q2 2011'

	MWh
Total Forecasted Electricity Consumption (from Equation 2)	$For\_Load^{Q2\ 2011}$
Total Forecasted Electricity Consumption for Contestable Consumers (from Equation 4)	$For\_Load^{Q2\ 2011}_{cc}$
Total Forecasted Electricity Consumption for Non-Contestable Consumers (from Equation 5)	$For\_Load^{Q2\ 2011}_{NCC}$

Table 3.2: Day Profile for the Hedge Quarter 'Q2 2011'

	Sunday/Public Holiday	**Weekday**	**Saturday**
Peak	$H^{Q2\ 2011}_{P,Sun/PH}$	$H^{Q2\ 2011}_{P,W}$	$H^{Q2\ 2011}_{P,S}$
Off-Peak	$H^{Q2\ 2011}_{OP,Sun/PH}$	$H^{Q2\ 2011}_{OP,W}$	$H^{Q2\ 2011}_{OP,S}$
Shoulder	$H^{Q2\ 2011}_{S,Sun/PH}$	$H^{Q2\ 2011}_{S,W}$	$H^{Q2\ 2011}_{S,S}$

where:

- $H^{Q2\ 2011}_{i,j}$ is the total number of half-hours 'H' in period type 'i' and day type 'j' for the Hedge Quarter 'Q2 2011'
- 'i' is the period type classification i.e. Peak 'P', Off-Peak 'OP' and Shoulder 'S' for the Hedge Quarter 'Q2 2011'
- 'j' is the day type classification i.e. Sunday/Public Holiday 'Sun/PH', Weekday 'W' and Saturday 'S' for the Hedge Quarter 'Q2 2011'
- Day Type and Period Type is based on the Day Type and Period Type for the Hedge Quarter 'Q2 2011'

[19] The Period Type and Day Type is defined according to Section 3.1 of the EMA's Procedures for Calculating the Components of the Vesting Contracts

b. ***Profile of Forecasted Total Electricity Consumption for Hedge Quarter 'Q2 2011'***

Table 4.1: Profile of Historical Total Electricity Consumption (MWh) for the same quarter as the Hedge Quarter 'Q' in the previous year 'Y-1' i.e. 'Q2 2010'

	Sunday/Public Holiday	**Weekday**	**Saturday**
Peak	$HTEC^{Q2\ 2010}_{P,Sun/PH}$	$HTEC^{Q2\ 2010}_{P,W}$	$HTEC^{Q2\ 2010}_{P,S}$
Off-Peak	$HTEC^{Q2\ 2010}_{OP,Sun/PH}$	$HTEC^{Q2\ 2010}_{OP,W}$	$HTEC^{Q2\ 2010}_{OP,S}$
Shoulder	$HTEC^{Q2\ 2010}_{S,Sun/PH}$	$HTEC^{Q2\ 2010}_{S,W}$	$HTEC^{Q2\ 2010}_{S,S}$

where:

- $HTEC^{Q2\ 2010}$ is the aggregate of the historical total electricity consumption (MWh) for 'Q2 2010'
- $HTEC^{Q2\ 2010}_{i,j}$ is the aggregate of the historical total electricity consumption (MWh) in period type 'i' and day type 'j' for 'Q2 2010'
- 'i' is the period type classification i.e. Peak 'P', Off-Peak 'OP' and Shoulder 'S' for the Hedge Quarter 'Q2 2011'
- 'j' is the day type classification i.e. Sunday/Public Holiday 'Sun/PH', Weekday 'W' and Saturday 'S' for 'Q2 2010'
- Period Type classification for this whole table (including for 'Q2 2010') is based on the Period Type classification for the Hedge Quarter 'Q2 2011'
- Aggregate of the Historical Total Electricity Consumption for 'Q2 2010' = $\sum HTEC^{Q2\ 2010}_{i,j} = HTEC^{Q2\ 2010}$

Table 4.2: Profile of Forecasted Total Electricity Consumption (MWh) for the Hedge Quarter 'Q2 2011'

	Sunday/Public Holiday	**Weekday**	**Saturday**
Peak	$FTEC^{Q2\ 2011}_{P,Sun/PH} = \frac{HTEC^{Q2\ 2010}_{P,Sun/PH}}{HTEC^{Q2\ 2010}} \times For\_Load^{Q2\ 2011}$	$FTEC^{Q2\ 2011}_{P,W} = \frac{HTEC^{Q2\ 2010}_{P,W}}{HTEC^{Q2\ 2010}} \times For\_Load^{Q2\ 2011}$	$FTEC^{Q2\ 2011}_{P,S} = \frac{HTEC^{Q2\ 2010}_{P,S}}{HTEC^{Q2\ 2010}} \times For\_Load^{Q2\ 2011}$
Off-Peak	$FTEC^{Q2\ 2011}_{OP,Sun/PH} = \frac{HTEC^{Q2\ 2010}_{OP,Sun/PH}}{HTEC^{Q2\ 2010}} \times For\_Load^{Q2\ 2011}$	$FTEC^{Q2\ 2011}_{OP,W} = \frac{HTEC^{Q2\ 2010}_{OP,W}}{HTEC^{Q2\ 2010}} \times For\_Load^{Q2\ 2011}$	$FTEC^{Q2\ 2011}_{OP,S} = \frac{HTEC^{Q2\ 2010}_{OP,S}}{HTEC^{Q2\ 2010}} \times For\_Load^{Q2\ 2011}$
Shoulder	$FTEC^{Q2\ 2011}_{S,Sun/PH} = \frac{HTEC^{Q2\ 2010}_{S,Sun/PH}}{HTEC^{Q2\ 2010}} \times For\_Load^{Q2\ 2011}$	$FTEC^{Q2\ 2011}_{S,W} = \frac{HTEC^{Q2\ 2010}_{S,W}}{HTEC^{Q2\ 2010}} \times For\_Load^{Q2\ 2011}$	$FTEC^{Q2\ 2011}_{S,S} = \frac{HTEC^{Q2\ 2010}_{S,S}}{HTEC^{Q2\ 2010}} \times For\_Load^{Q2\ 2011}$

where:

- $FTEC^{Q2\ 2011}_{i,j}$ is the aggregate of the forecasted total electricity consumption (MWh) in period type 'i' and day type 'j' for the Hedge Quarter 'Q2 2011'
- 'i' is the period type classification i.e. Peak 'P', Off-Peak 'OP' and Shoulder 'S' for the Hedge Quarter 'Q2 2011'
- 'j' is the day type classification i.e. Sunday/Public Holiday 'Sun/PH', Weekday 'W' and Saturday 'S' for the Hedge Quarter 'Q2 2011'

- From Table 3.1:
  - $For\_Load^{Q2\ 2011}$ is the aggregate of the forecasted total electricity consumption (MWh) for the Hedge Quarter 'Q2 2011'

- From Table 4.1:
  - $HTEC^{Q2\ 2010}$ is the aggregate of the historical total electricity consumption (MWh) for 'Q2 2010'
  - $HTEC^{Q2\ 2010}_{i,j}$ is the aggregate of the historical total electricity consumption (MWh) in period type 'i' and day type 'j' for 'Q2 2010'
  - 'i' is the period type classification i.e. Peak 'P', Off-Peak 'OP' and Shoulder 'S' for the Hedge Quarter 'Q2 2011'
  - 'j' is the day type classification i.e. Sunday/Public Holiday 'Sun/PH', Weekday 'W' and Saturday 'S' for 'Q2 2010'

Table 4.3: Profile of Forecasted Total Electricity Consumption (MWh) *per half-hour period* for the Hedge Quarter 'Q2 2011'

	Sunday/Public Holiday	Weekday	Saturday
Peak	$\frac{FTEC^{Q2\ 2011}_{P,Sun/PH}}{H^{Q2\ 2011}_{P,Sun/PH}}$	$\frac{FTEC^{Q2\ 2011}_{P,W}}{H^{Q2\ 2011}_{P,W}}$	$\frac{FTEC^{Q2\ 2011}_{P,S}}{H^{Q2\ 2011}_{P,S}}$
Off-Peak	$\frac{FTEC^{Q2\ 2011}_{OP,Sun/PH}}{H^{Q2\ 2011}_{OP,Sun/PH}}$	$\frac{FTEC^{Q2\ 2011}_{OP,W}}{H^{Q2\ 2011}_{OP,W}}$	$\frac{FTEC^{Q2\ 2011}_{OP,S}}{H^{Q2\ 2011}_{OP,S}}$
Shoulder	$\frac{FTEC^{Q2\ 2011}_{S,Sun/PH}}{H^{Q2\ 2011}_{S,Sun/PH}}$	$\frac{FTEC^{Q2\ 2011}_{S,W}}{H^{Q2\ 2011}_{S,W}}$	$\frac{FTEC^{Q2\ 2011}_{S,S}}{H^{Q2\ 2011}_{S,S}}$

where:

- 'i' is the period type classification i.e. Peak 'P', Off-Peak 'OP' and Shoulder 'S' for the Hedge Quarter 'Q2 2011'
- 'j' is the day type classification i.e. Sunday/Public Holiday 'Sun/PH', Weekday 'W' and Saturday 'S' for the Hedge Quarter 'Q2 2011'

- From Table 3.2:
  - $H^{Q2\ 2011}_{i,j}$ is the number of half-hours 'H' in period type 'i' and day type 'j' for the Hedge Quarter 'Q2 2011'

- From Table 4.2:
  - $FTEC^{Q2\ 2011}_{i,j}$ is the aggregate of the forecasted total electricity consumption (MWh) in period type 'i' and day type 'j' for the Hedge Quarter 'Q2 2011'

c. ***Profile of Forecasted Total Electricity Consumption of Contestable Consumers (CC)***

Table 5.1: Profile of Historical Total Electricity Consumption (MWh) of CCs for same quarter as the Hedge Quarter 'Q' in the previous year 'Y-1' i.e. 'Q2 2010'

	Sunday/Public Holiday	**Weekday**	**Saturday**
Peak	$HTEC^{Q2\ 2010}_{CC,P,Sun/PH}$	$HTEC^{Q2\ 2010}_{CC,P,W}$	$HTEC^{Q2\ 2010}_{CC,P,S}$
Off-Peak	$HTEC^{Q2\ 2010}_{CC,OP,Sun/PH}$	$HTEC^{Q2\ 2010}_{CC,OP,W}$	$TEC^{Q2\ 2010}_{CC,OP,S}$
Shoulder	$HTEC^{Q2\ 2010}_{CC,S,Sun/PH}$	$HTEC^{Q2\ 2010}_{CC,S,W}$	$HTEC^{Q2\ 2010}_{CC,S,S}$

where:

- $HTEC^{Q2\ 2010}_{CC}$ is the aggregate of the historical total electricity consumption (MWh) of 'CC' for 'Q2 2010'
- $HTEC^{Q2\ 2010}_{CC,i,j}$ is the aggregate of the historical total electricity consumption (MWh) of 'CC' in period type 'i' and day type 'j' for 'Q2 2010'
- 'i' is the period type classification i.e. Peak 'P', Off-Peak 'OP' and Shoulder 'S' for the Hedge Quarter 'Q2 2011'
  'j' is the day type classification i.e. Sunday/Public Holiday 'Sun/PH', Weekday 'W' and Saturday 'S' for 'Q2 2010'
- Period Type classification for this whole table (including for 'Q2 2010') is based on the Period Type classification for the Hedge Quarter 'Q2 2011'
- Aggregate of the Historical Total Electricity Consumption for 'Q2 2010' = $\sum HTEC^{Q2\ 2010}_{CC,i,j} = HTEC^{Q2\ 2010}_{CC}$

Table 5.2: Profile of Forecasted Total Electricity Consumption (MWh) of 'CC' for the Hedge Quarter 'Q2 2011'

	Sunday/Public Holiday	**Weekday**	**Saturday**
Peak	$FTEC^{Q2\ 2011}_{CC,P,Sun/PH} = \frac{HTEC^{Q2\ 2010}_{CC,P,Sun/PH}}{HTEC^{Q2\ 2010}_{CC}} \times For\_Load^{Q2\ 2011}_{CC}$	$FTEC^{Q2\ 2011}_{CC,P,W} = \frac{HTEC^{Q2\ 2010}_{CC,P,W}}{HTEC^{Q2\ 2010}_{CC}} \times For\_Load^{Q2\ 2011}_{CC}$	$FTEC^{Q2\ 2011}_{CC,P,S} = \frac{HTEC^{Q2\ 2010}_{CC,P,S}}{HTEC^{Q2\ 2010}_{CC}} \times For\_Load^{Q2\ 2011}_{CC}$
Off-Peak	$FTEC^{Q2\ 2011}_{CC,OP,Sun/PH} = \frac{HTEC^{Q2\ 2010}_{CC,OP,Sun/PH}}{HTEC^{Q2\ 2010}_{CC}} \times For\_Load^{Q2\ 2011}_{CC}$	$FTEC^{Q2\ 2011}_{CC,OP,W} = \frac{HTEC^{Q2\ 2010}_{CC,OP,W}}{HTEC^{Q2\ 2010}_{CC}} \times For\_Load^{Q2\ 2011}_{CC}$	$FTEC^{Q2\ 2011}_{CC,OP,S} = \frac{HTEC^{Q2\ 2010}_{CC,OP,S}}{HTEC^{Q2\ 2010}_{CC}} \times For\_Load^{Q2\ 2011}_{CC}$
Shoulder	$FTEC^{Q2\ 2011}_{CC,S,Sun/PH} = \frac{HTEC^{Q2\ 2010}_{CC,S,Sun/PH}}{HTEC^{Q2\ 2010}_{CC}} \times For\_Load^{Q2\ 2011}_{CC}$	$FTEC^{Q2\ 2011}_{CC,S,W} = \frac{HTEC^{Q2\ 2010}_{CC,S,W}}{HTEC^{Q2\ 2010}_{CC}} \times For\_Load^{Q2\ 2011}_{CC}$	$FTEC^{Q2\ 2011}_{CC,S,S} = \frac{HTEC^{Q2\ 2010}_{CC,S,S}}{HTEC^{Q2\ 2010}_{CC}} \times For\_Load^{Q2\ 2011}_{CC}$

where:

- $FTEC^{Q2\ 2011}_{CC,i,j}$ is the aggregate of the forecasted total electricity consumption (MWh) of 'CC' in period type 'i' and day type 'j' for the Hedge Quarter 'Q2 2011'
- 'i' is the period type classification i.e. Peak 'P', Off-Peak 'OP' and Shoulder 'S' for the Hedge Quarter 'Q2 2011'
- 'j' is the day type classification i.e. Sunday/Public Holiday 'Sun/PH', Weekday 'W' and Saturday 'S' for the Hedge Quarter 'Q2 2011'

- From Table 3.1:
  - $For\_Load^{Q2\ 2011}_{CC}$ is the aggregate of the forecasted total electricity consumption (MWh) of 'CC' for the Hedge Quarter 'Q2 2011'

- From Table 5.1:
  - $HTEC^{Q2\ 2010}_{CC}$ is the aggregate of the historical total electricity consumption (MWh) of 'CC' for 'Q2 2010'
  - $HTEC^{Q2\ 2010}_{CC,i,j}$ is the aggregate of the historical total electricity consumption (MWh) of 'CC' in period type 'i' and day type 'j' for 'Q2 2010'
  - i is the period type classification i.e. Peak 'P', Off-Peak 'OP' and Shoulder 'S' for the Hedge Quarter 'Q2 2011'
  - j is the day type classification i.e. Sunday/Public Holiday 'Sun/PH', Weekday 'W' and Saturday 'S' for 'Q2 2010'

Table 5.3: Profile of Forecasted Total Electricity Consumption (MWh) of CCs *per half-hour period* for the Hedge Quarter 'Q2 2011'

	Sunday/Public Holiday	**Weekday**	**Saturday**
Peak	$\frac{FTEC^{Q2\ 2011}_{CC,P,Sun/PH}}{H^{Q2\ 2011}_{P,Sun/PH}}$	$\frac{FTEC^{Q2\ 2011}_{CC,P,W}}{H^{Q2\ 2011}_{P,W}}$	$\frac{FTEC^{Q2\ 2011}_{CC,P,S}}{H^{Q2\ 2011}_{P,S}}$
Off-Peak	$\frac{FTEC^{Q2\ 2011}_{CC,OP,Sun/PH}}{H^{Q2\ 2011}_{OP,Sun/PH}}$	$\frac{FTEC^{Q2\ 2011}_{CC,OP,W}}{H^{Q2\ 2011}_{OP,W}}$	$\frac{FTEC^{Q2\ 2011}_{CC,OP,S}}{H^{Q2\ 2011}_{OP,S}}$
Shoulder	$\frac{FTEC^{Q2\ 2011}_{CC,S,Sun/PH}}{H^{Q2\ 2011}_{S,Sun/PH}}$	$\frac{FTEC^{Q2\ 2011}_{CC,S,W}}{H^{Q2\ 2011}_{S,W}}$	$\frac{FTEC^{Q2\ 2011}_{CC,S,S}}{H^{Q2\ 2011}_{S,S}}$

where:

- 'i' is the period type classification i.e. Peak 'P', Off-Peak 'OP' and Shoulder 'S' for the Hedge Quarter 'Q2 2011'
- 'j' is the day type classification i.e. Sunday/Public Holiday 'Sun/PH', Weekday 'W' and Saturday 'S' for the Hedge Quarter 'Q2 2011'

- From Table 3.2:
  - $H^{Q2\ 2011}_{i,j}$ is the number of half-hours 'H' in period type 'i' and day type 'j' for the Hedge Quarter 'Q2 2011'

- From Table 5.2:
  - $FTEC^{Q2\ 2011}_{CC,i,j}$ is the aggregate of the forecasted total electricity consumption (MWh) of 'CC' in period type 'i' and day type 'j' for the Hedge Quarter 'Q2 2011'

d. Profile of Total Electricity Consumption of Non-Contestable Consumers ('NCC')

Table 6: Profile of Forecasted Total Electricity Consumption of 'NCC' (MWh) per half-hourly period for the Hedge Quarter 'Q2 2011' (Note: Forecasted total electricity consumption of 'NCC' is calculated as the difference between forecasted total electricity consumption and forecasted electricity consumption of 'CC')

	Sunday/Public Holiday	Weekday	Saturday
Peak	Forecasted Total Electricity Consumption per half-hour period (from Table 4.3, Sunday/Public Holiday, Peak) *minus* Forecasted Total Electricity Consumption of Contestable Consumers per half-hour period (from Table 5.3, Sunday/Public Holiday, Peak)	Forecasted Total Electricity Consumption per half-hour period (from Table 4.3, Weekday, Peak) *minus* Forecasted Total Electricity Consumption of Contestable Consumers per half-hour period (from Table 5.3, Weekday, Peak)	Forecasted Total Electricity Consumption per half-hour period (from Table 4.3, Saturday, Peak) *minus* Forecasted Total Electricity Consumption of Contestable Consumers per half-hour period (from Table 5.3, Saturday, Peak)
Off-Peak	Forecasted Total Electricity Consumption per half-hourly period (from Table 4.3, Sunday/Public Holiday, Off-Peak) *minus* Forecasted Total Electricity Consumption of Contestable Consumers per half-hour period (from Table 5.3, Sunday/Public Holiday, Off-Peak)	Forecasted Total Electricity Consumption per half-hour period (from Table 4.3, Weekday, Off-Peak) *minus* Forecasted Total Electricity Consumption of Contestable Consumers per half-hour period (from Table 5.3, Weekday, Off-Peak)	Forecasted Total Electricity Consumption per half-hour period (from Table 4.3, Saturday, Off-Peak) *minus* Forecasted Total Electricity Consumption of Contestable Consumers per half-hour period (from Table 5.3, Saturday, Off-Peak)
Shoulder	Forecasted Total Electricity Consumption per half-hourly period (from Table 4.3, Sunday/Public Holiday, Shoulder) *minus* Forecasted Total Electricity Consumption of Contestable Consumers per half-hour period	Forecasted Total Electricity Consumption per half-hourly period (from Table 4.3, Weekday, Shoulder) *minus* Forecasted Total Electricity Consumption of Contestable Consumers per half-hour period (from Table 5.3, Weekday, Shoulder)	Forecasted Total Electricity Consumption per half-hour period (from Table 4.3, Saturday, Shoulder) *minus* Forecasted Total Electricity Consumption of Contestable Consumers per half-hour period (from Table 5.3, Saturday, Shoulder)

	Sunday/Public Holiday	Weekday	Saturday
	(from Table 5.3, Sunday/Public Holiday, Shoulder)		