



Smart Energy, Sustainable Future

SOLAR GENERATION PROFILE INFORMATION PAPER

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SOLAR GENERATION PROFILE

INFORMATION PAPER

1 Background

- 1.1 On 9 December 2015, the Energy Market Authority (“EMA”) issued an Addendum to the Final Determination Paper on the ‘Enhancements to the Regulatory Framework for Intermittent Generation Sources (“IGS”) in the National Electricity Market of Singapore’¹. It sets out the metering requirements for consumers with embedded IGS of 1 MWac and above, who do not wish to sell excess electricity into the grid. They can choose not to have the relevant metering arrangement (“M1 meters”) at each generation point (refer to Annex 1 for illustration) and instead use an alternative arrangement to be approved by the EMA to determine the IGS output for the settlement of the relevant market charges. One such example is to use an estimated IGS profile that is approved by the EMA, obviating the need for such consumers to install M1 meters. This will support the EMA’s overall objective to enhance the regulatory framework to facilitate the entry of IGS by streamlining existing processes.
- 1.2 EMA has further enhanced the regulatory framework for IGS by implementing new initiatives in 2018 that will **give contestable consumers (“CCs”) with embedded IGS the option to use the alternative arrangement such as the IGS profile, even when they are selling excess electricity to the grid.** In addition, the IGS profile will be referred to as the Solar Generation Profile (“SGP”), unless otherwise stated by EMA, given that embedded IGS in Singapore currently comprises mostly solar photovoltaics (“PVs”).
- 1.3 This information paper sets out the respective initiatives which incorporate the option of using SGP, the grid charge framework and the relevant considerations, to increase consumer awareness and help them make informed decisions.

¹More information can be found at:

<https://www.ema.gov.sg/cmsmedia/Consultations/Electricity/Addendum%20on%20Enhancements%20to%20the%20Regulatory%20Framework%20for%20IGS.pdf>

2 Initiatives and the Use of Solar Generation Profile

- 2.1 Eligible CCs with embedded IGS under the following existing and new schemes can now opt for the SGP:
- 2.1.1 **Enhanced Central Intermediary Scheme (“ECIS”)**². Under the ECIS, CCs with embedded generation (both IGS and non-IGS) below 10 MW are not required to register with Energy Market Company (“EMC”) as a Market Participant (“MP”) to get paid for injecting excess EG output into the grid. Such CCs can register with SP Services (“SPS”) and be paid at the prevailing half-hourly wholesale energy price. Specifically, CCs with embedded IGS can choose to, (i) continue to install physical meters or (ii) have their output estimated based on the SGP determined by the EMA (without need for installing physical meters), for the purpose of paying applicable market-related charges (e.g. AFP charges).
 - 2.1.2 **MP (IGS Non-exporting)**³. Consumers with embedded IGS below 10 MWac, who will not be selling any electricity back to the grid, can undergo a streamlined MP and Generation Facility (“GF”) registration, and pay EMC an estimated fixed charge determined by the EMA. This fixed charge will be based on the IGS profile (e.g. SGP) determined by the EMA, and the historical average rates of the respective charges. This fixed charge will be revised periodically to reflect updated market conditions.
 - 2.1.3 **MP**. In addition, CCs with embedded IGS (regardless of size) can also opt to use SGP, or continue to install physical meters, when they register with EMC as a MP to get paid for injecting its embedded IGS output into the grid.
- 2.2 An overview an overview of the eligible IGS consumers who can opt for the SGP can be found in Table 1.
- 2.3 Consumers who opt for the SGP will have their IGS generation (kWh) estimated based on the installed capacity of their IGS installation and the SGP determined by EMA. The SGP is derived based on factors such as the historical average solar irradiance in Singapore, from 7am – 7pm, and will be standardised for all IGS installations to be used throughout the year⁴.
- 2.4 Consumers will still be paid for the actual IGS generation sold back to the grid and to pay for the actual electricity consumed from the grid based on the actual meter readings of the load meter (“M2”).
- 2.5 However, consumers should note that there are changes to the calculation of grid charges and reactive power charges when opting for SGP. Details can be found in the sections below.

² More information can be found at:

<https://www.ema.gov.sg/cmsmedia/Enhanced%20Central%20Intermediary%20Scheme%20-%20Final%20Determination.pdf>

Table 1: Overview of IGS consumers who can opt for the SGP

No	Eligible IGS consumers	Metering Options	
		Install M1 meter	SGP
1	ECIS: Contestable consumers with embedded IGS below 10 MWac, registered via SPS.	√	√
2	Market Participant: Contestable consumers with embedded IGS (regardless of size), registered with EMC.	√	√
3	Market Participant (IGS Non-exporting): Contestable consumers with embedded IGS below 10 MWac who will not be selling any electricity back to the grid, registered with EMC.	N.A.	√

³ More information can be found at:

<https://www.ema.gov.sg/cmsmedia/Consultations/Electricity/Determination%20paper%202017%20-%20Enhancements%20to%20the%20regulatory%20framework%20vf.pdf>

⁴ More information can be found at: https://www.ema.gov.sg/Solar_Generation_Profile.aspx

3 Grid Charge Framework

- 3.1 Grid charges are paid by consumers, for the cost of transporting electricity through the power grid. They are paid to SP PowerAssets (“SPPA”), which is responsible for the operation and maintenance of the grid.
- 3.2 For consumers with embedded IGS, the applicable grid charges depend on the voltage level at which the consumer’s load is connected to the grid.

3.3 Low-tension (“LT”) consumers

- 3.3.1 Consumers taking supplies at 400/230V (“LT consumers”) pay a variable grid charge based on the per unit of electricity (in kWh) withdrawn from the grid. Grid charges for contestable LT consumers vary for peak and off-peak periods.

3.4 High-tension (“HT”) and above consumers

- 3.4.1 For consumers taking supplies at 6.6kV and above (“HT and above consumers”) the grid charge structure is made up of the contracted capacity charge (fixed component) and the usage charge (variable component which varies for peak and off-peak periods).
- 3.4.2 Depending on the type of backup supply required (i.e. full or partial backup), consumers with embedded IGS located at the HT and above network can choose from one of the following three schemes - (a) Summation Scheme; (b) Capped Capacity Scheme; or (c) Extended Capped Capacity Scheme. More details on the grid charges and the schemes are available at SP PowerAsset (“SPPA”) website⁵.

3.4.3 HT and above consumers under the summation scheme who opt for SGP

- 3.4.4 Under the Summation Scheme, the maximum demand for the consumers is derived from the sum of (i) kW output from the embedded IGS, and (ii) kW demand drawn from the grid. Hence, for consumers with embedded IGS who opt for the SGP to reduce metering costs, the kW output from their embedded IGS would be based on the profile, which is a fixed input and would not vary accordance to the output of their installation. Hence, there may be instances where such consumers would incur uncontracted capacity charge arising from using the SGP.
- 3.4.5 For example, during a sunny half-hour period, consumers would be consuming electricity from both the grid and their IGS installation. It may be likely that the actual amount of electricity generated by the PV IGS is higher than the SGP. Hence, the maximum demand computed based on (i) the actual amount withdrawn from the grid and (ii) the generation estimated by the SGP, may be lower than the backup required from the grid. In such situations, consumers are charged within their Contracted Capacity. Refer to Figure 1 for illustration.

⁵ More information can be found at: <https://www.spgroup.com.sg/wcm/connect/spgrp/dd1fd96d-0c21-4e88-8ded-210ceb61ca3a/%5BInfo%5D+Transmission+Service+Rate+Schedule.pdf?MOD=AJPERES>

- 3.4.6 On the other hand, on a rainy or cloudy half-hour period, consumers would be consuming more electricity from the grid as their IGS installation may be generating little or no electricity. However, as the SGP is standardised throughout the year, it would indicate that the IGS installation is still generating accordingly. This may result in the maximum demand computed using the SGP be higher than their Contracted Capacity. In such situations, consumers may incur uncontracted capacity charge. Refer to Figure 2 for illustration.
- 3.4.7 Hence, before deciding on the type of backup supply scheme they require and whether to opt for SGP or physical meters, consumers should assess their consumption profile and operation needs. They should also consider carefully the costs and benefits, including the risks and uncertainties due to weather variability
- 3.4.8 To avoid incurring uncontracted capacity charges, consumers may choose to either declare a higher expected maximum demand. Consumers could choose from the other two available schemes – Capped Capacity Scheme (CCS) and Extended Capped Capacity Scheme (ECCS). Under the CCS and ECCS, consumers would have to install a load limiting device to ensure their withdrawal is within their own Contracted Capacity.
- 3.4.9 For clarifications, please contact SP Group at installed@spgroup.com.sg or 6671 7192 .

Figure 1: Illustration of sunny half-hour period

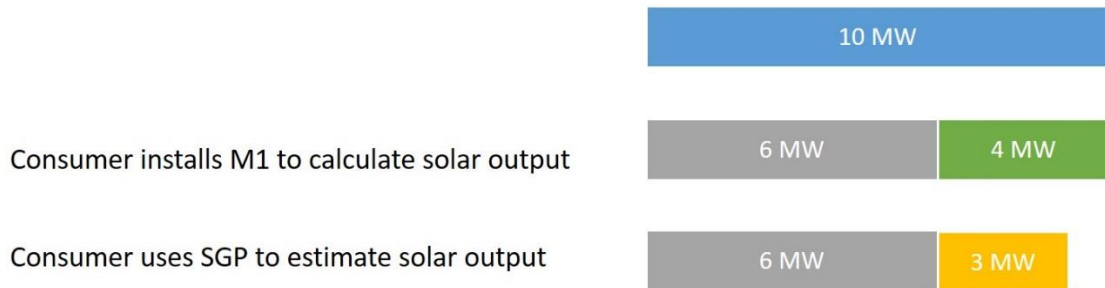
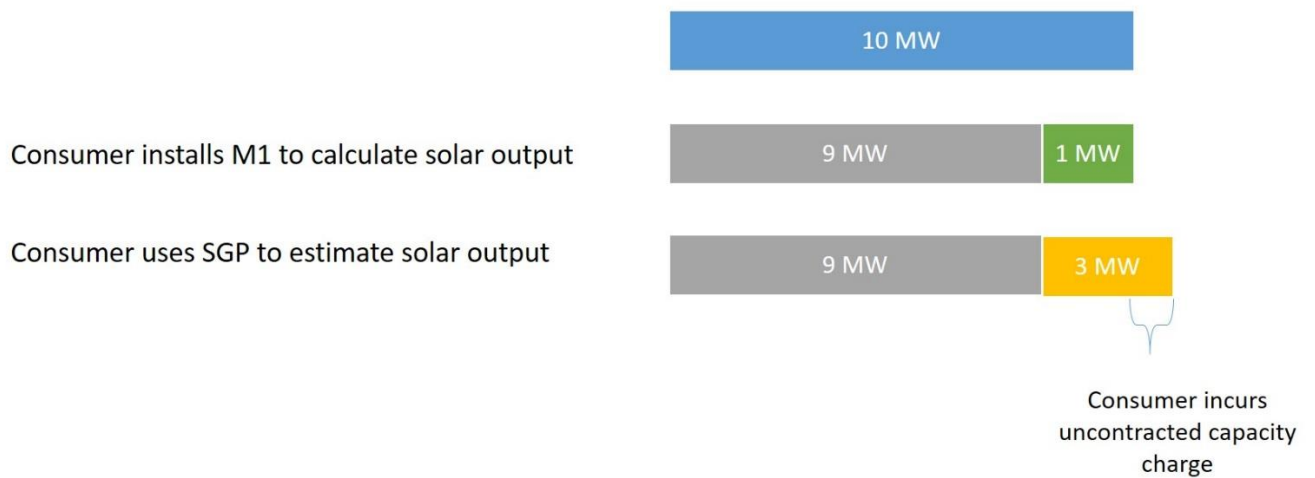


Figure 2: Illustration of rainy or cloudy half-hour period



Legend

- Consumer's declared Contracted Capacity
- Consumption from the grid measured by M2 Meter
- Gross generation measured by M1 Meter
- Estimated gross generation by the SGP

4 Reactive Power

- 4.1 Currently in the Transmission Code, High-Tension (and above) consumers would be required to implement power factor correction measures, if deemed necessary by the Transmission Licensee, to maintain a power factor of no less than 0.85. This is because a load with high reactive power will require more current-carrying capacity from the grid. For consumers with embedded generation, this is calculated using the Q-P ratio, based on the net load of the installation. SPPA imposes a reactive power penalty on consumers based on their net load if the installation's net load reactive energy (kVArh) consumption (Q_{net}) in that month is greater than 62% of its net load active energy (kWh) consumption (P_{net}) in the same month.
- 4.2 Going forward, the Q-P ratio will be determined based on the gross load of the installation, as shown in Figure 3 below.

Figure 3: Calculation of Q-P ratio based on gross load

$$\frac{Q_{net}}{P_{net}} + \frac{Q_{gen}}{P_{gen}} = \frac{Q_{load}}{P_{load}}$$

Annotations in the diagram:

- M2 reading (points to $\frac{Q_{net}}{P_{net}}$)
- Assumed 0 if voltage does not exceed +/- 3% (points to Q_{gen})
- M1 reading or SGP (points to P_{gen})
- Q-P ratio based on gross load (points to $\frac{Q_{load}}{P_{load}}$)

- 4.3 For solar consumers who opt for the SGP, the active power output (P_{gen}) is estimated based on the SGP, which may differ from their actual P_{gen} . As this necessarily affects the calculation of gross load, this may result in consumers incurring reactive power penalties due to the use of SGP, in the case when actual P_{gen} was higher compared to estimated P_{gen} based on the SGP.
- 4.4 SPPA will be implementing reactive power control at the installation level and an outcome is that the reactive power generation output (Q_{gen}) can be determined. If the voltage at the installation does not exceed +/- 3% from the nominal voltage level, Q_{gen} would assumed to be 0. If the voltage at installation varies outside of +/- 3%, Q_{gen} would be derived by SPPA using the applied reactive power control mode. EMA will update this information paper when SPPA's implementation of reactive power control is completed.
- 4.5 Given the above, other than the choice of backup supply scheme highlighted in Section 3, consumers would need to assess how SGP may affect the calculation of their active power output, taking into consideration their consumption patterns and weather changes.

Diagram 1: Illustration of metering set up for a typical consumer with embedded IGS

