



## **GUIDE TO ELECTRICITY IMPORTS**

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## **Section 1: Introduction**

- 1.1 Singapore plans to import up to 4GW of low-carbon electricity by 2035, as part of efforts to decarbonise our power sector and enhance energy security by diversifying energy supply sources. This is expected to make up around 30% of Singapore's electricity supply in 2035.
- 1.2 EMA envisages that there could be multiple potential importers competing for limited import rights into Singapore. As such, EMA will appoint electricity importers after conducting open and competitive [Request for Proposals](#) ("RFPs").
- 1.3 To provide regulatory clarity on how electricity imports will be treated in Singapore's electricity market, EMA is publishing this Guide that governs how electricity imports may enter Singapore. EMA reserves the right to amend the Guide as necessary.

## **Section 2: Electricity Imports – Market Approach**

- 2.1. Electricity imports will introduce new electricity supply to Singapore’s market. At 4GW of imports by 2035, the supply quantities of individual importers are expected to be similar to that of individual generation companies in our market. There is a need to ensure that our electricity market is able to recognise and accommodate the real-time pricing and delivery of electricity imports.
- 2.2. To ensure the orderly entry and integration of electricity imports into our market, EMA will require electricity imports to participate in our Singapore Wholesale Electricity Market (“SWEM”) and to comply with the Market Rules. Electricity imports will be required to operate within the same market as all other generators.
- 2.3. Accordingly, electricity imports will be required to do the following:
- 2.4. **Participation in the Singapore Wholesale Electricity Market (“SWEM”).** The Importer is required to register with the Energy Market Company (“EMC”) as a Market Participant (“MP”) and be subject to the Market Rules. The Importer must provide offers into the energy market and compete to secure dispatch into the Singapore network for each half-hourly period. Once dispatch for a particular quantity of electricity is secured, the importer will be scheduled to inject and sell such quantity of electricity into the market. The same approach is required for traditional generators.
- 2.5. **Automatic Financial Penalty Scheme (“AFPS”).** Under Market Rules, the AFPS will also apply. Penalties will be imposed if actual power quantity deviates from each half hourly real time dispatch schedule by more than 10MW. Further information on applicable market fees and charges is available on the [EMC website](#). The AFPS is not applicable for trial imports via the existing Singapore-Malaysia Interconnector, as the Pay-As-Scheduled Settlement is used for these trial imports as indicated in paragraph 2.9.
- 2.6. **Market Share Cap for Existing Generation Companies.** EMA has established a cap of 25% on the generation capacity market share (25% Market Share Cap”) to prevent the structural increase in electricity generation market concentration<sup>1</sup>. This is applied to Keppel Merlimau Cogen Pte Ltd, Sembcorp Cogen Pte Ltd, PacificLight Power Pte Ltd, Tuaspring Pte Ltd. With regard to Senoko Energy Pte Ltd, Tuas Power Generation Pte Ltd and YTL PowerSeraya Pte Ltd, EMA has imposed the higher of either the 25% Market Share Cap or their respective MW licensed capacity cap, until the current expiry date of their respective Generation Licence. Beyond the current expiry dates, their respective MW licensed capacity cap will be terminated, and the 25% Market Share Cap will apply.
- 2.7. **Eligibility to provide reserve and regulation.** All generating units that are greater than 10MW are required to provide regulation and reserves. These ancillary services help to ensure the security and reliability of the electricity

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<sup>1</sup> Review of the [Vesting Contract Regime Final Determination Paper](#) [10 September 2016]

supply, by using price signals to determine the procurement of the most efficient form of reserves and regulation. As Importers are expected to play a role similar to traditional generators, the Importer would also be required to provide primary and contingency reserves as per the Transmission Code<sup>2</sup>.

- 2.8. **Settlement.** By default, the settlement approach for imported electricity is “Pay-As-Metered”. The Importer is expected to deliver the scheduled quantity in each half-hourly dispatch period and will be paid based on the metered quantity. “Pay-as-Metered” is also adopted for local generators. It is possible that in the future, multiple importers could be delivering imports via a common new Interconnector. As a single common meter reading will be read, the respective Importers will be paid proportionately based on their respective scheduled quantities.
- 2.9. For information, the Pay-As-Scheduled Settlement is used for the trial imports via the existing Singapore-Malaysia Interconnector. In this case, the Importer is expected to deliver the scheduled quantity in each half-hourly dispatch period, and will be paid by EMC as per the Electricity Market Rules based on the scheduled quantity instead of the metered quantity. During daily operations, actual differences between the metered quantities and the scheduled quantities would mean that the Importer had either borrowed from or lent electricity to the source grid. The upstream generation company or electricity supplier is thus expected to enter into a commercial arrangement with the source grid or Importer separately to address these differences. For avoidance of doubt, if these trial imports are no longer using the existing Singapore-Malaysia Interconnector, for example, if they are moved to new interconnectors between Singapore and Malaysia that may be constructed and come into operation in future, EMA reserves the right to require these imports to adopt the Pay-As-Metered settlement.

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<sup>2</sup> Refer to Transmission Code section 4.8.6, 4.8.7 and Appendix F section 8.

### **Section 3: Electricity Imports – Technical Requirements**

- 3.1. Electricity imports will introduce new electricity supply to Singapore’s market. The supply of imported electricity needs to be reliable and must comply with the technical requirements of the Singapore power system. These requirements are no different from any other traditional generation connection to Singapore’s grid.
- 3.2. Accordingly, electricity imports will be required to do the following:
- 3.3. **Comply with EMA Technical Codes and other documents.** This includes the Transmission Code, Metering Code, System Operating Manual and any other documents as necessary.
- 3.4. **Connection through either High Voltage Alternating Current (“HVAC”) or High Voltage Direct Current (“HVDC”) Interconnector.**
  - a. HVAC import refers to an import source that is directly connected to the Singapore power system through a HVAC Interconnector. Apart from imports via the existing Singapore-Malaysia HVAC Interconnector, HVAC import shall only be used in dedicated Plant-to-Grid connection, where the import source is not connected to any grids other than the Singapore power system.
  - b. HVDC import refers to an import source that is connected to a HVDC facility (as defined in the Transmission Code), prior to connecting to the Singapore Power System. A HVDC Interconnector is typically used to reduce transmission losses over long transmission distance, as well as to connect two grids with different system frequency and control the quantity of electricity flow. HVDC import shall be used in Grid-to-Grid interconnections between the source grid and the Singapore power system. It may also be used in dedicated Plant-to-Grid connections.
- 3.5. **Broad Design Specifications for interconnection to Singapore.** The Interconnector and its relevant infrastructure shall:
  - a. Connect to the Singapore HVAC transmission network at 230kV or 400kV;
  - b. Operate in HVDC mode for a grid-to-grid connection or may operate in a HVAC mode for a dedicated plant-to-grid connection;
  - c. HVDC mode if used, shall utilise a metallic return path; and
  - d. Be designed for N-1 redundancy.

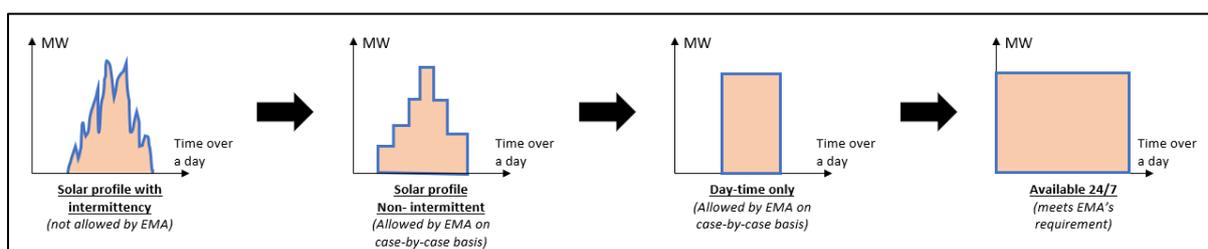
The above design specifications are non-exhaustive. The details of technical requirements can be found in the Transmission Code and Metering Code.

- 3.6. **Automatic Generation Control (“AGC”).** All generation and import facilities shall be dispatchable in accordance with EMC’s market dispatch schedule by

means of AGC signal from PSO. The AGC signal will be sent to the landing point receiving the imports in Singapore. Further details can be found in the Transmission Code and Electricity Market Rules.

- 3.7. **No intermittency.** The imported supply shall be non-intermittent, i.e. Imported electricity supply for each half hourly dispatch period must remain constant and stable to meet the half hourly real time dispatch schedule. The quantity of supply may only change during the transition between the dispatch periods, as per the market dispatch schedule in accordance to the Electricity Market Rules. See **Figure 1** below for a visualisation of non-intermittent supply.

*Figure 1. Visualisation of non-intermittent supply*



- 3.8. **Firm supply profile.** For projects that come from intermittent generation sources, EMA shall have the right to require such projects to eventually be able to provide energy on a 24/7 basis. This is because the Singapore power system requires regular supply of electricity throughout the day and night. Imported electricity shall achieve a minimal annual load factor of 75% within five years of commercial operation. EMA also reserves the right to set a daily load factor.
- 3.9. **Availability of supply.** Existing local generation has been observed to achieve 90% availability<sup>3</sup>. Using this as a guideline, each imported supply shall achieve similar availability standards that would make it as reliable as local generation. Availability is defined as the amount of time that an imports project is able to provide electricity over a year, after accounting for planned and unplanned outages. This is needed to ensure the reliability of electricity imports, which are generated at an overseas location.
- 3.10. **Potential limit on swing of imports from one dispatch period to the next.** EMA reserves the right to impose limitations on the period-by-period change of imported supply. The intent is to prevent a situation where electricity demand cannot be met due to limitations in the ramp-rate of local generation and imported electricity. As such, the importer will be required to state the maximum ramping rate of the import project. EMA will inform the industry if or when such limitations are needed.
- 3.11. **Potential curtailment of imported supply due to system circumstances.** To preserve system stability, EMA shall have the right to curtail the imported supply. The intent is to prevent a situation where the power system becomes unstable due to low inertia.

<sup>3</sup> Based on the historical 5-year average accounting for major and minor planned outage schedules for a local generator, as well as unplanned outages.

- 3.12. **Reduction in import quantity limit due to system circumstances.** If the Interconnector or any equipment that is related to or connected to or forms part of the Interconnector (i.e. including but not limited to submarine cable, transformers, overhead lines) are out of service (e.g. due to equipment outage for repair or maintenance), then total imports would be reduced to the quantum specified in the Agreed Operating Procedures. EMA shall have the right to reduce or suspend the import of electricity via any interconnector in a state of emergency that is declared by the Power System Operator (PSO) in Singapore in accordance with the Electricity Market Rules.
- 3.13. **Security and Operational Requirements.** Electricity import facilities within Singapore shall: (1) Comply with Electricity Act, Infrastructure Protection Act and Cybersecurity Act, (2) Comply with System Operation Manual and all codes, such as the Transmission Code, Metering Code, Market Rules, Regulated Supply Service Code and Cybersecurity Code of Practice. EMA will advise the Importer on the compliance process of the Infrastructure Protection Act and the Cybersecurity Act after the Importer submits their development plan.

## **Section 4: Electricity Imports - Local Backup**

- 4.1. For electricity imports to play a meaningful role in our power sector, the outage risk of electricity imports will have to be addressed in a reliable and economically efficient manner. Electricity imports have a different reliability profile compared to the existing CCGTs, with outages potentially taking up to months to repair in the case of subsea cable damage. In comparison, CCGT outages may take up to several weeks. Hence, to maintain system security and reliability, electricity imports will have to be supported by backup capacity in Singapore which can respond quickly and be able to sustain output for months.
- 4.2. Today, EMA plans and procures for sufficient reserves to ensure continued supply if an individual CCGT unit were to undergo a forced outage, using a N-1 philosophy. Primary reserves cover the period of 9 seconds to 10 minutes after outage, and contingency reserves cover from 10 minutes to 30 minutes after outage. This is provided by online generation facilities and demand side resources (e.g. interruptible loads).
- 4.3. Electricity imports will require a different design methodology for system security:
  - a. Incidents could take up to 6 months to repair, depending on the severity of subsea cable outage. This suggests the need for long-term backup capacity.
  - b. As EMA may allow individual import sources to be sized beyond 600MW, this will mean that more backup capacity may be needed to complement primary and contingency reserves, to prevent a load shed following an instantaneous loss of an entire imports source. The existing fleet of dispatched online CCGTs may only be able to provide up to 600MW of primary and contingency reserves. Hence, more fast response reserves will be needed to cater to import sources that are larger than 600MW.
- 4.4. Given the situation described above, EMA will likely require:
  - a. Long-term dedicated local backup for electricity imports, sized according to the largest electricity import source; and
  - b. Short-term local backup in the form of fast response capacity to the extent the largest import source exceeds 600MW. Such fast response capacity must be able to respond automatically within approximately 2 seconds.
- 4.5. EMA has launched a [co-creation exercise](#) to seek views from industry on how this back-up can be technically designed, as well as the technologies that can be used to provide this backup. At this point, we anticipate that a combination of batteries, fast response generators (e.g. diesel generators) and combined cycle gas turbines (CCGTs) will be needed to provide both types of backup.
- 4.6. As a starting point, capacity used to provide Short-term Back-up and Long-term Back-up will be dedicated for imports, and should be assumed to be unavailable

for other services. Nonetheless, EMA is open to ideas where capacity for Short-term and Long-term Back-up is eventually used for other services.

#### Procurement and Cost allocation of Backup

- 4.7. It is potentially wasteful from the system's perspective, if each importer were to procure its own backup capacity, as this could lead to over-procurement of backup. Hence EMA envisages that procuring a centralised pool of backup capacity for imports is more efficient for the entire system. Such backup capacity could act as a common safety net for all importers, and may also be tapped on by local generation. This is similar to the treatment for reserves. Regardless of the procurement method, EMA will have the right to activate the backup services to cater to any imports outage.
- 4.8. The method for procuring of the backup capacity has yet to be decided, as it requires a decision on the technical design of the backup.
- 4.9. As the creation of this backup capacity enables the entry of large-scale electricity imports, the total annual fixed cost of this backup capacity will be allocated as a surcharge to all electricity importers. This surcharge will be determined by EMA, denominated in \$/MWh and charged to importers based on their expected annual imported quantities. The collected revenues will be paid to backup providers.
- 4.10. Backup providers will recover their variable costs from the market when their backup capacity are dispatched into the market. To the extent that such providers are unable to recover their variable costs, the unrecovered portions will be charged to the importer(s) that caused the shortage event that led to the backup capacity being activated.

## **Section 5: Electricity Imports – Appointment and Licensing**

- 5.1. Electricity imports will introduce new electricity supply to Singapore’s market. As electricity import is a licensable activity under the Electricity Act, importers will need to be licensed before they can commence importation of electricity and supply to the SWEM.
- 5.2. **Importer Licence Requirements.** EMA will require importers to hold an Electricity Importer Licence and comply with Licence Conditions. The licensed importer entity shall be a Singapore-incorporated company.
- 5.3. **Importer Licence Tenure.** For Importers who build new interconnectors to Singapore, the licence tenure will be pegged to the duration of the upstream generation supply agreement or technical life of the interconnector, subject to EMA’s approval. This tenure is expected to be around 25 years.
- 5.4. **Performance Bond.** The Importer shall also be required to issue a performance bond of S\$33 million per 100MW of licensed imports capacity in favour of EMA upon issuance of EMA’s Conditional Approval. This Performance Bond will be forfeited to EMA if the Importer fails to deliver its project on time, or fails to pay relevant penalties in the event of any breach of regulatory requirements and obligations. After a period of 1 year of steady<sup>4</sup> commercial operations, EMA will reduce the performance bond requirement to S\$1 million per 100MW. EMA reserves the right to increase the required Performance Bond for Importers who did not meet the Authority’s requirements in other power projects.
- 5.5. **Licence Fees.** Licence fees are payable, comprising fixed and variable fees, and subject to regular review.
- 5.6. **Termination of Licence.** The Importer will be required to inform EMA 5 years in advance if they wish to exit the market as per the Transmission Code and Importer Licence.
- 5.7. **Regulatory Agreements.** A non-exhaustive list of agreements which may be required is listed below. It is the responsibility of the Importer to enter into all necessary agreements required by Authorities or commercially.
- a. The Importer is required to enter into a PSO-MP agreement<sup>5</sup> to allow the PSO to enforce obligations under the Electricity Market Rules vis-à-vis MPs.
  - b. The Importer is required to enter into an Import Facility Operating Agreement to enable PSO to centrally dispatch the Import Licensee’s import facility.

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<sup>4</sup> To satisfy this requirement, there shall be no major incidents that affect the continued delivery of imported electricity, and imports shall meet the supply profile that is stated in the importers’ Proposal.

<sup>5</sup> [https://www.ema.gov.sg/cmsmedia/Licensees/Electricity/Agreements/PSO-MP%20Agreement\\_06Feb2020.docx](https://www.ema.gov.sg/cmsmedia/Licensees/Electricity/Agreements/PSO-MP%20Agreement_06Feb2020.docx)

- c. The Importer is required to enter into a regulated Importer Connection Agreement with SP PowerAssets Ltd (SPPA) to use any SP-owned Interconnectors and gain access to the Singapore Grid. A Capacity Charge will be imposed, based on reserved capacity for electricity imports and the licence tenure.
- d. An agreement with the Market Support Services Licensee (SP Services) for the provision of metering services.

**5.8. Concurrent holding of Retailer Licence.** If the Importer chooses to also be a retailer in order to sell electricity to consumers via retail contracts, it will also be required apply to hold a Retailer Licence. Information is available on the [EMA website](#).

## **Section 6: Electricity Imports – Framework on Build, Own, Operate and Maintain Imports Infrastructure**

- 6.1. Electricity imports will require new infrastructure to enable the importation of electricity. This entails setting aside land and sea space for the development of this infrastructure. Similar to the treatment of generation and grid capacity, EMA will continue to play the role of a system planner and coordinator that ensures the optimal use of scarce space for landing points and HVDC facility sites (if any).
- 6.2. For new imports infrastructure that is built on new or unused land, EMA intends for SPPA to build, own and operate all imports-related infrastructure as far as possible. This comprises the subsea cable, landing points and HVDC converter sites that are within Singapore's borders. Importers will pay SP to access such infrastructure. EMA views such import infrastructure as common grid infrastructure that should be managed by SPPA to ensure a uniform and high standard of reliability, and to ensure the optimal use of scarce resources of land and sea space.
- 6.3. For imports infrastructure that is built on private land (e.g. at the sites of local gencos), which does not create significant additional land use burden to Singapore, EMA does not require SPPA to build, own and operate such imports-related infrastructure, nor require open access to this infrastructure.
- 6.4. The framework for treatment of imports infrastructure is as follows:
- 6.5. **Build.** SPPA will build the imports infrastructure in Singapore for new or unused land. However, EMA recognises that as electricity imports are new to Singapore, and the development of subsea cables will include the laying of cables outside of Singapore borders, the initial construction of such imports infrastructure may be best handled by the importer (or by a partnership between the importer and SPPA). This allows the importer to best manage the development and risk of the end-to-end imports infrastructure, including seeking the relevant regulatory consent of overseas jurisdictions. In such a case, subject to EMA's approval, the importer may be allowed to build the infrastructure in the first instance, with the importer's share of the assets within Singapore's borders subsequently transferred at nominal value to SPPA. With the asset transfer happening at nominal value (e.g. S\$1), the importer will only be charged a fee to use such infrastructure, to the extent that SPPA incurred its own cost for the development of this infrastructure.
- 6.6. The construction of all subsea cables within Singapore's borders will also require the permission of the Maritime Port of Authority, including compliance with MPA's requirements.
- 6.7. **Ownership:** SPPA will own as much of imports infrastructure in Singapore as possible. The Importer may be allowed to own the subsea cables in Singapore's waters as well as the equipment in the HVDC station, subject to EMA's assessment and approval on case-by-case basis with sufficient justification

provided by the importer. EMA will reserve the right to require the importer to remove the cables and equipment if necessary (e.g. due to need to reuse the space taken up by such cables when the cables are no longer in use).

- 6.8. **Operate/Maintain.** By default, SPPA will operate and maintain the imports infrastructure that it owns. Nonetheless, EMA recognises that HVDC imports infrastructure is an end-to-end system and there may be a need for coordinated operations with the operator of the overseas HVDC infrastructure. It is possible that under certain circumstances, the importer would be in a better position to coordinate the operations of the HVDC. Hence, subject to EMA's approval, the importer may be allowed to operate and maintain the specific HVDC equipment. SPPA will continue to operate and maintain the remaining HVDC infrastructure (including the building "shell").
- 6.9. **Open Access Treatment for SP Infrastructure.** By default, all SPPA owned infrastructure will be subject to open and non-discriminatory access. Hence multiple importers can be allowed to access such common infrastructure to import electricity without being unduly discriminated.
- 6.10. **Use-it-or-lose-it ("UIOLI").** For SPPA-built import infrastructure such as the existing Singapore-Malaysia Interconnector, to ensure the Interconnector capacity is not unduly hoarded by a Licence with long tenure, the Importer will be subject to UIOLI safeguards. Under UIOLI, EMA reserves the right to proportionately reduce the interconnector capacity that is reserved by the importer, if such capacity is not utilised for at least 3 months in a year.
- 6.11. **Overseas Infrastructure.** This document only refers to import infrastructure within Singapore. Overseas import infrastructure (including the portion of the subsea cable that is outside Singapore's maritime borders) can be built, owned, operated and maintained by other parties. Nonetheless, as construction of an interconnector is an end-to-end event, EMA encourages importers to coordinate with SPPA when constructing the entire length of the interconnector, so as to ensure smooth construction and subsequent operations.

## **Section 7: Electricity Imports - Carbon Treatment**

- 7.1. To ensure that electricity imports enable Singapore to access electrons from low carbon sources, EMA will adopt the following approach:
- 7.2. **Generation Source Type.** EMA will prefer low-carbon sources. However, we are prepared to consider fossil fuel generation technologies if they are necessary to complement low-carbon sources, so as to make the electricity imports commercially viable or ensure stability of supply. EMA will reject any proposals which are comprised of coal-fired generation. EMA will require electricity imports to minimally achieve an annual emission factor that is no higher than 0.15tCO<sub>2</sub>e/MWh within five years of commercial operations.
- 7.3. **Renewable Energy Certificates (“RECs”).** Renewable Energy Certificates (RECs), or equivalent forms of proof of generation, will be required by the EMA to verify that electrons imported in Singapore come from low-carbon sources. It is expected that consumers buying low carbon electricity from importers will also buy the RECs (or equivalent proof) from importers to justify that their purchased electricity is from a low carbon source. Where the Importer imports electricity into Singapore that is generated from zero-carbon generation sources, the Licensee shall submit relevant RECs in respect thereof annually to the EMA for verification. The RECs submitted must be in accordance with the Singapore REC standard or an internationally recognised standard that is verified by accredited platforms or providers and approved by the EMA. For avoidance of doubt, REC ownership and trade will be determined on a commercial basis.

~ End ~