Our Clean Energy Future

HARNESSING DISTRIBUTED ENERGY RESOURCES VIA VIRTUAL POWER PLANTS TO PROVIDE ENERGY AND ANCILLARY SERVICES IN THE SINGAPORE WHOLESALE ELECTRICITY MARKET

CONSULTATION PAPER AND CALL FOR REGULATORY SANDBOX PROPOSALS

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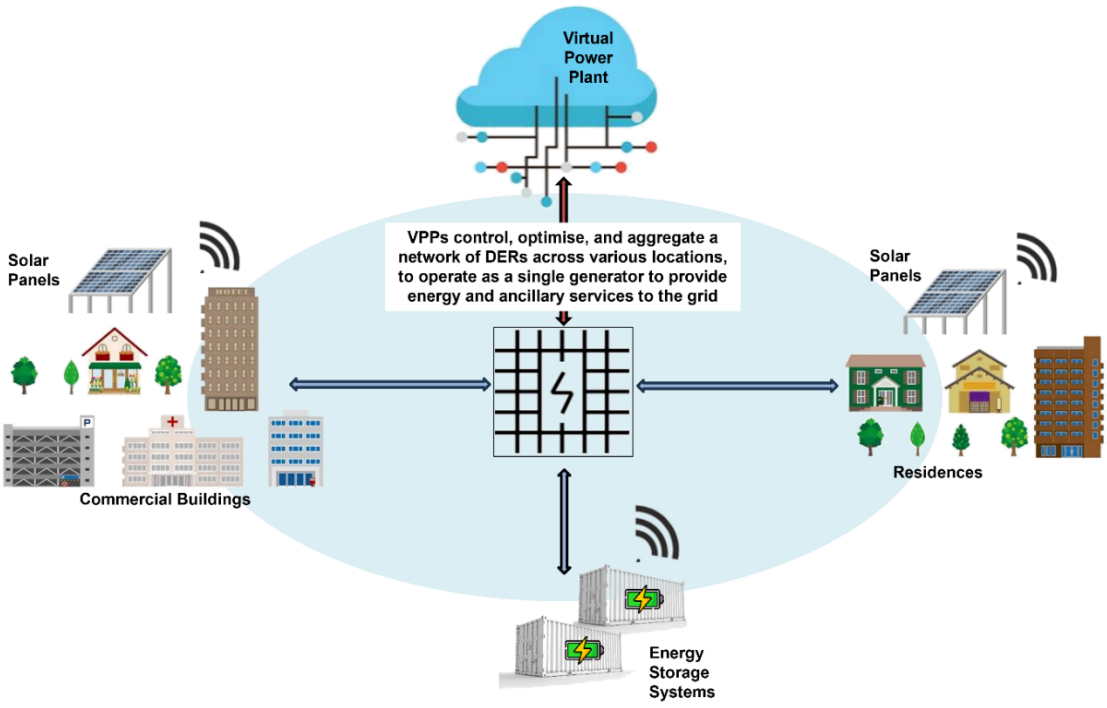
BACKGROUND

1. Distributed Energy Resources (DERs) are small generation units that are installed by consumers to generate, store, or use electricity. These include rooftop solar panels and small batteries for storage or backup. As Singapore moves towards net-zero emissions by 2050, we will see a proliferation of DERs. We have already installed over 1 GWp of solar capacity. Additionally, some consumers may deploy battery energy storage systems as they become cheaper.

2. DERs on their own may be small (typically less than 10 MW each) and are distributed across multiple locations in Singapore. It may not be commercially viable for each DER to individually provide services to the grid, because this requires the deployment of costly pilot wires between each DER and the grid. A Virtual Power Plant (VPP) can be deployed to improve the commercial viability for these DERs to provide these services (see Figure 1). A VPP is a digital platform capable of controlling, optimising, and aggregating a network of DERs across various locations, to operate as a single generator to provide energy and ancillary services to the grid.

Figure 1: Illustration of a VPP



3. VPPs have shown to be capable of contributing to system needs in other jurisdictions. In the US, a project sponsored by the Advanced Research Projects Agency–Energy demonstrated the ability of VPPs to regulate the voltage and frequency of the grid while maintaining power quality. Similarly, the South Australian Tesla VPP demonstrated the ability of VPPs to provide grid services such as fast frequency response (responding to frequency changes within 1s) and inertia to the power system in response to frequency fluctuations in the grid.[1]

4. There is currently no regulatory framework allowing the aggregation of DERs via a VPP to provide energy and ancillary services in the Singapore Wholesale Electricity Market (SWEM). In view of the potential benefits VPPs can bring to the power system, EMA intends to pilot VPPs via a regulatory sandbox, to inform the regulatory framework for VPPs. EMA invites proposals for the regulatory sandbox, and industry feedback on the parameters for the sandbox.

PARAMETERS FOR REGULATORY SANDBOX

5. Under the sandbox, each VPP shall aggregate DERs and register as a single Generation Registered Facility (GRF) with the Energy Market Company (EMC) to provide energy and all ancillary services to the grid. The DERs managed by the VPP will not need to register individually with EMC. EMA will assess the outcomes of the sandbox based on the VPP's technical ability to meet stipulated compliance thresholds and provide benefits to the system.

6. The parameters under the sandbox are as follows:

a. The total sandbox capacity shall be 100 MW. This is to allow a range of small to medium-sized VPPs to demonstrate the use cases.

b. Each VPP shall have a mix of assets, and may aggregate any generation assets and load facilities.[2] This allows the VPP to optimise across various DERs to provide grid services.

c. The VPP shall provide energy and all ancillary services (frequency regulation, and primary and contingency reserves).

d. The sandbox shall have a duration of one year. The criteria for the sandbox is detailed in Table 1 below:[3]

Table 1: Criteria for VPP deployment under the regulatory sandbox

[1] Inertia is the grid's ability to maintain a steady electricity flow when there are sudden changes in supply or demand

[2] Examples include batteries, solar panels.

[3] Unless otherwise stated, the VPP shall comply with requirements stipulated under the Transmission Code and System Operation Manual.

	Current requirements for GRFs	Requirements under sandbox
Energy	A GRF will be deemed to have deviated from its real-time dispatch schedule if its deviation is more than 10 MW. If this happens, the GRF will be subject to the Automatic Financial Penalty Scheme (AFPS) as detailed in Appendix 5D of the Market Rules.[4]	The VPP will be deemed to have deviated from its real-time dispatch schedule if its deviation is more than 5% (i.e., 95% compliance threshold). The VPP shall be given two concessions where there will not be any penalty for deviation. On the third non-compliance and beyond, the VPP will be subject to the following financial penalty for a given dispatch period, similar to the AFPS: Financial penalty = S$5,000 or (Uniformed Singapore Energy Price (USEP) + Hourly Energy Uplift Charge (HEUC)) × [(Deviation % - 5%) × bid (in MW) × ½ hour], whichever is higher.
Primary reserves	Each registered facility offering primary reserve shall be capable of achieving its scheduled MW response within 9 seconds of being triggered and sustained for an additional 9 minutes and 51 seconds from the time it was triggered.	
	There shall be no payment for deviation from these requirements.	The VPP shall be given two concessions where the VPP will still receive payment. On the third non-compliance and beyond, there shall be no payment for deviation from these requirements
Contingency reserves	Each registered facility offering contingency reserve shall be capable of achieving its scheduled MW response within 10 minutes of being instructed to do so and shall be able to maintain that scheduled MW response for not less than 30 minutes.	
	There shall be no payment for deviation from these requirements.	The VPP shall be given two concessions where the VPP will still receive payment. On the third non-compliance and

[4] Under the AFPS, the financial penalty for a given dispatch period is S$5,000 or 2 × (USEP+HEUC) × [½ × (Deviation quantity in MW) × ½hour – 2.5 MWh], whichever is higher. HEUC captures any differences between the total amounts received from retailers and total amounts paid to generators for energy, reserve and regulation products.

		beyond, there shall be no payment for deviation from these requirements
Frequency regulation	A registered facility providing regulation must be able to increase or decrease its output in 60 seconds, up to the maximum or minimum output specified in the most recent standing capability data submitted in accordance with section 4.4 in Chapter 5 of Market Rules.[5]	
	There shall be no payment for deviation from these requirements.	The VPP shall be given two concessions where the VPP will still receive payment. On the third non-compliance and beyond, there shall be no payment for deviation from these requirements

7. The VPP shall be equipped with communication capabilities that enable the Power System Operator (PSO) to communicate with the VPP via the Energy Management System (EMS), and the VPP to communicate with and control the DERs. The VPP shall comply with the communication protocols as detailed in the System Operation Manual, such as the requirement to use a pilot wire or optical fibre communications to communicate with the EMS. The VPP can communicate with its DERs via wireless communication to dispatch according to market schedule.

8. Industry may propose other means, such as wireless communication, to allow the VPP to communicate with the EMS. The proposal shall state how the alternative means can achieve the intent for the VPP to receive the dispatch instructions in real-time and how it can meet the criteria in Table 1. The proposal shall also list the cybersecurity protocols and tools that will be deployed in wireless communications. As a fail-sure measure to assess the robustness of wireless communications, the VPP shall also be prepared to communicate with the EMS via existing secure File Transfer Protocol (FTP) or may propose other alternatives.[6]

MARKET SETTLEMENT

9. As per the existing settlement treatment for GRF, the VPP shall be levied the prevailing market/regulation/reserve charges where applicable.

10. Market settlement shall be between EMC and VPP only.

[5] Standing Capability Data for GRF, as detailed in Appendix 6E of the Market Rules, comprises a series of operating specifications of GRF, including its maximum regulation capacity.

[6] FTP is a standard network protocol used for the transfer of files from one host to another over a Transmission Control Protocol-based network (communications standard for delivering data and messages through networks, such as the Internet). In the event the secure FTP is used as the communication protocol, the VPP shall participate only in energy and reserves market that do not require signals from the EMS via pilot wire communication to control the VPP.

REQUEST FOR COMMENTS AND CALL FOR PROPOSALS

11. EMA invites written comments and feedback on the proposed parameters for VPP to participate in the SWEM at EMA_ECDD_Demand@ema.gov.sg.

12. Industry that is interested to participate in the regulatory sandbox shall submit proposals with the following details:

a. Number, type, and capacity of DERs to be aggregated under the VPP, and where applicable, to list the DERs that are currently registered with EMC and their market registration details;

b. Communication technology with PSO (to include specifications of technology used, and cybersecurity tools and protocols); and

c. Lead-time required to commence the sandbox. This refers to the earliest date that the VPP can commence operations in SWEM, upon receiving EMA's approval of the sandbox.

13. EMA plans to select two or three sizeable projects based on 1) diversity of assets, 2) ability to meet the sandbox criteria and 3) benefits accrued to the grid. EMA reserves the right to vary the parameters for each sandbox proposal based on discussions with the VPP aggregator and feedback received to this consultation.

14. The closing date for comments and sandbox proposals is **31 December 2024, 2359 hrs** Singapore time. Anonymous and/or late submissions will not be considered.

15. EMA will acknowledge receipt of each submission via email. If you did not receive an acknowledgment of your submission within two business days, please contact EMA_ECDD_Demand@ema.gov.sg.

16. EMA reserves the right to make public all or parts of any written submissions made in response to this consultation paper and to disclose the identity of the source. Any part of the submission, which is considered by respondents to be confidential, should be clearly marked. EMA will take this into account regarding the disclosure of information submitted. EMA may also approach respondents for clarification while the consultation is ongoing.