

Seeking Innovative Solutions to Better Manage Contracted Capacity

Problem Statement

- Globally, there is a fundamental shift in how consumers interact with power systems and infrastructure, due to the digitalisation, decentralisation and decarbonisation of the power grid particularly from deployment of Embedded Generation (EG) such as solar and energy storage.
- In light of these developments, policies and infrastructure will need to stay relevant to be able to support higher levels of EG.
- As EG deployment is expected to grow in the future, EMA is interested in exploring innovative solutions to allow EG consumers to manage their load demand and reduce costs.

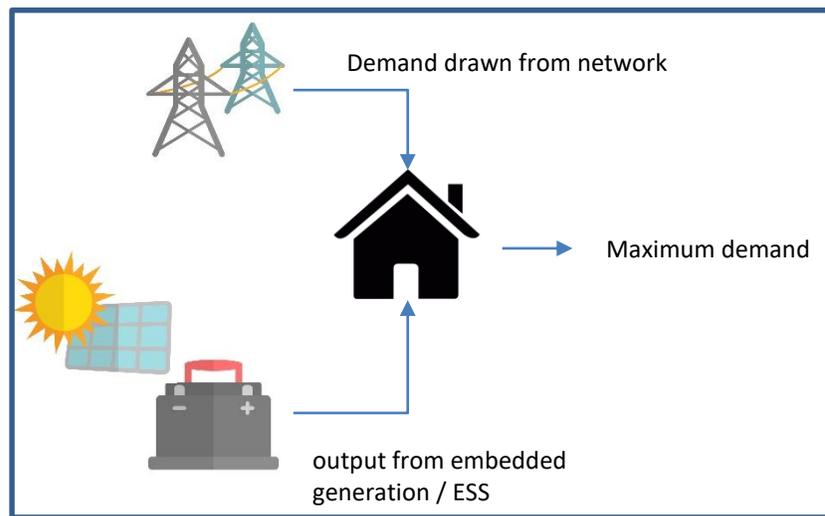
High Tension and above Consumers with embedded generation must choose from three types of grid connection schemes to procure full or partial backup

Scheme	Key Requirements
Summation Scheme	<ul style="list-style-type: none"> EG consumers can summate half-hourly maximum demand drawn from network and output from EG to determine maximum demand. Uncontracted Capacity Charge (UCC) applies when half-hourly maximum demand exceeds contracted capacity.
Capped Capacity Scheme (CCS)	<ul style="list-style-type: none"> EG consumers can cap their power demand drawn from network with suitable Load Limiting Device. UCC applies when maximum demand exceeds contracted capacity and is limited to 120% of Contracted Capacity. Uncontracted Standby Capacity Charge (USCC) at 5x of CCC applies when demand drawn from network exceeds 120% of contracted capacity for a duration of more than 10s continuously.
Extended Capped Capacity Scheme (ECCS)	<ul style="list-style-type: none"> EG consumers can cap their power demand drawn from network with suitable Load Limiting Device. UCC applies when maximum demand exceeds contracted capacity and is limited to 120% of Contracted Capacity. 2-tier USCC at <ul style="list-style-type: none"> 5x of CCC applies when demand drawn from network exceeds 120% and up to 200% of the contracted capacity for a duration of more than 100 seconds continuously. 12x of CCC applies when demand drawn from network exceeds 200% of the contracted capacity for a duration of more than 10 seconds continuously.

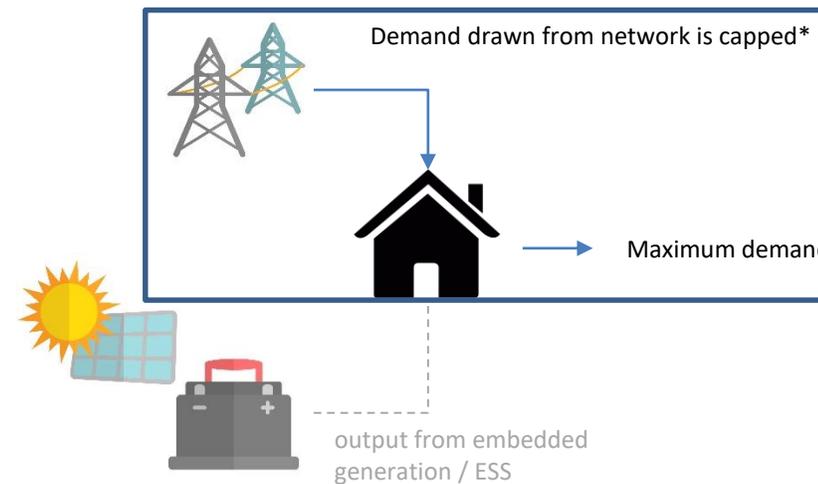
*The USCC shall be applicable in the event that the load limiting device installed and maintained at consumer's own expense fails to disconnect the load.

Currently, consumers tend to prefer the Summation Scheme over the other schemes

- Currently, choice of grid connection schemes is skewed towards Summation Scheme as requirements for CCS and ECCS to cap their demand drawn from the network and install a Load Limiting Device (LLD) is less favoured by consumers.
 - LLD will cut off electricity supply when load exceeds a certain capacity for a specified duration.
- There is industry interest to explore how contracted capacity charges can be reduced, e.g. using Energy Storage Systems (ESS). This can be done already under the CCS and ECCS but not under the Summation Scheme.



Summation Scheme



CCS / ECCS

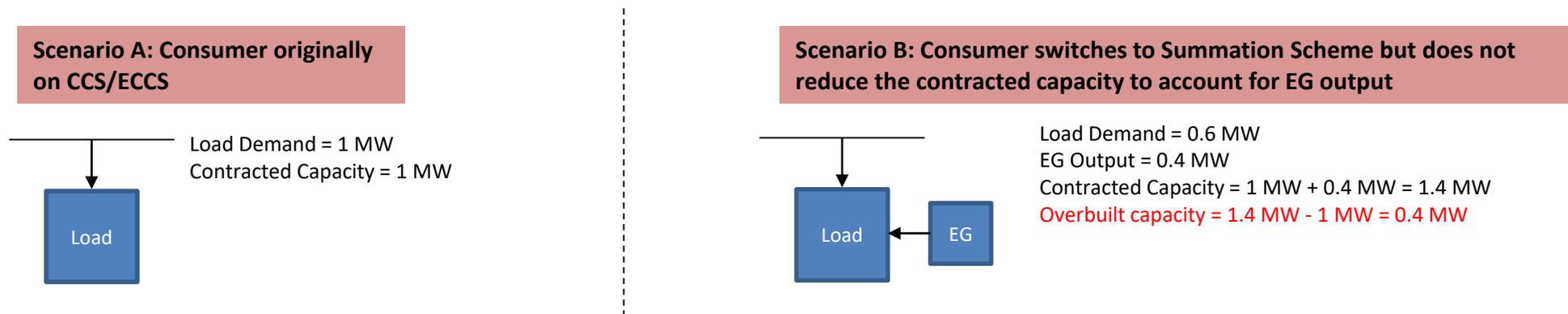
*Consumers can opt to declare higher contracted capacity for partial backup against their EG.

The grid connection schemes are meant to provide options to consumers, based on their risk appetite for backup

Summation Scheme	CCS/ECCS
<ul style="list-style-type: none">• Consumers do not need to install and maintain a LLD but pay higher contracted capacity charges to ensure that they always have backup supply from the grid if their EG/ESS fails to operate.• Consumers can switch to the CCS/ECCS where they can reduce their contracted capacity based on the capability of their EG/ESS to manage their load drawn from the grid.	<ul style="list-style-type: none">• Consumers need to install and maintain a LLD but pay lower contracted capacity charges (as the maximum demand is capped based on the demand declared by the consumer) in exchange for the added risk of being cut off from the network, if demand exceeds contracted capacity.<ul style="list-style-type: none">• ECCS consumers have the option of extending the duration and upper limit threshold when demand exceeds contracted capacity but face higher USCC compared to CCS consumers.• There are 4 consumers on CCS and 8 consumers on ECCS as of 4 July 2019.

However, there could be solutions to better allow consumers to manage their load demand and increase uptake for the CCS/ECCS

- If more EGs and distributed generation are installed in the future, this could further increase the high adoption rate of the Summation Scheme.
 - Grid resources are sized to fully backup the consumers capacity leading to higher contracted capacity. This could lead to inefficiency in the system.
 - If consumers are not properly adjusting their contracted capacity when switching to the Summation Scheme after installing an EG, this could also lead to over-catering of grid resources.



- Hence, a more balanced adoption of the grid connection schemes should be encouraged where possible. However, if the requirements for the CCS/ECCS are perceived to be overly punitive, this will deter consumers for signing up for these schemes.

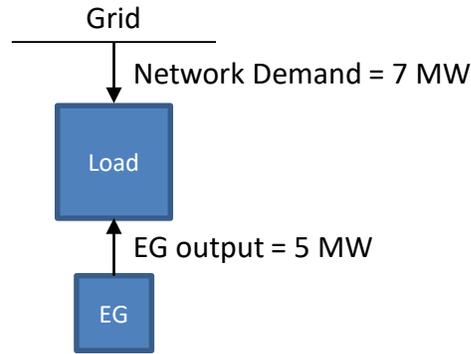
Seeking Industry Feedback

- EMA seeks comments and feedback on innovative solutions to better allow consumers to manage their load demand drawn from the grid.
- Some ideas worth exploring include:
 - How the cost of implementing LLDs could be lowered;
 - How power drawn from the network could be moderated or reduced when it exceeds the contracted capacity of the Load Facility; and
 - How to trigger power supply cut-off only when localised system constraints are due to happen.

APPENDIX

Illustration of UCC and USCC under Grid Connection Schemes

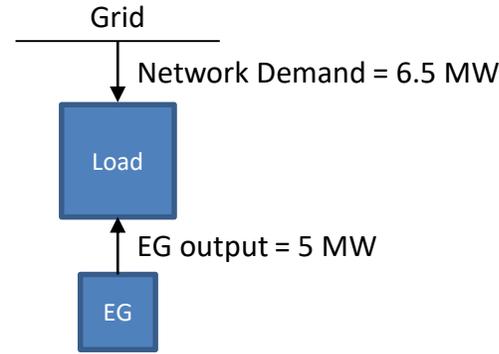
Summation Scheme



- HT consumer with **10 MW load** declares monthly contracted capacity of **10 MW under Summation Scheme**.
- Load increases to 12 MW.
 - Network power increases from 5 MW to 7 MW.
 - EG output remains at 5 MW.

- Max Demand = 7 MW + 5 MW = 12 MW
- Uncontracted Capacity = 12 MW – 10 MW = 2 MW
- UCC = \$13.35/kW/month*1000*2 MW = **\$26,700**

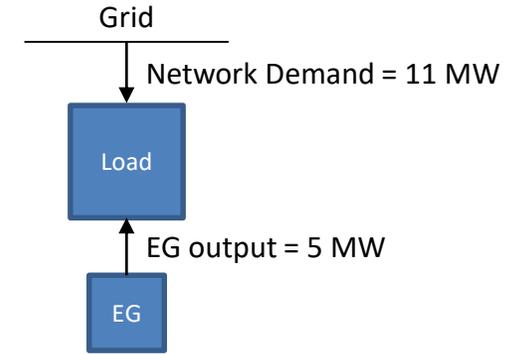
CCS



- HT consumer with **10 MW load** declares monthly contracted capacity **capped at 5 MW of network power under CCS**.
- Load increases to 12 MW.
 - Network power increases from 5 to 7 MW (140%).
 - EG output remains at 5 MW.
- HT consumer exceeds 120% of contracted capacity (5 MW to 7 MW) for duration of **more than 10s continuously**.

- Max Demand = 7 MW
- Uncontracted Capacity = 7 MW – 5 MW = 2 MW
- UCC (up to 120% of contracted capacity) = \$13.35/kW/month*1000*(5 MW*20%) = \$13,350
- If LLD does not disconnect load:
 - USCC = \$44.50/kW/month*1000*(5 MW*20%) = \$44,500
- Total UCC & USCC = **\$57,850**

ECSS



- HT consumer with **10 MW load** declares monthly contracted capacity **capped at 5 MW of network power under ECSS**.
- Load increases to 16 MW.
 - Network power increases from 5 to 11 MW (220%).
 - EG output remains at 5 MW.
- HT consumer exceeds 120% of contracted capacity for duration of 100s continuously and 200% of contracted capacity (5 MW to 11 MW) for duration of **more than 10s continuously**.

- Max Demand = 11 MW
- Uncontracted Capacity = 11 MW – 5 MW = 6 MW
- UCC (up to 120% of contracted capacity) = \$13.35/kW/month*1000*(5 MW*20%) = \$13,350
- If LLD does not disconnect load:
 - Tier 1 USCC (up to 200% of contracted capacity) = \$44.50/kW/month*1000*(5 MW*80%) = \$178,000
 - Tier 2 USCC (exceeding 200% of contracted capacity) = \$106.80/kW/month*1000*(5 MW*20%) = \$106,800
- Total UCC & USCC = **\$298,150**

Use of System (UOS) Charges effective from 1 April 2019

J USE OF SYSTEM (UOS) CHARGES EFFECTIVE FROM 1 APRIL 2019

Table 9 : UOS Charges [Exclusive of GST]#

	Contracted Capacity Charge (\$/kW/month)	Peak Period Charge (c/kWh)	Off-Peak Period Charge (c/kWh)	Reactive Power Charge (c/kVArh)	Uncontracted Capacity Charge ⁷ (\$/kW/month)	Uncontracted Standby Capacity Charge ¹⁰ (\$/kW/month)		
						CCS ⁸	ECCS ⁹	
							Tier 1	Tier 2
Ultra High Tension ¹	7.11	0.06	0.02	0.44	10.67	35.55	35.55	85.32
Extra High Tension ²	7.87	0.08	0.03	0.48	11.81	39.35	39.35	94.44
High Tension - Large ³	8.90	0.74	0.08	0.59	13.35	44.50	44.50	106.80
High Tension - Small ⁴	8.90	0.96	0.09	0.59	13.35	44.50	44.50	106.80
Low Tension - Large ⁵	-	5.44	4.12	-	-	-	-	-
Low Tension - Small ⁶	-	5.44	-	-	-	-	-	-

Please refer to Table 9A in Appendix 5 for charges inclusive of GST.

Use of System (UOS) Charges effective from 1 April 2019

- 1 Ultra High Tension - for consumers taking supplies at 230kV, 50Hz, 3-phase, 3-wire for connection with minimum Contracted Capacity of 85,000kW*
- 2 Extra High Tension - for consumers taking supplies at 66kV, 50Hz, 3-phase, 3-wire for a Contracted Capacity:
 - (a) between 25,501kW and 84,999kW for service connection from the nearest feasible 66kV substation*
 - (b) between 85,000kW and 170,000kW for connection from the nearest feasible 66kV source station*

The above shall apply to new and existing customers.

- 3 High Tension-Large - for consumers taking supplies at 22kV or 6.6kV, 50Hz, 3-phase, 3-wire for a Contracted Capacity:
 - (a) between 1,700kW and 12,750kW for 1 or 2 HT 22kV services*
 - (b) between 12,751kW and 25,500kW for 3 or 4 HT 22kV services*
- 4 High Tension-Small - for consumers taking supplies at 22kV or 6.6kV, 50Hz, 3-phase, 3-wire for connection with Contracted Capacity of less than 1,700kW.
- 5 Low Tension-Large - for contestable consumers taking supplies at 400V/230V.
- 6 Low Tension-Small - for non-contestable consumers taking supplies at 400V/230V. These are consumers who choose to buy electricity from SP Group at the regulated tariff.

Use of System (UOS) Charges effective from 1 April 2019

- 7 The Uncontracted Capacity Charge (UCC) applies in the event that the maximum demand in kW (measured by the half-hour integration meter) exceeds the Contracted Capacity. UCC applies to:
 - (a) Normal customers without embedded generation;
 - (b) Customers with embedded generation who require top-up supplies and opt to summate their kW output from embedded generation and kW demand from the network (i.e Summation Scheme) for determining maximum demand; and
 - (c) Customers with embedded generation who require top-up supplies and opt to cap their power demand in kW drawn from the network (i.e Capped Capacity Scheme or Extended Capped Capacity Scheme). The UCC applies in the event that the maximum demand in kW (measured by the half-hour integration meter) exceeds the contracted capacity and shall be limited to 20% of the Contracted Capacity.
- 8 For Capped Capacity Scheme (CCS), the Uncontracted Standby Capacity Charge (USCC), at 5 times of Contracted Capacity Charge, applies in the event that the demand in kW (measured by the power meter) drawn from the network exceeds 120% of the contracted capacity for a duration of more than 10 seconds continuously.
- 9 For Extended Capped Capacity Scheme (ECCS), the 2-tier Uncontracted Standby Capacity Charge (USCC) applies as follows:
 - Tier 1: 5 times of Contracted Capacity Charge is applicable if the demand in kW drawn from the network exceeds 120% and up to 200% of the contracted capacity for a duration of more than 100 seconds continuously.
 - Tier 2: 12 times of Contracted Capacity Charge is applicable if the demand in kW drawn from the network exceeds 200% of the contracted capacity for a duration of more than 10 seconds continuously.
- 10 For both CCS and ECCS, the consumer shall at its own expense, install and maintain Load Limiting Device, in accordance with requirements that the Transmission Licensee may stipulate from time to time.

* Based on power factor of 0.85