

RCP PAPER NO. : **EMC/RCP/155/2026/CP105**

SUBJECT : **REVIEW OF THE UNKNOWN EXPOSURE ESTIMATION
METHOD IN THE ESTIMATED NET EXPOSURE
CALCULATION**

FOR : **DISCUSSION**

PREPARED BY : **FENG RUILI
PRINCIPAL ANALYST**

REVIEWED BY : **POA TIONG SIAW
SVP, MARKET ADMINISTRATION**

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Executive Summary

This paper proposes a new method to estimate a Market Participant's (MP) exposure during the days for which meter data is not yet available (the "unknown exposure" period). The objective is to improve the accuracy and responsiveness of the daily Risk Exposure mechanism in the National Electricity Market of Singapore (NEMS).

The current Estimated Net Exposure (ENE) method calculates unknown exposure using a rolling 90-day Average Daily Exposure (ADE). Analysis of historical NEMS data from 2020 to May 2026 showed that this approach understated some MPs' ENE during volatile market conditions, delaying margin calls at the moment they matter most.

EMC proposes a USEP-based ENE method for retail electricity licensees and the MSSL. This method estimates unknown exposure using the latest available daily USEP during the unknown period. Our analysis concludes that this significantly improves the timeliness and accuracy of net exposure monitoring and margin call triggers for retail electricity licensees and the MSSL.

The USEP-based method is not suitable for other classes of MPs (including generators and wholesale traders), whose withdrawal and negative injection quantities are not predictable.

EMC therefore recommends that the RCP:

- a) support in-principle to adopt the USEP-based ENE method for retail electricity licensees and the MSSL, and to retain the current ADE-based ENE method for all other classes of MPs; and
- b) task EMC to assess the system changes and resources required to implement the method and to report to the RCP before proposing the required rule changes.

At the 155th RCP meeting, the RCP **by majority vote supported** EMC's recommendations.

1. Introduction

At the 137th RCP Meeting, the panel unanimously supported the proposed approach for a holistic review of the current prudential requirements. This included a proposal (Proposal 2) to enhance the credit support framework by reviewing the Average Daily Exposure (ADE) calculation, the core component determining a market participant's (MP) Estimated Net Exposure (ENE) and overall Risk Exposure (RE).

This paper examines how the "unknown exposure" component of a Market Participant's (MP) Estimated Net Exposure (ENE) is calculated, with the aim of improving the accuracy and responsiveness of the Risk Exposure (RE) mechanism. The RE mechanism functions as an early warning system, triggering a margin call in a timely manner when an MP's risk exposure exceeds the prescribed threshold. The primary source of error in estimating an MP's RE lies in how unknown exposure is calculated within its ENE. Without an accurate and timely RE mechanism, an MP's net exposure may not be sufficiently covered by the credit support it has provided, especially when the market is volatile.

2. Background

2.1 Estimated Average Daily Exposure (ADE) and its Role in Credit Support Value (CSV) and Risk Exposure (RE) Mechanisms

In the National Electricity Market of Singapore (NEMS), the estimated ADE represents the typical daily trading liability of an MP. The ADE is the simple average of the MP's net settlement amounts from the 90 most recently available Preliminary Settlement Statements (PSS) or corresponding Final Settlement Statements (FSS).

The ADE serves two functions in the prudential framework:

1. Calculating the CSV: The CSV is calculated by multiplying the MP's Estimated ADE by 38 days for MPs and 33 days for the Market Support Services Licensee (MSSL). This requirement is designed to ensure that the MP provides sufficient baseline credit support to cover its average trading exposure, taking into account a 20-day payment cycle and an 18-day default remediation and suspension process.

$$\text{Credit Support Value (CSV)} = 38 \text{ days} \times \text{ADE}$$

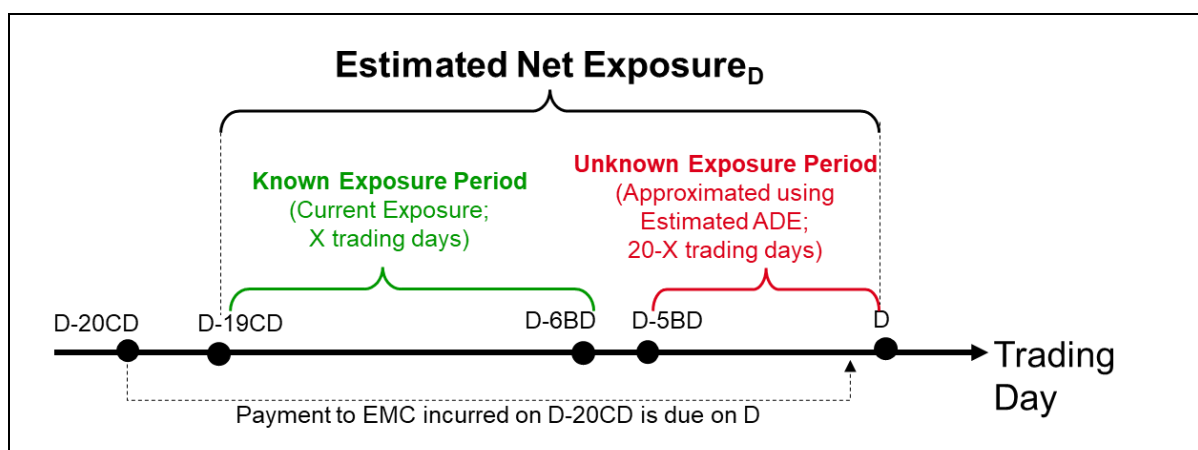
2. Approximating Unknown Exposure in RE: As metering and settlement data becomes available only after several days, EMC uses the historical 90-day ADE to approximate the MP's "unknown" unpaid trading exposure when calculating its daily RE (as detailed in [Section 2.2](#)), which is used for monitoring continuous adequacy of credit support.

The CSV and RE mechanisms together form a two-tiered safeguard against credit defaults. The CSV provides a baseline, while the RE mechanism acts as a dynamic daily monitor of the adequacy of credit support held in respect of each MP based on actual market conditions.

2.2 Estimated Net Exposure and its Role in Risk Exposure Mechanism

Settlement in the NEMS takes place 20 days in arrears. Estimated Net Exposure (ENE) is a daily metric calculated by EMC to estimate an MP's trading liability over this 20-day payment cycle. As metering data is only available to EMC 5 business days (BDs) after a trading day, EMC determines the net settlement amount for a given trading day only 6 BDs after that trading day. To bridge this gap, EMC uses the ENE formula to approximate an MP's net exposure on any given day by combining both known and estimated unknown exposures (Refer to [Box 1](#)).

Box 1: Breakdown of ENE into known and unknown exposures over a 20-day payment cycle



The ENE¹ is calculated using the following formula:

$$\text{Estimated Net Exposure} = \text{Current Exposure} + [(20-X) \times \text{Estimated ADE}] - \text{Prepayment Amount} + \text{Unpaid Amount}$$

Where:

- **Current Exposure:** The MP's known exposure. It is calculated as -1 multiplied by the aggregated net settlement amounts from available preliminary or final settlement statements for all trading days where the invoices are not yet due for payment.
- **X:** This is the number of trading days to which the "Current Exposure" relates.
- **(20-X) x Estimated ADE:** This is the unknown exposure. As the payment cycle is 20 days, the remaining days (20 – X) lacking settlement data are estimated by multiplying them by the MP's estimated ADE.
- **Estimated ADE (established MPs):** Once an MP has sufficient trading history, their estimated ADE is calculated as -1 multiplied by the simple average of the net settlement amounts from their 90 most recently available PSS or FSS.²
- **Forecast ADE (new MPs):** Until a new MP accumulates 90 days of settlement statements, their estimated ADE is determined by a forecast ADE.³
- **Prepayment Amount:** Any advance payments the MP makes to EMC to proactively reduce their exposure.
- **Unpaid Amount:** Due and unpaid invoice amounts (less any credit support already recovered by EMC).

¹ By convention, a positive ENE indicates that the MP has a payment liability to EMC (e.g. they owe money to the market). A negative ENE indicates that EMC owes money to the MP.

² In the NEMS settlement system, a negative net settlement amount means the MP owes money to EMC. Multiplying this by -1 converts their typical daily debt into a positive exposure value. If a negative estimated ADE is calculated (meaning the MP generally receives more money from the market than they pay), the rules treat the ADE as a zero value for the purpose of calculating credit support.

³ If a new MP does not yet have 90 days of trading history, the initial ADE is based on the MP's own projections of the gross energy quantities they will inject or withdraw, multiplied by historical average prices. Once they begin trading, their ADE is dynamically calculated using a formula that takes the greater of their forecasted quantities or their actual maximum daily withdrawal/injection quantities, which is then multiplied by average historical prices. This prevents a new MP from underestimating their forecast to avoid putting up sufficient credit support. Once 90 days of actual settlement statements are available, they transition to the standard calculation.

The purpose of calculating the ENE is to monitor the adequacy of credit support through the Risk Exposure mechanism (RE). Each business day, EMC calculates an MP's RE:

$$\text{Risk Exposure} = \text{Estimated Net Exposure} / \text{Credit Support Held}$$

The resulting RE percentage determines when the margin call mechanism is triggered:

1. Notification: EMC notifies a MP when its ENE reaches 45% (or 50% for the MSSL) of its provided credit support.
2. Margin call: If the ENE reaches or exceeds 55% (or 60% for the MSSL) of its credit support, EMC issues a margin call.⁴
3. Remedy: The MP must satisfy the margin call within two BDs by providing additional credit support or making a prepayment to bring its RE down to 35% (or 40% for the MSSL) or lower.

2.3 Where does default risk in the NEMS originate?

In this paper, net creditors refer to MPs to whom EMC owes money (typically generators and demand response providers). Net debtors refer to MPs who owe EMC money (typically retailers). While net position reversals can occur, due to prolonged negative energy prices or generators scheduled below their bilateral contract levels, payment default risk historically originates from retailers.

Table 1⁵ shows that margin calls in the NEMS have been issued mostly to retailers (refer to Appendix A for MP classification). From 2020 to 2025, no generator or the MSSL was issued a margin call or default notice.

Table 1 Total number of margin call issued from 1 January 2020 to 31 December 2025

	2020	2021	2022	2023	2024	2025
Retailers	8	11	0	0	0	0
Generators	0	0	0	0	0	0
MSSL	0	0	0	0	0	0
Wholesale Market Traders	0	1	0	0	0	0

Liberalisation of the retail market (Open Electricity Market) in 2019 contributed to increased margin call issuance in 2020, after a number of new retailers entered the market.

The high number of margin calls in 2021 was driven by price volatility from the global energy crisis that disrupted natural gas supplies from Indonesia. During this period, the actual trade exposures of many retailers significantly exceeded their actual credit support provided to EMC. A retailer failed to satisfy its margin calls, resulting in an unprecedented default levy of \$506,061.55 imposed upon non-defaulting MPs.⁶ The absence of margin calls in more recent years reflected relatively stable USEP conditions since 2023. However, as the 2021 crisis demonstrated, the shortcoming of current ENE method surfaces only during periods of high price volatility, which is exactly when prudential safeguard matters most.

⁴ If an MP believes there is a manifest error in their ENE calculation, such as a metering or system calculation error, they can submit a formal request for EMC to reassess the ENE and potentially revoke or revise the margin call.

⁵ To align with EMC's current practice, the count of margin calls reported in Table 1 is based on Run Date. The figures differ from the 2021 NEMS report which was based on Trading Date.

⁶ The EMA introduced the Performance Bond (PB) Regime in February 2024 for retail electricity licensees. While both credit support and PBs safeguard against default, EMA has clarified they serve different purposes. The PB regime is enforced directly by the EMA and is therefore not reviewed in this study.

3. Analysis

3.1 Are the current RE and ENE methods adequate?

Since a retailer's RE is calculated using its estimated ADE, it may fail to accurately reflect its actual settlement amounts during the unknown exposure period (refer to [Box 1](#)). To assess the accuracy and responsiveness of the current RE and ENE methods, they are benchmarked against the "Actual Risk Exposure (ARE)" and "Actual Net Exposure (ANE)". For clarity, neither ARE and ANE is defined in the NEMS Market Rules, both are used only for the purpose of this study. ARE is calculated retrospectively using actual settlement amounts for the 20-day payment cycle:

$$\text{Actual Risk Exposure} = \text{Actual Net Exposure} / \text{Credit Support Held}$$

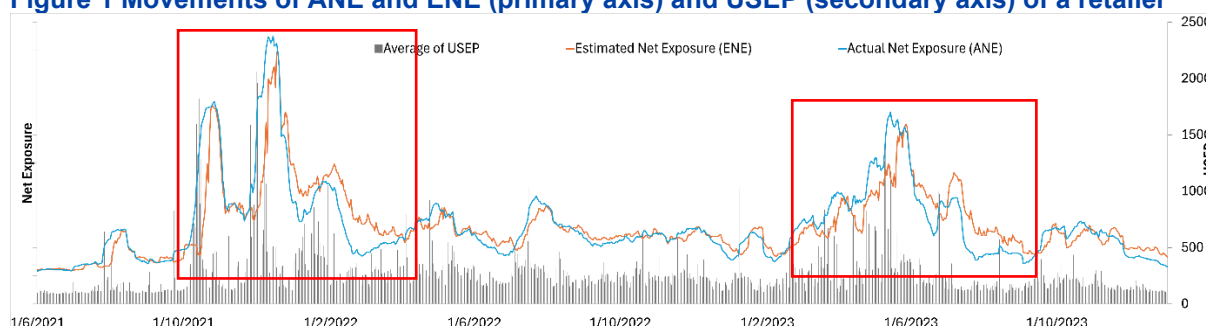
Where

- Actual Net Exposure (ANE): It is calculated as -1 multiplied by the aggregated net settlement amounts of an MP for all trading days on day D and the days immediately preceding it, but which are not yet payable on day D.

The key difference between ANE and ENE is data availability. For daily real-time monitoring, EMC currently can only rely on the 90-day ADE to bridge the data gap. Using NEMS data from 2020 to May 2026, EMC calculated the ANE and ENE for several retailers. Prepayments were excluded from ANE and ENE calculations to remove the impact of retailer's voluntary actions on their exposure calculations. This also better reflects the reality that a defaulting retailer is unlikely to make prepayments during an actual event of default. Refer to [Appendix B](#) for an illustration of how the ENE and ANE are calculated for a retailer.

[Figure 1](#) shows the ANE and ENE of a typical retailer. During periods of high USEP volatility (especially in Q4 2021 and mid 2023), the ENE line (orange) consistently lagged the surging ANE line (blue). The ENE understates exposure while USEP is rising and overstates it when USEP falls, because the inflated data points persist in the 90-day rolling window into the following quarter. The core concern is that the current ENE method underestimates retailers' ANE during sudden USEP spikes, masking potential credit support insufficiency and leaving the market exposed to uncovered default risk. The 90-day historical average is inherently too slow to react to real-time price fluctuations.

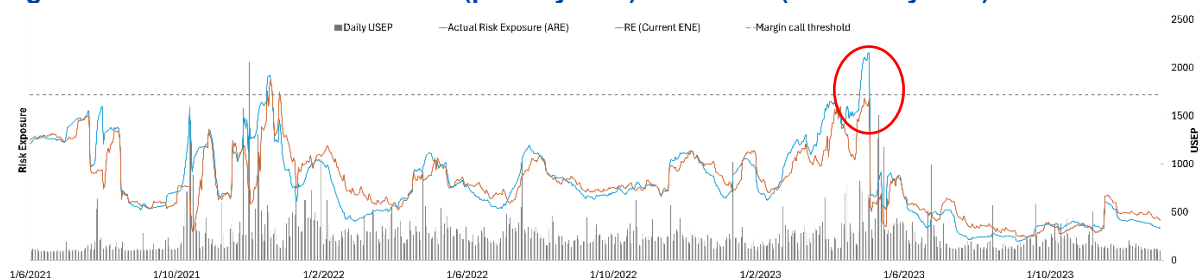
Figure 1 Movements of ANE and ENE (primary axis) and USEP (secondary axis) of a retailer⁷



The daily RE monitored by EMC is therefore inaccurate, creating a blind spot in which a retailer's calculated RE might appear safely below the 55% margin call threshold, while its Actual Risk Exposure (ARE) has already breached it. For example, in [Figure 2](#) (circled in red), a retailer's ARE exceeded the margin call threshold on 25 April 2023 while its RE remained below it. EMC was therefore unable to issue a margin call to the retailer.

⁷ Similar ANE and ENE movements are observed in other retailers.

Figure 2 Movements of ARE and RE (primary axis) and USEP (secondary axis) of a retailer



In practice, retailers tend to make prepayments when their RE approach the margin call threshold. Margin calls actually issued are therefore fewer than the examples used in this study. The analysis here reflects the worst-case scenarios, in which retailers make no prepayment.⁸

3.2 Key drivers of retailer's and the MSSL's unknown exposure

The “unknown exposure” period (5BDs immediately following a trading day) exists primarily because the metering data required to calculate an MP's exact settlement amount is not yet available to EMC. To improve the estimate, EMC examined the data availability of the components that drive retailers' settlement amounts.

Table 2 breaks down the settlement amount into its components to identify the key drivers of a retailer's settlement amount. The key components that have the most material impact on retailers' and the MSSL's settlement amounts are Energy Services (USEP multiplied by Withdrawal Energy Quantity) and financial hedge instruments (bilateral/vesting contracts).

Table 2 Breakdown of retailers' and the MSSL's settlement amounts⁹

Categories	Detailed Items	Weightage (% absolute amount) ¹⁰		
		Retailer without BESC	Retailer with BESC	MSSL
Energy Service	Load Energy Settlement Debit (LESD)	98%	52%	84%
Reserve Service	Reserve Settlement Credit (RSC)	<1%	<1%	<1%
Regulation Service	Regulation Settlement Debit (FSD)	<1%	<1%	<1%
Financial Hedge Instruments	Bilateral Energy Settlement Credit (BESC)	0%	-47% ¹¹	15%
	Vesting Contract Settlement Credit (VCSC)			
Uplift Charges	Monthly Energy Uplift (MEUC)	<2%	<1%	<2%
	Hourly Energy Uplift (HEUC)			
	Net Energy Adjustment Debit (NEAD)			
Financial Adjustments	Net Metering Adjustment Amount (NMEA)	<1%	<1%	<1%
Administrative Charges	EMC Admin Fee	<1%	<1%	<1%
	PSO Admin Fee			

⁸ In this study, the retailer's actual risk exposure (ARE) and risk exposure (RE) are calculated using the actual historical credit support held by EMC with respect to the retailer. Prepayment and unpaid dues are excluded in the calculation of ANE and ENE, and corresponding ARE and RE.

⁹ Refer to EMC website for definitions of the cost components (<https://www.home.emcsg.com/glossary>)

¹⁰ Weightage is derived from total settlement amount data from 2020 to 2025 for retailers and the MSSL.

¹¹ The BESC of retailers is represented by negative percentage because it offsets the LESD in Energy Service.

Since a retailer's settlement amount is primarily driven by Energy Service and Financial Hedge Instruments, it could be calculated exactly during the Unknown Exposure Period if USEP, Withdrawal Energy Quantity (WEQ) and bilateral/vesting contracts were all known.

However, not all data is available to EMC at the time a retailer's ENE is calculated. The data availability of the components during the 20-day settlement cycle is summarised as follows:

- **Available in advance or real-time:** USEP¹², MEUC¹³, Administrative Fees, Bilateral Contracts¹⁴ and Vesting Contracts¹⁵.
- **Delayed or after the Unknown Exposure Period:** Actual WEQ¹⁶, HEUC¹⁷, FSD¹⁸, NEAD¹⁹ and NMEA²⁰.

At the time that EMC calculates a retailer's ENE, the retailer's USEP and hedge contracts are known while WEQ is not. However, EMC assesses that the unavailable WEQ can be reliably estimated based on two empirically supported observations:

1. **WEQ is stable.** Appendix C.1 shows that retailers' WEQ remains predictable and relatively constant, even when the USEP is volatile. Therefore, historical average WEQ is a reliable proxy for unknown WEQ.
2. **Settlement amounts correlate with USEP.** Appendix C.2 demonstrates strong negative correlation between settlement amounts and the USEP for most retailers from 2020 up to May 2026. However, there are instances where the correlations between settlement amounts and USEP weakens. Such instances could be attributed to the effects of bilateral or vesting contracts, which decouple settlement amounts from USEP. This observation is in line with the findings in Table 2 where financial hedge instruments (e.g. bilateral and vesting contracts) have substantial impact on settlement amounts for retailers and the MSSL.

3.3 *USEP-based method to estimate unknown exposure*

Therefore, EMC proposes to replace the 90-day ADE with a USEP-based method for retail electricity licensees and the MSSL. The method derives a "proxy WEQ" by removing the effect of financial hedges from the known exposure period (thereby isolating the underlying physical energy demand), averaging that quantity and applying the average to the latest available USEP to estimate exposure across the unknown period.

¹² The USEP is calculated and published ex-ante every half-hour.

¹³ The MEUC is estimated prior to the beginning of the calendar month, and its value is published on the first business day of that month

¹⁴ The contract quantities for bilateral energy, reserve or regulation contracts must be submitted to EMC at least 10 days before the dispatch day to which they apply.

¹⁵ The MSSL must submit the electronic data containing all relevant vesting quantities and prices at least 10 calendar days before the vesting period commences.

¹⁶ The exact WEQ of a retailer is not known in real-time. The MSSL requires time to read and validate meters and only submits this actual metering data to EMC 5 business days after the trading day.

¹⁷ The HEUC acts as a balancing item that captures the financial differences between the total amounts payable to generators and receivable from loads. These imbalances arise from transmission losses, inertia flows, and metering errors. As the HEUC calculation strictly relies on the final metered quantities, it is not published during the unknown period and is only made available after the actual metering data is processed.

¹⁸ FSD is a debit calculated as the interval's Allocated Regulation Price (AFP) multiplied by the retailer's WEQ.

¹⁹ NEAD is a debit applied to market participants who withdraw energy to recover the net adjustments caused by embedded generation facilities. The formula to calculate an MP's daily NEAD relies entirely on actualised physical quantities of an MP – Withdrawal Energy Quantity, Injection Energy Quantity and Withdrawal Price Quantity of Embedded Generators.

²⁰ NMEA captures the financial imbalances in the settlement system that arise when metering errors are discovered and corrected.

Table 3 outlines the exposure calculation by dividing the 20-day settlement cycle into three distinct periods based on data availability:

1. Known Exposure Period: Days where actual settlement amount and the USEP are known. Bilateral and Vesting Contract Settlement Credit are known.
2. Unknown Exposure Period: More recent days where only the USEP is known, but settlement amount is not known yet. Bilateral and Vesting Contract Settlement Credit are known.
3. Current Day: Today where settlement amounts and the USEP are unknown. Vesting Contract Settlement Credit is unknown. Bilateral contracts are known.

Table 3 General approach to estimate ENE (including current and unknown exposures) using USEP-based method

Period	Step	Description
Known Exposure Period	1) Calculate Current Exposure	Sum the actual settlement amounts of all the days in this period.
	2) Calculate daily proxy WEQ (with adjustment for hedges if applicable)	Divide daily settlement amount (with adjustments for hedges if applicable) by the USEP to obtain a daily proxy WEQ.
	3) Average proxy WEQ	Average the daily proxy WEQs over the known exposure period.
Unknown Exposure Period	4) Apply average proxy WEQ	Multiply the average proxy WEQ by the latest available daily USEP to estimate settlement amounts.
	5) Re-apply hedges	For retailers and the MSSL, specific hedges are reapplied to the estimated settlement amount in Step 4.
Current Day	6) Estimate Current Day	Average the exposures from the unknown exposure period to represent today.
Finally, sum the current exposure (Step 1), estimated unknown exposure (Step 4/5) and current day exposure (Step 6) to obtain the total ENE for current day.		

Step 6 estimates the current day by averaging the exposures derived for the unknown exposure period. EMC notes that this step reintroduces a small element of smoothing, since the current day is an average of the preceding days in the unknown exposure period, rather than from the latest available USEP. Nevertheless, the effect is limited because it applies to one day of a 20-day cycle, and the preceding days are estimated from the latest available USEP rather than from a 90-day average.

Tables 4, 5 and 6²¹ provide detailed examples of this method applied across unhedged retailer, hedged retailer and the MSSL.

- Retailer without bilateral contract (Table 4) is the most straightforward case, with no bilateral contracts to adjust for, so the proxy WEQ is just settlement amount divided directly by the USEP.

²¹ Figures in Tables 4, 5 and 6 have been scaled and do not represent actual settlement amounts of any MP. They are provided to demonstrate the calculation approach.

- Retailer with bilateral contract ([Table 5](#)) introduces a Bilateral Withdrawal Fraction (BWF) and tax adjustment into the denominator, because part of the retailer's Energy Service is offset through bilateral contracts, so this portion must be stripped out to isolate WEQ. Where a retailer fully covers its withdrawal with injection energy quantities, the net difference between Energy Service and bilateral contract is largely the prevailing Goods and Services Tax (GST) imposed on Energy Service, which the bilateral contract does not net off. Retailers may alternatively provide bilateral quantities as Bilateral Absolute Quantity (BAQ), refer to [Appendix D](#) for an example with BAQ input.
- The MSSL with vesting contracts ([Table 6](#)) introduces an estimated Vesting Contract Settlement Credit (VCSC), calculated from the difference between a hedge price (HP) and the USEP multiplied by hedge quantity (HQ) for each period, aggregated across the 48 periods of the day. Where USEP exceeds the vesting price, the MSSL receives a positive VCSC and the gencos must pay vesting debits to the MSSL. Where USEP is below the vesting price, the VCSC is negative, and the MSSL pays vesting debits to the gencos. The MSSL's settlement amounts therefore move in either direction depending on the vesting position. The VCSC is subtracted from the settlement amount before division by USEP, removing the hedging effect to reveal the MSSL's unhedged market exposure, as with the retailer case.

Table 4 Calculation of ENE for a retailer without bilateral contract using the USEP-based method

Date	Period	Settlement Amount (A)	USEP (B)	Proxy WEQ	Average proxy WEQ	Current Exposure	Unknown Exposure	Current Day Exposure	ENE on 20/1/2022
-	-	(A)	(B)	(C) = (A)/(B)	(D) = Average of (C)	(E) = -1*sum(A)	(F) = (D) * (B)	(G) = Average of (F)	(E) + (F) + (G)
1/1/2022	Known Exposure Period	-34,793,064.12	381.90	91,104.62	108,036.71	558,214,099.23			983,425,598.37
2/1/2022		-34,535,376.66	393.04	87,866.63					
3/1/2022		-50,184,799.50	446.95	112,284.01					
4/1/2022		-28,722,043.65	250.40	114,703.41					
5/1/2022		-32,931,101.19	297.79	110,585.60					
6/1/2022		-57,033,267.30	497.06	114,741.60					
7/1/2022		-55,346,624.88	451.24	122,653.95					
8/1/2022		-45,813,479.13	475.34	96,379.81					
9/1/2022		-54,016,886.64	596.78	90,513.46					
10/1/2022		-85,556,108.76	712.19	120,130.91					
11/1/2022		-40,690,578.33	352.32	115,492.42					
12/1/2022		-38,590,769.07	321.64	119,982.18					
13/1/2022	Unknown Exposure Period	Unknown	297.11				32,098,786.80		
14/1/2022			303.27				32,764,292.93		
15/1/2022			287.33				31,042,187.78		
16/1/2022			629.98				68,060,966.34		
17/1/2022			624.75				67,495,934.34		
18/1/2022			856.58				92,542,084.74		
19/1/2022			444.81				48,055,808.81		
20/1/2022	Current day		Unknown				Unknown	53,151,437.39	

Table 5 Calculation of ENE for a retailer with bilateral contract (in terms of BWF) using the USEP-based method

Date	Period	Settlement Amount	USEP	BWF	Proxy WEQ	Average proxy WEQ	Current Exposure	Unknown Exposure	Current Day Exposure	ENE on 18/1/2020
-	-	(A)	(B)	(C)	(D)=(A)/ (B)/ (1+GST-C)	(E) = Average of (D)	(F) = -1*sum(A)	(G) = (E)*(B)* (1+GST-C)	(H) = Average of (G)	(F) + (G) + (H)
30/12/2019	Known Exposure Period	-10,427.75	83.15	1	1,791.56	1,781.44	240,322.43			
31/12/2019		-8,343.09	74.34	1	1,603.27					
1/1/2020		-135,334.21	82.93	0	1,525.15					
2/1/2020		-17,715.15	129.69	1	1,951.37					
3/1/2020		-20,056.68	137.51	1	2,083.66					
4/1/2020		-11,135.54	86.81	1	1,832.50					
5/1/2020		-8,665.51	74.38	1	1,664.33					
6/1/2020		-9,182.75	76.72	1	1,709.88					
7/1/2020		-9,011.69	73.79	1	1,744.66					
8/1/2020		-10,450.05	78.24	1	1,908.06					
9/1/2020	Unknown Exposure Period	Unknown	74.52	1				9,292.72		334,906.77
10/1/2020			75.34	1				9,394.98		
11/1/2020			75.83	1				9,456.08		
12/1/2020			75.25	1				9,383.75		
13/1/2020			85.16	1				10,619.54		
14/1/2020			74.55	1				9,296.46		
15/1/2020			72.55	1				9,047.06		
16/1/2020			75.37	1				9,398.72		
17/1/2020			74.07	1				9,236.61		
18/1/2020	Current day		Unknown	1				Unknown	9,458.44	

Table 6 Calculation of ENE for the MSSL with vesting contract using the USEP-based method

Date	Period	Settlement Amount	USEP	Estimated VCSC	Proxy WEQ	Average proxy WEQ	Current Exposure	Unknown Exposure	Current Day Exposure	ENE on 30/7/2021
		(A)	(B)	(C) = (HP-USEP)*HQ @ Periodic level	(D) = [-1*(A) – (C)] /(B)	(E) = Average of (D)	(F) = - 1*sum(A)	(G) = (E)*(B)-(C)	(H) = Average of (G)	(F) + (G) + (H)
11/7/2021	Known Exposure Period	-589,108.82	98.95	181,885.39	4,115.45	4,314.30	5,677,157.73			13,718,842.26
12/7/2021		-598,703.25	100.34	177,730.89	4,195.46					
13/7/2021		-567,086.74	96.44	189,368.83	3,916.61					
14/7/2021		-567,254.95	96.19	190,101.83	3,920.92					
15/7/2021		-598,592.17	104.59	165,071.10	4,144.96					
16/7/2021		-641,102.52	113.03	139,910.55	4,434.15					
17/7/2021		-693,351.46	127.16	97,774.82	4,683.68					
18/7/2021		-680,090.23	115.1	133,743.40	4,746.71					
19/7/2021		-741,867.60	156.85	9,255.68	4,670.78					
20/7/2021	Unknown Exposure Period	Unknown	109.01	151,874.61				318,427.42		
21/7/2021			115.94	131,228.22				368,971.92		
22/7/2021			170.78	32,298.61				704,497.83		
23/7/2021			160.08	396.94				690,236.48		
24/7/2021			114.87	134,418.01				361,165.83		
25/7/2021			192.02	95,617.44				732,814.77		
26/7/2021			533.11	1,112,650.10				1,187,347.28		
27/7/2021			640.18	1,431,893.58				1,330,036.08		
28/7/2021			286.38	376,972.86				858,556.86		
29/7/2021			211.35	153,259.85				758,567.81		
30/7/2021	Current day		Unknown	Unknown				Unknown	731,062.23	

3.4 Impact Assessment of ENE methods

To assess accuracy, EMC compared the deviations of the current ADE-based ENE and the USEP-based ENE methods from the Actual Net Exposure (ANE) using average % absolute error in this study:

$$\text{Average \% absolute error} = \frac{1}{N} \sum_{i=1}^N \frac{|ANE_i - ENE_i|}{ANE_i} \times 100\%, \text{ for } ANE_i > 0$$

Where:

- ANE_i = Actual Net Exposure on day i
- ENE_i = Estimated Net Exposure on day i (either Current ENE or USEP-based ENE)
- N = number of days in the year (e.g., 365, or 366 for a leap year, or fewer if data is incomplete for that year)
- i = index running over each day in the year²²

Table 7 summarises the average percentage absolute error for eight retailers and three generators. A lower percentage indicates an ENE closer to the ANE. The “improvement” row shows the reduction in error achieved by the USEP-based method. Following are the key findings:

- **Accuracy:** Across all eight retailers and every year recorded, the USEP-based ENE consistently yields a much lower average percentage of absolute error.
- **Consistency:** The current ENE errors are volatile, with percentage error frequently spiking sharply and fluctuating unpredictably from year to year. For example, Retailers 2 and 7 saw their error jump to 32% in 2024 and 60% in 2022 respectively. In comparison, the USEP-based ENE errors stay low and stable throughout. For most retailers, the error rate remains consistently low, generally hovering between 1% and 5%. The exception is Retailer 7. At very low withdrawal volumes in 2024 and 2025, small daily variations in Retailer 7’s WEQ still produce material estimation error under the USEP-based method, albeit with a consistent improvement over the current method.
- **Sensitivity to hedge contracts:** For retailers with bilateral or vesting contracts, changes in bilateral quantities, hedge price and quantities can affect the accuracy of ENE calculation. If a retailer changes their bilateral quantity frequently, the current ENE method will exhibit higher error rate. In contrast, since the USEP-based ENE method takes into account the changes in bilateral or vesting contracts, it remains accurate despite those changes.
- **Adaptability:** Data is not available for some retailers in certain years, marked by ‘-’, likely reflecting when a retailer started operating or winding down their activities. Despite different operating modes (e.g. starting up, winding down, very low WEQ), the USEP-based method proves to be more robust for these retailers.
- **Limitation:** Generators are net creditors, with negative ANE, for most of the time, so the data for average % absolute error is marked by ‘-’ for those years. Both methods

²² Days on which an MP was a net creditor ($ANE_i \leq 0$) are excluded.

record errors of several hundred per cent, and the year-to-year swing in either direction, reflecting the instability of the USEP-based method. This is because the USEP-based method corrects for USEP volatility but not for WEQ uncertainty. The USEP-based method assumes constant withdrawal or negative injection quantity across the 20-day settlement cycle. However, this assumption does not hold for generators and wholesale market traders, whose positions can reverse rapidly on operational need or forced outage.

Table 7 Comparison of percentage absolute error between current ENE and USEP-based ENE against ANE on an annual basis from 2020 through May 2026

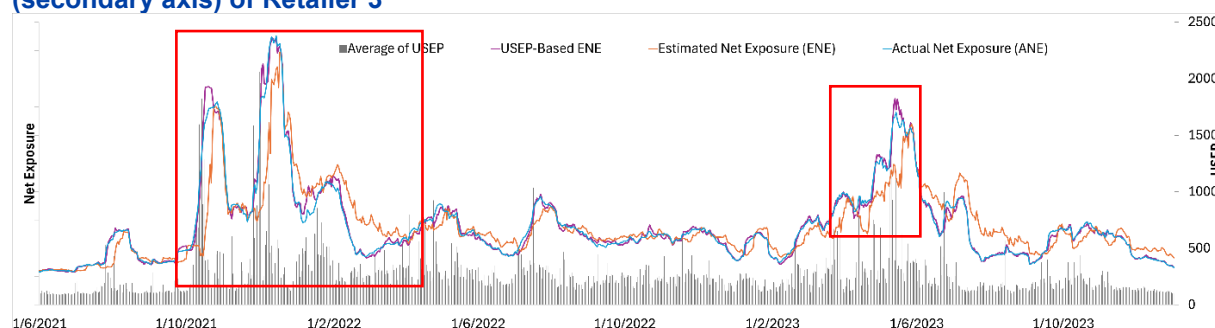
MP	Method	Average % absolute error						
		2020	2021	2022	2023	2024	2025	2026 (May)
Retailer 1	Current ENE	9%	9%	10%	22%	13%	8%	7%
	USEP-based ENE	2%	3%	4%	4%	2%	2%	3%
	Improvement	7%	6%	6%	18%	11%	6%	4%
Retailer 2	Current ENE	24%	16%	10%	15%	32%	12%	18%
	USEP-based ENE	1%	2%	2%	3%	2%	2%	2%
	Improvement	23%	14%	8%	12%	30%	11%	16%
Retailer 3	Current ENE	8%	9%	14%	19%	15%	8%	7%
	USEP-based ENE	2%	3%	4%	3%	3%	3%	2%
	Improvement	7%	7%	10%	16%	11%	5%	5%
Retailer 4	Current ENE	8%	10%	10%	17%	16%	8%	7%
	USEP-based ENE	2%	3%	3%	3%	3%	2%	3%
	Improvement	6%	7%	7%	14%	14%	6%	5%
Retailer 5	Current ENE	3%	7%	7%	14%	7%	4%	4%
	USEP-based ENE	1%	2%	2%	2%	2%	1%	1%
	Improvement	2%	5%	5%	12%	6%	3%	3%
Retailer 6	Current ENE	10%	11%	18%	31%	16%	10%	-
	USEP-based ENE	2%	2%	3%	4%	2%	2%	-
	Improvement	8%	8%	15%	28%	13%	8%	-
Retailer 7	Current ENE	8%	12%	60%	32%	44%	44%	14%
	USEP-based ENE	2%	3%	5%	4%	25%	37%	5%
	Improvement	6%	9%	55%	28%	19%	7%	9%
Retailer 8	Current ENE	-	-	11%	19%	13%	9%	9%
	USEP-based ENE	-	-	4%	3%	3%	2%	3%
	Improvement	-	-	7%	16%	11%	7%	6%
Generator 9 ²³	Current ENE	46%	82%	1,992%	56%	110%	56%	49%
	USEP-based ENE	45%	88%	1,396%	58%	115%	72%	57%

²³ Generator 9 is an embedded generator (EG). The extreme deviations observed in 2022 were caused by highly volatile net positions, as the EG switches between being a net creditor and debtor frequently throughout that year.

	Improvement	1%	-6%	597%	-2%	-6%	-17%	-9%
Generator 10 ²⁴	Current ENE	-	10%	0%	532%	8%	11%	189%
	USEP-based ENE	-	103%	3%	451%	59%	9%	33%
	Improvement	-	-93%	-3%	81%	-51%	3%	156%
Generator 11 ²⁵	Current ENE	-	-	4%	79%	-	-	-
	USEP-based ENE	-	-	2%	29%	-	-	-
	Improvement	-	-	2%	50%	-	-	-

To visualise how the current ENE and the USEP-based ENE move against the USEP, Retailer 3 is used as an example for the visual illustration of what [Table 7](#) quantifies (see [Figure 3](#)). The blue line represents the Actual Net Exposure (ANE), orange line represents the current ENE, purple line represents the USEP-based ENE and grey bars represent the daily USEP. As observed in [Figure 3](#), the purple line (USEP-based ENE) tracks the blue line (ANE) far more closely than the orange line does, throughout the whole period. The orange line diverges most sharply from blue exactly at the USEP spikes, for example around early 2022 and again in mid-2023, where the USEP (grey bars) surges. This mirrors the result in [Table 7](#) where Retailer 3's current ENE errors are particularly high in 2022 and 2023 because current ENE overshoots or undershoots when USEP move sharply. The current ENE does not adjust its estimate to the latest available USEP the way the USEP-based method does. Between the USEP spikes, both orange and purple lines hug the blue line reasonably well. This is consistent with the results in [Table 7](#) showing that even current ENE performs better in years with calmer USEP.

Figure 3 Movements of current ENE, USEP-based ENE and ANE (primary axis) and USEP (secondary axis) of Retailer 3



3.5 Impact on Retailers (including the MSSL)

Improved accuracy matters only if it translates into a more consequential measure. The risk exposure mechanism is an early warning system. Therefore, what matters is whether the method can correctly and in a timely fashion trigger margin calls when a retailer's actual risk exposure breaches the threshold.

²⁴ Generator 10 is an Embedded Generator. The large deviation observed in 2023 was mainly caused by a single event, where the EG switched unexpectedly from being a net creditor to a net debtor, with relatively significant positive exposure over a short period of time.

²⁵ Generator 11 displays empty values ('-') across multiple years because it typically operates as a net creditor. In this study, the average percentage absolute error is not calculated for net creditors (negative net exposure). Table 7 omits the remaining generators for the same reason; their frequent net creditor status results in empty values from 2020 to 2025.

In this study, risk exposure is calculated by dividing ENE by retailer's actual credit support posted with EMC. When this ratio crosses the margin call threshold, it signals the retailer's risk is no longer adequately covered by its credit support, and a margin call should be issued to request the retailer to top-up its credit support or make prepayments to lower its ENE.

Table 8 shows that across almost every retailer, the current ENE method misses more margin calls than the USEP-based ENE. When it does catch them, it also triggers them substantially later. The USEP-based ENE reduces missed margin calls to zero or near-zero for most retailers. When the actual risk exposure exceeds the threshold, the lag in margin call trigger using the USEP-based method is typically 1-2 days, compared to 6-9 days with the current ENE. Worse, the current ENE sometimes fails to trigger a margin call at all ("missed margin call" observed for Retailers 2, 3 and 4). Missed margin calls are more serious because the retailer's exposure risk went uncovered for an extended period.

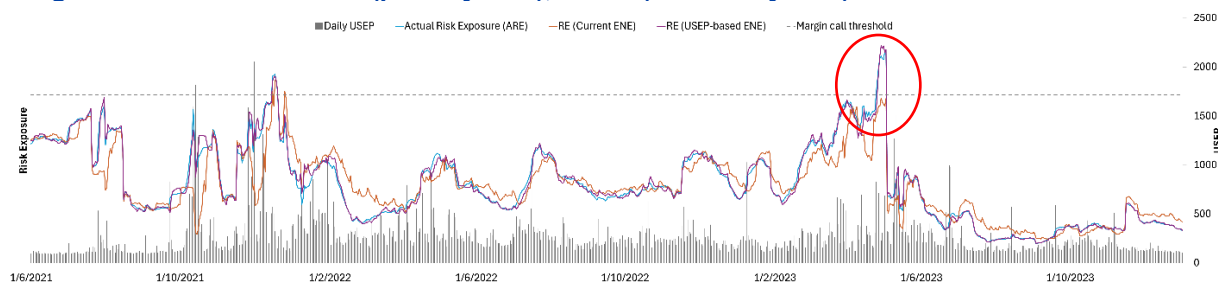
Table 8 Comparison of number of missed margin calls and average lag time in triggering margin call between current and USEP-based ENE from 2020 to 2026 (up to May 2026).²⁶

Retailer	Current ADE-based method		USEP-based method	
	Missed Margin Call	Average lag in margin call trigger	Missed Margin Call	Average lag in margin call trigger
Retailer 1	5	6.5 days	1	1 day
Retailer 2	4	Missed margin call	0	1 day
Retailer 3	1	Missed margin call	0	1 day
Retailer 4	2	Missed margin call	0	1 day
Retailer 5	6	9 days	1	2 days
Retailer 6	0	9 days	0	1 day
Retailer 7	0	8 days	0	1 day
Retailer 8	14	6 days	1	1 day

Figure 4 reflects the same observations for Retailer 3 in RE terms. The current ENE line (orange) can be seen lagging behind the Actual Risk Exposure line (Blue) and staying below the dashed margin call threshold even while actual exposure has already crossed it (on 25 April 2023). As such, no margin call was issued, and the market was left exposed to Retailer 3's default risk. In contrast, the RE for USEP-based ENE line (purple) tracks much closer to the blue ARE line, crossing the margin call threshold at nearly the same time as ARE does. As the USEP-based ENE is responsive enough to the underlying USEP price movement, it can detect the breach of threshold almost as soon as it occurs. This is why Retailer 3's USEP-based method triggers the margin call within 1 day.

²⁶ Generators are excluded from Table 8 because Table 7 showed that it is not meaningful to extend the USEP-based ENE method to generators.

Figure 4 Movements of RE (current ENE), RE (USEP-based ENE) and ARE (primary axis) and margin call threshold at 55% (primary axis), USEP (secondary axis) of Retailer 3



4. Proposed Solution

EMC therefore proposes to apply the USEP-based method to retailers and the MSSL. As shown in [Table 7](#), the USEP-based method reduced estimation error for every tested retailer, including the MSSL, in every year recorded. For most retailers, the error rate remains consistently low and stable even during volatile USEP conditions. The method also proves to be more robust for retailers with different operating modes (e.g. new retailers starting up, winding down and running at low WEQ), as well as for those that frequently change their bilateral or vesting position, which the USEP-based method accounts for.

This improvement in accuracy is important because the risk exposure mechanism is an early warning system and what ultimately matters is whether a margin call is triggered correctly and promptly when a retailer's actual risk exposure breaches the threshold. [Table 8](#) shows that the USEP-based ENE reduces missed margin calls to zero or near-zero for most retailers, and that where the threshold is breached, the trigger typically lags by 1–2 days compared with 6–9 days under the current method. A retailer's exposure would therefore be far better covered under the USEP-based method, particularly during periods of volatile USEP.

The same does not hold for other classes of MP, such as generators and wholesale market traders. As shown in [Table 7](#), the USEP-based method did not consistently perform better than the current ADE-based ENE method and in several years performed worse. This is because the USEP-based method corrects for USEP volatility but not for WEQ uncertainty: it assumes a constant withdrawal or negative injection quantity across the 20-day settlement cycle, an assumption that holds for retailers but not for MPs whose settlement positions can reverse rapidly on operational need or forced outage. EMC therefore proposes to retain the current ADE-based method for all other MPs. [Table 9](#) summarises the proposed ENE methods for different types of MP.

Table 9: Proposed ENE methods

	Retailers and the MSSL	Other MPs
Estimated Net Exposure	ENE = Current Exposure + Unknown Exposure – Prepayment + Unpaid Amount	
Current Exposure (X)	-1 x aggregate net settlement amounts set on all MP's PSS or FSS if available that are not yet due for payment on a given day.	
Unknown Exposure (20-X)	USEP-based method	ADE-based method (current ENE)

	Unknown exposure = Proxy WEQ x daily USEP (account for bilateral and vesting quantities)	Unknown exposure = (20-X) x Estimated ADE
New MPs	MP with < 20 days of trade: GST x Rolling 20-day average WEP x Maximum (ForecastedDailyWithdrawal or ActualDailyWithdrawal)	MP with < 90 days of trade: GST x Rolling 90-day average WEP x Maximum (ForecastedDailyWithdrawal or ActualDailyWithdrawal)

Other Considerations

The USEP-based method draws on daily USEP, settlement amounts and bilateral and vesting contract quantities, all of which EMC already maintains for settlement purposes. No new data, and no additional submission and reporting obligation is required from MPs. The incremental burden is a one-time change to EMC's risk exposure mechanism. Nevertheless, EMC anticipates that operational complexity may increase to maintain and run two ENE methods in parallel for different types of MPs. If this concept is supported, EMC will perform a detailed assessment of operational system changes and resources required to assess the feasibility of implementing the proposal.

Other considerations include the emergence of new classes of MPs or licensees in the future that may have very different business models and risk profiles (e.g. large energy storage operators) that may entail frequent switching of net settlement positions. In such cases, EMC could consider applying the ENE methods on a case-by-case basis, with defined criteria.

5. Consultation

This concept paper was published for industry consultation on 21 August 2026. The comments raised and EMC's responses are provided in Table 10.

Table 10: Summary of industry comments and EMC's responses

S/N	Comment Received	EMC Response
<i>Comments from Senoko Energy</i>		
1.	Overall comments - Senoko supports EMC's objective of improving the accuracy and responsiveness of the Risk Exposure (RE) framework. An accurate and timely prudential monitoring mechanism is important to ensure adequate credit support coverage and reduce the risk of uncovered market exposures during periods of market volatility.	EMC appreciates Senoko Energy's comments.
2.	3.1 Adequacy of Current RE and ENE Methods - Senoko acknowledges EMC's findings that the current ADE-based methodology may understate estimated exposure during periods of elevated USEP volatility, resulting in delayed or missed margin call triggers. Enhancing responsiveness during	

	stressed market conditions would strengthen the effectiveness of the prudential framework.	
3.	3.3 USEP-Based Methods to Estimate Unknown Exposure - We agree that retailers' settlement exposures are largely correlated to USEP and that a USEP-based methodology appears more reflective of current market conditions than a historical 90-day rolling average. The proposed methodology is expected to improve the timeliness and accuracy of exposure estimation for retailers and the MSSL during the unknown exposure period.	
4.	Proposed Solution - Senoko supports EMC's proposal to apply the USEP-based ENE methodology to retail electricity licensees and the MSSL while retaining the current ADE-based methodology for generators and wholesale market traders. EMC's analysis demonstrates that generators' withdrawal and negative injection quantities are less predictable, making the USEP-based approach unsuitable for those participant classes.	
5.	Others - Senoko notes EMC's intention to review the adequacy of the Credit Support Value (CSV) framework following implementation. Given the expected improvement in ENE accuracy and earlier detection of exposure risks, EMC should assess whether existing CSV requirements remain appropriate and proportionate, while ensuring continued market protection and avoiding unnecessary prudential burden on market participants.	
<i>Comments from Keppel Electric</i>		
6.	Keppel proposes that retailers who have BESC arrangements with generators continue to be assessed under the existing 90-day ADE methodology. Such retailers are naturally hedged as their exposures are backed by generator licensees. As EMC has noted, where withdrawals are covered by bilateral quantities, the residual exposure is largely limited to GST-related obligations, resulting in a materially different credit risk profile	EMC considers that the USEP-based method is more suitable than the 90-day ADE method for retailers with BESC arrangements. The USEP-based method accounts for bilateral arrangements, so a naturally hedged retailer's lower exposure is automatically reflected in its ENE. Retailers also have the flexibility to change their bilateral quantities, and where withdrawals are only partially covered, the

	compared to a retailer without BESC arrangements.	residual exposure may be material. Even where withdrawals are fully covered, the residual GST amount is exposed to USEP movement: GST applies to the Load Energy Settlement Debit (LESD), which is directly dependent on USEP. For some hedged retailers, that residual GST amount is larger than the settlement amounts of smaller unhedged retailers.
<i>Comments from PacificLight Power</i>		
7.	We support EMC's proposed USEP-based Estimated Net Exposure (ENE) methodology to be applied to retailers and MSSL as it provides a more accurate and timely reflection of retailer risk exposure. The proposal should improve collateral efficiency by enabling more meaningful credit support adjustments while strengthening prudential oversight, as supported by the significant improvement in the number of missed margin calls and lag time in margin call triggers.	EMC appreciates PacificLight Power's comments.
8.	Nonetheless, we recommend EMC to consider refining the methodology to improve the residual errors as follows: a) Adopt day-type based proxy WEQ (weekday, Saturday, Sunday, public holiday); and b) Adopt maximum exposure across Known and Unknown Exposure period based on the same day type to estimate Current Day Exposure.	EMC agrees that a retailer's WEQ varies systematically by day type. If the concept is supported, EMC could assess the day-type segmented proxy WEQ against the single-average approach and weigh any accuracy improvement against the additional complexity. EMC agrees that the estimation for Current Day Exposure is the least accurate estimate. However, EMC is cautious about adopting maximum exposure because it would introduce systematic upward bias into the ENE. This goes against the objective of tracking actual net exposure more accurately and optimizing credit support efficiency.
<i>Comments from Seraya Energy</i>		
9.	a) The examples in the proposal to estimate ENE only include negative daily Settlement Amount. How would the calculation change for retailers with positive daily Settlement Amount (i.e., EMC pays Retailer)?	Following Seraya Energy's comment, EMC has streamlined the USEP-based formula so that a single formula applies to all retailers — unhedged retailers, retailers with BAQ or BWF input, and retailers with positive settlement amounts. Please refer to Appendix E . The approach and principle of the method are unchanged; Appendix E consolidates the formulas in Tables 4 and 5 and Appendix D . But please note that the formulas set out in this paper may be

		refined further during the detailed design and system change stage.
	b) When NEMS Maintenance occurs and USEP is unavailable, what will be the temporary solution for those affected periods?	EMC agrees that a fallback mechanism is required where USEP is unavailable. But EMC assesses that the impact is limited because the USEP-based ENE method uses the previous day's published USEP. A delay in publication during NEMS maintenance would therefore not affect the ENE calculation, provided the affected USEP becomes available before the next daily ENE run. If the concept is supported by the RCP, EMC will confirm the fallback as part of the detailed design and system change assessment and set it out in the relevant Market Rules.
<i>Comments from EMC Markets and Operations</i>		
10.	The EMC Markets and Operations team acknowledges the intent of CP105 to improve the accuracy and responsiveness of the daily Risk Exposure (RE) mechanism in the National Electricity Market of Singapore (NEMS).	EMC notes Markets and Operations' views on the proposal.
11.	However, we have several concerns regarding the proposed methodology. a) Increased Complexity. The proposed approach introduces multiple participant-specific methodologies, with distinctions based on participant type, trading period, bilateral contracts, and vesting contracts. This significantly increases the complexity of Estimated Net Exposure (ENE) calculations, making prudential outcomes more difficult not only for EMC Markets and Operations to administer but also market participants to monitor, validate, and predict, particularly where an MP have different ENE calculation scenarios to manage.	EMC agrees that operational complexity is a relevant consideration and will assess the system changes and resources required if the concept is supported. The proposal introduces one additional method rather than multiple MP-specific methodologies. As set out in Table 9, there are two methods: the USEP-based method for retail electricity licensees and the MSSL, and the current ADE-based method for all other MPs. The streamlined formula in Appendix E applies to all retailers, and each MP falls into one class only, so no MP has multiple ENE formulas to manage. This distinction between the two methods is deliberate. A uniform method would mean either extending a method that is unsuited to some MPs or forgoing a material improvement for retailers, which accounts for the highest exposure and 95% of margin calls in the NEMS since 2020. EMC considers that administrative uniformity does not justify that trade-off. On predictability, the USEP-based method is more transparent than the current one.

		Its inputs (e.g. daily USEP and the MP's own bilateral or vesting quantities) are observable to the MP in near real time, whereas the 90-day ADE is a rolling average of past settlement statements that may not reflect changes in a retailer's current portfolio.
	b) High Implementation and Ongoing Costs. The proposed methodology would require substantial system development and implementation effort. Given the number of calculation pathways involved, extensive validation would be required to ensure that the calculations are accurate. These implementation costs would be borne by the market and should therefore be carefully weighed against the incremental benefits of improved ENE estimation accuracy. EMC Markets and Operations recommends that a comprehensive cost-benefit analysis be conducted before the endorsement of this proposed methodology.	EMC considers implementation cost an important consideration to be weighed against the benefit. This paper currently seeks in-principle support. If the concept is supported by the RCP, EMC will assess in detail the system changes and resources required.
	c) Risk Exposure for Other MPs. EMC Markets and Operations would also like the paper to address situations where Generation Companies (Gencos) or Embedded Generators (EGs) experience shifts in market net exposure such as movements from creditor to debtor positions during generating units' maintenance to better safeguard the financial integrity of the market.	EMC agrees that the paper does not resolve how Gencos and EGs are best monitored, and notes that their current ADE-based ENE method is unchanged by the proposal. As Gencos are structurally net creditors and none has been issued a margin call in recent years, EMC suggests prioritising retailers and the MSSL, which carry substantive net positive exposure on regular basis and account for 95% of margin calls since 2020.

12.	Separately, EMC Markets and Operations team would like to propose for EMC to look into strengthening the existing First ENE Notification framework. Instead of requiring MPs to take action only when a margin call is issued, the following could be considered when a MP receives a First ENE Notification: • Assess the adequacy of their credit support, • Provide additional credit support and/or prepayment, and • Be subject to enhance monitoring if elevated risk exposure persists e.g., consider subjecting the MP to lower alert threshold for a period of time.	EMC welcomes this proposal and views it as complementary to CP105. The First ENE Notification framework is only as reliable as the ENE that triggers it: under the current method, notification at 45% can be reached late or missed entirely where the ENE understates actual exposure. As the proposal concerns the design of the notification and threshold framework rather than the ENE method, EMC proposes that it be considered alongside the review of the Credit Support Value mechanism.
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6. Conclusion and Recommendation

The current ENE method relies on a rolling 90-day ADE to estimate settlement data for the days on which metered data is unavailable for all MPs. Analysis of historical NEMS data from 2020 to May 2026 showed that this approach understated some MPs' ENE during volatile market conditions, delaying margin calls at the moment they matter most.

EMC proposes a USEP-based ENE method for retail electricity licensees and the MSSSL. This method estimates unknown exposure using the latest available daily USEP during the unknown period. Our analysis concludes that this significantly improves the timeliness and accuracy of net exposure monitoring and margin call triggers for retail electricity licensees and the MSSSL.

The USEP-based method is not suitable for other classes of MPs (including generators and wholesale traders), whose withdrawal and negative injection quantities are not predictable.

Therefore, EMC recommends that the RCP:

- a) support in-principle to adopt the USEP-based ENE method for retail electricity licensees and the MSSSL, and to retain the current ADE-based ENE method for all other classes of MPs; and
- b) task EMC to assess the system changes and resources required to implement the method and to report to the RCP before proposing the required rule changes.

7. Decision at 155th RCP Meeting

The concept paper was discussed at the 155th RCP meeting. The panel **by majority vote**:

- a) supported in-principle to adopt the USEP-based ENE method for retail electricity licensees and the MSSSL, and to retain the current ADE-based ENE method for all other classes of MPs; and

- b) tasked EMC to assess the system changes and resources required to implement the method and to report to the RCP before proposing the required rule changes.

The following RCP members supported EMC's recommendation:

1. Mr. Andrew Tan (Representative of Retail Electricity Licensee)
2. Mr. Cheong Zhen Siong (Representative of Wholesale Electricity Trader)
3. Mr. Dallan Kay (Representative of Retail Electricity Licensee)
4. Mr. Fong Yeng Keong (Representative of Consumers of Electricity in Singapore)
5. Mr. Teo Chin Hau (Representative of Generation Licensee)
6. Dr. Toh Mun Heng (Representative of Consumers of Electricity in Singapore)
7. Mr. Wong Yew Chung (Person experienced in Financial Matters in Singapore)

The following RCP members abstained from voting:

1. Mr. Henry Gan (Representative of EMC)
2. Mr. Sherman Toh (Representative of Transmission Licensee)
3. Ms. Teo Swee Teng (Representative of Market Support Services Licensee)

Appendix A: List of Participants in NEMS (as of 31 December 2025) and their classification in this paper

No.	Category in this paper	Participant / Service Provider	EMA Licence
1	Retailer	Bioenergy	Retail Electricity Licensee
2	Retailer	Cleantech Solar Singapore Assets	Retail Electricity Licensee
3	Retailer	Diamond Electric	Retail Electricity Licensee
4	Retailer	Engie South East Asia	Retail Electricity Licensee
5	Retailer	Flo Energy Singapore	Retail Electricity Licensee
6	Retailer	Just Electric	Retail Electricity Licensee
7	Retailer	Keppel Electric	Retail Electricity Licensee
8	Retailer	MyElectricity*	Retail Electricity Licensee
9	Retailer	Sunseap Energy	Retail Electricity Licensee
10	Retailer	Union Power	Retail Electricity Licensee
11	Retailer	PacificLight Energy	Retail Electricity Licensee
12	Retailer	Sembcorp Power	Retail Electricity Licensee
13	Retailer	Senoko Energy Supply	Retail Electricity Licensee
14	Retailer	Seraya Energy	Retail Electricity Licensee
15	Retailer	Tuas Power Supply	Retail Electricity Licensee
16	Retailer	SP Services	Market Support Services Licensee
17	Generators	Aster Chemicals and Energy*	Generation Licensee
18	Generators	ExxonMobil Asia Pacific	Generation Licensee
19	Generators	Keppel Merlimau Cogen	Generation Licensee
20	Generators	Keppel Sakra Cogen*	Generation Licensee
21	Generators	Keppel Seghers Tuas Waste-to-Energy Plant (Tuas DBOO Trust)	Generation Licensee
22	Generators	Linde Gas Singapore	Generation Licensee
23	Generators	Meranti Power*	Generation Licensee
24	Generators	National Environment Agency	Generation Licensee
25	Generators	PacificLight Power	Generation Licensee
26	Generators	Sembcorp Cogen	Generation Licensee
27	Generators	Sembcorp Floating Solar Singapore	Generation Licensee
28	Generators	Sembcorp Solar Singapore	Generation Licensee
29	Generators	Senoko Energy	Generation Licensee
30	Generators	Senoko Waste-to-Energy	Generation Licensee
31	Generators	Singapore Refining Company	Generation Licensee
32	Generators	Taser Power	Generation Licensee
33	Generators	TP Utilities	Generation Licensee
34	Generators	Tuas Power Generation	Generation Licensee
35	Generators	TuasOne	Generation Licensee
36	Generators	YTL PowerSeraya	Generation Licensee
37	Wholesale Market Traders	Air Liquide Singapore	Electricity Wholesaler Licensee
38	Wholesale Market Traders	BEWGI-UE NEWater	Electricity Wholesaler Licensee
39	Wholesale Market Traders	Blue Whale Energy*	Electricity Wholesaler Licensee
40	Wholesale Market Traders	Crystal Clear Environmental	Electricity Wholesaler Licensee
41	Wholesale Market Traders	Green Power Asia	Electricity Wholesaler Licensee
42	Wholesale Market Traders	HSBC Institutional Trust Services (Singapore)	Electricity Wholesaler Licensee

43	Wholesale Market Traders	JE Green Solutions	Electricity Wholesaler Licencee
44	Wholesale Market Traders	Keppel DHCS*	Electricity Wholesaler Licencee
45	Wholesale Market Traders	Keppel EaaS*	Electricity Wholesaler Licencee
46	Wholesale Market Traders	LYS Genco Beta	Electricity Wholesaler Licencee
47	Wholesale Market Traders	PSA Corporation	Electricity Wholesaler Licencee
48	Wholesale Market Traders	Public Utilities Board	Electricity Wholesaler Licencee
49	Wholesale Market Traders	Seatrium ACE*	Electricity Wholesaler Licencee
50	Wholesale Market Traders	Singapore District Cooling	Electricity Wholesaler Licencee
51	Wholesale Market Traders	Singapore LNG Corporation	Electricity Wholesaler Licencee
52	Wholesale Market Traders	SolarLand Alpha Assets	Electricity Wholesaler Licencee
53	Wholesale Market Traders	Sungreen Energy*	Electricity Wholesaler Licencee
54	Wholesale Market Traders	Sunseap Commercial Assets	Electricity Wholesaler Licencee
55	Wholesale Market Traders	Sunseap Leasing	Electricity Wholesaler Licencee
56	Wholesale Market Traders	SP Energy Services*	Electricity Wholesaler Licencee
57	Wholesale Market Traders	Terrenus Energy SL1X	Electricity Wholesaler Licencee
58	Wholesale Market Traders	Terrenus Energy SL2	Electricity Wholesaler Licencee
59	Wholesale Market Traders	Terrenus Energy SR3	Electricity Wholesaler Licencee
60	Wholesale Market Traders	Yang Solar*	Electricity Wholesaler Licencee
61	Wholesale Market Traders	9 Solar Fintech*	Electricity Wholesaler Licencee

* The following market participant changes took place in 2025: - Aster Chemicals and Energy, Seatrium ACE, Keppel Sakra Cogen, Sungreen Energy, Blue Whale Energy, Yang Solar, MyElectricity, Keppel EaaS, 9 Solar Fintech, Keppel DHCS and SP Energy Services joined the market in January, February, February, April, July, July, August, August, September, September and December respectively. - Shell Singapore withdrew from the market in April.

Appendix B – Illustration of Estimated Net Exposure (ENE) and Actual Net Exposure (ANE) calculations

Trading Day	Daily USEP	Settlement Amount	Period	ENE on 30/7/2021	ANE on 30/7/2021
11/7/2021	98.95	- 2,980.55	Known Exposure	Current Exposure = -1 x sum of net settlement amounts known on 30/7/2021 but not due (e.g. from 11 to 19 July 2021) = 37,853.62	Sum of Actual Net Exposure (ANE) from 11 to 30 July 2021 = 153,844.60
12/7/2021	100.34	- 3,793.39			
13/7/2021	96.44	- 3,365.00			
14/7/2021	96.19	- 3,521.17			
15/7/2021	104.59	- 3,972.83			
16/7/2021	113.03	- 4,642.23			
17/7/2021	127.16	- 4,847.57			
18/7/2021	115.10	- 3,944.88			
19/7/2021	156.85	- 6,786.00			
20/7/2021	109.01	- 3,599.08	Unknown Exposure	Unknown Exposure=(20-X) x Estimated ADE = (20-9) x 3,417.84 = 37,596.24	
21/7/2021	115.94	- 4,837.77			
22/7/2021	170.78	- 7,085.14			
23/7/2021	160.08	- 6,710.89			
24/7/2021	114.87	- 3,721.03			
25/7/2021	192.02	- 5,920.42			
26/7/2021	533.11	- 25,067.65			
27/7/2021	640.18	- 28,880.61			
28/7/2021	286.38	- 12,694.85			
29/7/2021	211.35	- 7,960.27			
30/7/2021	240.27	- 9,513.27			
Calculated Exposure (Prepayment and Unpaid Amount are not considered in this study)				\$75,449.90	\$153,844.60
Assume the MP provides \$158,400 of actual credit support				RE = 75,449.90/158,400 = 48% (no margin call)	ARE = 153,844.60/158,400 = 97% (should have issued margin call)

Appendix C.1 – Coefficient of variation (CV) of retailers for WEQ and USEP

The Coefficient of Variation (CV) is a statistical measure used to quantify the relative dispersion or volatility of data points around their mean. It is calculated using the formula:

$$CV = \frac{\text{Standard Deviation}}{\text{Mean}}$$

In this analysis, the CV is used to provide a comparable comparison of volatility between two entirely different metrics: the Uniform Singapore Energy Price (USEP) measured in dollars, and the Withdrawal Energy Quantity (WEQ) measured in MWh. By standardizing the measurement of volatility, the CV data supports the assumption of the proposed USEP-based ENE method.

As the table below demonstrates, the CV for retailers' WEQ is materially lower than the CV for the USEP for most retailers in most years. This indicates that a retailer's WEQ remains stable, even when spot prices experience extreme fluctuations. Because the WEQ is stable, it is reasonable to derive a "Proxy WEQ" from the known period and apply it to the unknown period to estimate an MP's exposure.

Retailers	2020		2021		2022		2023		2024		2025		2026	
	WEQ	USEP	WEQ	USEP	WEQ	USEP	WEQ	USEP	WEQ	USEP	WEQ	USEP	WEQ	USEP
Retailer 1	0.06	0.37	0.05	1.35	0.09	0.46	0.07	0.74	0.11	0.65	0.06	0.36	0.05	0.23
Retailer 2	0.08	0.37	0.08	1.35	0.06	0.46	0.09	0.74	0.10	0.65	0.05	0.36	0.04	0.23
Retailer 3	0.08	0.37	0.04	1.35	0.06	0.46	0.25	0.74	0.05	0.65	0.06	0.36	0.02	0.23
Retailer 4	0.08	0.37	0.05	1.35	0.09	0.46	0.13	0.74	0.08	0.65	0.06	0.36	0.05	0.23
Retailer 5	0.23	0.37	0.29	1.35	-	0.46	-	0.74	-	0.65	-	0.36	-	0.23
Retailer 6	-	0.37	1.16	1.35	0.21	0.46	0.13	0.74	0.17	0.65	0.09	0.36	0.10	0.23
Retailer 7	0.21	0.37	0.10	1.35	0.40	0.46	0.49	0.74	0.11	0.65	0.11	0.36	-	0.23

Note: CVs of WEQ of generators and wholesale traders are not calculated because their withdrawal or negative injection energy quantities are highly infrequent.

Appendix C.2 – Average annual correlation between retailers’ settlement dues and the USEP

In the NEMS, a retailer’s settlement due primarily consists of the Load Energy Settlement Debit (LESD), representing their financial liability for purchasing electricity from the spot market. As LESD is recorded as negative values in the settlement system, a strong negative correlation (approaching -1.0) indicates that as the USEP increases, the retailer’s settlement due proportionally increases (becomes more negative).

Selected retailers	Correlation between retailer’s settlement amount and USEP						
	2020	2021	2022	2023	2024	2025	2026
Retailer 1	-0.98	-0.99	-0.93	-0.98	-0.94	-0.83	-0.96
Retailer 2	-0.96	-0.98	-0.94	-0.98	-0.98	-0.94	-0.96
Retailer 3	-0.68	-1.00	-0.92	-0.69	-0.79	-0.51	-0.75
Retailer 4	-0.47	-0.99	-0.96	-0.98	-0.98	-0.90	-0.90
Retailer 5	-0.92	-0.99	-	-	-	-	-
Retailer 6	-	-0.95	-0.81	-0.98	-0.97	-0.97	-0.97
Retailer 7	-0.92	-1.00	-0.86	-0.93	-0.99	-0.97	-

Note: Correlations between generator’s and wholesale trader’s settlement amount and USEP are not analysed because their negative dues (withdrawal or negative injection energy quantities) are highly infrequent.

Appendix D – Illustration of USEP-based ENE calculation with Bilateral Absolute Quantity (BAQ) input

Note: If a MP has no BAQ, the MP can input '0' in column C

Date	Period	Settlement Amount	USEP	BAQ	Proxy WEQ	Average proxy WEQ	Current Exposure	Unknown Exposure	Current Day Exposure	ENE on 18/1/2020
-	-	(A)	(B)	(C)	(D) = - 1*(A)/(B) + (C)	(E) = Average of (D)	(F) = -1*sum(A)	(G) = (B)* [(E)-(C)]	(H) = Average of (G)	(F) + (G) + (H)
30/12/2019	Known Exposure Period	-203,341.19	83.15	1,500	3,945.47	3,968.68	2,250,611.51			4,123,080.83
31/12/2019		-162,690.29	74.34	1,500	3,688.46					
1/1/2020		-203,341.19	82.93	1,500	3,951.96					
2/1/2020		-345,445.52	129.69	1,500	4,163.62					
3/1/2020		-391,105.35	137.51	1,500	4,344.20					
4/1/2020		-217,143.00	86.81	1,500	4,001.36					
5/1/2020		-168,977.36	74.38	1,500	3,771.81					
6/1/2020		-179,063.61	76.72	1,500	3,833.99					
7/1/2020		-175,728.00	73.79	1,500	3,881.46					
8/1/2020		-203,776.02	78.24	1,500	4,104.50					
9/1/2020	Unknown Exposure Period	Unknown	74.52	1,500				183,966.32		
10/1/2020			75.34	1,500				185,990.64		
11/1/2020			75.83	1,500				187,200.30		
12/1/2020			75.25	1,500				185,768.46		
13/1/2020			85.16	1,500				210,233.12		
14/1/2020			74.55	1,500				184,040.38		
15/1/2020			72.55	1,500				179,103.01		
16/1/2020			75.37	1,500				186,064.70		
17/1/2020			74.07	1,500				182,855.42		
18/1/2020	Current day	Unknown	1,500				Unknown	187,246.93		

Appendix E – Illustration of the streamlined single USEP-based formula that applies to all retailers

Example of a retailer with both BAQ and BWF input, and positive settlement amounts

Date	Period	Settlement Amount	USEP	BAQ	BWF	Proxy WEQ	Average Proxy WEQ	Current Exposure	Unknown Exposure	Current Day Exposure	ENE on 20/6/2026
		(A)	(B)	(C)	(D)	(E) = [(-A/B)+C]/(1+GST-D)	(F)=Average of (E)	(G)=-1*sum(A)	(H)=[(F)*(1+GST-D)-C]*B	(I)=Average of (H)	(G)+(H)+(I)
1/6/2026	Known Exposure Period	13,477.66	187.52	280	1	2,313	2,315	-174,506			
2/6/2026		15,923.76	208.04	280	1	2,261					
3/6/2026		17,730.60	259.46	280	1	2,352					
4/6/2026		18,003.65	251.87	280	1	2,317					
5/6/2026		21,867.91	292.12	280	1	2,279					
6/6/2026		29,803.88	295.31	280	1	1,990					
7/6/2026		18,000.13	225.77	280	1	2,225					
8/6/2026		11,093.99	252.49	280	1	2,623					
9/6/2026		16,874.77	254.96	280	1	2,376					
10/6/2026		11,729.18	186.40	280	1	2,412					
11/6/2026	Unknown Exposure Period	Unknown	223.82	280	1				- 16,043.12		-305,234
12/6/2026			188.32	280	1				-13,498.71		
13/6/2026			168.21	280	1				-12,057.29		
14/6/2026			166.90	280	1				-11,963.13		
15/6/2026			173.39	280	1				-12,428.16		
16/6/2026			182.79	280	1				-13,102.60		
17/6/2026			184.42	280	1				-13,218.87		
18/6/2026			181.14	280	1				-12,983.96		
19/6/2026			172.43	280	1				-12,360.01		
20/6/2026	Current day		Unknown	280	1				Unknown	-13,072.87	