Energy Market Company

Notice of Market Rules Modification

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Rule Reference:	Chap 6 Sec 7.7, 9.2 App 6C & 6D
Proposer:	EMC, Market Admin
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The hourly energy uplift rebate (HEUR) captures differences between total amounts receivable from retailers and total amounts payable to generators for energy, reserve and regulation. As its calculation relies on metering data, the value of HEUR for a given settlement interval is only finalised 10 business days after the trading day.

This paper assesses the proposal for EMC to publish real-time estimates of the HEUR. Provision of real-time estimates of HEUR would enable retailers to assess their exposure to spot price fluctuations in a more timely way, thereby allowing them to better manage their risk arising from spot price exposure, especially when there is significant nodal price separation.

Since the value of actual HEUR is primarily determined by the Net Energy Settlement Credit (NESC), we examined a proposed methodology (set out in section 3.2 of this paper) which uses appropriate proxy values from the real-time and/or forecast schedules as substitutes for the inputs used in calculating the sub-components of the NESC, so as to estimate the HEUR ex-ante (“Estimated HEUR”).

The proposed methodology was applied to calculate the Estimated HEUR for all settlement intervals from 1 January 2015 to 31 December 2015. The results show that Estimated HEUR is quite close to the Simplified Actual HEUR (i.e. the NESC component of Actual HEUR), with 88.2% of the magnitude deviations below $1.00/MWh. The Estimated HEUR also exhibits similar trend as Simplified Actual HEUR.

The Estimated HEUR will, however, always differ from the Actual HEUR due to intertie imbalances, price revisions, metering errors and metering adjustments.

At its 88th meeting, the RCP by majority vote **supported** EMC’s proposed methodology set out in section 3.2 of this paper to provide real-time estimates of HEUR, and tasked EMC to draft the relevant rule modifications.

At its 89th RCP meeting, the RCP unanimously **supported** the proposed rule modifications and recommends that the EMC Board **adopt** the proposed rule modifications as set out in **Annex 3**.

Date considered by Rules Change Panel:	06 September 2016
Date considered by EMC Board:	13 October 2016
Date considered by Energy Market Authority:	31 October 2016

Proposed rule modification:

See attached paper.

Reasons for rejection/referral back to Rules Change Panel (if applicable):

Energy Market Company

PAPER NO.	:	**EMC/BD/07/2016/06**
RCP PAPER NO.	:	**EMC/RCP/89/2016/337**
SUBJECT	:	**PROVISION OF REAL-TIME ESTIMATES OF THE HOURLY ENERGY UPLIFT REBATE**
FOR	:	**DECISION**
PREPARED BY	:	**YAP YUN BEN** **ECONOMIST**
REVIEWED BY	:	**PAUL POH LEE KONG** **EVP, MARKET ADMINISTRATION**
DATE OF MEETING	:	**13 OCTOBER 2016**

Executive Summary

The hourly energy uplift rebate (HEUR) captures differences between total amounts receivable from retailers and total amounts payable to generators for energy, reserve and regulation. As its calculation relies on metering data, the value of HEUR for a given settlement interval is only finalised 10 business days after the trading day.

This paper assesses the proposal for EMC to publish real-time estimates of the HEUR. Provision of real-time estimates of HEUR would enable retailers to assess their exposure to spot price fluctuations in a more timely way, thereby allowing them to better manage their risk arising from spot price exposure, especially when there is significant nodal price separation.

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The proposed methodology was applied to calculate the Estimated HEUR for all settlement intervals from 1 January 2015 to 31 December 2015. The results show that Estimated HEUR is quite close to the Simplified Actual HEUR (i.e. the NESC component of Actual HEUR), with 88.2% of the magnitude deviations below $1.00/MWh. The

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At its 88th meeting, the RCP by majority vote **supported** EMC's proposed methodology set out in section 3.2 of this paper to provide real-time estimates of HEUR, and tasked EMC to draft the relevant rule modifications.

At its 89th RCP meeting, the RCP unanimously **supported** the proposed rule modifications and recommends that the EMC Board **adopt** the proposed rule modifications as set out in **Annex 3**.

1. Introduction

This paper assesses the proposal for EMC to publish real-time estimates of hourly energy uplift rebate (HEUR). The intent of the proposal is to enable market participants (MPs) to assess their financial positions in a more timely way, particularly when there is significant nodal price separation.

2. Background

2.1 Purpose of Hourly Energy Uplift Rebate

The HEUR captures settlement differences between total amounts receivable from retailers and total amounts payable to generators for energy, reserve and regulation, and distributes it to loads based on their withdrawal energy quantities (WEQ) for that settlement interval.

As it relies on metering data, HEUR is first computed 6 business days (BD) after the trading day (based on metering data used in the preliminary settlement statement), but is subject to revision and **finalised 10 BD after the trading day** (based on metering data used in the final settlement statement). We refer to the finalised HEUR as Actual HEUR in this paper.

2.2 Factors Contributing to Variation in HEUR

HEUR varies each settlement interval and is computed using the following formula:

$$\text{Actual HEUR} = \frac{\text{Hourly Energy Uplift Amount (HEUA)}}{\sum_a \text{WEQ}}$$

$$= \frac{\sum_a (\text{NESC} + \text{NRSC} + \text{NTSC} + \text{NFSC} + \text{NMEA})}{\sum_a \text{WEQ}}$$

Each component of HEUA and their impact on HEUR is discussed in Table 1.

Table 1: Components of HEUA

Component	Description	Impact on HEUR
Net Energy Settlement Credits (NESC)	This component captures the difference between the amount receivable and payable by EMC for energy settlement. Variation in this component could be due to several factors including difference in settlement prices applied to loads and generators (i.e. USEP[1] and MEP[2] respectively), difference between IEQ[3] and WEQ due to transmission losses, transmission constraints, intertie imbalances and metering error.	Given that most of the factors that contribute to the variation in this component will persist in each settlement interval, this component is a **major determinant of HEUR**.

[1] Uniform Singapore Energy Price (USEP, in $/MWh), which is the load weighted-average of nodal prices at all off-take nodes, is the energy price payable by buyers of electricity.

[2] Market Energy Price (MEP, in $/MWh) is the nodal price that generators will receive in SWEM.

[3] IEQ = Injection energy quantity (MWh), i.e. quantity of energy injected by generators.

Component	Description	Impact on HEUR
Net Reserve Settlement Credits (NRSC)	This component captures the difference between the amount receivable and payable by EMC for reserve settlement. Given that the amount receivable and payable by EMC for reserve always equal, this component will always be zero or very small due to rounding.	Since this component will always be zero or very small, this component has no impact on HEUR.
Net Transmission Rights Settlement Credits (NTSC)	This component captures the difference between the amount receivable and payable by EMC for financial transmission rights (FTR) settlement. There are currently no FTRs in SWEM, and hence, this component will always be zero.	Since this component will always be zero, this component has no impact on HEUR.
Net Regulation Settlement Credits (NFSC)	This component captures the difference between the amount receivable and payable by EMC for regulation settlement. Given that the amount receivable and payable by EMC for regulation always equal, this component will always be zero or very small due to rounding.	Since this component will always be zero or very small, this component has no impact on HEUR.
Net Metering Error Adjustment (NMEA)	This component captures any imbalances in settlement amount arising from metering error adjustments that could be due different rates being applied to generators and loads, and inability to identify the counterparty to a metering error.	Given that this component will be very likely to be non-zero whenever there is metering error adjustment, this component **could affect HEUR**.

Therefore, HEUR is largely determined by the NESC and NMEA components.

2.3 Proposal Received

A proposal received during the 2016/17 Rules Change Work Plan Prioritisation exercise suggests that EMC provides a real-time estimate of HEUR because this information will enable MPs to assess their financial positions in a timelier manner, particularly when there is significant nodal price separation, and enhance the availability of real-time information.

3. Analysis

3.1 Assumptions Used in Estimating Real-Time HEUR

The proposed methodology to estimate the HEUR in real-time (hereafter referred to as "Estimated HEUR", which will be discussed in section 3.2) relies on a few assumptions, which are discussed in the following.

To formulate an appropriate methodology to estimate HEUR, we first assess the feasibility of estimating the two major components of HEUR (i.e. NESC and NMEA) identified in section 2.2.

3.1.1 Feasibility of Estimating NMEA Ex-Ante

The NMEA that is posted as part of a trading day's (e.g. day T) HEUR depends on the settlement surpluses/deficits arising from the settlement rerun conducted on day T+5BD (for T-43BD and/or T-248BD). Thus, it is **not feasible to obtain an estimate of NMEA** on day T itself.

Since it is not feasible to incorporate NMEA in Estimated HEUR, the Actual HEUR (which is computed and published on T+10BD) would always deviate from the Estimated HEUR due to the exclusion of NMEA.

To assess the impact of NMEA on HEUR, we calculate a "Simplified Actual HEUR" which comprises only the NESC component of Actual HEUR (i.e. excludes NMEA, NRSC, NFSC, and NTSC) and compared it with Actual HEUR for all settlement intervals from **1 January 2015** to **31 December 2015 (17,440 periods[4])** (hereafter referred to as "study period"). The results for the comparison between the Simplified Actual HEUR and Actual HEUR at different percentiles are shown in Table 2 below.

Table 2: Comparison between Simplified Actual HEUR and Actual HEUR at Different Percentiles[5]

Percentile	Simplified Actual HEUR ($/MWh)	Actual HEUR ($/MWh)	Percentage Deviation (%)	Magnitude Deviation ($/MWh)
25th	-0.49	-0.49	0	0.00
50th	-1.59	-1.60	0	0.01
75th	-0.73	-0.72	1	0.01
90th	-0.60	-0.64	6	0.04
95th	-0.24	-0.30	21	0.06
99th	-0.03	-0.42	94	0.39

Generally, there is minimal deviation between the Simplified Actual HEUR and Actual HEUR, with 0% absolute percentage deviation ("percentage deviation") up to the 51st percentile and with 95.3% of the absolute magnitude deviations ("magnitude deviation") below $0.10/MWh.

This result indicates that the NMEA component does not affect Actual HEUR significantly. Any difference between Estimated HEUR and Actual HEUR is thus primarily attributed to the NESC component. Thus, the NMEA component is excluded when computing Estimated HEUR.

3.1.2 Feasibility of Estimating NESC Ex-Ante

[4] There are 17,520 settlement intervals in 2015. However, 78 settlement intervals with ex-post re-runs were excluded to eliminate factors that could skew the assessment of the proposed methodology in the later sections (since for settlement intervals with ex-post re-runs, deviation of Estimated HEUR from Simplified Actual HEUR could be due not only to the proposed methodology, but also due to the different set of inputs used, such as prices, load forecast quantity, etc). Also, 2 more settlement intervals were excluded because the MEPs and USEP for these settlement intervals were $0/MWh, resulting in $0/MWh Estimated, Actual and Simplified Actual HEUR, which were not useful for the assessment of the proposed methodology.

[5] Data are arranged in ascending order of absolute percentage deviation and rounded to 2 decimal places for comparison purposes here, as Actual HEUR is published only up to 2 decimal places. Since what matters is the magnitude of difference between Simplified Actual HEUR and Actual HEUR, the analysis uses the absolute values of their differences. Absolute percentage difference is calculated by taking the absolute value of [(Simplified Actual HEUR-Actual HEUR)/Actual HEUR] × 100% and the absolute magnitude difference is calculated by taking the absolute value of (Simplified Actual HEUR-Actual HEUR).

NESC comprises 3 sub-components, which are Generation Energy Settlement Credit (GESC), Load Energy Settlement Debit (LESD) and Bilateral Energy Settlement Credit (BESC) as shown in the following formula:

$$NESC_h^a = GESC_h^a - LESD_h^a + BESC_h^a$$

NESC can be estimated by using parameters in the real-time and/or forecast[6] schedules to proxy the inputs required in the calculation of each NESC sub-components. It is therefore **feasible to estimate NESC ex-ante**. The proposed input substitutes are shown in Table 3.

Table 3: Proposed Input Substitutes for NESC Estimation

Sub-component	Proposed Substitute	Reason
GESC = MEP[7] × IEQ	IEQ should be substituted with (scheduled energy quantity × 0.5).	Generation Registered Facilities (GRFs) produce energy based on their scheduled energy quantity (in MW) in each dispatch period. Thus, scheduled energy quantity is used as a proxy for the IEQ of GRFs[8]. Scheduled energy quantity is multiplied by 0.5 to convert its unit from MW to MWh to be consistent with IEQ's unit.
LESD = USEP[9] × WEQ	WEQ should be substituted with (load forecast quantity × 0.5).	Load forecast (in MW) is an estimate of the consumption of load in a dispatch period. Thus, the load forecast is used as a proxy for aggregate WEQ. Load forecast quantity is multiplied by 0.5 to convert its unit from MW to MWh to be consistent with WEQ's unit.
BESC = USEP × $\sum_j(BEQ^{j,a} - BEQ^{a,j})$	This component is assumed to be zero.	BESC is always zero because EMC will debit the selling party and credit the buying party by the same dollar amount (USEP × Bilateral Energy Quantity).

3.2 Proposed Methodology to Compute Estimated HEUR

Estimated HEUR will therefore comprise only the NESC component, and proposed to be calculated as follows:

1. Using data in the real-time and/or forecast schedules, compute the Estimated GESC, Estimated LESD and BESC for each settlement interval of the real-time and/or forecast schedules, where:

    - Estimated GESC = $\sum$[10] MEP × Scheduled Energy Quantity × 0.5

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[6] Forecast schedules refer to the short-term schedule, pre-dispatch schedule and market outlook scenario.

[7] GESC uses finalised MEPs, whereas the proposed methodology will use the MEPs in the real-time and forecast schedules to calculate the Estimated GESC.

[8] GESC includes IEQ of Generation Settlement Facilities (GSFs), whereas the proposed methodology will exclude GSFs in the calculation of Estimated GESC because they are not scheduled.

[9] LESD uses finalised USEP, whereas the proposed methodology will use the USEP in the real-time and forecast schedules to calculate the Estimated LESD.

- Estimated LESD = USEP × Load Forecast Quantity × 0.5
- BESC = 0

2. Compute the Estimated HEUR using the following formula:

- Estimated HEUR $= \frac{\text{Estimated NESC}}{\text{Load Forecast Quantity} \times 0.5}$

$$= \frac{\text{Estimated GESC} - \text{Estimated LESD}}{\text{Load Forecast Quantity} \times 0.5}$$

3.3 Results of Estimated HEUR under the Proposed Methodology

The proposed methodology was applied to calculate the Estimated HEUR for all settlement intervals in the study period. These results are compared against the Simplified Actual HEUR, as shown in Table 4 below.

Table 4: Comparison between Estimated HEUR and Simplified Actual HEUR at Different Percentiles[11]

Percentile	Estimated HEUR ($/MWh)	Simplified Actual HEUR ($/MWh)	Percentage Deviation (%)	Magnitude Deviation ($/MWh)[12]
25th	-0.484	-0.780	38	0.295
50th	-0.363	-0.814	55	0.450
75th	-0.457	-1.457	69	1.000
90th	-0.255	0.288	188	0.542
95th	-0.376	0.140	369	0.516
99th	-0.123	0.008	1609	0.131

Note that the percentage deviation appears very large at higher percentiles because of the relatively small Simplified Actual HEUR that is being used as the denominator in the calculation of percentage deviation. The Estimated HEUR is generally quite close to the Simplified Actual HEURs, with 88.2% of the magnitude deviations below $1.00/MWh.

The Estimated HEUR also exhibits similar trend as the Simplified Actual HEUR (see **Annexes 1** and **2**). Specifically, both Estimated and Simplified Actual HEUR spiked during significant nodal price separation periods and exhibit a very high correlation of 0.9935.

These results are also compared against Actual HEUR for all settlement intervals in the study period and shown in Table 5 below.

[10] For the purpose of this paper, the sigma sign (∑) is the sum of the respective values across all facilities for that settlement interval.

[11] Data are arranged in ascending order of percentage deviation.

[12] Magnitude deviations may not tally due to rounding.

Table 5: Comparison between Estimated HEUR and Actual HEUR at Different Percentiles[13]

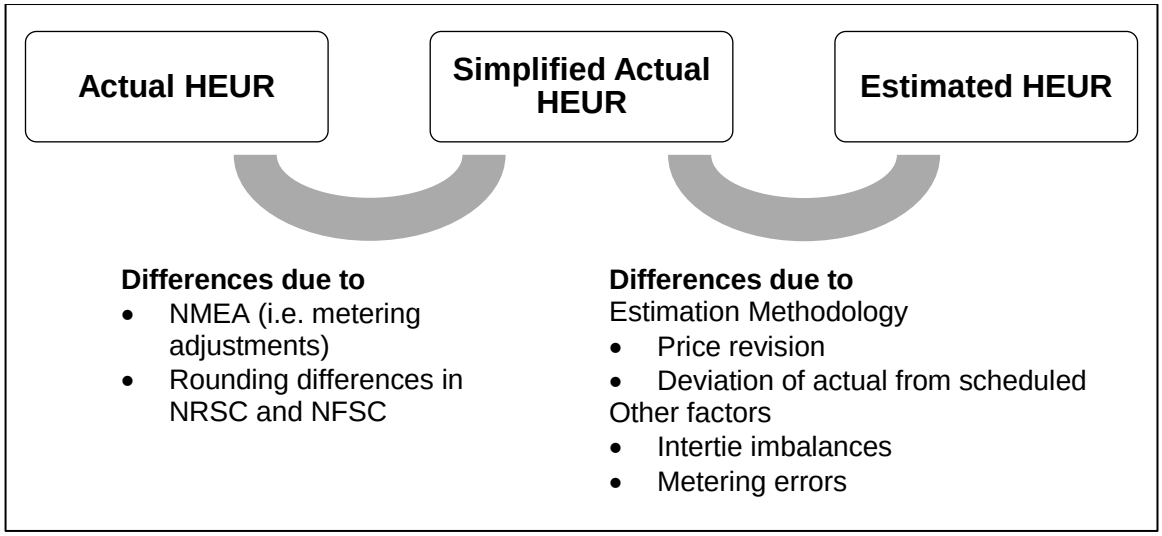
Percentile	Estimated HEUR ($/MWh)	Actual HEUR ($/MWh)	Percentage Deviation (%)	Magnitude Deviation ($/MWh)[14]
25th	-0.28	-0.46	38	0.18
50th	-0.49	-1.11	56	0.62
75th	-0.45	-1.45	69	1.00
90th	-0.14	0.15	191	0.29
95th	-0.33	-0.07	375	0.26
99th	-0.35	-0.02	1661	0.33

Table 5 illustrates a distribution of the differences between Estimated HEUR and Actual HEUR that is very similar to the distribution of the differences between Estimated HEUR and Simplified Actual HEUR in Table 4. This is consistent with the conclusion in section 3.1.1 of this paper that the NMEA component does not affect Actual HEUR significantly.

Given the above results, Estimated HEUR should produce useful insights for MPs in assessing the extent and/or direction of HEUR for a particular settlement interval during real-time when they compare the Estimated HEUR across time.

However, note that Estimated HEUR will always differ from Actual HEUR due to intertie imbalances, price revisions, metering errors and metering adjustments. Figure 1 below summarises the differences between Actual HEUR, Simplified Actual HEUR and Estimated HEUR.

Figure 1: Summary of Differences between Actual HEUR, Simplified Actual HEUR and Estimated HEUR



[13] Data are arranged in ascending order of percentage deviation and rounded to 2 decimal places for comparison purposes here, as Actual HEUR is published only up to 2 decimal places.

[14] Magnitude deviations may not tally due to rounding.

For settlement intervals with outlier Actual HEUR values (i.e. Actual HEUR that falls out of a 95% confidence interval, based on rolling 2-year historical data), EMC currently publishes the following information on a monthly basis to explain the possible causes:

(a) the ratio of (∑WEQ+∑IXQ) to (∑IEQ+∑IMQ) as an indicator of metering errors,
(b) whether lines or security constraints were binding as an indicator of price separation, and
(c) the ratio of ∑NMEA to ∑WEQ as an indicator of metering adjustments.

4. Cost-Benefit Analysis

4.1 Benefits of Estimated HEUR

Given that the Estimated HEUR provides quite an accurate estimation of the Simplified Actual HEUR, MPs could potentially benefit from the provision of this information. Firstly, access to such information will provide MPs with a clearer view of the electricity market conditions in a timelier manner.

Secondly, HEUR can vary significantly when there is nodal price separation and thus affect the amount payable[15] by retailers to the EMC. Providing Estimated HEUR ex-ante could enable retailers to assess their exposure to the spot price fluctuations, thereby assisting in their risk management.

4.2 Implementation Cost

The breakdown of the estimated implementation time and costs are set out in Table 6 below.

Table 6: Estimated Implementation Time and Costs

Time Estimates	**Man week(s)**	**Calendar week(s)**
1. Change Requirement Scoping and Analysis	2	1
2. Development of Standing Data/ MCE/ Testing	10.8	7
3. User Acceptance Testing (UAT)	3	2
Total Time Required	15.8 man-weeks	10 calendar-weeks
Cost Estimates		
1. Power Systems Consultant Resource/ EMC Manpower	Within EMC's budget ($37,100.00)	
Total Additional Cost Required	0	

5. Consultation

The concept paper was published for industry consultation on 6 May 2016, and the following comments were received from National Environment Agency, Pacificlight Power, Senoko Energy and Keppel Merlimau Cogen.

Comments from National Environment Agency

[15] The amount payable by buyers of electricity (e.g. retailers) is the sum of USEP, Allocated Regulation Price, Hourly Load Curtailment Uplift, Monthly Energy Uplift Charge, EMC fees and Power System Operator fees for their energy withdrawal.

1. *We noticed that EMC only uses one year of data (2015) to come out with conclusion. Is it possible to analyse a few more years of data?*

2. *What is the percentage of market participants that will use the data? If only handful, worth to spend the money to provide the data?*

3. *Is it possible to estimate the costs in implementing?*

EMC's Response

1. EMC believes that using one year of data, comprising 17,440 data points, for analysis is sufficiently representative; adding a few more years will not change our conclusion.

2. This information could potentially be used by most retailers since it enables them to better assess their financial position in real-time. Specifically, three stakeholders have commented that they would find it useful (see other comments in this section).

3. We have updated the implementation costs in dollar terms in Table 6.

Comments from Pacificlight Power

Under the current process, it takes ten (10) business days after the trading day before the hourly energy uplift rebate (HEUR) for each settlement interval is finalized. PLP is therefore supportive of EMC's proposal to publish real-time estimates of HEUR, based on the estimation of Net Energy Settlement Credits (NESC), a major component of the HEUR.

With respect to operational implementation of the change, we would recommend that real-time estimates of the HEUR be published through the MCR Report Web Service interface.

EMC's Response

We note Pacificlight Power's support. If this proposal is implemented, the Estimated HEUR will also be published through the MCR Report Web Service interface.

Comments from Senoko Energy

We are supportive of having accurate real-time estimates of HEUR, as it would assist in our risk management during periods of price separation.

We think that a more detailed comparison between the Estimated HEUR and Actual HEUR over periods of price separation would be useful. EMC should consider assessing the accuracy of the Estimated HEUR regularly and clarify instances where the deviations from Actual HEUR are significant.

EMC's Response

We note Senoko Energy's support.

In response to Senoko Energy's suggestion to compare Estimated HEUR and Actual HEUR, we have included the comparison in section 3.3 of this paper (see Table 5).

If Actual HEUR deviates significantly from Estimated HEUR, MPs can refer to the Monthly HEUR report published by EMC, which would explain the possible causes for outlier Actual

HEUR values (i.e. when Actual HEUR falls out of a 95% confidence interval, based on rolling 2-year historical data).

Comments from Keppel Merlimau Cogen

1. *Keppel is of the view that having real-time estimates of the HEUR would be useful to market participants. In particular, the estimated HEUR would provide a more timely financial impact during significant price separation and high prices periods hence allow market participants to better manage their risks.*

2. *The proposed substitute for the calculation of the GESC sub-component uses scheduled energy instead of IEQ, as metering data is not available ex-ante. However, IEQ refers to net generation, while scheduled energy refers to gross generation. For a more accurate HEUR estimation, Keppel proposes modifying the GESC formula using an adjustment factor based on historical scheduled energy and historical IEQ quantities, i.e.:*

   Keppel's Proposed Modification to the Formula:

   Estimated GESC = ∑MEP × (Scheduled Energy Quantity × 0.5 – Adjustment Factor)

   Adjustment Factor = (Average Historical Scheduled Energy × 0.5) – Average Historical IEQ

   This would give a better estimate of the GESC sub-component as compared to EMC's proposed methodology.

EMC's Response

1. We note Keppel's view that Estimated HEUR is beneficial from a risk management perspective.

2. Both scheduled energy quantity and load forecast quantity includes auxiliary and/or station load. Hence, if an adjustment is to be made to Estimated GESC to obtain a "net" figure as proposed by Keppel, then a similar adjustment ought to be made to Estimated LESD as well, because the load forecast reflects gross withdrawal (i.e. includes generators' auxiliary or station load), while WEQ only captures consumption that is net of any auxiliary and/or station load.

   As the two adjustment factors would be quite close, including an adjustment factor would at most marginally improve the Estimated HEUR.

   Further, the inclusion of adjustment factors also gives rise to the need for periodic reviews and/or update of the figures used. This would incur additional operational costs.

   Given the limited benefits and additional costs, it is not necessary to include an adjustment factor to account for generators' auxiliary or station load.

6. Conclusion

This paper examines a proposed methodology to calculate the Estimated HEUR ex-ante. The proposed methodology produced quite accurate estimations with a large percentage of the estimations having magnitude deviations below $1.00/MWh.

We have also assessed the cost and benefits of publishing Estimated HEUR, and while the benefits of this proposal could not be quantified, some stakeholders have indicated that the proposal would indeed be beneficial for their risk management purposes.

7. Decision at the 88th RCP Meeting

At its 88th meeting, the RCP by majority vote **supported** EMC's proposed methodology to provide real-time estimates of HEUR set out in section 3.2 of this paper, and tasked EMC to draft the relevant rule modifications.

The details of the voting outcomes are as follows:

Those who voted in support of the proposal:

1.	Mr. Henry Gan	Representative of the EMC
2.	Ms. Priscilla Chua	Representative of Generation Licensee
3.	Mr. Marcus Tan	Representative of Generation Licensee
4.	Ms. Grace Chiam	Representative of Generation Licensee
5.	Mr. Luke Peacocke	Representative of Retail Electricity Licensee
6.	Mr. Daniel Lee	Representative of Retail Electricity Licensee
7.	Mr. Sean Chan	Representative of Retail Electricity Licensee
8.	Mr. Lim Han Kwang	Representative of the Transmission Licensee
9.	Mr. Lawrence Lee	Representative of the Market Support Services Licensee
10.	Dr. Toh Mun Heng	Representative of Consumers of Electricity in Singapore

Those who abstained from voting:

1.	Mr. Soh Yap Choon	Representative of PSO

8. Proposed Rule Modifications

Arising from the RCP's decision, EMC has drafted the proposed rule modifications, as set out in **Annex 3**, to publish estimated HEUR using the proposed methodology set out in section 3.2 of this paper. Table 7 below summarises the proposed rule changes.

Table 7: Summary of Proposed Rule Modifications

Chapter/Section	Proposed Changes	Reason for Change
Chapter 6 Section 7.7.3.13	Added a new section to include estimated HEUR in the list of information to be published by the EMC for each dispatch period of the market outlook scenario, pre-dispatch schedule scenario and short-term schedule.	To require the EMC to publish estimated HEUR for each dispatch period of the market outlook scenario, pre-dispatch schedule scenario and short-term schedule.
Chapter 6 Section 9.2.4.13	Added a new section to include estimated HEUR in the list of information to be published by the EMC as part of the real-time schedule.	To require the EMC to publish estimated HEUR as part of the real-time schedule.
Appendix 6C Section C.4.1.13	Added a new section to include estimated HEUR in the list of information to be produced by the market clearing engine for each dispatch period.	To require the market clearing engine to produce estimated HEUR for each dispatch period.
Appendix 6D Section D.25.1.13	Added a new section to set out the formula to calculate the estimated	To establish the proposed methodology to calculate

Chapter/Section	Proposed Changes	Reason for Change
	HEUR.	estimated HEUR.
	Added an explanatory note that the estimated HEUR is meant only to serve as an indicative figure of the HEUR and will not be used for settlement.	To clarify that the estimated HEUR will not be used for settlement but merely serves as an indicative figure of the HEUR only.

9. Legal Sign-off

The text of the proposed rule modifications has been vetted by EMC's external legal counsel, whose opinion is that the modifications reflect the intent of the rule modification proposal as expressed in the third column of the table in **Annex 3**.

10. Industry Consultation for Proposed Rule Modifications

The proposed rule modifications, as set out in **Annex 3**, were published for consultation on 20 July 2016, and comments were received from Buri Energy and Pacificlight Power.

Comment from Buri Energy

We are supportive of the proposed changes, and resulting rules drafting.

EMC's Response

We note Buri Energy's support.

Comment from Pacificlight Power

Consistent with the comments made in our submission dated 27 May 2016, PLP is supportive of the publication of the Estimated Hourly Energy Uplift Rebate (HEUR) through the MCR Report Web Service Interface. We are also agreeable to the proposed methodology for computing the estimated HEUR.

EMC's Response

We note Pacificlight Power's support.

11. Decision at the 89th RCP Meeting

At its 89th meeting, the RCP unanimously **supported** the proposed rule modifications as set out in **Annex 3**.

12. Recommendations

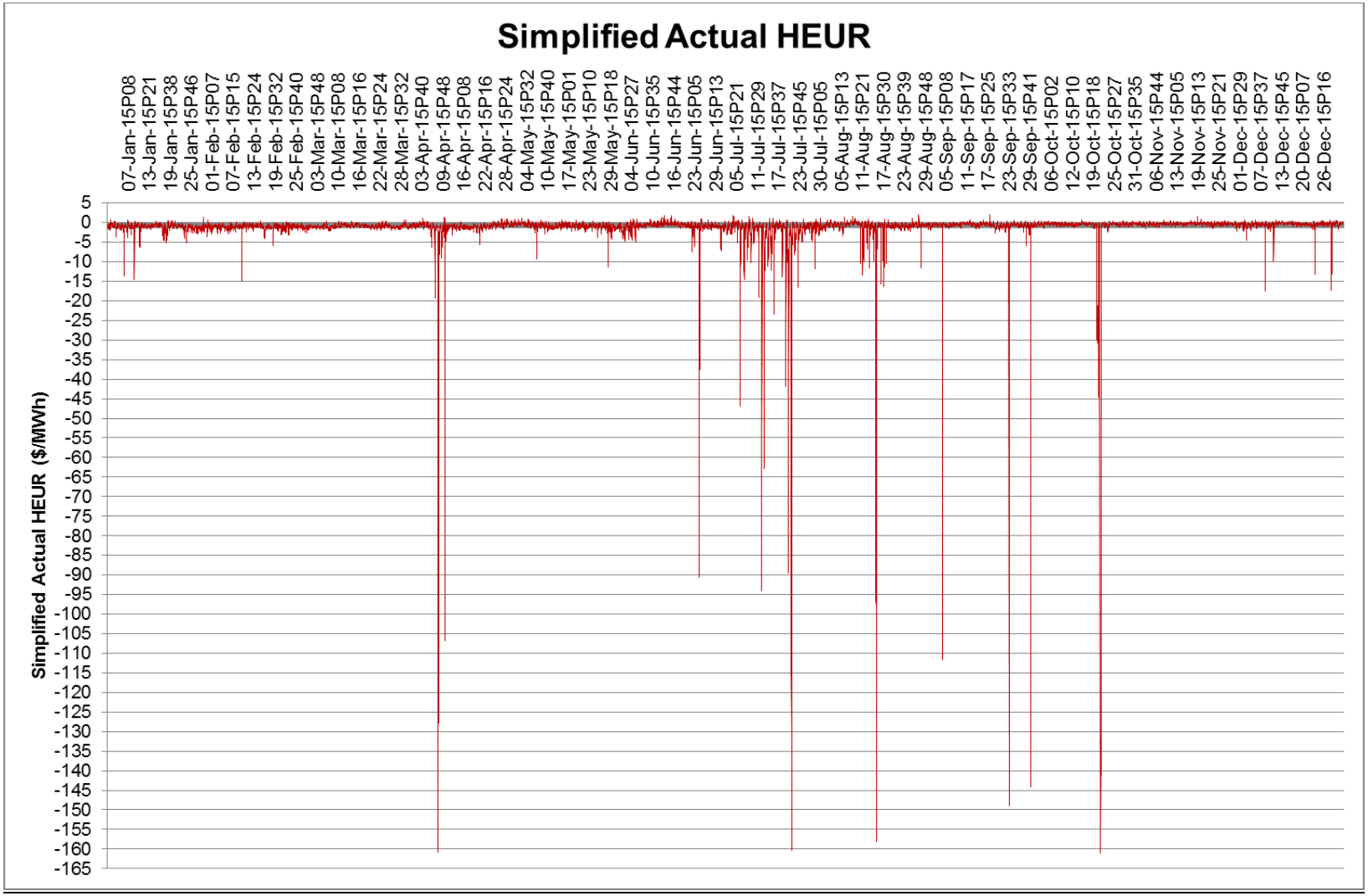
The RCP unanimously recommends that the EMC Board:

(a) **adopt** the proposed rule modifications as set out in **Annex 3**;

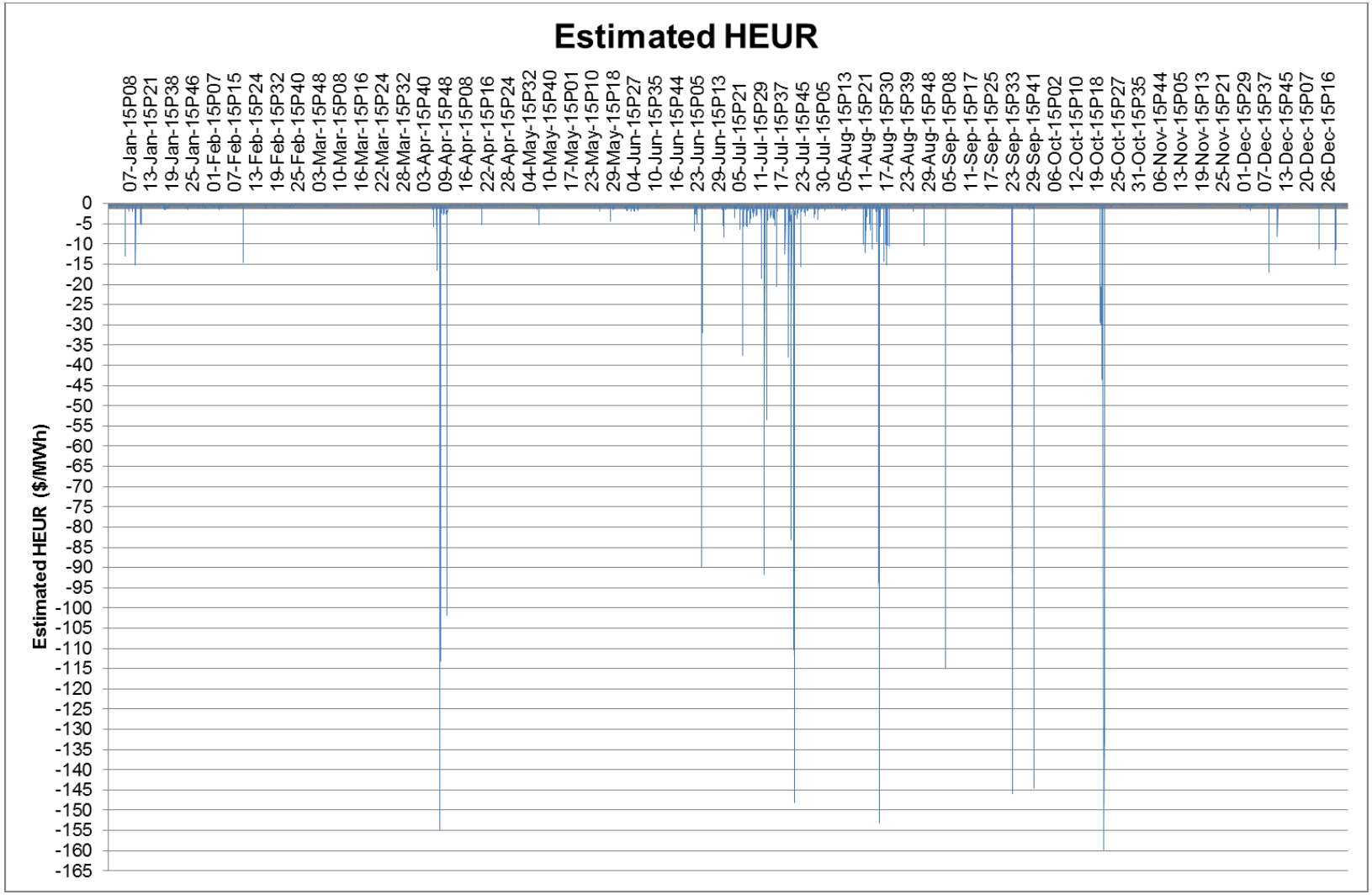
(b) **seek** the EMA's approval of the proposed rule modifications as set out in **Annex 3**; and

(c) **recommend** that the proposed rule modifications as set out in **Annex 3** come into force **10 calendar weeks** after the date on which the approval of the Authority is published by the EMC.

Annex 1: Simplified Actual HEUR (in $/MWh) for Year 2015



Annex 2: Estimated HEUR (in $/MWh) for Year 2015 under Proposed Methodology



Annex 3: Proposed Rule Modifications

Existing Market Rules (1 July 2016)	Proposed Rules Changes (Deletions represented by strikethrough text and additions represented by double underlined text)	Reasons for rule change
Chapter 6	**Chapter 6**	
7.7 RELEASE OF SCENARIO INFORMATION … 7.7.3 In accordance with sections 7.7.1, 7.7.2 and 7.7.2A, the *EMC* shall *publish* the following information for each *dispatch period* and for each *market outlook scenario*, *pre-dispatch schedule scenario* and *short-term schedule*: … 7.7.3.11 any predicted system *regulation* shortfalls; and 7.7.3.12 a list of *security constraints* and *generation fixing constraints* applied.	**7.7 RELEASE OF SCENARIO INFORMATION** … 7.7.3 In accordance with sections 7.7.1, 7.7.2 and 7.7.2A, the *EMC* shall *publish* the following information for each *dispatch period* and for each *market outlook scenario*, *pre-dispatch schedule scenario* and *short-term schedule*: … 7.7.3.11 any predicted system *regulation* shortfalls; ~~and~~ 7.7.3.12 a list of *security constraints* and *generation fixing constraints* applied~~.~~; and 7.7.3.13 the projected estimated hourly *energy* uplift rebate, determined in accordance with section D.25.1.13 of Appendix 6D.	To include estimated HEUR in the list of information that shall be published by the EMC for each dispatch period and for each

Existing Market Rules (1 July 2016)	Proposed Rules Changes (Deletions represented by strikethrough text and additions represented by double underlined text)	Reasons for rule change
		market outlook scenario, pre-dispatch schedule scenario and short-term schedule.
9.2 THE REAL-TIME SCHEDULING PROCESS … 9.2.4 The *EMC* shall, in accordance with the *market operations timetable*, *publish* the following information as it pertains to each *dispatch period:* … 9.2.4.11 any system *regulation* shortfalls reported by the *market clearing engine*; and 9.2.4.12 a list of *security constraints* and *generation fixing constraints* applied.	**9.2 THE REAL-TIME SCHEDULING PROCESS** … 9.2.4 The *EMC* shall, in accordance with the *market operations timetable*, *publish* the following information as it pertains to each *dispatch period:* … 9.2.4.11 any system *regulation* shortfalls reported by the *market clearing engine*; ~~and~~ 9.2.4.12 a list of *security constraints* and *generation fixing constraints* applied~~.~~; and 9.2.4.13 the estimated hourly *energy* uplift rebate, determined in accordance with section D.25.1.13 of Appendix 6D.	To include estimated HEUR in the list of information that shall be published by the

Existing Market Rules (1 July 2016)	Proposed Rules Changes (Deletions represented by strikethrough text and additions represented by double underlined text)	Reasons for rule change
		EMC in accordance with section 9.2.4 of Chapter 6.
APPENDIX 6C	**APPENDIX 6C**	
C.4 ADDITIONAL DATA C.4.1 The *market clearing engine* shall, at a minimum, produce the following information for each *dispatch period*: … C.4.1.11 details of the extent of any constraint violations; and C.4.1.12 the value, in dollars, of the objective function specified in Appendix 6D.	**C.4 ADDITIONAL DATA** C.4.1 The *market clearing engine* shall, at a minimum, produce the following information for each *dispatch period*: … C.4.1.11 details of the extent of any constraint violations; ~~and~~ C.4.1.12 the value, in dollars, of the objective function specified in Appendix 6D~~.~~; and C.4.1.13 estimated hourly *energy* uplift rebate, determined in accordance with section D.25.1.13 of Appendix 6D, expressed in $/MWh.	To include estimated HEUR in the list of information in section C.4.1 that shall be produced by the market clearing engine.
APPENDIX 6D	**APPENDIX 6D**	

Existing Market Rules (1 July 2016)	Proposed Rules Changes (Deletions represented by strikethrough text and additions represented by double underlined text)	Reasons for rule change
D.25 ADDITIONAL OUTPUTS	**D.25 ADDITIONAL OUTPUTS**	
D.25.1 The *market clearing engine* shall, at a minimum, produce the following information for each *dispatch period*:	D.25.1 The *market clearing engine* shall, at a minimum, produce the following information for each *dispatch period*:	
…	…	
D.25.1.11 details of the extent of any constraint violations $\sum_{j \in VIOLATIONGROUPBLOCKSSEC_{y(s)}} ViolationGroupBlock_{y(s),j}$ $\{y \in VIOLATIONGROUPS\}$	D.25.1.11 details of the extent of any constraint violations $\sum_{j \in VIOLATIONGROUPBLOCKSSEC_{y(s)}} ViolationGroupBlock_{y(s),j}$ $\{y \in VIOLATIONGROUPS\}$	
; and	~~; and~~	
D.25.1.12 the value, in dollars, of the objective function value NetBenefit specified in section D.14.	D.25.1.12 the value, in dollars, of the objective function value NetBenefit specified in section D.14~~.~~; and	
	D.25.1.13 the estimated hourly *energy* uplift rebate (HEUR) in accordance with the following formula:	To establish the formula to compute estimated HEUR.
	Estimated HEUR =	

Existing Market Rules (1 July 2016)	Proposed Rules Changes (Deletions represented by strikethrough text and additions represented by double underlined text)	Reasons for rule change
	$$\frac{\sum_{g \in \text{ENERGYOFFERS}} \left(\text{MEP}^{m(g)} \times \text{Generation}_g \times \tfrac{1}{2}\right) - \left(\text{USEP} \times \sum_{\substack{p \in \text{ENERGYBIDS} \\ p \notin \text{INTERTIEEN ERGYBIDS}}} \text{Purchase}_p \times \tfrac{1}{2}\right)}{\sum_{\substack{p \in \text{ENERGYBIDS} \\ p \notin \text{INTERTIEEN ERGYBIDS}}} \text{Purchase}_p \times \tfrac{1}{2}}$$ **Explanatory Note: The estimated hourly energy uplift rebate produced by the market clearing engine for each dispatch period is meant only to serve as an indicative figure of the hourly energy uplift rebate and will not be used for settlement.**	To clarify that the estimated HEUR shall be an indicative figure of HEUR only and will not be used for settlement.