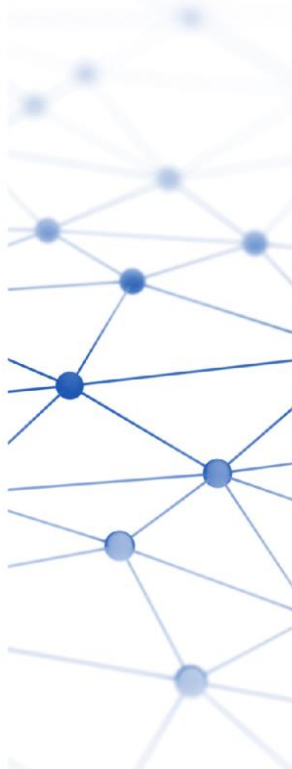


Industry Working Group 1 Report to the Market Advisory Panel: Recommendations to the EMA on the Forward Capacity Market



16 October 2020



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Executive Summary

The Industry Working Group 1 (IWG 1) was established by the Market Advisory Panel (MAP) on 31 Jul 2019 to assist the MAP in analysing issues relating to **resource adequacy** in the National Electricity Markets of Singapore (NEMS). This report aims to present recommendations for the MAP's consideration and endorsement before being submitted the Energy Market Authority (EMA) for consideration.

This report is divided into 5 parts. Part 1 of the report provides an overview of the IWG 1's formation, the work packages and a summary of the IWG 1 meetings held. Part 2 provides an overview of the proposed Forward Capacity Market (FCM) and how this proposed market would function in Singapore's context. Part 3 gives an independent and neutral review of the proposed of FCM by AFRY. Part 4 provide the details of the IWG 1's proposed recommendations to the EMA. Finally, Part 5 contains specific recommendations and comments obtained from MAP members at the 3rd MAP meeting held in October 2020.

The **key recommendations** of the IWG 1 to the EMA regarding the design of the FCM are as follows:

- Provide a level-playing field for all technologies (technology-neutrality) and participants
- Provide more clarity on the interactions between the FCM and the real-time markets
- Review of forward capacity market on a regular basis
- Develop a participation model for distributed energy resources (DERs) for future capacity auctions

EMC would like to thank IWG 1 members for their time and active participation which had been instrumental in producing this final report. We look forward to their continued support for future MAP initiatives.

Part 1: Overview of the IWG 1, Work Scope and Meetings Summary

1.1 Background

At the first Market Advisory Panel (MAP) meeting on 17 Jun 2019, panel members decided to establish the Industry Working Group 1 (IWG 1) in accordance with clause 2.7 of the Constitution of the Market Advisory Panel with the following terms of reference:

- Study and analyse the issues on resource adequacy in National Electricity Market of Singapore (NEMS) and the Forward Capacity Market (FCM) proposed by the Energy Market Authority (EMA);
- Identify and evaluate the applicability of international best practices, where relevant;
- Analyse options and examine the impact of each option on the overall objectives; and
- Assess the feasibility of the proposed solutions and provide final recommendations to the MAP.

The decision to establish IWG 1 was finalized by the MAP at the second MAP meeting held on 31 Jul 2019.

1.2 Composition of Industry Working Group 1

The IWG 1 comprised of 10 representatives from the various stakeholders in the NEMS. All the members have at least 5 years of experience in the energy industry and have a good level of technical and/or commercial knowledge and expertise in the operation of power systems and the electricity market. The members of the IWG 1 are as follows:

- Mr. Zhenhui Li (Chairman), Energy Market Company
- Mr. Albert Siah, YTL PowerSeraya
- Mr. Chin Hau Teo, PacificLight Power
- Mr. Harry Whitaker, Shell Energy
- Mr. Jian Hui Tan, Keppel Energy
- Mr. Marcus Tan, Senoko Energy
- Mr. Poh Soon Loh, Power System Operator, Energy Market Authority
- Mr. Ross Han, I Switch
- Mr. Jian En Song, Sembcorp Power
- Mr. Tony Tan, Tuas Power Generation

At its inception, the working group was advised by Mr. Philip Harris, the founding Chairman, President and CEO of PJM Interconnection, on issues to consider in order to implement a workable capacity market. Mr. Stephen Woodhouse and Mr. Simon Bradbury from AFRY Management Consulting engaged by EMC to be independent consultants to review EMA's proposed FCM design.

1.3 Focus of IWG 1's Recommendations

In the original terms of reference agreed by the MAP¹, three work packages were identified. However, at the second MAP meeting, it was agreed for the IWG 1's work to focus on the second work package.

The objectives of the three work package's objectives were:

- Discuss the rationale and objectives of implementing a capacity market in Singapore;
- Analyse the design parameters of EMA's proposed FCM design with the intent to ensure that they are generally in line with international practices and suitable for Singapore's energy markets;
- Provide high-level estimates for costs and time required for implementing the FCM based on publicly available information from the EMA.

The rationale and objectives of implementing a capacity market in Singapore is discussed in Part 2, Section 2.1 and 2.2 of this report. As there are still on-going discussions between the industry and EMA on the FCM, design, the working group is unable to provide any high-level cost estimates on the system costs.

¹ Refer to Annex A for the Terms of Reference.

The revised timeline released by EMA in their third consultation paper together with a short description on how the FCM would work in general are discussed in Part 2, Section 2.3. and 2.4 of the report.

The IWG 1's recommendations to MAP will focus on the design parameters of the EMA's proposed FCM design. The intent is to ensure that the FCM design is in-line with international best practices and at the same time, suitable and applicable for Singapore's electricity market. AFRY's review of the FCM, as summarized in Part 3 of the report, is one of the main documents that the working group relied on to make its recommendations. It is hoped that these recommendations will be endorsed by the MAP and made to the EMA before finalisation of the EMA's determination paper on the FCM in late 2020.

1.4 IWG 1 Meetings Summary

The IWG 1 conducted 3 working meetings. At the first meeting held on 31 Jul 2019, discussions centred around logistical matters and the IWG 1's terms of reference. Mr. Philip Harris also shared with the group his experience in leading PJM interconnection as its founding CEO and how the capacity issues that PJM faced previously were resolved.

The second IWG 1 meeting was held on 6 Dec 2019. The meeting concentrated on discussing, clarifying and gathering feedback on EMA's 2nd consultation paper on FCM design. EMC, as the designated market administrator and market operator, presented the high-level FCM design to the working group members. For details on the presentation and discussion at the second meeting, please refer to 2nd Meeting Minutes and 2nd Meeting Presentation Slides in Annex A.

The third IWG 1 meeting was held on 3 Jul 2020 focusing on AFRY's independent review of EMA 3rd consultation on FCM design. Working group members provided useful feedback to the report which are reflected in the later part of this report. For details on the presentation and discussion at the third meeting, please refer to 3rd Meeting Minutes and 3rd Meeting Presentation Slides in Annex A.

Part 2: Overview of Singapore Forward Capacity Market

2.1 Rationale for Introducing a Forward Capacity Market in Singapore

The Singapore Wholesale Electricity Market (SWEM) was designed as an energy only market (EOM) at its inception in 2003. Generating assets are paid based on half-hourly spot prices for electricity injected into the grid. The EOM’s design is expected to provide price signals to attract long term investments in generation capacity in the SWEM.

However, the EOM cannot guarantee that the desired reliability level can be achieved in a timely manner. As a result, a pattern of “feast” and “famine” in system capacity developed in the SWEM (Figure 1). The Vesting Price² serves as a reference price where generators can earn a reasonable return in the long run whereas the Uniform Singapore Energy Price³ (USEP) serves as an average price at which generators are paid in the SWEM. Therefore, when the Vesting Price is above the USEP, a ‘feast’ situation occurs in which there is overcapacity with sustained low spot prices. Conversely, a ‘famine’ situation occurs when there is under capacity with sustained high spot prices.

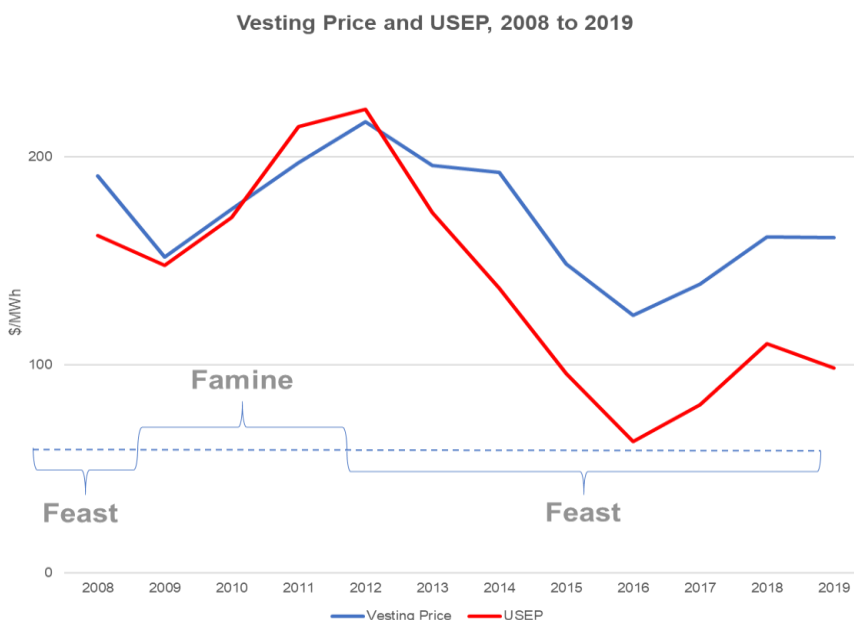


Figure 1: Vesting Price and USEP, 2008 to 2019

For a summary of the various types of capacity remuneration mechanisms, please refer to Section 3 in the Terms of Reference for IWG 1 in Annex A.

The forward capacity market was deemed as suitable by EMA as a solution to achieve the desired reliability in a timely manner. This is based on experiences of other jurisdictions who have faced or are facing similar challenges regarding resource adequacy.

² The Vesting Price is set considering both the long run marginal cost (LRMC) of the most efficient generation technology that accounts for at least 25% of the total electricity demand in Singapore.

³ The Uniform Singapore Energy Price (USEP) is the uniform price of energy that applies for settlement purpose for all energy injections or withdrawals that are deemed to occur at the Singapore hub. It is the weighted-average of the nodal prices at all off-take nodes in each half hour.

2.2 Objectives of the Singapore Forward Capacity Market

There are 2 main objectives that the proposed FCM seeks to achieve. **The first objective is to maintain resource adequacy based on a minimum acceptable reliability standard.** It also aims to facilitate an orderly exit and entry of capacity resources and attract and retain supply to meet the reliability standard.

The second objective is to maximize economic efficiency in the long run by ensuring that consumers do not pay for more capacity than needed, and to provide a level playing field for all types of resources to compete fairly.

2.3 FCM Implementation Timeline of the EMA

The EMA has revised the FCM implementation timeline after considering feedback from the 2nd Consultation. Based on the revised timeline, the 1st compressed auction will be conducted in Q3 2021 for Delivery Period Q4 2023. 2 more compressed auctions are scheduled in Q4 2021 and 1H 2022 for Delivery Period 2024 and 2025. The 1st end-state auction is expected to be held in 2H 2022 for Delivery Period 2026. Please refer to Figure 2 below.

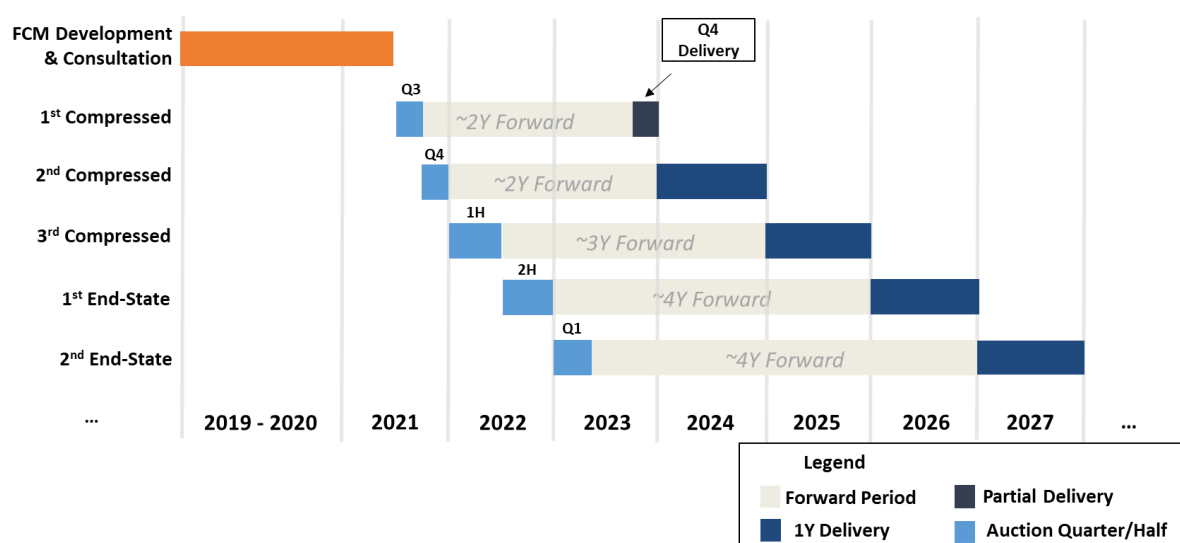


Figure 2: Implementation and Transition Timeline to Full FCM

The 1st rebalancing auction (T-1) is expected to be held in Q2 2024 for Delivery Period 2025. In the steady state, a base auction (T-4) and a re-balancing auction (T-1) is expected to be held annually in Q1 and Q2 starting from year 2024. Please refer to Figure 3 below.

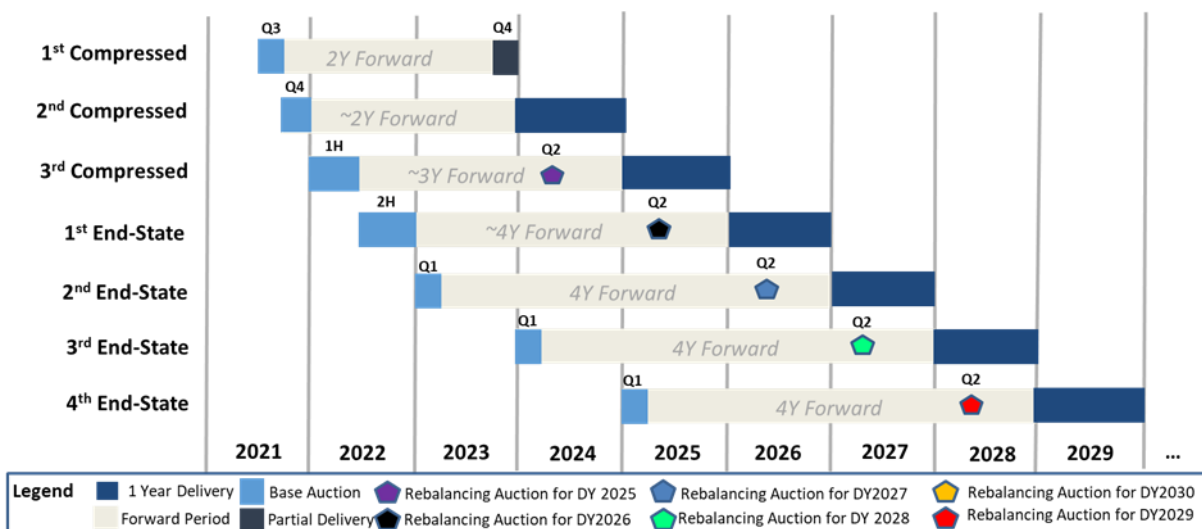


Figure 3: Preliminary Timeline for Base Forward Auction

A minimum of 2-year forward period for the compressed auction is maintained to give Electricity Futures market participants and electricity retailers sufficient lead time to adjust their contract positions. Additionally, with experience gained from each auction, EMA intends to further adapt and incorporate enhancements where appropriate to the FCM's features and roles, to ensure alignment with its policy objectives.

2.4 Overview of the Proposed FCM Design

High-level description of the proposed FCM for Singapore⁴

The proposed FCM market is designed to procure enough capacity to meet the EMA's proposed reliability standard 4 years ahead for a delivery period of 1 year via a competitive auction. The FCM will operate alongside the existing real-time markets. Both existing and new resources are expected to compete by submitting competitively priced capacity offers. Successful resource suppliers will be awarded capacity supply obligations (CSOs) and will be remunerated based on the FCM's clearing price during the delivery period. Penalties will be imposed on CSO holders that do not comply with their obligations during the delivery period.

How will the proposed FCM work in Singapore's context?

An administrative demand curve will be determined by the EMA based on a minimum acceptable reliability standard of no more than three expected Loss of Load Hours (3 LOLH)⁵ per year. Resource suppliers that are interested in participating in the capacity auction will be required to undergo a resource qualification process by the Power System Operator (PSO) to determine their resource's qualified capacity (QCAP). Interested resource suppliers will then submit their offers based on their QCAP to EMC. These offers will form the supply curve for the capacity auction.

An auction clearing algorithm will determine an optimized allocation of CSOs among the participating resources and a uniform clearing price for all successful resources based on the administrative demand curve, the supply curve and any constraints imposed by the EMA. Bilateral trading of CSOs among the qualified resources are allowed after the first base auction of the delivery period.

Resources will be remunerated based on their quantity of CSOs before the start of the delivery period and the auction clearing prices relevant to the resource⁶. Performance penalties will be imposed on resources that underperform during the delivery period. Capacity payments and performance penalties for the resources are settled monthly whereas capacity charges for retailers and consumers are settled daily.

Most capacity markets are considered structurally uncompetitive at least some of the time because the residual supply tends to be small relative to the size of some suppliers. Therefore, the EMA will be imposing market power mitigation measures such as imposing a 25% cap on resource suppliers for the capacity market, a must-offer requirement to mitigate physical withholding by resource suppliers⁷ and an offer price cap on offers submitted by resource suppliers that failed the 1 pivotal supplier test based on the Residual Supply Index (RSI).

⁴ Please refer to EMA's 3rd Consultation Paper – Developing a Forward Capacity Market to enhance the Singapore Wholesale Electricity Market for more details of the market design.
https://www.ema.gov.sg/ConsultationDetails.aspx?con_sid=20190610AkFa3aH9d5bm

⁵ LOLH represents the expected number of hours per year when available generating capacity is insufficient to serve the half-hourly demand across all hours of the year rather than just daily peak demand. Please refer to the following documents for more information on how LOLH is translated into the required reserve margin which is critical in determining the FCM's demand curve.
<https://www.ema.gov.sg/cmsmedia/About-Us/Infosheet%20on%20RRM%20and%20EDF.pdf>

⁶ In the steady state, CSO quantities and prices may change as at least 1 re-balancing auctions will be conducted before the start of the delivery year.

⁷ Please refer to the EMA's 3rd Consultation Paper on FCM, Section VI for more details.

Part 3: AFRY Review of the FCM

3.1 Introduction

As part of the 2nd work package under the Terms of Reference for IWG 1, EMC engaged AFRY Management Consulting (AFRY) to conduct an independent review of the EMA's proposed FCM market. The aim of the review was to provide neutral feedback based on AFRY's international experience in designing energy markets, with the intent of improving the FCM design to suit Singapore's context.

The review was divided into sections. The first section examined aspects of the proposed FCM design that are well-defined and in line with good practices. The second section addressed areas that require attention. These areas are further divided into 2 groups: 1. areas that require immediate attention; and 2. areas that can be deferred to a future review of the FCM. The third section looked at areas to be explored further for distributed energy resources (DER). The last section discussed areas where more clarity is required.

3.2 Areas AFRY Consider Well-Defined and Aligned with Good Practices

Implementing Offer Mitigation instead of Short-run Marginal Cost Bidding in Spot market

The switch from the requirement to submit short-run marginal cost (SRMC) bidding in the spot market to mitigating real-time market offers to a pre-defined threshold⁸ only if the resource suppliers failed a 1 pivotal supplier test is considered a positive move by AFRY. AFRY considers the offer mitigation approach to be far more superior and effective even though there is still a restriction on energy price formation, albeit with a much-reduced impact as compared to the SRMC bidding requirement suggested previously.

Minimum Participation Threshold

AFRY considered the proposed minimum participation threshold of 1 MW as a positive first step to provide scope for participation from smaller scale resources such as distributed energy resources (DER). AFRY suggested to lower the participation threshold to 0.1 MW in future auctions to unlock more distributed energy resources to participate in the future.

Resource Qualification Methodology

AFRY considered the proposed approaches for resource qualification for the various resources type to be pragmatic and rightly acknowledged differences between technologies in terms of technical characteristics and performance. AFRY provided an example of how the solar and demand resource qualification focused on the ability to deliver in a subset of hours and therefore reflected the limited hours of operations but, at the same time, recognized the value of such resources' contribution to system reliability. However, AFRY recommends more clarity on the review process for demand resources as the details on this are limited.

Bilateral Transaction's Granularity

In the area of bilateral transactions, AFRY is supportive of a 30-minute temporal granularity for bilateral transaction, as it allows for period-by-period sculpting of obligations across a day to reflect conditions.

⁸ Currently the pre-defined threshold is defined as three times the short run marginal costs of a F-Class Combined Cycle Gas Turbine unit. A figure of \$355/MWh was proposed by EMA based on EMA's "Review of the Long Run Marginal Cost Parameters for Setting the Vesting Contract Price for 2019 and 2020"

3.3 Areas AFRY Highlighted for Immediate Attention

Multi-Year Commitment Scheme for New/Repowered CCGTs

AFRY highlighted a potential pitfall of Multi-Year Commitment scheme for new/repowering Combined Cycle Gas Turbine (CCGT) units. AFRY acknowledged that there may be wider policy considerations by EMA unknown to them, but from an energy market perspective, they believe that explicitly providing only new CCGTs with access to longer term commitment may result in a deviation from the long-term goals of the FCM.

AFRY argued that this preferential treatment of new capacity over existing capacity may serve to unduly hasten closure of existing plants. It may also risk skewing the new build investment towards CCGTs to the detriment of the development of resources such as Energy Storage System (ESS), Solar or Demand Response aggregation. AFRY cited an example from Great Britain (GB) where such discriminations in the GB capacity market resulted in a legal challenge in the courts. The arrangements in GB have now been revised in response⁹. AFRY added that if there is a need to differentiate between new and existing capacity, then it will be preferable for non-discriminatory treatment across all new resources.

AFRY also cautioned on the risks of locking in CCGT technology with an enduring missing money problem when there are alternative technologies available. Singapore has growing solar aspirations and the EMA have ongoing studies on integrating imports, renewables and new technologies. These initiatives are bound to reduce the potential operating hours for the CCGT, resulting in greater uncertainty over potential CCGT revenue. Therefore, the existing CCGT owners may price in a greater uncertainty into their offers in the capacity market. Given that CCGTs will remain as the backbone of the power system, a higher auction clearing price can be expected.

Resource Floor and Cap

AFRY opined that there may be unintended consequences from imposing the resource floor of 9,000 MW for Frequency Responsive CCGT. One such consequence is the creation of an uneven playing field for balancing services by favouring CCGTs at the expense of other newer viable technologies such as batteries and demand side response. These resources can fulfil the requirement and may even be more suitable than CCGT in providing such services.

The additional resource cap of 200 MW from demand response and storage respectively, coupled with the resource floor may also compromise the technology neutrality of the FCM design. The 200 MW cap risks hampering development of these more innovative technology types. Developers will face regulatory uncertainty linked to these caps as there is no clarity on how they may change and over what timescale.

EMA's Policy on Participation in the FCM and the Real-time Market

AFRY's understanding of the proposed FCM rules on participation is that non-participation of a must-offer resource in a capacity auction would also imply non-participation in the energy market for that delivery period. However, there may be genuine reasons why older existing resources approaching closure may prefer not to commit to a 4-year ahead capacity auction given commercial uncertainties. Preventing such old existing resources from energy market participation may hasten a closure decision and contribute towards bringing an adequacy issue forward. Instead, AFRY proposes for these old existing resources to be able to opt-out. The EMA can then explicitly adjust the auction demand requirement to reflect potential ongoing contribution of these resources that have opted out, by shifting the demand curve to the left by an amount equivalent to the de-rated capacity of these resources that have opted out.

Lack of Compensation by the PSO for Out-of-Market Commitment

AFRY understands that resources with CSOs can be activated out-of-market by the PSO for emergency purpose if they are available. However, these resources would not be remunerated for these activations. The EMA expects these resources to include a premium to cover costs that cannot be recovered. AFRY

⁹ The Great Britain Capacity Remuneration Mechanism (CRM) originally offered contracts up to 15 years for new generation and storage technologies only. New demand side response resource was only eligible for 1-year contracts and not the longer tenure. Following legal challenge and temporary suspension of the scheme during the legal process, demand side resource is now eligible for contracts of up to 15 years.

reasoned that if a resource is not scheduled in the spot market, it is reasonable to infer that it is one of the higher cost units with lower running hours and/or a resource that has relatively higher missing money from the spot market. Therefore, it is highly likely that this resource will be among the price-setting resources in the FCM.

Given that any premium to cover out-of-market commitment costs has the potential to influence the overall FCM clearing price, thus increasing costs of the FCM, AFRY suggests that an assessment of this potential outcome and its implications for FCM costs would be useful for understanding its validity and scale.

3.4 Areas AFRY Highlighted for Future Attention

Capacity Product Design

AFRY opined that the current capacity product is structured around a 4-hour notification period, which is suitable for the existing CCGT fleet where a 4-hour start up period is typical. However, this may not be the speed of response that the system needs to deliver adequacy in the future. Therefore, there is a risk that the 4-hour parameter may become enshrined in the arrangements going forward. This may create regulatory risk for investments made based on the 4-hours parameter when a shorter notification period is required by the system in the future.

Therefore, AFRY advised that implicit design features such as notification period and expected shortage duration should be revisited to ensure that product design is appropriate for Singapore needs and is adaptable to evolving circumstances in a way that does not introduce instability.

EMA's Approval of Bilateral Transactions

AFRY agreed on the need for reporting and a registry to record CSO allocation. However, the wording relating to bilateral transactions raises a concern that there is a requirement for the EMA to agree to bilateral transactions, which could create a barrier to trade and has the potential to reduce the likelihood of transactions occurring. This may create regulatory risk, depending on the type of review and involvement EMA intends to have.

AFRY gave examples of the GB and Irish Capacity Remuneration Mechanism (CRM). The GB CRM allows bilateral trading with a requirement to register the bilateral transactions but without the need for regulatory approval. For the Irish CRM, secondary trading through a centralised marketplace is allowed with such activity monitored by the regulatory authorities but regulatory approval is also not required for such trading to take place.

Therefore, AFRY would propose no EMA role in approving bilateral trades as is the case with the current spot market arrangements. If this cannot be achieved in the first auction, it can be an objective for future auctions.

3.5 Areas AFRY Highlighted for Distributed Energy Resources Participation (DER)

Lowering of Participation Threshold

AFRY opined that reducing the participation level below the currently proposed 1 MW threshold may help to increase the scope for involvement of DER within the FCM. This will be advantageous for DER business models as it provides access to an additional revenue stream. It will also be beneficial for the operation of the FCM as it increases competitive pressure and could reduce costs associated with the capacity market.

Removing Caps on Demand Response and Storage

The proposed 200 MW cap has the potential to frustrate development of DER business models and it would be preferable for the cap to be removed if possible or to review the cap level on a regular basis to ensure that it does not negatively impact DER's development.

Establishing a Review Process for Self-Certification of DER/aggregated Capacity Potential

AFRY noted that the current qualification process acknowledges that there is diversity in the make-up of aggregated resources and allows for self-declaration followed by EMA's review. DER providers can approach this proactively and engage with the EMA to present different DER formations in advance to help to smooth this process.

Allowing Firm Service Level (FSL) and Guaranteed Load Drop (GLD) Aggregation

AFRY advised that if FSL and GLD consumers can combine and aggregate for the purpose of FCM participation, it could allow more resources to participate and create greater flexibility for aggregators.

Clarity on Potential Penalty Arrangements

AFRY would like to see more clarity on the potential penalty arrangements for DER in the event of extended system stress events. This would allow such risks to be assessed and priced appropriately within the capacity offers.

Interactions between Existing Demand Response and Interruptible Load Scheme

AFRY highlighted that there is a need to consider linkages between the FCM and the existing demand related schemes in the spot market. AFRY opined that contribution from the DER community to this process will help to deliver appropriate compatibility between the different arrangements.

For more details, please refer to 'AFRY's report on proposed FCM' in Annex A.

Part 4: Recommendations to the EMA

4.1 Introduction

At the 3rd IWG 1 meeting, EMC presented AFRY's assessment of the FCM design based on EMA's 3rd consultation paper. EMC invited working group members to review AFRY's assessment. The working group agreed with AFRY's assessment in general. More specific recommendations by the various classes of participants can be found in the Part 5 of the report. The key recommendations to the EMA are as follows.

4.2 Recommendation 1: Provide a Level-Playing Field for all Technologies and Participants

At the 3rd IWG 1 meeting, members provided suggestions on how to better achieve a level-playing field for all technologies and participants in different aspects of the FCM design.

The first area looked at is the multi-year commitment (MYC) for new plants that meet the EMA's new Heat Rate Standards. AFRY highlighted that the MYC itself alters the playing field for new and existing resources from an energy market perspective. By further differentiating between CCGTs and other new resources (demand resources and energy storage) which can also contribute to climate change objectives such as reducing carbon footprint, this may further worsen the 'unlevel' playing field for new and existing resources. Some workgroup members also commented that the current design of the MYC leans towards attracting H-class CCGTs which are 'lumpier' and may pose higher system risk due to the corresponding increase in contingency reserve to cater for bigger units. Some working group members also suggested to remove the MYC scheme and standardise the treatment of a single year commitment term for all resources, regardless of whether the plant is new, refurbished or existing.

The second area regards the resource floor of 9 GW of Frequency Responsive CCGTs and the resource caps of 0.2 GW on demand response and energy storage systems respectively. Although the working group understands that CCGTs would continue to form the backbone of Singapore's power system in the coming years and have the relevant local track record, the resource floor does tilt the balance away from energy storage systems. Although grid-scale energy storage systems have little or no track record in Singapore, evidence from overseas markets such as Australia and the United States of America do show that grid-scale energy storage systems can have higher performance when compared to conventional thermal generators. The resource caps for demand response and energy storage systems should be reviewed more regularly. This is to ensure a balance between the continued development in Singapore to support a 'greener' power system and the volatile nature of such technologies when there is high penetration of intermittent renewable energy sources such as solar.

Therefore, the working group as a whole recommends the following actions to achieve a more level-playing field for all technologies and participants:

- To remove MYC due to its discriminatory nature;
- To explore alternative non-discriminatory mechanisms to attract new planting in Singapore, such as setting a sustainable price floor for FCM auction;
- To allow all types of frequency-responsive resources that meet PSO's technical specifications to be included in the resource floor of 9 GW Frequency Responsive; and
- To review the caps for demand response and energy storage systems on a regular basis. As a start, the working group is proposing reviews on an annual basis until such technologies have matured.

4.3 Recommendation 2: Provide more Clarity on the Interactions between the FCM and the Real-time Markets

As the FCM was designed to enhance Singapore's energy market ecosystem, working groups members would like the EMA to provide more information on how Singapore's energy market would look like post-FCM. This would assist all stakeholders in the ecosystem to better understand and appreciate the impact of the FCM and be more committed to the changes to Singapore energy market.

Some working group members also opined that the timeline to issuance of the final determination paper for FCM in late 2020 is too tight and gives very little room for the industry to deliberate together with the EMA on outstanding issues¹⁰.

Instead, they have proposed for the EMA to delay the implementation so as to give the industry more time to engage on FCM design. They reasoned that energy demand is expected to remain depressed given the Covid-19 pandemic and there is no imminent threat of capacity supply shortage since the economy is expected to contract before recovering slowly.

However, if the EMA is determined to proceed with the timeline set out in the 3rd consultation paper, the working group would like to have more sessions with the EMA to discuss aspects of the FCM design.

Therefore, the working group as a whole recommends the following actions.

- For the EMA to provide more details specifically on the impacts/interactions of:
 - FCM's compliance and penalty framework with the FCM settlement framework;
 - EMA's regulatory policy for LDL with the FCM settlement framework;
 - FCM Demand Response with the real time-market Demand Response and Interruptible Load Schemes;
 - FCM must-offer obligation in the real-time-market;
 - FCM impact on real-time and futures market; and
 - EMA's proposed 1 Pivotal Supplier Test (1 PST) in the real-time-market
- For the EMA to provide detailed procedural papers on the determination of components of the demand curve such as price cap, reserve margin and the slope of demand curve.

4.4 Recommendation 3: Review of Forward Capacity Market on a Regular Basis

As technologies for solar, energy storage systems and demand resources are developing at an increasing rate, it is important for resource qualification to be reviewed on a regular basis.

While technologies such as energy storage systems and demand resources have negligible operational 'track' record in Singapore, these technologies are contributing significantly to the renewable energy goals in countries such as the United Kingdom, Ireland and the United States of America. Singapore need not be the front runner in implementing and trying out new resource qualification methodologies, but resource qualification methodologies should be aligned with best practices and suitable for Singapore's context.

Some working group members also opined that all resources should be qualified across all hours in a year as loss of load can happen on any given hour of the year. They cited an extensive blackout on 18 Sep 2018 during off-peak hours. They support the idea that all resources (thermal and non-thermal) should be subject to the same qualification and compliance requirements.

As a whole, the working group recommends the following actions to ensure that qualification methodologies used are up to date and aligned with best practice.

- To conduct independent review of resource qualification at a higher frequency. As a start, a review every 2 years is recommended until the technologies have matured.
- To conduct a cost benefit analysis after the initial phase of FCM, akin to a similar study for the wholesale electricity market in 2005/2006

¹⁰ Refer to Paragraph 7.3 in the 3rd Meeting Minutes in Annex A for more details.

4.5 Recommendation 4: Development of a Participation Model for Distributed Energy Resources

AFRY's review of the EMA's proposed FCM also produced a few sub-recommendations regarding distributed energy resources (DERs). These recommendations outlined a possible participation model for DERs to participate in the FCM. For example, by lowering the participation threshold and removing caps on demand response and ESS, barriers to entry would be lowered to allow more DERs to participate in the FCM. This would exert competitive pressure on capacity prices in the long run.

The IWG 2 is currently working on designing a model with the EMA, PSO and the industry for DERs to participate in the spot markets. IWG 2's proposed participation model for DERs and the sub-recommendations by AFRY's review on DERs could serve as future inputs when the FCM is reviewed by the EMA.

The working group as a whole recommends the following actions to ensure that DERs can play a bigger role in Singapore's energy future.

- To ensure that the participation model that IWG 2 is designing and proposing is workable both in the FCM and the spot market; and
- To remove the resource caps as Singapore gains more operational experience dealing with demand resources and energy storage systems.

4.6 Conclusion

In the preparation of this report, the working group has taken the proposed FCM framework as given and strived to provide constructive and neutral feedback based on insights of our consultants and group members' working experience. The intent of the recommendations is to help improve the FCM design to better suit Singapore.

The working group would like to stress that the implementation of a FCM in Singapore is the single most fundamental and impactful market design change since the start of the Singapore Wholesale Electricity Market in 2003. We hope that there will be more opportunities for the industry to fine-tune the FCM design together with the EMA.

Summary of Recommendations

- The FCM design should promote **a level-playing field for all technologies (technological-neutral) and participants** as far as possible to instill confidence for existing and potential participants.
- The EMA can **provide more clarity on the interactions between various FCM components and the current spot-markets, and the EMA's other regulatory policies such as that for Large Discrete Load (LDL)**. This would further enhance transparency in the market and attract new entrants to the SWEM in the long run.
- The EMA can **review the forward capacity market on a regular basis**. For example, the current proposed qualification methodologies may not always be suitable because system dynamics can change substantially in the future¹¹.
- The FCM can **include a participation model for distributed energy resources (DERs) via aggregation** for future forward capacity auctions. This would provide competitive pressure on the forward capacity prices and help achieve one of the FCM objectives of minimizing long run costs for consumers.

¹¹ The Singapore government has announced a solar target of 2 GWp by 2030 and an energy storage deployment target of 200 MW beyond 2025. This would drastically change the system dynamics due to the solar contributing to 20% of peak demand. Please refer to this link for the announcement <https://www.ema.gov.sg/ourenergystory> and this link for the forecasted peak demand in 2020 <https://www.ema.gov.sg/cmsmedia/Singapore%20Electricity%20Market%20Outlook%202019.PDF>

Part 5: Specific Comments/Recommendations of Panel Members by Participant Class

5.1 Introduction

At the 3rd MAP meeting held on 9 October 2020, additional recommendations and comments were put forth by some panel members. These recommendations and comments are presented in the tables below for the EMA's consideration.

5.2 By majority of Generation-Class Panel Members¹²

Recommendation 1: To provide a Level-Playing Field for all Technologies and Participants

Recommendations	Rationale
To explore the idea of implementing a sustainable price floor in the FCM design which is applicable to all capacity.	The proposed MYC discriminates between FCM participants in at least 2 dimensions: 1. between the existing and new resources and 2. between the CCGT-type of technology and other new technologies. This does not adhere to the general principle of a technology agnostic FCM.
As a start, the generation-class panel members recommended setting the proposed price floor at 0.6 x Gross CONE for a period of 10 years.	This recommendation was calculated based on the vesting contract parameters and a reasonable and sustainable rate of returns on these parameters. Please see calculation below.

Rationale for a Price floor of 0.6 x Gross CONE

Based on the evaluation of generation-class panel members' consultant, a price floor of 0.6 x Gross CONE will not materially alter the outcome of the FCM auction price and increase cost to consumers.

Using the vesting contract parameters for FY2019/2020, a price floor of 0.6 x Gross CONE would enable a generation company to pay for its fixed annual running cost, interest cost and debt repayment (around 56% of total). Please see below table for a breakdown.

No	Component	\$/kW-year	% Total
1	Fixed Annual Running Cost	55	64% of Total
2	Interest Cost	38	
3	Debt Repayment	33	
4	Tax	17	36% of Total
5	Equity Return	43	
6	Equity Repayment	37	100% of Total
7	Total	223	

¹² These members represent Senoko Energy, YTL PowerSeraya, Tuas Power Generation and PacificLight Power

Recommendation 3: Review of Forward Capacity Market on a Regular Basis

Recommendations	Rationale
To qualify solar and demand response resources based on all hours of the year to ensure consistent treatment between thermal and non-thermal generators.	<p>The proposed methodology discriminates thermal generator which meet electricity demand on a 24/7 basis. The proposed methodology did not place any emphasis on generation during off-peak periods where temporary reliability issues may occur.</p> <p>Generation-class panel members opined that the current qualification methodology is overly generous for solar resources when compared to European markets. Please see table provided by the generation-class panel below.</p>

Qualified capacity per technology (indicative)

Country	Thermal	Solar	Demand-Side	Storage
Italy	80% (Existing) 90% (New)	11%	50%	Case by Case by TSO
United Kingdom	90%	1.6%	84.3%	14.9% (0.5h) 95.5% (+4.5h)
Ireland	80% - 90% (GT) 60% - 90% (ST)	12.7%	0% (<0.5h) 89% (>6 hr)	0% (<0.5h) 77% (+6h)
France*	100%	25%	100%	100%
Poland	90% & above	1.8%	100%	96.11%
Belgium**	91% (CCGT) 88% (GT)	2% - 5%	100%	90%

*Based on reliability coefficient

**Provisional

Other Specific Recommendations:

Recommendations	Rationale
Changes to the FCM framework should be consulted via a formal rule change processes where the pros and cons are clearly evaluated based on the market condition at that point in time.	This will help enhance consultation and discussion process for industry stakeholders.
Use of Gross CONE instead of Net CONE	This will reduce the need to establish a methodology to derive the Net-CONE parameter.
FCM clearing price must always be on the demand curve	This is similar to the current approach in the spot-markets.
FCM charges must be separate pass-through items by all retailers	This will provide price signals to consumers and encourage consumers to shift consumption away from peak periods.
Remove Heat Rate Standard for a refurbished/life extended machine.	It would be uneconomical to refurbish/extend the life of such existing resources if the heat rate standard is imposed.

Building new H-class CCGT resources may incur additional costs to the power system due to their larger size compared to refurbishment/life extension of existing resources.

To remove the 1 Pivotal Supplier Test on existing generators for both the FCM and spot markets.

The current 25% cap on installed capacity for the generators should suffice for the purpose of mitigating any market power issue.

5.3 By Some Retail Class Panel Members¹³






Recommendation 1: To provide a Level-Playing Field for all Technologies and Participants

Recommendations	Rationale
Supportive of the MYC initiative by EMA.	<p>This will provide more certainty for new resources to participate in the electricity sector in Singapore.</p> <p>By reducing investment risks, this can encourage development of new technologies that can contribute to meeting Singapore’s reliability requirement and other government policy objectives.</p>

¹³ Ohm Energy and Sunseap provided these views

Annex A

Reference Documents

Documents	Document Description
 IWG_Issue1_ResourceAdequency.pdf	Terms of Reference for IWG 1
 IWG 1 Minutes_Final.pdf	2 nd IWG 1 Meeting Minutes
 IWG 1 - EMA 2nd Consultation on 0612	2 nd IWG 1 Meeting Presentation Slides
 IWG 1 Minutes 3rd Mtg_Final.pdf	3 rd IWG 1 Meeting Minutes
 EMC_FCMReviewSlides_v100.pdf	3 rd IWG 1 Meeting Presentation Slides
 EMC_EMA3rdFCMConsultationReview_v40	AFRY's Review Report on Proposed FCM