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Ensuring an Orderly Thermal Transition

We appreciate the opportunity to respond to the Authority's consultation paper *Ensuring an Orderly Thermal Transition*, published 13 June 2023.

We agree that an orderly transition towards a future state with more renewable generation mix is essential to ensure the power system remains secure and confidence in the industry is maintained.

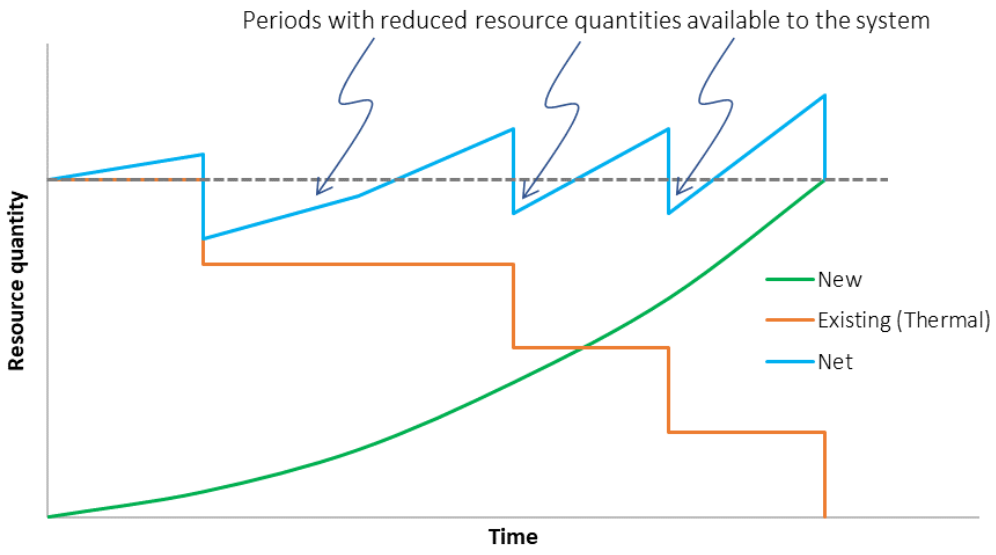
We set out below our view on the key issues. We elaborate on these in our responses to the consultation questions.

The relative size of the thermal units create significant risks for the transition

The size of the generating capacity of the existing thermal units means if one or more is decommissioned there will be material step reductions in the resources available to balance energy/capacity/ voltage/frequency. These step reductions could impact power system reliability until sufficient alternative resources enter the market. A stylised example of this is shown in Figure 1 (the top line, in blue).

The stepped reduction in existing resources (shown in orange) is a characteristic of the size of the slower starting thermal generators. If there are insufficient new resources added before the existing resources exit (shown in green), the net effect could be a reduction in the available resources to the market (shown in blue). Even if new resources completely offset the once the transition is complete, there is a reliability risk in the transition as thermal exits.

Figure 1: Illustration of potential resource imbalance with insufficient (timely) entry of new resources to offset stepped reduction offered by existing thermal generators[1]



There can be a lag between the system need becoming certain and resources entering the market due to a variety of factors (such as consenting delays, regulatory and demand uncertainty, and cost pressures[2]), which could result in extended periods of resource inadequacy and a reduction in system reliability. This could impact confidence in the electricity market and the future electrification of the wider economy.

A desired outcome during the transition should be to ensure that sufficient alternative back-up resources are available to the market *before* the thermal units exit. There are many factors that need to be considered to achieve this, including consenting of both generation and network assets.

Operational security risks

The Authority's analysis highlighted the uncertainty and volatility in the revenue of the thermal generators but did not consider the impact on operational security if thermal generation exits without sufficient alternative resources in place.

Operational risks from the thermal generators exits include:

- Balancing supply and demand during increased load periods
- Managing voltage stability during normal and outage conditions
- Managing frequency during events
- Managing transient voltage recovery

[1] Note, new resources could also be step change increases, however as per this illustration the timing may not be aligned to the exiting thermal.

[2] See pages 2, 17-27 of the generation investment survey [here] undertaken as part of the Electricity Authority's wholesale market competition review in October 2022. Some of these have also been raised by Contact (see pages 7, 27 and 34 of Contact's 2022 Annual Report.

- Ensuring sufficient fault current for the reliable operation of protection equipment and inverters.

The System Operator's (SO's) market insights[3] looking at winter risks showed that a reduction in thermal generation capacity offered into the market increased the risk of insufficient capacity for a secure market dispatch (i.e. covering both the energy and instantaneous reserve requirements). New resources coming online will reduce this risk, but if these projects are delayed (or if the peak demand grows at a faster rate) these risks would persist or even increase.

The Annual Security of Supply Assessment (SOSA) published by the SO also highlighted the winter capacity risk and the impact on the North Island Winter Capacity Margin (NI-WCM) under "thermal decommissioning" and "constrained thermal development" sensitivities. This shows the NI-WCM declining below the security standard[4] by 2024 unless sufficient new resources come to the market[5] before then.

The SO undertook system security assessments in 2016[6] to better understand the operational risks if certain thermal generation units in the upper North Island closed. For market participants to better understand the potential system security operational risks, this analysis would need to be updated considering changes in system conditions (including new investments, grid configuration changes and asset retirements).

We think it is important for industry stakeholders to understand the potential implications on the different operational security risks if thermal generators exit before sufficient alternative resources are in place.

Dry year risk

The Authority's analysis highlights the volatility in the usage and profitability of thermal generation (particularly the Rankines) in performing the dry-year back-up generation role. That analysis shows that in the near term (2025) there is significant volatility in the expected revenue (based on modelled future spot prices) and that "in the majority of years the Rankine units would have negative cashflows if reliant solely on spot market sales for their revenue".

The SO's recent SOSA highlights the impact of "thermal decommissioning" and "constrained thermal development" sensitivities on the winter energy margin (NZ-WEM). The SOSA shows that:

- If there is decommissioning of existing thermal generation, and assuming consented thermal generation is not developed but consented renewable projects are

[3] See Winter peak analysis: 2024 and 2025.
[4] Falling below the security standard implies an inefficient level of reserve shortfall and demand curtailment is expected to occur in the market relative to the level of spare capacity (i.e. additional capacity resources are needed in the market).
[5] See "Thermal decommissioning" sensitivity in "Stage 1 – existing and committed" of Figure 10 on Page 30 here
[6] See here

developed as expected[7] then the NZ-WEM remains at or above the standards till 2028.

- To remain above the standards after 2028, additional renewable projects would need to be consented and developed by 2028.
- However, if currently consented renewable projects are not developed (i.e. come online) before the decommissioning of existing thermal generation then the margins would fall below the standards from 2025.

We think it is important for parties to understand the impact of thermal generation decommissioning on dry-year risk.

Risk management

The Authority notes the importance of contracts as part of risk management and incentivising future investment. However, we highlight below issues identified for both the spot market and contracts (as raised in other investigations)[8].

Spot market

An additional integrated standby ancillary service will become increasingly important as penetration of intermittent generation increases. This would strengthen the incentivise for investment in additional flexible resources which would help reduce operational capacity risks when the thermal units decommission. This was raised as one of the options in the Authority's Winter 23 consultation paper (Option F: New integrated ancillary service).

We consider that that a review of the administered prices applied during scarcity situations should occur. This was also one of the options considered by the Authority as part of its Winter 23 consultation paper (Option I). Updates to the administered prices applied during scarcity would have flow on effects in incentives for investment in additional resources and contracting to manage price risk, both of which are important to reduce the thermal transition risk.

Given the benefits these options could have for reducing the thermal transition risk, we support the investigation of both.

Contracts

MDAG[9] has highlighted several issues with the current contract arrangements. The issues include liquidity and pricing of some contracts, costs of trading on the futures market and the material gap between what sellers and buyers believe the risk management value of the product is worth (which could indicate a different valuation of the risk between buyers and sellers).

Given the potential issues with the contracts and spot market and the potential delays in implementing any solution within a reasonable time, we support further investigation of option G (Introduce minimum notice period for plant capacity reductions). We also support investigation of options I-K to identify a preferred back-stop option that could potentially be

[7] Based on the system operator surveys undertaken as part of the SOSA process.
[8] These being the EA's winter 23 consultation paper (here) and MDAG's issues paper (here).
[9] See here

used (at short-notice) if the risk of a thermal exit is high (without sufficient alternative resources in place).

Security of supply information to industry stakeholders should reflect changes to the market and system

The SO monitors security of supply to meet demand on a time horizon of 10 years into the future through to real-time. Our approach to security of supply must evolve to reflect changes in the market and system.

One of the Authority's options includes providing more information to assist decision makers. *We believe that this information on security of supply risks should evolve to reflect the changing risks, changing economics and changing expectations of the power system.*

An example of a changing risk, in a future with high intermittent renewable generation (which will make up a large portion of the alternative energy resources), is that the power system will be more exposed to variable weather conditions and weather events. Greater consideration of these risks is needed in the adequacy standards (e.g. risks posed by extended periods of calm, cloudy days).

The SO has published a market insight paper[10] on key issues for evolving security of supply assessments and information provision. We are seeking feedback from stakeholders on these key issues.

Options

Below is a summary of the options supported by Transpower.

Table 1: Options supported or supported for further investigation

Options supported	Comments
A – Provide more information to assist decision making	Participants can understand operational risks of thermal exit. Risk assessments should reflect the changing system conditions.
B – Review administered prices	Ensure administered prices adequately reflect scarcity given changing system and market conditions.
C – Modify stress testing mechanism	Participants can better understand the financial risks of thermal exit.
D – Clarify availability and use of discretionary demand	Provides greater visibility but should ideally be offered and scheduled via the market process.
F – Introduce new ancillary service product	Provides incentives for flexible resources in the market. May also create space in the offer stack for less flexible thermal generators.

[10] See here

Options supported	Comments
G – Introduce minimum notice period for plant capacity reductions	Support further development of this option (e.g. need to ensure the plant is offered into market during the minimum notice period).
I – Introduce contingent contract obligation J - Introduce strategic reserve K – Pre-arrange short-term emergency reserve	Support further investigation of these options to short-list a preferred potential back-stop if it becomes apparent the market is unable to provide sufficient alternative resources before thermal generators exit.

We are unclear if Option E would be beneficial.

We support the Authority's consultation on options to mitigate the risk of disorderly transition of thermal generation.

We answer the specific consultation questions in the appendix.

Yours faithfully,

Joel Cook
Head of Regulation

Appendix

Questions	Transpower response
1. Do you agree with the desired outcome as described? If not, what do you think is the desired outcome in respect of thermal generation during the transition?	A desired outcome during the transition should be to reduce the reliability risks by ensuring sufficient alternative back-up resources are available to the market *before* the thermal units exit. The capability of the thermal units means if one or more is decommissioned without sufficient alternative resources already on the system to fill the gap, this will result in step reductions in the resources available to balance energy/capacity/voltage/frequency. There can be a lag between system need and resources entering the market due to a variety of factors (such as consenting delays, regulatory and demand uncertainty, and cost pressures), which could result in extended periods of resource inadequacy and a reduction in system reliability. This could impact confidence in the electricity market and the future electrification of the wider economy. The Authority's analysis highlighted the high volatility in thermal generation net cash flows (and in particularly Rankine net cash flows) based on weather variability. However, we think other variables will also impact the viability of thermal generation in the future. These include uncertainty around the rate of electrification; uncertainty around the uptake of batteries, which are also subject to uncertainties and delays; variations in weather patterns and the impact on intermittent generation (e.g. inflows, wind, sun).
2. Are there any other aspects of thermal transition risks that should be considered by the Authority?	**Impacts of an early thermal exit:** The Authority's assessment does not consider the impact on the market's ability to meet demand and provide system needs if the thermals exit the market before there is sufficient alternative resources available in the market. By considering the impacts it would help industry understand the potential implications on system security and wholesale market prices. **Impacts on outages:** The risks to asset outages (e.g. to maintain or upgrade transmission and generation assets) also need to be considered. Removing assets from service for maintenance or upgrades increases the reliance on other in-service assets to provide energy and other reliability services (such as voltage support). If there is insufficient alternative back up resources before the thermal generators exit this could impact the ability of the SO to coordinate outages and maintain its Principal Performance Obligations (**PPOs**). To ensure the PPOs are met, outages may be cancelled

Questions	Transpower response
	which will increase the likelihood of unplanned outages and load curtailment in the longer term. This can also impact the grid owner's ability to undertake improvement works on the grid to meet future demand/ generation needs. For those outages that cannot be moved, this could result in increased use of load curtailment or constraining on available market resources to manage the PPOs. Both these would impose large costs on customers and reduce confidence in the electricity market to manage the transition (particularly if load curtailment is used).
3. Do you agree with the above expectation of the likely role of thermal generation throughout the transition? If not, what is your view and reasoning?	We agree there is likely to be an overall downward trend of more expensive, less flexible, thermal generation over time as more alternative renewable resources come online. The consultation paper concludes that thermal usage is likely to remain significant in the near term.[11] This is not entirely clear as the Concept analysis highlights this usage is highly uncertain. Thermal usage in the near term (shown in Figure 6 of the consultation paper) ranges from 19% down to 4% (noting 4% is much lower than the previous minimum of 10% in 2022 as shown in Figure 1 of the consultation paper). The more expensive thermal units are likely to have even lower usage. During the transition we expect the uncertainty in the thermal requirement within each year to be high until sufficient alternative resources come online. In addition to the uncertainty provided by weather (as indicated in the Concept analysis), uncertainties related to the rates of electrification (e.g. data centres, electric vehicles, process heat conversion) as well as renewable generation and battery uptake could further widen the uncertainty of the thermal requirement to what has been modelled.
4. What (if any) improvements could be made to information to aid decision-makers in relation to thermal transition risk?	Decision-makers need to understand the risks to system security and system operation if thermals exit before sufficient alternative resources are in place. These would include security of supply risks (energy and capacity), as well as other risks such as reactive power support. **Security of supply risks:** The SO's SOSA includes sensitivities around thermal decommissioning to highlight the impact on the winter energy and capacity margins. In our recent market insight paper[12]

[11] See paragraph 3.29(b) in the consultation paper.

[12] Transpower, Evolving security of supply assessment in New Zealand July 2023

Questions	Transpower response
	[~~here~~] we highlighted opportunities to enhance and evolve the SOSA to consider the potential changes to the power system. One of these opportunities includes improving the provision of capacity risk information to the market in the 1–3-year time horizon. This and other issues are discussed in the market insight paper. We consider these would help the market to better understand the risks and aid its decision making. **System security risks:** Industry would also need to understand the potential implications of other system security risks, such as system voltage and/or frequency during normal and abnormal conditions. As an example, system security assessments were undertaken in 2016 following the announcement of thermal decommissioning[13]. These types of assessments would need to be updated for the industry to understand system security risks and their potential implications in operating the power system to ensure the PPOs are not compromised. **Additional information to aid the system operator in its risk assessments:** While the SO undertakes its assessments of potential system security risks (e.g. when planning outages), it has little visibility of contracts between parties which could impact some of its assessments. Greater visibility of forward-looking contracts between market participants would assist the SO to understand potential system conditions when undertaking its system security risk assessments. Greater visibility of potential outages further into the future (including those beyond 12 months) for both generation and load (including potential plant retirements) would also assist the SO in assessing and informing the market of potential system risks.
5. Are there any aspects in current spot market arrangements that are likely to undermine incentives to make efficient decisions in relation to back-up resources? If so, what are they?	**Incentives for increased flexibility:** The current spot market arrangements do not provide additional incentives for flexible resources (i.e. resources that can quickly adjust output when required to balance supply and demand if, for example, there is a reduction in intermittent generation). Providing additional incentives in the spot market for flexible resources would improve operational co-ordination with less flexible resources (such as some thermal generators) scheduled for energy and more flexible resources incentivised to "hold back" as a standby in case there was

[13] See Upper North Island Operational Limits following Huntly Rankine Unit Retirements.pdf (amazonaws.com)

Questions	Transpower response
	change in load or reduction in intermittent generation. It is important to incentivise investment in flexible resources, which are needed with the growing levels of intermittent generation. This was raised as one of the options in the Authority's Winter 23 consultation paper (Option F: New integrated ancillary service). Given the benefits this option could have for the thermal transition risk, we encourage investigation of this option as a priority, as well as any interim measures to this longer-term solution to increase the incentives for flexible resources in the market. **Scarcity prices:** A review and updating of the scarcity pricing values would ensure they accurately reflect prices during scarcity conditions given the changing role of electricity in the wider economy. These issues were raised by the Authority in its Winter 23 consultation paper. Updates to the scarcity prices would have flow on effects in incentives for investment in additional resources and contracting to manage price risk, both of which are important to reduce the thermal transition risk.
6. Do current arrangements provide balanced incentives to conclude forward contracts to manage thermal risks of transition appropriately? If not, what are the reasons for your view?	Parties exposed to forward contracting would be better placed to respond to this. However we note MDAG, in its issues paper[14] raised an issue with the current contracting arrangements was the material gap between what sellers and buyers believed risk management value was. This could indicate potential misalignment between risk value between buyers and sellers (and therefore the incentives to contract).
7. Do current arrangements ensure reasonable availability of forward contracts related to back-up services – such as dry year cover? Please explain your reasoning.	It is not clear current arrangements ensure reasonable availability of forward contracts related to back-up services – such as dry year cover. However, we note MDAG issues with the current contract arrangements[15] as discussed in our response to question 6. The issue of differences in risk valuation between buyers and sellers could become more acute for low-probability-high-impact events.

[14] See here
[15] See here

Questions	Transpower response
8. To what extent do current arrangements create potential for misaligned incentives between retailers and consumers in relation forward contracting with adverse impacts on thermal transition risk? Please explain your reasoning.	We are unclear to what extent this impacts the thermal transition risk.
9. To what extent do current arrangements relating to use of ripple control in periods of tight supply affect thermal transition risk? Please explain your reasoning.	The current arrangements improve the visibility of discretionary load (including ripple control) during tight periods. Ideally demand-side resources should be offered via the market (such as the Dispatch Notified Participation product) which would provide greater visibility of the market resources to balance supply and demand. Ripple control only shifts demand during tight peaks and cannot substitute for thermal generators during a dry year situation.
10. Do you agree with the Authority's view above that lumpiness does not (at present) threaten to disrupt an orderly thermal transition? If so, or if not, please explain your reasoning.	We do not agree. We think lumpiness is a key issue that can contribute to a situation of insufficient alternative resources before the thermal units exit the market (as discussed earlier see Figure 1 in this response). The stepped reduction in existing resources is a characteristic of the lumpy nature of the less flexible thermal generators. If there is an insufficient amount of new resources added before the existing resources exit, the net effect could be a reduction in the available resources to the market. Even though the new resources offset the existing resources which exited once the transition is complete, there is a risk in the transition. It is not clear whether the current market arrangements will provide sufficient incentives to ensure reliability is maintained during the transition.
11. To what extent are there any selective support mechanisms paid outside the wholesale market which could pose a challenge to	It is unclear to what extent being paid from a single gross pool reduces the thermal transition risk. As the Concept analysis indicates there is extreme volatility in the net revenue available to back-up generators based on weather conditions alone (see Figure 3 in the consultation paper). In Concepts' analysis, in many years (looks like ~30 years out of 40) the Rankine generators could be losing money

Questions	Transpower response
achieving an efficient thermal transition? Please explain your reasoning.	relative to their go-forward costs. If several of these loss-making years were to occur sequentially, we consider there will be an increased risk of exit irrespective of the market being a gross revenue pool. If the current market arrangements are insufficient to ensure sufficient alternative resources are in place before the exit of the thermal generators, then potentially a well-designed support mechanism may help reduce reliability risks during the transition.
12. To what extent is thermal generation providing a service that is needed but not explicitly priced and rewarded? Please explain your reasoning.	Synchronous generators (including thermal generators) provide inertia, voltage support to support local voltage and to enable active power transfer across the network, system strength to enable reliable protection and inverter operation and are less variable and uncertain in their output (compared to intermittent generators) thus resulting in less frequency keeping costs. The need for these services provided by synchronous generators will increase as more intermittent, inverter-based resources[16] are connected to the grid which is currently being considered as part of the EA's FSR work program. The FSR program is also looking at potential solutions (market and asset owner requirements) to address these needs. The reserves procured in the market considers the amount of inertia on the system. If there is less inertia, more fast instantaneous reserves (FIR) will be required (all else being equal). Reducing the amount of thermal generation on the system could have flow-on effects into the reserve market and, with the energy-reserve co-optimisation, also into the energy market. Currently grid-connected generators (including thermal generators) provide voltage support as part of the asset owner performance obligations (AOPO) which is critical for the reliable operation of the power system. To ensure sufficient voltage support is available to operate the grid, sometimes constraints might be required by the SO to ensure sufficient generation is online to support the voltage within the required ranges[17]. The impact of these constraints are reflected in the energy costs to wholesale purchasers.

[16] An increase in grid forming inverter resources would help support a future with less synchronous generation and more asynchronous wind and solar.
[17] Agreements with asset owners are also sought to address this issue.

Questions	Transpower response
	If thermal generators exit without sufficient alternative voltage support resources in the same area there would be reduced ability for the SO to operate the grid within its PPOs. This would impact the power transfer limits across the grid (resulting in increased locational price separation), requiring constraints more frequently on any remaining generators and/or load curtailment to ensure the voltages remain within required limits while operating the grid. This would also impact the ability to maintain assets on the grid (e.g. transmission lines, reactive devices, or generators) as removal of assets in a region (e.g. for maintenance) will increase the need for voltage support in that region. Cancelling outages also has a cost in terms of greater chance of failure of assets which can affect safety and unplanned load curtailment.
13. To what extent will thermal retirement/investment decisions be driven by non-financial factors? Please explain your reasoning	We are unclear to what extent this impacts the thermal retirement/investment decisions.
14. What (if any) other factors could undermine an efficient thermal transition? Please explain your reasoning.	The volatility of prices. As the Concept analysis indicates there is an extreme volatility in the net revenue available to back-up generators based on weather conditions alone (see Figure 3 in the consultation paper). If several of these loss-making years were to occur sequentially, we consider there could be an in increased risk of exit. Delays in implementing market and information initiatives that (a) improves the information to the market on potential risks of fossil-fuelled thermal exit and (b) increases alternative back-up resources before fossil-fuelled thermals exit. Delays in new resources coming to market. Materials, supply chain challenges and other project constraints have been raised which could impact delivery timelines. See pages 2, 17-27 of the generation investment survey [here] undertaken as part of the Electricity Authority's wholesale market competition review in October 2022. Some of these have also been raised by Contact (see pages 7, 27 and 34 of Contact's 2022 Annual Report [here].

Questions	Transpower response
	If there are insufficient alternative back-up resources available in the market before the thermals exit, then reliability will likely be impacted during the transition. The reduction in reliability will impact confidence in the electricity market and the wider electrification of the economy.
15. Do you have any views on the options discussed above, and how useful they might be if thermal transition risks increase in future?	Option A: We support providing information to assist decision makers; however, we think these should also evolve given the potential changes to the system. In our recent market insight paper we explore issues with the SOSA and information we provide and how this could evolve going forward [here]. As noted, the SOSA is produced annually. Additional resources would be required if a more frequent publication is needed, or further development of the adequacy assessments are needed. Option B: The valuing of energy and reserve shortfalls is essential to the current market design. It is therefore important to ensure scarcity price values accurately reflect the changing role of electricity in the economy. This will also be used to inform the development of any contracts and investment in alternative resources. This is important to ensure sufficient alternative resources are in place before the thermal units exist. Delays in implementing these initiatives can increase the risk of a disorderly exit. Option C: Updating the Stress Testing regime was also suggested by MDAG. In addition to providing additional information to the market on the operational risks to the system from an early thermal exit, updating the Stress Testing regime could provide further information that can help market participants understand the potential financial risks due to thermal exits. Option F: We see the "standby reserve" ancillary service as an important feature of the future market to value more flexible resources in a future with increased intermittent generation and demand response. More flexible resources would be reserved for the ancillary service, leaving space in the energy supply stack for less flexible resources, which might include some less flexible thermal generation. We see the development of an ancillary service that values flexibility as an important feature of the future market that would also help with the transition. Delays in this development could impact the orderly transition as it could mute investment in alternative back-up resources and under-value flexible resources in the market. There may be opportunities to explore incremental

Questions	Transpower response
	approaches in implementing this ancillary service, recognising that the end goal is a co-optimised product, which might be difficult to implement in the shorter-term. Option G: This option can help reduce the uncertainty in plant exit, increasing the potential for investment and contracting for alternative resources before the plant exits. However consideration should be given to ensure these resources are still available and offered into the market during their notice period. It would also be useful to understand what the trigger might look like for this implementation. Option I-K: These options could help reduce the reliability risks during the transition. We support exploration and further development of these options and their triggers to identify a preferred back-stop option that could be implemented at shorter notice if the risk of a disorderly exit becomes more apparent.
16. What other options (if any) could be explored to mitigate thermal transition risks, should these risks increase in future? Please explain your reasoning.	Providing participants with greater visibility of potential system risks if the thermals were to exit. The SO produced a market insight on winter capacity risks [here], but there are opportunities to refine this as to better inform industry stakeholders of the potential system risks in the next 1-3 years. We also feel there may be benefits in reviewing the SOSA methodology to ensure it is still fit for purpose considering the changing future as discussed in our recent market insight paper [here].