Submission to the Australian Energy Market Commission (AEMC) on the Directions Paper: Economic Assessment of Inertia Procurement Options

Due Date: 5 February 2025

Author: Dr Anne S. Smith, Rainforest Reserves Australia

Introduction

The transition to a renewable energy future is an essential and urgent undertaking for Australia, requiring the modernization and adaptation of the nation's power systems. As the energy mix shifts to include higher levels of inverter-based renewable energy, the stability of the power grid faces unprecedented challenges. The role of inertia in maintaining system stability cannot be overstated, as it mitigates frequency deviations and enhances the resilience of the grid against disturbances.

This submission responds to the AEMC's Directions Paper on inertia procurement options, providing an extensive analysis of the proposed frameworks, their technical and operational implications, and the potential consequences of inaction. It highlights opportunities for improvement and identifies significant breaches and shortfalls in the current approach. The focus is on aligning inertia procurement with Australia's broader energy policy goals, ensuring cost-effectiveness, and fostering innovation.

The paper's importance lies in addressing the systemic gaps in inertia procurement, which, if left unresolved, could lead to heightened instability, increased operational costs, and challenges to achieving the renewable energy transition. Without a proactive and integrated approach, Australia risks undermining the reliability and resilience of its power system, which is critical to supporting economic growth and community wellbeing in the face of climate change and evolving energy demands.

A balanced and well-integrated framework is essential to safeguard Australia's energy future. This submission explores these critical issues in detail and provides practical recommendations to address them effectively.

---

1. The Role of Inertia in System Stability

Inertia provides critical support for maintaining the frequency stability of the power grid. Traditionally, synchronous generators, such as coal and gas plants, have been the primary providers of inertia. However, as these are phased out in favor of renewable sources, there is a pressing need to establish alternative mechanisms for inertia provision.

Key functions of inertia include:

- **Mitigating Frequency Deviations**: Inertia slows the rate of frequency change, allowing more time for other frequency control services to respond.
- **Enhancing Grid Resilience**: By providing instantaneous energy during disturbances, inertia helps prevent cascading failures.

- **Facilitating Renewable Integration**: A stable grid supported by adequate inertia enables higher penetration of renewable energy sources.

Challenges in the Current Context

1. **Reduced Synchronous Generation**: The decline in coal and gas plants has led to a significant reduction in inherent inertia, leaving the grid more vulnerable to rapid frequency changes.
2. **Inadequate Synthetic Inertia Deployment**: While technologies such as grid-forming inverters can provide synthetic inertia, their deployment remains limited due to cost and regulatory barriers.
3. **Geographic Disparities**: Regions with high renewable energy penetration often lack localized inertia resources, creating vulnerabilities in specific areas of the grid.

Shortfalls Identified:

- **Lack of Comprehensive Planning**: Current frameworks do not adequately account for the spatial and temporal variability of inertia requirements.
- **Insufficient Standards for Synthetic Inertia**: The absence of clear technical standards for synthetic inertia undermines confidence in its reliability.
- **Overreliance on Market Mechanisms**: While market-based approaches can incentivize inertia provision, they are insufficient to address long-term structural needs.

Breaches Identified:

- **Failure to Address Regional Vulnerabilities**: Current strategies do not ensure equitable distribution of inertia resources, exacerbating risks in weaker parts of the grid.
- **Inconsistent Alignment with Policy Objectives**: The lack of integration between inertia procurement mechanisms and broader renewable energy policies hinders their effectiveness.
- **Delay in Technological Adoption**: Insufficient incentives for adopting advanced technologies like grid-forming inverters have delayed their deployment, leaving critical gaps in grid stability.

The AEMC's recognition of these issues and its commitment to exploring improved procurement options is a step in the right direction. However, a more proactive and holistic approach is required to ensure the resilience and stability of Australia's power system as it undergoes this transformative change. Future strategies must prioritize long-term resilience, equitable resource distribution, and innovation-driven solutions to mitigate risks effectively.

---

2. Evaluation of Proposed Procurement Approaches

2.1 Long-Term Procurement

Long-term procurement of minimum levels of inertia aligns with the principles of reliability and predictability. It offers a structured approach to addressing baseline requirements, ensuring stability even as renewable penetration increases. The following considerations are critical:

- **Regulatory Frameworks**: The design must integrate seamlessly with existing market mechanisms, avoiding redundancy or conflicts.
- **Investment Incentives**: Clear and consistent policies are required to encourage investment in technologies that provide inertia, such as synchronous condensers and hybrid renewable solutions.
- **Cost-Effectiveness**: Long-term procurement can mitigate price volatility and reduce costs by providing certainty to market participants.

Shortfalls Identified:

- **Inadequate Coordination with FCAS**: Insufficient alignment between long-term contracts and FCAS services creates inefficiencies.
- **Unclear Contractual Terms**: Existing contracts lack the specificity required to incentivize sustained investment in inertia technologies.

Breaches Identified:

- Insufficient clarity in current long-term contracts to incentivize sustained investments.
- Overlap with existing Frequency Control Ancillary Services (FCAS) markets creates unnecessary complexity.

2.2 Operational Procurement

Operational procurement of additional inertia offers flexibility to address real-time system needs. This approach is valuable for managing unexpected demand fluctuations or sudden disturbances. However, it presents challenges, including:

- **Market Integration**: Operational mechanisms must complement existing ancillary services markets.
- **Real-Time Feasibility**: Ensuring that inertia sources can respond promptly to system demands is critical.
- **Cost-Benefit Analysis**: While operational procurement may reduce short-term costs, over-reliance on it could increase systemic risks.

Shortfalls Identified:

- **Fragmented Market Design**: Operational procurement mechanisms are not adequately integrated with broader market structures, reducing their efficiency.
- **Reactive Rather than Proactive**: Operational procurement focuses on addressing immediate needs rather than building long-term resilience.

Breaches Identified:

- Current operational frameworks lack adequate safeguards to prevent excessive cost burdens on consumers.
- Limited mechanisms to ensure equitable geographic distribution of operationally procured inertia.

- Insufficient transparency in the operational procurement process undermines stakeholder trust.

---

3. Key Areas for Further Examination

3.1 Interaction with Existing Frameworks

The new procurement mechanisms must be harmonized with:

- Frequency Control Ancillary Services (FCAS)
- The Integrated System Plan (ISP)
- Renewable Energy Zones (REZs)

Shortfalls Identified:

- **Lack of Alignment**: Current inertia procurement strategies conflict with REZ-specific development plans, leading to inefficiencies.
- **Incomplete Integration**: The absence of a unified strategy undermines the effectiveness of inertia provision.

Breaches Identified:

- Existing inertia procurement strategies conflict with REZ-specific development plans, leading to inefficiencies.
- Lack of comprehensive integration within the ISP increases the risk of fragmented implementation.

3.2 Technical Requirements and Capabilities

Technological advancements, such as grid-forming inverters and advanced energy storage systems, can contribute to synthetic inertia. The AEMC should:

- Develop standards for inertia-providing technologies.
- Encourage innovation through funding and pilot projects.

Shortfalls Identified:

- **Undefined Standards**: The lack of technical standards for synthetic inertia creates inconsistencies in system reliability.
- **Innovation Barriers**: Limited funding and support for pilot projects hinder the development and deployment of advanced solutions.

Breaches Identified:

- Absence of mandated technical standards for synthetic inertia creates inconsistencies in system reliability.
- Limited funding for emerging technologies slows progress toward innovative solutions.

3.3 Implementation and Operational Considerations

Implementation challenges include:

- Coordination between Transmission Network Service Providers (TNSPs) and market participants.
- Ensuring geographic distribution of inertia resources to prevent localized vulnerabilities.

Shortfalls Identified:

- **Coordination Gaps**: Insufficient collaboration between stakeholders has resulted in disjointed implementation strategies.
- **Geographic Disparities**: Failure to account for regional differences in inertia needs exacerbates system vulnerabilities.

Breaches Identified:

- Inadequate stakeholder engagement has led to gaps in coordinated implementation strategies.
- Operational inertia procurement mechanisms fail to address the unique challenges of remote and regional grids.

3.4 Costs and Timing

A phased approach to implementation, with transparent cost structures, will ensure a smoother transition and minimize economic disruptions.

Shortfalls Identified:

- **Lack of Transparency**: Ambiguities in cost allocation mechanisms hinder stakeholder confidence.
- **Delayed Reforms**: Prolonged timelines for implementing proposed frameworks exacerbate current vulnerabilities.

Breaches Identified:

- Insufficient transparency in cost allocation mechanisms undermines stakeholder confidence.
- Delays in implementing proposed reforms exacerbate existing vulnerabilities.

---

4. Recommendations (Extended)

4.1 Adoption of a Hybrid Model

A hybrid model combining long-term and operational procurement mechanisms is the most effective approach to ensure grid stability and resilience while integrating renewable energy sources. By addressing both baseline inertia requirements and dynamic operational needs, the hybrid model offers flexibility and reliability. Specific actions under this model include:

- **Establishing Regional Inertia Thresholds**:
    - Region-specific inertia thresholds should account for geographic and temporal disparities in energy demand and generation capacity. Thresholds must be based on robust modeling and stakeholder input to prevent vulnerabilities in weaker parts of the grid.
- **Incorporating Demand Response Mechanisms**:
    - Operational procurement should integrate advanced demand response systems, leveraging digital technology to adjust energy consumption patterns in real-time, reducing the strain on the grid.
- **Leveraging Storage Solutions**:
    - Large-scale battery storage systems and pumped hydro should be incorporated as supplementary resources to provide synthetic inertia and enhance grid stability during peak demand or emergencies.

4.2 Enhancing Transparency and Stakeholder Engagement

Transparency and stakeholder engagement are pivotal for building confidence and ensuring equitable decision-making. Recommendations include:

- **Publishing Comprehensive Impact Assessments**:
    - Detailed cost-benefit analyses for proposed procurement mechanisms should be made publicly available. These analyses must address not only economic considerations but also environmental and social impacts.
- **Establishing a Stakeholder Advisory Panel**:
    - An advisory panel comprising representatives from industry, academia, consumer groups, and technical experts should provide ongoing input to ensure balanced and inclusive decision-making.
- **Periodic Stakeholder Consultations**:
    - Regular consultations with all relevant stakeholders will ensure that procurement strategies remain responsive to evolving needs and challenges.

4.3 Investment in Emerging Technologies

Technological innovation is essential to addressing long-term inertia challenges. The AEMC must take proactive measures to foster the development and deployment of cutting-edge solutions. Key recommendations include:

- **Increasing R&D Investments**:
    - Government funding for research into grid-forming inverters, advanced storage systems, and hybrid technologies must be significantly expanded.
- **Introducing Technology Neutral Incentives**:
    - Policies should incentivize all forms of inertia-providing technologies without bias toward specific solutions, encouraging competition and innovation.
- **Scaling Pilot Programs**:
    - Pilot projects must be scaled to test advanced solutions in diverse geographic and market conditions. Findings should guide the refinement of procurement frameworks.

4.4 Regular Review and Adaptation

The energy market is dynamic, requiring regular assessments and updates to procurement frameworks. Recommendations include:

- **Annual Performance Reviews**:
  - Independent reviews should evaluate the effectiveness of implemented strategies annually, ensuring they align with technological advancements and market conditions.
- **Establishing a Rapid Response Mechanism**:
  - A rapid response framework should be developed to address emerging challenges or gaps in inertia provision promptly.
- **Aligning with International Best Practices**:
  - Australia should benchmark its inertia procurement strategies against leading international examples, adopting proven practices and innovations.

---

5. Conclusion

The AEMC's exploration of inertia procurement options is a vital initiative to ensure the stability and resilience of Australia's energy system during its renewable energy transition. This submission underscores the importance of adopting a hybrid procurement model, enhancing transparency, fostering innovation, and maintaining adaptability.

The energy market is at a crossroads, and proactive measures are essential to mitigate the risks of reduced synchronous generation and ensure seamless integration of renewable resources. By addressing the identified breaches and shortfalls, the AEMC can pave the way for a secure, equitable, and sustainable energy future.

Collaboration among policymakers, industry stakeholders, technical experts, and the community will be crucial in achieving these goals. This submission calls on the AEMC to prioritize comprehensive, data-driven, and forward-looking approaches that uphold system stability while embracing the opportunities presented by renewable energy.

References

1. Australian Energy Market Commission (2024). *Directions Paper: Economic Assessment of Inertia Procurement Options*.
2. Australian Energy Market Operator (2023). *Integrated System Plan*.
3. International Renewable Energy Agency (IRENA) (2023). *Innovation Landscape for a Renewable-Powered Future*
4. Energy Systems Catapult (2022). *The Role of Flexibility in a Net Zero Energy System*.
5. CSIRO (2023). *Advanced Grid Technologies and Their Role in Future Energy Systems*.
6. International Energy Agency (IEA) (2023). *Grid Stability and Flexibility in Renewable Energy Systems*.