12 February 2025

To:

Australian Energy Market Commission
Level 15, 60 Castlereagh Street
Sydney NSW 2000

RE: Real-time data for consumers rule change proposal

Reference: ERC0399

We appreciate the opportunity to provide comprehensive feedback on the AEMC's directions paper regarding real-time data access for electricity consumers. The transition to a cleaner and more efficient energy system requires careful consideration of technical, economic, and security aspects to create a framework that enables both current and future innovations in the energy sector.

Our submission provides detailed analysis and recommendations across five critical areas:

1. Data Storage Architecture: We propose a three-tier storage framework that optimizes data accessibility while maintaining efficiency and cost-effectiveness. Our recommendations include specific technical requirements for local storage, data compression, and long-term archival.

2. Economic Framework: We present an alternative cost model that balances infrastructure investment with consumer benefits, including detailed analysis of implementation costs and projected savings.

3. Technical Standards: Our submission outlines comprehensive specifications for next-generation smart meters, including communication protocols, processing capabilities, and security features.

4. Market Structure Evolution: We provide a detailed transition framework for Metering Service Providers, defining new service categories and market roles that align with future requirements.

5. Security Framework: We present a multi-layered security architecture that addresses identified threats while enabling innovation and protecting consumer privacy.

Our recommendations are based on extensive research and practical experience in the energy sector, including recent publications on data compression and security in smart meter applications. We believe these detailed technical specifications and implementation frameworks will contribute significantly to developing a robust and future-proof system for real-time data access.

We look forward to further engagement on this important initiative and are available to provide additional technical details or clarification as needed.

Yours sincerely,

- [redacted] Senior Lecturer of Power Systems Engineering
- [redacted] PhD student in Power Systems Engineering

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Executive Summary

This submission addresses critical aspects of the AEMC's proposed framework for enabling consumer access to real-time data from smart meters. Our analysis has identified five interconnected areas that require substantial consideration to ensure the framework's success and longevity.

The first critical area concerns data storage architecture. The current proposal denies the necessity of local data storage, which we believe is crucial for enabling advanced analytics, machine learning applications, innovative energy services, and avoiding duplication and higher chance of security evasion. Without proper local storage requirements, the potential benefits of real-time data access may be significantly limited.

Secondly, we identify concerns with the proposed cost structure that may impede adoption and create market inefficiencies. A revised economic model is needed to promote early adoption while ensuring equitable cost distribution across all stakeholders.

The third area focuses on technical standards for smart meters. We believe the framework needs to differentiate between current and future smart meter specifications to encourage innovation while maintaining backward compatibility. This differentiation is essential for creating a future-proof system that can adapt to technological advances.

Fourth, we address the evolving role of Metering Service Providers (MSPs) in the new framework. The current proposal creates uncertainty about their future role, which needs clarification to ensure market stability and efficient service delivery.

Finally, we emphasise the critical importance of security architecture in a high-resolution data environment. The proposed framework requires a more robust approach to security measures that protect consumer privacy while enabling innovation.

These five areas are fundamental to creating a future-proof framework that supports Australia's transition to a more dynamic and efficient consumer-centric energy system. Our detailed analysis and recommendations for each area follow.

Detailed Feedback

1. Local Storage Requirements

Relevant to Question 3 and Question 5

The absence of specific data storage requirements in the current proposal creates significant technical and operational challenges that need to be addressed. Smart grid applications typically require substantial historical data for value creation, business models development and assessment, effective operation and service delivery. Under the current proposal, each smart meter generates 86,400 data points daily at one-second intervals, resulting in roughly 1.4 MB of uncompressed data per day for each basic parameter (would be 4.2 MB for all parameters suggested to be recorded in the proposal). For advanced analytics and seasonal/weekly/daily/hourly pattern recognition required in many smart grid applications, a minimum of six months to one year of historical data is typically required. Furthermore, the reliability of data access could be compromised by potential communication channel disruptions and data transmission losses, making local storage capabilities essential for ensuring continuous data availability and system resilience.

We propose implementing a comprehensive three-tier storage framework that addresses these challenges while optimising cost and efficiency. The first tier would consist of local storage at the meter level, maintaining a rolling 90-day window of high-resolution data. This local storage would utilise efficient compression algorithms capable of achieving a 10:1 compression ratio, significantly reducing storage requirements while maintaining data integrity. Direct API access would be provided for authorised applications, enabling real-time analysis and response.

The second tier would focus on data aggregation, where high-resolution data is summarised at multiple time scales and maintained for 24 months. This approach ensures that valuable historical data is preserved while managing storage costs effectively. The third tier would provide long-term archival storage of aggregated data perhaps at lower resolution (half hourly), essential for research, long-term analysis, and regulatory compliance.

To address some of the challenges efficiently (e.g. the third tier data storage), we have recently published a research paper that proposes innovative approaches to data compression for cost-efficient local storage. Our paper, available at https://www.cell.com/cell-reports-physical-science/fulltext/S2666-3864(24)00055-9, presents solutions that could help avoid these implementation challenges from the beginning. We recommend incorporating these compression techniques along with clear data retention policies and standardised APIs for data access. These standards should be mandatory for all meter installations, ensuring consistency across the network while maintaining flexibility for future innovations.

2. Cost Allocation Model

Relevant to Question 1

The proposed cost structure in the AEMC's framework raises two significant concerns regarding equity and practical implementation. The current proposal suggests that consumers who opt into the program during the first 15 years would bear the cost of the solution, after which the program would become free of charge for all consumers. This approach presents several challenges that need to be carefully considered.

The first major issue concerns the treatment of early adopters. Under the proposed framework, early adopters would effectively be penalised by bearing the full cost of implementing the solution, while later adopters would receive the same benefits at no cost after the 15-year period. This approach contradicts the principle of incentivising early adoption, which is crucial for the successful implementation of new energy technologies and services, as we have seen in residential solar system. Early adopters typically play a vital role in driving innovation, creating essential markets to begin with, providing valuable feedback, and demonstrating the benefits of new technologies to the broader market. Penalising them with higher costs could significantly impede the initial uptake and slow down the overall implementation of the program. More importantly, it is very unlikely that early adopters see immediate benefits from the high-resolution data due to the current unavailability of smart grid services that depend on high-resolution and real-time data. Consequently, incentives become critical.

The second critical issue relates to the practical challenges of cost calculation and allocation. The cost per consumer would necessarily depend on the total number of consumers who opt into the program during the initial 15-year period. This creates a significant challenge for utilities and Metering Service Providers (MSPs) in determining a fair and accurate cost structure. Without knowing the future adoption rate, it becomes extremely difficult to establish an equitable pricing model that neither overcharges early participants nor creates financial risks for service providers. This uncertainty could lead to either excessive costs for early adopters if adoption is low, or potential financial shortfalls for service providers if the costs are set too low.

These issues suggest the need for a revised approach to cost allocation that better balances the interests of all stakeholders while providing clear market signals. The framework should consider alternative mechanisms that distribute costs more equitably across all beneficiaries of the system, while still maintaining appropriate incentives for early adoption. This could include exploring different cost-sharing models or implementing a gradual transition in cost allocation that better reflects the shared benefits of the system. An out of the box solution could be the one presented in our paper, available at https://www.cell.com/cell-reports-physical-science/fulltext/S2666-3864(24)00055-9, that allows to use current infrastructure and keep the upfront cost manageable.

3. Future Smart Meter Capabilities

Relevant to Question 3 and Question 4

The technical specifications for next-generation smart meters require careful consideration to ensure they meet both current and future needs. Current smart meters in Australia lack many of the communication capabilities that are becoming standard in other markets, particularly in Europe. We recommend establishing comprehensive technical requirements that address this gap while providing flexibility for future innovations.

Communication capabilities should include built-in WiFi supporting IEEE 802.11ac or better standards, and Ethernet connectivity with a minimum of 100BASE-TX, and provisions for cellular backup using 4G/5G networks. Additionally, support for low-power wireless protocols such as LoRaWAN or Zigbee should be included to enable integration with home energy management systems and other smart devices

Processing capabilities need to support minimal local analytics (edge analytics) and data management. This includes a minimum 32-bit processor with sufficient RAM (32 MB seems sufficient for minimal edge computing) and local storage to handle basic data processing tasks similar to the existing edge computing devices. A hardware security module should be mandatory to ensure data integrity and protect against tampering.

The implementation of these requirements should follow a phased approach that recognises the practical constraints of the market while maintaining momentum toward the desired end state. This includes establishing clear certification processes for new devices and defining upgrade paths for existing installations.

4. Role of Metering Service Providers

Relevant to Question 5

The evolution of MSP roles in the context of real-time data access requires careful consideration to ensure market stability and service quality. Currently, MSPs perform essential functions including meter reading, maintenance, data collection, validation, and compliance monitoring. However, the proposed framework's emphasis on direct data access raises questions about their future role and value proposition.

We envision a transformed role for MSPs that leverages their expertise while adapting to new market requirements. In the future, MSPs could evolve into comprehensive data service providers, offering advanced analytics, real-time monitoring, and predictive maintenance services. This evolution would add significant value to the energy ecosystem while maintaining the benefits of their existing expertise.

Market integration represents another crucial area where MSPs could play a vital role. As the complexity of data services increases, there will be growing demand for reliable service orchestration, API management, and data quality assurance. MSPs are well-positioned to fulfill these functions, given their existing relationships with retailers and network operators.

To facilitate this transition, we recommend developing a comprehensive framework that defines new service categories and establishes clear qualification requirements. This framework should include specific performance metrics and a detailed timeline for market transition, ensuring stability while promoting innovation.

5. Cybersecurity and Privacy Protection

Relevant to Question 8

The implementation of high-resolution data collection and access creates significant security and privacy challenges that must be comprehensively addressed. The proposed one-second data resolution enables detailed analysis of consumer behaviour through non-intrusive load monitoring (NILM) techniques. This granular data can reveal sensitive information about household activities, occupancy patterns, and even individual appliance usage.

Our security analysis has identified several critical attack vectors that must be mitigated. These include potential man-in-the-middle attacks during data transmission, data injection attacks that could compromise system integrity, and denial of service attacks that could disrupt data access. Additionally, the risk of unauthorised behaviour pattern analysis and device fingerprinting must be carefully managed.

To address these challenges, we propose implementing a multi-layered security framework that encompasses data protection, network security, and operational security measures. Data protection should include end-to-end encryptions for all transmissions, secure key management systems, and robust access control mechanisms. Network security measures should implement proper segmentation, intrusion detection systems, and continuous traffic monitoring.

Operational security requires regular security audits, clear incident response procedures, and mechanisms for rapid security updates. These measures should be supported by mandatory security standards and regular assessments to ensure ongoing compliance and effectiveness. We have addressed these security and privacy challenges in detail in our recent publication (https://www.cell.com/cell-reports-physical-science/fulltext/S2666-3864(24)00055-9), which presents comprehensive safety and security mechanisms for both existing and future smart metered consumers. We recommend incorporating these approaches to ensure robust protection of consumer data and privacy.

6. Response to Question 2: Should the prices for real-time data access be published by the AER?

To give customers a choice, we believe all costs (upfront and access to real-time data costs) must be known to customers so they can choose between a new smart meter and the private meters in the market. This will also encourage retailers to build a hardware/software solution that is cheaper than the existing private meters. This will benefit customers in the long-term and give them more choices to access their own electricity data.

Conclusion

The success of this framework requires a balanced approach that addresses immediate practical needs while establishing a foundation for future innovation. Our recommendations provide a comprehensive roadmap for implementing secure, efficient, and equitable access to real-time energy data.

The implementation of robust technical standards, equitable cost distribution mechanisms, and comprehensive security frameworks will be crucial for success. Equally important is the establishment of clear roles for market participants and the development of future-proof technical specifications that can adapt to evolving requirements.

We emphasise that these recommendations should be viewed as interconnected elements of a comprehensive system rather than isolated measures. Success will require careful coordination and ongoing adaptation to ensure that the framework continues to serve the long-term interests of all stakeholders in the energy sector.