



## POSITION STATEMENT

# Technology Evolution and Electricity Markets

*Approved by the IEEE-USA  
Board of Directors (November 21, 2025)*

### **Introduction and Rationale**

Recently introduced technologies, such as advanced grid management systems and renewable energy sources, have the potential to significantly lower electricity costs, improve grid reliability and resilience, enhance national security, and reduce environmental impact. To fully realize these benefits, it is essential to integrate these technologies effectively into the electric grid and both wholesale and retail electric markets. This integration requires a regulatory structure designed to capture opportunities for improvement while mitigating potential disruptive effects. The current electricity regulatory and market structures in the US are highly fragmented. Wholesale electric markets operate under federal jurisdiction, while retail electric markets are under state jurisdiction. This fragmentation leads to regional variations in regulations, technical requirements, market rules, and financial incentives. As a result, each region must continually evolve and adapt to local conditions. Stakeholder<sup>1</sup> committees and regulatory authorities play a crucial role in establishing administrative processes that address ever-changing complexities and guard against adverse outcomes.

### **Recommendations**

Given the diverse conditions across regions, a universal set of recommendations for optimal integration of the new technologies may not be feasible. However, applying a set of core principles can guide the adaptive evolution of market rules and regulations as new technologies reshape the electric landscape. IEEE-USA proposes the following foundational principles to help ensure an effective and flexible transition:

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<sup>1</sup> Stakeholders are anyone with a stake in operation or financial outcome related to operation of the electric grid. Simply stated they are producers, users, buyers, sellers, and grid operators. Organizations such as NERC and RTOs have defined formal processes for engagement. Stakeholders also participate in regulatory proceedings and litigation.

**Explicitly provide flexibility to evolve regulatory policy in parallel with the introduction of new technology for electricity production, storage, and use:**

- Technology is not static and is changing rapidly.
- Advances are likely to continue across all segments of grid planning, operation, and use.
- One crucial aspect will be the ongoing development of ancillary services markets to accommodate the increased use of Inverter-Based Resources (IBRs), such as solar, wind power, and batteries, which have different operational characteristics compared to traditional rotating machines. To ensure the reliable and optimal integration of these resources, regulations and market rules must support them effectively.
- It will be important that legislation and regulation be explicitly designed to accommodate technological change.

**Evaluate possible unintended consequences when developing market rules, rate designs, and environmental and other regulations, utilizing stakeholder processes in wholesale markets to inform the continuing development of market rules and regulations:**

- Deregulation and industry restructuring over the last two decades shifted emphasis from regulating utilities to regulating markets.
- Increased complexity has resulted in both planning and operation.
- Policymakers' regulatory decisions directly impact the value of new technology and deployment on the grid and into the markets.
- Actions by states, including contracting for supplies, may also affect market outcomes.
- Potential unintended consequences include reliability issues, adverse environmental impacts, and economic damage to businesses and electric consumers.
- Regulators should consider how proposed actions will impact the formation of electric prices, the efficiency of grid operations, and the behavior of market participants to help minimize these unintended adverse outcomes.
- Stakeholder engagement helps minimize unintended consequences arising from the implementation of new technology and regulatory actions.
- Stakeholder processes and public participation in regulatory proceedings should be maintained or enhanced as necessary, aligning with national, regional, and state requirements.
- Arbitrary actions not vetted by market participants can result in poor market outcomes and negatively impact reliability.

**Implement policies that recognize the integration of local retail electricity markets within regional wholesale markets to support technical innovation, economic efficiency, and reliability for the entire electric system:**

- Regional wholesale and local retail electric markets must work together.
- Rules at both levels need to ensure effective generation, dispatch, and transmission management, while also providing a framework to identify and implement technological opportunities.
- For example, both local retail and wholesale market rules should support regional reliability objectives, including resource adequacy and reserves.
- The interaction between retail and wholesale markets is also a key consideration when establishing service arrangements for data centers and other large loads. The choice of contractual and technical arrangements can significantly impact both the reliability and the wholesale and retail prices of electricity.

**Enhance price transparency in regional wholesale markets and for retail consumers. Accurate price signals enable efficient and reliable electricity production and consumption and support optimal deployment of new technologies:**

- Technologies that alter either demand or supply patterns impact market prices and the planning and operation of the electric system.
- Accurate price signals<sup>2</sup> promote proper valuation of technical innovation and efficiency of operation once it is deployed.
- Market pricing should signal efficiency, optimize cost, and encourage reliable actions of both retail and wholesale customers.
- Where transparent regional wholesale electric markets do not exist, states should reconsider their formation or create local retail pricing mechanisms to achieve price transparency comparable to that provided by RTOs using Locational Marginal Pricing.

*The IEEE-USA Energy Policy Committee developed this statement and represents the considered judgment of a group of U.S. IEEE members with expertise in the subject field. IEEE-USA advances the public good and promotes the careers and public policy interests of the nearly 160,000 engineering, computing, and allied professionals who are U.S. members of the IEEE. The positions taken by IEEE-USA do not necessarily reflect the views of IEEE or its other organizational units.*

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<sup>2</sup> A **price signal** is information conveyed to consumers and producers, via the **price** charged for a product or service, which provides a **signal** to increase or decrease supply or demand.