Interoperability

Barrier Description: Interoperability refers to the ability for software products and devices to communicate with each other within a building, among other buildings, and with the electric grid and its components.

Phase 1: *Develop and align technical standards and communication protocols*		**Phase 2:** *Deploy policies/programs for technical standards and market facilitation*		**Phase 3:** *Adapt to changes in technology deployment, standards, or policy*	
Challenges	**Practices**	**Challenges**	**Practices**	**Challenges**	**Practices**
Government program managers and industry service providers are not collaborating Government officials and industry service providers must work together to ensure that technology and policy standards align	**Establish government-supported industry task forces** that can play a role in developing technical standards that drive policy. Examples of this include the *Interoperability Steering Committee* [1] in Australia and the *Smart Community Alliance* (JSCA) [2] in Japan.	**Resources are lacking for monitoring effectiveness:** Programs should ensure that customers are receiving competitive energy services.	**Deploy automated communication modules** that can minimize human interaction in communicating energy use data with external market participants and deliver competitive rates in an automated fashion [3].	**Devices and systems can become outdated and may lack necessary functionalities as technology develops:** Devices and systems must adapt to changes in standards or the energy system.	**Develop semantic models capable of processing and analyzing data** in a manner that can be consistently understood by third-party applications.
New digital standards are not compatible with existing protocols: Technical standards must be compatible with existing protocols, particularly regarding cybersecurity and privacy.	**Create multi-sectoral working groups** to ensure that technical standards are being developed in parallel with existing cybersecurity and privacy protocols. For example, Australia's *Cyber Working Group* works in parallel with interoperability policy development to ensure that interoperability is accompanied by robust cybersecurity and privacy measures [1].	**Establishing building connectivity can be expensive when done in isolation:** Efforts should take place to reduce these costs.	**Establish building connectivity as part of normal equipment lifecycle investments** to lower costs [4]. **Coordinate with industry** [4].	**Stacking technologies can lead to conflicting actions taken by digital devices.** For example, there may be a trade-off between temperature control and CO_2 detection in the operation of a smart window [6].	**Improve data dashboards and visualization**. This approach increases device interoperability by more effectively storing, processing, and filtering data. In combination with artificial intelligence technologies, these approaches can ensure that the proper action is taken by smart devices.
		Accessibility to relevant data and tools is low: Without robust incentives, installing and operating technologies can be difficult.	**Create digital hubs for sharing data and monitoring energy use.** This approach can improve consumer access to standards, empower users to understand their energy use across multiple services, and enhance competition between service providers. Several examples have accomplished this [4] [5].		

Key Objectives

- Equip consumers with actionable energy use information.
- Ensure clear communications protocols between consumers and the external market.
- Develop policies compatible with interoperability standards.

Description of Phases

Phase 1: *Develop technical standards and communication protocols*

Achieving the interoperability of digital devices requires a convergence of policy, technology, and infrastructure. Energy efficiency practices such as demand response that are supported by improvements in digital technologies are more likely to succeed. Similarly, deployment of advanced technologies could be accelerated through government incentives or mandates. During the development of standards, we recommend creating task forces that bring together industry experts and policymakers to ensure there is robust technology and consumer support underpinning these policies.

Phase 2: *Develop policies that facilitate market adoption*

Currently, consumers must contend with the expense and complexity of connecting and managing disparate –and oftentimes incompatible—building systems. Interoperability ensures the market for energy services is both competitive and accessible to consumers. Industry and government must work in tandem to make it easy for consumers to compare energy efficiency incentive programs (e.g., rebates on the purchase and installation of smart thermostats) provided by different energy service providers.

Phase 3: *Adapt to changes in technology, standards, or policy*

Digital building systems must adapt to rapid changes in technologies, standards, and policies. Semantic models capable of interpreting a range of data in a standardized format are key to enabling the inclusion of new data in building energy systems. Another concern is that devices may perform conflicting actions in response to certain indicators. The rise of smart building devices necessitates easy-to-read dashboards that can curate data from multiple sources. Additionally, technologies that display energy use data in real time can further incentivize consumer adoption.

Examples cited in the report and other sources:

[1] Distributed Energy Integration Program (DEIP) Interoperability Steering Committee, https://arena.gov.au/knowledge-innovation/distributed-energy-integration-program/
[2] Japan: Universal Home Network Connection Standard Development (Report section C.5) and Information Technology Services Industry Association's Smart House Standardization Study Group Report, https://www.jisa.or.jp/it_info/engineering/tabid/1635/Default.aspx and
[3] Germany: Smart Meter Gateways (Report sections 5.7, C.4)
[4] Australia: The Innovation Hub for Affordable Heating and Cooling (*i*-Hub) (Report sections 5.1, C.1)
[5] Japan: HEMS Dashboard (Report section 3.1.4)
[6] Data availability, quality, and analysis barrier (Report section 4.4)