ESIG
ENERGY SYSTEMS INTEGRATION GROUP

Deployment of Advanced Functionality
in Solar, Wind, and Battery Resources

AT A GLANCE

As rising numbers of solar, wind, and battery resources are deployed in power systems around the world, their role on the grid continues to evolve. To maintain grid stability and reliability, these resources need to begin providing some of the grid services traditionally provided by conventional power plants. Although solar, wind, and batteries are already required to have the ability to deliver some grid services, more advanced controls will be needed by a portion of these resources so that they can provide the full range of necessary grid services in a high-renewables grid.

Power systems around the world need to make the technological leap to deploy this advanced, grid-forming functionality. However, system operators and planners, equipment owners, and manufacturers face a circular problem (see figure): Which comes first, the requirement for a capability or the capability itself? How do grid operators know what performance or capability is possible from new equipment, and therefore what they could conceivably require? How should they go about evaluating the costs and benefits of having such equipment on the grid? And what drives manufacturers to invest in new technology without it being mandated for interconnection to the grid or otherwise incentivized by the market?

The Cost of Inaction

The failure to break the chicken-and-egg cycle could hinder our ability to meet energy transition targets and increase the costs of this transition. In the absence of clear requirements and market incentives for advanced functionality, thousands of solar, wind, and battery resources will connect to the grid without advanced controls. This will increase systems' needs for additional reliability support and drive up costs.

The "chicken-and-egg" cycle can be broken by adopting the perspective of evolving system needs and will require close cooperation between system operators, equipment manufacturers, and equipment owners. Successful pilot projects in Australia and Great Britain are providing critical knowledge about the deployment process and are valuable models for power systems around the world.

Batteries as Low-Hanging Fruit

Battery storage is particularly low-hanging fruit for the deployment of advanced controls. Batteries have dedicated energy storage (by definition), have no moving parts, and can potentially be operated at a lower rating (leaving some "space" in the inverter to deliver extra current during disturbances) without foregoing energy, as wind or solar would have to do. With clear requirements and market incentives, a significant proportion of battery storage resources in today's interconnection queues could be equipped with advanced grid-forming functionality, helping power systems avoid the costs of installing much larger additional grid-supporting devices or additional grid reinforcements in the future.

The Circular Problem of Requirements and Deployment of Advanced IBR Controls