Variable Renewable Energy: a Regulatory Roadmap

Research Highlights

There is not a one-size-fits-all approach to the regulation of variable renewable energy (VRE), but international experience reveals many approaches that are proving successful. Drawing upon research and experiences from various international contexts, the 21st Century Power Partnership in conjunction with the Clean Energy Solutions Center and Clean Energy Regulators Initiative identified key issues and ideas that have emerged as variable deployment has grown.

Many variables shape the issues that arise in a given context, especially power system characteristics, geographic and spatial availability of renewable resources, institutional organization of the power system, public policy goals, and the political economy of power system issues. Still, common issues arise at each stage of variable renewable energy deployment. The Power Partnership research, published in 2014, identified four broad categories of regulatory issues:

Facilitating New VRE Generation – In accordance with policy mandates, regulators play a role in facilitating new VRE generation through various mechanisms, including setting tariffs, organizing auctions, and influencing grid codes and the interconnection of new VRE generation.

- Ensuring Adequate Grid Infrastructure – Regulators play a role in shaping the grid infrastructure development of a power system, which is a key dimension of VRE deployment and system integration.
- Ensuring Short-term Security of Supply *(Flexibility)* – Regulators play a role in encouraging power system flexibility, which in turn plays an important role in the integration of VRE into power systems, especially as levels of deployment grow.
- Ensuring Long-term Security of Supply *(Resource Adequacy)* – Regulators play a key role in ensuring adequate power system resources, including incorporating VRE into resource planning, and managing potential impacts on the economics of other resources in the system.

These four domains are interrelated, and become more so as VRE deployment levels grow.

Case Studies in Integrating Renewables Around the World

The Power Partnership surveyed regulatory experiences around the world in each of these domains, and gleaned lessons for meeting the challenges from countries including Australia, Denmark, Germany, Guatemala, India, Mexico, the United Kingdom, and the United States. Unique forces are at play in each regulatory context, but the research provides a framework that highlights the common issues and ideas that emerge across contexts and at each stage of VRE deployment and integration. Some successes:

Case Study in VRE Generation

Denmark sustains high levels of VRE procurement through increased support for resource characterization and project site assessment, and through streamlined, transparent processes.

Challenge: To achieve aggressive renewable energy targets, Denmark is looking to obtain more power from offshore wind. The country is working to cultivate a robust yet cost-efficient offshore wind development industry.

Solution: Denmark has refined its approach to offshore wind tenders over the last 10 years (with 8 offshore wind facilities currently operating) and also gained experience from similar approaches in the oil and gas sector. The tender process in Denmark involves the following steps and practices:

- **Site assessment and selection.** In order to reduce risk and cost to investors, Denmark funds site assessment and selection for suitable offshore wind sites.
- **Development of transparent tender process.** Before releasing initial offshore wind tenders, applicants and the Danish Energy Authority are given the opportunity to negotiate and address any imprecise or unclear aspects of the tender conditions. Tender conditions are then finalized in cooperation with key energy authorities and aligned with Denmark's Electricity Act to ensure an efficient process.
- **Pre-qualification.** Applicants are assessed on the basis of technical and financial qualifications.

- **Tender award.** Award of the tender is based on (in order of priority): price/kWh, design and location of the project, and timeline for building the project.

Case Study in Grid Integration

Australia mitigates plausible risk of stranded transmission assets by transferring the risk to parties best able to evaluate and manage it.

Challenge: The remoteness of Australia's VRE resources has posed a challenge for development. To address this barrier, the Australian Energy Market Commission (AEMC) proposed two options under the conceptual framework of "Scaled Efficient Network Extension" (SENE), in which upfront costs are minimized through economies of scale and cost-sharing. The two options varied mainly in how costs and risks were allocated.

Solution: SENE evaluated policy options that would place risks primarily on consumers or on renewable energy generators. Ultimately, AEMC elected the second SENE option, in which RE generators or investors would finance transmission extension. AEMC cited that analysis projecting future generation was not robust enough for consumers to take on the risk and that generators and investors would have "better information, capability and incentive to weigh the benefits of scale efficiencies versus stranding risk."

Case Study in Resource Adequacy

United Kingdom implements a capacity market to spur business model evolution for conventional thermal generators, and reallocate risk between generators and load.

Challenge: The United Kingdom is working to meet ambitious RE targets while ensuring reliability of the electricity system.

Solution: As part of its Energy Market Reform, the United Kingdom adopted a capacity market mechanism to ensure security of electricity supply by incentivizing producers to deliver power as needed under conditions of insufficient capacity. Ultimately, the capacity market provides an additional tariff stream to conventional generators, thus incentivizing resource adequacy investment and contributing to long-term system reliability. Under this mechanism suppliers assume most of the risk of resource adequacy, but some level of risk is shifted to customers.

Case Study in Flexibility

California increases flexibility through the use of demand-side resources.

Challenge: California's Renewable Portfolio Standard (RPS) target of 33% renewable installed capacity by 2020 requires innovative solutions to address possible integration challenges associated with intra- hour variability of VRE. While demand response is currently used as an emergency (peak-reduction) resource in California, the state's Public Utilities Commission is testing its ability to boost power system flexibility.

Solution: To address the unknowns, California commissioned a study to assess the capabilities of demand response resources and to suggest modifications to current programs so that demand response could play a substantial role in providing ancillary services. The study examined demand response programs in the state and attempted to quantify the level of fit between the technical requirements of these programs and ancillary services market requirements. The California Public Utilities Commission (CPUC) is now assessing whether to mandate modifications to demand response programs or to make other necessary changes. The barriers to change are not insubstantial. For example, reducing the response time of demand response through automated control equipment requires new capital investment, which would in turn require the CPUC to clarify eligibility of various investors to recover such costs. Additionally, relaxing the limits on the timing and frequency of demand response events could diminish customer willingness to voluntarily participate in such programs. These issues have yet to be clarified, but the type of analysis carried out provides important insights for regulators.

For more information, see: Miller, M.; Cox, S. (2014). *Overview of Variable Renewable Energy Regulatory Issues: A Clean Energy Regulators Initiative Report*. 47 pp.; NREL/TP-6A20-61350. http://www.nrel.gov/docs/fy14osti/61350.pdf

The 21st Century Power Partnership is a multilateral effort of the Clean Energy Ministerial and serves as a platform for public-private collaboration to advance integrated policy, regulatory, financial, and technical solutions for the large-scale deployment of renewable energy in combination with deep energy efficiency and smart grid solutions.

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NREL/FS-6A20-63027 • October 2014
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