Integrating Utility-Scale Renewables into the Grid

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Meet the Author:

An IEEE Fellow, electricity industry visionary, and leader, Dr. Mani Vadari delivers strategic services to a global set of utilities, vendors, and service providers seeking deep subject matter expertise in setting the business and technical direction to develop the next-generation electric/energy system. As a Business Architect, Dr. Vadari has been delivering solutions focusing on Transmission/ Distribution/ generation operations, Energy markets, and Smart Grid for over 35 years. In addition, he is an Adjunct Professor at Washington State University and an Affiliate Professor at the University of Washington. He has published two popular books, "Smart Grid Redefined: Transformation of the Electric Utility" and "Electric System Operations – Evolving to the Modern Grid, 2nd Edition", in addition to over a hundred industry papers, articles, and blogs. His books are serving as textbooks at several universities in the US and around the world

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An important concern that will need to be addressed by the industry as it tries to combat climate change is the incorporation of new sources of renewable energy (e.g., wind and solar) into the electric grid. These new resources offer both great benefits and imposing challenges.

On the plus side, integrating renewables will result in a variety of positive outcomes, including the reduction of carbon emissions, the curbing of reliance on foreign sources of energy, and the creation of new green sector jobs that have become a constant topic of discussion in the current economic and political climate. Yet these valuable new-generation resources pose some special issues, too.

Renewables can be more expensive, and staffing wind and solar farms require workers with new skills and work regimes. And since neither the sun nor wind is a constant or predictable source of energy, integrating these resources into the grid poses new issues as well. The issues arise from the need for an electrical grid to match supply to consumption at all times. To combat the volatility of renewable sources of supply, utilities need to maintain greater reserves of generation from fossil-based generation which defeats the original purpose of trying to replace them. In addition, challenges of renewables integration can be more complex in distribution when their market penetration goes beyond 10-20 percent.

Impediment or opportunity?

For these reasons, many in the electric utility industry have been slow to embrace renewables. In order to allow renewable energy sources to evolve into a viable solution, new tools need to be developed to forecast and control their production capabilities and integrate their output into the overall generation profile as they become increasingly prolific, new forms of energy capture and storage must also be devised or further improved. Ultimately, it becomes a question of optics: Will this process be viewed as an impediment to progress, or as the next great opportunity for the electric industry?

Renewables success stories

Yet in some locations around the world, high energy prices, environmental concerns, and/or supportive government policies have already pushed the door open for renewables to proliferate:

- *Ireland set aggressive national and regional targets of 15 percent electricity generation by wind by 2010, 40 percent renewable electricity generation by 2020, and net-zero carbon by 2035.*
- *Germany has created a tariff system that provides priority access for renewable energy to the power grid by obligating grid operators to purchase this electricity.*
- *China has set a target of producing 16 percent of primary energy from renewable sources (including large hydropower) by 2020. For the electricity sector, the target is 20 percent of capacity from renewables by 2020, including 30 GW of wind power, 20 GW of biomass power, and 300 GW of hydropower capacity.*

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- *The European Union under its EU 20/20/20 mandate is committed to reducing its overall emissions to at least 20 percent below 1990 levels by 2020. It also has set for itself the target of increasing the share of renewables in energy use to 20 percent by 2020.*

Note: It is important to note that all of these countries are well on their way to reaching their goals possibly ahead of schedule.

The U.S. has not been left entirely out of the game, either. Texas and California—both states with high electricity demand and that boast their own regional transmission organizations to deal with grid integration—lead the country as the No. 1 and 2 states for renewable generation resources. The upper Midwestern states and Pacific Northwest also have well-developed renewables generation, though each faces well-publicized issues—mainly around transmission access and grid integration.

Possible Solutions:

The good news is that there are solutions to the challenge of renewables integration. These are the principal technical and business solutions that I believe hold the most promise:

- *Better controls and economically feasible solutions in storage*
- *Demand response – if linked up with some kind of a price-responsible demand*
- *Renewable energy zones allow the output from large wind farms to float between control areas while preventing instability in any one area.*