



# Smart Grid 101 – Understanding the key players

 Dr. Mani Vadari

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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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***“To be adept at the smart grid, you must first understand a) the underlying electric power system and b) the key players and their respective roles. That second task is surprisingly complex, especially in the United States, where decades of half-hearted and ill-timed regulatory changes have resulted in a patchwork of overlapping jurisdictions and approaches.***

***Yet it is essential to understand the major actors and their functions. First, it will help you do a better job today. Second it will help you understand what may be coming your way tomorrow as these changes continue to ripple through the system. Author, trainer and smart grid pioneer Mani Vadari is here to explain.” -- Jesse Berst***

The electric power system is divided into two major categories. The high-voltage transmission system -- sometimes referred to as "the bulk power system" -- ships large amounts of power long distances. The local medium-voltage distribution system delivers power to customers within a defined service territory.

From the 70s through the 90s (and with tweaks thereafter), the U.S. electric power system went through a series of regulatory changes. Those changes failed to create a fully deregulated market. Instead, they produced a patchwork. Some parts of the country have full deregulation and regional transmission operators (RTOs). Other parts still have vertically integrated utilities and no RTOs. Some locations like ERCOT (most of Texas) transformed into full-scale retail markets.

Along the way, these changes transformed the traditional utility and created a long list of new participants, as we will discuss below.

## Transforming the "traditional" utility?

The traditional vertically integrated utility faced the most dramatic change after the passing of FERC orders 888/889 heralding the onset of deregulation. Prior to deregulation, it managed the entire business of marketing energy. It obtained fuel for the plants, generated electricity, transmitted it, distributed it, and collected payment for it within a single corporate structure

With the onset of deregulation, most utilities have extensively modified their structures. Meanwhile, other kinds of organizations are slowly extending their reach into this arena. The changes in traditional vertically integrated utilities can be summarized as follows:

- Creation of utility holding companies to better manage a combination of business units some of which are regulated by FERC, some by state PUCs, and some not regulated at all.
- Full functional separation of the generation business unit from the core utility. The utility's wholesale trading arm also moves with this business unit because they can now buy and sell in the open market whether there is an RTO or not.

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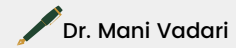
- Separation of the Transmission and Distribution (T&D) business units into either one or two separate business units. The two do not have to be completely separate as would be the case with the generation business unit. This business unit(s) will need to treat the generation/trading business unit at arm's length and exactly the same as any other generation company.
- Retail and customer service stays with the regulated T&D entities. An exception to this has occurred in states with full retail choice like Pennsylvania and Texas where independent retail companies have operated for years.

## Meet the new participants:

There are many new participants in the deregulated market and their interactions can get quite complex. It is important to note that not all are independent companies. – They could be business units within one company.

- *Vertically Integrated Utility (see above):* A full-service store that can offer one or more of the following functions: generation, transmission, distribution and retail all under a holding company mechanism.
- *Generator:* Any entity that generates electric power and feeds it into the grid.
- *Independent Power Producer:* An independent (non-utility affiliated) generator of energy and therefore a seller.
- *Regional Transmission Operator (RTO) and Independent System Operator (ISO).* A new entity with the primary responsibility of ensuring short-term and long-term reliability of grid operations. To ensure fair access to the transmission system, its management and control are completely independent of generation entities and any other market participant. Examples include Pennsylvania Jersey Maryland Power Pool (PJM), the Electric Reliability Council of Texas (ERCOT) and the New York Independent System Operator (NYISO), the Independent System Operator of New England (ISO-NE), California Independent System Operator (CAISO), Southwest Power Pool (SPP), Midwest Independent System Operator (MISO). There are also several of these in Canada and in other countries.
- *Control Area or Balancing Authority:* An electric system or systems, bounded by interconnection metering and telemetry, capable of controlling generation to maintain its interchange schedule with other Control Areas and contributing to frequency regulation of the Interconnection. Where RTOs do not exist, this role is still performed by some organization that has the authority and responsibility to run a balancing market and ensure enough ancillary services are available for the system to run efficiently.
- *Market Operator:* Third party responsible for forward markets matching supply/demand, including energy and ancillary services and FTR auctions if appropriate. Can be a separate entity or run by the RTO.
- *Scheduling Coordinator:* Responsible for creating and submitting balanced schedules and ancillary services requirements (provisions). Presently more appropriate to the ERCOT and California models.

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- *Power Marketer/Broker*: An entity that buys and/or sells energy and transmission services. With a few exceptions, this entity does not own generation/transmission facilities.
- *Transmission Asset Owner*: Owns or controls facilities used for the transmission of power. Can sometimes also be responsible for the short-term reliability of grid operations. Examples can include a vertically integrated utility or an independent transmission company.
- *Transmission User (TU)*: A transmission user buys the rights to transfer energy (from the seller to the buyer) through the transmission provider's transmission lines.
- *Distributed Asset Owner or Distribution System Operator*: Owns, operates and maintains distribution-level substations, lines, and equipment. This entity interfaces to small-to-medium customers and is ultimately responsible for the "obligation to serve." It may stay regulated much like the local telephone company.
- *Wholesale Energy Merchant*: Similar to competitive retailers (below), but deals with wholesale customers, not retail customers. Could also be a Power Marketer/broker.
- *Wholesale Customer*: These are generally transmission-level customers – that is, large commercial or industrial customers who buy large amounts of power directly from the transmission grid.
- *Competitive Retailer*: Entities that are responsible for arranging physical delivery and conducting commercial transactions with end-use customers but are not a part of a utility. Many terms like ESP (Energy Service Provider), LSE (Load Serving Entity) or Retail Energy Provider (REP) have been used in different markets for this role.
- *Retail Customer*: Distribution-level customer – e.g. residential, small commercial.