A Vision for the Modern Grid

What will the Modern Grid Look Like?

Background

Before we can begin to modernize today's electric grid, we first need a clear vision of the power system required for the future. Given that vision, we can create the alignment necessary to inspire passion, investment, and progress toward an advanced US grid for the 21st century.

Goals

The grid must be more reliable.
A reliable grid will provide power dependably, when and where its users need it and of the quality they value.

The grid must be more secure.
A secure grid will withstand physical and cyber attacks without suffering massive blackouts or exorbitant recovery costs. It will also be less vulnerable to natural disasters and will recover faster.

The grid must be more economic.
An economic grid will operate under the basic laws of supply and demand, resulting in fair prices and adequate supplies.

The grid must be more efficient.
An efficient grid will take advantage of investments that lead to cost control, reduced transmission and distribution electrical losses, more efficient power production and improved asset utilization.

The grid must be more environmentally friendly. An environmentally friendly grid will reduce environmental impacts through initiatives in generation, transmission, distribution, storage and consumption.

The grid must be safer.
A safe grid will not cause any harm to the public or to grid workers and will be sensitive to users who depend on it as a medical necessity.

The Vision

First, it will heal itself.
The modernized grid will perform continuous self-assessments to detect, analyze, respond to, and as needed, restore grid components or network sections. It will handle problems too large or too fast-moving for human intervention. Acting as the grid's "immune system", self-healing will help maintain grid reliability, security, affordability, power quality and efficiency.

Second, it will motivate consumers to be active grid participants and will include them in grid operations.
Active participation of consumers in electricity markets brings tangible benefits to both the grid and the environment, while reducing the cost of delivered electricity. In the modernized grid, well-informed consumers will modify consumption based on the balancing of their demands and the electric system's capability to meet those demands.

Third, the Modern Grid will resist attack.
Security requires a system-wide solution that will reduce physical and cyber vulnerabilities and will recover rapidly from disruptions. The Modern Grid will demonstrate resilience to attack, even from those who are determined and well equipped. Both its design and its operation will discourage attacks, minimize their consequences and speed service restoration. It will also be less vulnerable to natural disasters.

Fourth, the Modern Grid will provide the level of power quality desired by 21st century users.
New power quality standards will balance load sensitivity with deliverable power quality at a reasonable price. The modernized grid will supply varying grades of power quality at different pricing levels.

Fifth, the Modern Grid will accommodate all generation and storage options.
It will seamlessly integrate all types and sizes of electrical generation and storage systems with a

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simplified interconnection process analogous to "plug-and-play". Large central power plants including environmentally-friendly sources such as wind and solar farms and advanced nuclear plants will continue to play a major role in the Modern Grid as large numbers of smaller sources are deployed.

Sixth, the Modern Grid will enable markets to flourish.
The Modern Grid will enable more market participation through increased transmission paths, aggregated demand response initiatives and the placement of energy resources including storage within a more reliable distribution system that is closer to the consumer.

Finally, the Modern Grid will optimize its assets and operate more efficiently.
Asset management and operation of the grid will be fine-tuned to deliver the desired functionality at a minimum cost. Improved load factors and lower system losses will result.

The seven characteristics described above represent unique yet interdependent features that define the vision of the Modern Grid. Table 1 below summarizes these seven points and compares today's grid with the vision of the Modern Grid.

Much work remains to be done to achieve this vision.

The integration of existing technologies, the development of new ones and integrated testing to show their benefits are all needed. Regulatory and legislative reform to modify regulations and statutes that are inconsistent with this vision is also needed. New stardards must be developed and some existing standards will require changes. Various process issues must be resolved. We also need metrics to provide the milestones for measuring our progress towards this vision. And perhaps, most important of all, the totality of societal benefits must be included in the calculus of Modern Grid investments to provide the financial incentive needed to move us forward.

A clear understanding and consensus for this vision among all stakeholders will generate a huge force for change. Only through their aligned efforts can this vision for the Modern Grid become a reality.

Today's Grid	Principal Characteristic	Modern Grid
Responds to prevent further damage. Focus is on protection of assets following system faults.	**Self-heals**	Automatically detects and responds to actual and emerging transmission and distribution problems. Focus is on prevention. Minimizes consumer impact.
Consumers are uninformed and non-participative with the power system.	**Motivates & includes the consumer**	Informed, involved and active consumers. Broad penetration of Demand Response.
Vulnerable to malicious acts of terror and natural disasters.	**Resists attack**	Resilient to physical and cyber attack. Less vulnerable to natural disasters rapid restoration capabilities.
Focused on outages rather than power quality problems. Slow response in resolving Power Quality (PQ) issues.	**Provides power quality for 21st century needs**	Quality of power meets industry standards and consumer needs. Various levels of Power Quality (PQ) at various prices.
Relatively small number of large generating plants provide majority of generation. Numerous obstacles exist for interconnecting Distributed Energy Resources (DER).	**Accommodates all generation and storage options**	Very large number of diverse distributed generation and storage devices deployed to complement the large generating plants. "Plug-and-play" convenience. Significantly more focus on and access to renewables.
Limited wholesale markets still working to find the best operating models. Not well integrated with each other. Transmission congestion separates buyers and sellers.	**Enables markets**	Mature wholesale market operations in place; well integrated nationwide and integrated with reliability coordinators. Retail markets flourishing where appropriate. Minimal transmission congestion.
Minimal integration of limited operational data with asset management processes and technologies. Siloed business processes. Time based maintenance.	**Optimizes assets and operates efficiently**	Greatly expanded sensing and measurement of grid conditions. Grid technologies deeply integrated with asset management processes to most effectively manage assets and costs. Condition based maintenance.

Table 1: Comparison between Today's Grid and the Modern Grid

It is a big job, but we can do it by working together. The work is already underway at MGI and its partner organizations. But we need your active support in making grid modernization an essential part of our national energy policy. Your active participation is essential as we lay out the framework for a modernized grid that can enable our nation's future growth and preserve our global competitiveness and way of life.