Grid Modernization

Challenges, Opportunities, Progress

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Evolution of the Electric Grid

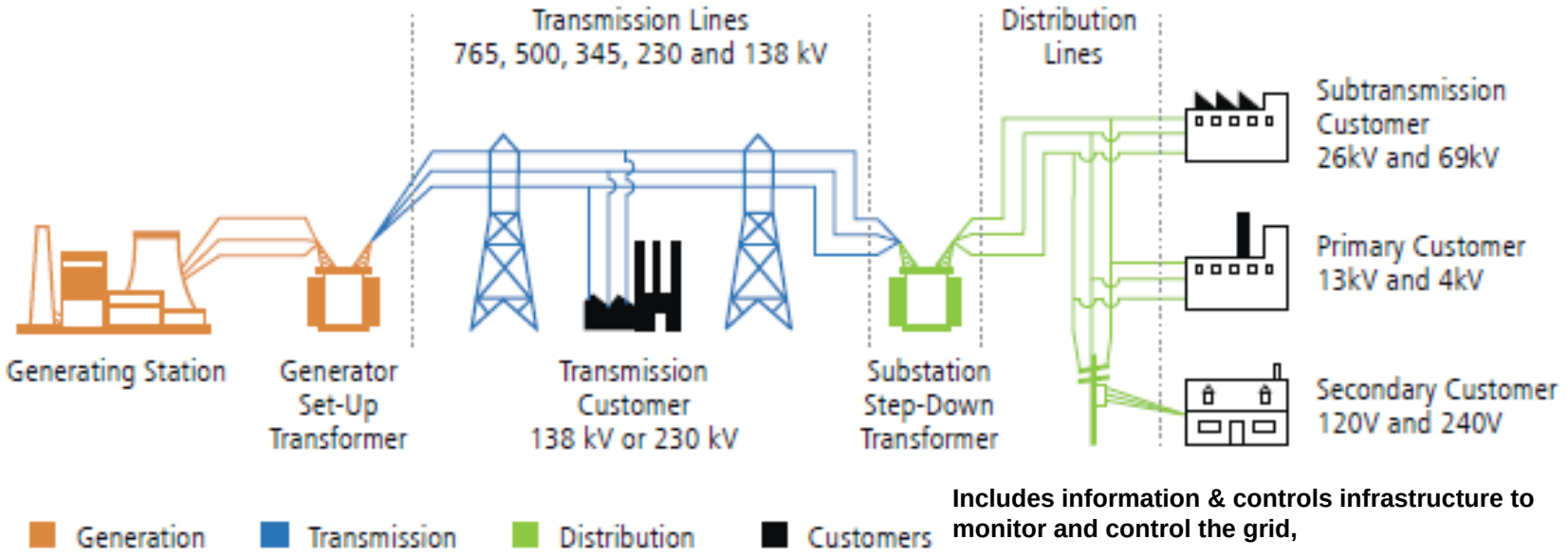
- Individual Grids (Local)
  - Developed in the late 1800s by early builders of small local grids.
- Interconnected Grids (Regional)
  - By the second half of the last century, power systems had developed to become larger and more complex; by the 1960s there were several large, interconnected, synchronized U.S. systems.

Drivers for further grid modernization include:

- ⇨ **Changing consumer demands**, increasingly engaged customers, declining sales
- ⇨ **Evolving public policy**, new environmental regulations, de-carbonization
- ⇨ **New distributed technologies**, both supply and demand side resources

- **Integrated Grid** (Enabling Customers: Local ←→ Regional)
  - Over the next two decades, the grid will evolve to meet the increasing demands;
  - Will require planning and operating to optimize and extract value throughout the electric grid.

Today's Electric Grid



Includes information & controls infrastructure to monitor and control the grid,

- **Reliable, affordable, & increasingly clean**
- **At a strategic inflection point** – a time of significant change
  - Changes underway include retirements of large centralized plants, deployment of distributed resources, severe weather and climate change, low load growth, growing jurisdictional interactions at Federal & state levels
- **Innovative technologies and services are being introduced** at an unprecedented rate – often increasing efficiency, reliability, and the role of customers; also increasing uncertainty

Source: U.S. DOE *Quadrennial Energy Review*. *April 2015*

Grid Modernization – U.S. DOE

The future grid provides a **critical platform for U.S. prosperity, competiveness, and innovation** in a global clean energy economy. It **must deliver reliable, affordable, and clean electricity** to consumers where they want it, when they want it, how they want it.

Grid modernization is needed to:

- **Achieve Public Policy Goals**
  - Maintain access to reliable, affordable electricity;
  - Reduce environmental impacts;
- **Sustain Economic Growth and Innovation**
  - Encourage new technologies, products, services, & business models
- **Mitigate Risks and Secure the Grid**
  - Keep the lights on & protect against threats (extreme weather, cyber threats, physical attacks, aging infrastructure)

Source: U.S. DOE *Grid Modernization Initiative*. IEEE ISGT Feb 2015

Grid Modernization – MN e21

Customer Demands and public policy requirements are driving the need for a modern grid that will support new ways in which electric energy will be generated, delivered, and used.

Planning for a Modern & Efficient Grid

Proactive planning for an intelligent, flexible, efficient, open, and secure distribution system over the next several decades that **can handle new distributed energy technologies and the complexity of many actors on the system**.

Desired outcomes include:

A cleaner, more flexible grid that is reliable, resilient, and secure and **enables customers to manage and potentially reduce their energy costs**.

Source: e21 Initiative. *Phase I Report: Charting a Path to a 21st Century Energy System in Minnesota.* December 2014.

Future Electric Grid

Tomorrow's grid will:

- **Be more distributed**, flexible, intelligent, real-time controlled, autonomous, **open and secure**;
- Be **cleaner and reliable**;
- **Operate resiliently** against natural disasters and attacks.

Tomorrow's distribution systems will:

- **Enable a high level of integrated Distributed Resources, both supply and demand side, with active participation by consumers**;
- Manage two way flows of electricity;
- Provide for seamless integration and interoperability of varied systems and components;
- Implement modern distribution management systems (DMS) including advanced control and communications;
- Be planned in coordination with resource and transmission planning; could incorporate stakeholder informed planning scenarios.

MN PUC – Distribution Grid Modernization

The Public Utilities Commission, under the leadership of Commissioner Lange, is developing a Minnesota stakeholder process on Grid Modernization with a focus on Distribution Planning

- *September to December 2015*

  Three stakeholder meetings, topics to include:

  - Current status of MN distribution systems (design, operations, performance, capability, planning process)
  - National distribution grid modernization work & emerging best practices
  - Stakeholder perspectives

- *Mid-February 2016*:

  Summary report and recommended next steps (based on information received in stakeholder meetings)

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Some Considerations for Local Governments

Work is underway to modernize the electric grid in support of new ways in which electricity will be generated, delivered, & used.

- Consider electric distribution systems in community planning and development (e.g. ‘complete streets’).
- Discuss grid capabilities, constraints, and future needs with your electric distribution utility.
  - Distribution feeder carrying capacities (customer load, distributed solar, electric vehicles, etc), communications, controls;
  - New customer technologies to manage energy use and reduce costs;
  - Resilience.
- Participate in the MN PUC distribution grid modernization stakeholder meetings in Fall 2015.

Thank you!

- *Discussion and Questions*

Biography

Matt Schuerger is an independent consultant working on power system planning and analysis and engaged in the development of new and emerging utility business and regulatory structures. He has thirty years of experience in the utility industry, including extensive work with the integration renewable energy into local distributed and regional bulk electric systems.

Renewable energy integration projects include work as a consultant for: the Minnesota Department of Commerce on the 2013/2014 Minnesota Value of Solar Methodology, and on the 2013/2014 Minnesota Renewable Energy Integration and Transmission Study, for the Minnesota Public Utilities Commission on the 2006 Minnesota Wind Integration Study, for the Minnesota Department of Commerce on the 2008 and 2009 Minnesota Dispersed Renewable Generation Studies and Minnesota Renewable Energy Standard Transmission Studies, and for DOE's National Renewable Energy Laboratory on the 2012 Hawaii Solar Integration Study, the 2011 Maui Smart Grid Demonstration Project.

Matt has guest lectured on renewables integration and reliability at the University of Minnesota Electrical Engineering Department and has taught technical courses on renewable energy and power systems to engineers and managers on-site at Minnesota Utilities (for the University of Minnesota Center for Electric Energy) and to MISO power system operators.

Matt is a licensed Professional Engineer with a M.S. degree in Electrical Engineering (Power Systems) from the University of Minnesota, a B.S. in Mechanical Engineering from Purdue University, and an MBA from the University of St. Thomas. He is formerly the Executive Vice President of District Energy Saint Paul, Inc, a privately held provider of district heating, district cooling, and cogenerated electricity.

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