
Building a Minnesota Conversation on
Grid Modernization
With a Focus on Distribution Systems

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May 12, 2015

Outline of Presentation

- ❖ MN PUC Initiative on Grid Modernization
- ❖ Background
 - Evolving Electric Grid
- ❖ Grid Modernization
- ❖ Distribution
 - Distributed Energy Resources
 - Distribution Systems
 - Investments, Efficiency
- ❖ Summary, Framing, & Recommendations for MN PUC Process

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.

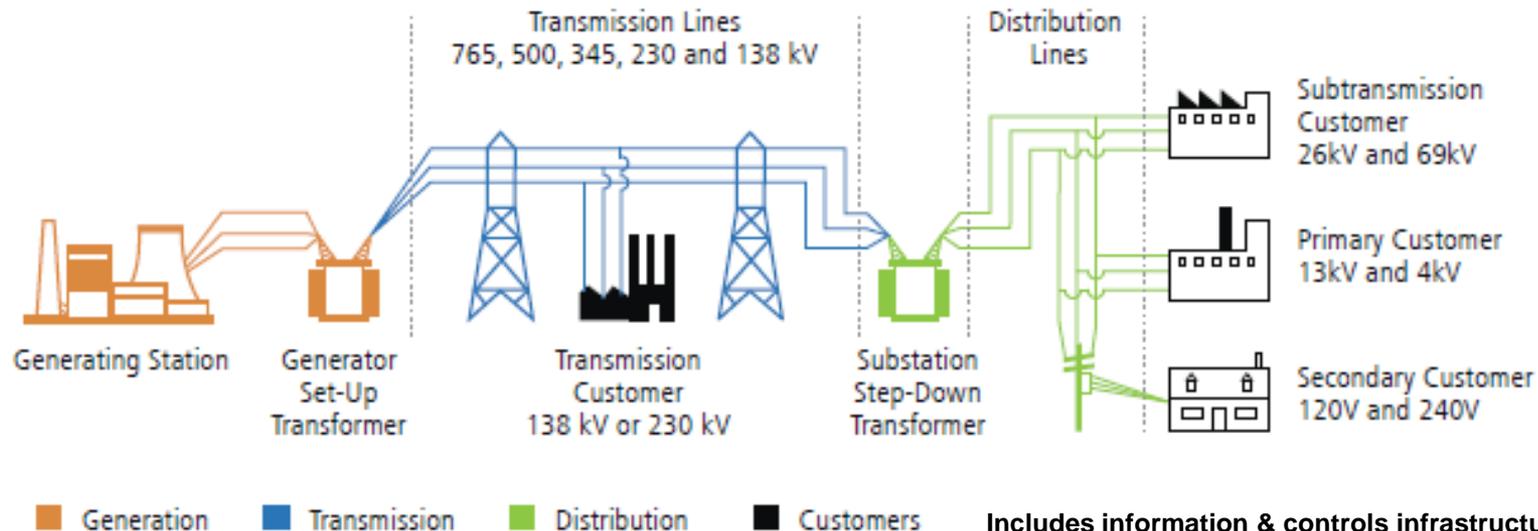
Drivers for further grid modernization include:

- ⇒ **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



- ❖ **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

Grid Modernization – U.S. DOE

The future grid provides a ***critical platform for U.S. prosperity, competitiveness, 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)

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.

Distributed Energy Resources

Supply and demand side resources that can be used throughout an electric distribution system to meet energy and reliability needs of customers; can be installed on either the customer or the utility side of the electric meter

- Include ***Efficiency*** (End use efficiency), ***Distributed Generation*** (Solar PV, Combined heat and power, Small wind), ***Distributed Flexibility and Storage*** (Demand response, Electric vehicles, Thermal storage, Battery storage), and ***Distributed intelligence*** (Information and control technologies that support system integration)

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 attack and natural disaster.

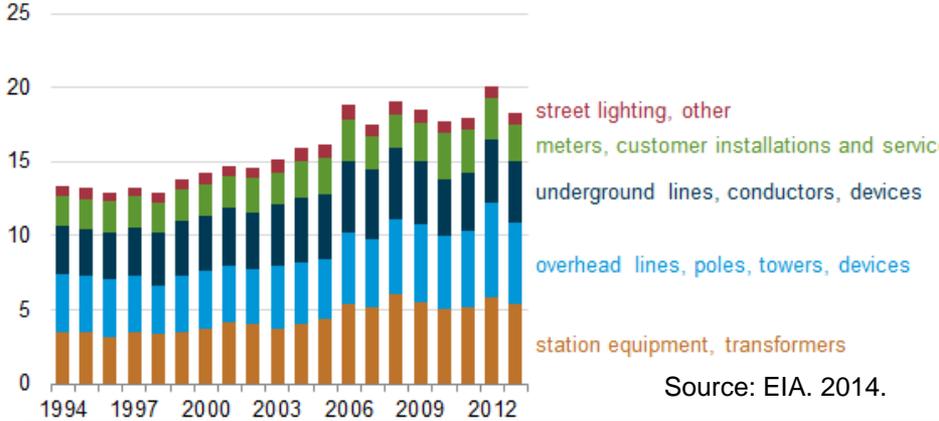
Tomorrow's distribution system will:

- 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.

Grid Investments

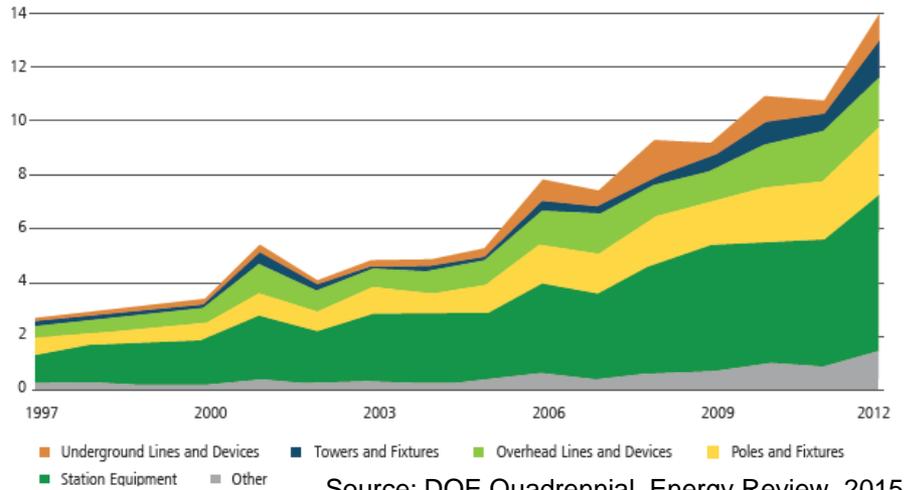
U.S. Distribution System Investments

billion U.S. dollars (real 2013)



U.S. Transmission Investments (IOUs)

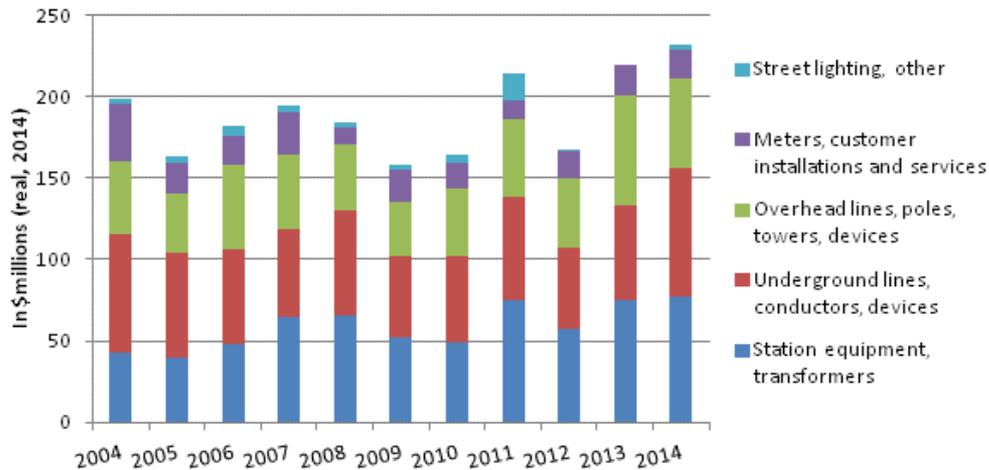
Billions of 2012 Dollars



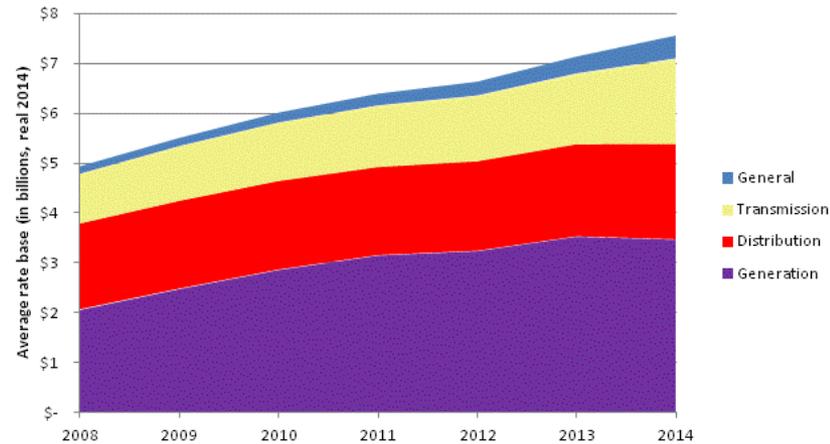
Unprecedented opportunity to invest in the 21st century grid

Minnesota

Minnesota IOUs' distribution system capital investments



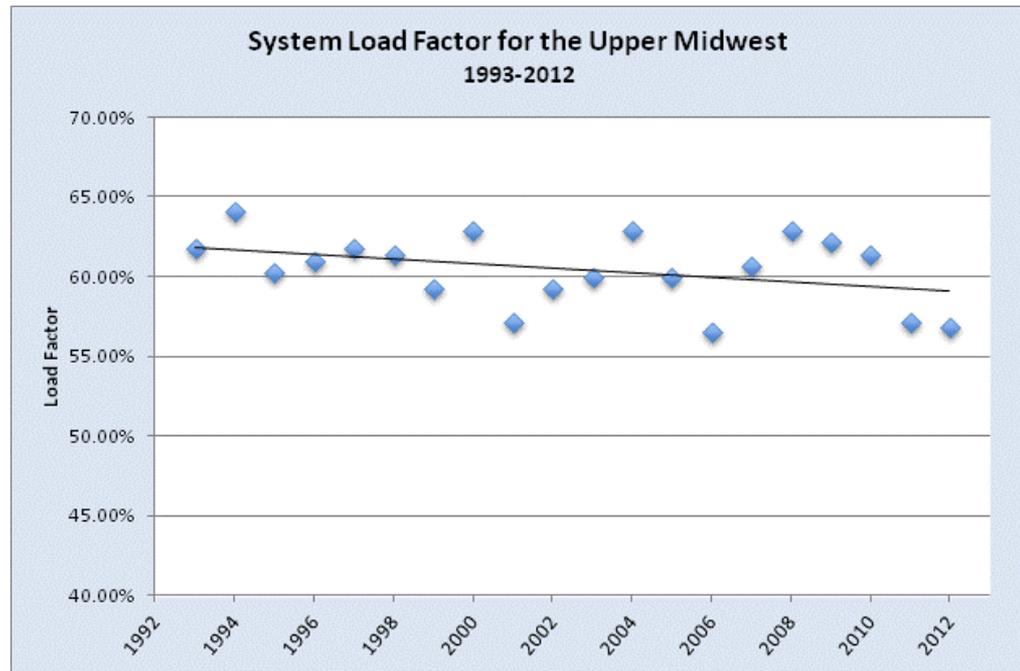
Electric Rate Base by Component - sample MN IOU, 2008-2014



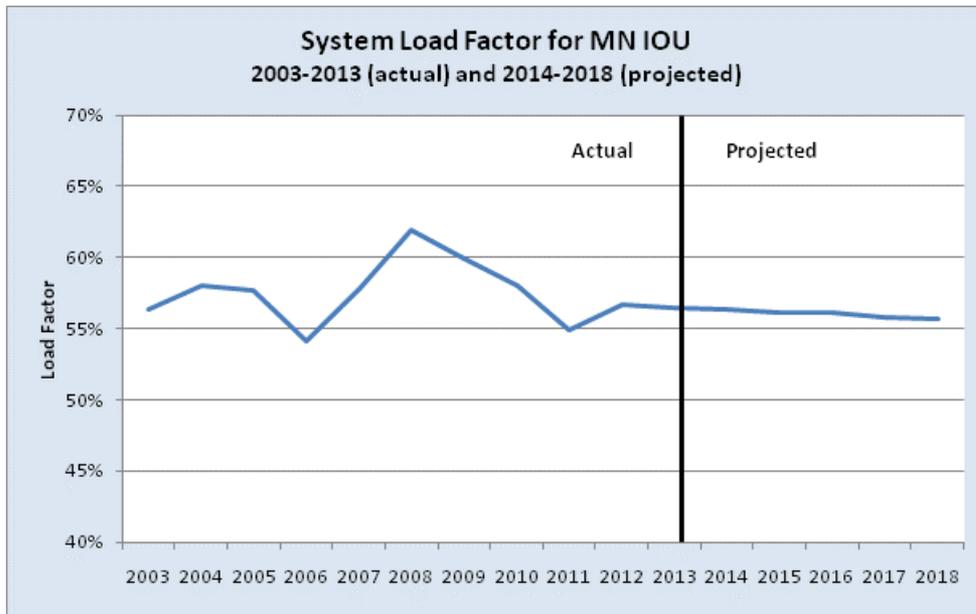
Source: MN PUC Filings

Grid Efficiency

- ❖ System Load Factor is a measure of the average utilization levels of grid investments (generators, transmission, distribution)



Source: EIA – MISO region



Source: MN PUC Filings – sample MN IOU

- ❖ Opportunity to reduce system costs by better utilizing existing system assets

Summary

- ❖ Today's interconnected power grid is reliable, affordable, increasingly clean;
- ❖ The grid is at a strategic inflection point, a time of significant change;
- ❖ Changing customer demands, new technologies, and evolving public policy will drive increased deployment of distributed resources;
- ❖ Tomorrow's integrated electric grid will be more distributed and flexible; will optimize and extract value through the grid; will operate resiliently against natural disaster and attacks; will be cleaner, reliable, and affordable;
- ❖ Development of tomorrow's grid is already underway; there is an unprecedented opportunity to invest in a 21st century grid;
- ❖ Updates to distribution planning process will be needed to support a reliable, efficient, robust grid in a changing (and uncertain) future; should be coordinated with resource and transmission planning; could incorporate stakeholder informed planning scenarios.

Framing for MN PUC Process

The Minnesota PUC's grid modernization initiative will be designed to address the following key questions:

1. Are we planning for and investing in the distribution system that we will need in the future?
2. Are the planning processes aligned to ensure future reliability, efficient use of resources, maximize customer benefits, and successful implementation of public policy?
3. What commission actions would support improved alignment of planning for and investment in the distribution system?

Recommendations for MN PUC Process

Develop 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)

Some Additional Resources

CPUC. Ruling on Guidance for Public Utilities - Distribution Resources Plan (14-08-013). February 6, 2015.

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