Integrating the Grid

Minnesota Progress and Challenges

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Overview of Presentation

- Background
- Planning – Resources, Transmission
- Grid Integration of Renewables
- Integrated Distribution Planning
- Future Developments
Minnesota Electricity Generation

Source: U.S. Energy Information Administration
Resource Plans

Minnesota Integrated Resource Plans

- Mix of supply and demand side resource options that a utility could use to meet the service needs of its customers
  - Filed every 2-4 years by all major generator owning utilities;
  - Detailed analysis performed for a minimum 15-year time horizon;
  - Minimize costs; Comply with state policies and Commission Orders.

- Commission must consider:
  - Reliability;
  - Customer rates and bills;
  - Socioeconomic and environmental impacts;
  - Financial, social, and technological factors affecting utility operations; and
  - Risk management.

- Determine the size, type and timing of any resource additions
Transmission Plans

**Minnesota: CapX2020 Transmission Initiative**

- Eleven MN Electric Utilities
  - Scenario planning; Collaborative process

- Transmission expansion
  - 600 miles of double-circuit capable 345 kV transmission; $2 billion investment
  - Foundation for future development; Capacity to meet renewable energy development
  - 10+ year timeline

**Regional: MISO Transmission Planning**

- Annual MISO transmission expansion plan
- Multi-Value Portfolio (approved MISO in 2011)
  - 17 lines, 10 states, $5 billion investment
  - Multi-values; Supports state RESs
  - 10+ years timeline
Wind Integration into the Midwest Regional Grid

Work on grid integration of large amounts of wind generation in Minnesota and the upper Midwest began in the early 2000s:

- Initial work focused on interconnection
- Minnesota utilities & MISO developed regional transmission plans

Higher penetrations of variable renewables required a forward looking systems approach and regional consensus on planning scenarios.

- Several Minnesota grid integration studies facilitated significant learning on all sides of the challenge (2004, 2006, 2009, 2014)

Today, the regional grid is planned and operated differently; new approaches/tools; improved market rules; and, wind generators are able to and are required to perform much better.
Minnesota Renewable Energy Integration and Transmission Study (MRITS 2014)

- **Reliability Study**
  - Completed by Minnesota Utilities and Transmission Companies; in coordination with MISO
  - Independent technical review

- **Increase Minnesota wind and solar generation**
  - 40% and 50% of annual electric energy

- **Three core and interrelated analyses:**
  - Developed a conceptual transmission plan;
  - Evaluated hour by hour operational performance of the power system for full year; and
  - Evaluated transient stability and system strength.
Grid Balancing and Flexibility

Source: Harnessing Variable Renewables. IEA.
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.

Includes:

- **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)
Valuing DER on the Grid

Minnesota Value of Solar Methodology

Value of distributed solar – *to the utility, its customers, and society*

Includes the value of avoided *energy* and its delivery, *generation capacity*, *transmission capacity*, *location-specific distribution capacity*, and *environmental value*

- **Expressed in a present value, $ per kWh, for a 25-year levelized stream**

- **Separates customer electricity usage and production**
  
  Customers are billed for all electricity usage under their existing applicable tariff and are *credited* for all solar energy production under the VOS rate.

- **Implementation**
  
  Investor Owned Utilities may apply to the MN PUC for a VOS tariff, in lieu of Net Metering, for solar PV;

  Xcel is required to purchase energy generated by solar gardens at the value-of-solar rate.
Minnesota Grid Modernization
Focus on Distribution Planning

**Principles:**
- Maintain and enhance the safety, security, reliability, and resilience of the electricity grid, at fair and reasonable costs, consistent with the state’s energy policies;
- Enable greater customer engagement, empowerment, and options for energy services;
- Move toward the creation of efficient, cost-effective, accessible grid platforms for new products, new services, and opportunities for adoption of new distributed technologies;
- Ensure optimized utilization of electricity grid assets and resources to minimize total system costs;
- Facilitate comprehensive, coordinated, transparent, integrated distribution system planning.
Integrated Distribution Planning

Proposed framework

Evolving Electric Grid

- Minnesota’s electric grid is reliable, affordable, increasingly clean;

- The grid is at a time of significant change, drivers include:
  - Evolving public policy, new environmental regulations, de-carbonization;
  - Changing consumer demands, increasingly engaged customers;
  - New distributed technologies, both supply and demand side resources;

- Tomorrow’s integrated grid will optimize and extract value throughout the system
  - will be more distributed and flexible;
  - will operate resiliently against natural disaster and attacks;
  - will be cleaner, reliable, and affordable;

- The regional transmission grid and markets will continue to be vital;
  The local electric distribution systems will need updated planning to support a reliable, efficient, robust grid in a changing (and uncertain) future.
Thank you!

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