Emerging Trends in Power System Planning Models

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NREL’s Power System Modeling Capabilities

Credit: Elaine Hale (NREL)
A quick overview of 2 of NREL’s planning models

• **Regional Energy Deployment System (ReEDS)**
  – Capacity expansion model of North America
  – Recently updated to include flexible solve structure (sequential, sliding-window, or intertemporally optimized), demand-side representation, endogenous retirements, and user-specified solve periods, among other improvements
  – Now open access

• **Electricity Markets and Investment Suite (EMIS)**
  – Capacity expansion model for evaluating the impact of market design on investment decisions and reliability
  – Part of the Scalable Integrated Infrastructure Planning (SIIP) modeling framework that represents the next generation of *integrated* modeling tools
Key planning model development activities

• Detailed representation of the challenges associated with variable renewable energy (VRE) integration
  – Increase temporal and spatial resolution, either explicitly or implicitly (inside- vs. outside-the-optimization)
  – Develop a more detailed representation of storage
  – Incorporate impacts from broader energy economy/system

• Electricity market representation and associated behavior of participants
  – Formulate new types of capacity expansion models that represent individual investor firms with heterogeneous risk profiles
  – Explore how different market designs perform under uncertainty
Remember…

NREL’s Power System Modeling Capabilities
Coordinated workflow to capture broader system interactions

Data, Scenario inputs

Consumer Technology Adoption
dGen

Capacity Expansion / Planning
ReEDS / RPM / EMIS

Probabilistic Resource Adequacy Assessment
PRAS (LOLE, EUE, CC)

Production Cost / Operations
PLEXOS / SIIP

Power Flow

Flexibility Inventory

This is our current workflow; many challenges associated with different software languages, data structures, and inability to co-optimize
Co-Modeling: Scalable Integrated Infrastructure Planning (SIIP) modeling framework
Emerging Economic Modeling Capabilities within SIIP

General Equilibrium Model of State and National Economies

SLiDE

Holistic Electricity Model
Multi-Perspective Agent-Based Modeling

Electricity Markets and Investment Suite (EMIS)
Wholesale Market Design Testbed

Credit: Elaine Hale (NREL)
Electricity Markets and Investment Suite (EMIS)

Multiple firms, technologies, products/timescales, project build phases, and economic/policy scenarios

How can markets efficiently support an ever-evolving power grid?
Part of the full team...