Emerging Trends in Power System Planning Models

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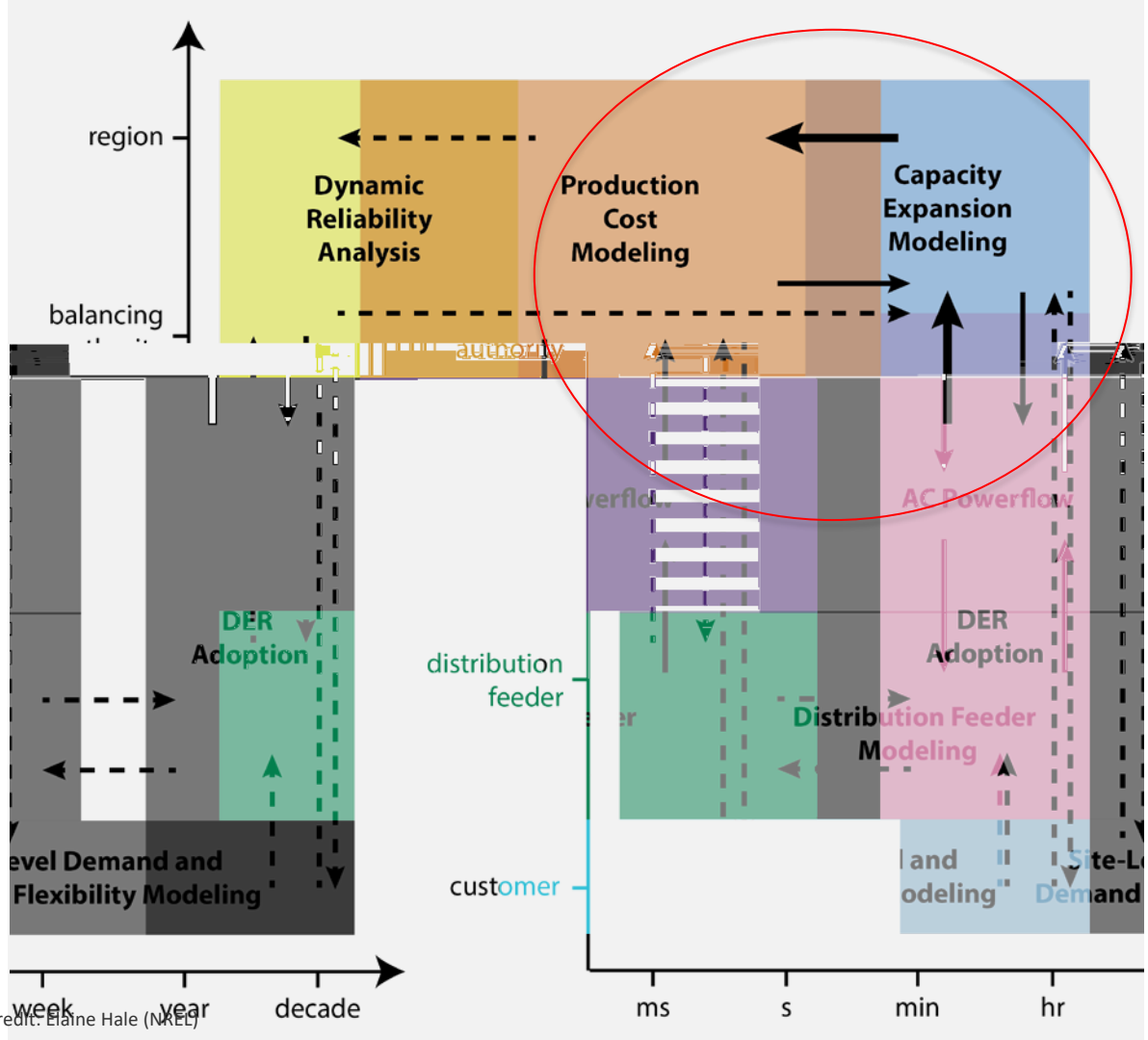
The National Academies of Science, Engineering, and Medicine: *Models to Inform Planning for the Future of Electric Power in the US*

February 3, 2020

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

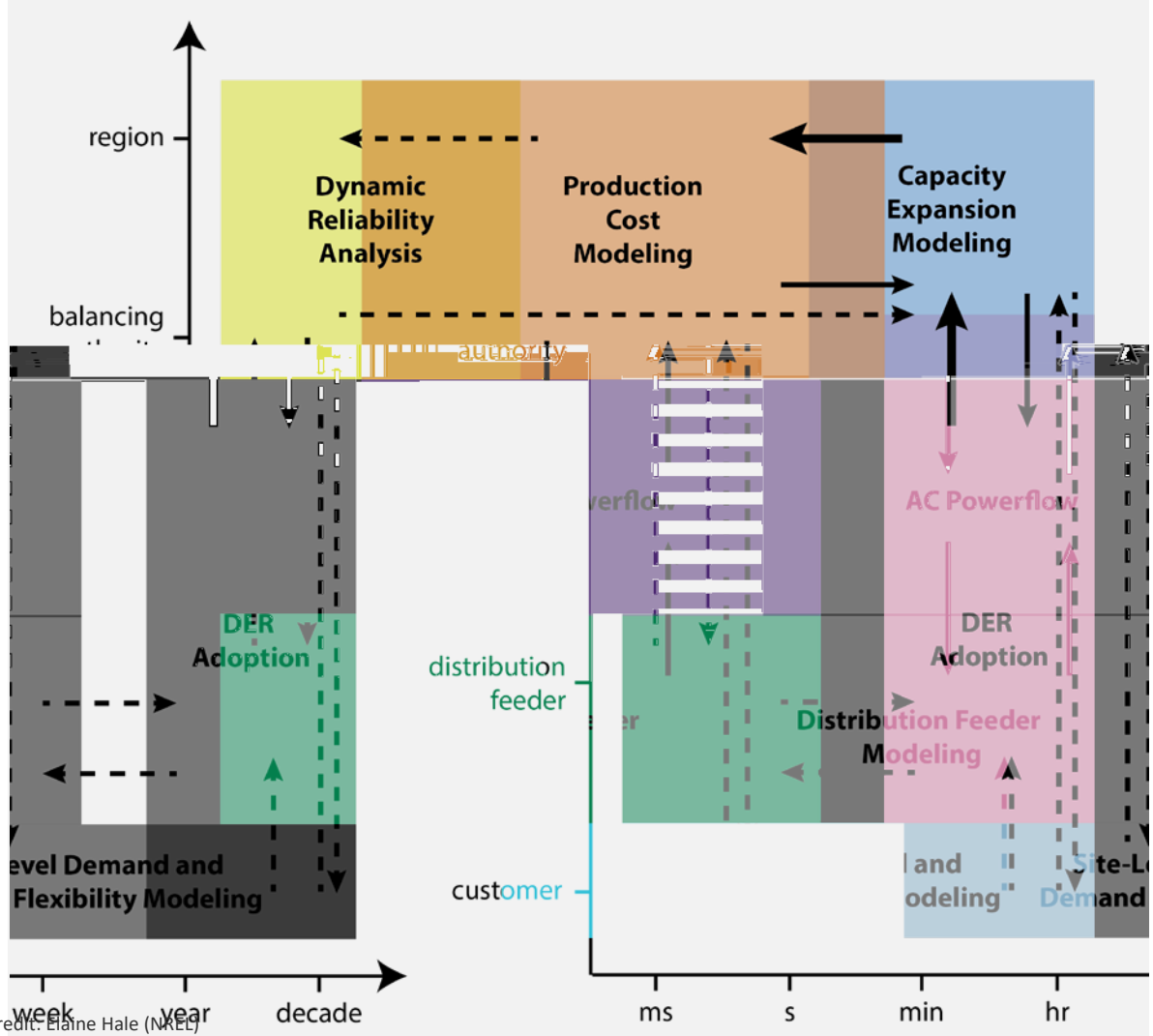
Key planning model development activities

- **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 heterogenous risk profiles
  - Explore how different market designs perform under uncertainty

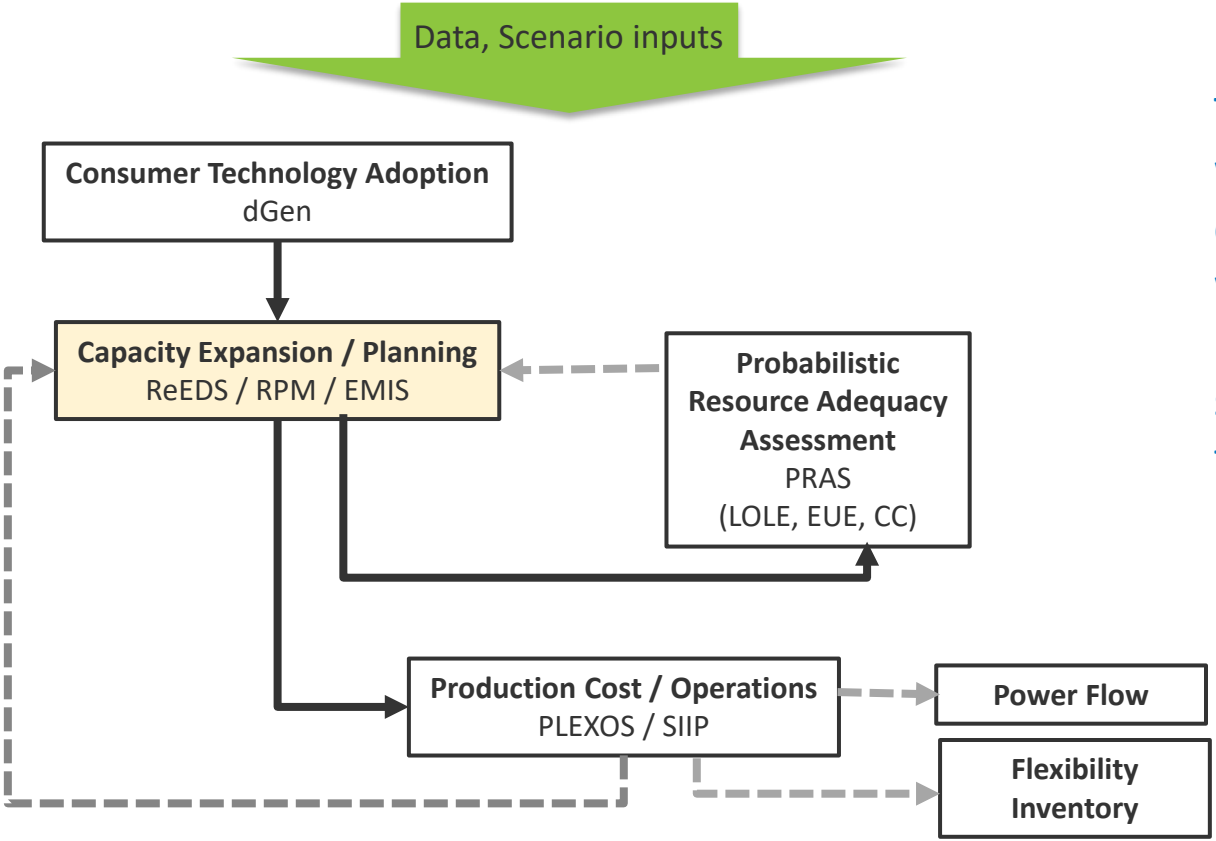
Remember…

NREL's Power System Modeling Capabilities



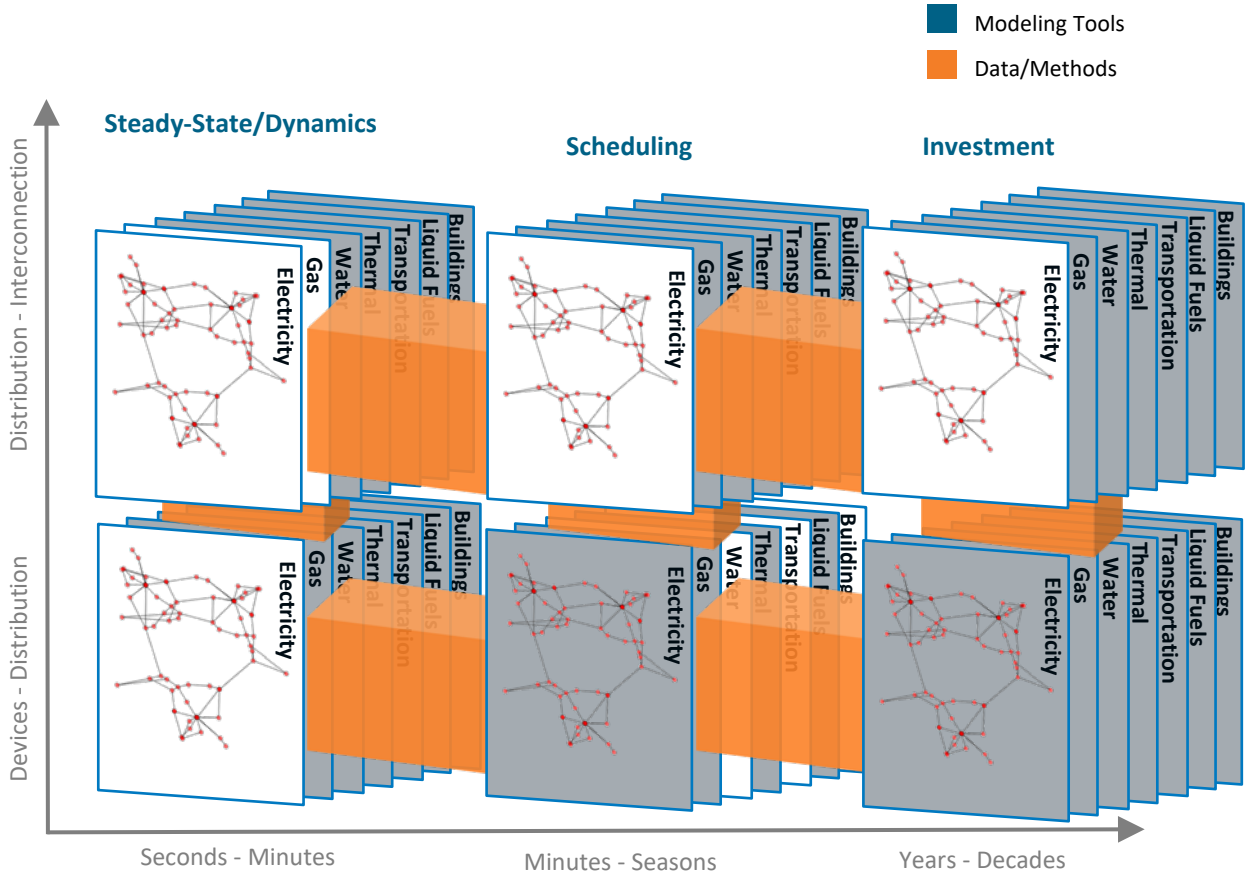
Credit: Elaine Hale (NREL)

Coordinated workflow to capture broader system interactions



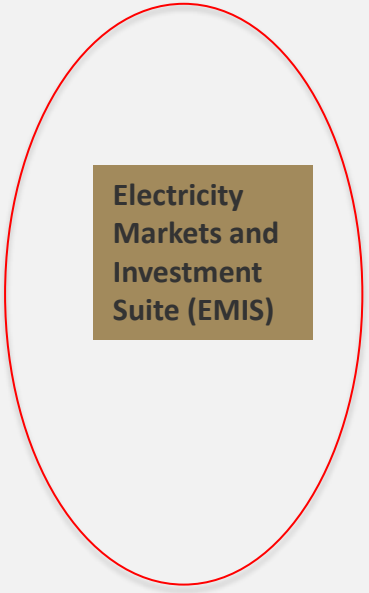
This is our current workflow; many challenges associated with different software languages, data structures, and inability to co-optimize

Co-Modeling: Scalable Integrated Infrastructure Planning (SIIP) modeling framework



Credit:
Doug Arent (NREL)

Emerging Economic Modeling Capabilities within SIIP

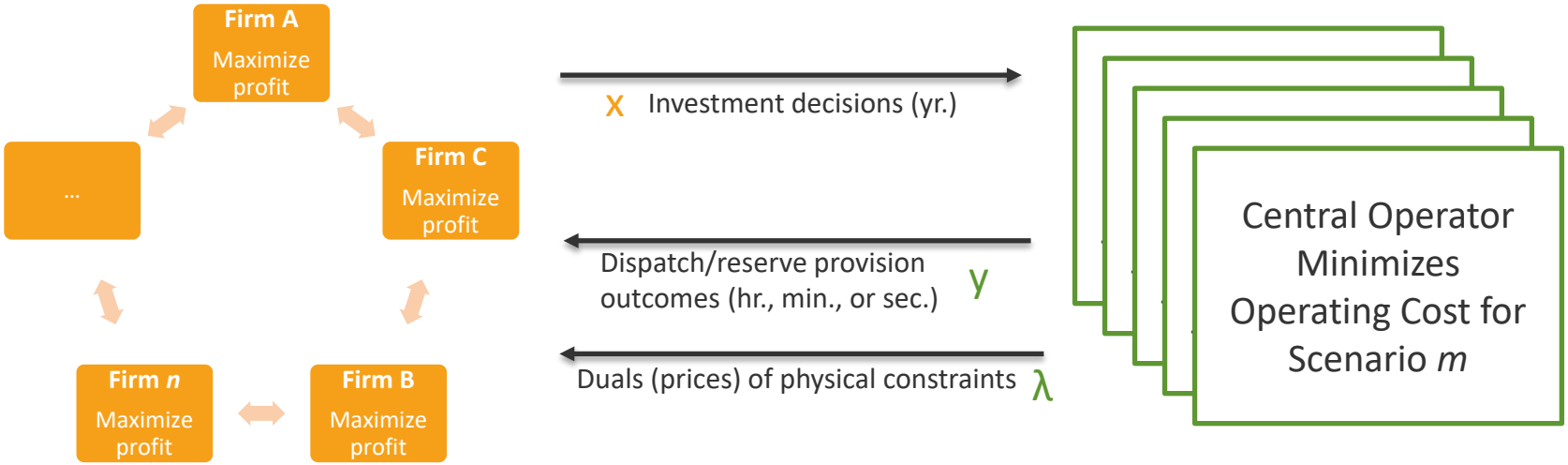


General Equilibrium Model of State and National Economies

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…

ReEDS: https://www.nrel.gov/analysis/reeds/

SIIP::POWER
PowerSystems.jl
PowerSimulations.jl

SIIP::WATER
WaterSystems.jl
WaterSimulations.jl

PRAS: https://nrel.github.io/PRAS

Thank you

www.nrel.gov

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