



# QuEst Planning: A Long-term Capacity Expansion Planning Tool for Energy Storage Systems & Modeling Flexibility



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## Project Objective

- Develop open-source long-term capacity expansion planning (CEP) model focused on energy storage systems (ESS)
- Improve ESS models to ensure cost-optimal ESS, generation, and transmission investments are identified to build a reliable and affordable grid

## Background & Motivation

- U.S. power system is experiencing rapid load growth and requires reliable and affordable investment solutions
- ESSs dominate interconnection queues and there is a need to improve ESS modeling in open-source CEP models
- Need to better characterize uncertainties to identify cost-optimal ESS, generation, and transmission investments via CEP
- Ensure reliability criterion is met while optimizing investments in the CEP



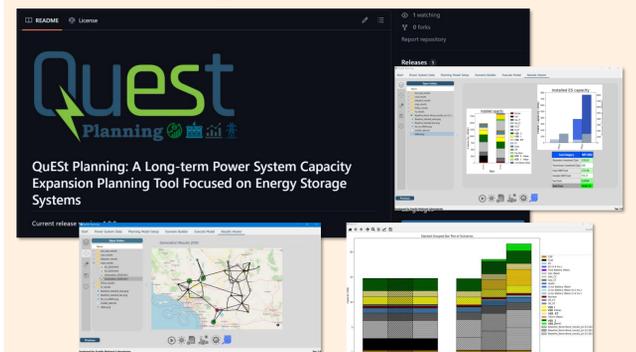
Ensure CEP models are sufficient to identify **reliable, cost-optimal** solutions

## Approach

- Open-source tool development:**
  - QuEst Planning provides user defined model flexibility: spatio-temporal scope, scenarios & long-term uncertainties, investment candidates
  - Collaborate with utilities for industry-based research (e.g. Public Service Company of New Mexico)
  - QuEst Planning provides a user friendly GUI to enable model design, scenario generation, and enhanced results viewer & scenario comparison
  - Model a broad range of ESS technologies to optimally site & size ESS onto transmission network
- Research thrusts:**
  - Deploy iterative MIP to evaluate reliability of incumbent solutions and present reliability for years with reliability constraints
  - Assess tradeoffs of modeling assumptions:
    - Interregional transmission investments with ESSs
    - Spatio-temporal scope in CEP

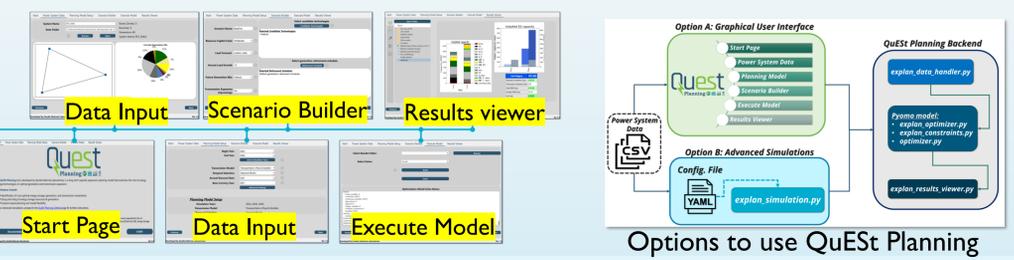
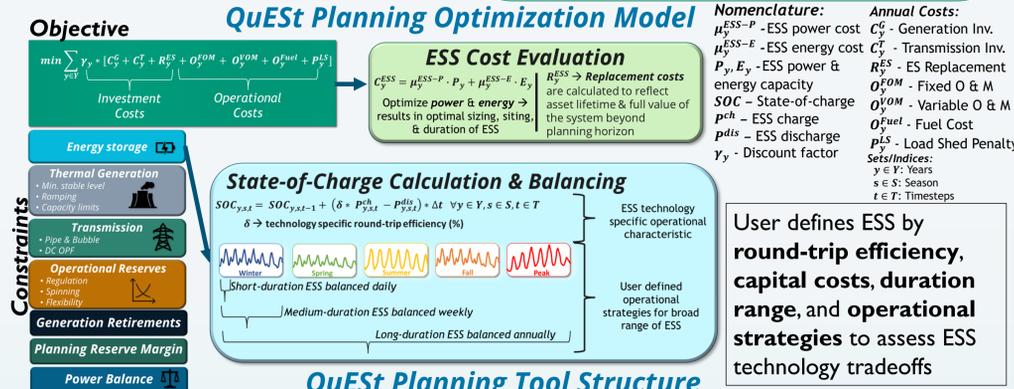
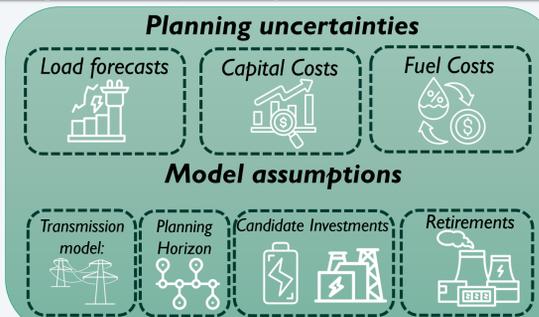
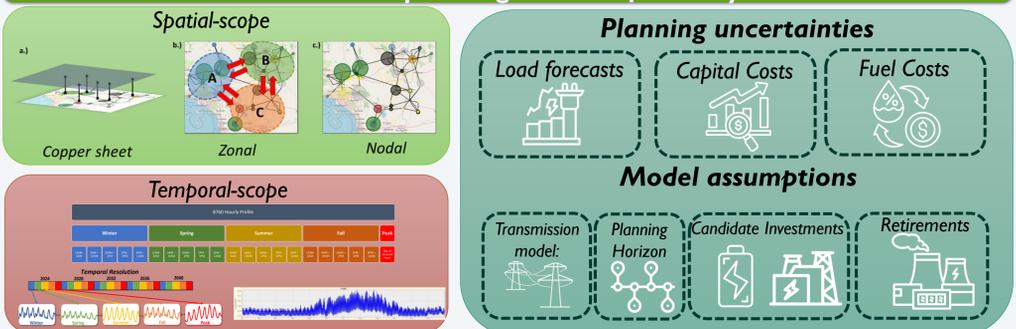
## Progress

- Open-source python package released on Sandia Labs GitHub ([v 1.0.0](https://github.com/sandia-labs/quest)) & QuEst platform
- Development of framework to incorporate reliability-based constraints
- Enhanced visualizations via GUI including: improved mapping software, interactive results viewer, and scenario comparison dashboard
- EESAT26 abstract accepted, conference paper to follow
- ESS Modeling Best Practices briefing written for the Michigan Public Service Commission



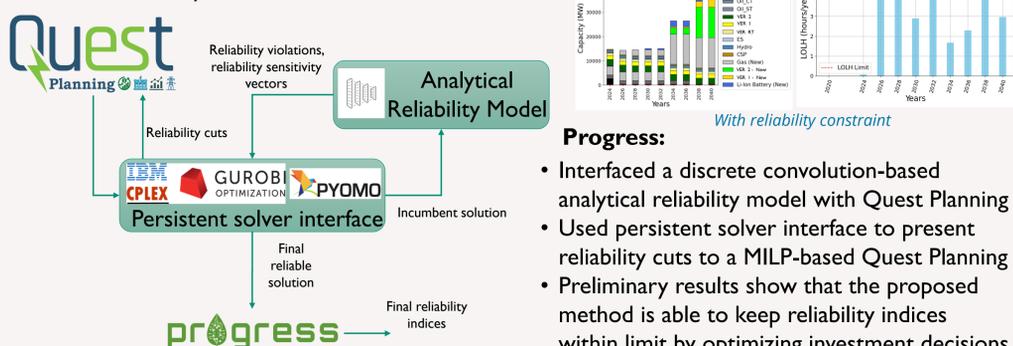
## Overview of QuEst Planning

Enables **robust** uncertainty characterization and model assumptions for **scenario-based planning & model flexibility**



## Reliability-based CEP Framework

- Objectives:**
- Develop a reliability-constrained capacity expansion planning framework for reliable planning decisions
  - Leverage the mixed-integer programming (MIP) persistent interface to introduce reliability cuts
  - Develop an analytical reliability assessment framework and interface it with the CEP framework for fast reliability evaluation



## Future Work

- Perform case study for US power systems to determine role of ESS in delivering affordable and reliable investment portfolios— consider load growth due to data centers, nuclear energy, and firm capacity retirements
- Develop integrated workflow for QuEst Planning, ProGRESS and QuEst PCM via QuEst Workspace
- Write a journal paper on modeling ESS in planning models

