Sandia National Laboratories

INTEGRATED QUEST TOOLBOX FOR COORDINATED GRID PLANNING WITH ENERGY STORAGE

Dilip Pandit, Cody Newlun, Atri Bera, Sel Ly, Tu Nguyen
Sandia National Laboratories

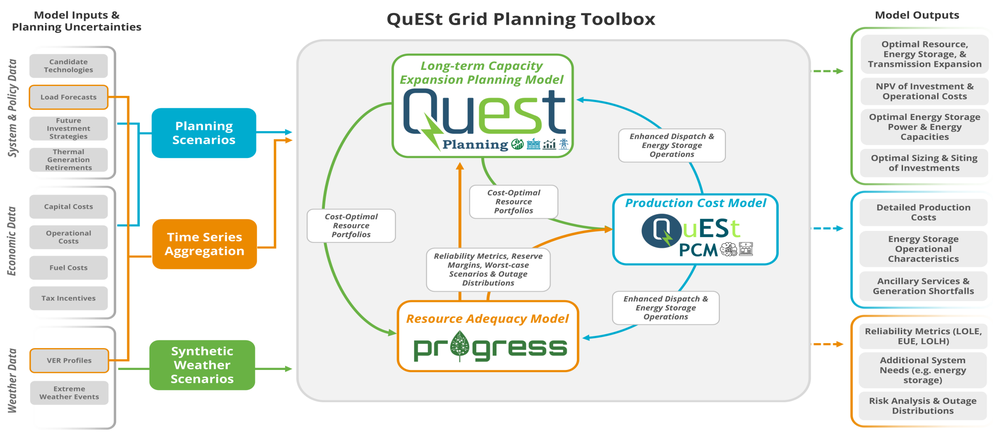
PROJECT PROFILE
Topic: Analytics & Tools| Vertical: Analytics
Strategic Pathway: Optimize
Project start and finish: FY26-Ongoing

PROBLEM

- **Challenge:** Modern grid planning requires **coordinated use of multiple tools** with *diverse data requirements* and *spatial and temporal resolutions*, leading to significant integration and scalability challenges.
- **Motivation:**
  - ➢ Increasing *large load penetration* and *retirement of firm capacity* poses multiple challenges to the power grid, requiring **comprehensive planning frameworks** that capture evolving system risks.
  - ➢ While ESS is essential in alleviating these challenges, co-ordination between planning tools is crucial to capture true value of ESS in mitigating such risks.
- **Current practice:**
  - ➢ Existing planning workflows rely heavily on *manual execution* of planning studies with *minimal automation.*
  - ➢ Key planning functions such as *expansion planning (CEP), resource adequacy (RA), and production cost modeling (PCM)* are *performed in silos*, leading to **inefficient practices** and **inaccurate results**, leading to decisions affecting ESS.

APPROACH

- Develop a **unified** and **automated platform** that seamlessly coordinates **CEP, RA,** and **PCM tools** to address **planning needs with ESS.**
- **Why Sandia:** Sandia has open-source CEP, RA, and PCM tools along with the **AI-powered QuESt Workspace**, which is ideal for tool integration.



- Developed tool **backend** and **QuESt workspace pipelines through UI** to coordinate QuESt planning, ProGRESS and QuESt PCM tools.
- Pipelines **eliminate manual data transfer practices**, ensure input consistency, **accelerate scenario analysis** and **support integrated ESS evaluation** across planning, reliability, and operational modeling.

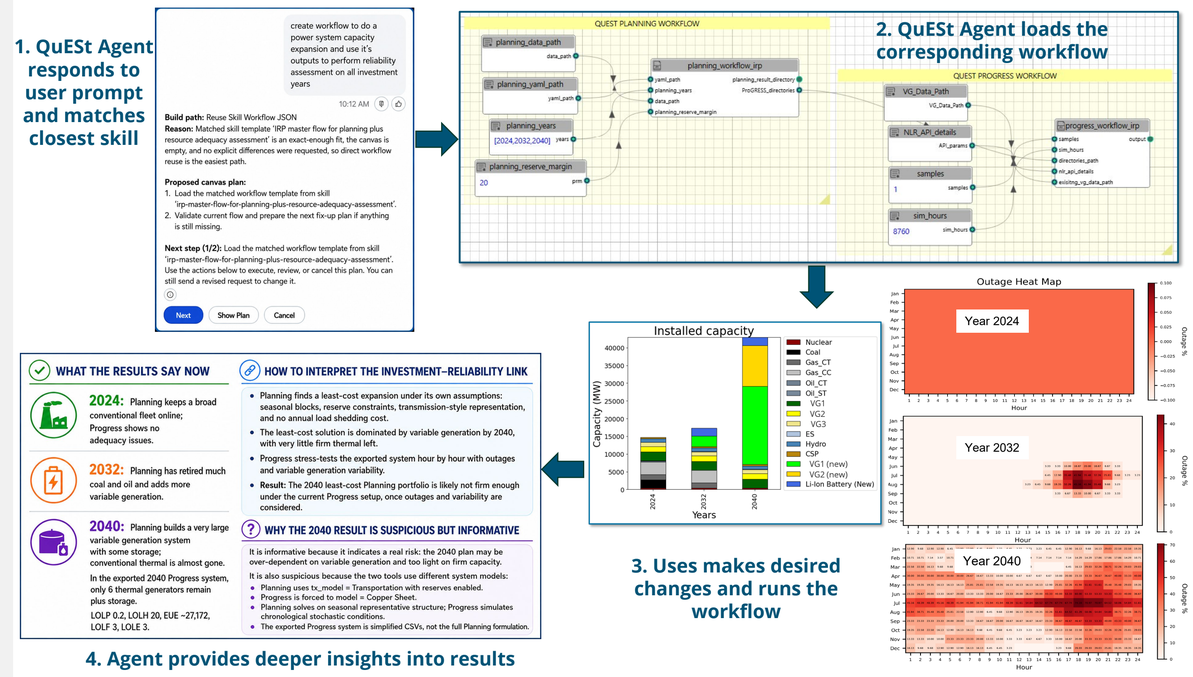
QuESt workspace allows **AI-enabled workflow building** and **results analysis**.

FUTURE DIRECTIONS

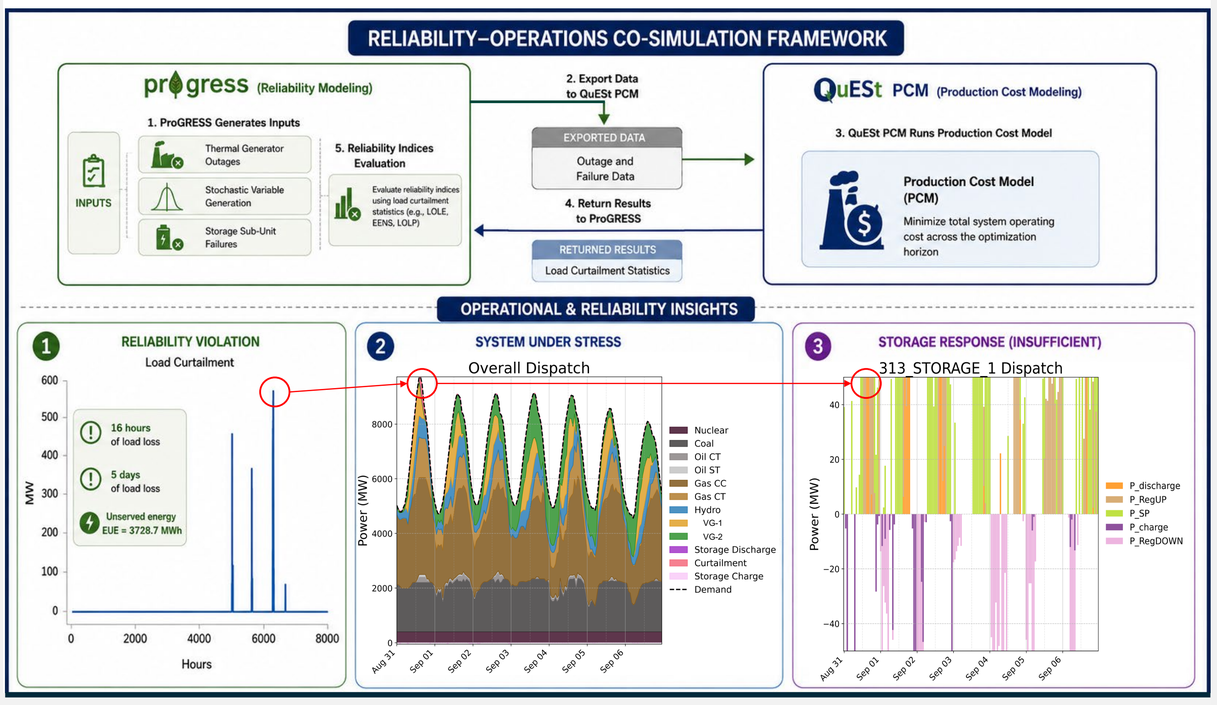
- Complete **Planning →RA → PCM integration** using **QuESt Workspace** and **QuESt AI agents** to evaluate the *high-fidelity operations* of the *cost-optimal* and *reliable* grid expansion plans.
- **Expand** agent capabilities to support diverse grid planning scenarios.
- **Automate** grid planning tool coordination using agentic AI to implement remedial actions such as *automatic tuning of planning model parameters to find a generation portfolio that respects system reliability standards.*

RESULTS

- **Case I (CEP +RA):** CEP followed by reliability analysis of the investment portfolios, leveraging QuESt workspace and AI agent.
- **Key components:** Individual workflows for CEP and RA tools using QuESt Workspace, pipelines within workspace to export planning outputs to RA tool.



- **Case II (RA + PCM):** Backend integration between ProGRESS and QuESt PCM tested. Dispatch optimization for a single sample (8760 simulation hours) within RA framework is performed using the PCM tool.
- **Key components:** mapping variable generation data, generator and transmission line forced outages, and storage sub-unit failures from ProGRESS tool into format compatible for QuESt PCM tool.



CONCLUSIONS & IMPACT

- Results demonstrate:
  - ✓ **Planning → RA integration** enables comprehensive evaluation of how generator, ESS, and transmission investments impact system reliability, revealing that meeting planning reserve margins alone does not guarantee resource adequacy.
  - ✓ **RA → PCM integration** bridges reliability assessment with detailed operational simulation, enabling high-fidelity evaluation of system operation and ESS behavior.
- Enables coordinated planning–operations evaluation, *improving storage representation* under realistic dispatch and market conditions.
- Provides a *unified framework for ISOs, utilities, and researchers* to assess reliability risks and investment trade-offs, supporting more informed planning, operations, and policy decisions.

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