

GRID MODERNIZATION INITIATIVE PEER REVIEW

Planning and Design Tools

Portfolio Overview

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Planning and Design Tools

Summary

What is the problem?

- Rapid changes in grid outpacing current modeling and analytic capabilities

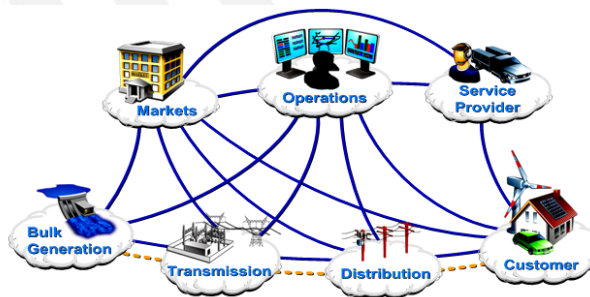
Expected Outcomes

- Drive development of next-generation tools that address evolving grid needs

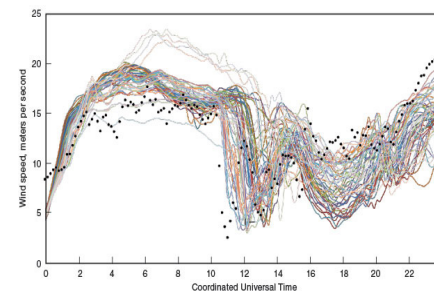
Federal Role

- Attack strategic technology gaps in tools capabilities
- Partner with industry for demonstrations and to focus R&D
- Work with vendors to transition R&D into practice

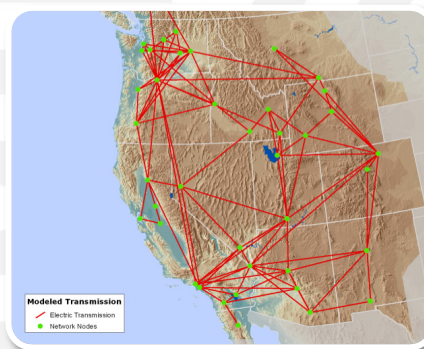
Technology Gaps



Simulating Interactions
Across Domains



Modeling Uncertainty



Increase Resolution
and Fidelity

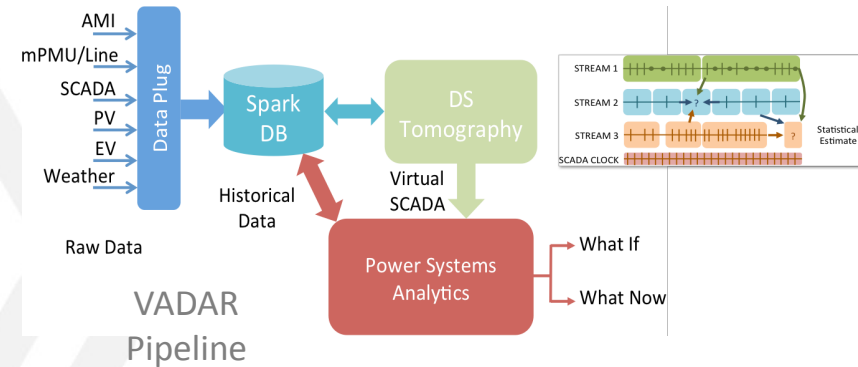


Computational speed

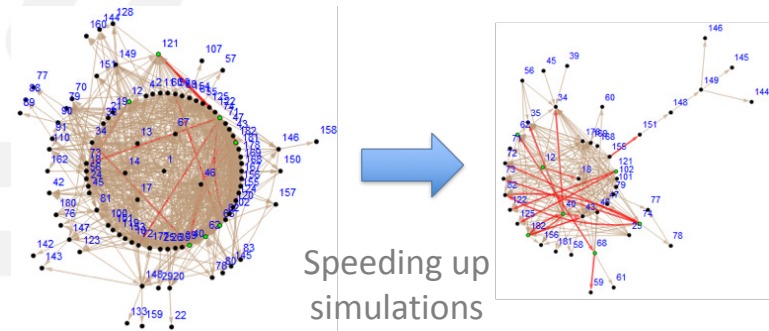
Activities and Technical Achievements

MYPP Activity Description

Activity	Technical Achievements by 2020
<p>1. Scaling Tools for Comprehensive Economic Assessment</p>	<ul style="list-style-type: none"> Enhance performance of stochastic production cost modeling from 100 to 10,000 transmission nodes; expand to include distribution system.
<p>2. Developing and Adapting Tools for Improving Reliability and Resilience</p>	<ul style="list-style-type: none"> Scalable simulation framework that couples transmission, distribution, and communications systems for integrated modeling at regional scale.
<p>3. Building Computational Technologies and High Performance Computing (HPC) Capabilities to Speed up Analyses</p>	<ul style="list-style-type: none"> Scalable math libraries and tools for enhanced analysis; co-simulation frameworks to support coupling of tools and models, uncertainty quantification, and systems optimization.

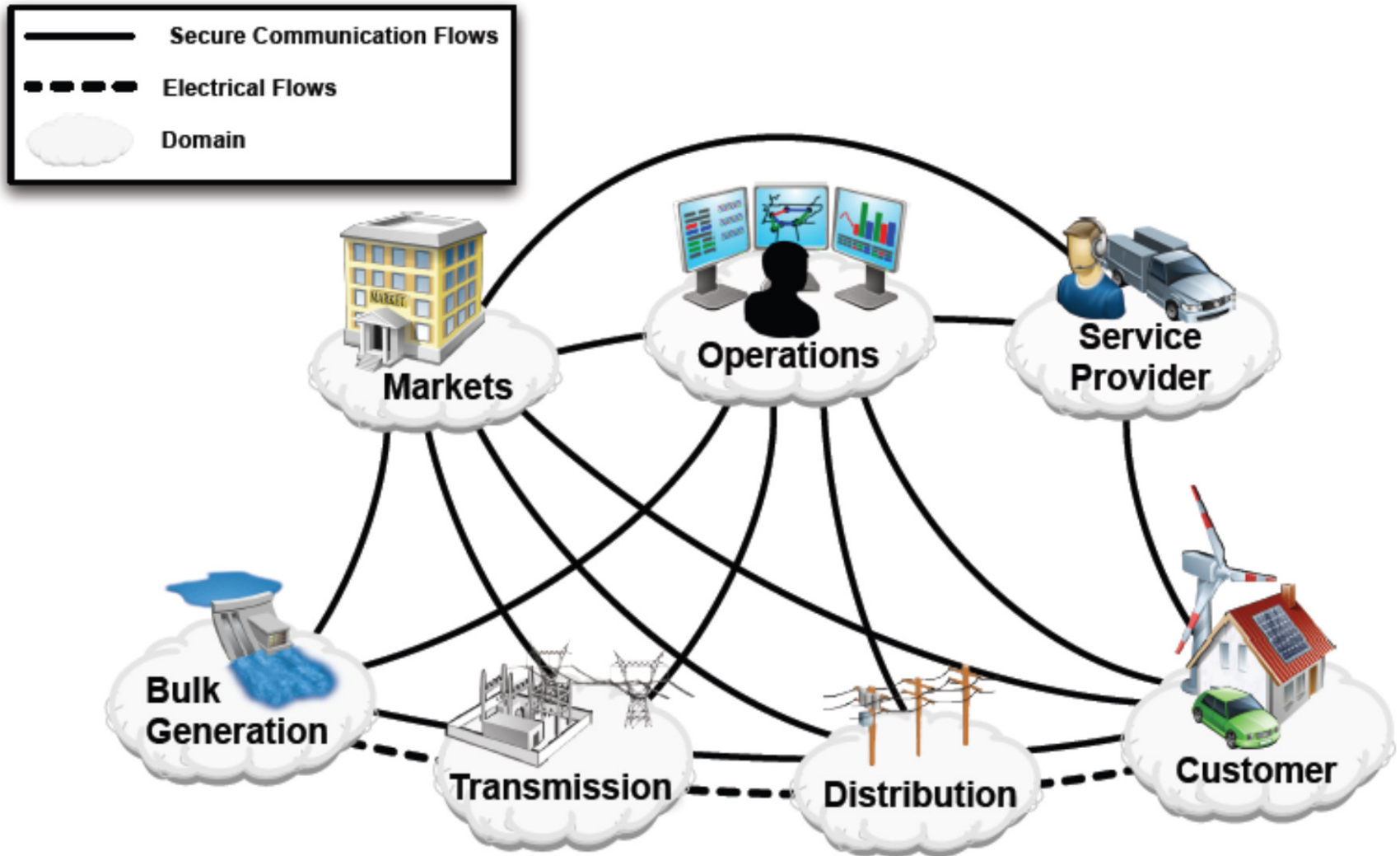


New planning and design tool capabilities



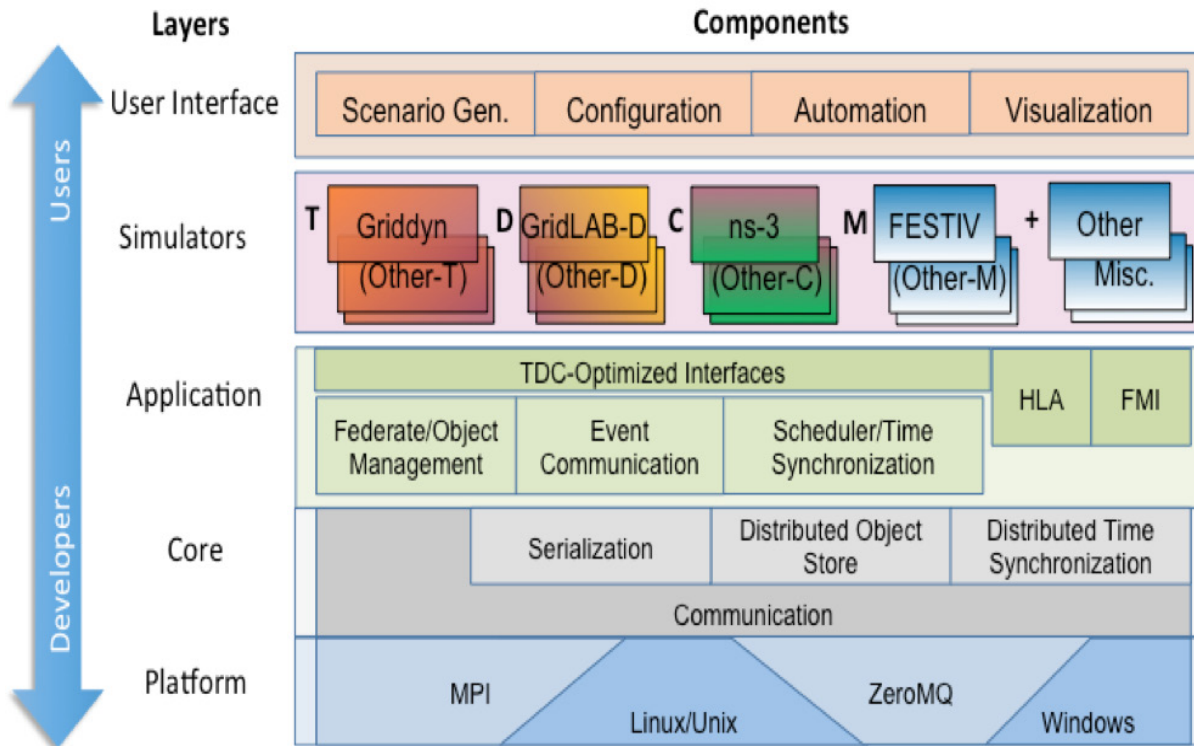
Algorithms and libraries

Foundational Projects



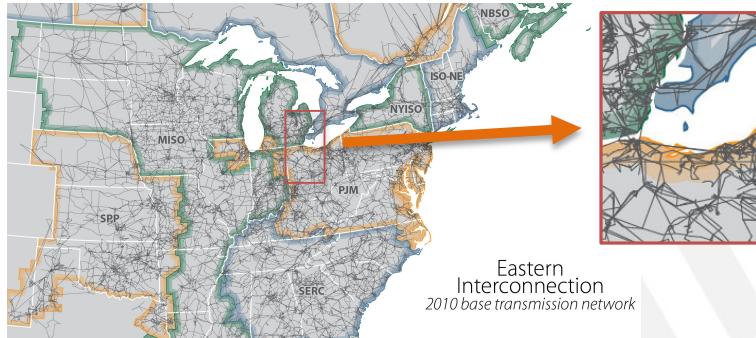
Foundational Projects

1.4.15 - Development of Integrated Transmission, Distribution and Communication Models (Lead: PNNL)



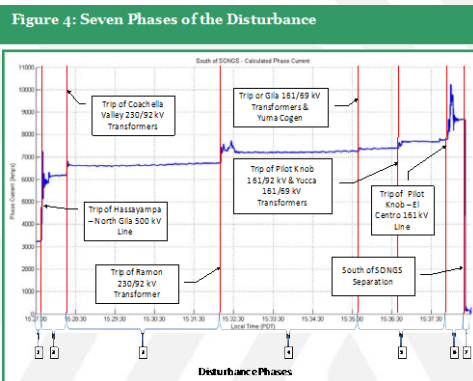
Create HELICS™, an **open-source co-simulation platform**, enabling interactions between leading commercial & lab developed simulators on a wide range of computing environments (HPC to laptop).

Foundational Projects



1.4.26 – Development of Multi-scale Production Cost Simulation (Lead: NREL)

- Develop scalable algorithms used for deterministic and stochastic PCM

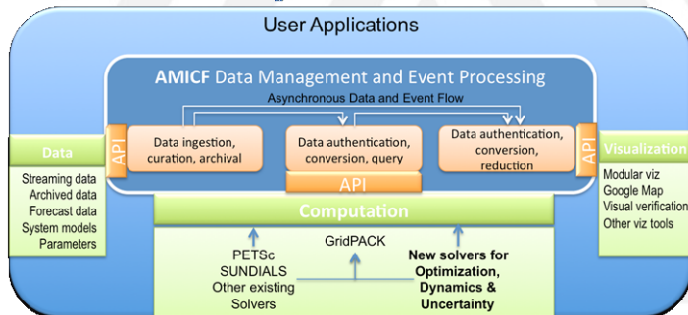


Arizona / So Cal Outage
FERC/NERC
April 2012

1.4.17 - Extreme Event Modeling (Lead: LANL)

- Improve performance of tools for modeling cascading outages and develop new approaches for contingency analysis

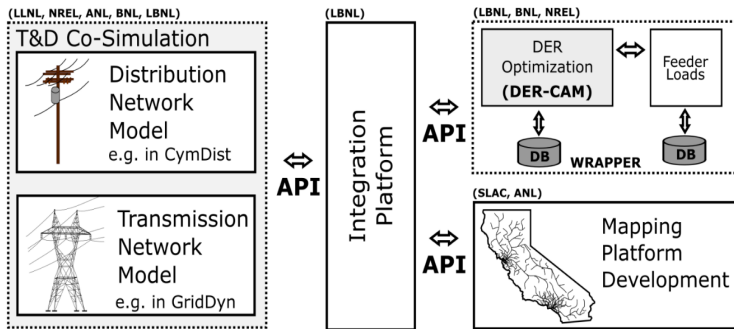
Figure 4: AMICF structure



1.4.18 - Computational Science for Grid Management (Lead: ANL)

- Applying DOE innovations in computational science to develop unified grid math library optimization, dynamics, and uncertainty

Regional Demonstration Projects



1.3.05 DER Siting and Optimization Tool for California (Co-Lead: LBNL and LLNL)

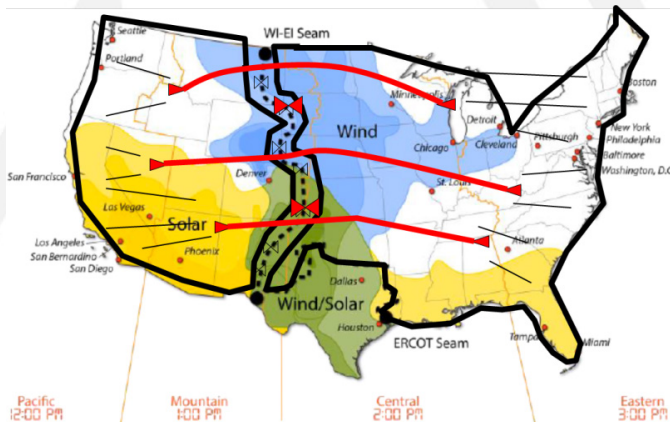
- DER tools integrating behind-the-meter adoption, distribution-transmission power flows, and visualization

1.3.33 Midwest Interconnect Study (Lead: NREL)

- Apply state-of-the-art tools to analyze economic efficiency and reliability benefits of 4 transmission futures for the U.S.

1.3.21 Alaska Microgrid Partnership (Lead: NREL)

- First-time consortia of DOE Labs and Alaska organizations developing best practices and tools for microgrid design and deployment



Program-Specific Projects

Transmission

- GM0111 - Protection and Dynamic Modeling, Simulation, Analysis, and Visualization of **Cascading Failures** (Lead: ANL)
- GM0074 - Models and methods for assessing the value of **HVDC and MVDC technologies** in modern power grids (Lead: PNNL)
- WGRID-38: North American Renewable **Integration Study** (NARIS) (Lead: NREL)
- SI-1631: Assessing the Value and Impact of **Dispatchable Concentrating Solar** Power in a SunShot Future (Lead: NREL)

Distribution

- GM0057 - LPNORM: A LANL, PNNL, and NRECA Optimal **Resiliency Model** (Lead: LANL)
- SI-1545 - **Rapid QSTS** Simulations for High-Resolution Comprehensive Assessment of Distributed **PV Impacts** (Lead: SNL)
- SI-1756 - **Visualization and Analytics** of Distribution Systems with Deep Penetration of **Distributed Energy Resources** (VADER) (Lead: SLAC)
- SI-1639: System Advisor Model (Lead: NREL)

Multiple Domains

- SI-1625 - CyDER: A Cyber Physical **Co-simulation** Platform for **Distributed Energy Resources** in Smart Grids (Lead: LBNL)
- GM0229 - Integrated Systems Modeling of the Interactions between **Stationary Hydrogen, Vehicle and Grid Resources** (Lead: LBNL)

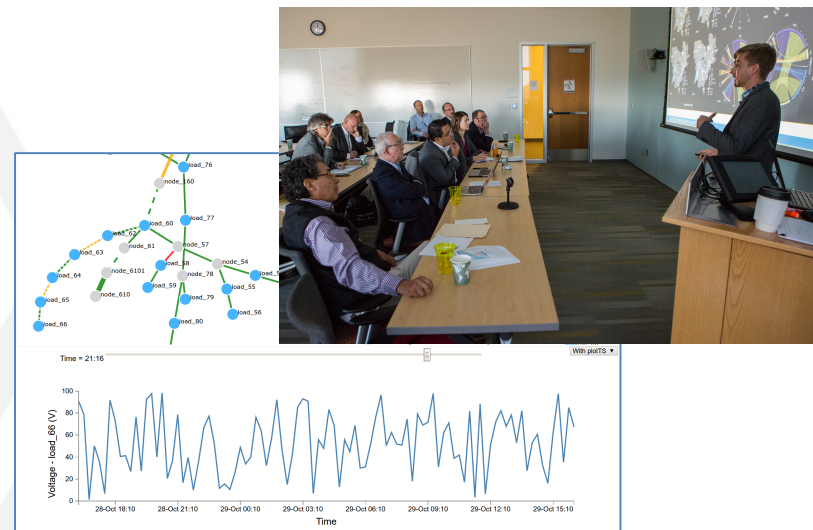
Load Modeling

- GM0094 - Measurement-Based Hierarchical Framework for Time-Varying **Stochastic Load Modeling** (Lead: ANL)
- GM0064 - Open-Source High-Fidelity Aggregate Composite Load Models of **Emerging Load Behaviors** for large-Sale Analysis (Lead: PNNL)

Accomplishments and Emerging Opportunities

Accomplishments

- Formed working group to coordinate release and sharing of software and data
- All GMLC-led projects hosted stakeholder meetings / technical review committees
- PCM, Seams Study, NARIS projects are coordinating R&D and review committees
- HELICS™ specification and use-case documents
- Extreme Event Strategy Roadmap
- Initial version of DER Optimal Siting Tool prototype completed
- Reduced runtime for important grid calculation (SCACOPF) from 10 hours to 10 min using DOE research (StructJuMP)



Next Year

- Significantly increased industry and vendor engagement
- Completion of additional software tool prototypes
- Tools demos on HPCs with 10X to 100X improvements