# 2014 Smart Grid R&D Program Peer Review

# Project Summary

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| **Project Title:** | **Microgrid Design Toolset** |
| **Organization:** | Sandia National Laboratories (with support from LBNL and PNNL) |
| **Presenters:** | Jason Stamp and Kevin Schneider |
| **FY 2014 Funding ($K):** | $900k |

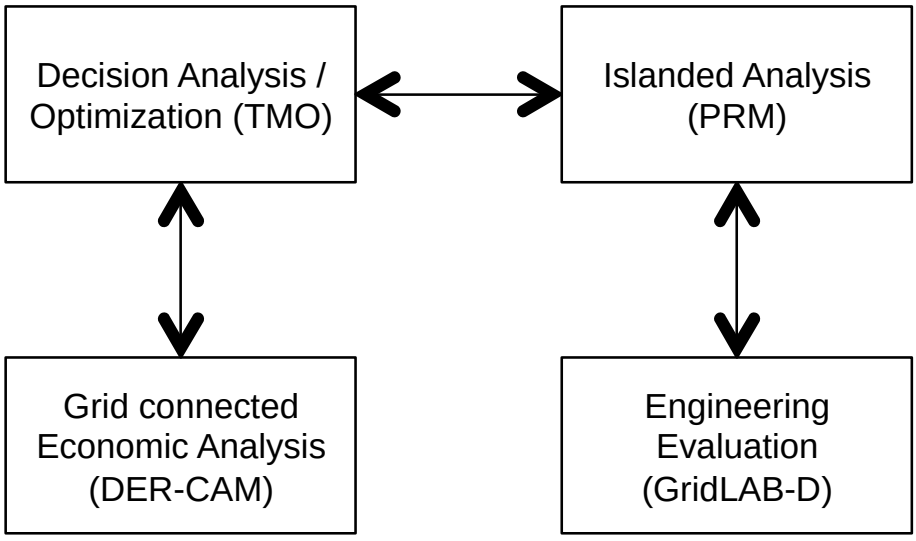
## Project Objectives, Significance, and Impact

The objective of the Microgrid Design Toolset (MDT) project is the development of a decision-support tool to aid microgrid planners and designers in quantitative analysis to meet individual stakeholder-defined objectives and constraints for cost, reliability, environmental emissions, and efficiency. The tool leverages and integrates software capabilities developed by SNL, LBNL, and PNNL for the optimization of microgrid designs. The significance of the project is meeting the need identified by the microgrid stakeholder community in the 2011 and 2012 DOE microgrid workshops for "a standard set of collaborative tools that addresses uncertainty, has a more holistic approach (to integrated energy systems, communications, vehicles, combined heat and power systems, etc.), and broadly assesses value streams; and validate the tools on both domestic and international systems" (Summary Report: 2012 DOE Microgrid Workshop, page iii). Achieving those goals will accelerate adoption of microgrids through clear and quantitative understanding of their benefits by all stakeholder groups. The impact of the project will be more widespread microgrid benefits, including improved energy security for critical loads, better integration of renewable energy (that has environmental benefits), better energy efficiency, and overall energy resiliency.

## Technical Approach

Several DOE national laboratories have been working on microgrid technology and issues for many years. In this project, Sandia will leverage the existing work to the greatest extent possible. The MDT leverages Sandia's TMO (Technology Management Optimization) software to evaluate and optimize the decision space. The MDT depends on four existing software capabilities from the national laboratories (as shown in the figure below):

- Technology Management Optimization (TMO) by SNL: As the central integration platform for MDT, TMO finds design solutions (along with their costs) that meet the objectives/constraints, then displays design solutions in Pareto and histogram charts for design optimization/trade-off analysis
- Performance Reliability Model (PRM) by SNL: Calculates reliability, fuel usage, and emissions for candidate microgrid design options provided by TMO for islanded operations
- GridLAB-D by PNNL: Conducts balanced load flow analysis for each PRM performance calculation to help determine engineering feasibility
- Distributed Energy Resources Customer Adoption Model (DER-CAM) by LBNL: Conducts optimization analysis on costs and CO2 emissions for candidate microgrid design options provided by TMO for grid-connected operations, and then feeds results to TMO to further support design solution analysis



## Technical Progress and Results

Each of the four component tools in the MDT already had good software and application maturity. The team is using an iterative development methodology for MDT, within a rapid application development approach. There are four stages to the process:

- Proof-of-concept (completed FY13)
- Prototype (early CY15)
- Alpha release (late CY15)
- Beta and final release (beyond)

In CY15, a prototype MDT will be used by one or more energy assurance planners in communities for microgrid design analysis, with technical support and assistance provided by the national lab team. In addition, user feedback on new or improved features of the tool will be sought in FY15 as the basis for continuing tool development.

The proof-of-concept was demonstrated in November 2013. A test problem was developed with design objectives for financial aspects, energy security, energy efficiency, and environmental performance. TMO generated successive sets of design options, which were then sent to DER-CAM (for economic and environmental analysis while grid-connected) and PRM (for energy security and efficiency analysis while islanded). PRM in turn incorporated analysis from GridLAB-D in its calculations. The overall best set of design tradeoffs was calculated by the MDT and interpreted using TMO.

## Project Collaborations and Technology Transfer

Previous sections have covered the project collaborations between the three DOE laboratories, and have mentioned the transition plans. A prototype of MDT is targeted for release to interested users from industry in early CY15. At that time, MDT will be used by one or more energy assurance planners in communities for microgrid design analysis, with technical support and assistance provided by the national lab team. In addition, user feedback on new or improved features of the tool will be sought in FY15 as the basis for continuing tool development. To meet these two goals, the MDT project has recently gathered candidates for an Industry Advisory Group (IAG), including representation from:

- Microgrid A&E firms
- Vendors
- Some prospective application sites
- Academia