Breakout Session 2:
Modeling, Analysis and Design

- Research Topic A: Performance Optimization Methods
- Research Topic B: Uncertainty in the Modeling and Design Process

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Framing of the Topic

What is covered

The focus of this breakout session was modeling and analysis tools to assist planning and design of microgrids.

What is not covered

- Design methods and practices
- Standalone single function models
- Operational details
- Definition of Requirements: customer, performance, security, energy surety, islanding etc.

Current Technology Status

State of the Practice

- HOMER, RETSCREEN, GRIDLAB-D, WebOpt, OpenDSS, Sandia model
- Ad-hoc cobbling together available tools and components, pilot programs (inconsistency in analysis) piecemeal view of using technologies
- Grants and demonstration projects have fostered tool development, it is now time to integrate them
- There is a lot of activity in the academic sector; Virginia Tech, PKD tools are fairly well recognized, campuses are ideal locations for microgrids
- Not much practitioner interest (Distribution Planners, A&E, DB Firms, etc)

Current Technology Status

State of the Art

- Minimal interest to consider urban installations
- Limited uncertainty analysis
- Very good capability to do electrical design with limitations in speed and collaboration capability
- Challenge in handling power quality
- Missing valuable capability in other applications such as marine
- Tools geared to early adopter community; this drives model types

Current Technology Status

Current R&D activities

- WebOpt/HOMER extending along the same lines
- GRIDLAB-D muilti-level, agent-based, open source, covers demand response, ancillary services
- Diagnostic modeling (Pecan St, EMCS, etc.)
- DOD active research in MGs for relocatable bases, fixed bases, ships, aircraft
- Real time environmental models (ERCOT, ICF, etc.)
- Predictive models of grid conditions (capacity-day predictions, next-day, demand response, ancillary services)
- Critical loads value during disaster response

Needs and Challenges

What is needed and why

- Local and dynamic control of power quality (major value stream)
- Assessment of diminishing returns of outages/power quality (power quality is expensive)
- Better understanding of critical loads and facilities; these are key microgrid opportunities
- Vehicle – microgrid connection modeling
  1. Vehicle storage and charging control offers services to microgrid and macrogrid
  2. Little experience with mobile sources
- Ability to model both communications and power together to assess interoperability
- Collaborative tools to move to widespread application

Needs and Challenges

What are challenges

- Privacy issues
- Value streams depend on integration
- Interoperability and communications compatibility of equipment
- Intellectual property constraints
- Complexity of models or simulations needed to accurately address uncertainties
- Complex methods lead to uncertain solution times and non-user friendly packages
- Traditional power system design methods are not intended to address quickly changing technology (smart grid)

R&D Scope

- Need to understand what kind of models are needed to move from retail to **wholesale** approach, and assessing **value streams** such as power quality, seamless transfers
- **Collaborative** approach
  - Model validation
  - Non-traditional strategies and teaming
  - International collaboration
  - Development of reference models; tool standardization, interface standardization
  - Building reference problems
  - Synergy between power and communications modeling platforms
  - Multi-disciplinary, integrated energy modeling
- **Resilient** and robust designs, how MGs behave under stress, impacts of quickly **changing technologies**.

R&D Metrics

Outcome

Standard set of collaborative tools that are broadly accepted and used by current and future MG developers. These tools improve on current tools by addressing uncertainty, being more holistic*, broadly assessing value streams, and having been validated on both domestic and international systems.

* integrated energy systems, communications, vehicles, CHP, etc.

R&D Metrics

Milestones

1. Peer reviewed conference on characterization of current and evolving tools, IP constraints, and modeling standards. Uncertainties, gaps and barriers are identified. Identify and include stakeholders, practitioners, expert advisory committee, user groups.
2. Foster development of a collaborative modeling environment, engaging the international community and perhaps IEEE.
3. Validation of reference models using operational microgrid installations across the globe.
4. Developing applications of new microgrids (community energy systems, clusters).
5. Transfer management of the tool to practitioner community.