

A hand holding a pen over a molecular model. The background is a blurred image of a hand holding a pen over a molecular model, with a blue and yellow color scheme.

Asia Development Bank
Partnership Forum:
Innovation for Resilient and
Smart Communities

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Smart Grid Technology Solutions for Resilient and Smart Communities

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Battelle Memorial Institute

- Global enterprise
 - Applying science and technology to real-world problems
 - Managing machinery of scientific discovery and innovation
 - Creating commercial value by bringing new technologies to international marketplace
 - International leader in STEM education
- Non-profit, charitable trust formed by the Will of Gordon Battelle in 1929



- Generates \$6 billion annually in global R&D
- Oversees 20,000 employees in 130 locations worldwide

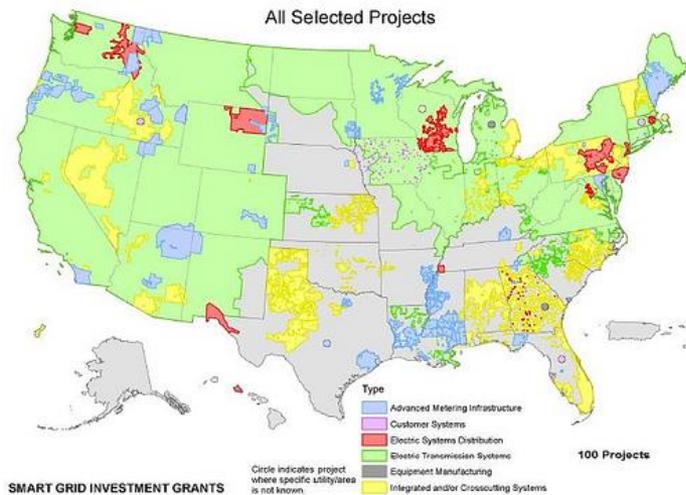


Network of Battelle-Managed Labs

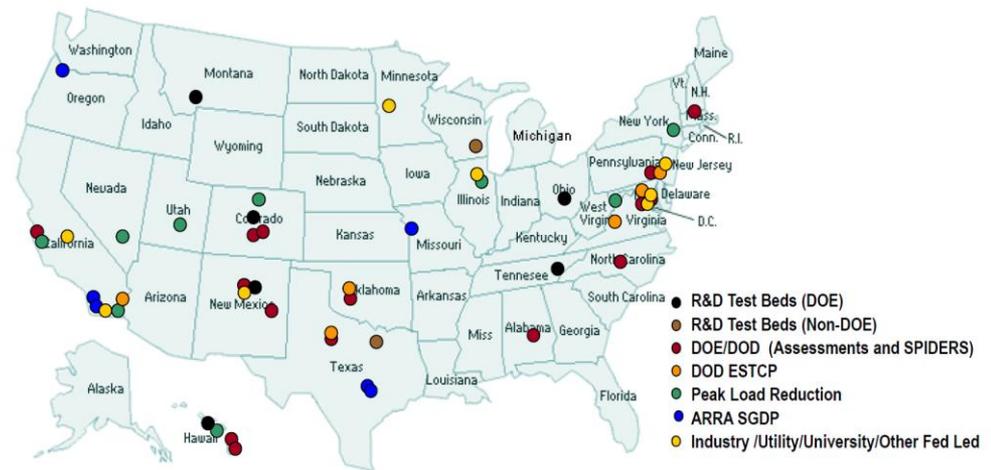


Building on Experiences of USDOE Smart Grid Activity

Smart Grid Investment Grants

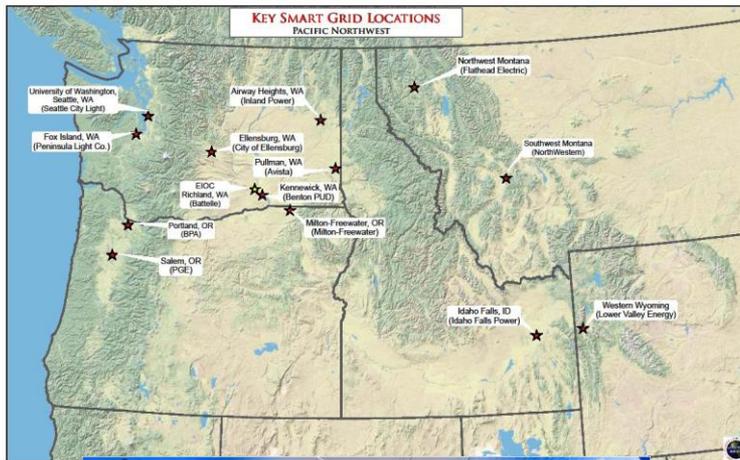


Smart Grid Initiatives



Between 2009 - 2014
 32 projects overall (16 demonstrations)
 \$870M total w/ \$435M from DOE (50%)

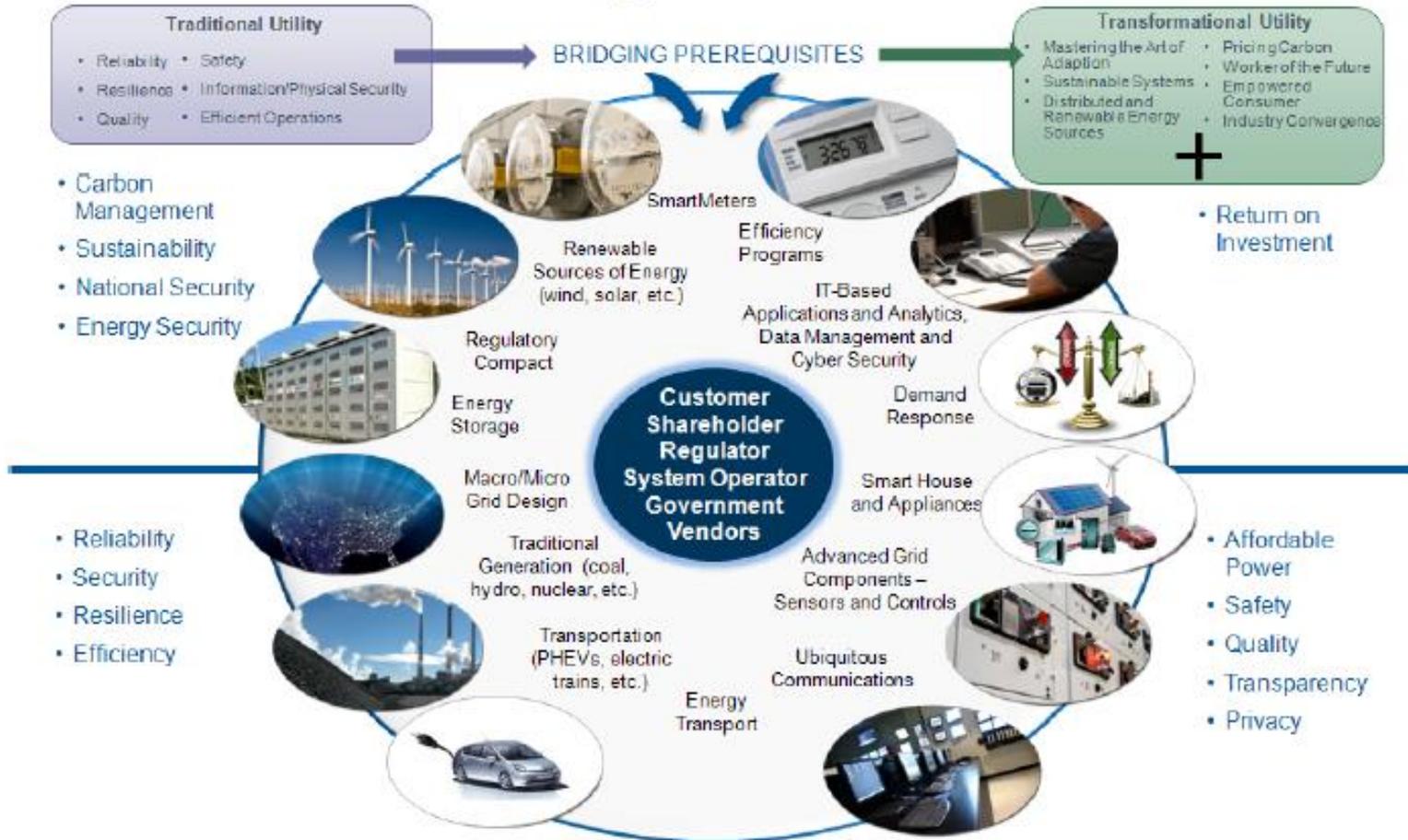
Battelle Engaged in the Two Largest US DOE Smart Grid Demonstration



- PNNL - \$177.6 million (\$88.8 million DOE funding) PNNL led this project which involved 60,000 consumer sites to demonstrate two-way communications, storage, demand response, interoperability standards, cybersecurity.
- BMI - \$150.3 million (\$75.2 million) infrastructure for 110,000 consumers testing 13 technologies including distribution automation and control, smart meters and appliances, home area networks, plug-in hybrid electric vehicles, energy and battery storage, and renewable generation

Touching All Aspects of the Smart Grid

Dimensions of Energy Transformation – Advantages of Smart Grid



From Generation - Catalytic Pyrolysis Technology

Commercializing Technology for Converting Biomass to Fuel

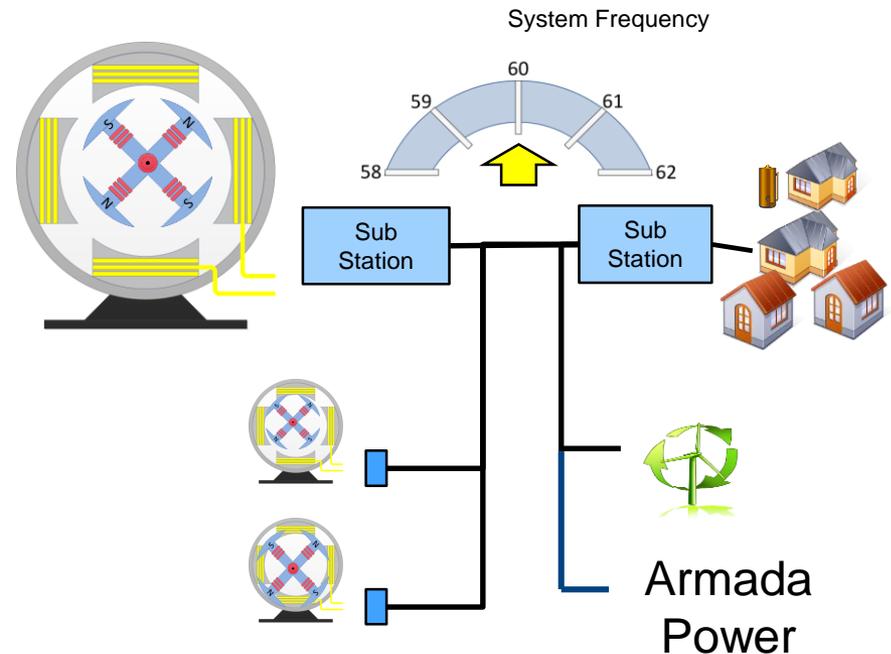


- Unique aspect is small-scale, distributed production
 - ~100 tons per day feed
 - ~1 tanker per day fuel
- System can take a wide variety of feed stocks



Armada Power

- For Profit Power Company.
 - 50% Battelle owned, est 2015
- Provides Frequency regulation services and sells “power” into the electric grid.
 - Addressable U.S. Market is 4000 to 8000 MWs
 - Addressable Japan Market is 3000 MWs
 - Expect 100 MW of FR capacity to create \$180M company value at 10X EBITDA



To - Full System Modeling, Analysis and Operation



Electricity Infrastructure Operations Center

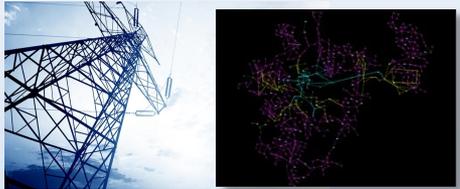
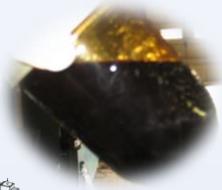
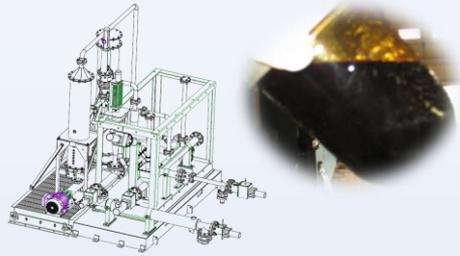
- ▶ Fully capable grid control center for training and backup
- ▶ Live data resources from actual grid operations nationwide
- ▶ State-of-the-art grid operation & modeling tools
- ▶ Access to advanced computers and high speed networks

*Unique platform to research, develop & test
next-generation tools and concepts
for operating the energy infrastructure*

WHAT BATTELLE CAN OFFER

Offering solutions and building capacity based on a combination of hardware understanding and software

Broad Expertise in Energy and Environment



**Energy Management
&
Alternative Energy**



Energy Management

- Demand Management
- Energy Management
- Grid Distribution & Transmission
- Energy Storage



Alternative Energy

- Biomass energy, products, and fuels
- Fuel Cells
- Hydrogen/Alternative Fuels
- Renewable/Hybrid Power Systems

Battelle Grid Systems Portfolio

Distribution System
Modeling and Simulation



Transmission Modeling
and Simulation



Active Demand
Management Solutions



Microgrids, Renewables
and Storage

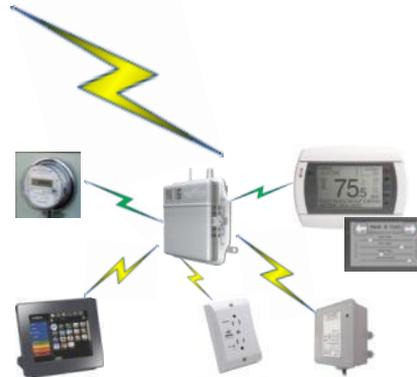


Grid Analytics and
Visualization

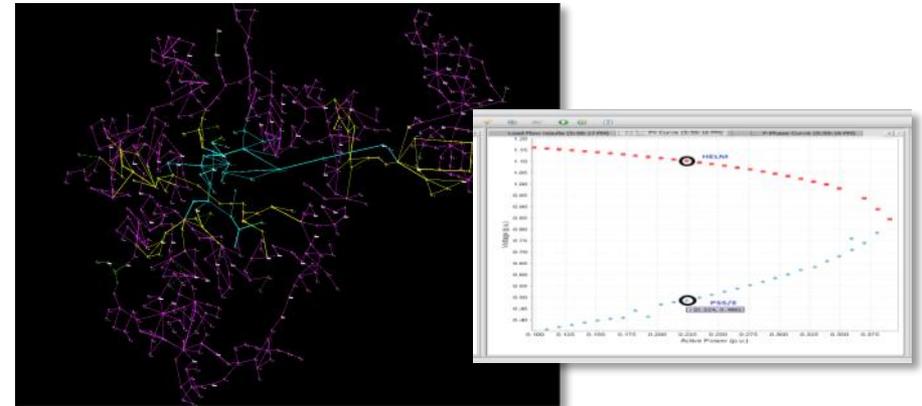


Software Tools

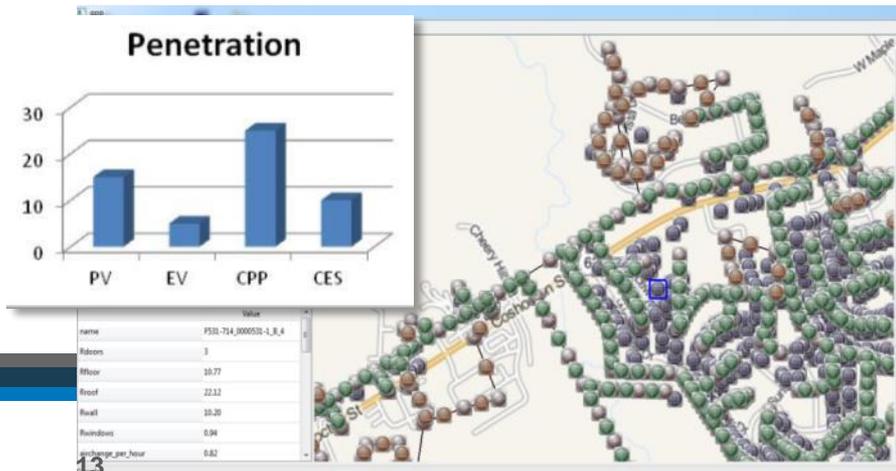
Active Demand Management (ADM)



Transmission Modeling



Distribution Modeling

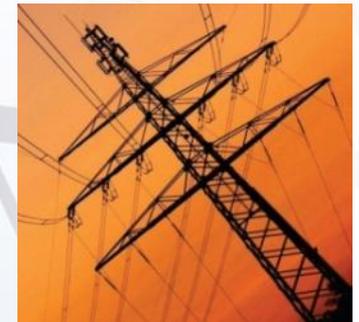
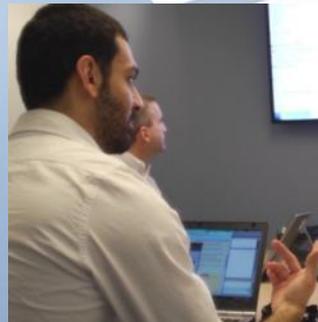


Analytics and Visualization



Grid Command™

A full suite of modeling, decision-making and operational tools



GridCommand™ services and products range from data analytics to production and field support



◀ **Data Warehouse/
Computing Center**

**Software
Development
Center**



◀ **Modeling and
Simulation Center**

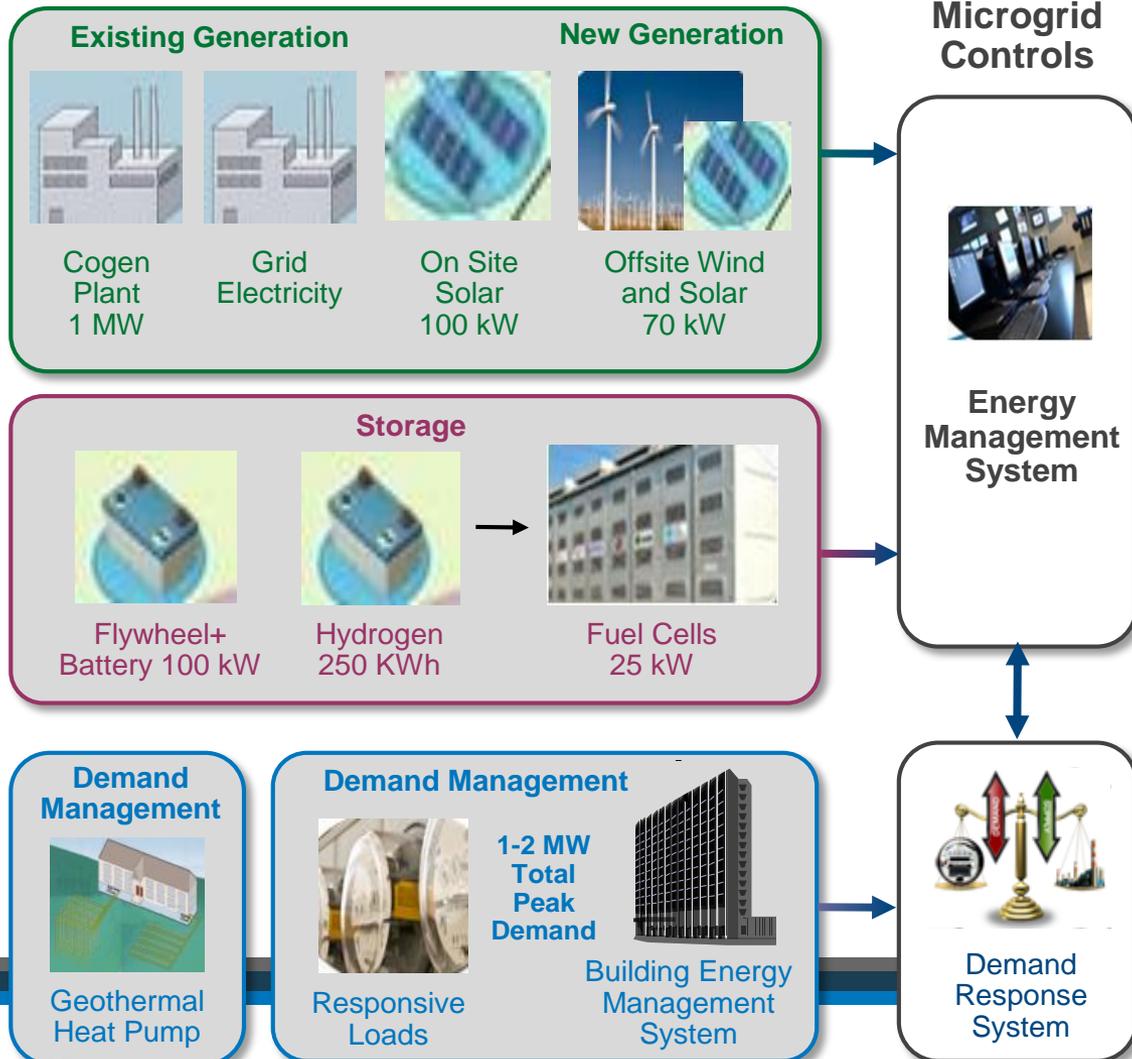
**Smart Grid
Integration Center**



◀ **Production and
Field Support
Center**

GridCommand™ allows effective decisions about resource allocation and technology integration on the grid

Architecture



Capabilities

- Renewable integration
- Distributed generation
- Demand response
- Electric vehicles
- Volt-VAR control
- Energy storage
- Microgrid design and operations
- Distribution modeling

GridCommand™ Distribution User Friendly Graphical Interface

Able to assess the impacts of a variety of independent or complex scenarios, such as:

Load Growth

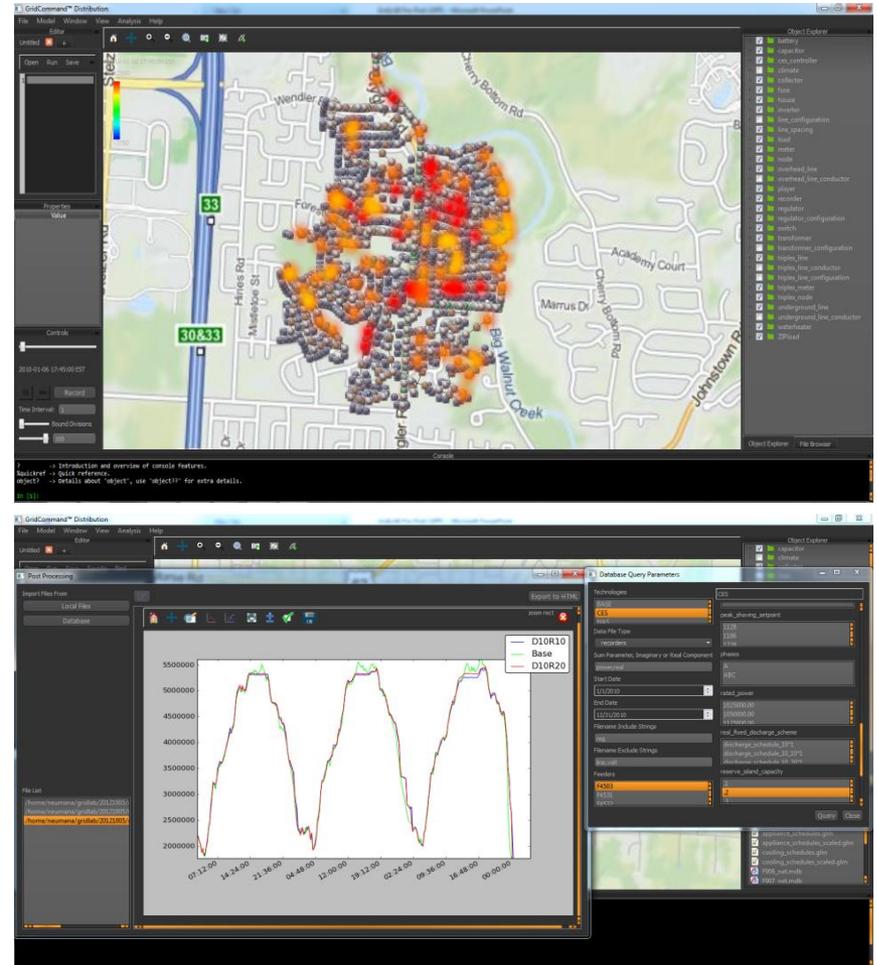
- Distributed energy

Resources

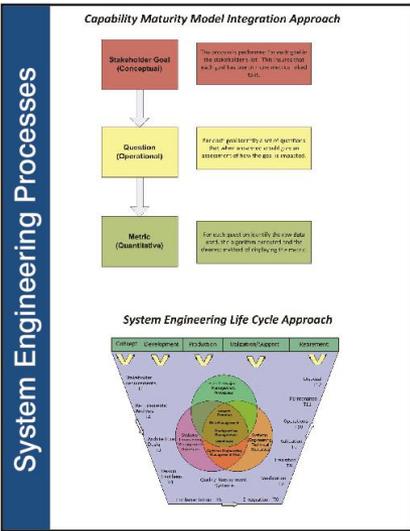
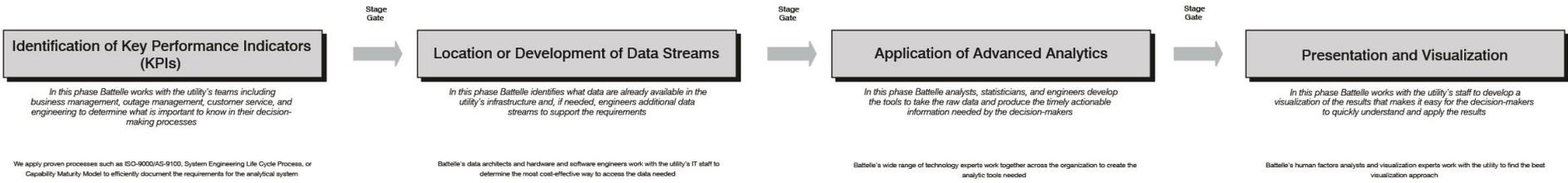
- Distributed Renewables (PV)
- Electric Vehicles
- Storage
- Distributed Generation

Control implementations

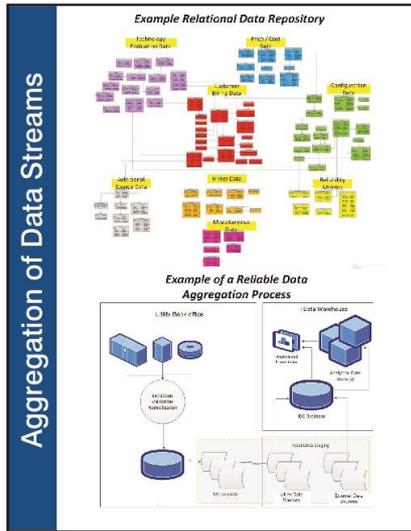
- Controls
- Volt-VAR.
- Capacitor banks
- Demand Response



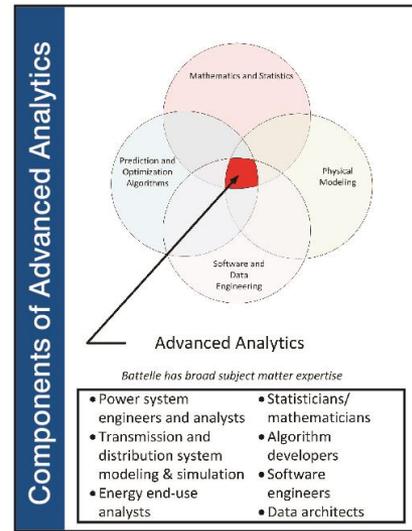
Grid Analytics and Visualization Advanced Decision Making Capability



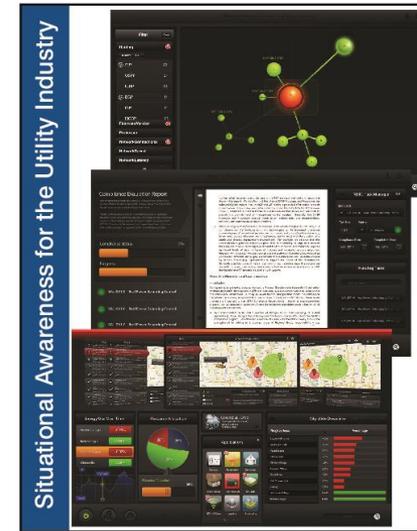
At the end of this phase, Battelle's engineers understand what information is needed to support the utility's decision-making process. This understanding is documented in the system requirements



At the end of this phase, the raw data needed are identified and available for use by the analytics



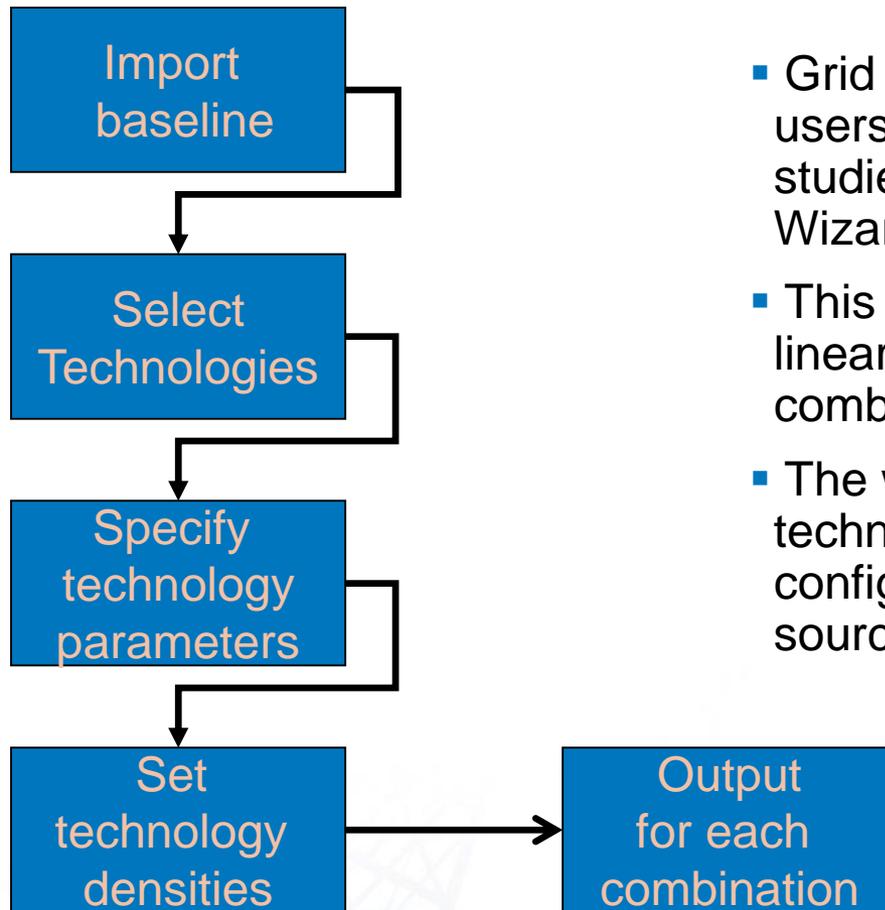
Battelle uses industry-standard tools, e.g., Agora and GridLab-D, for transmission system and distribution system modeling enabling predictive algorithms



Battelle uses available visualization products as well as custom-developed tools to ensure the information is easy to use without a long period of training

Leverage existing utility information systems to develop actionable information for decision support

Parametric Analysis Enables Efficient Exploration of Multiple Scenarios



- Grid Command Distribution allows users to quickly setup parametric studies using the Parametric Analysis Wizard
- This wizard generates a generalized linear model for every technology combination specified within minutes
- The wizard is highly configurable. New technologies can be added by editing a configuration file, it does not require source code modification

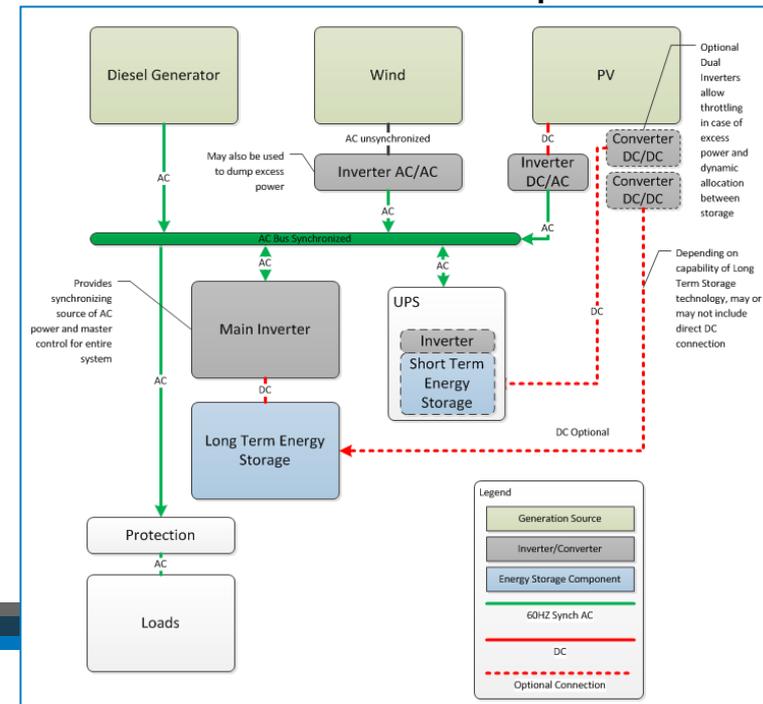
Microgrids, Renewables, and Storage

- Offerings support microgrid installations/evaluations:
 - Platform enables dynamic load management
 - Distribution Modeling to evaluate distributed energy resources (DER) and microgrid design and operations

- Additional Capabilities

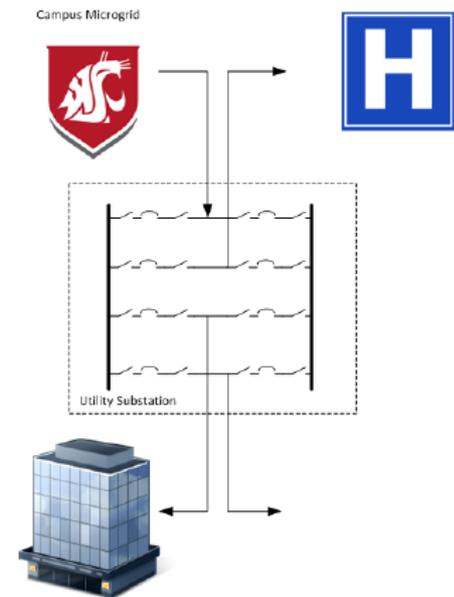
- Systems integration services
- Data analytics
- Technology evaluation
- Failure testing

Micro Grid Example



Case Study: Washington State University Microgrid

- Purpose of this project is to use distribution dynamic simulations to determine the capacity of microgrids to act as a resiliency resource.
- These simulations assist with the design and development of operational strategies.
- Operational generator tests, AMI diagnostics system are used to validate simulations.
- Assess in three parts:
 - 1) prevention – hardening the system,
 - 2) survivability – reacting to real-time events, and
 - 3) recovery – rapidly restoring end-user loads.
- Model dynamic impact of the transformer and line in-rush – essential to modeling microgrids as a resiliency resource.
- Examine models that also add value as a resiliency resource: customer resource, community resource, black start resource.





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