



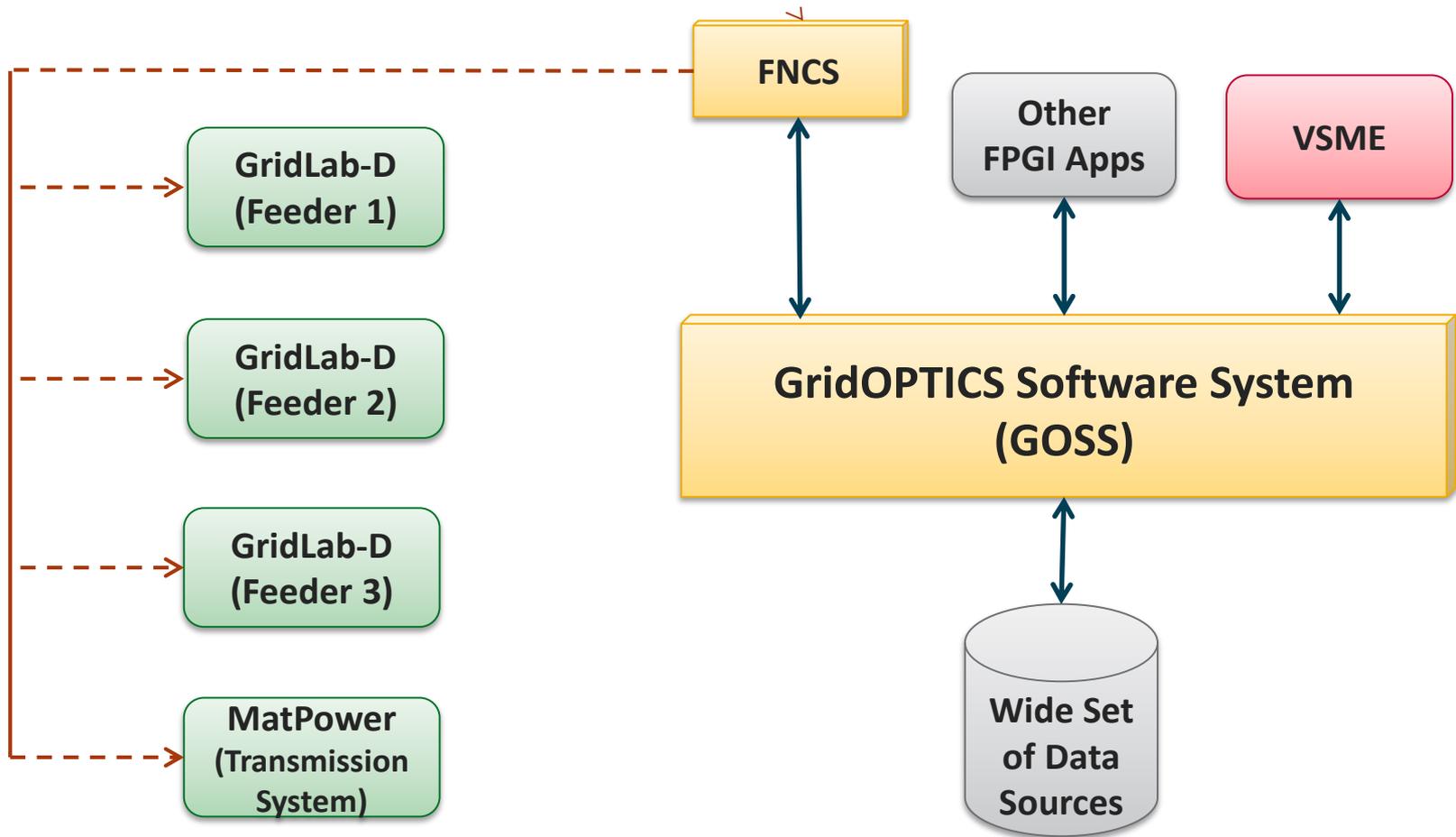
# Modular Visualizations for the Smart Grid: The Visual Steering and Modeling Environment

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- ▶ Develop **interactive visual analytics tools and environment** on top of GridOPTICS to support future power grid operations and planning, particularly in demand response and distributed energy resources:
  - Connect to ensemble of **FPGI models, applications, simulations, and sensors** that enact or simulate future power grid activities and processes such as transmission/distribution, demand-response, and network communications
  - Develop mechanisms, user interfaces, and visual methods to support the **computational steering** of power grid activities and processes (through their computational components)
  - Develop advanced **visual analytics tools** to view, monitor, analyze, and gather insights from power grid activities, processes, and data
  - Provide visual analysis **dashboards** that collect sets of visual analytics tools into common user environments to support situational awareness and decision-making
  - Allow users to construct and define **forecast scenarios** based on model and system parameters, data, and known contingencies
  - Drive visual analytics tool development by focusing on **demand-response use cases** to demonstrate applicability and usefulness of visual analytics tools and environment
  - Conduct **usability evaluations** of future power grid visual analytics tools and environment

# Integration with GridOPTICS and FNCS

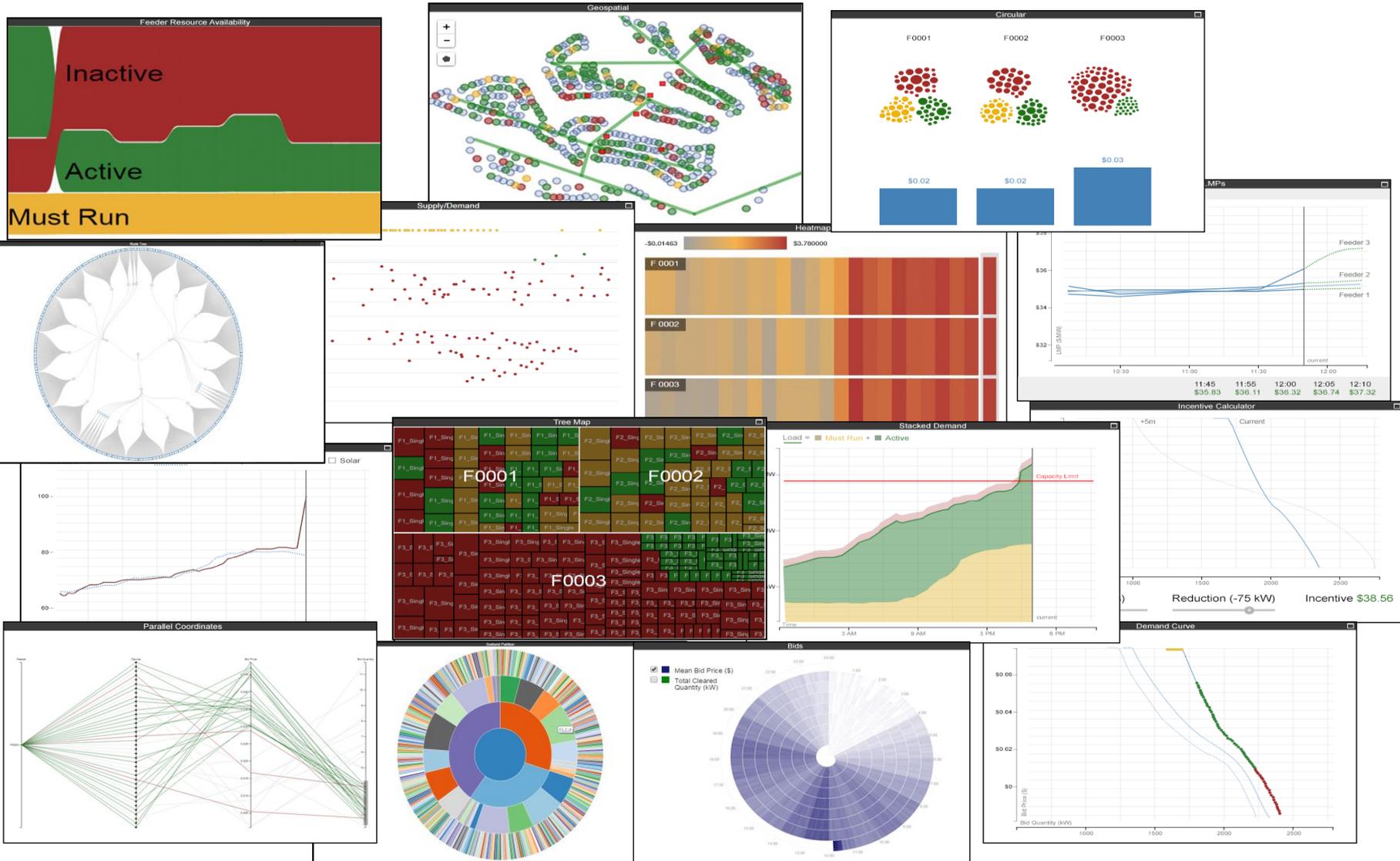


# VSME Dynamic Information Visualization Techniques and Tools



Pacific Northwest  
NATIONAL LABORATORY

Proudly Operated by **Battelle** Since 1965



# VSME Dashboard

00:12:05:00



**Settings** ▾

**Feeder**

F0001

**Categories**

- Unresponsive
- Must Run
- Active
- Inactive

**Generator**

- Generator 1 on off
- Generator 2 on off
- Generator 3 on off

**Simulator**

Temperature

Apply

Congestion

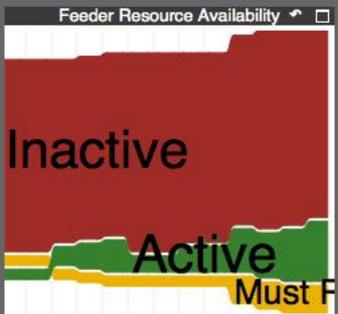
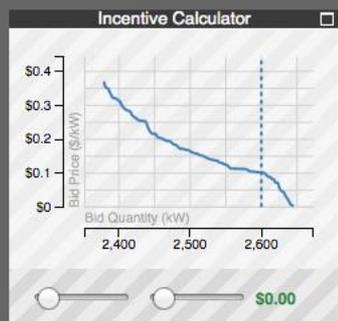
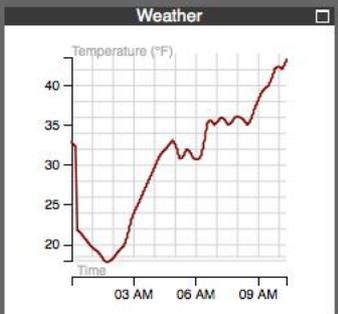
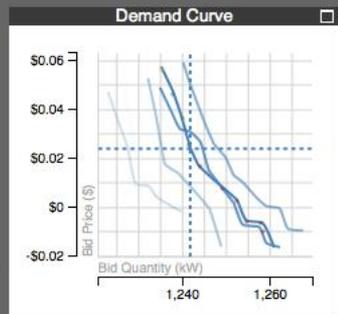
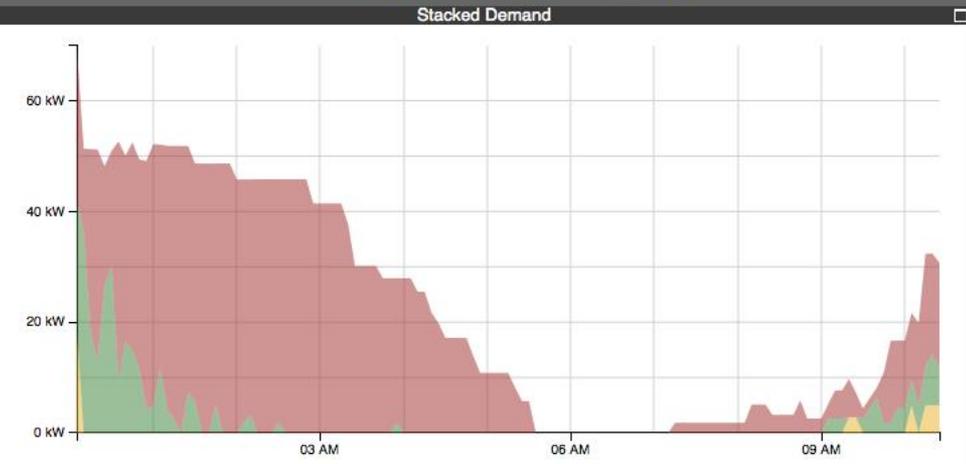
Apply

Incentive

Apply

Manage Widgets

Temperature: 43.41° Wind Chill: --- Wind Speed: --- Humidity: --- Rec. High: 43.41° Rec. Low: 17.85°



# Model Configuration

**SIMULATIONS SETTINGS** Apply and Restart

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**GENERAL**

Simulation Time  
May 3, 2015 9:00 AM to May 3, 2015 9:00 AM

Case Sub case  
Day ahead Wind ramp

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**MARKET**

Market Clearing Time (s) Price Signal Statistics (h)

Aggregators  
1 Aggregator

Aggregator Limits (MW) Price Cap (\$)

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**WEATHER**

Weather Data  
Hawaii

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**GENERATION**

Distributed Generation  
2 DG's (node 57 and 152)

Node 57			
Base Cost (\$/MW)	Incremental Cost (\$/MW)	Minimum Gen (MW)	Maximum Gen (MW)

Node 152			
Base Cost (\$/MW)	Incremental Cost (\$/MW)	Minimum Gen (MW)	Maximum Gen (MW)

# Scenario Testing and Visual Steering

**EVENT PARAMETERS**

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**MARKET**

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**RETAIL**

Incentive (\$)	Capacity Limit (kW)
<input type="text"/>	<input type="text"/>

**WHOLESALE**

Node	LMP (\$/MW)
<input type="text"/>	+ <input type="text"/>

---

**FAULT**

---

**RETAIL**

Trip Generator	Line Break
<input type="text"/>	<input type="text"/>

**WHOLESALE**

Trip Generator	Line Break
<input type="text"/>	<input type="text"/>

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**CAPACITY GENERATION**

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**DISTRIBUTION SIDE**

Solar (MW)	Wind (MW)
<input type="text"/>	<input type="text"/>

Diesel (MW)

- ▶ Selection of information visualization tools and composition of dashboard may be tailored to problem space, scenarios, and user preferences
- ▶ Information visualization tools link to data types rather than domain-specific fields. Allows flexible configuration of visualizations to different data streams.
- ▶ Computation may be separated from visualization rendering. Potential to enable to automated pattern discovery.

- ▶ Two-year visualization project coming to an end
- ▶ Plan to open source current version
- ▶ Looking to extend use case to cover more distribution system smart grid areas such as distributed generation, storage, wind, PV, electric vehicles, etc.
- ▶ Looking to provide more scenario management capabilities