ProsumerGrid™

Software for Planning & Optimal Coordination of Distributed Energy Resources

DER Planning and DSO Simulation Studio

Integrated Grid Planning Symposium

November 16th, 2017

Key Themes for Today

1	• *Company Background*
2	• Modeling the Integrated Grid
3	• Sample Analyses

About Us

Startup company based in Atlanta, with origins at the Georgia Institute of Technology.

Incorporated in 2014 to develop and commercialize innovative *Software for Simulation, Planning, & Optimal Coordination of Distributed Energy Resources.*

Leading multidisciplinary research (2009-2017) in areas of:

- Power Systems Modeling and Operations
- Networked control
- Stochastic Optimization
- Visualization
- Integration of Renewables
- Power System Economics
- Co-Simulation of Cyber-Physical Systems

Our History

2011-2014

Background research on Power Systems, Electricity Markets, Decentralized Grid Optimization

Fall 2014 I-Corps

100 interviews to validate our value proposition

June, 2016

ARPA-e Grant

DER/DSO Simulator

Spring 2014

DOE ACC Clean Energy Challenge Winner

May. 2015

Multi-Scale Power Systems Project

October 2017

Demonstrating our solutions with utility data

+15 Electric Utility Partners
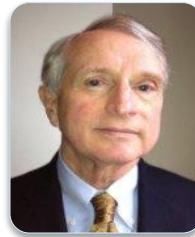
Our Founding Team

A multidisciplinary team

Santiago Grijalva, PhD (CEO)
Future Electricity Grids
- 20+ years of industry experience
- ECE Professor, Georgia Tech
- Former Center Director NREL
- Contributed to PowerWorld

John Higley (CFO)
Industry Engagement
- Retired Managing Partner for Deloitte's Global Energy & Utilities
- Former EVP at EMA
- Contributed to PROMOD

Shabbir Ahmed, PhD (VP R&D)
Stochastic Optimization
- ISyE Professor, Georgia Tech
- Former Chair of Stochastic Prog.

Umer Tariq, PhD (Software Arch.)
Cyber-Physical Systems
- PhD ECE, Georgia Tech
- Federated Co-simulation

Magnus Egerstedt, PhD
Networked Control
- ECE Professor, Georgia Tech
- Expert on distributed controls

Marcelo Sandoval, MSc, MBA (COO)
Power System Planning, Ops. & Control
- Former Electrical Engineer at ABB, Intel, Eaton Grid Tie Solar Team.
- ECE PhD Candidate

Our Partners

- **Strategic partners** to help address the complexity of DER integration & DSO/DSP activities.
  - Major DSO/DSP efforts in NY and CA
  - Major utilities in NY and CA provide realistic data, use cases, feedback

- **Newport Consulting** provides unique business strategy advice & strategic connections.

- **NYSSGC** has enabled a unique collaboration with National Grid, Con Edison, and Avangrid.

- **NRECA** provides a unique partnership channel to more than 800 electric cooperatives.

Key Themes for Today

1 • Company Background

2 • *Modeling the Integrated Grid*

3 • Sample Analyses

The Challenge

- The electric grid is transforming into a more sustainable and customer-oriented model where Distributed Energy Resources (DERs) become the center of electric grid planning and operations.

| Solar PV	Distributed Energy Storage	Distributed Generators	Electric Vehicles	Demand Response

- Investment decisions involve $1.5 trillion in the U.S. 2010-2030.*

- Electric utilities, regulators and energy service companies require better software tools to simulate, plan, and coordinate the operation of large numbers of intermittent DERs.

Our Solution

A software platform that allows electric utilities to simulate, plan, and optimally coordinate thousands of distributed energy resources (DERs)
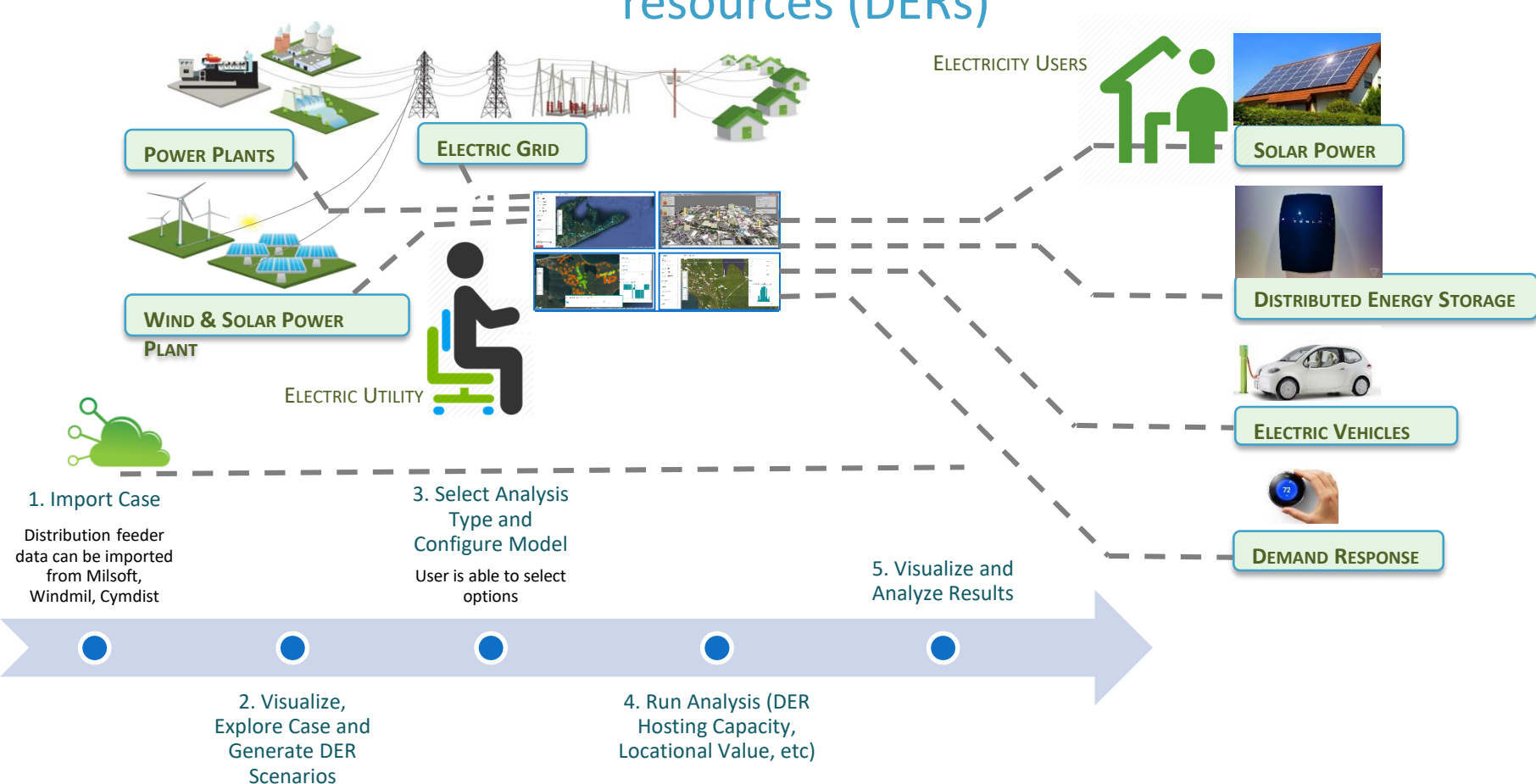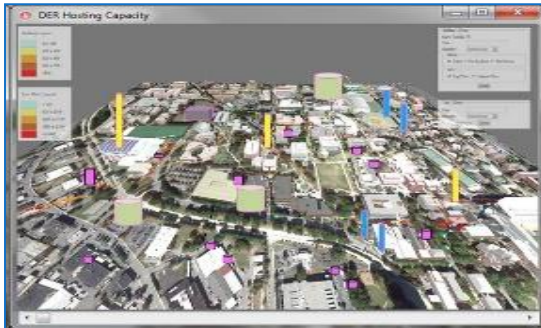
Our Approach

ProsumerGrid uses advanced optimization, co-simulation of physics and market constraints and user-friendly visualization to develop an interactive, multi-agent software capable of simulating the integrated T&D+DERs impacts at the physical, information, and market levels.
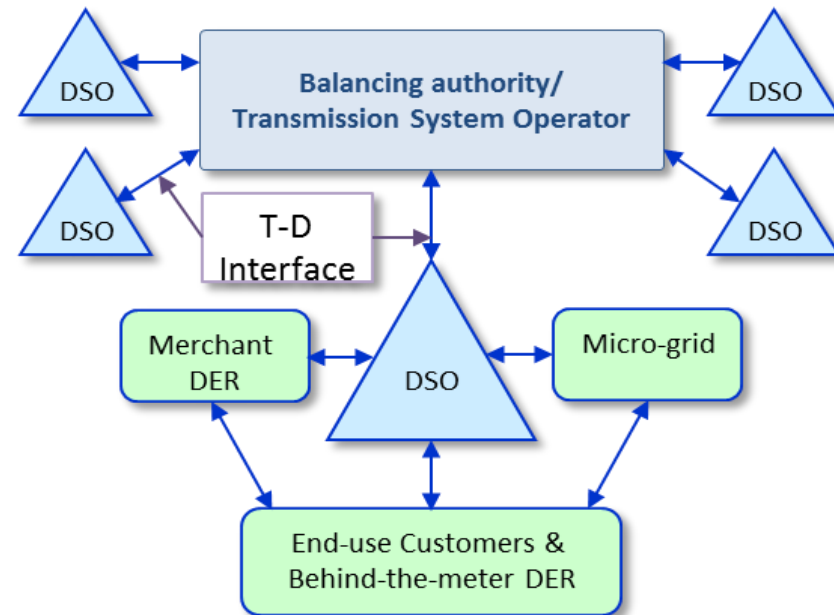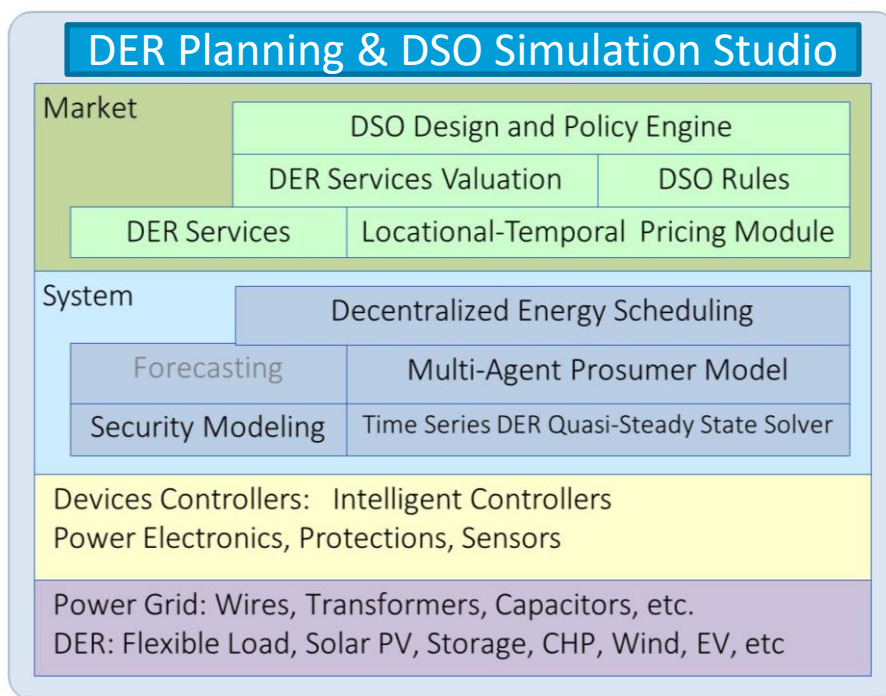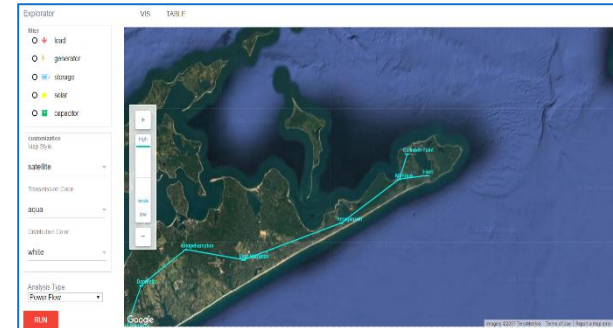
Capabilities: Long-Term Planning Analyses

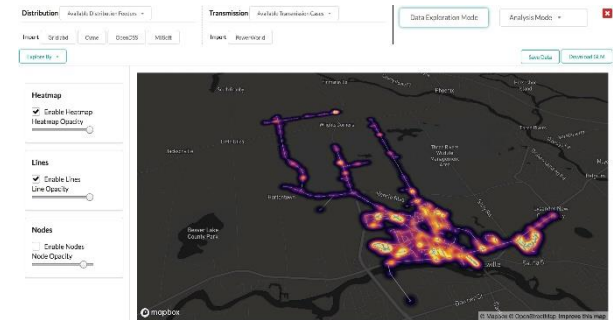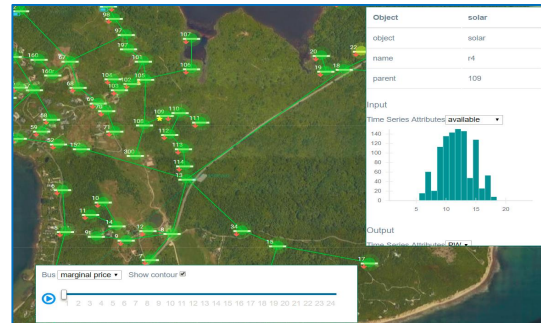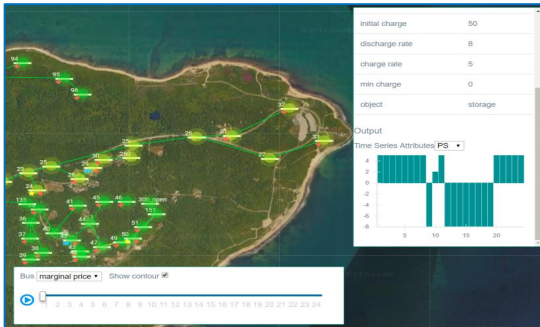| DER HOSTING CAPACITY ANALYSIS TOOL	DER LOCATIONAL VALUE & NWA ANALYSIS TOOL	INTEGRATED T&D+DER SIMULATION
HOW MANY DERs CAN BE INSTALLED IN A DISTRIBUTION CIRCUIT?	CAN DERs HELP TO AVOID EXPENSIVE CAPITAL INVESTMENTS?	WHAT ARE THE INTEGRATED T&D IMPACTS?

Capabilities: Operational Planning Analyses

Optimal dispatch DER Distribution Services

How to optimally coordinate DER?

## Aggregation of DER for Transmission Sim

How to aggregate DER services to the transmission system?

Design of DER Services & DSO Markets

How to Design Distribution Level Markets, Services, Incentives?

Unique Features

- Geo-Referenced, Interactive Visualization

- Simulation of multi-agent interactions: microgrids, aggregators, DSO/DSP, ISO.

- Decentralized energy scheduling of DER-rich systems of arbitrary size.

- Explicit modeling for transaction of DER-based energy services (timescales can go from seconds to years).

- Analytics for valuation of DER services and utility business models.
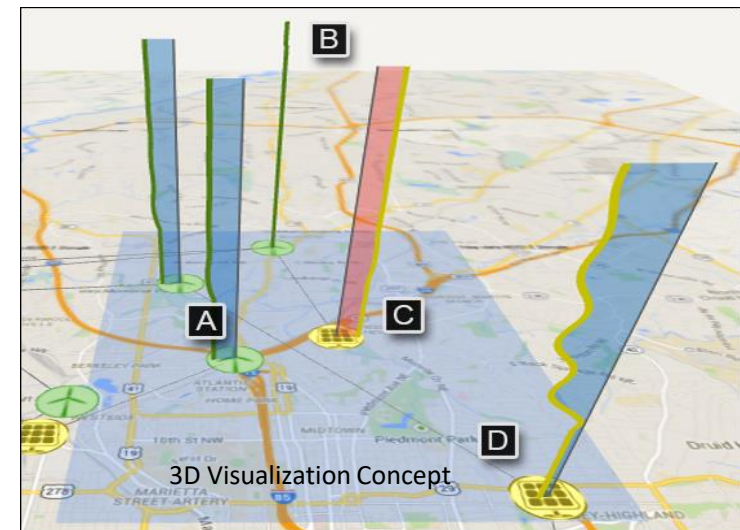
3D Visualization Concept

Key themes for today

1 • Company Background

**2** • Modeling the Integrated Grid

3 • *Sample Analyses*

Data & Use Cases

- **Established formal partnerships with more than 15 Electric Utilities and Coops.**

- We are helping utilities design roadmaps, define use cases and perform analysis.

- Demonstrating solutions with realistic data-sets.
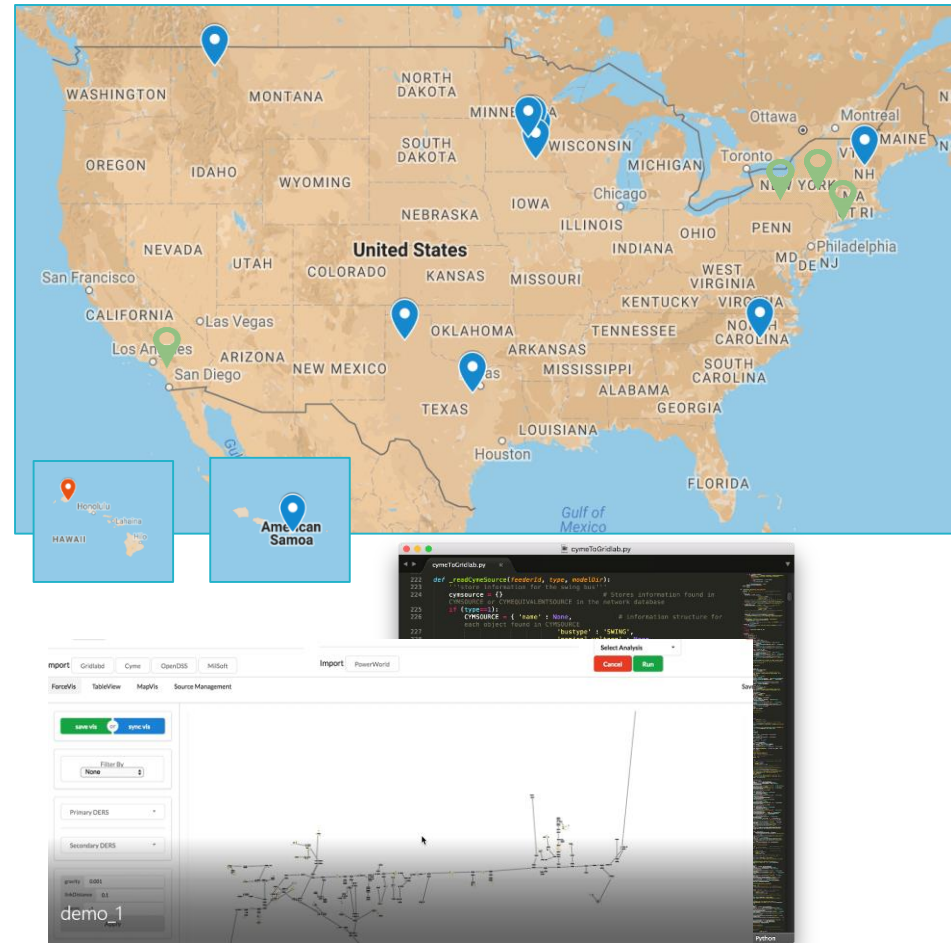
Advanced Visualization

- **Geo-Referenced, User-Friendly, Interactive Visualization**

- Web Based Visualization
  - 2D edit view, 2D map, 3D map
  - Interactive, user friendly

- Data Management
  - Able to read system models in many industry-used formats (CYMDIST, MILSOFT, OpenDSS, GridLAB-D)
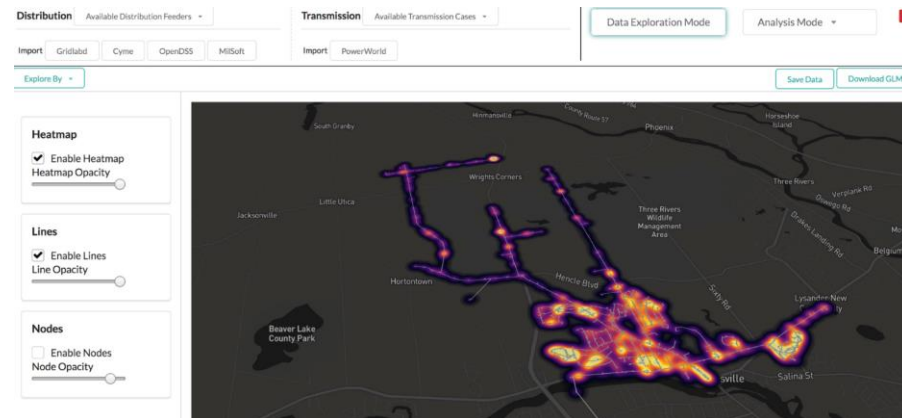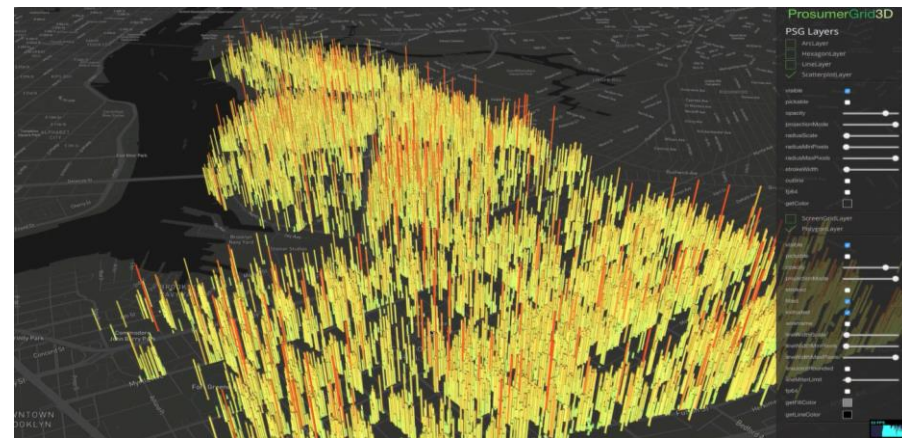
DER Hosting Capacity Analysis Tool

- **Supports interconnection studies of arbitrary combinations of multiple types of DER, in complex distribution systems**

- Seamless selection of DER penetration options.

- Interactive, 3D Visualization and Analytics

DER Locational Value & NWA Analysis Tool

- **Enables to model, assess and potentially recommend DERs as non-wire alternatives to distribution upgrades**

- Integrated (combined and simultaneous effect) of various DER

- Consideration of physical, market, DER & T&D constraints.

- Economic optimization of DER operation

- Locational and temporal specificity (multi-years at 1 hour granularity at specific feeder location)
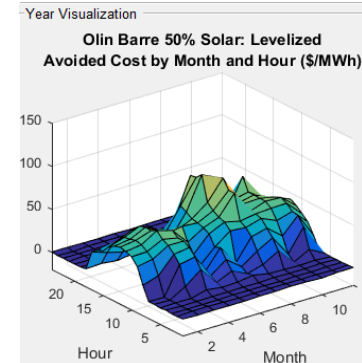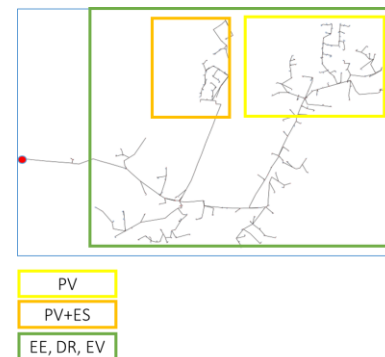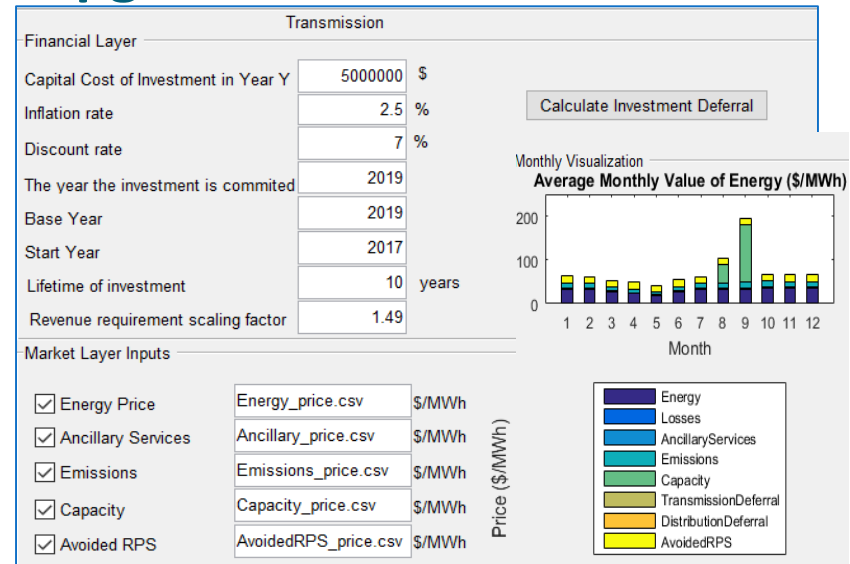
Integrated T&D+DER Analysis Tool

- **Enables a combined transmission and distribution modeling to analyze the impact of DERs to the distribution, sub-transmission, transmission grid**

- Medium case:
  - WECC model obtained from the CAISO is utilized for transmission.
  - 240 buses (half of the buses in CA)
  - 143 generators, 139 loads (20 loads are distribution models)

- Large case:
  - Transmission: 2000-bus case
  - Distribution: D1 (14,450 nodes), D2 (8,500 nodes), and D3 (250 nodes) for 100 buses, 100+ DER per feeder
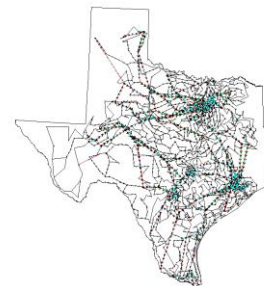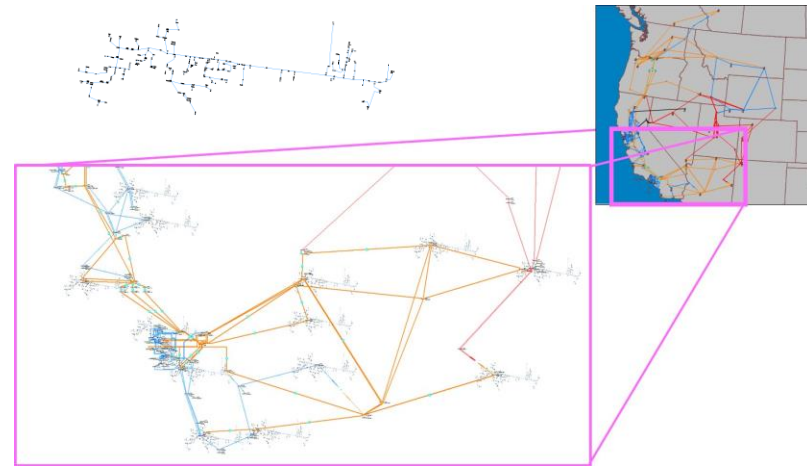
| Number of Devices in Case			
Buses	2007	Trans. Lines (AC)	2481
Generators	282	Series Capacitors	0
Loads	1417	LTCs (Control Volt)	0
Switched Shunts	41	Phase Shifters	0
2 Term. DC Lines	0	Mvar Controlling	0

DER Optimal Dispatch Simulation

- **Advanced Stochastic Optimization determines the minimum-cost schedule of energy operations of a set of DERs**

- Decision variables examples: energy storage (charge discharge), solar PV curtailment, demand response, generator output.

- Sample analysis: Quantifying benefits of energy storage for arbitrage, peak demand reduction, ISO bidding and asset upgrade deferral
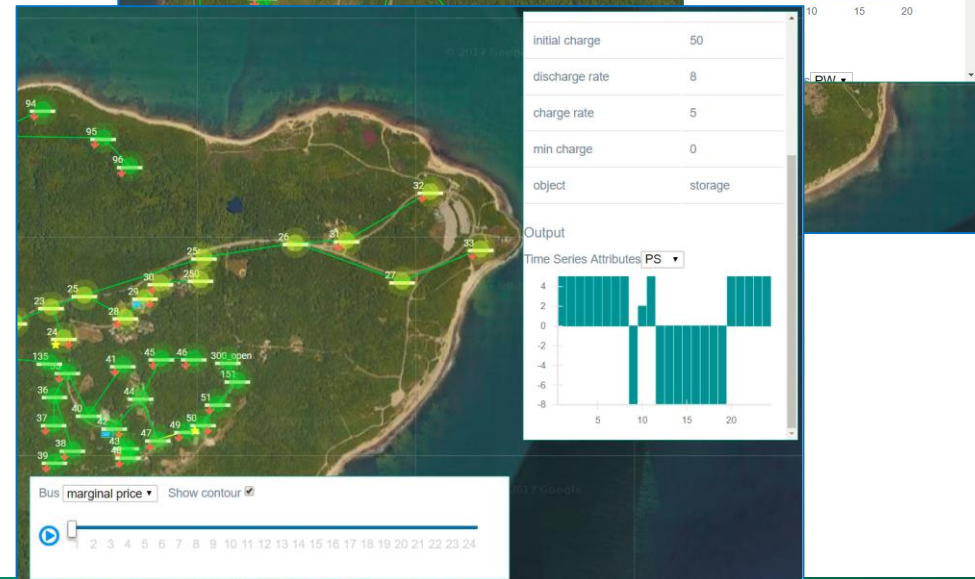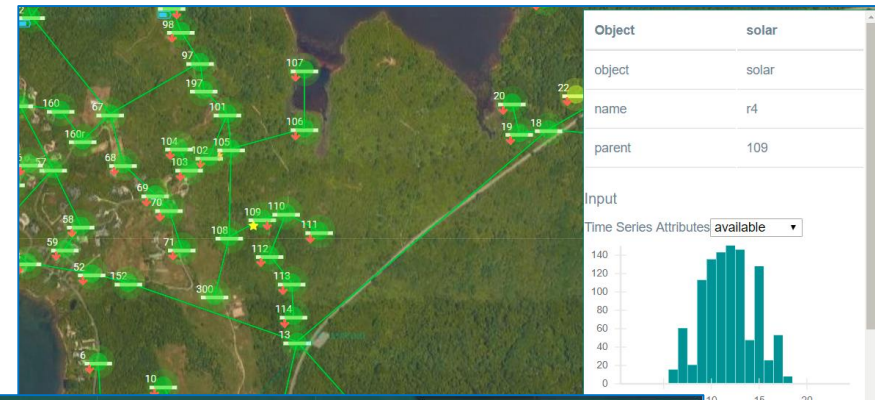
DER Services Pricing or Incentive Signal Design

- **The pricing module uses the optimization module to determine the locational and time-vector marginal prices.**
- Visualization of marginal prices for energy derived from the optimization formulation
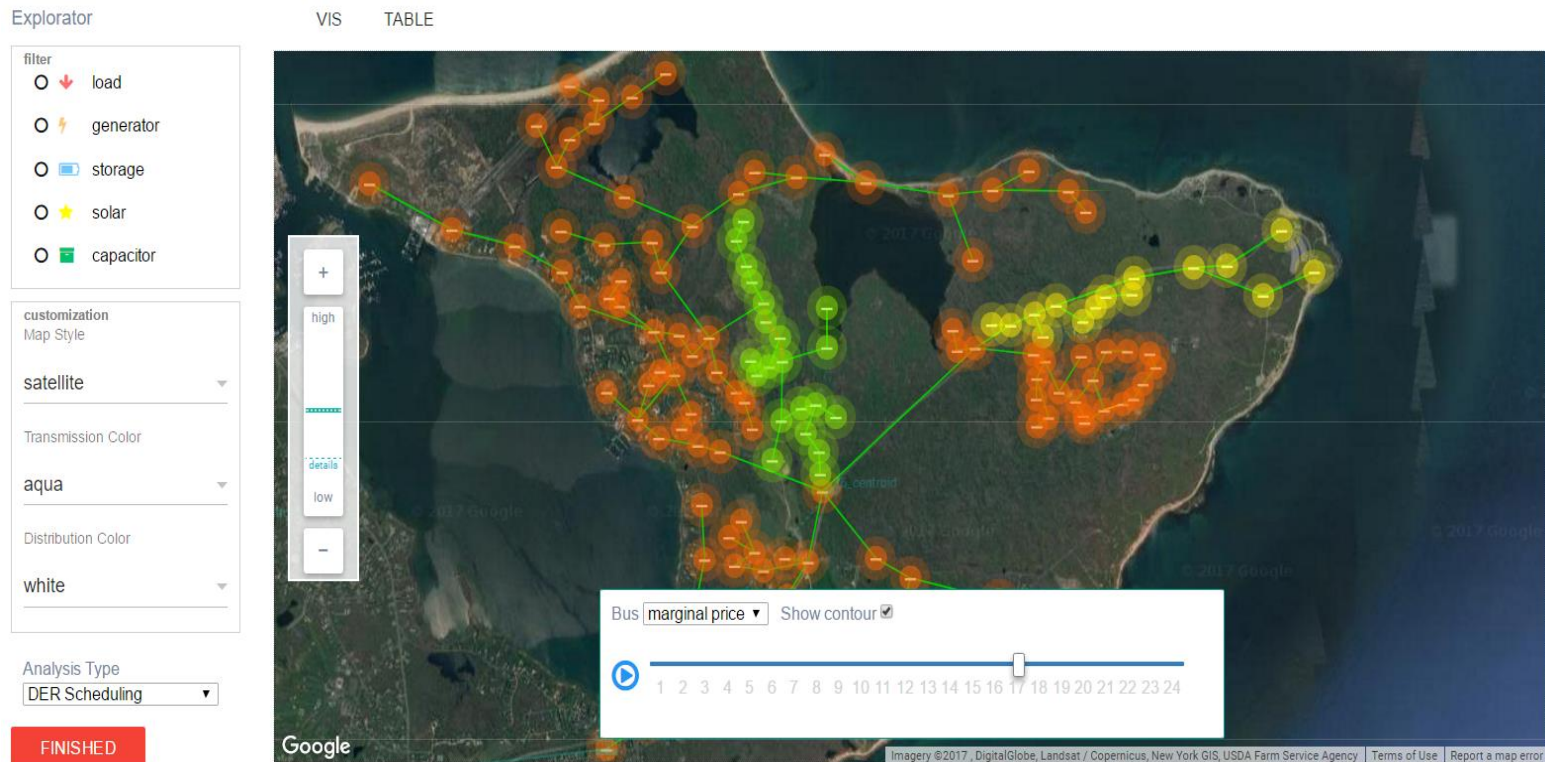
Capabilities Summary

- 1) Web Based Visualization
  - 2D edit view, 2D map, 3D map
  - Interactive, user friendly
- 2) Data Management & Power Flow Simulation
  - Able to read system models in many industry-used formats (CYMDIST, MILSOFT, OpenDSS, GridLAB-D)
  - Able to setup T&D time-series simulation (GridLAB-D, MATPOWER)
  - Able to set up DER optimization studies and conduct energy scheduling related analysis.

- 3) Analysis
  - Integrated T&D DER Analysis
    - Time-series, Multi-DER Impact Analysis
  - DER Non-Wire Alternative Assessment
    - DER Optimization for NWA Evaluation
    - DER Portfolio Assessment and Valuation
  - DER Hosting Capacity
  - DER Coordination through Portfolio Optimization

Thanks

CONTACT US

info@prosumergrid.com

Learn more: www.prosumergrid.com