U.S. DEPARTMENT OF ENERGY

Distribution Grid Locational Performance Modeling

Developing an Integrated Modeling Tool for Regulation

Phase I – Scoping and Proof of Concept

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INTERNATIONAL DISTRICT ENERGY ASSOCIATION

mrc Microgrid Resources Coalition

Problem Statement

Research at LBNL

DER deployment with respect to different stakeholders in the grid space:

- customer adoption
- economic dispatch
- grid planning

This Project

Recognize locational value of DER

Impact of tariffs on placement, sizing, and operation of DER in distribution networks

Trade-off between utility and customer investment

Problem Statement

DER value proposition can be partially assessed with current tools and practices

- DER economics
- build-out scenarios
- grid impacts

No integrated tool is available to understand how economic signals may influence and leverage DER adoption and inform / help utilities in distribution system planning

Approach

Leverage capabilities to develop an **Integrated Modeling Tool** to address gap

Build modeling framework to assist in regulatory proceedings

- Distributed resources plans
- Resource requirements (RPS, AEPS, EEPS, …)
- Rate cases

Better informed decisions will generate benefits across stakeholders

Approach

Develop the **Integrated Modeling Tool** around following requirements:

- long-term analysis compatible with different regulatory proceedings
- estimate DER deployment based on economic signals
- conduct power flow analysis of the distribution system
- consider economics of grid planning and operations
- wholesale market integration

Status: scoping and prototype development

Phase I - Demonstration / Proof of Concept

Demonstrate how tariffs can be used to influence:

- DER deployment
- DER operations
- grid conditions (voltage, line loading)

Develop software prototype

- leverage **DER-CAM**
- integrate with distribution power flow tool
- develop capabilities to study sensitivity to tariff modifications

Carry out representative case study

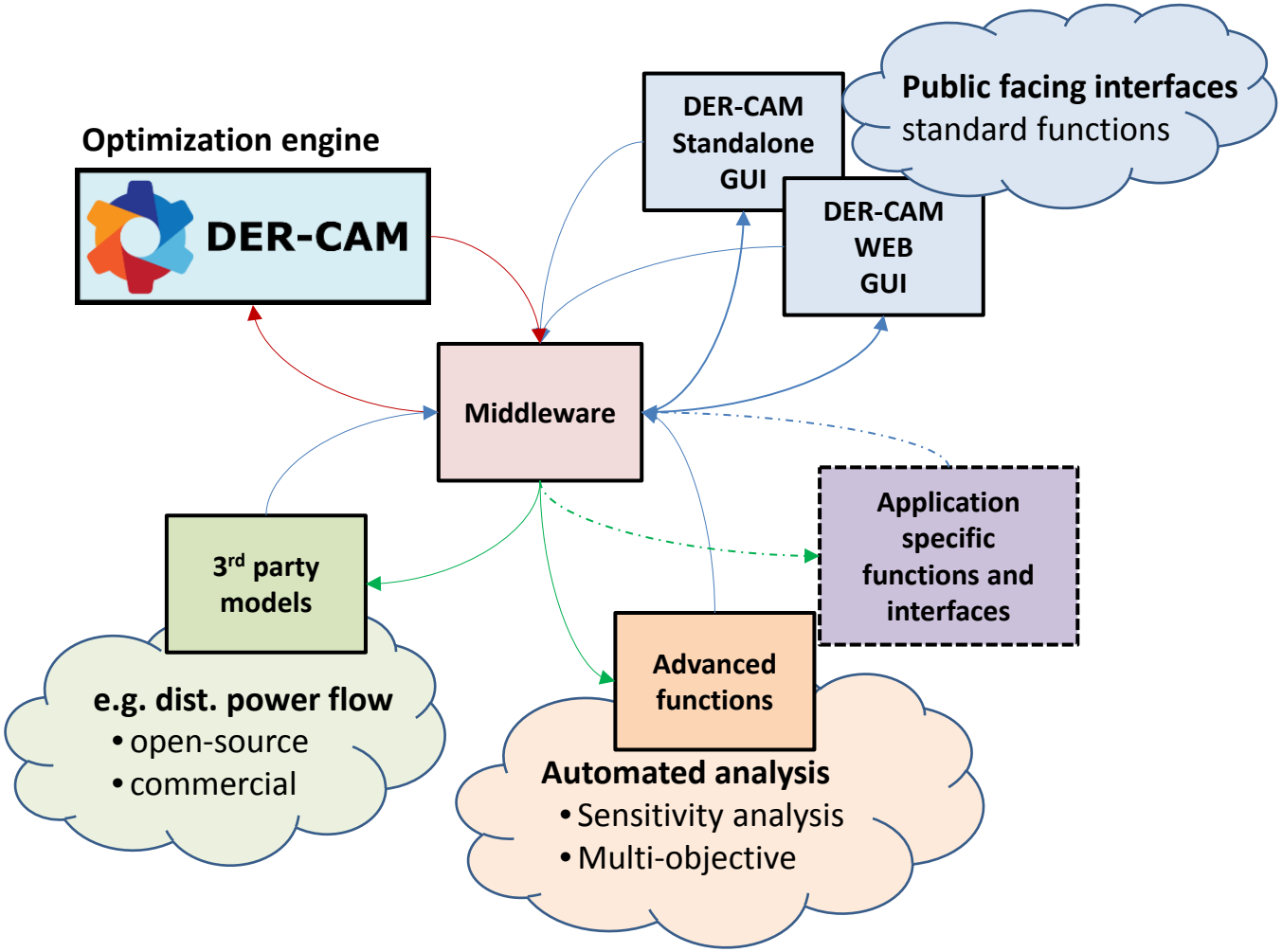
- analyze impact of modifying TOU rates

Distributed Energy Resources – Customer Adoption Model (DER-CAM)

State-of-the-art decision support tool for decentralized energy systems

- Free state-of-the-art mathematical optimization tool
- Finds simultaneously the optimal portfolio, sizing, placement, and dispatch of DER in buildings and microgrids
- Flexible objective definition (or multi-objective)
- Co-optimizes multiple stacked revenue streams (self-generation, load shifting, peak shaving, net-metering, feed-in, ancillary services)
- Grid connected and islanded operation (including load prioritization and curtailment)
- Multi-node, multi-energy systems (electric, cooling, and heating loads)
- Includes power-flow and heat-flow constraints
- Supports N-1 security-constrained design

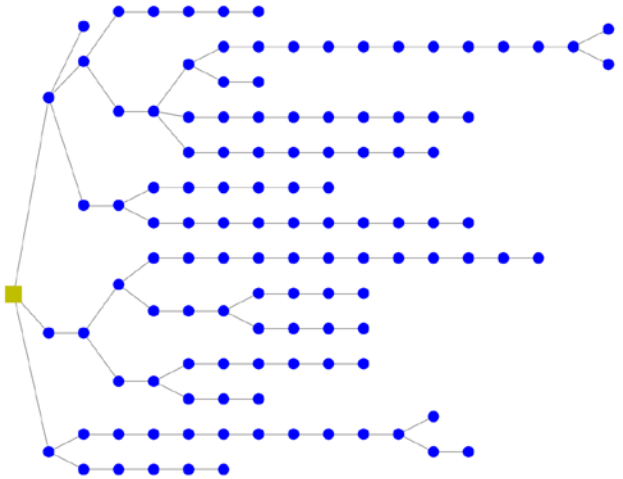
Distributed Energy Resources – Customer Adoption Model (DER-CAM)



Case Study

Datasets

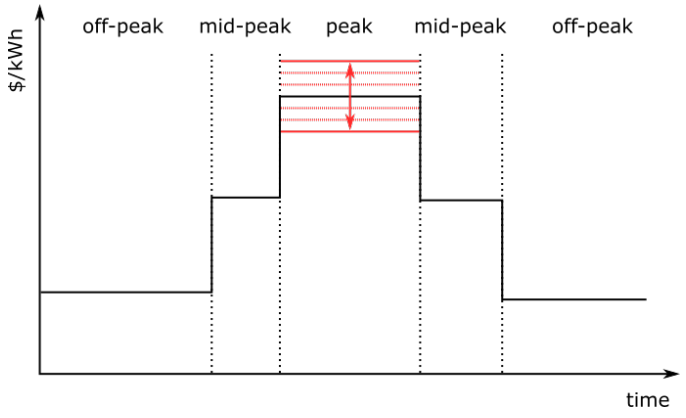
- Standard test feeder (radial 119 bus)
- DoE building energy load datasets
  - Residential Energy Consumption Survey
  - Commercial Reference Building Models
- CBECS and U.S. Census data
- TMY weather data
- DER techno-economic data
- PGE tariffs



Case Study

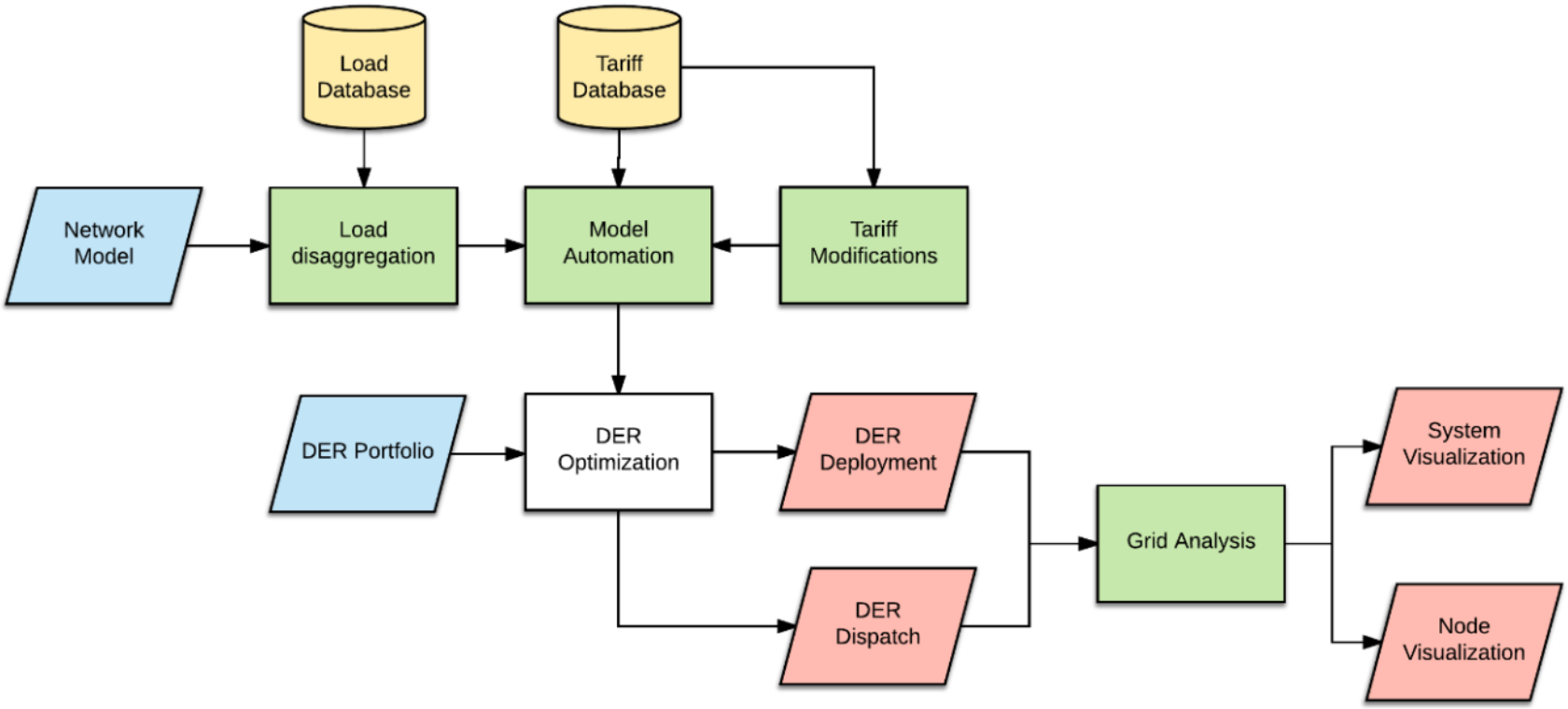
Sensitivity to TOU (peak)

- DER deployment
- DER operations
- Grid impacts

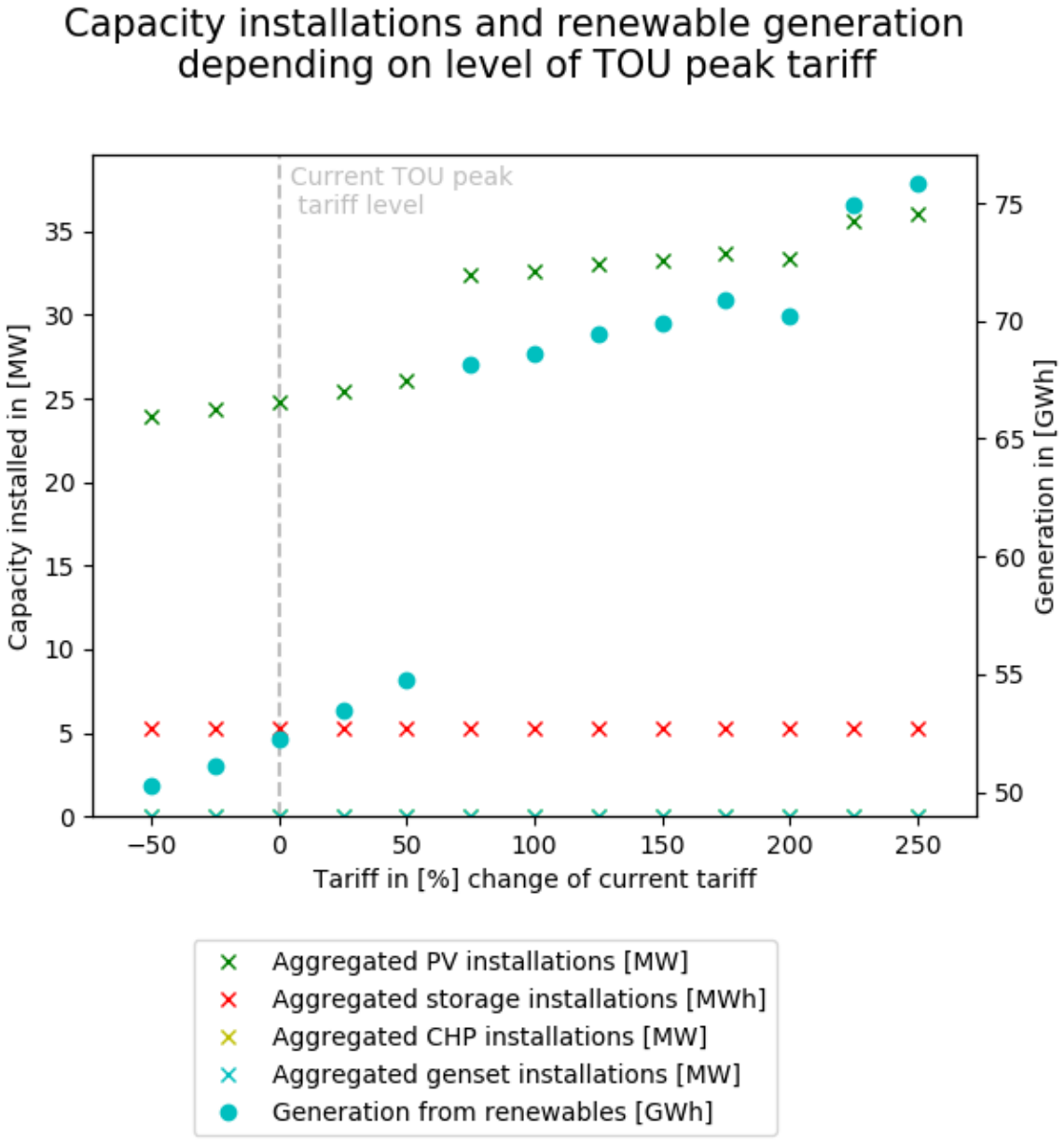


Case Study

Prototype model components & Workflow



Integrated Modeling Tool



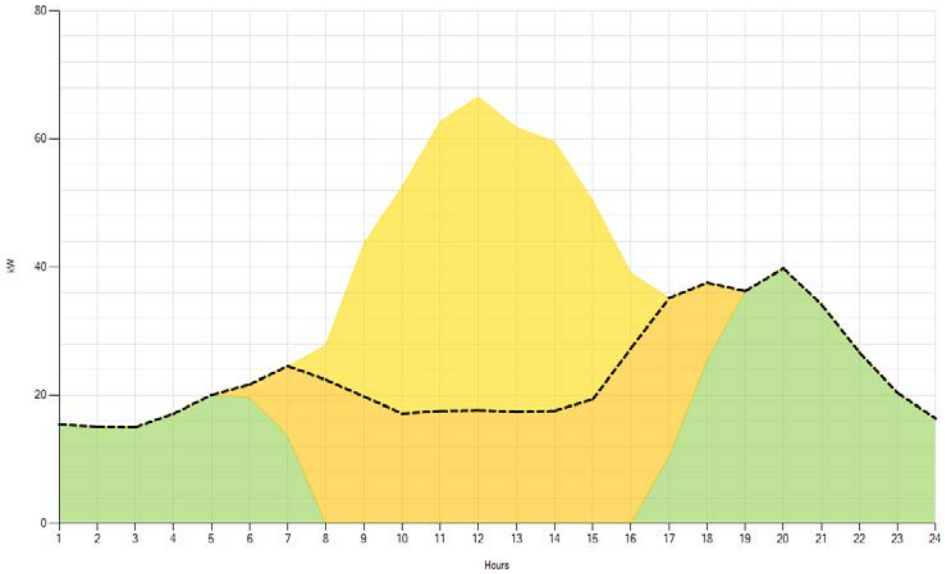
Aggregate DER deployment

Example

System wide PV deployment in response to increased peak TOU rates

Note: Sensitivity to a specific tariff can be evaluated while considering broader system, i.e., other customer classes and tariffs

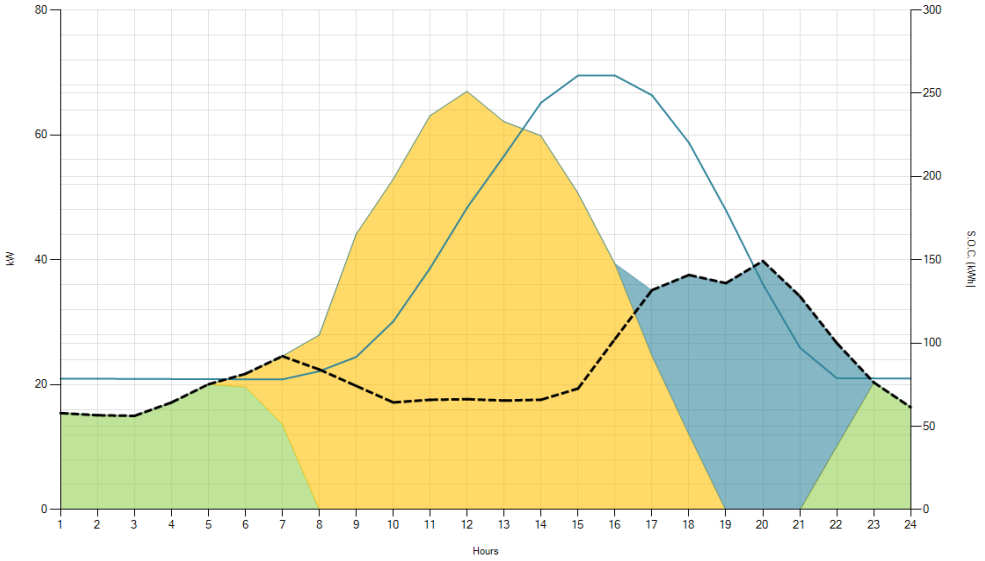
Integrated Modeling Tool



[Midrise apartment, May]

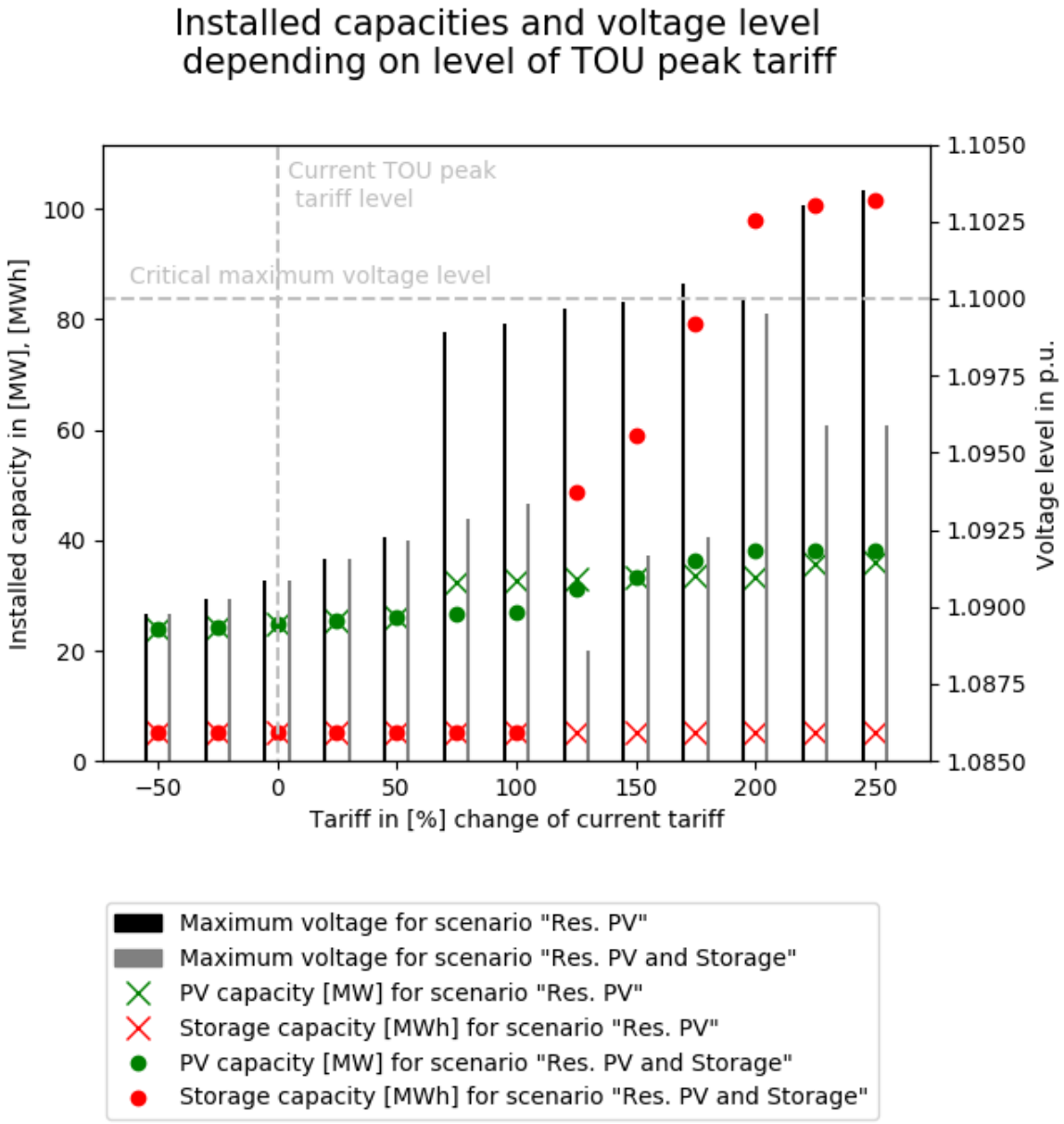
DER operations

Example
Impact of tariffs in power injection levels



Estimate sensitivity of specific customer segments to changes in tariffs

Integrated Modeling Tool



Grid impact

Example

Impact of combined PV and storage on maximum voltage levels

Integrated Modeling Tool

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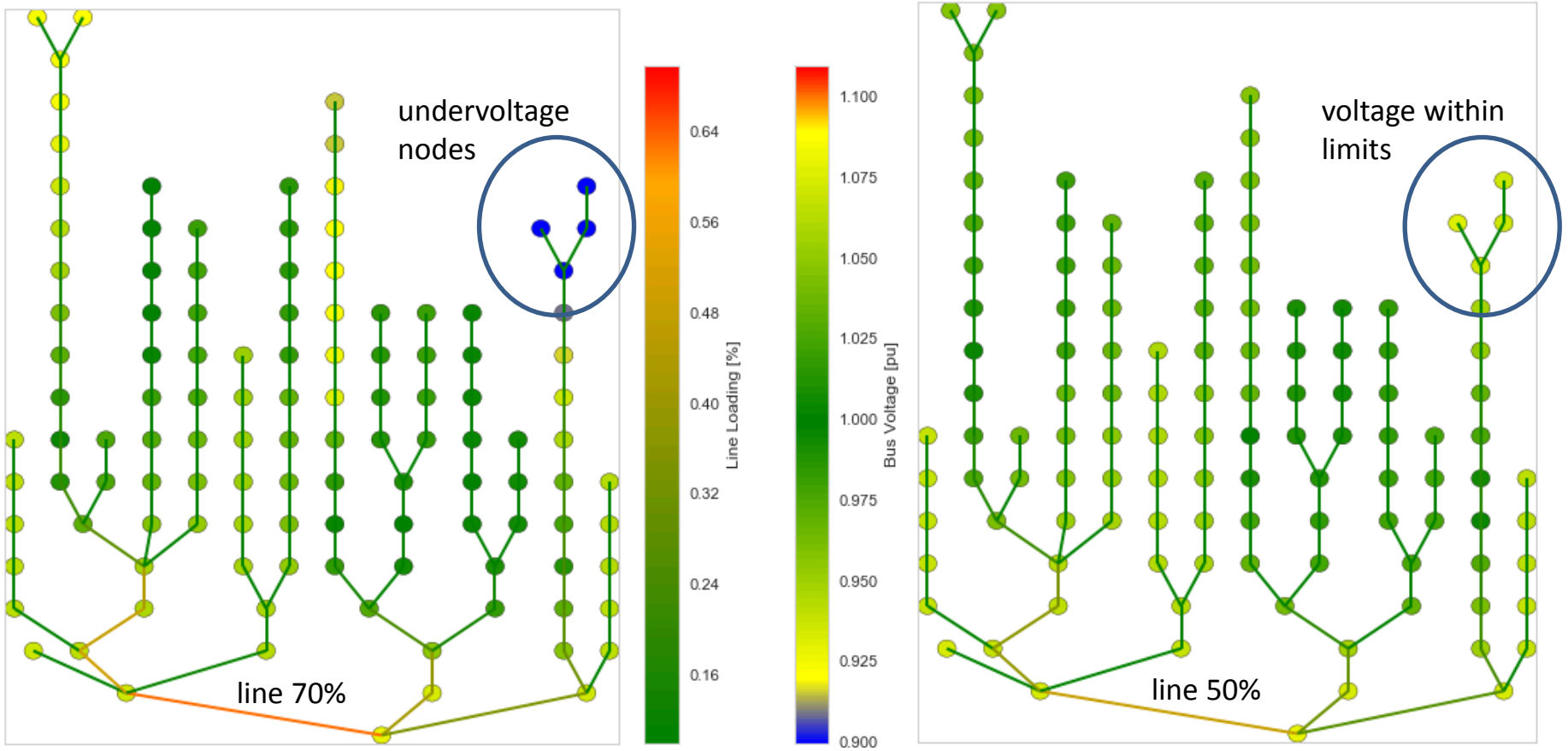
No DER allowed

With DER investments



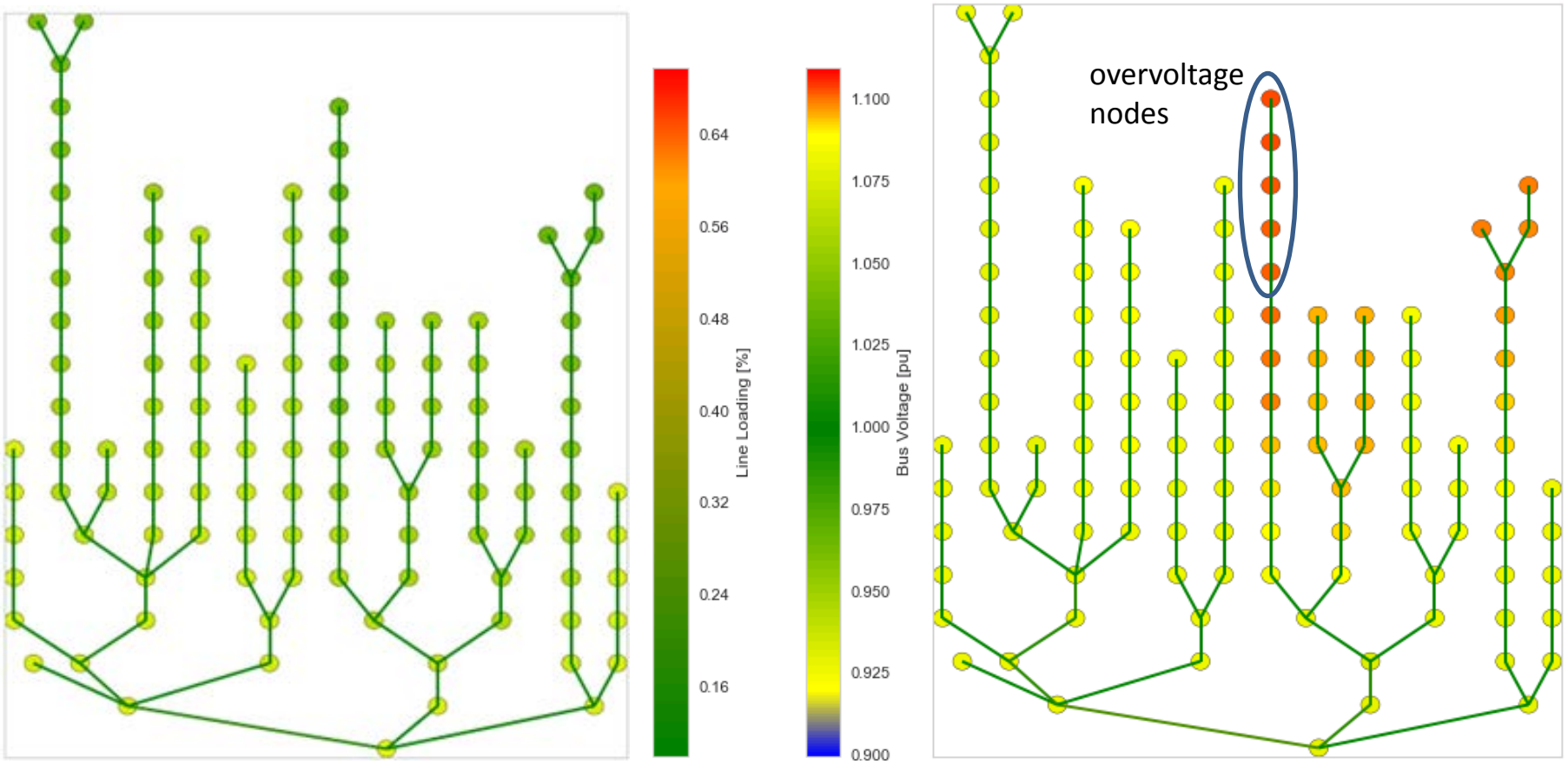
[July, peak, 5pm]

System-level visualization of grid impact on voltage levels, line loading

Integrated Modeling Tool

No DER allowed

With DER investments



[May, weekend, 12pm]

System-level visualization of grid impact on voltage levels, line loading

Integrated Modeling Tool

Outlook

- Multi-year planning capabilities
- Extend power flow capabilities (OPF, network expansion)
- Locational valuation metrics: avoided costs
- Load data analytics

ACKNOWLEDGMENT

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Discussion

https://building-microgrid.lbl.gov/

https://gig.lbl.gov