NREL Transforming ENERGY

Grid Modernization of Cooperatives and Municipal Utilities via Breakthrough System Monitoring, Control and Optimization

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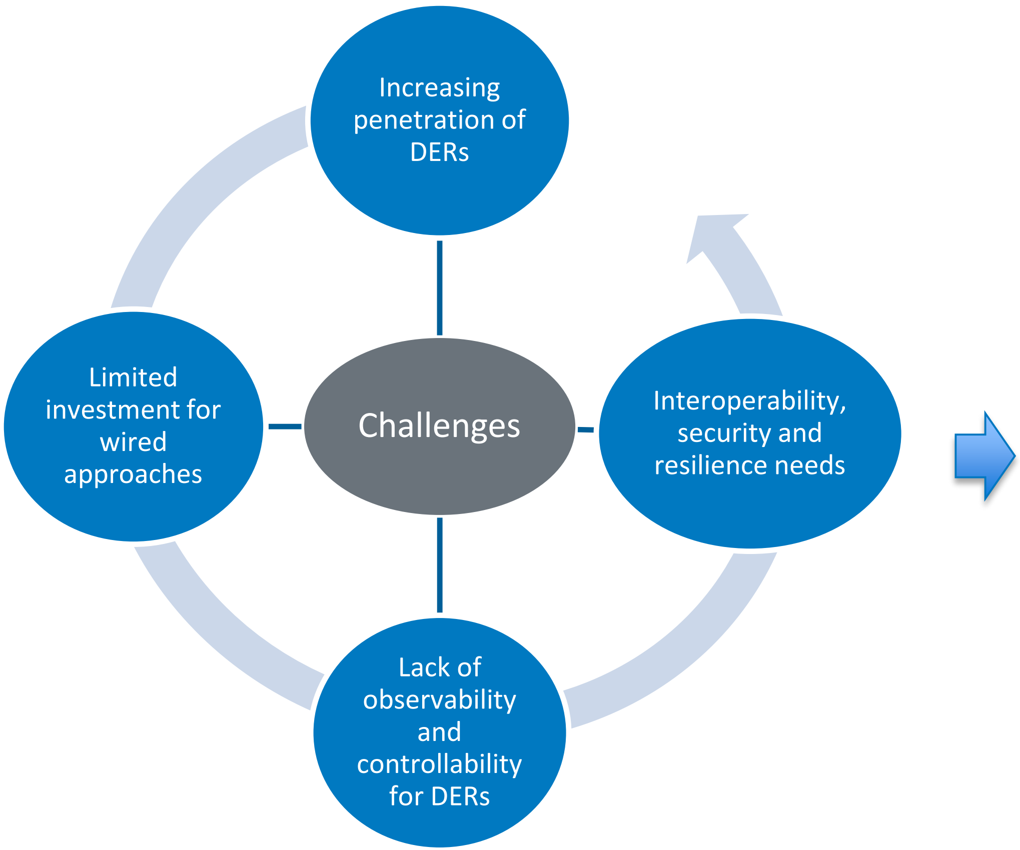
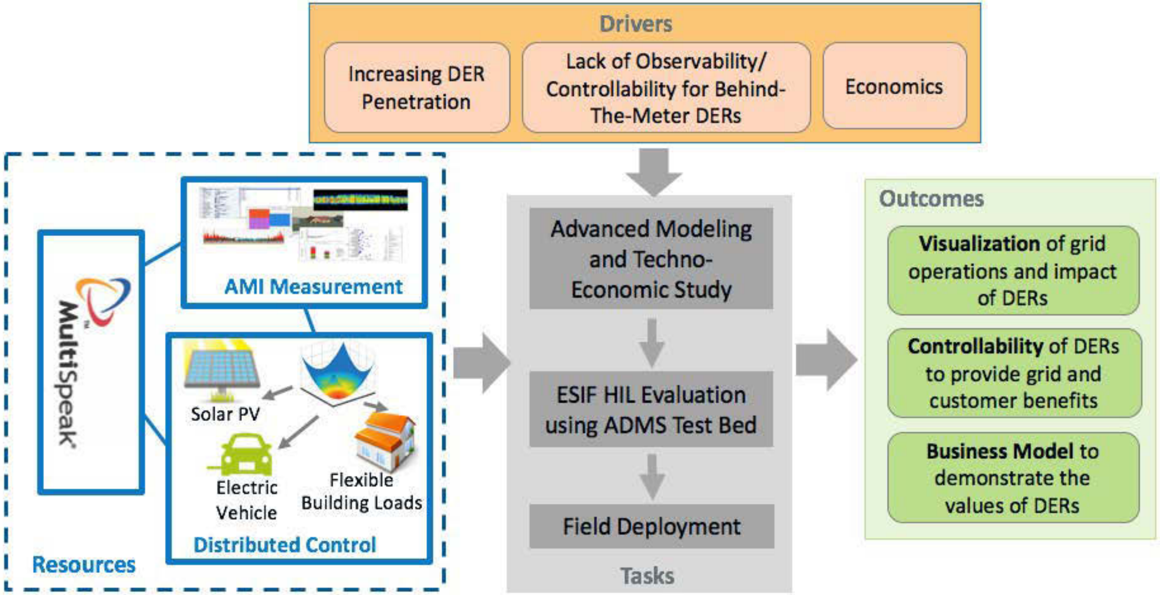
State-of-the-Art



NEEDS:

- **Visualization** of grid operations and impacts of distributed energy resources (DERs)
- **Controllability** of DERs to provide grid and customer benefits
- **Business Model** to demonstrate the value of DERs
- **Pilot Demonstration**

Project Overview



- Develop and validate new grid visualization, control paradigms, and business models for Holy Cross Energy (HCE) through integration of grid-friendly intelligent DER assets.

Project Impact:

- Enable cooperatives and municipally-owned utilities to fully leverage DERs as part of their strategies for providing safe, reliable, and affordable electric services
- Meets U.S. Department of Energy (DOE) grid modernization goal of achieving at least 10% active devices to provide grid flexibility by 2035.

Project Team:

- NREL
- DOE Office of Electricity
- Survalent
- Heila Technologies
- HCE
- U.S. Advanced Research Projects Agency-Energy (ARPA-e)
- National Rural Electric Cooperative Association
- University of Colorado Boulder

Coordination with Other Projects

Advanced Distribution Management System (ADMS) Testbed Project

- ADMS Testbed
- HIL experiment resources

Holy Cross Energy (HCE) High Impact Project

- Control Algorithm
- Heila box to host the control algorithm for field deployment

ARPA-E NODES Project

Scope for Enhanced Technology

- Model the impact of increasing DER on HCE grid
- Develop the use case to implement advanced control for DERs in order to provide grid service
- Techno-Economic Cost-Benefit Analysis
- Set up ADMS testbed, integrated Survalent's ADMS and conduct HIL experiments
- Field deployment at HCE

New ESIF Capability Developed

- Advanced co-simulation platform with plug-and-play control implementation
- Enhanced ADMS test bed capability
- New communication and interoperability capability energized from Multispeak

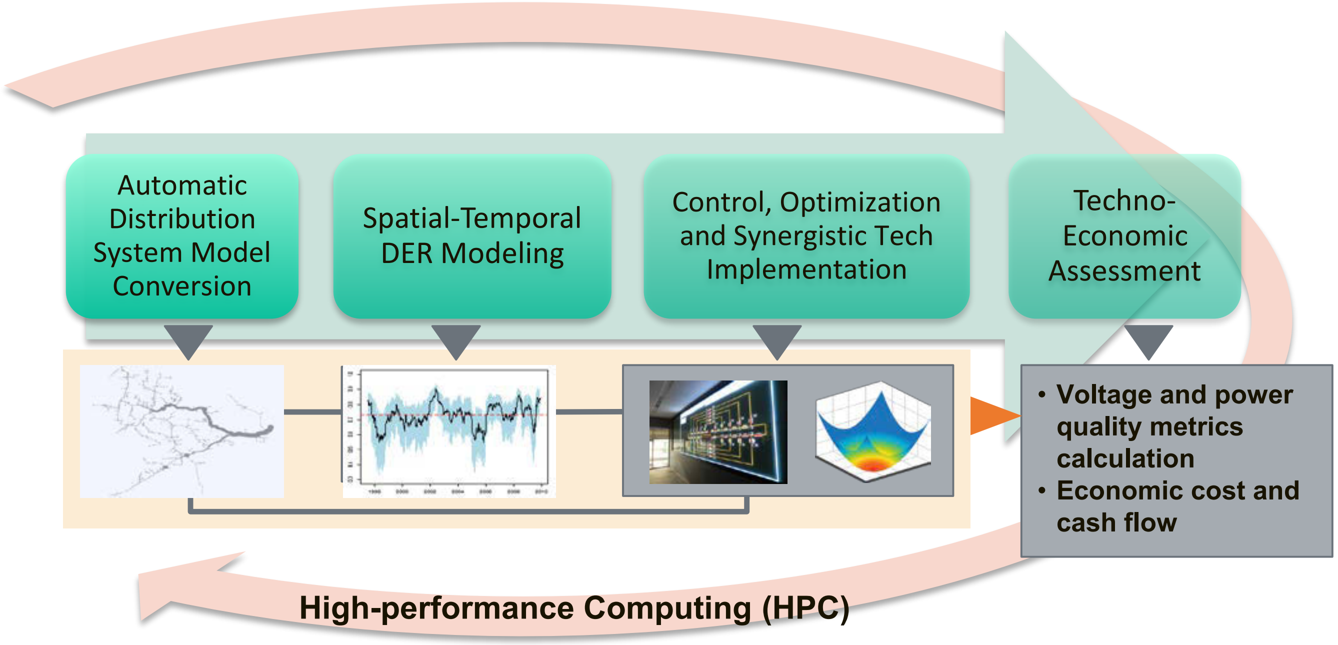
HCE Feeder Selection

- Electrical Co-Op
- Est. 1939
- 60,000 meters
- 3,020 miles of distribution
- 120 miles of transmission
- Winter Peak 260 MW

11 substations, 52 feeders

The AX feeder was selected for its mix of commercial and residential loads. We also foresee a greater DER demand in this area.

Modeling and Simulation Platform



*Streamlined Platform to Enable Distributed Energy Resource Grid Integration (SPEED-DER), NREL Software Record, SWR-18-48, 2018.

DER Modeling and Impact Visualization

Distributed PV

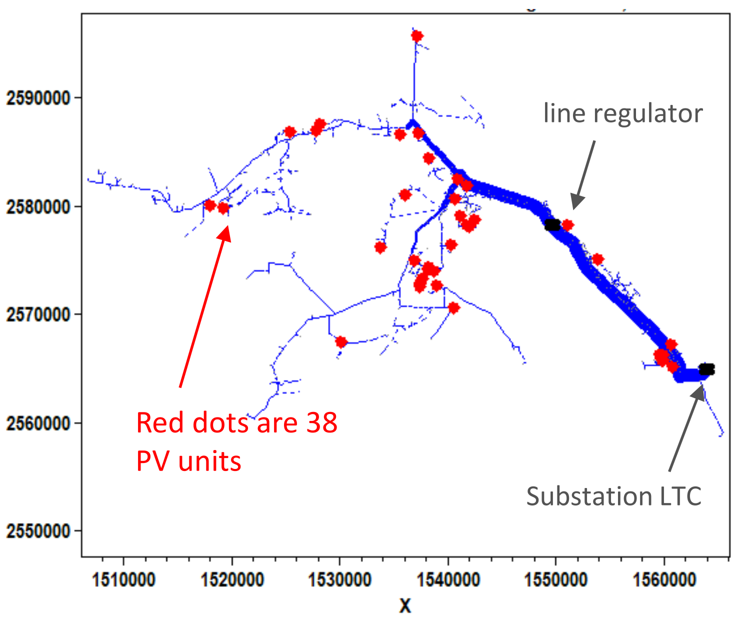
Electric Vehicle

Home Battery
Energy Storage

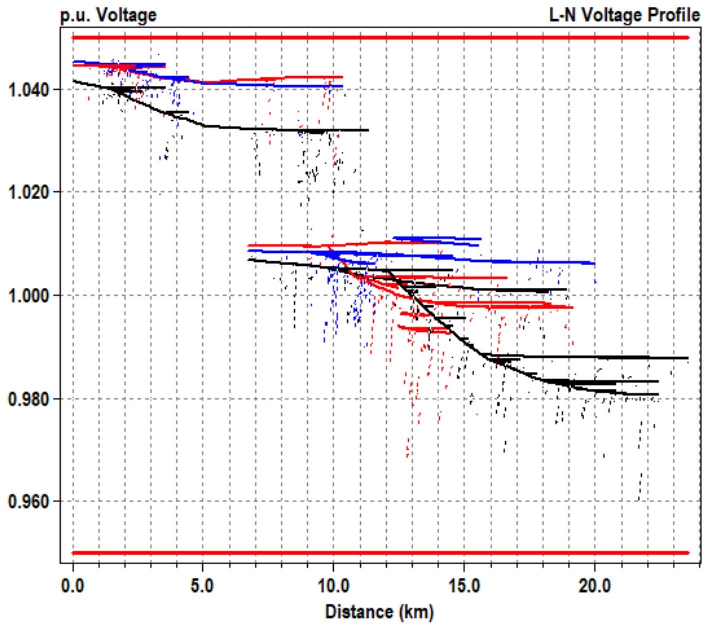
HVAC Load

Electric Water
Heater Load

HCE Feeder Modeling and Validation

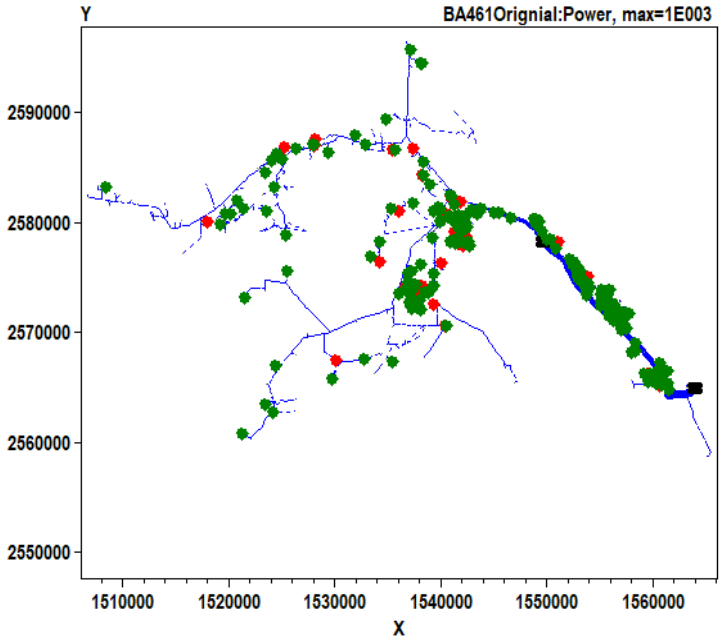


Feeder Topology



Voltage Profile

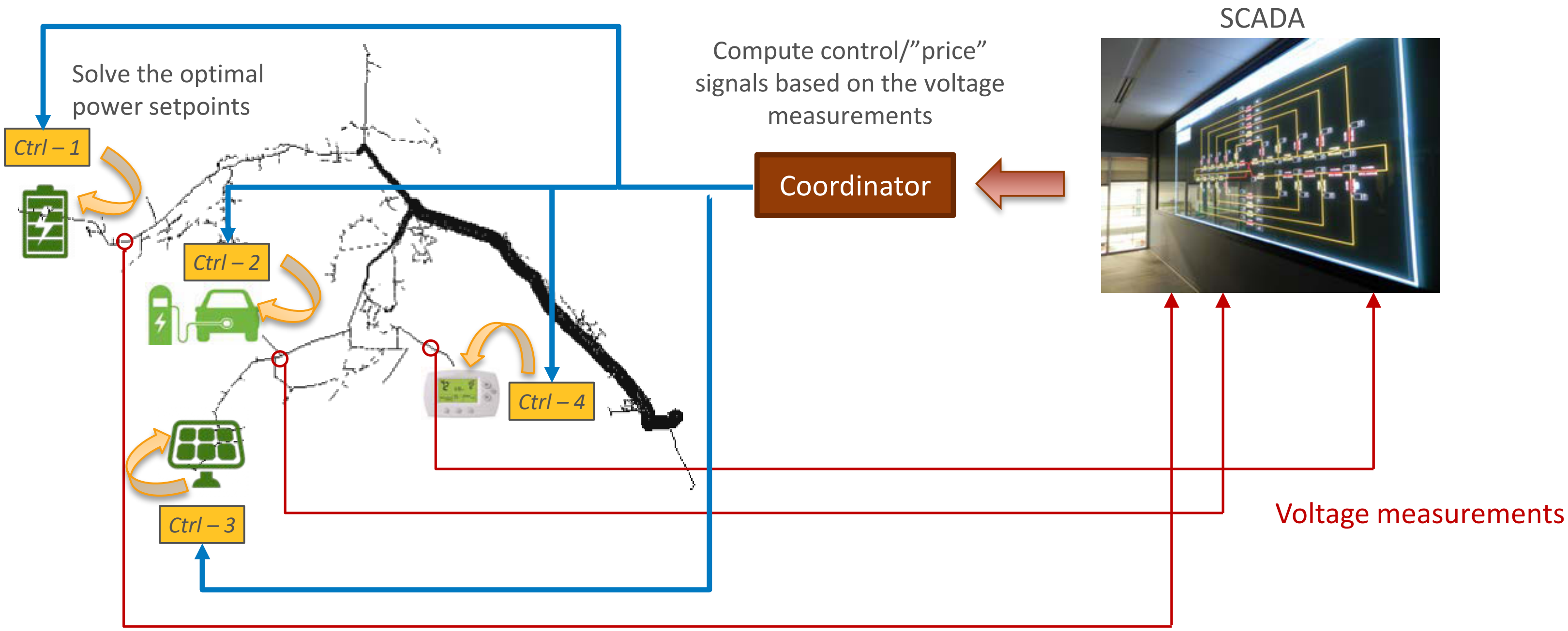
High PV Penetration on Distribution Feeder



Add more PVs --> 2.3 MW (50% of peak load)

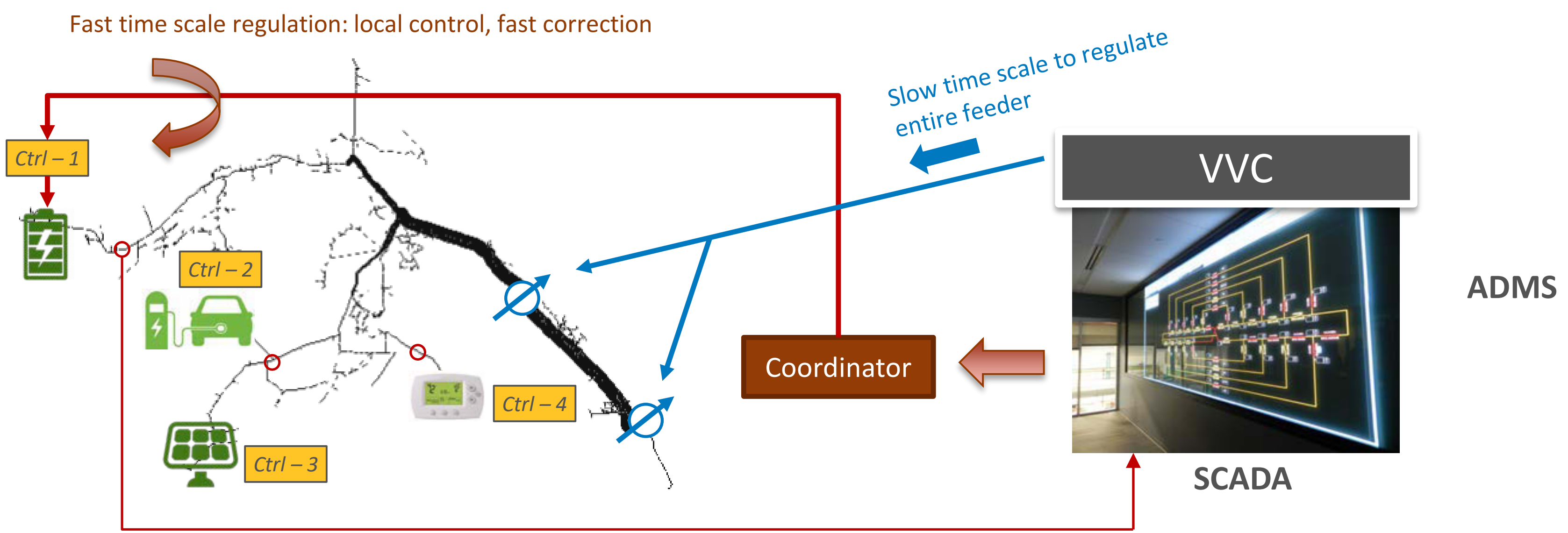
- Existing PV
- 50% PV penetration

Use DER to Increase Grid Flexibility and Improve Voltage Quality



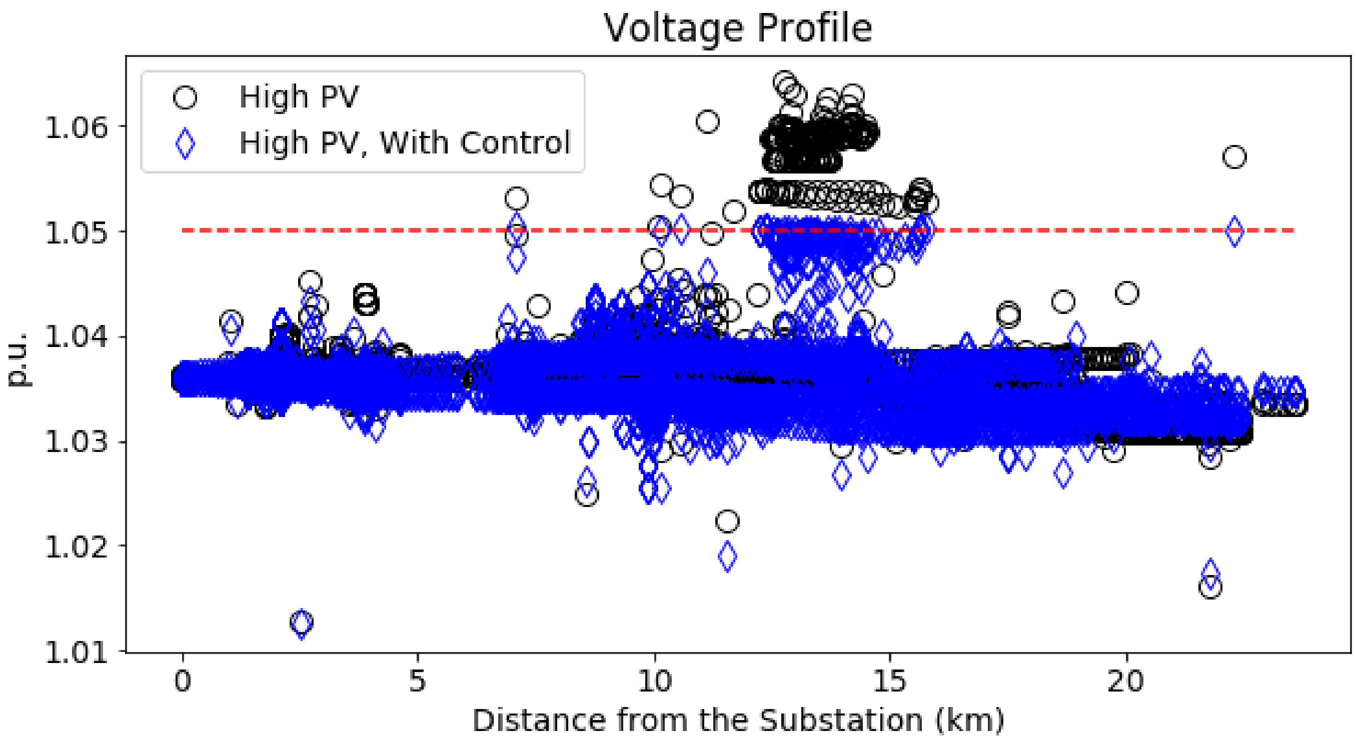
Intelligent, distributed control for DERs

Use DER to Achieve Conservation Voltage Reduction and Peak Demand Management

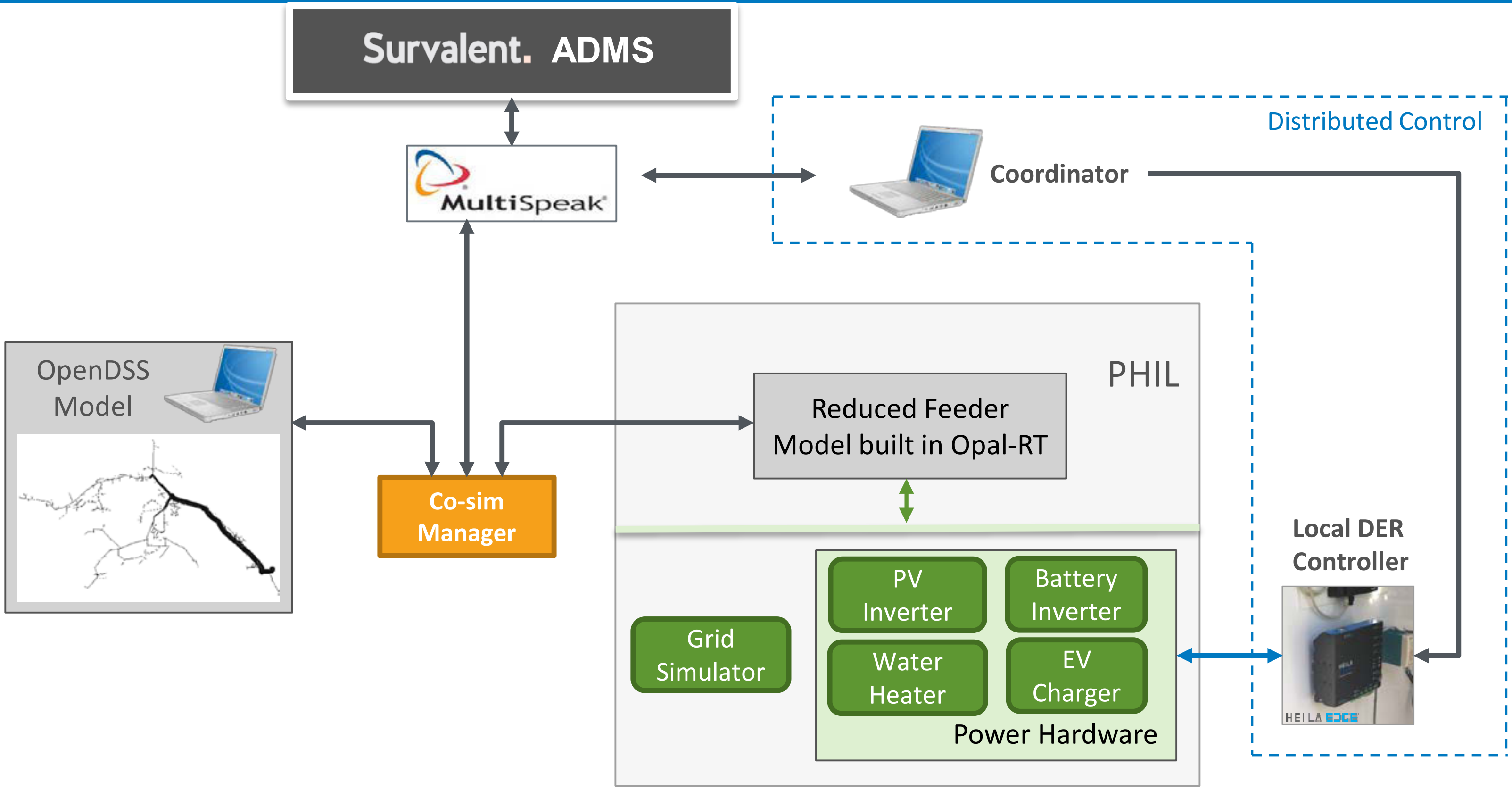


Coordinated control between DERs and voltage regulators to achieve conservation voltage reduction (CVR) energy savings and peak demand management.

Controllable DER Impact on Distribution Voltage



Conduct Hardware in-the-loop Experiments for the Use Case



Field Deployment

Basalt Vista Affordable Housing Project

- 27 homes for teachers and local workforces.
- 4 selected for field deployment
- Designed to ZNE building with all electric construction
- Adjacent to Basalt High School

Leveraging DERs and Grid Flexibility by controlling:

- Renewable source and storage
- Mobility charging (EVSE)
- Comfort (Hot water + HVAC)

Thank you

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