Connected Communities
U.S. DEPARTMENT OF ENERGY

Grid-Interactive, Efficient Bldgs (GEBs) and Connected Communities

Program Overview

July 26, 2023

Problem, Opportunity, and Vision

THE WAY ELECTRICITY IS GENERATED AND CONSUMED IN THE U.S. IS QUICKLY CHANGING

Urgency to decarbonize buildings and electricity grid

Increasing: deployment of variable energy resources, and efficiency

Increasing electrification of vehicles and buildings

Need to modernize fragile electricity system infrastructure

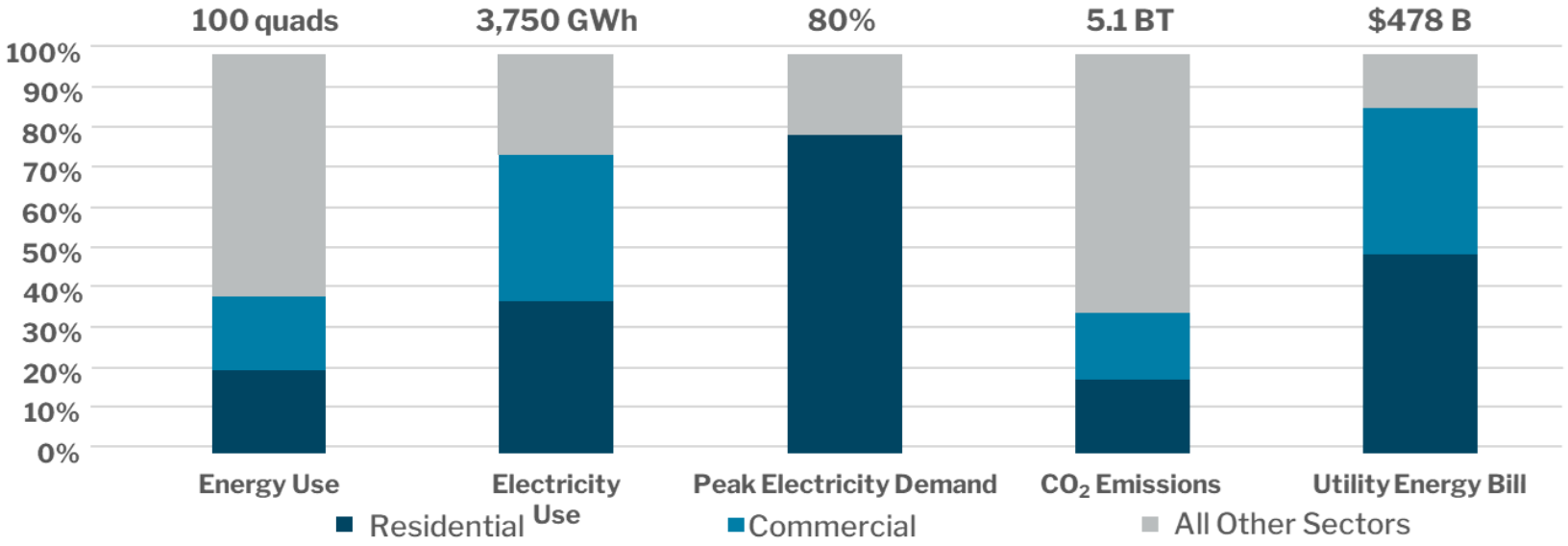
Need to expand access, meet customer needs, and save money

The opportunity for buildings-to-grid: integrate building efficiency and DERs to benefit owners, occupants and the grid.

Connected Communities
U.S. DEPARTMENT OF ENERGY

Why Buildings are critical to the carbon free grid

- **30%** of energy used by bldgs. is **wasted**
- **Buildings Use 75% of all electricity**



BTO is working to achieve a carbon-neutral US building sector by 2050

Sources: US EIA (Monthly Energy Review, Annual Energy Outlook 2020, Electric Power Monthly, Natural Gas Summary)

Connected Communities

Characteristics of a Connected Community

A group of grid-interactive efficient buildings (GEBs) with diverse, flexible end use equipment and other distributed energy resources (DERs) that collectively work to maximize building, community, and grid efficiency while meeting occupants' comfort and needs.

Energy Efficient, Smart Buildings

Integration of DERs

Coordinated Controls

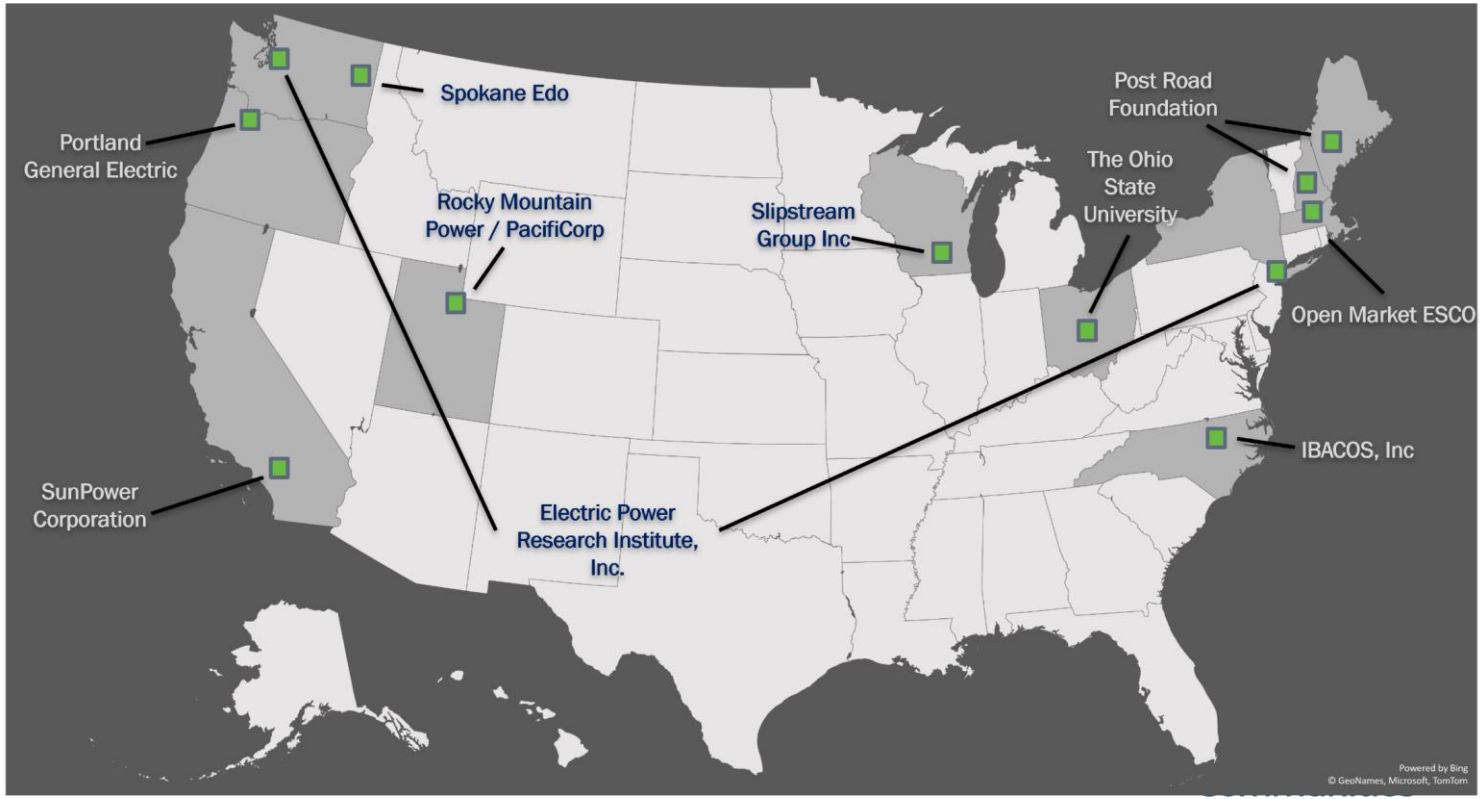
Supporting the Grid and Lowering Carbon

Connected Communities
U.S. DEPARTMENT OF ENERGY

Awarded *Connected Communities* Projects

10 Selected Projects

- $61 Million Total funding
- Final Awards made March 2023



www.energy.gov/eere/buildings/articles/meet-does-newest-connected-communities-grid-interactive-efficient-buildings

Awarded *Connected Communities* Projects

Project Lead	Community Buildings Mix	EE Goal	DERS				
			PV	Battery	EV Charging	CHP/District	Wind
SunPower Corporation	230+ new SF homes	ZERH	X	X	X		
IBACOS, Inc.	500 new and 500 existing single-family and multi-family homes	ZERH-30% new, 10-15% existing homes	X	X	X		
Spokane Edo	50-75 existing residential and 25-50 commercial (serves the majority of Spokane's designated Opportunity Zones)	7.5% - 15%	X	X	X		
Portland General Electric	580 single-family and multi-family existing homes & small commercial buildings (exploring new ways to reach historically underserved populations)	10%	X	X	X		
Post Road Foundation	350 existing single-family homes, 50-65 small commercial, 5 industrial (one community in Opportunity Zone)	16%	X	X	X		
Open Market ESCO	Up to 2000 existing multi-family units (LMI population w/Some buildings in Opportunity Zones)	30%	X	X	X		
Electric Power Research Institute	600+ units in existing and new multi-family affordable housing	30%	X	X	X		
Rocky Mountain Power / PacifiCorp	700 units in multi-family affordable housing, comm buildings (retail, office, higher ed), industrial building, EV bus depot, and EV test track	30% - 50%	X	X	X		
Slipstream Group	15-16 comm buildings (mix of MUSH and private market)	39%	X	X	X		
The Ohio State University	Campus project of 20 buildings, mix of commercial and multi-family	10% or 35% vs 2017 EPC	X	X	X	X	X

What are the results we're after?

Documented Performance

Collecting data on highest impact programs, technologies, and engagement strategies. What worked in different contexts?

Value Propositions

Better understanding of motivations by stakeholder, from grid to end user; what incentives and messaging resonates?

Business Model Innovation

Learning how to scale. Who paid for upfront costs, how were costs recouped, how were benefits shared?

Technology Innovation

Seeking insights on research needs. What technology performance and pricing needs work across efficiency, flexibility and DER integration?

Connected Communities
U.S. DEPARTMENT OF ENERGY

Anticipated Outcomes from Connected Communities Research

- How **diverse groups of buildings** can reliably and cost- effectively **serve as grid assets** using **efficiency** and **demand flexibility with DERs**;
- **How GEBs improve energy affordability** and **grid reliability** with environmental and community benefits;
- Demonstrate how DERs, such as managed charging of electric vehicles, can contribute to overall building load management, grid services and reduced cost of DER ownership and operation;
- **Prove pathways to install the hardware, software and communications** for building grid-interactivity;
- Insights on **occupant impact**, including **benefits**, from advanced sensing, controls and capabilities to balance comfort and grid needs;
- **Willingness** and **ability** of **occupants** to change timing of energy use, and needed compensation;
- **Demonstrate value** of integrating demand flexibility and DERs across buildings to attract customers, utilities, and other key stakeholders.

Connected Communities National Coordinator

Cindy Regnier, LBNL

Connected Communities
U.S. DEPARTMENT OF ENERGY

Coordination Across a Diverse Cohort of Pilots

National Coordinator (LBNL) will work with BTO/DOE to:

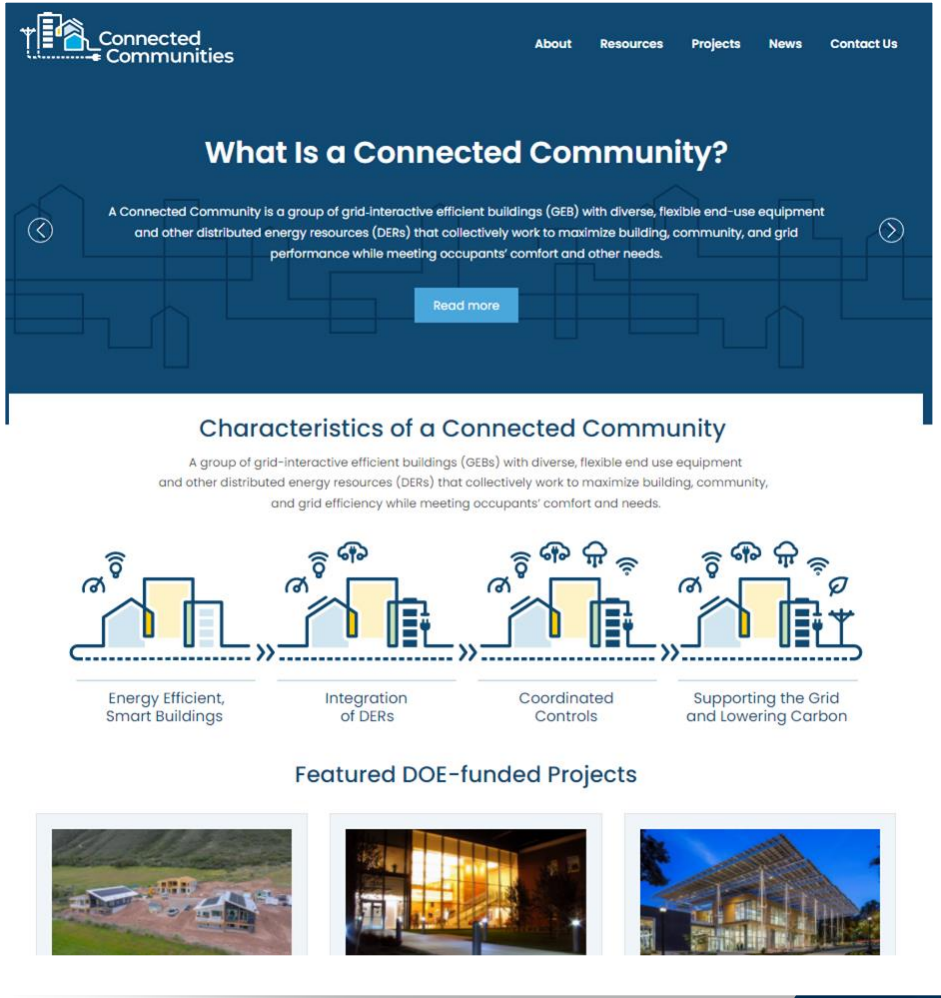
- Provide **technical assistance** to awardees, particularly around M&V
- Work with BTO to **facilitate shared learning** across both awardees and key stakeholders during project implementation stages and provide technical assistance to awardees with common challenges.
- **Synthesize** information across many projects in an effort to replicate and scale innovation.
- Cultivate a **broader community of learning and innovation** among non-awardees who could benefit from project insights.

Enabling Impact from Project to Industry

Technical Assistance designed to enable impact beyond the cohort

1. **Interoperability**
   a. E.g. Reviews of solutions for scaled deployment
   b. DERMS product landscape review
2. **Cybersecurity and data privacy**
   a. Example cybersecurity plans, training, tools
3. **Evaluation methods**
   a. Grid service metrics, quantification, and individual DER contribution
   b. EE and net energy impacts
   c. Customer and stakeholder surveys
   d. Hourly calculation method to estimate GHG reductions
   e. Cost-benefit analysis
   f. Business models
4. **And more in development…..**

Connected Communities
U.S. DEPARTMENT OF ENERGY



Website launched to engage broader community of stakeholders and share information

ConnectedCommunities.lbl.gov

FY24 Proposed Activities

1. **Cohort engagement**
   a. Annual cohort event; two smaller “coastal” events
   b. Facilitating cohort collaboration topics, speakers, information exchange
2. **Evaluation**
   a. Review cohort evaluation plans
   b. Technical assistance in application (e.g., baselining, data standards, eval methods)
3. **Cross-cutting R&D and technical assistance**
   a. Interoperability
   b. Coordinated controls
   c. Utility and business application models
   d. Cohort technical assistance to enable scaling/replication
4. **Stakeholder engagement and scaling**
   a. Collaborations, document/disseminate models, lessons learned
   b. Roadmap for transitioning projects to utility programs, replication in other states

Connected Communities
U.S. DEPARTMENT OF ENERGY

Thank you!

Cindy Regnier, P.E.
LBNL
CMRegnier@lbl.gov

Connected Communities
U.S. DEPARTMENT OF ENERGY

SunPower Corporation

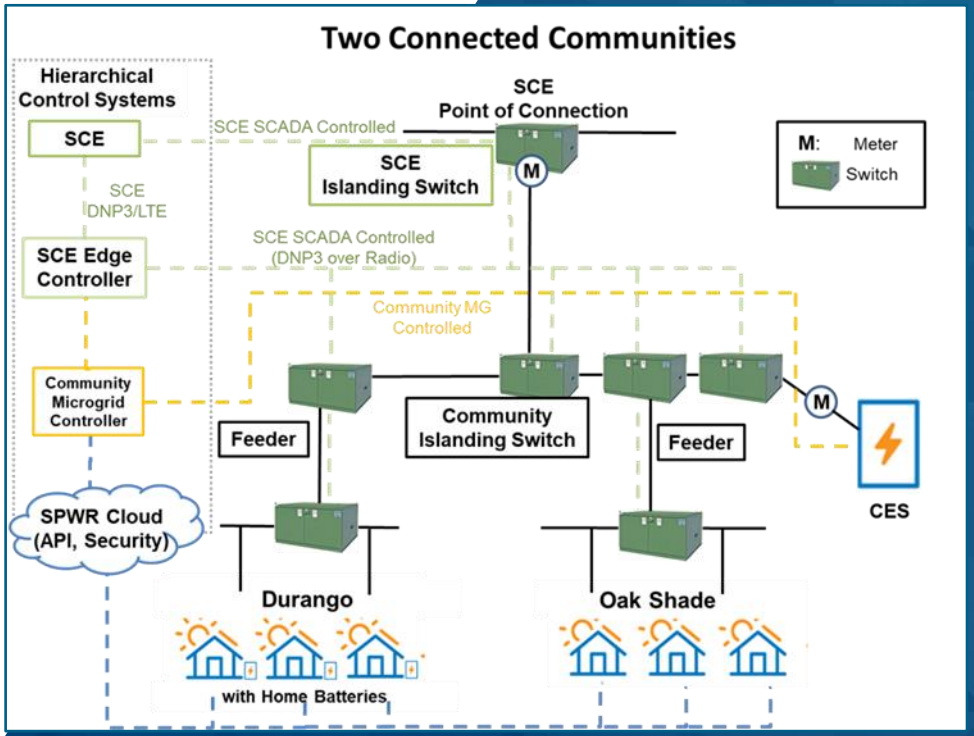
with KB Home, University of California Irvine, Schneider Electric and Southern California Edison

Community Description

Two new home neighborhoods in California connected with microgrids equipped with distributed energy resources, load flexibility, energy efficiency, and reliability and resiliency measures. Homes will be all-electric, meet DOE zero energy ready homes criteria with PV and home energy management systems. Both neighborhoods (200+ homes) will have in home-batteries and be connected by a community battery which will power a microgrid in the event of a grid outage. The connected communities will be able to share resources as needed and provide grid services to the local utility.

KEY INNOVATION:

- ✓ Integration of existing commercial technology including nested microgrids.
- ✓ Evaluate value of community battery, residential batteries, and home energy management systems.
- ✓ Shifting natural gas fuel end-uses to high efficiency all-electric technology and utilizing controllable HVAC, water heaters and ENERGY STAR labeled appliances.
- ✓ Utility distribution SCADA and automation system edge controller w/close coupled community nested microgrid



IBACOS

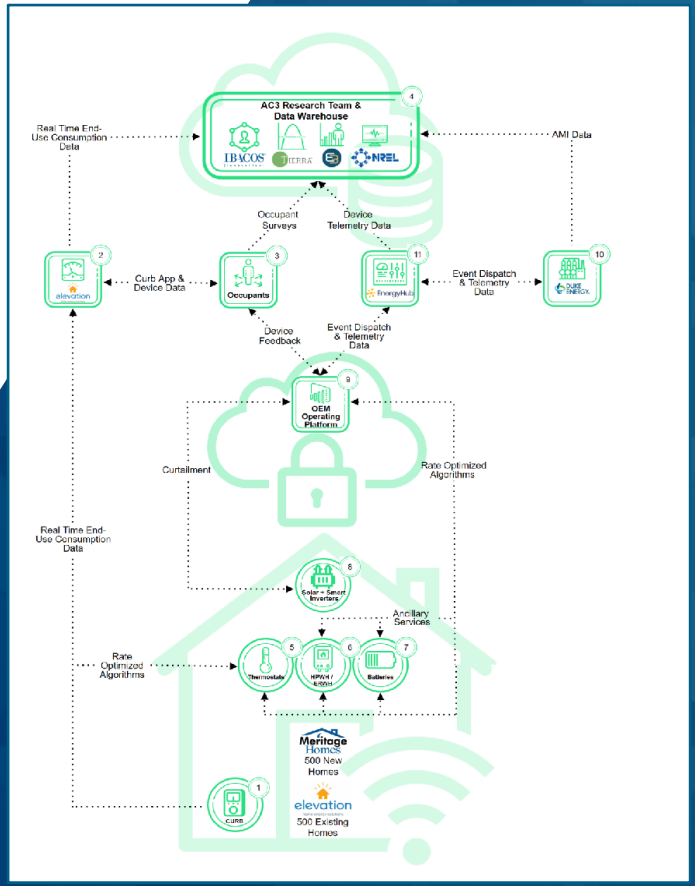
with Tierra Resource Consultants, NREL, Energy and Environmental Economics, Duke Energy, Meritage Homes, Elevation, and Energy Hub

Community Description

A mix of 500 new homes and 500 existing single-family and multifamily owner-occupied and rental properties will be connected through the EnergyHub DERMS platform to provide up to 3.8 MWs of aggregated flexible load to serve grid needs in Duke Energy's North Carolina service area. The project team will explore the capabilities of a connected network of DER technologies to serve utility peak capacity and resource adequacy needs at the bulk system and local transmission and distribution level. Data on aggregated grid impacts and value across a range of buildings, end uses, and technologies will be collected to help identify best approaches to delivering flexible distributed capacity at scale.

KEY INNOVATION:

- ✓ All existing homes receive energy audits to determine baseline efficiency levels, and approximately 100 of the existing homes receive energy efficiency upgrades including duct repair, insulation and air sealing with expected improvement of 10-15%.
- ✓ New homes meet or exceed DOE's Zero Energy Ready Home criteria
- ✓ High potential feasibility and scalability using commercial, off the shelf technologies.
- ✓ Multi-pronged control and integration strategy including rate optimized DERs with price responsive automated demand response.
- ✓ Will pilot emerging winter peak DER management to defer utility capital investments
- ✓ Assess occupant experience using device data and participant surveys



Edo

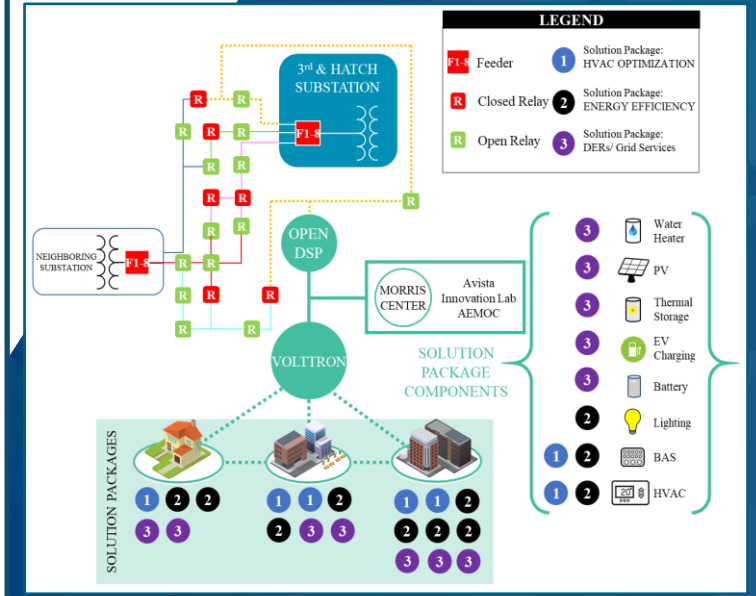
with Avista Utilities, McKinstry, PNNL, and Urbanova

Community Description

This project will demonstrate non-wires alternatives that support deferring or avoiding major capital investments in a 55MW-peak distribution substation by creating targeted (locationally specific) virtual power plants (VPP) from existing buildings, while optimizing power quality and supporting adjacent feeder needs. 75 to 125 participants will be recruited from existing single and multi-family residential and commercial buildings, and building flexibility will be augmented by DERs to demonstrate 1–2.25 MW of flexible load. EE measures are realized by improving small and large commercial building operations and retrofitting for single and multi-family homes. The project includes the Spokane EcoDistrict with an existing battery, thermal storage, onsite PV, and an all-electric central plant.

KEY INNOVATION:

- ✓ Developing an integration platform to systematically deploy VOLTTRON in multiple building types and optimizing VPP dispatch with OpenDSO.
- ✓ Coordinating VPP scheduling and dispatch of building resources using Avista Utility's Active Energy Management Operations Center.
- ✓ Demonstrating a novel utility and private sector partnership with a shared-value business model for building-to-grid integration services.
- ✓ Demonstrating multi-year operation of buildings and DERs as VPPs to provide insight on their dependability and load flexibility as dispatchable utility resources.
- ✓ Developing a Connected Communities Playbook that details project design (prices, incentives), market potential and behavioral research to enable reaching scale and replicability.



Portland General Electric

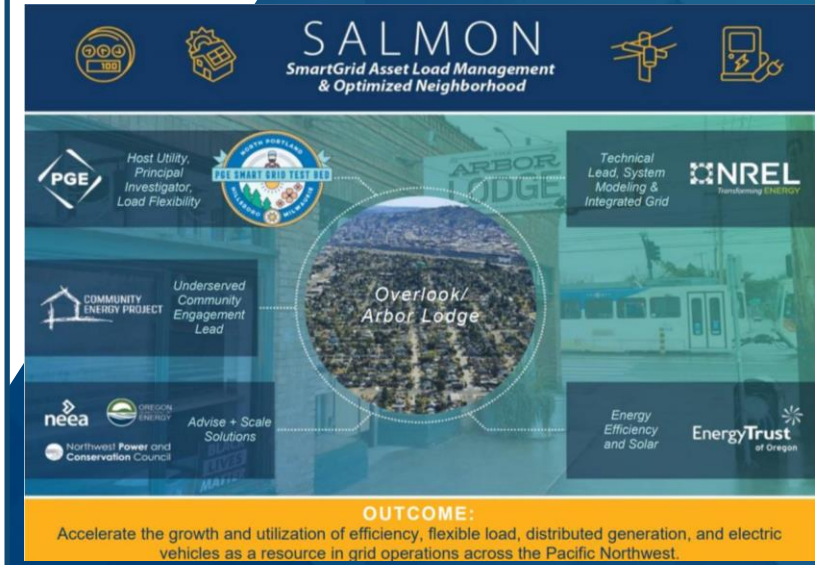
with Energy Trust of Oregon, NEEA, Community Energy Project, NREL, Open Systems International, Inc.

Community Description

A mix of residential and commercial buildings in Portland's Overlook/Arbor Lodge neighborhood will be encouraged to participate. The project goal is to demonstrate 1.4 MW of flexible loads through retrofitting approximately 580 (~21%) buildings with various measures including smart thermostats, smart water heaters, shell measures, high efficiency HVAC, solar with smart inverters, storage, and managed electric vehicle charging. Measures will be integrated into PGE's Advanced Distribution and DER Management Systems, and optimized by NREL to demonstrate multiple grid services.

KEY INNOVATION:

- ✓ Community engagement with a special focus on low-income and traditionally underserved residents facing gentrification
- ✓ Demonstrates a range of grid services
- ✓ Strong market transformation activities that leverage existing utility programs and distribution channels and works with national organizations to disseminate findings



Post Road Foundation

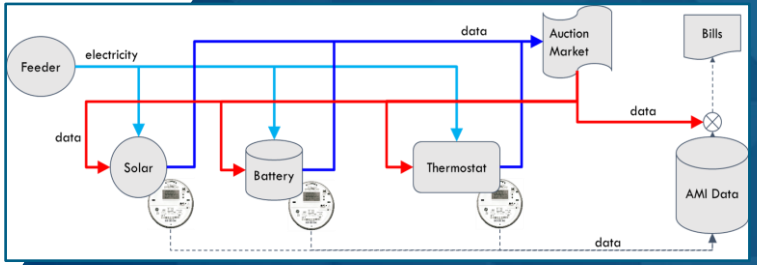
with SLAC, New Hampshire Electric Cooperative, Efficiency Maine Trust, and Knowledge Problem, LLC

Community Description

Up to 250 single-family homes and 5 to 10 small commercial buildings in rural New Hampshire and 100 single-family homes, 50 small commercial buildings, and 5 industrial buildings in two communities in rural Maine will participate in the pilot. The goal is to expand and test capabilities of a "prices-from-devices" transactive energy service system (TESS) platform developed at SLAC. In New Hampshire, batteries, heat pumps for HVAC, EV chargers and other DERs will be deployed. In Maine, heat pumps for HVAC or water heating, thermal phase-change storage, and batteries will be deployed.

KEY INNOVATION:

- ✓ The opportunity to test comprehensively the technical, business and policy motivations for transactive energy in rural areas.
- ✓ Use of web/mobile app data analysis and structured quantitative surveys to evaluate occupant experience.
- ✓ Exploring the use of blockchain technology, developed in part by the DOE multi-lab *Blockchain for Optimized Security and Energy Management* project, to secure the system.



Key Idea / Takeaway:
Demonstrate whether two-way "prices-from-devices" transactive energy is viable in rural America from both a financial and policy perspective and prepare for scale-up so that TESS can be quickly adopted nationwide.

Open Market ESCO

Subrecipient: Fraunhofer USA

Connected Communities Project Description

Up to 6 affordable and mixed-income multifamily housing communities, representing approximately 1,000 households, selected from two portfolios located in Massachusetts will be transformed into GEBs. The Project will demonstrate how both an aggregated portfolio and individual multifamily apartment communities can reliably and cost-effectively serve as grid assets by strategically deploying efficiency, demand flexibility, renewable generation, and energy storage, while providing energy savings, resilience, comfort, and environmental benefits to underserved communities.

KEY INNOVATION:

- ✓ Demonstrate financeable pathways for existing affordable multifamily housing to transition into GEBs
- ✓ Develop and/or enhance new or existing platforms to integrate control of energy storage, PV, and connected devices, fully automating the load flexibility within existing affordable housing communities
- ✓ Pilot new approaches to “Resiliency as a Service” for vulnerable communities to optimize battery storage design and financing

OpenMarket ESCO
Energy Innovation

Electric Power Research Institute

with Gas Technology Institute, Seattle City Light, Community Roots Housing, Vistar Energy and Sentient Buildings

Community Description

Several existing and new affordable housing multifamily communities with 300+ dwelling in each of two different climates (Seattle-marine and New York City-mixed-humid) will participate in the pilot. The communities will undergo different decarbonization upgrades to demonstrate core goals of reducing energy burden and moving towards zero net carbon, while increasing the availability of DERs and aggregating them to provide multiple grid services (e.g. distribution upgrade deferral, temporal capacity constraint alleviation, etc.). Community solar and community energy storage (both thermal and electrical), as well as managed bi-directional EV charging infrastructure will be tested.

KEY INNOVATION:

- ✓ Evaluation of flexible loads and community scale DER data to provide multiple grid services in multiple climates.
- ✓ Focus on disadvantaged (LMI) housing communities
- ✓ Affordable building retrofit decarbonization pathways, packaging EE, DER and DG offerings
- ✓ Coordinated controls emphasize energy cost savings, using energy cost threshold
- ✓ Grid carbon emissions signal influences load shifting
- ✓ Improved community resilience using bi-directional EV charging

Rocky Mountain Power/PacifiCorp

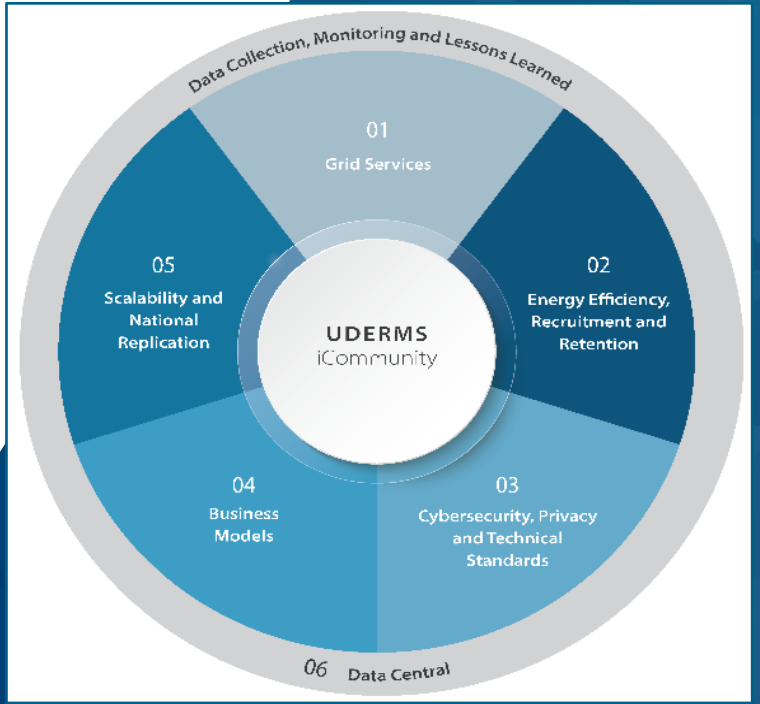
with PNNL, Utah State, Wasatch Group, GIV Group, Utah Transit Authority, Packsize Int'l., Open Systems Int'l. and Sonnen

Community Description

Includes a diverse range of buildings from a large suburban apartment complex, downtown complex of mixed-use retail and apartments, University laboratory and office building with a microgrid, a mass transit transportation center, manufacturing building, and residential home. PacifiCorp will evaluate the viability of strategic aggregation and deployment of DER bundles in wholesale markets and provide data to support inclusion of this model in Integrated Resource Planning.

KEY INNOVATION:

- ✓ Grid distribution analysis and model simulation to determine if the integration of flexible loads with energy efficiency can defer the investment of expensive capital upgrades at the local distribution network.
- ✓ Approach to utility business model, analysis of potential savings from distribution upgrades, and integration into IRP provides strong pathways for scale and replicability.
- ✓ Utility-led project focused on support of DER inclusion in Integrated Resource Planning activities



Slipstream Group Inc.

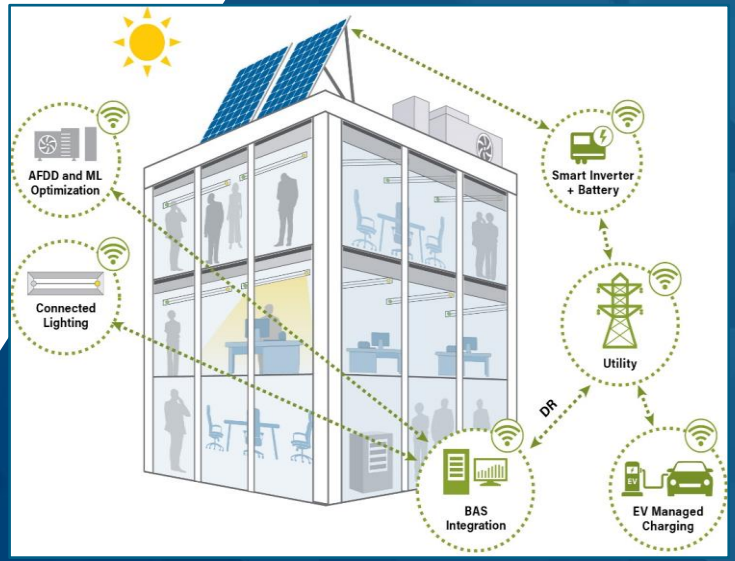
with Madison Gas & Electric, City of Madison, RMI, ACEEE and bluEvolution

Community Description

This lead-by-example pilot will start with city-owned buildings before expanding lessons to additional privately-owned buildings to upgrade approximately 15 existing facilities into GEBs. Project deliverables include scalable business models for utilities bundling of aligned demand response and energy efficiency incentive programs, and turnkey installation under a single vendor and a GEB toolkit with integrated financing options to address opportunities in public and private buildings.

KEY INNOVATION:

- ✓ Lead-by-example approach with a mix of both publicly owned and privately owned commercial buildings
- ✓ Strong M&V plan that includes thoughtful approaches to occupant and financial, as well as energy impacts.
- ✓ Combines readily-available and proven technologies for a high degree of scalability and replicability.



The Ohio State University

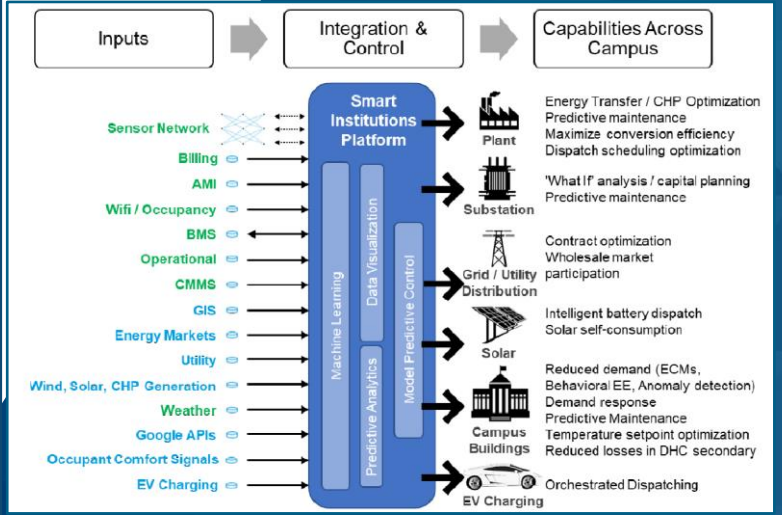
with ENGIE North America Inc., NREL and University of California, Berkeley

Community Description

Up to 20 campus buildings of diverse vintage and uses (commercial, multi-family) with 10.3 MW of peak demand are integrated with a 105 MW combined heat and power plant; a co-located central chiller plant; ~65,000 ft2 of PV; 29 EV charging stations; and 50 MW of wind energy through a power purchase agreement. The goal is to leverage this mature campus infrastructure and transform operations and demonstrating cybersecure orchestrated control of buildings and distributed energy resources for energy efficiency, demand management, and provision of grid services including frequency regulation, synchronized reserve, and energy and capacity markets participation

KEY INNOVATION:

- ✓ Cybersecure AI- and model predictive control-based approach, integrating local fault detection, ubiquitous sensing and AI-based comfort optimization
- ✓ Aiming for a quantifiable improvement in occupant experience.
- ✓ Robust methods to survey and measure occupant experience (IEQ, productivity, wellbeing, building services attitudes and behaviors) and comfort.
- ✓ Business model for institutional energy management



Schematic of Smart Institutions Architecture. Green shows current data integration and blue shows data that will be added during the project.