REYNOLDS LANDING

AT ROSS BRIDGE

Alabama Power

SMART NEIGHBORHOOD ™

Tomorrow's Homes. Today.
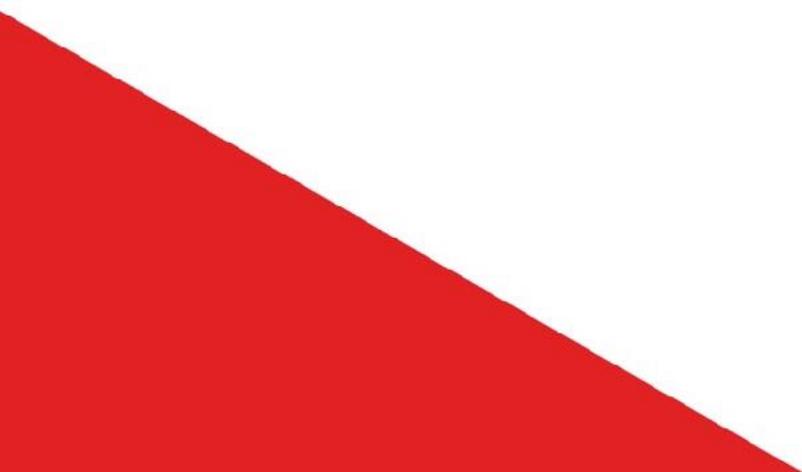
Objective

Design and build a first of a kind living laboratory to prepare APC for future grid needs and customer expectations

Scope

Demonstrate **distributed energy resources (DER)** use cases optimizing cost, reliability, and environmental impact with a **community-scale microgrid**

Demonstrate 62 **high-performance homes with connected home technologies** providing an improved customer experience

Demonstrate **building-to-grid integration** with real time utility to customer interaction

SMART NEIGHBORHOOD®
Alabama Power

Distributed Generation

Reynolds Landing

Objective:
Design and build a first-of-a-kind high-performance community and residential microgrid to learn how to better serve changing customer needs.

Demonstrate **62 high-performance homes** with connected home technologies providing an improved customer experience

Alabama Power

SMART NEIGHBORHOOD™

Comfortable
Convenient
Connected
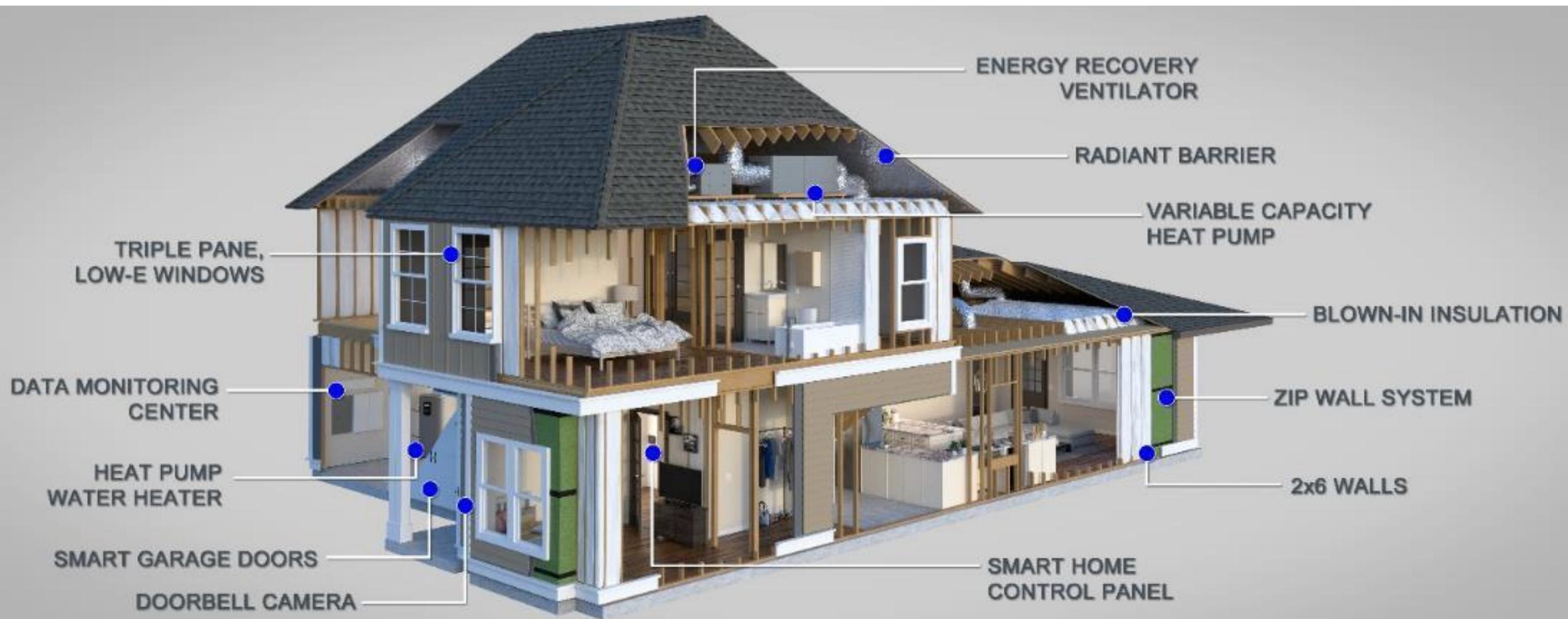
ENERGY RECOVERY VENTILATOR

RADIANT BARRIER

VARIABLE CAPACITY HEAT PUMP

TRIPLE PANE, LOW-E WINDOWS

BLOWN-IN INSULATION

DATA MONITORING CENTER

ZIP WALL SYSTEM

HEAT PUMP WATER HEATER

2x6 WALLS

SMART GARAGE DOORS

SMART HOME CONTROL PANEL

DOORBELL CAMERA

COMFORTABLE

Building better = HERS

- Advanced air sealing

- 2x6 Zip walls with R-24 blown in blanket insulation

- Radiant barrier roof decking to reduce hot attic temperatures

- R-49 blown attic insulation

- Triple Pane Low E windows

What does all this mean to homeowners?

Less heat gets into your house in the summer, and cold in the winter. This helps you stay **more comfortable** and your home **more efficient** all year round.
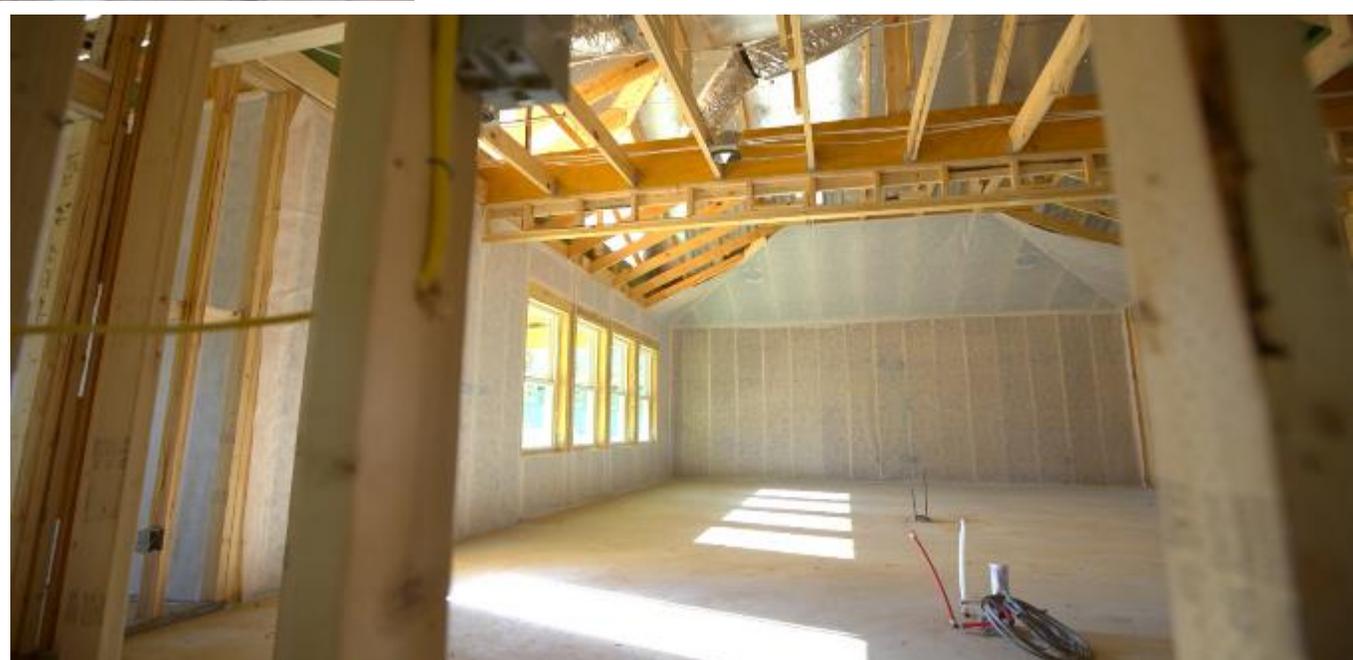
COMFORTABLE

HEATING & COOLING

Incredibly energy efficient technology.

Carrier® Infinity® Heat Pump
with Greenspeed™ Intelligence
plus Infinity® Remote Access Touch Control Thermostat

- Adapts to the needs of your home

- Operates longer at steadier, lower capacities, ensuring **incredible energy efficiency and quiet operation**

- **Touch control thermostat** can manage temperatures, humidity, ventilation, airflow, indoor air quality and up to eight zones

- **Wi-Fi enabled** remote access

Photos courtesy of Carrier

COMFORTABLE

The most efficient way to heat water.

Rheem Professional *Prestige*® Series Hybrid Electric Water Heater

• 50, 65, 80 gallon capacities

• LCD display with built in water sensor alert with **audible alarm**

• EcoNet WiFi- connected technology and mobile app **gives users control** over water system

• Customizable temperature control with **energy savings mode** and **vacation mode**

HERS

The Home Energy Rating System Index (HERS) is the industry standard by which a home's energy efficiency is measured. Developed by Residential Energy Services Network (RESNET), the HERS Index is nationally recognized and is the most in-depth energy assessment for your home you will find.

- Smart Neighborhood homes received an average HERS score of 45
- A typical resale home represents 130 on the HERS Index.
- Home built to the State Energy Code ERI 70

HERS INDEX

MORE ENERGY

150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

45

LESS ENERGY
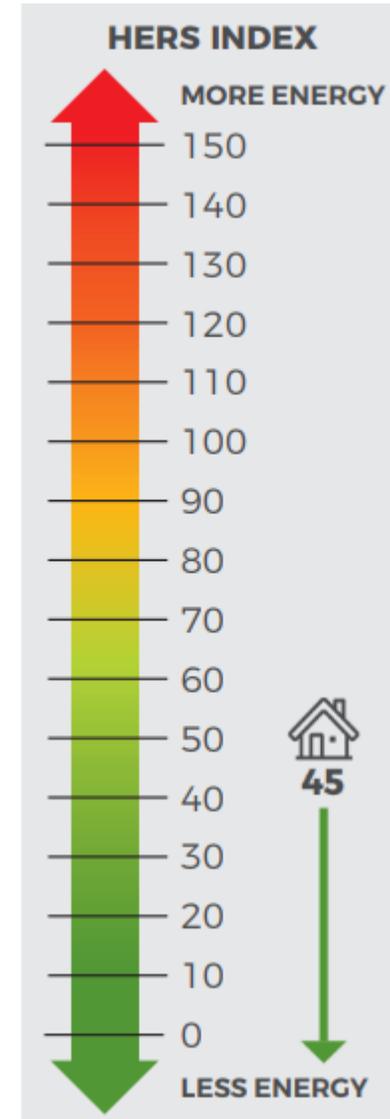
Energy Consumption vs. HERS Index Score
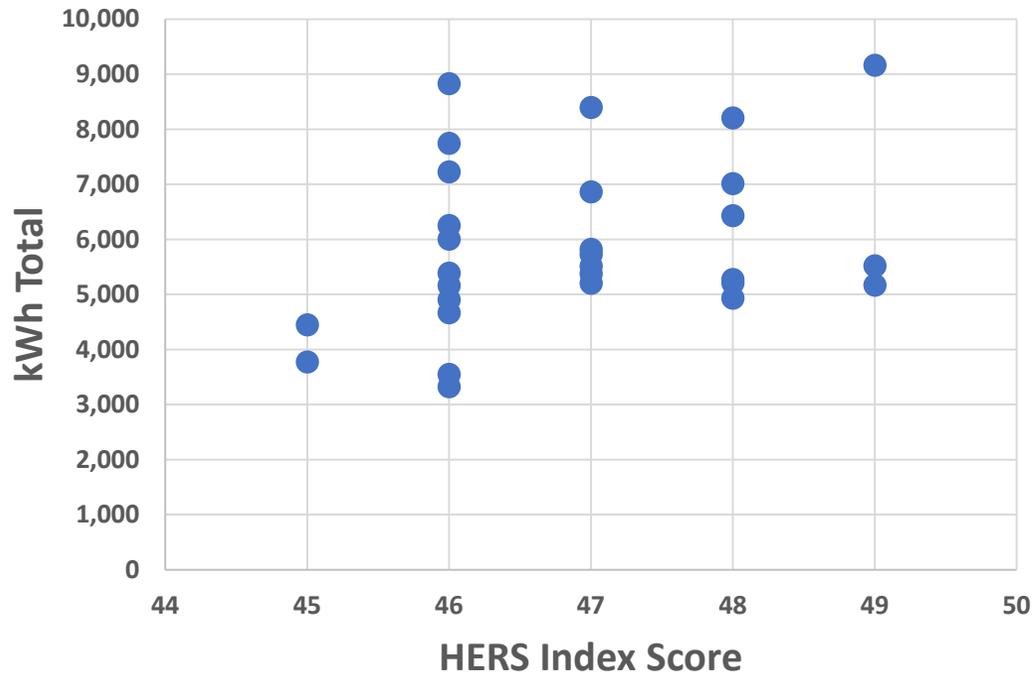
Energy Usage Historgram

CONVENIENT
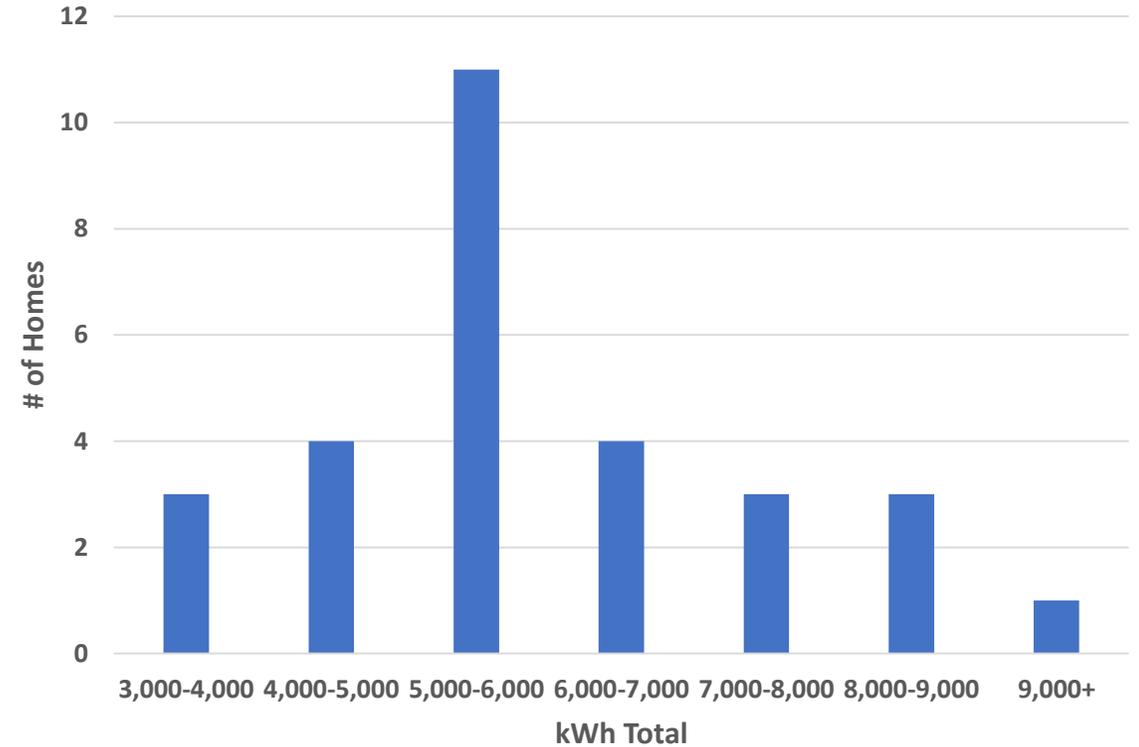
Efficient, Effective, Effortless

- 4-door Flex Refrigerator with **Family Hub** in the door with Internet connectivity

- Slide-in **Induction** Range for the most efficient and safest cooking technology available

- Over-range microwave with **PowerGrill** to toast and broil

- Top control dishwasher with **WaterWall** cleaning technology

- **AddWash** Front-load Washer with Steam

- Electric Dryer with **FlexDry** Technology

Photos courtesy of Samsung

HOME CONTROL, SECURITY & ENTERTAINMENT

CONNECTED

vivint. SmartHome™

The brains behind your smart home.

- **Voice-activated** security system

- Smart locks allow for **keyless entry**

- **Lighting control** to manage lights throughout the house

- Smartphone **linked cameras** to monitor your home from afar

- Smart **garage door control**

- **Google Mesh**

- **Amazon Dot** integration

Doorbell Camera | Ping Camera | Element Thermostat | Vivint App | Glance Display | Smart Drive | Smart Door Lock | Nest Thermostat | Amazon Echo

15

SMART HOME Features

CONNECTED

Doorbell Camera

Ping Camera

Carrier Thermostat

Vivint App

Glance Display

Smart Drive

Smart Door Lock

Amazon Echo

Jasco Smart Outlet

Google Mesh Wi-fi

Outdoor camera

Garage door controller

Motion detector

Door / window sensor

Recessed door sensor

Smoke detector

CO detector

Flood / freeze sensor

Glass break sensor

CUSTOMERS

Education

Marital Status

Age
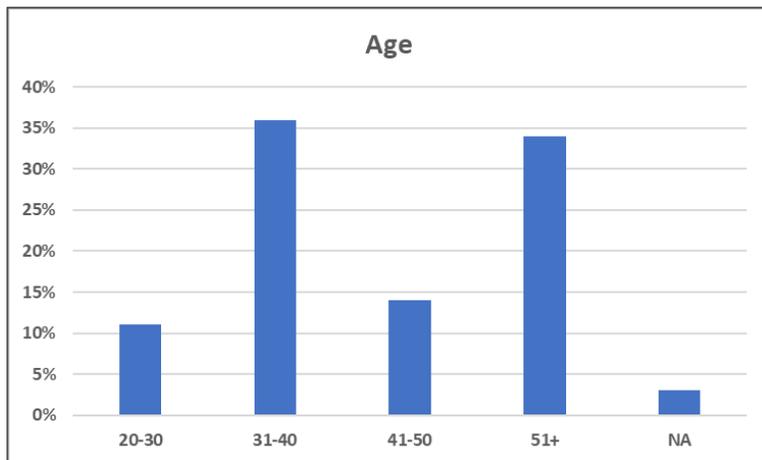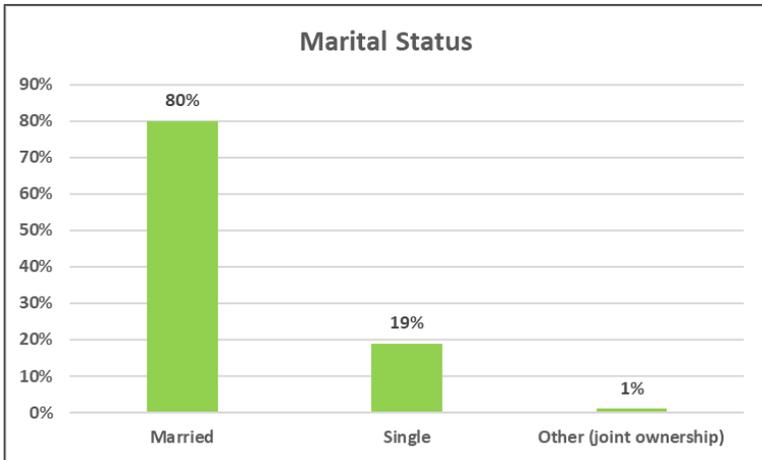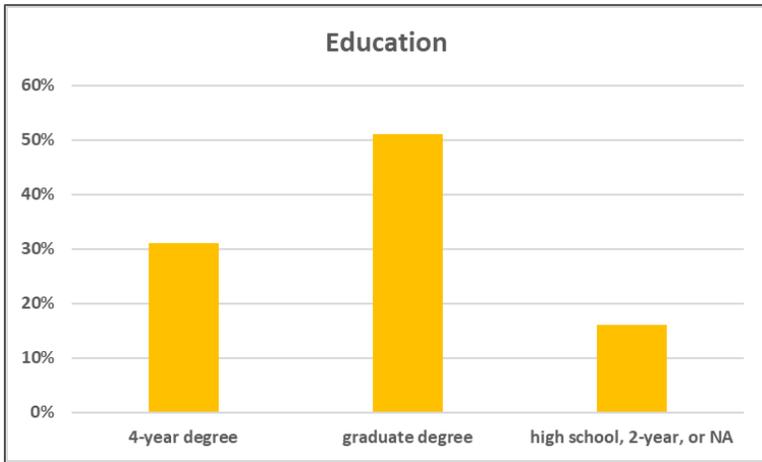
Why Smart Neighborhood?
- 51% of Homeowners - Location
- 31% of Homeowners - Technology
- 17% of Homeowners - Other
  - New construction
  - Energy efficiency
  - Design

What do they like?
- Convenience
- Ease of use
- Simplicity
- Consistency

What do they NOT like?
- Changing platforms
- Self educating
- Poor connectivity
- Fails

What is important to them?
- Stability of platform
- Relationships
- Understanding of use of technology
- Meeting them where they are
- Being heard/valued

17

RESEARCH COMPONENTS

Alabama Power

SMART NEIGHBORHOOD™

1 High Performance Homes

2 Distributed Energy Resources

3 Building to Grid Integration

4 Connected Home Devices

18
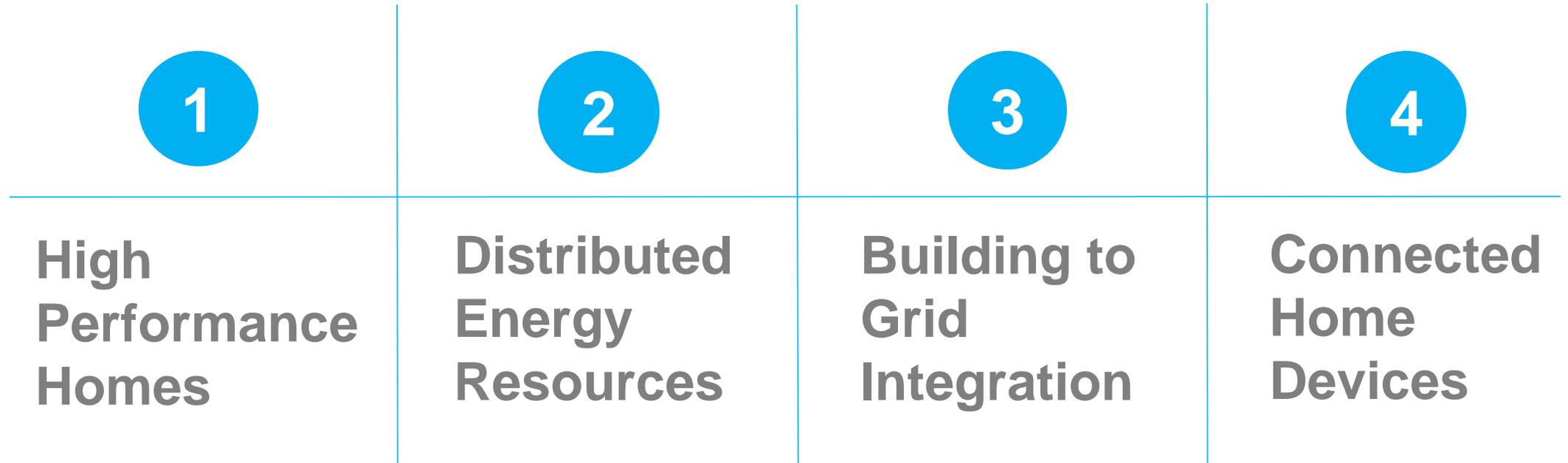
Home Data Monitoring

Smart Neighborhood Building's Use Cases

Smart Neighborhood (Microgrid)

Substation / Feeder Head — Ross Bridge Area Feeder — Point of Interconnection (POI) — House #1 — House #62 — Meteorological Data Monitoring — Gen
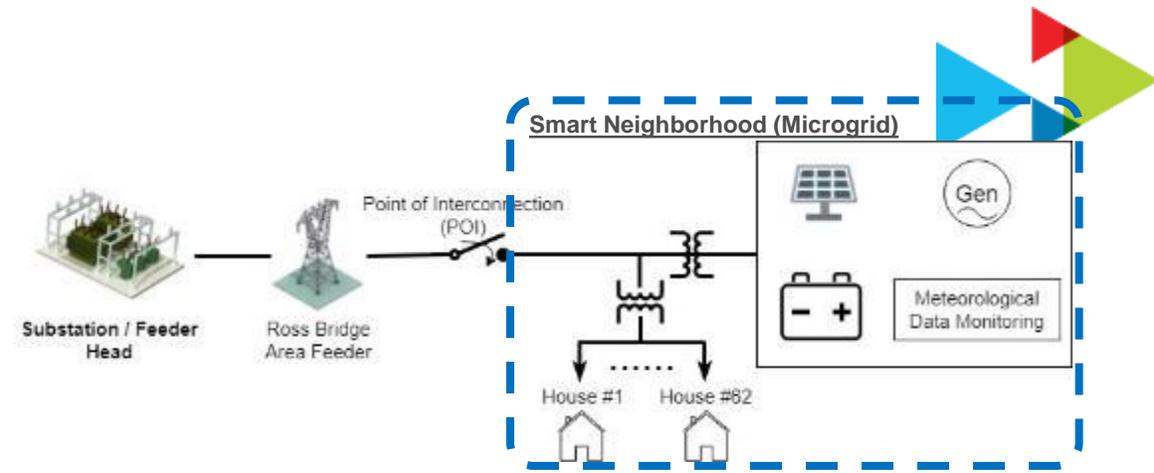
UC1 - Achieving Load Shape Change with Behind-the-Meter DER

- 1.1 - Demonstrating the impact & value of customer load shapes and annual energy use from energy efficient homes
- 1.2 - Demonstrating the value of changing end-use customer load behaviors to change load patterns
- 1.3 - Demonstrating the impact & value of thermal storage
- 1.4 - Demonstrating the impact & value of advanced, high performance HVAC and water heating technologies

UC2 - Optimization of Demand Response

- 2.1 - Demonstrating the effectiveness of enabling demand response control at the single-home level
- 2.2 - Demonstrating the effectiveness of controlling Behind-the-Meter DER (optimizing thermal and comfort settings) across multiple homes

Summary Information

|	Savings (kWh)	Peak (kW)	Summer Peak Reduction	Peak (kW)	Winter Peak Reduction
Smart Neighborhood	44%	3.16		5.08	
Baseline Neighborhood	--	3.77	16.1%	7.71	34.2%

ENERGY EFFICIENCY

Average Household Winter Load (Jan 2018)
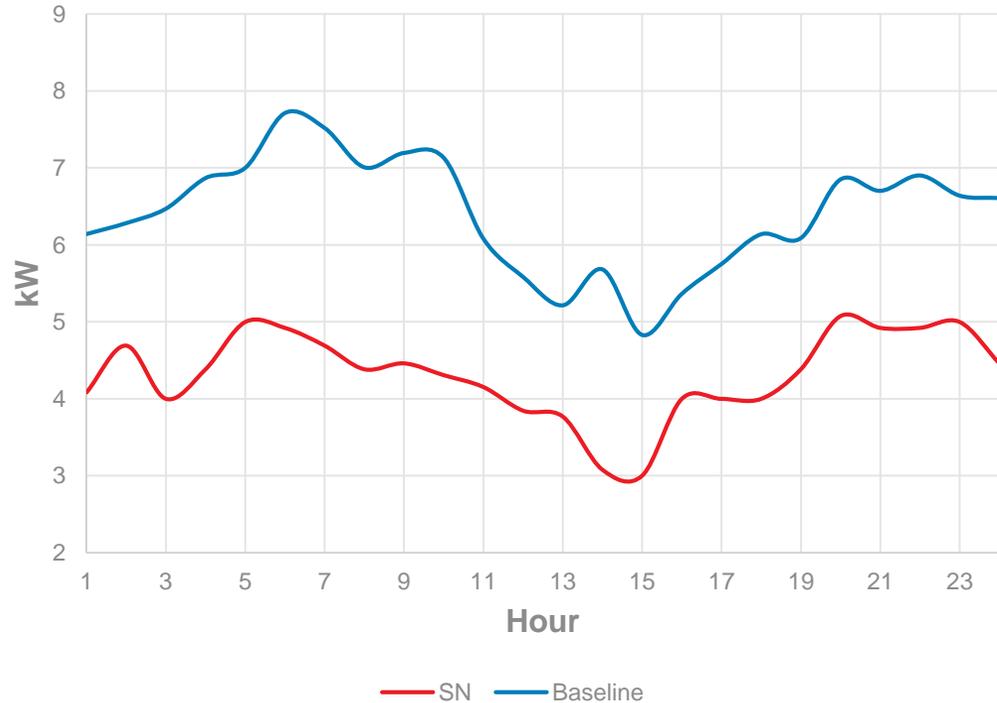
Average Household Summer Load (Aug 2018)
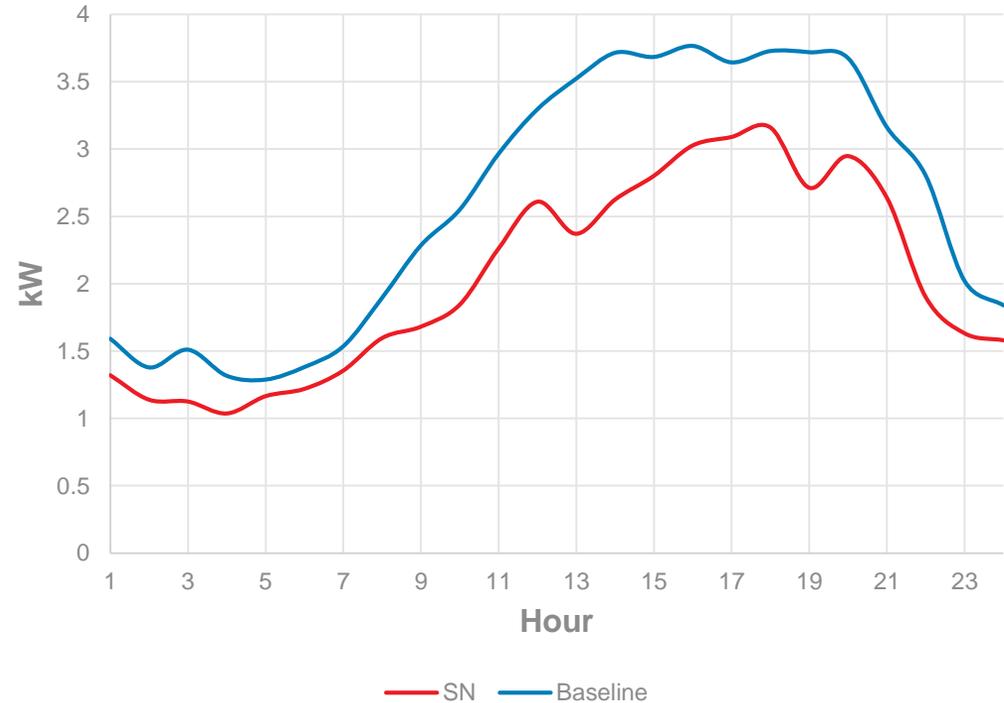
CONSUMPTION BY END-USE

Smart Neighborhood Monthly Usage (KWH)

EV 4.33 (0.59%)
Stove 32.17 (4.40%)
Refrig 35.14 (4.80%)
Dryer 45.37 (6.20%)
WaterHeating 62.33 (8.5...)
Other 211.74 (28.94%)
HVAC 309.75 (42.34%)
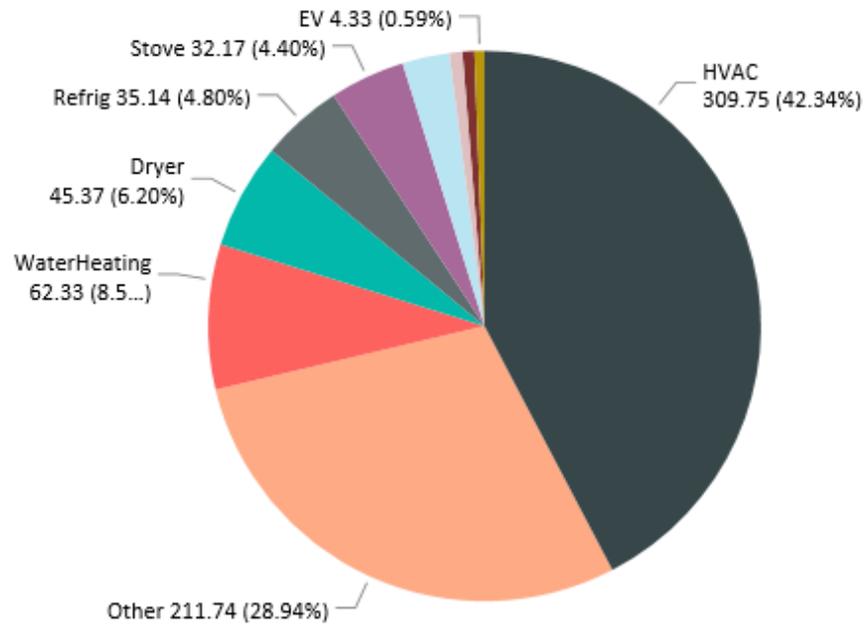
Residential electricity consumption by end use, 2015
percent of total

air conditioning 17%
lighting 10%
TVs and related 7%
clothes dryers 5%
space heating 15%
previously published end uses
new end uses
ceiling fans
air handlers (heating)
separate freezers
cooking
dehumidifiers
microwaves
pool pumps
air handlers (cooling)
humidifiers
dishwashers
clothes washers
hot tub heaters
evaporative coolers
hot tub pumps
water heating 14%
refrigerators 7%
not elsewhere classified 13%

Source: U.S. Energy Information Administration, 2015 Residential Energy Consumption Survey

LOADSHAPE IMPACTS

Average WH Load

SN_HPWH   Elec_WH_ Model
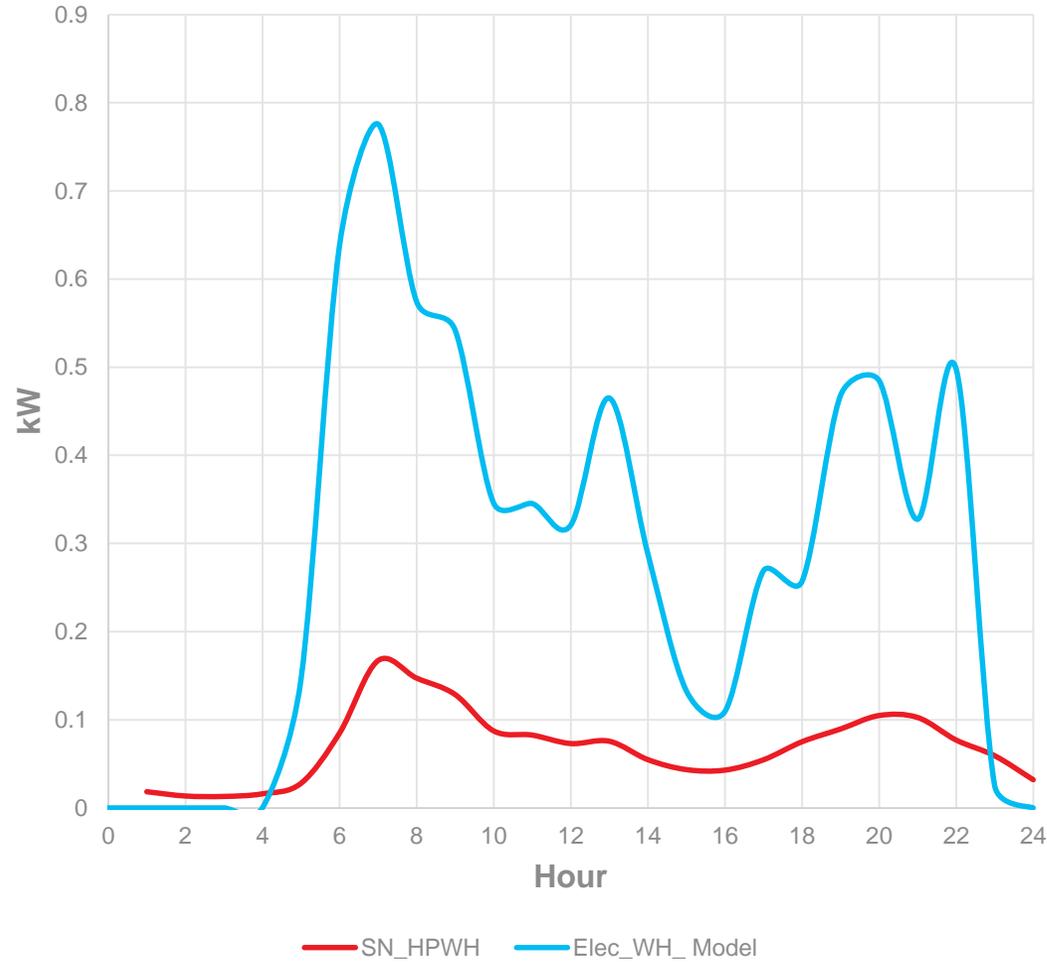
## Average Summer HVAC Load

SN_HVAC   HP_HVAC_Model
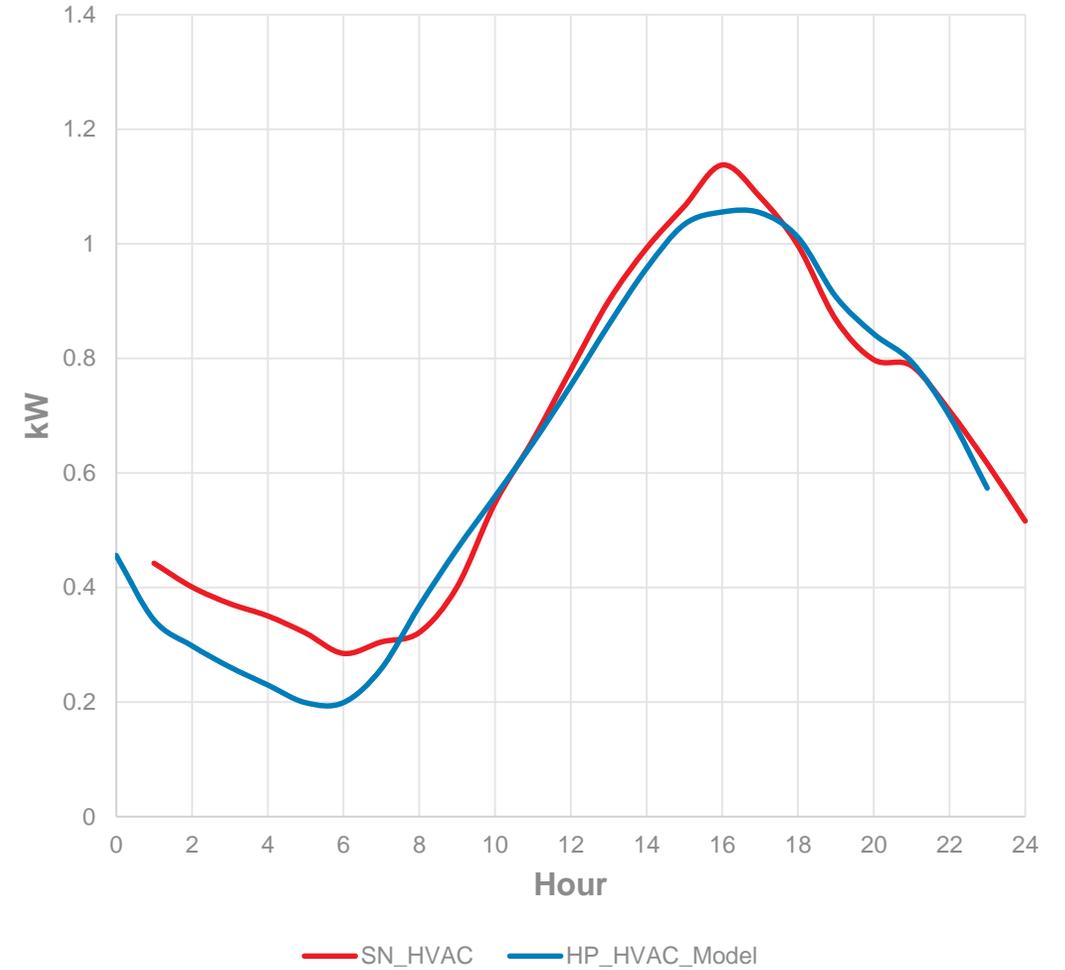
Demonstrate **distributed energy resource (DER)** use cases optimizing cost, reliability, and environmental impact with a **community-scale microgrid**

Smart Neighborhood (grid-connected) Use Cases

Smart Neighborhood (Microgrid)

Substation / Feeder Head — Ross Bridge Area Feeder — Point of Interconnection (POI) — House #1 ... House #62 — Gen / Meteorological Data Monitoring

UC3- Power quality (within the smart neighborhood)

3.1- Base economic dispatch (Maintain a set of energy schedule)

UC4- Distribution grid services

4.1- Utilize DER within microgrid during grid-tied mode to provide primary service support at the point of common coupling and quantify effects on microgrid

4.2- DER provides feeder-level load relief (peak shaving) ⭐

4.3- FOT: Smart Neighborhood becomes a grid capacity asset by

UC5- Operational cost reduction

5.1- Evaluation of PV and Battery operations using combinations of electricity price (LMP), weather conditions, and load variations ⭐

5.2- Evaluation of utility rates – Comparing traditional TOU rates versus transactive controls ⭐

UC6- Additional stacked services

6.1- Realizing a secondary benefit through DER Operations ⭐

⭐ Feasibility Study

TRANSACTIVE CONTROLS
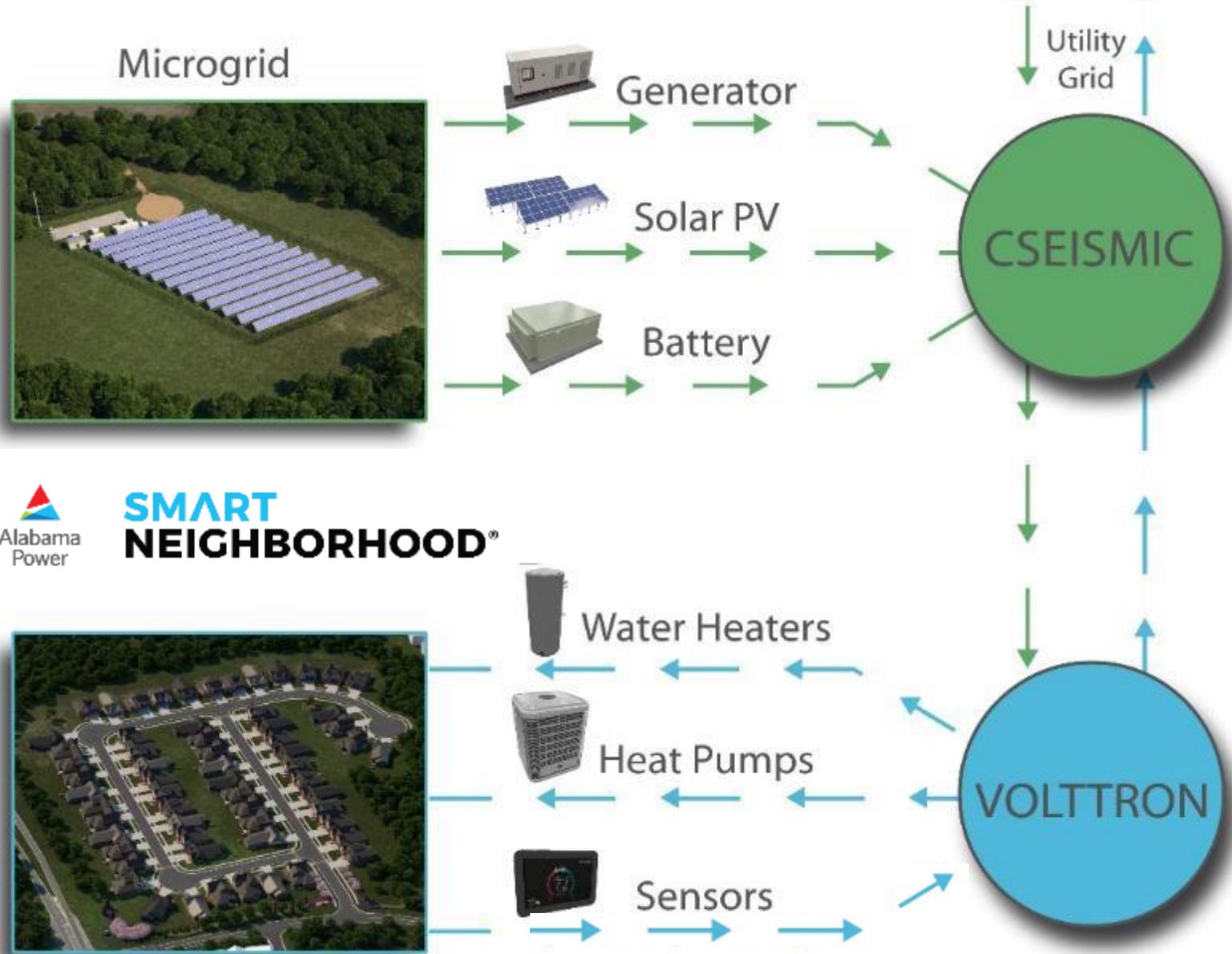
WATER HEATER CONTROLS

HVAC CONTROLS

Home volttronuaag1 - Iteration 960 - Mode Auto - Override=False

Home volttronuaag1 - Iteration 960 - Z1 Manual - Z2 Manual

Home volttronuaag1 - Iteration 960 - Mode Auto

Home volttronuaag1 - Iteration 840 - Mode Auto - Override=False

Home volttronuaag1 - Iteration 840 - Z1 Manual - Z2 Manual

Customer Override

Pre-Heat

Avoid Peak Demand