Smart Neighborhoods
(aka Connected Communities)

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Southern Company R&D – Smart Buildings, Load Flexibility
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Southern Company

Research & Development

Southern Company Smart Neighborhood Initiatives

Understanding tomorrow's home today

Two first-of-a-kind smart home communities at the intersection of energy efficiency, distributed energy resources & buildings-to-grid integration and the traditional utility model

Georgia Power Smart Neighborhood™

- 46 townhomes
- Atlanta, Georgia
- Homeowner owned solar + storage
- Grid integration of solar, storage, HVAC, water heating & EV charging

Alabama Power SMART NEIGHBORHOOD®

- 62 single-family homes
- Birmingham, Alabama
- Utility owned, grid-connected microgrid
  - → 330 kW solar
  - → 680 kWh storage
  - → 400 kW NG generator
- Grid integration of microgrid, water heating & HVAC

Major Research Partners

Electric Power Research Institute and
U.S. Department of Energy's
Oak Ridge National Laboratory

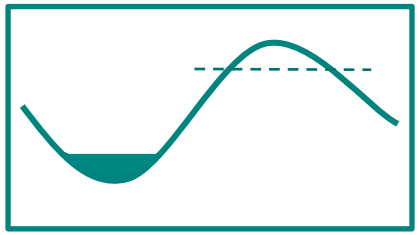
Key Vendor Partners

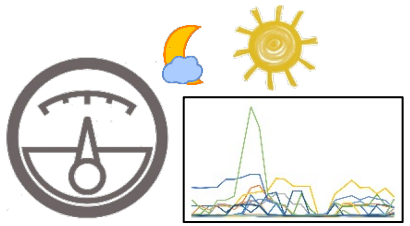
LG Chem, Delta, Carrier, ecobee, Rheem, SkyCentrics, Flair, Vivint, Pulte Homes, Signature Homes

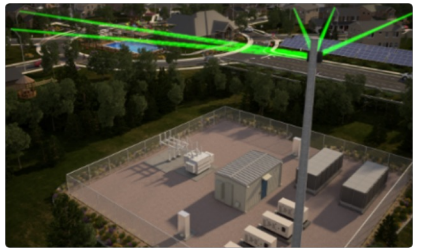
Key Results

Homes are 30-40% more efficient
EV makes up 15-20% of total usage
Successful microgrid islanding
New business opportunities deployed

Project Objectives







High Performance Homes	Manage Behind-the-Meter Assets	Potential Revenue & Rate Design Impacts	Renewable Energy Grid Integration
Load shifting	Energy Use Optimization	Informed Load Forecasting	Localized solar + storage
Tighter envelope	Buildings as a resource	New building codes & standards	New infrastructure needs
Advanced Building Energy Systems	Create load shapes	How to price energy with tech options	Balance grid & customer benefits

Connected Devices in Home

- Volttron
- CSEISMIC
- Pricing Signals
- Weather
- Solar forecasts
- Other relevant data

Southern Company's RES

ecobee Cloud

Delta Cloud

Flair Cloud

SkyCentrics Cloud

SiteSage Cloud

Relevant data **from** devices

Relevant settings or commands **to** device

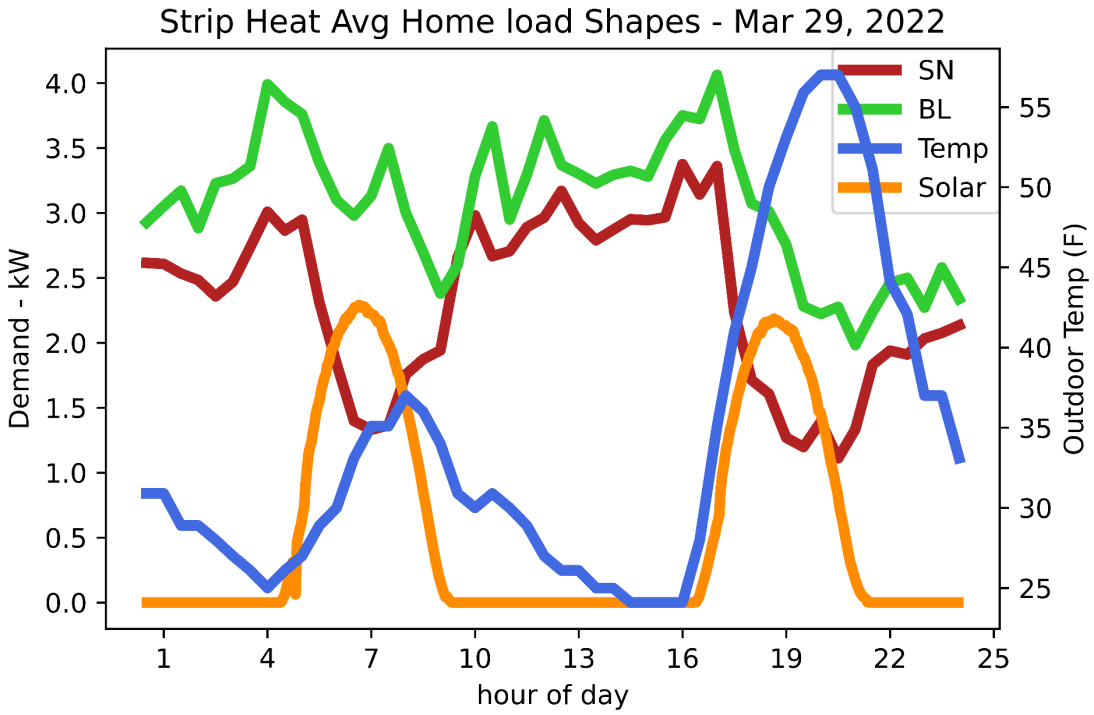
Energy Monitors

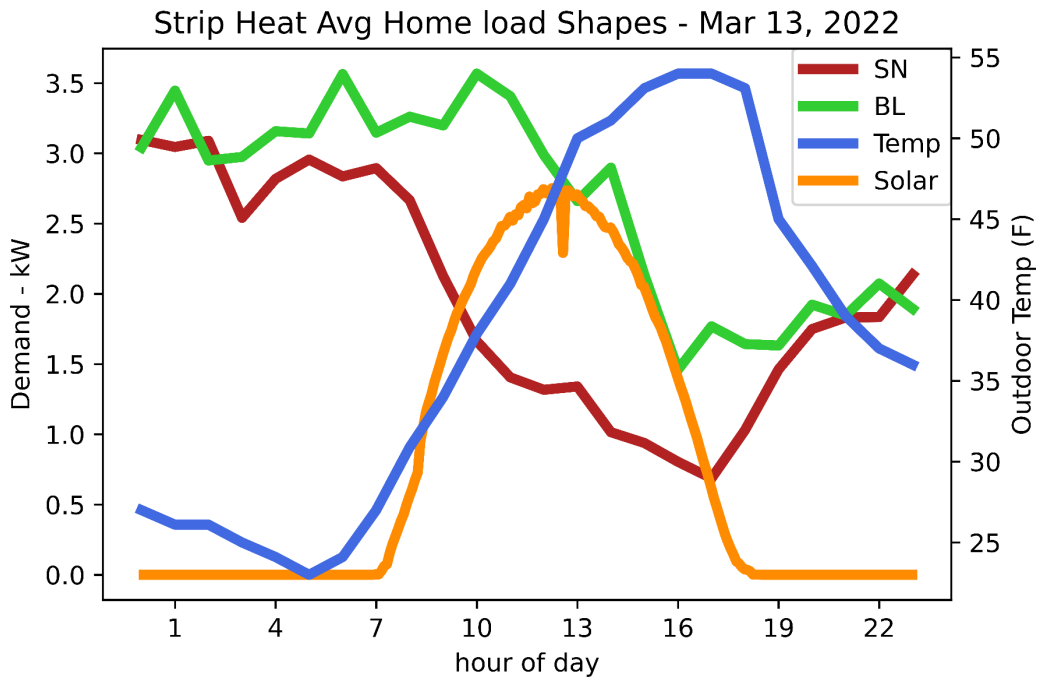
Minisplit Controller

Battery & Solar

Component Level Performance – Heat Pump Winter Efficiency

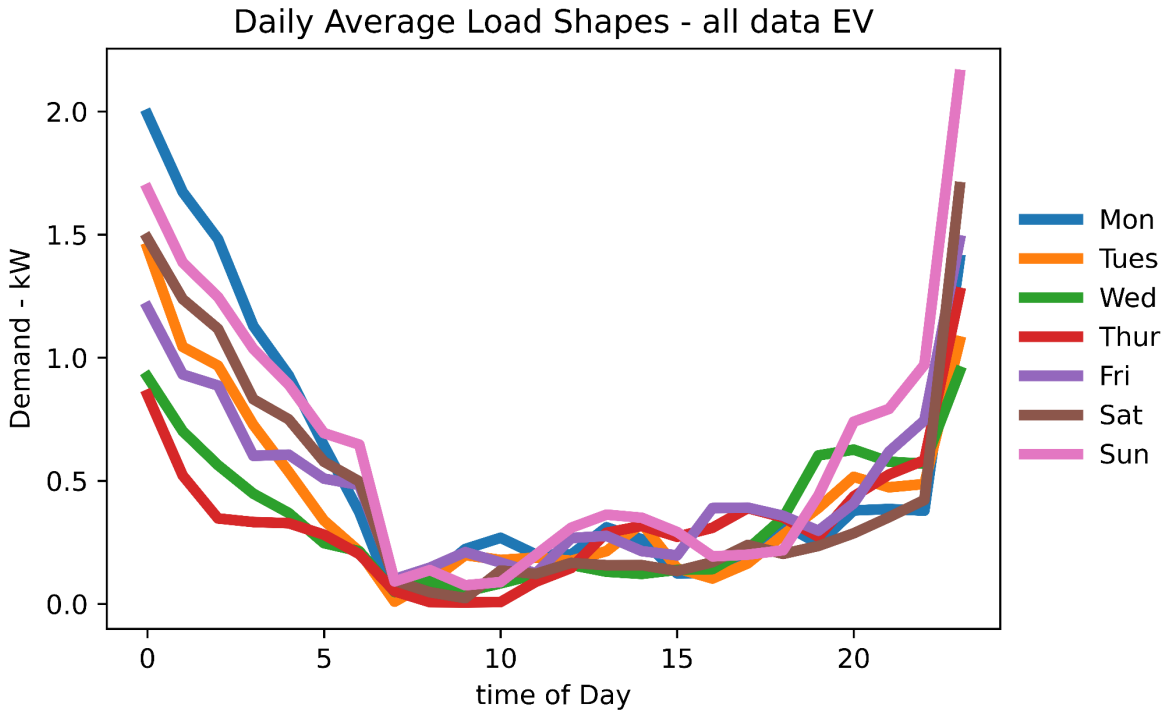
- On the coldest mornings of the year, the SN homes reduce the winter peak by approximately 1 kW on average
  - This is with no control and comes from envelope upgrades & higher efficiency heat pumps

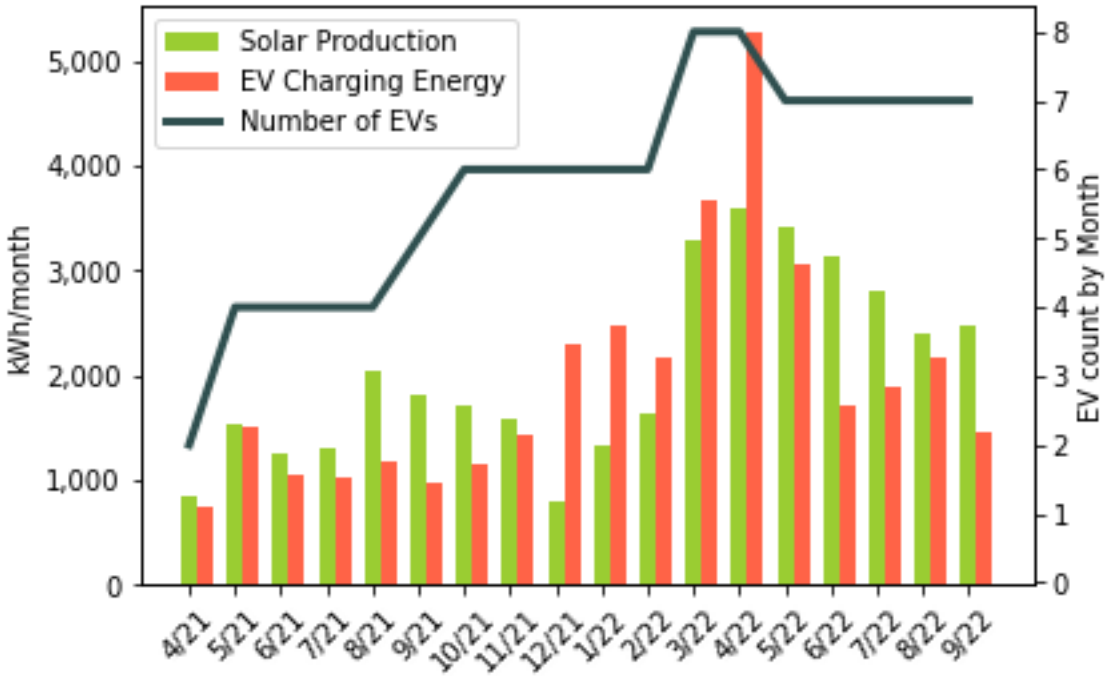




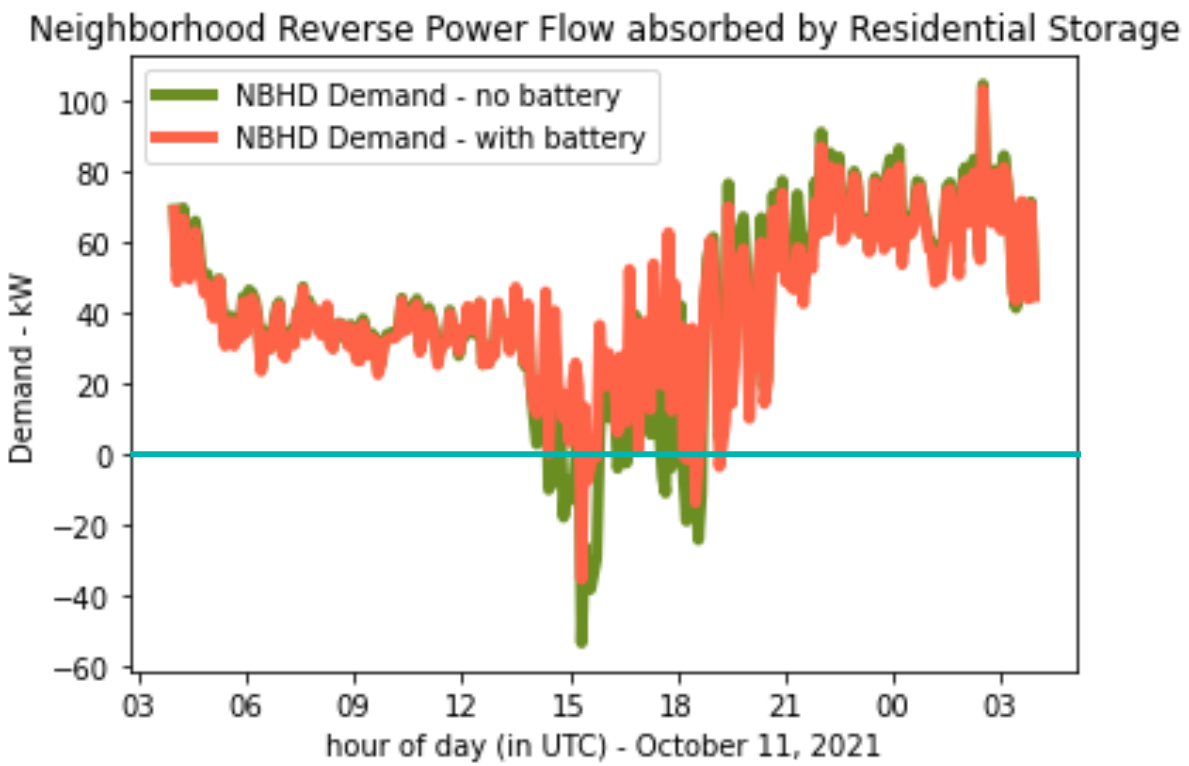
Component Level Performance – EV Load Shapes & Solar

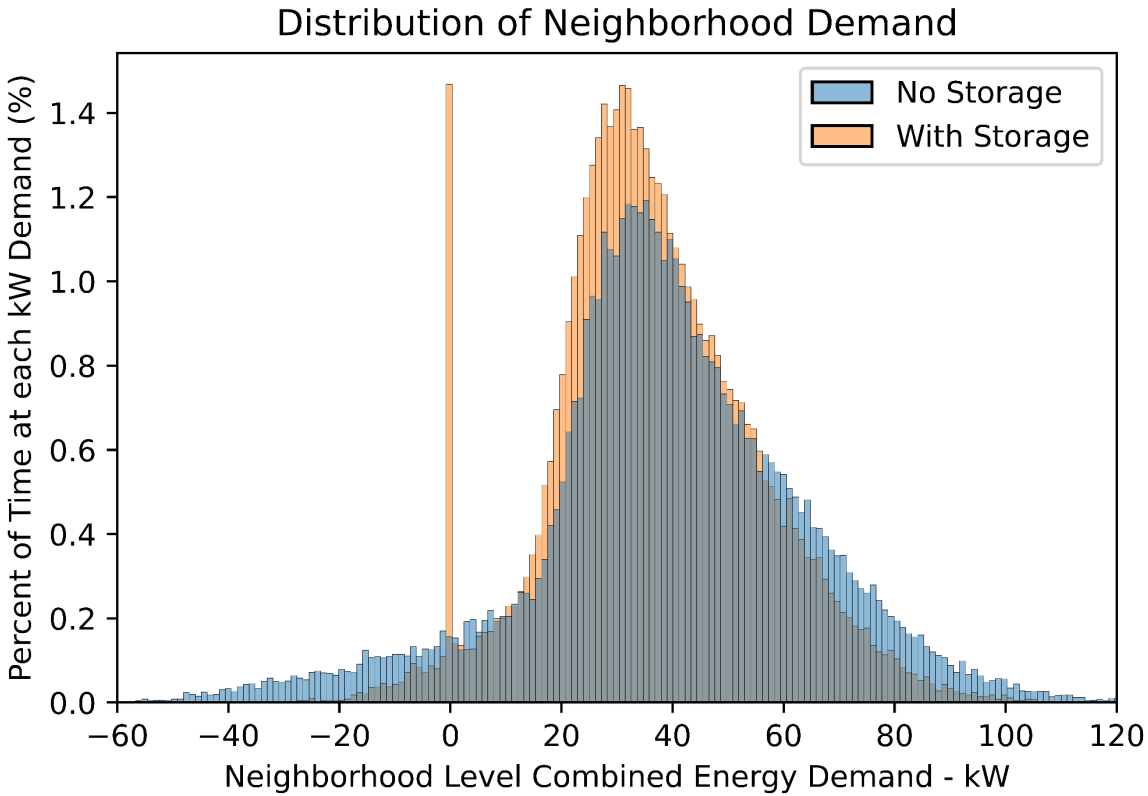
- 8 of the 46 homes have at least one EV
- On Average, at-home EV charging uses about the same energy as a small rooftop PV system generates



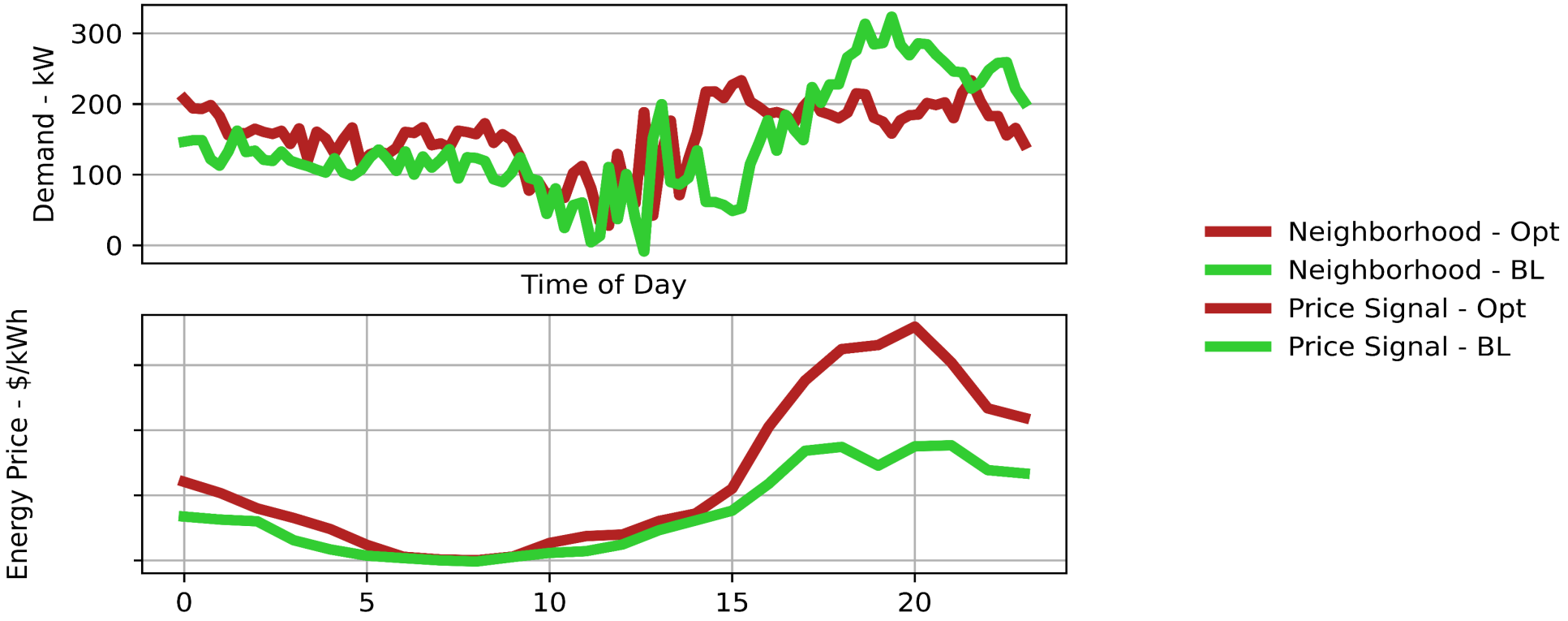


Benefits of pairing storage with Solar



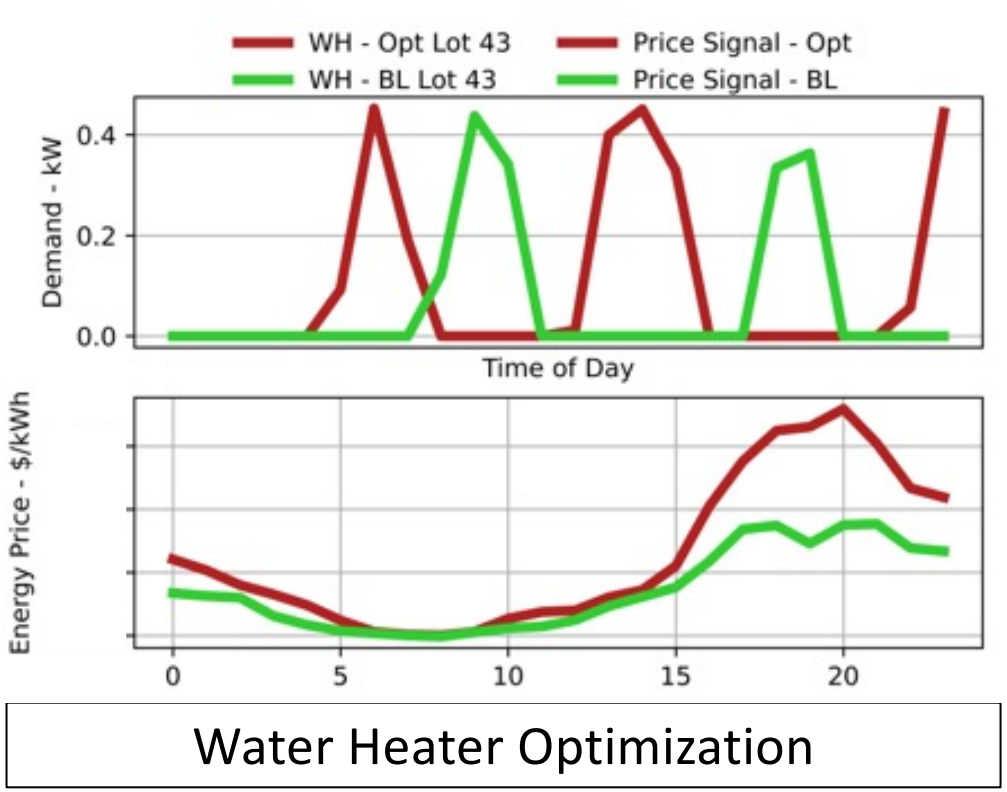


Home Energy Optimization Results

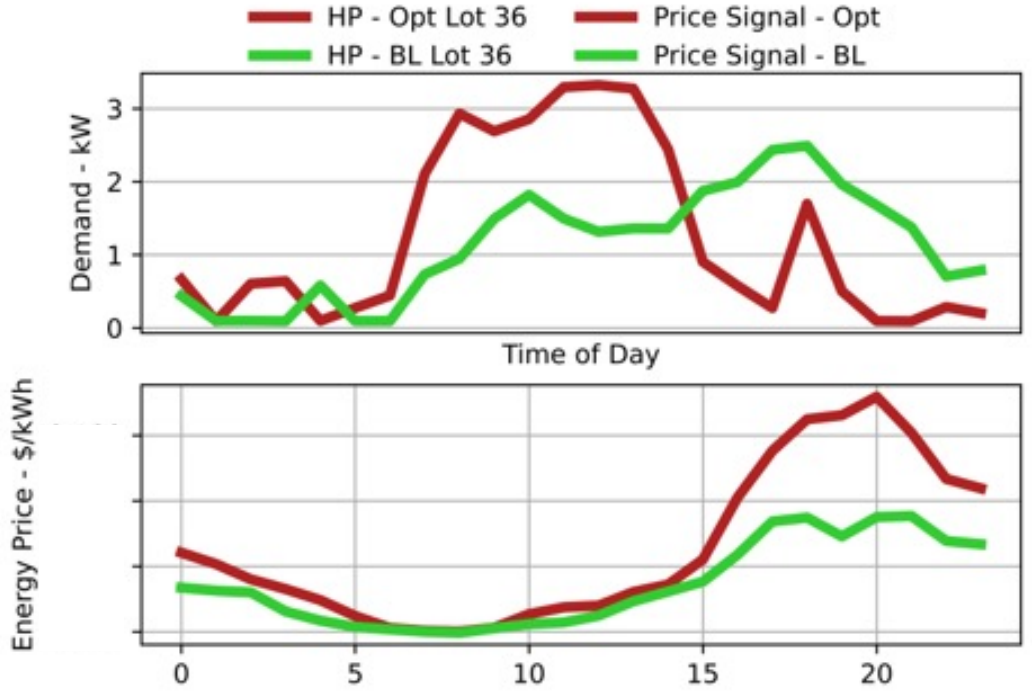


- Controls receive forecasted System Grid price and shifts HVAC, Water Heating & storage to minimize costs while maintaining comfort
- As prices increase, the controller attempts to minimize demand

Device Level Optimization Results



Water Heater Optimization



HVAC Optimization

- Reinforcement Learning/Model Predictive Controls use granular device level data collection to forecast energy usage and control impacts

Atlanta: Energy Efficiency Stats

42% less energy purchased & 25% energy savings annually compared to homes with the same floorplan

Homes average selling back 873 kWh of energy to GPC from the solar

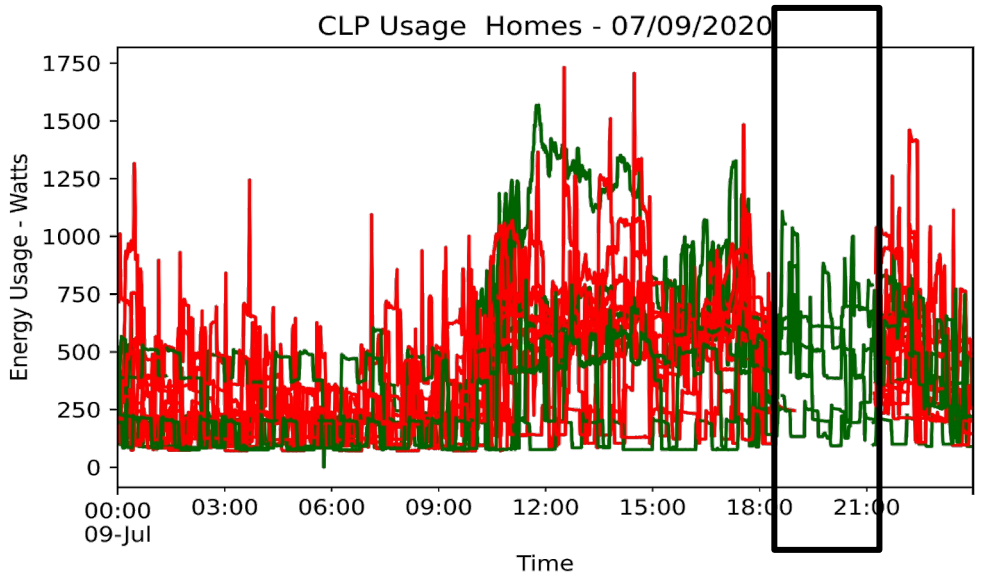
Winter Demand is 30% lower (heat pump & water heater driven)

Summer demand is 62% lower (heat pump & solar driven)

9.3 tons of CO_2 is avoided per home compared to homes with the same floorplan

Some Lessons Learned

- It takes a lot of parties to bring a Smart Neighborhood together, each with different objectives – who leads to scale this?
- Newly commercial technologies still have issues
  - Lack of design experience
  - Lack of operational understanding
  - Unfamiliar installation challenges
- Data collection, storage and usage are not simple
  - Firmware updates can change data formats
  - Short Notice API Changes
- Device Connections from house to cloud
  - About half the homes are fully connected after ~ 2 years with reconnect visits
- Homeowner perception – balancing transparency and oversharing
- Local device features (ecobee's eco+) can fight against control signal



Connected Communites Barriers / Gaps

#	Gap	Lead	Key Support Role in Next 2 Years?
1	Quantification of Device Level and Building Level Grid Service Capabilities	R&D	N/A
2	Seamless Device Installation/Onboarding and Ongoing Information & Control	R&D	N/A
3	Planning & Operations Tools (may vary by application)	R&D	N/A
4	Data Management & Cyber Security	TO	Yes
5	Customer Appetite	Marketing	Yes
6	Regulatory Considerations	Regulatory Affairs	No
7	Utility Business Case (including Grid Services Valuation)	System Planning / Marketing / New Ventures	Yes
8	Legal (e.g. Data Privacy)	Legal / Regulatory Affairs	No
9	Planner & Operator Trust	System & Dist. Planning	Yes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