VAEEC 2021 ENERGY EFFICIENCY FORUM

Getting Smarter with Energy Efficiency Technology

November 15th, 1:05-2:20 pm

Sponsored by Virginia Natural Gas
An AGL Resources Company

AGENDA

Getting Smarter with EE Technology

- Google Energy Solutions
- Smart Communities in AL and GA
- Urban Planning and Energy Technology
- Q&A

Sponsored by Virginia Natural Gas® An AGL Resources Company

Keven Brough
Google

Phil Markham
Southern Company

Damian Pitt
Virginia Commonwealth University

KC Bleile
Viridiant
Moderator

Sponsored by Virginia Natural Gas

VAEEC Smart Communities Discussion

November 2021

A Google Perspective

- Philosophy (from my perch)
- Products
  - EIE
  - Renew
- Policy

Product Overview

At Google, we build technology that helps people do more for the planet.

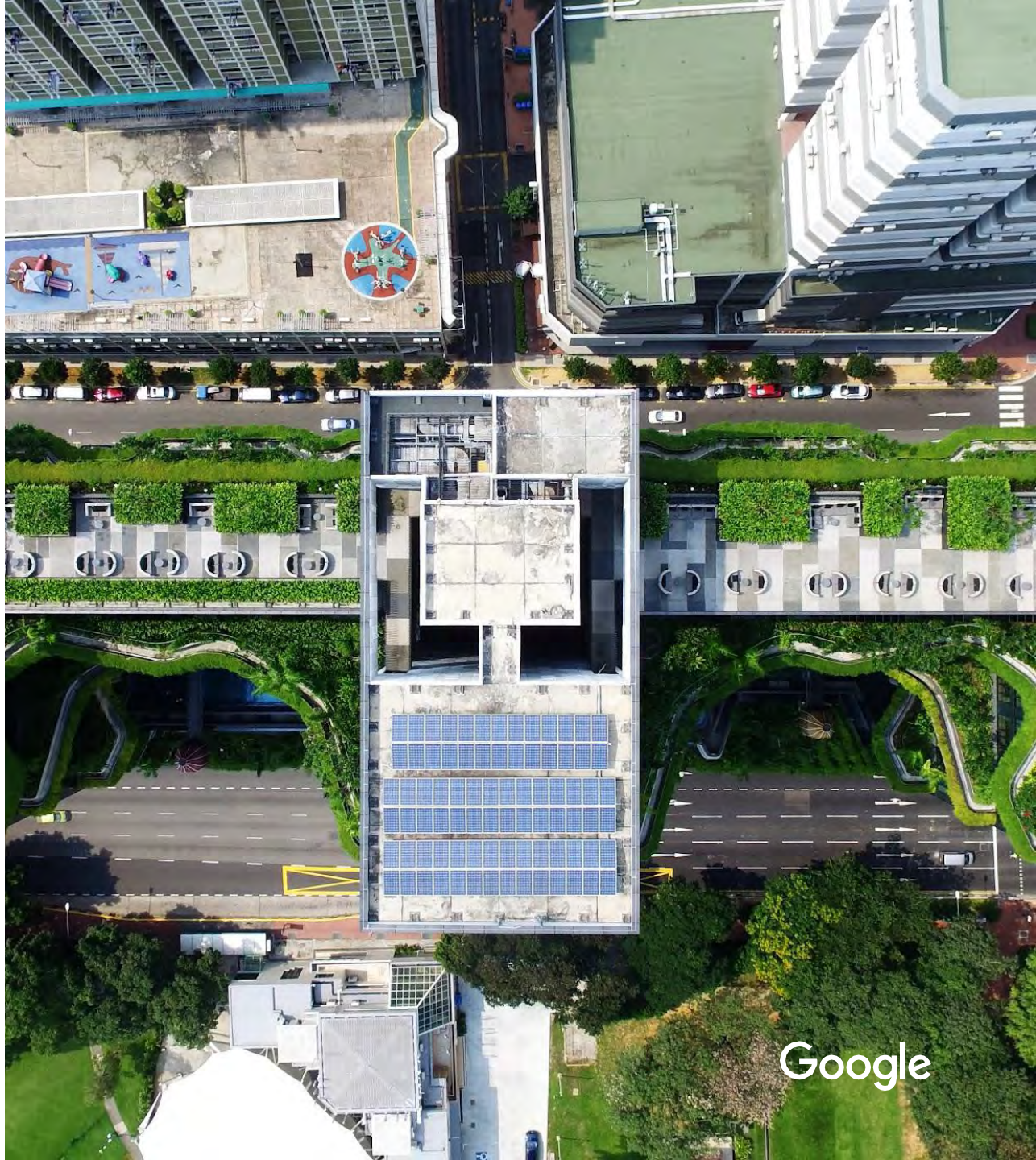
The global state of climate change requires action - and the time to act is now

2030

CO_2 emissions need to be cut in half

2050

achieve carbon neutrality



Our third decade of climate action: realizing a carbon free future.

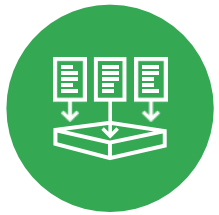
Help over 500 cities or local governments reduce

1 gigaton

of carbon emissions annually by 2030 and beyond.

Product Overview

Cities are central to climate change action, contributing 70% of the world's CO2 emissions. However, lack of data and insights have made it challenging to take action.



Data

Time

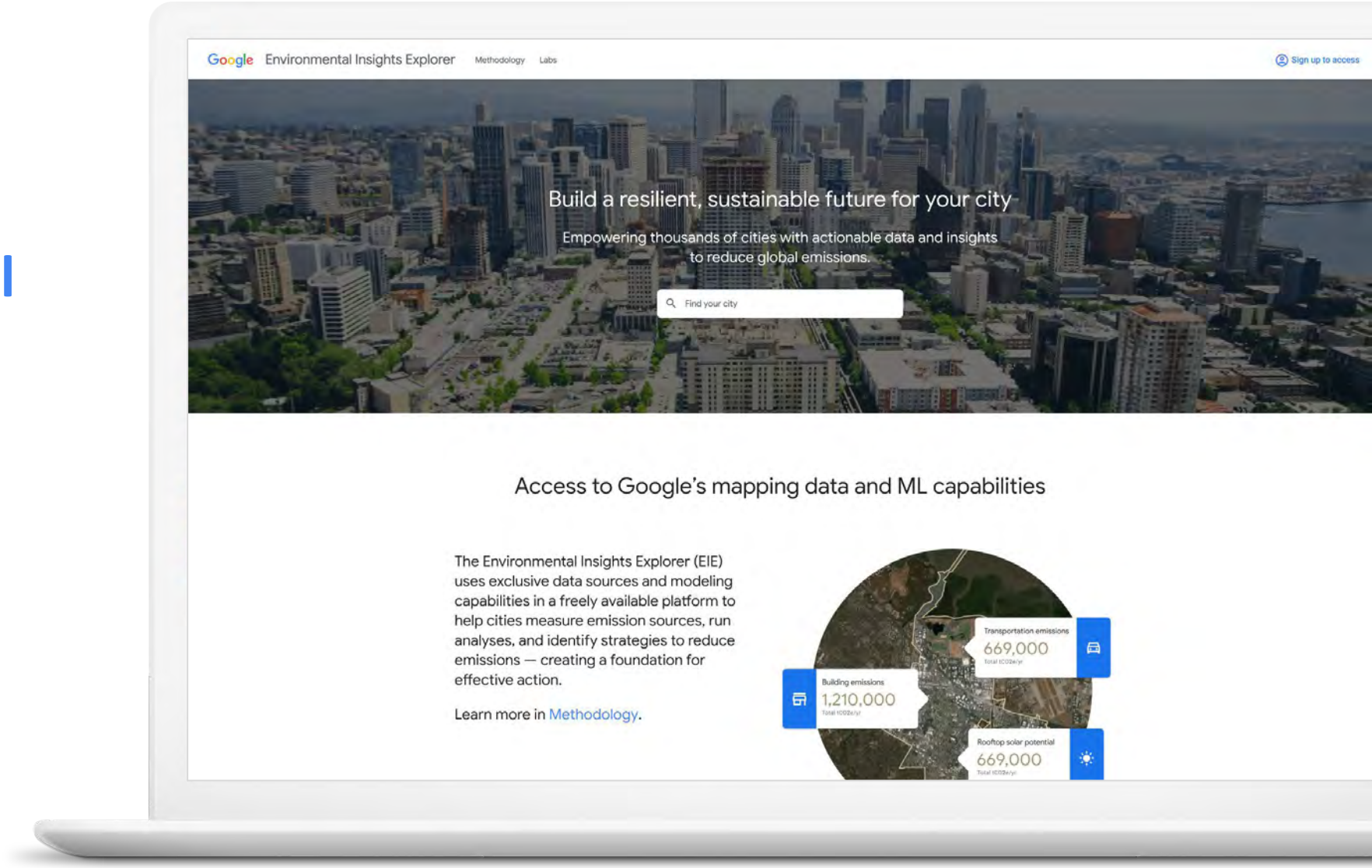
Expertise

Resources

Data access is limited and costly

The Solution:
The Environmental Insights Explorer

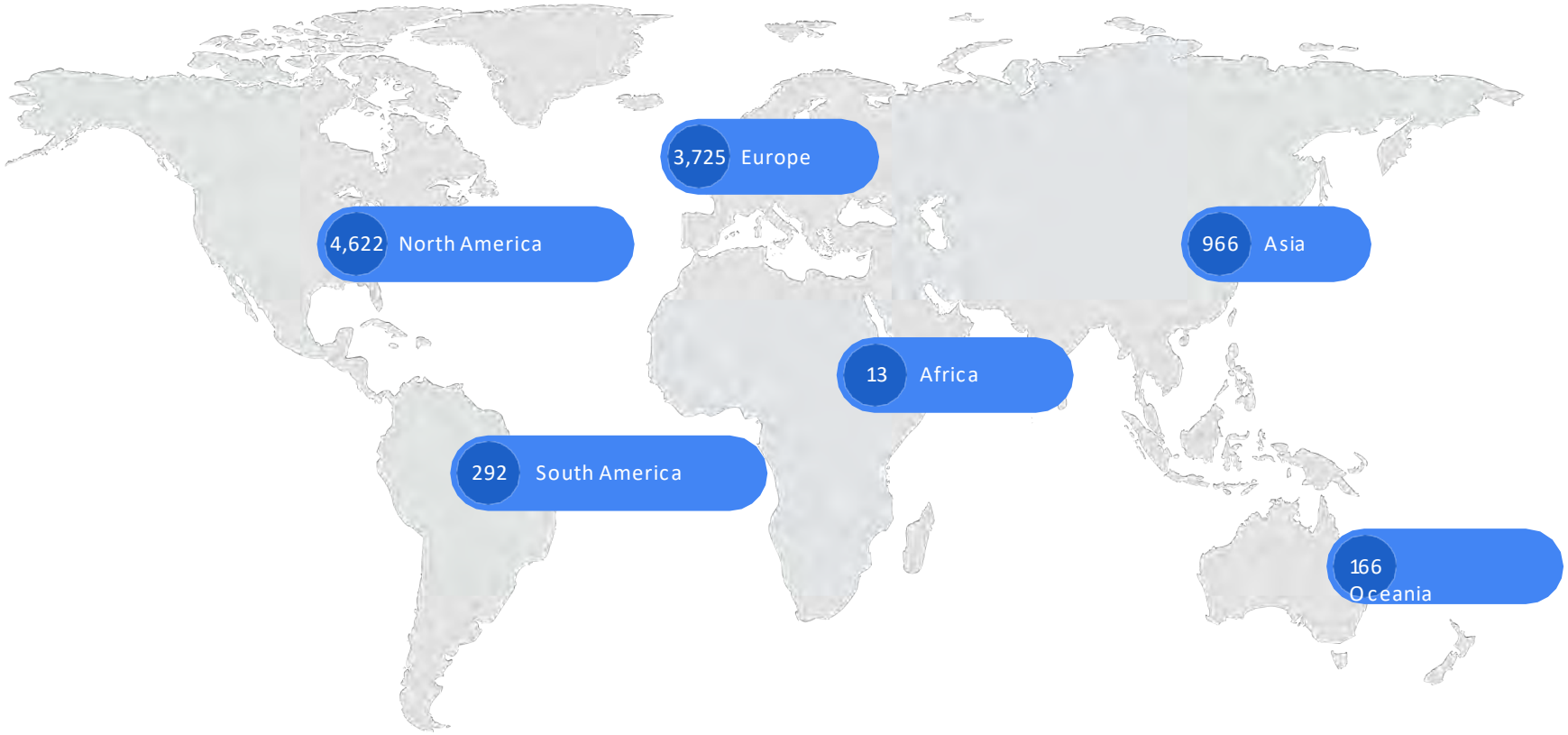
Providing trustworthy, timely insights to accelerate climate action through data-driven decisions.



Product Overview

Today, EIE is accessible to thousands of cities worldwide.

To browse current set of cities, go to….



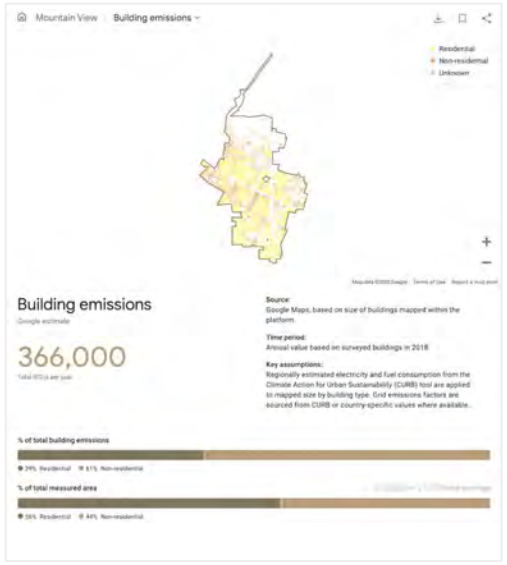
9,000+

City datasets currently available

EIE helps cities address and measure climate impact in 4 ways

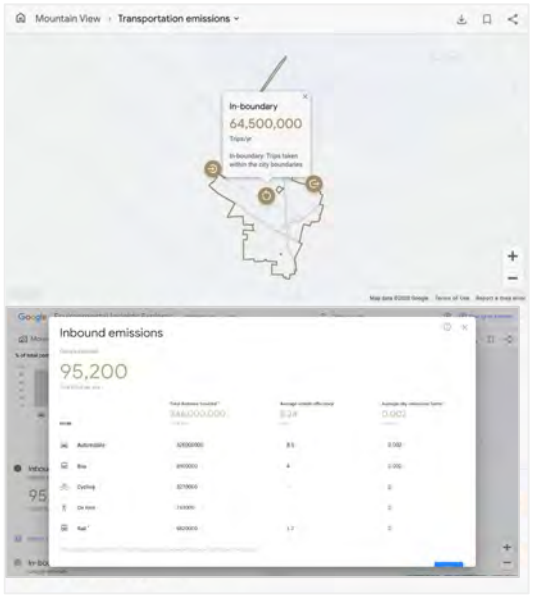
Measure

Estimate your city's greenhouse gas (GHG) emissions



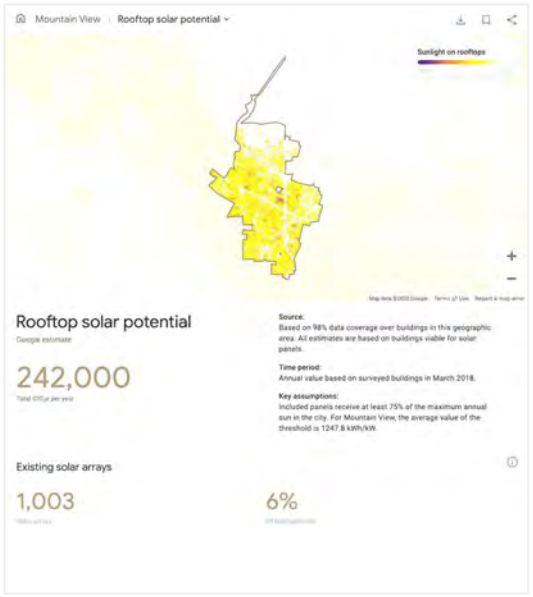
Plan

Run scenarios based on granular levels of data and adjustable inputs



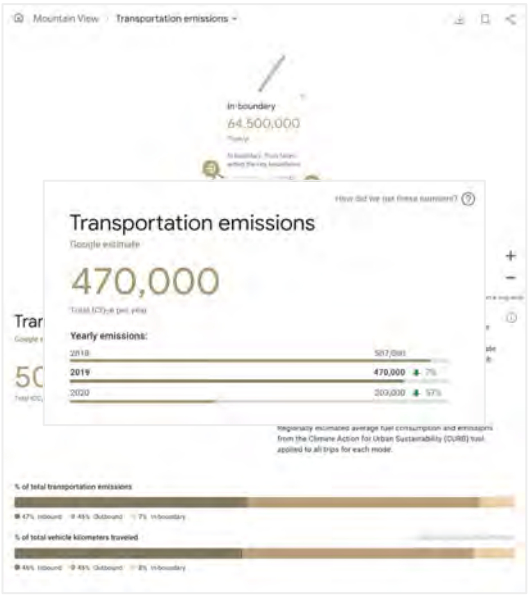
Act

Inform mitigation goals and identify reduction opportunities

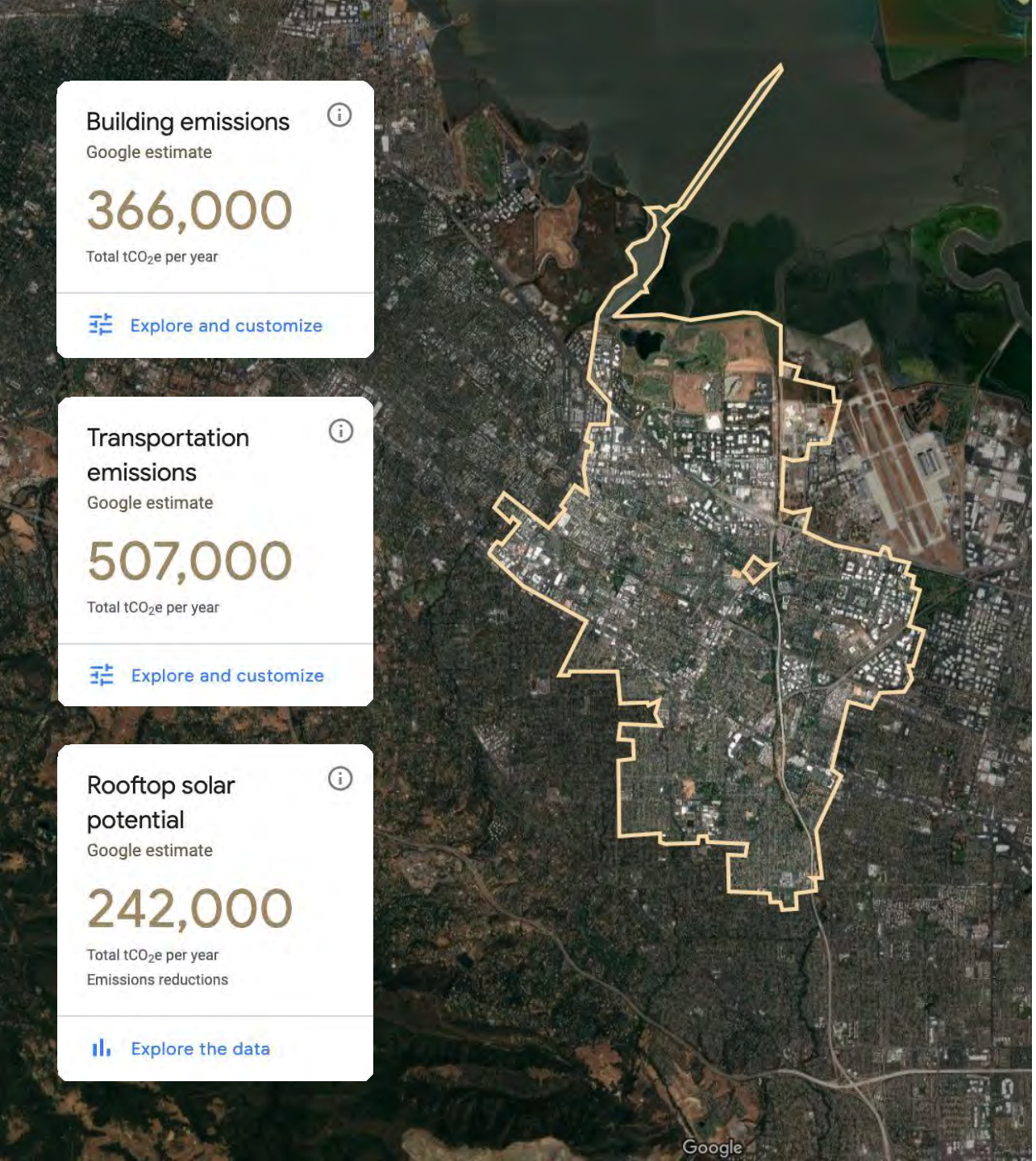


Track

Monitor progress in meeting goals and the effects on human health



Product Overview



EIE data serves insights across three key areas:

- Building emissions
- Transportation emissions
- Rooftop solar potential
- New data pilots (Tree Canopy, AQ)

Product Overview

Cities are the primary actors

Supporting staff in the offices/ departments of Environment & Sustainability

Lara Cottingham
Chief Sustainability Officer
City of Houston, TX USA

Consultants and Conveners are helpers

Collaborate with key organizations & NGOS that governments rely on to complete climate action plans.

Consultants
Greenlink Analytics
Providing clean energy expertise and consulting.

Conveners
Global Covenant of Mayors
Represent networks of governments prioritizing climate.

EIE partners with external organizations and providers of climate tools in the industry:

GLOBAL COVENANT of MAYORS for CLIMATE & ENERGY OCEANIA

C40 CITIES

ICLEI Local Governments for Sustainability EUROPE

dunsky

greenlink

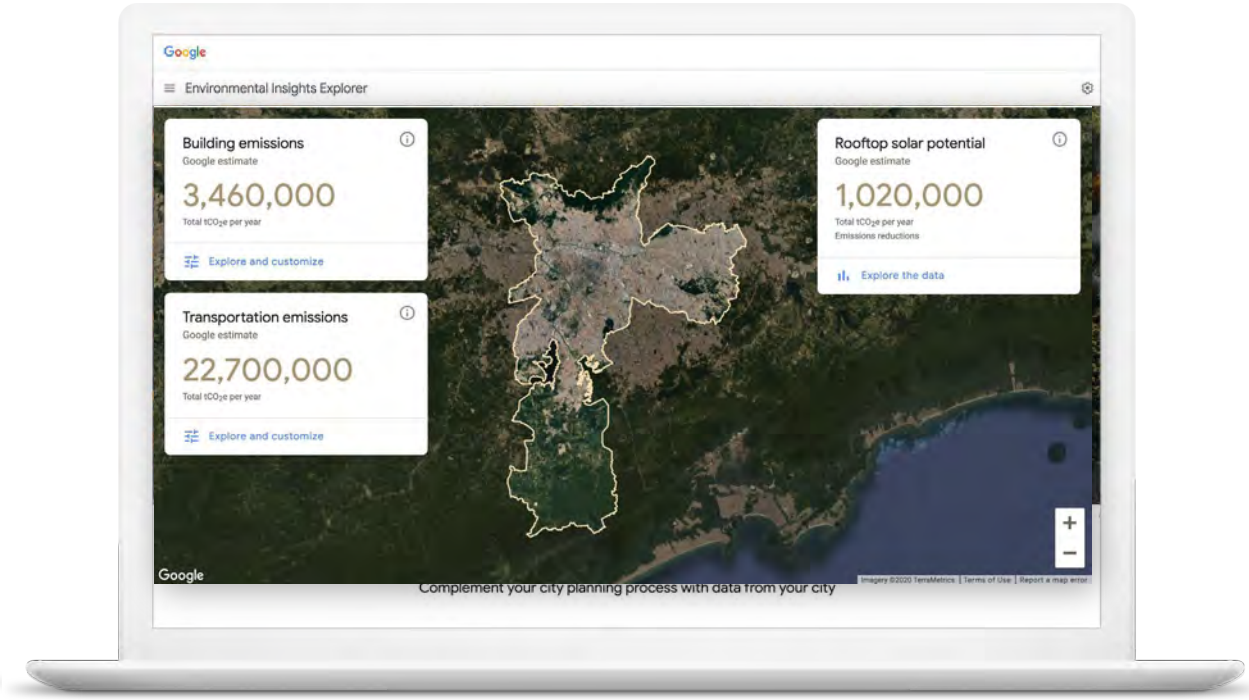
ICLEI Local Governments for Sustainability USA

Ironbark Sustainability

beyond ZERO emissions

Product Overview

[View EIE Tutorials]

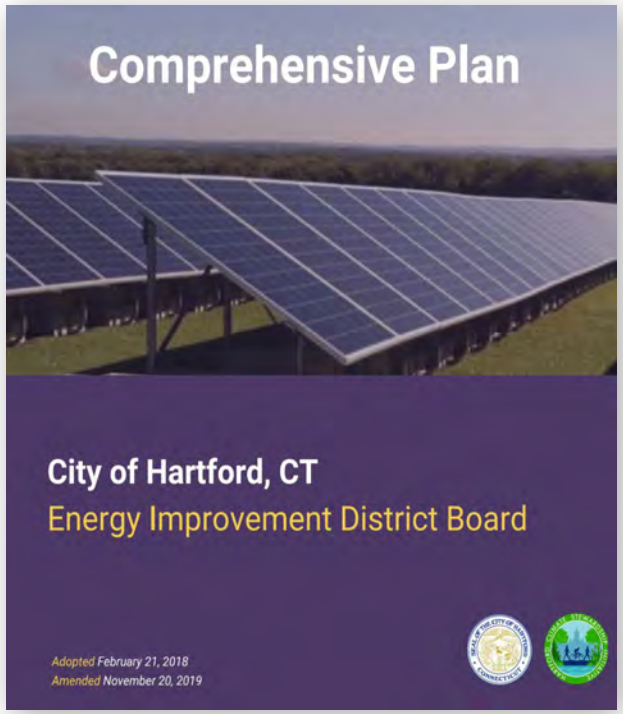


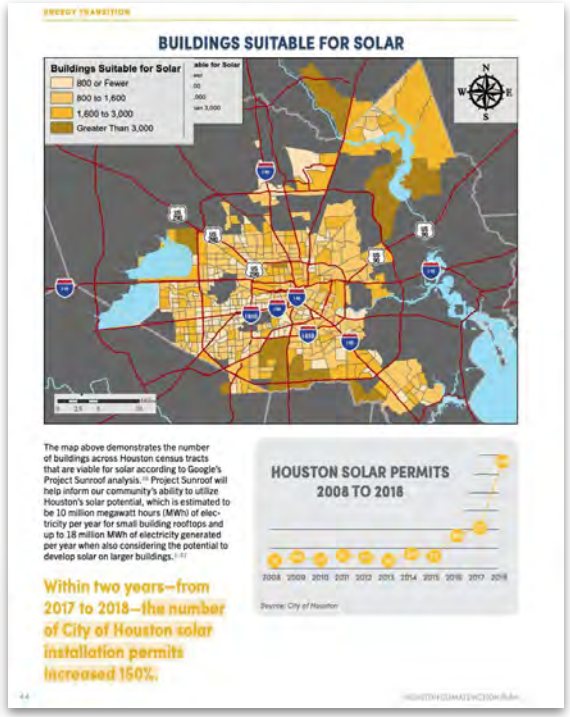
[Explore the EIE Site]

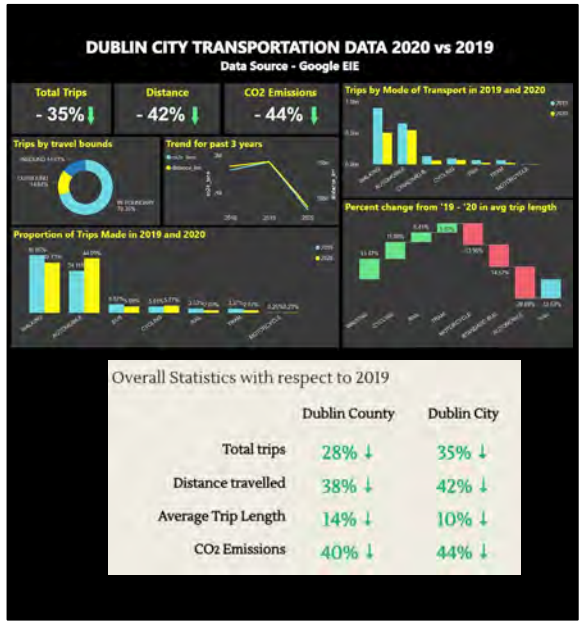
Google

Product Overview

Supporting Governments to reduce emissions and protect vulnerable populations



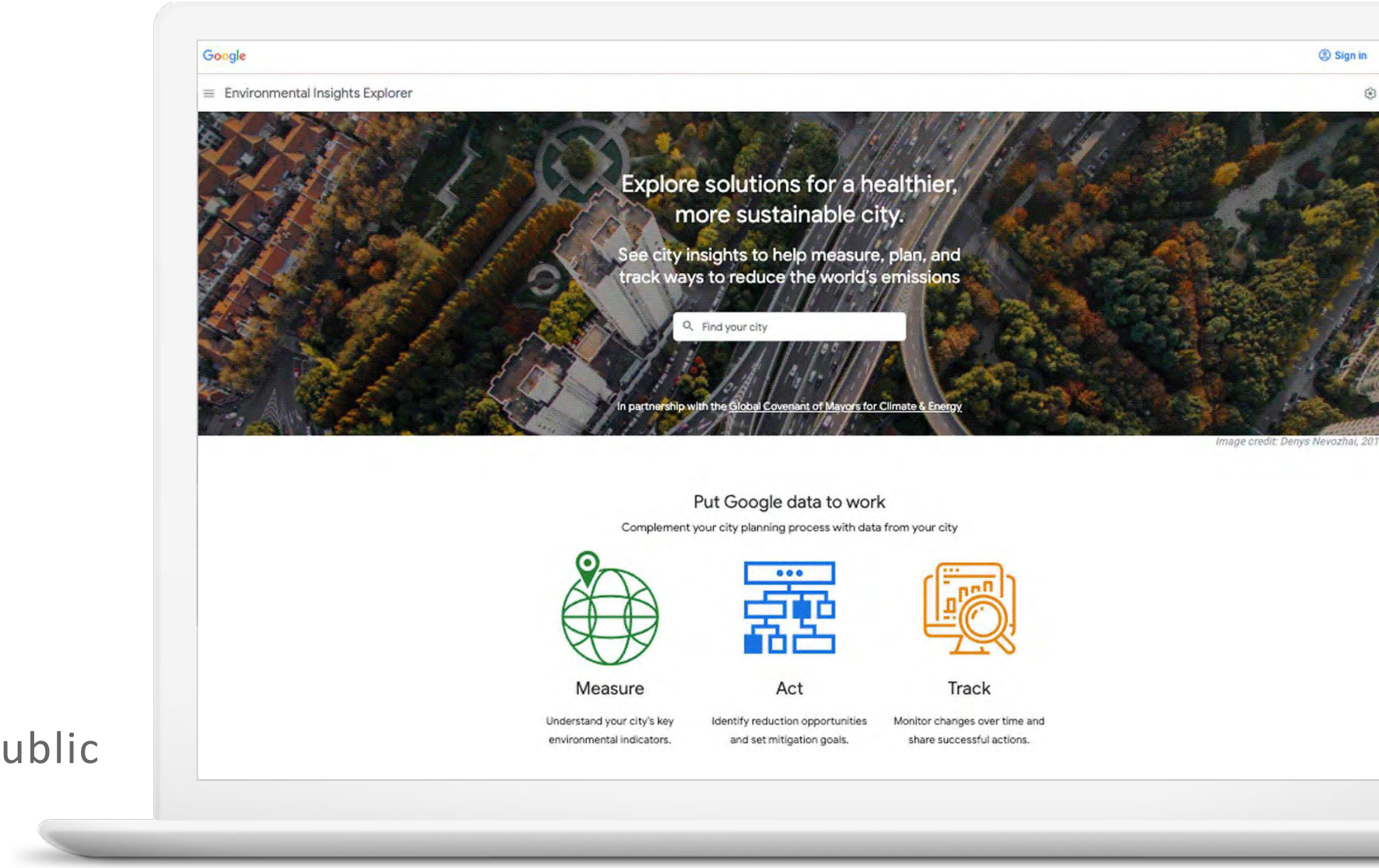




Product Overview

At the Insights Workspace you can:

1. Test drive EIE data
2. Incorporate data into planning efforts
3. Share data across departments and the public



Nest Renew

A service for your Nest thermostat that makes it easy to support a clean energy future, right from your home.

Getting more clean energy on the grid is key to addressing climate change.

- And a smart, dynamic grid
- needs smarter homes.

Nest thermostats have helped customers save over 80B kWh — enough to power 23M electric cars for a year.


But people want to
do more.

There are two questions we want to answer with Nest Renew

Present

How can we help make better use of the clean energy on the grid today?

Future

How can we help support the growth of clean energy?

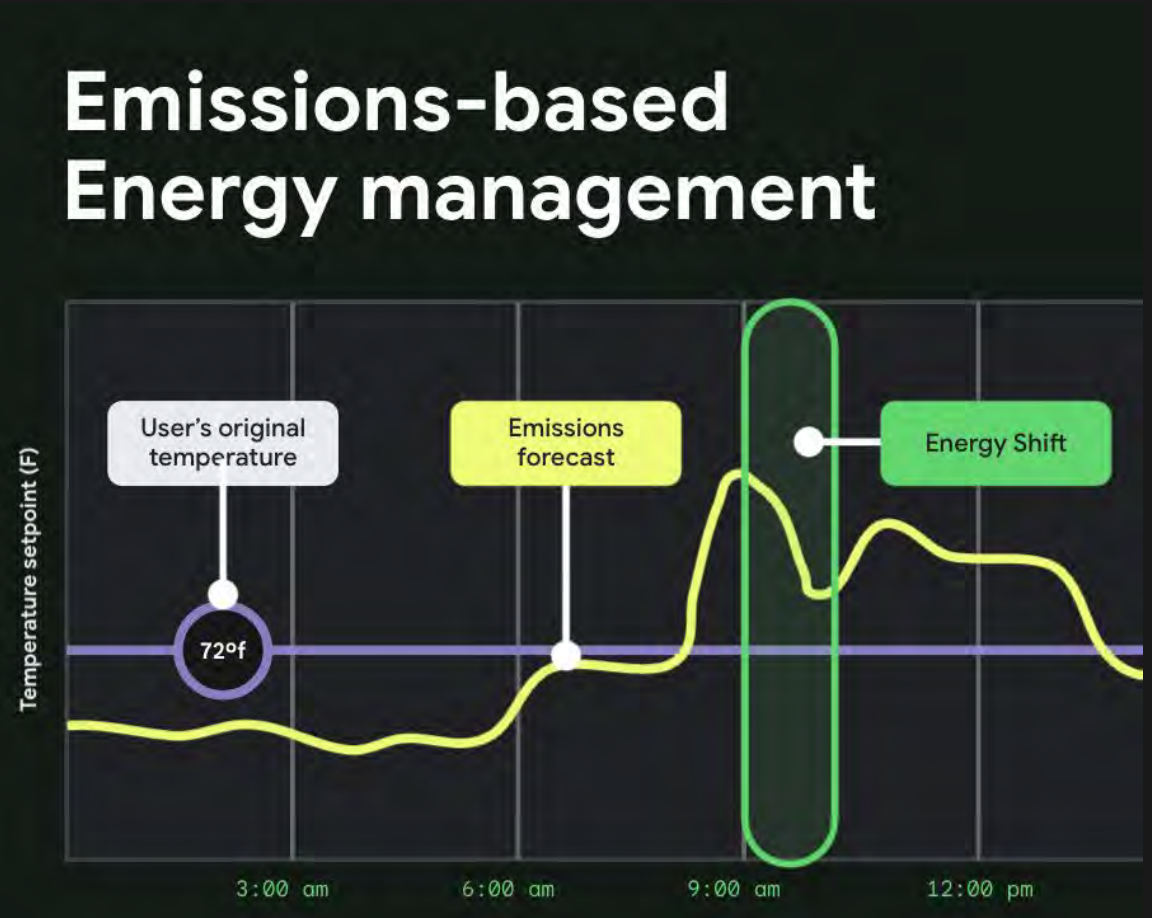
See Your Power

Gives customers the ability to see when the electricity serving their home is cleaner - and when it’s not so clean - so they can take additional actions around the house to increase impact.

Even a few actions when the grid is not so clean, like turning off extra lights or running the laundry a little later, can start to really add up.

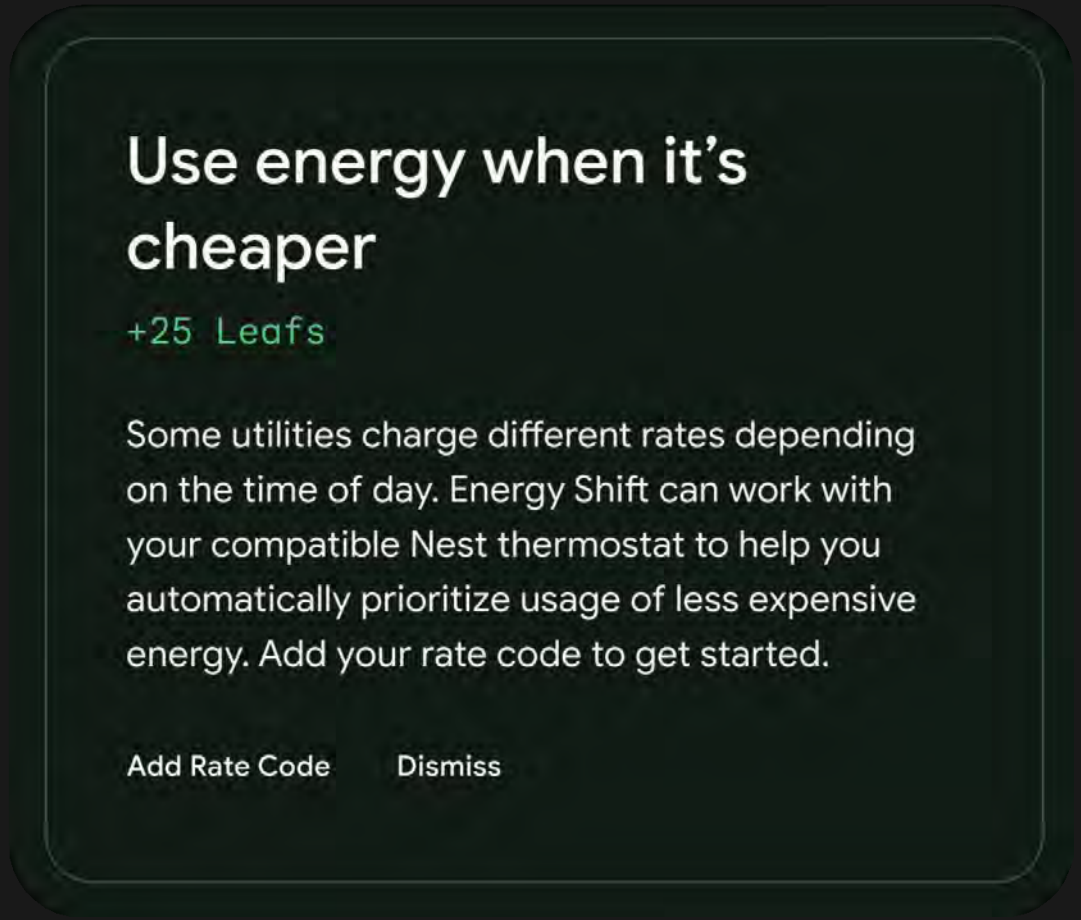
Energy Shift

Energy shift will help customers with a compatible Nest thermostat shift their HVAC electricity usage to when energy is cleaner.



Energy Shift

For customers on certain time-of-use plans, Energy Shift will also help them automatically respond to price signals embedded in their utility rate.



Utility Program Enrollment

Rush Hour Rewards is an existing residential demand response program that Nest provides through DERMS providers that collectively serve more than 30% of U.S. households.

Rush Hour Rewards programs will be surfaced to all Renew users in eligible areas making enrollment more accessible, decreasing friction, and enabling demand response programs to have an even greater impact on grid stability.

Earning leafs & badges will help customers easily track their impact. **Energy Impact Program** gives customers the ability to put their leafs to work, extending their impact. When they reach milestones, they can help steer our donations to nonprofits focused on clean energy.

GRID ALTERNATIVES

ELEVATE ENERGY

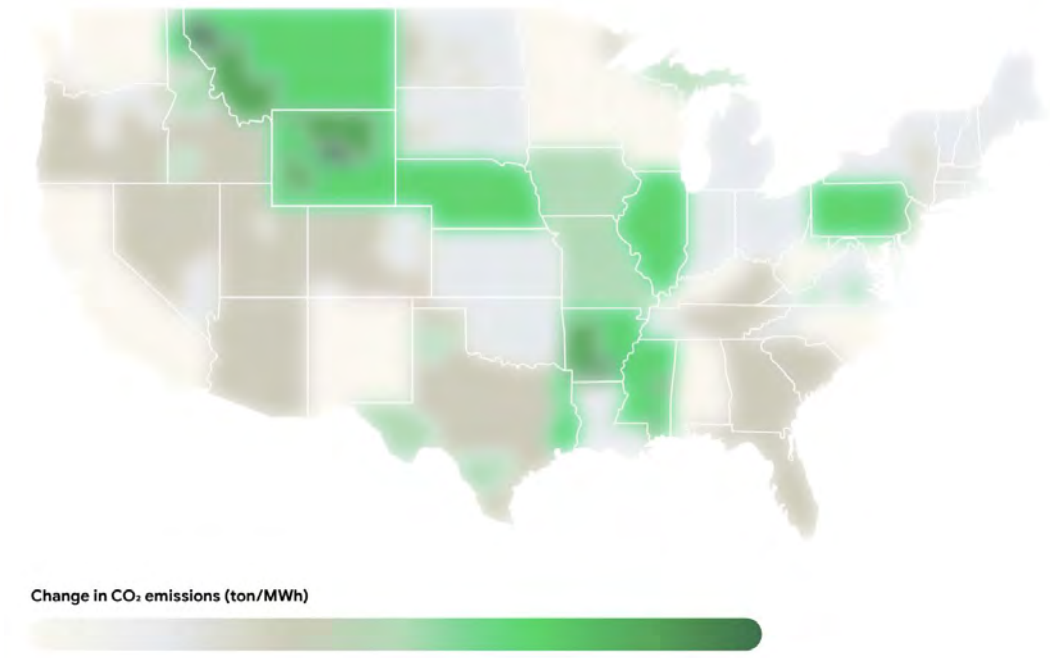
EARLY PREVIEW PREMIUM ONLY

Clean Energy Match helps our customers support clean energy by matching their estimated fossil fuel electricity use with renewable energy credits from U.S. wind and solar plants.

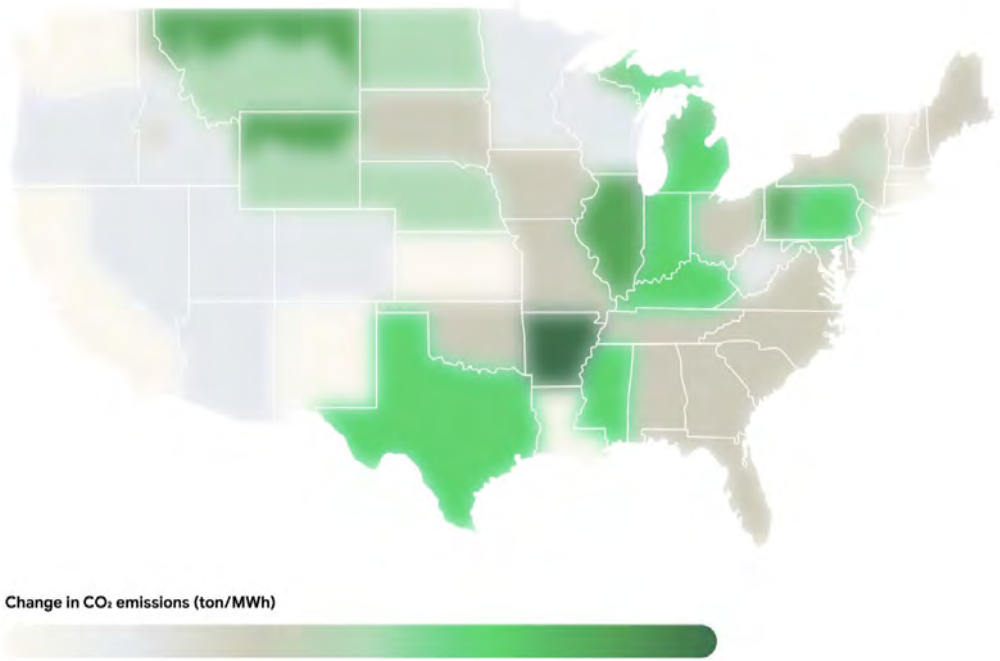
Clean energy match

Carbon-targeted procurement

Emissions Factor of New Wind Generation



Emissions Factor of New Solar Generation



Nest Renew

A new service from Google that works with your Nest thermostat to make it easy to **support a clean energy future**, right from home.

Announcement: October 6

Launches: Q4 2021
(limited early preview)

Basic

Join for free to start making an impact.

See your Power

See when the electricity serving your home is clean, or not so clean, so you can take additional actions to increase your impact.

Energy Shift

A new feature for Nest Thermostats that makes small adjustments to help you save energy and make better use of clean energy sources in your region.

Earn Renew Leafs

You earn Leafs when you use Renew features to support clean energy. When you reach a Leaf milestone, extend your positive impact by directing Nest funds to nonprofit partners.

Premium

Maximize your impact and support for a clean energy future.

Clean Energy Match

Match your home's fossil fuel electricity use with renewable energy credits from wind and solar plants. Together, we can help support a cleaner future.

More Leafs, more impact

Unlock more Leafs each day as a member of Premium to help you reach more milestones. The more you reach, the more you'll be able to help steer our support to our non-profit partners

Bill Pay

Conveniently pay your utility bill through Google

$10/MO


aes


Portland General
Electric


Southern
Company


Consumers Energy
Count on Us


DUKE
ENERGY


nrg


SOUTHERN CALIFORNIA
EDISON


uplight

Southern Company Smart Neighborhoods

VAEEC 2021 Energy Efficiency Forum

November 15th, 2021

Phil Markham

Research & Development

Southern Company

Southern Company

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

Alabama Power

SMART NEIGHBORHOOD®

Objective

Design and build a **first-of-a-kind smart home community** to understand and prepare for evolving customer expectations and future grid needs

Scope

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

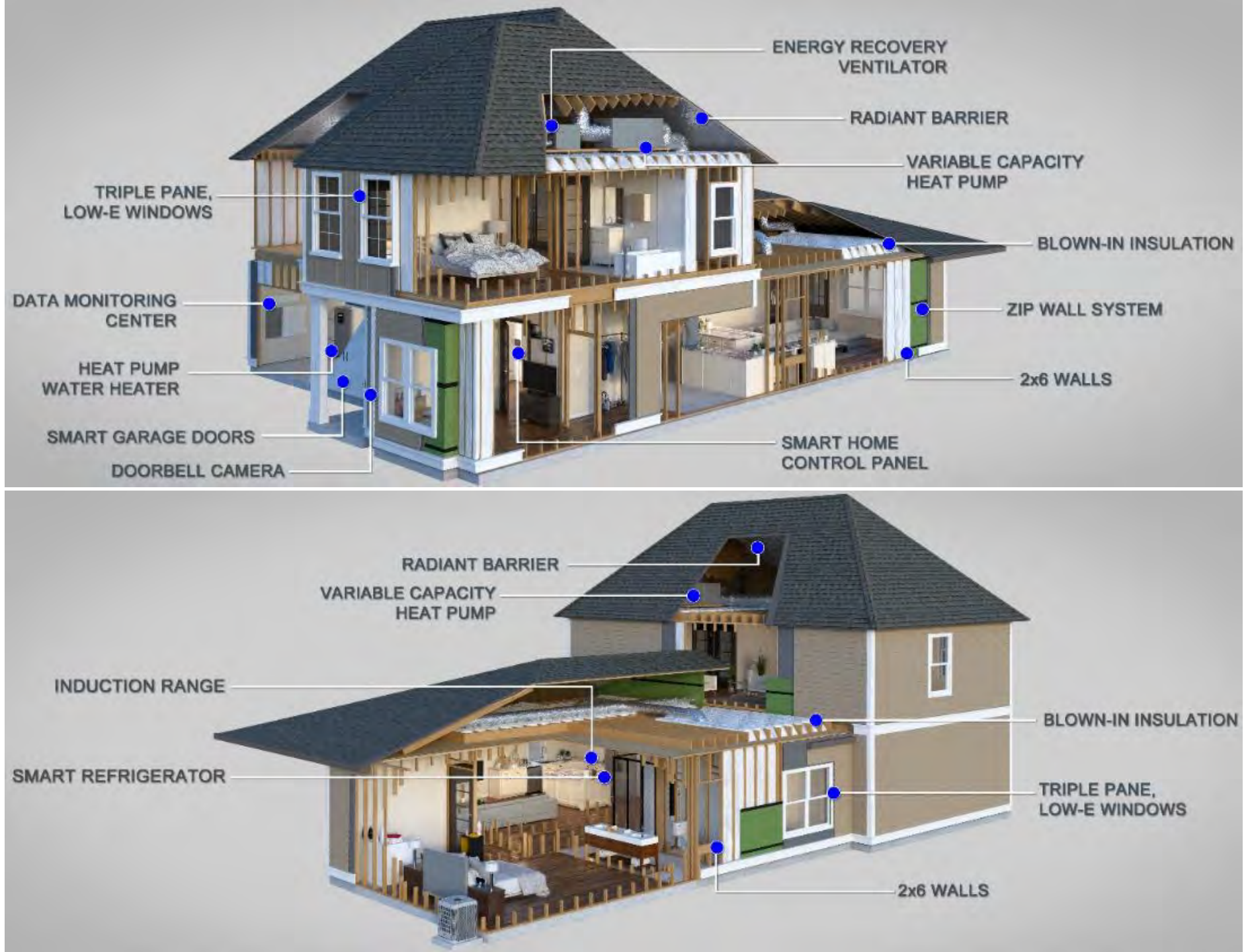
Demonstrate **62 high-performance homes with connected home technologies** providing an improved customer experience

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

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

Demonstrate **DER** use cases optimizing cost, reliability and environmental impact with a **community-scale microgrid**

Total DER output used by the neighborhood
Annual production: 538,000 kWh
Annual SN consumption: 688,000 kWh
SN load from Microgrid: 189,000 kWh (27.5% of total neighborhood consumption)


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
RADIANT BARRIER
VARIABLE CAPACITY HEAT PUMP
INDUCTION RANGE
BLOWN-IN INSULATION
SMART REFRIGERATOR
TRIPLE PANE, LOW-E WINDOWS
2x6 WALLS

DATA COLLECTION

SiteSage Status: Current use: 2.09 kW | $0.25/hr | Current voltage 123v | Outside Temp: 37°F | Affinity Group

Share My SiteSage Window

Measured Power

Top Appliances/Circuits On Now

- A/C (1653w)
- Garage Plugs (156w)
- Furnace (60A) (79w)
- Living Room / B. Door Lig... (40w)
- Low Volt (40w)
- Stove (33w)
- Den Plugs / Back W.P. (32w)
- Ref. (23w)
- Foyer Plugs / Bed 2 Plugs (20w)
- Bed 3&4 Plugs{1} (14w)
- D.R. / Kit. / Hall / Stai... (14w)

30-Day Carbon Footprint

AL Avg.	My CO_2
1893 lbs.	2169 lbs.

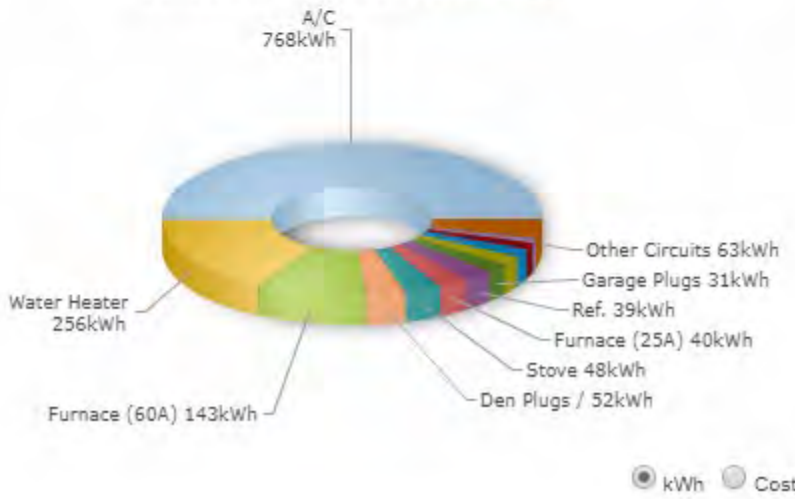
30-Day  Phantom Power $4

Sensors

Attic Temp	57°F
Cold Water Temp	58°F
Downstairs Temp	68°F
Garage Temp	55°F
Hot Water Temp	123°F

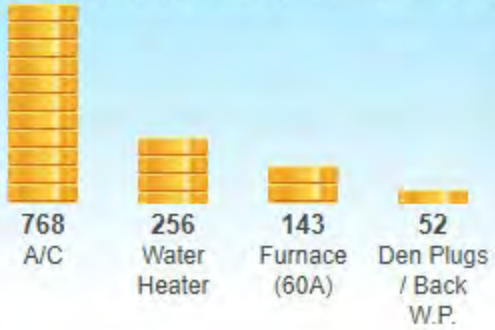
Where I've used electricity in the past 30 days: Top 12 Circuits

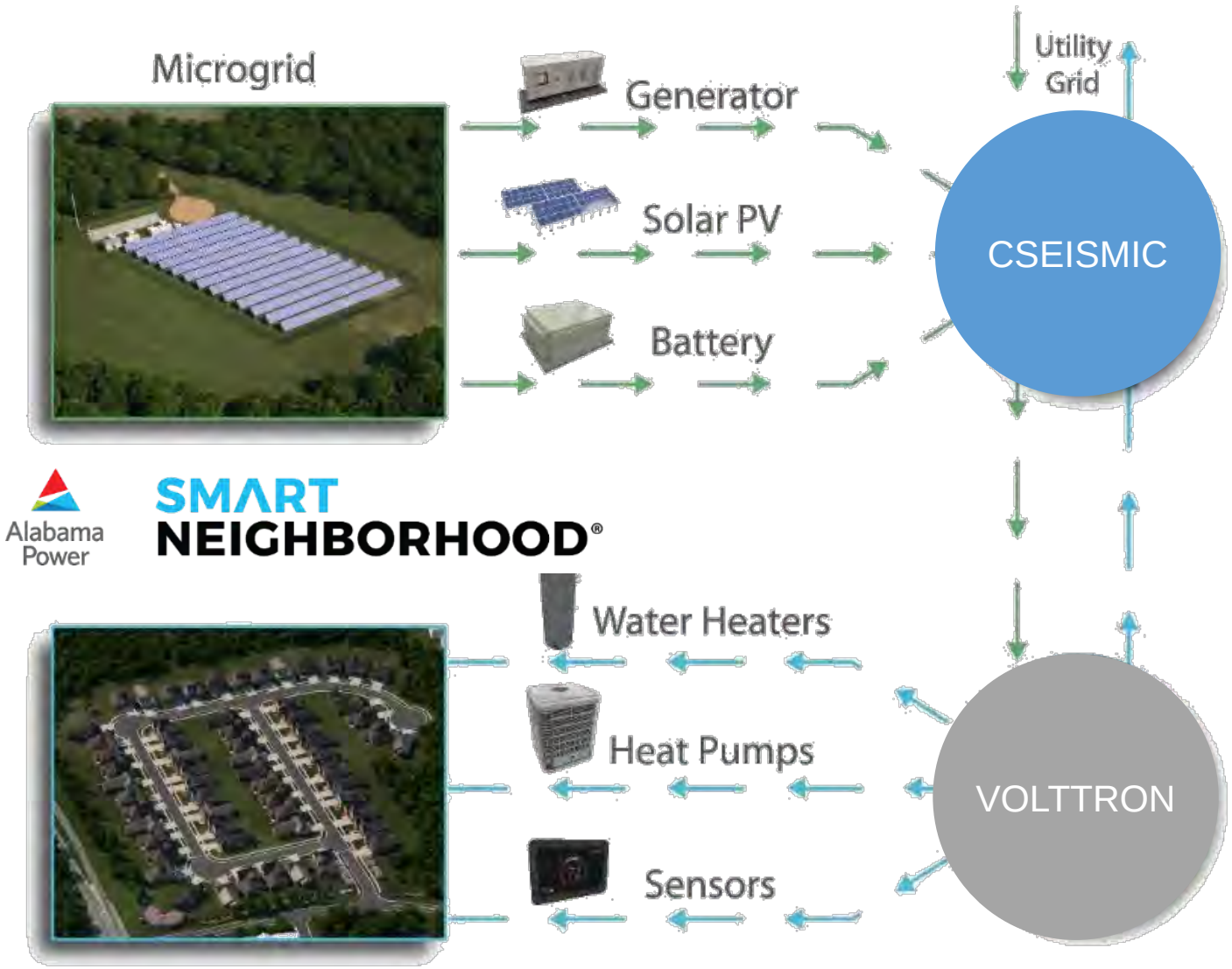
Click a slice or label for detail / View All Circuits



Electricity Usage in kWh by Month

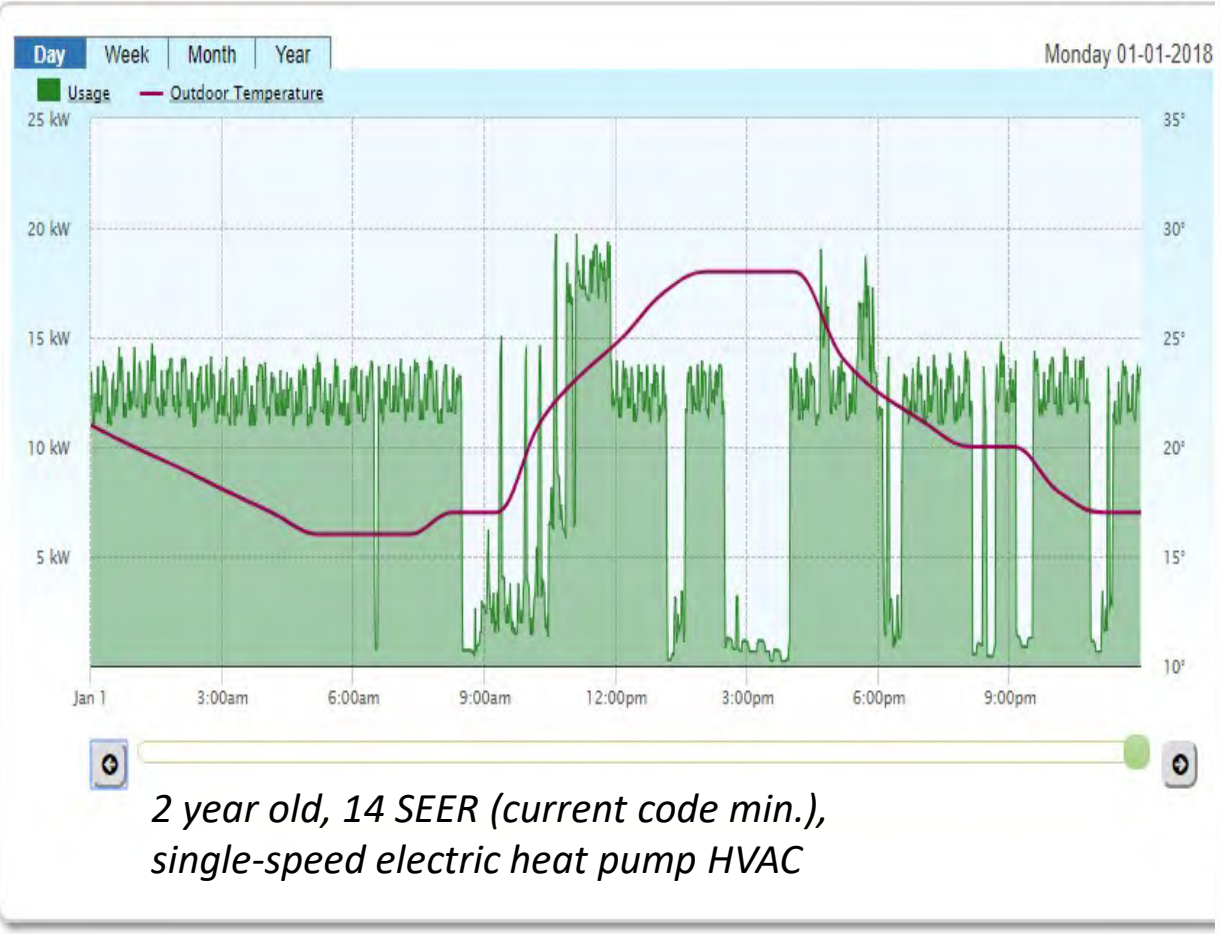
Top 4 Electricity Users by kWh - Last 30 days




Microgrid
Generator
Utility Grid
Solar PV
CSEISMIC
Battery
Alabama Power
SMART NEIGHBORHOOD®
Water Heaters
Heat Pumps
VOLTTRON
Sensors

Two Homes on a Cold Day (1/1/2018):

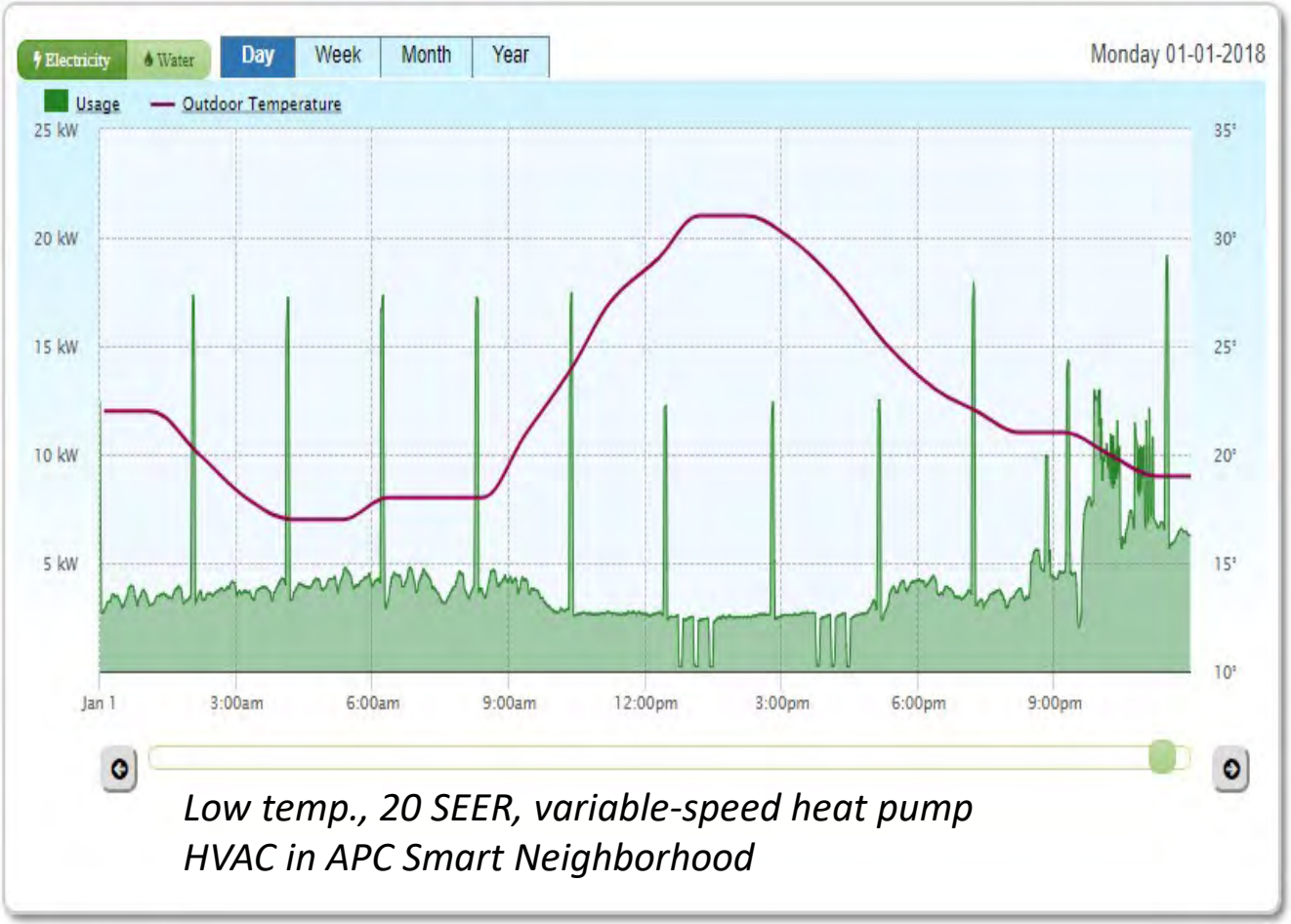
Home 1: Standard



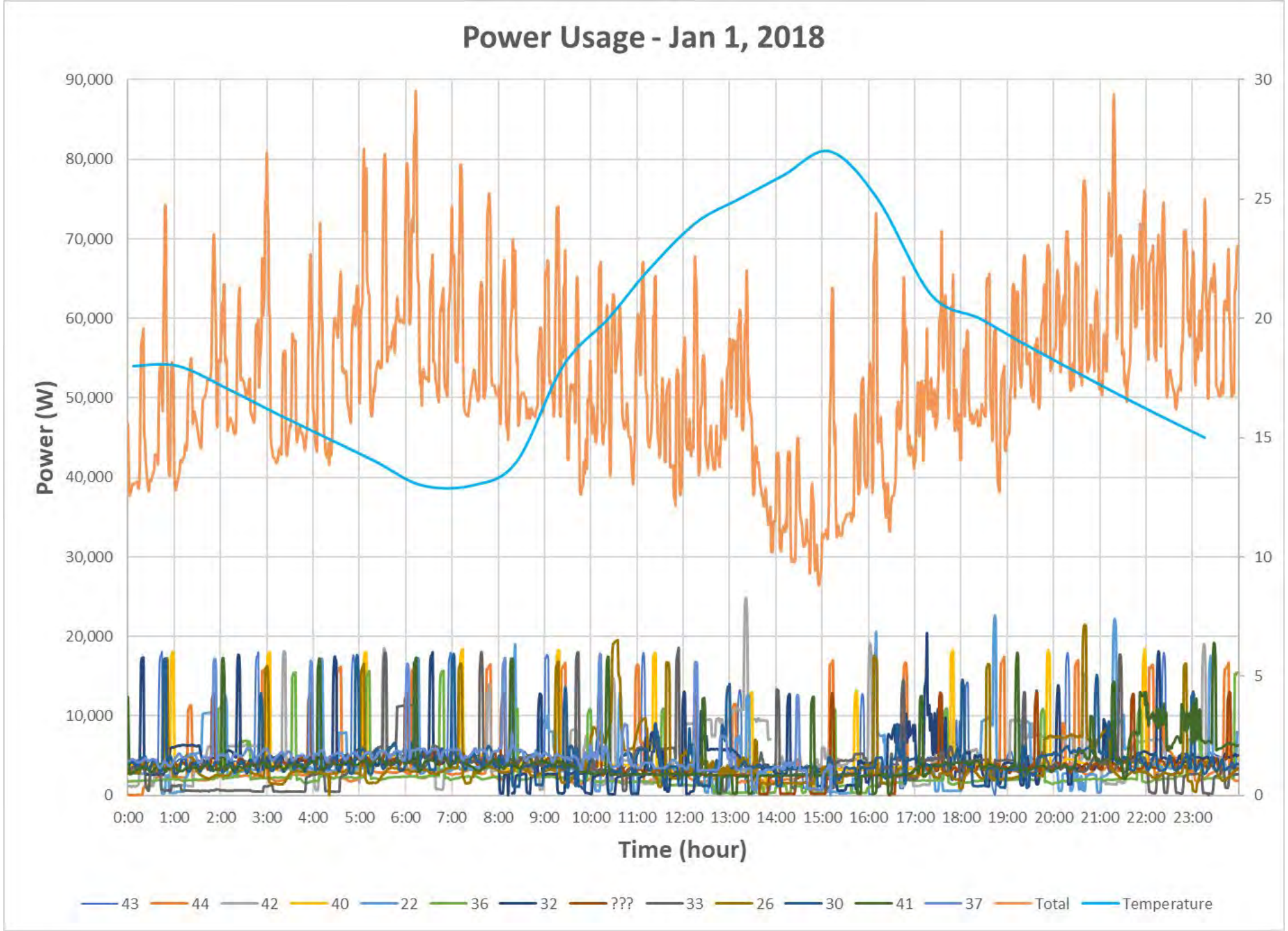
2 year old, 14 SEER (current code min.), single-speed electric heat pump HVAC

Home 2: Smart Neighborhood

Defrost cycle runs for 5 mins every 2 hours



Low temp., 20 SEER, variable-speed heat pump HVAC in APC Smart Neighborhood


Power Usage - Jan 1, 2018
Power (W)
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
30
25
20
15
10
5
0
0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00
Time (hour)
43 44 42 40 22 36 32 ??? 33 26 30 41 37 Total Temperature

Georgia Power

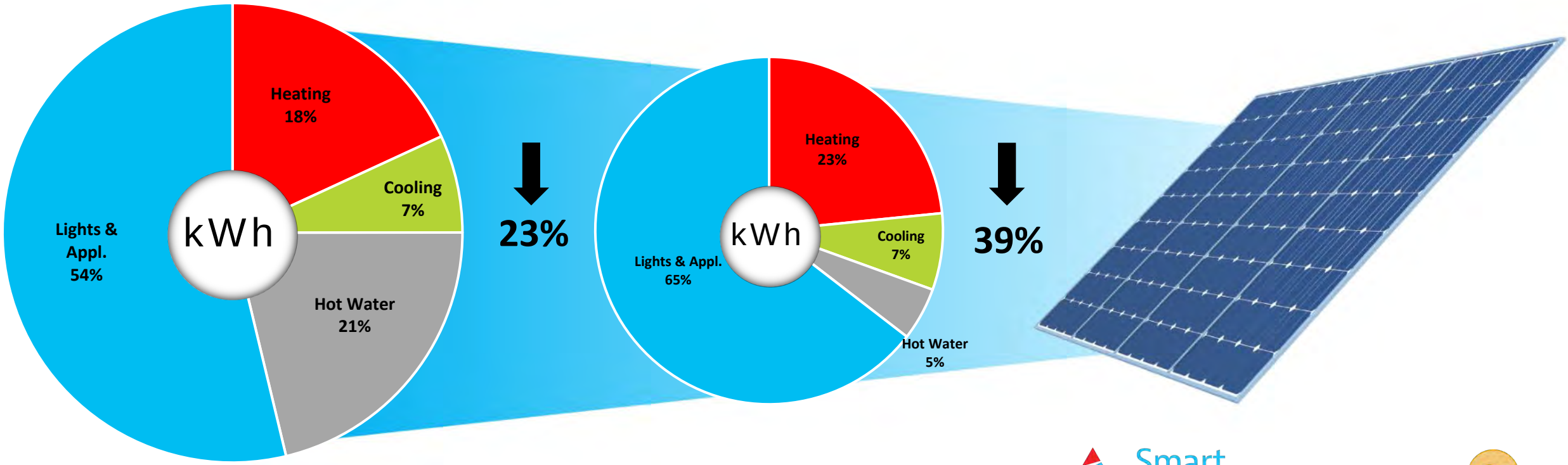
Smart Neighborhood™

Pulte Homes

- 3.6 kW per home
  - 166 kW total for neighborhood
- Producing 12.5 kWh/day (6/2019 – 9/2020)
  - ~90% of modeled results
  - May has the highest solar generation by month in Atlanta
- Approx. 30 - 40% annual energy use of homes

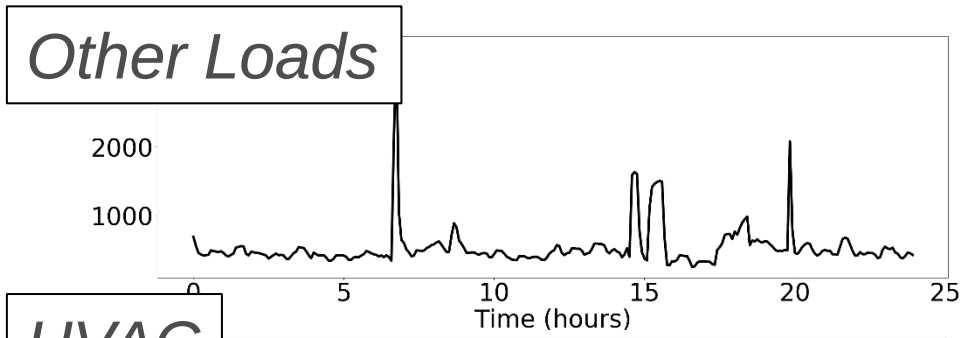
- 2 x LG Chem RESU10h
- DC-Coupled Delta Electronics Inverter
- Critical Load Panel
  - Refrigerator
  - Safety Lighting
  - Internet
  - Rooftop Retreat

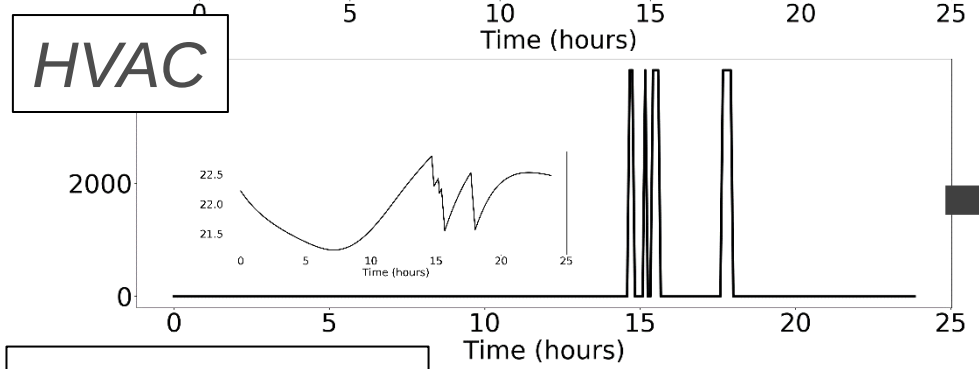
	Altus Home built to code	Smart Neighborhood Efficiency Update	Add in Solar Generation
Total (kWh):	15,911	12,295	7,480

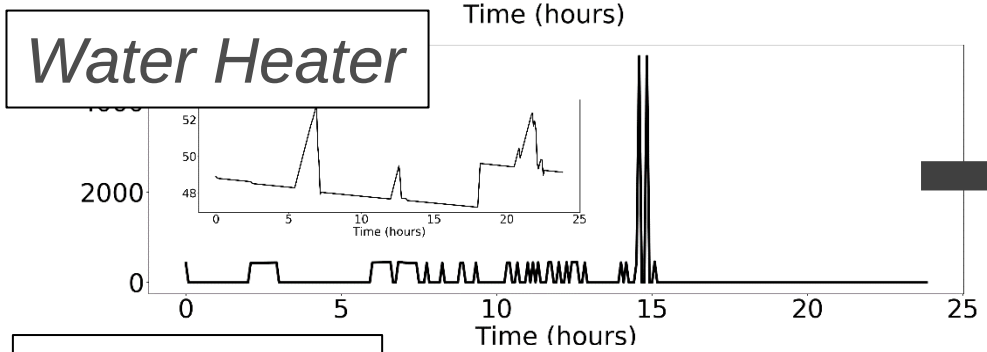


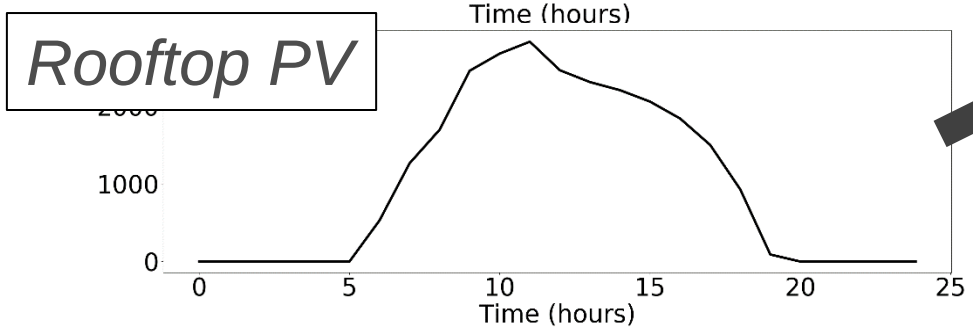
Georgia Power Smart Neighborhood™

Pulte Homes

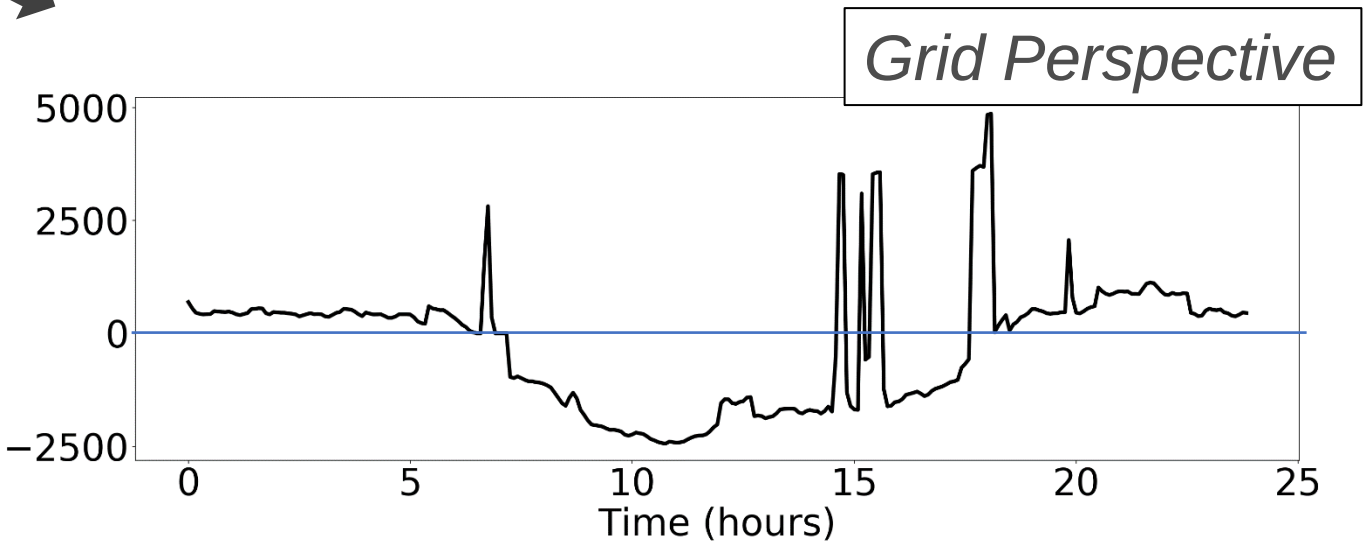








- No Incentive to do anything:
  - Optimization is purely based on energy efficiency of the devices.



- 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

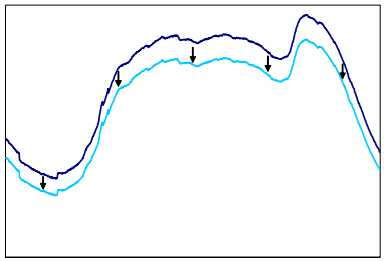
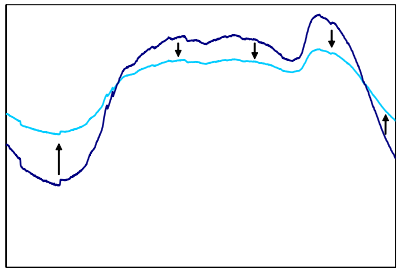
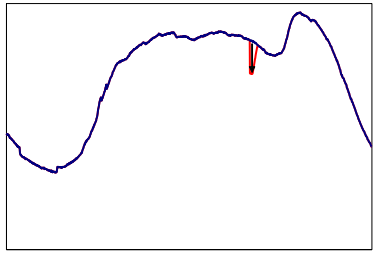
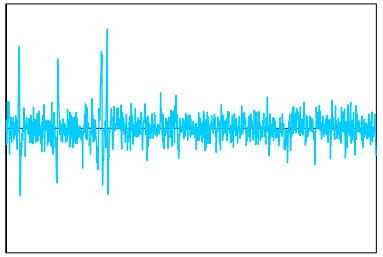
Sub Metering

Minisplit Controller

Battery & Solar

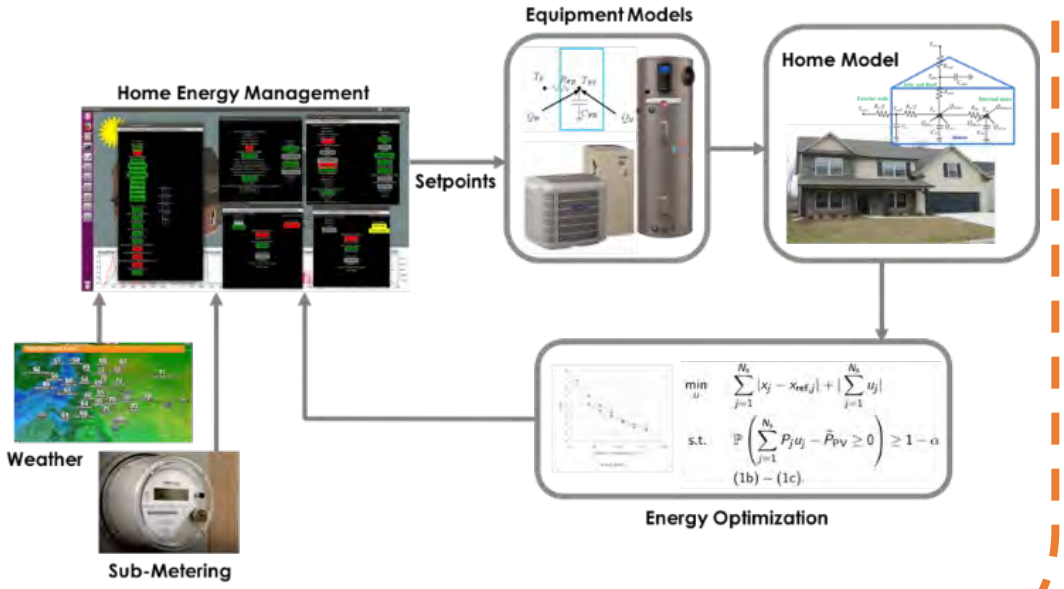
It is a balancing act to effectively manage resource efficiency and homeowner comfort

Grid Side Optimization

Vs.

Homeowner Optimization



Grid Level

Grid Mgmt. Platform (DERMS)

Southern Co Interval Pricing Signal

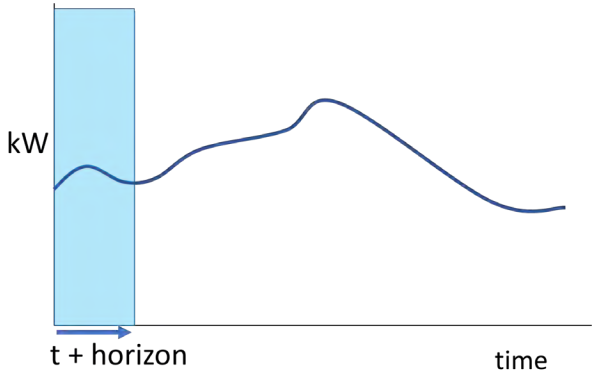
New Optimization Signal, Sent to Home Level Optimizer

Individual Home Level

External Data Inputs
- Weather
- Pricing Signal

Learned/Built Inputs
- Simple Thermal model
- Comfort Constraints
- Equipment Performance

Implement Control Strategy
- Create Schedules & Setpoints



LESSONS LEARNED

Local Community Planning for Smart Technology and Energy Efficiency

Getting Smarter with Energy Efficiency Technology

Virginia Energy Efficiency Council, Energy Efficiency Forum

November 15, 2021

Dr. Damian Pitt, Associate Professor, Urban & Regional Studies & Planning,
School of Government and Public Affairs, Virginia Commonwealth University

Overview

- Smart energy efficiency technologies support three movements in urban planning and energy policy
  - Climate Action Planning, Smart Cities, Smart Grid
- What can local governments do to support energy efficiency and advance smart efficiency technologies?
- What are some examples of leading cities that have integrated smart technologies for energy efficiency into their climate action agendas?

Climate Action Planning

- Recent (last 15-20 years) movement to address climate change through local municipal action
  - Primarily climate mitigation, reducing local carbon footprint, in response to lack of U.S. federal action on Kyoto Protocol
- Re-frames local land use and transportation functions, adds new initiatives for efficiency and renewables
  - Streamline permitting, remove zoning barriers, upgrade building codes where possible
  - Provide technical assistance to residents, businesses, developers

Smart Cities Movement

- Recent (last 10-15 years) movement to integrate information and communication technology (ICT) with urban infrastructure (Batty *et. al*, 2012) and services
- Framed around citizen engagement and intelligent governance, sometimes energy / resource efficiency
  - Smart, connected, energy efficient infrastructure (e.g., streetlights) – Internet of Things (IoT)
  - “Big data” to optimize transit and transportation services

Smart Cities and Energy Efficiency

- Generally focused on public services… what is the role of cities to foster smart technology in private bldgs.?
  - Sharing of energy data among large institutional and office buildings
  - High tech version of energy disclosure and benchmarking
- Can cities help expand smart energy efficiency technology into private buildings, at scale?

Cities and Energy Efficiency

- Comprehensive Planning
  - Sets forth broad policy goals and recommendations
  - City policy and public / private initiatives and programs

➢ Sustainability / Climate Action Plans

» How do we reduce GHG emissions and/or adapt to climate change impacts

» Most progressive and sustainable cities increasingly focused on equity implications of climate action and resilience

Image from RVA Green 2050 Planning Process

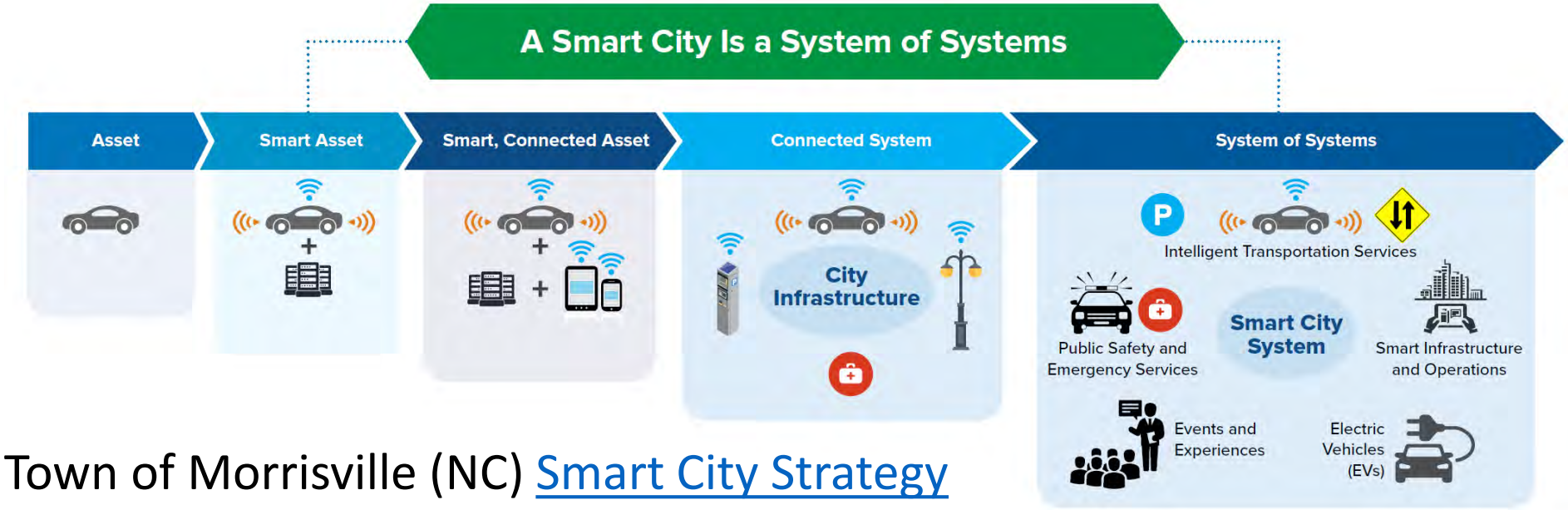
Cities and Energy Efficiency

- Building code authority
  - Rare to implement requirements exceeding state building code
- Zoning authority
  - Identifies types of uses allowed, regulates size, height, etc.
  - Typically no requirements around internal appliances, tech., etc.
- Permitting incentives
  - “Fast-track” approval, density bonuses, can incentivize “green building”
- Technical assistance
  - Support property owners & developers with info and guidance
  - Connect to resources for energy efficiency audits, upgrades

To what extent are U.S. cities incorporating smart energy efficiency technology now?

Types of Smart City Plans

- Transportation: transit, autonomous vehicles, etc.
- Infrastructure: fiber optics, streetlights, public safety
- Sustainability: little focus on building energy efficiency



Town of Morrisville (NC) Smart City Strategy

Climate Action Plans

- Review of CAPs in four leading U.S. cities for discussion of smart energy efficient technology
  - Chicago: nothing at all about smart tech for efficiency
  - Portland: energy performance tracking in office / residential bldgs, technical assistance and partnerships, ecodistricts, net-zero bldgs
  - Seattle: Smart Meters and benchmarking
  - Austin: “Smart Grid/Intelligent Energy Management Systems,” demand response, benchmarking “measurement and verification,”
- Nothing directly about smart appliances or buildings

Comp Plans: Richmond 300

Objective 15.3
Reduce air pollution related to private buildings.

a. Engage local professional expertise to develop incentives and/or other components of a robust Green Building program that may include:
   i. Transitioning from natural gas to electric.
   ii. Changing the Zoning Ordinance to encourage developers to renovate buildings with deep energy retrofits and/or build new construction following green building guidelines by creating incentives such as reducing parking requirements or density bonus.
   v. Evaluating the potential of green development zones as permitted by state code.

e. Advocate in the General Assembly for enabling legislation allowing jurisdictions to:
   i. Adopt residential PACE programs.
   ii. Require energy benchmarking and public disclosure, and adopt local ordinance requiring benchmarking by large privately owned buildings.
   iii. Adopt stricter energy efficiency requirements in their building codes.

i. Develop guide for high-performance / net zero energy new construction and historic retrofits to encourage green construction practices.

j. Evaluate creating legislation to require stronger energy-efficiency and green-building standards of developers requesting zoning variance and/or site plan approvals.

Eco Districts and Smart Neighborhoods

- Eco-Districts: anything green at neighborhood level
  - Can include smart buildings, efficiency (Spokane, Alexandria)
- 2030 Districts Network: “to establish a global network of thriving high performance blgb districts and cities… to catalyze transformation in the built environment”
  - Helps property owners and managers maximize bldg performance: HVAC, interior equipment, lighting and/or whole building measures
  - Sometimes integrated into Smart Cities initiatives (San Diego)

Technical Assistance

- Boulder (CO) EnergySmart Services program
  - Connects homes & businesses with expert Energy Advisor to answer questions, identify contractors, apply for financing
  - Funded by DOE BetterBuildings and Boulder Climate Action Plan tax
  - Administered by CLEAResult: energy optimization and demand management services
  - Aligned with Boulder County BuildSmart, high energy efficiency building code (net-zero required for new homes above 5,000 sq. ft.)

Next Steps

- Research into the role of cities in supporting the clean energy transition: solar PV and other distributed energy resources (DERs)
  - Energy storage, electric vehicles, micro-grids
  - Demand management and smart homes
- To what extent are cities doing this now?
  - Content analysis of comprehensive plans, sustainability / climate plans, and zoning codes

Questions?

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Up Next

VIRTUAL NETWORKING BREAK

2:20-2:40 pm