NREL
NATIONAL RENEWABLE ENERGY LABORATORY



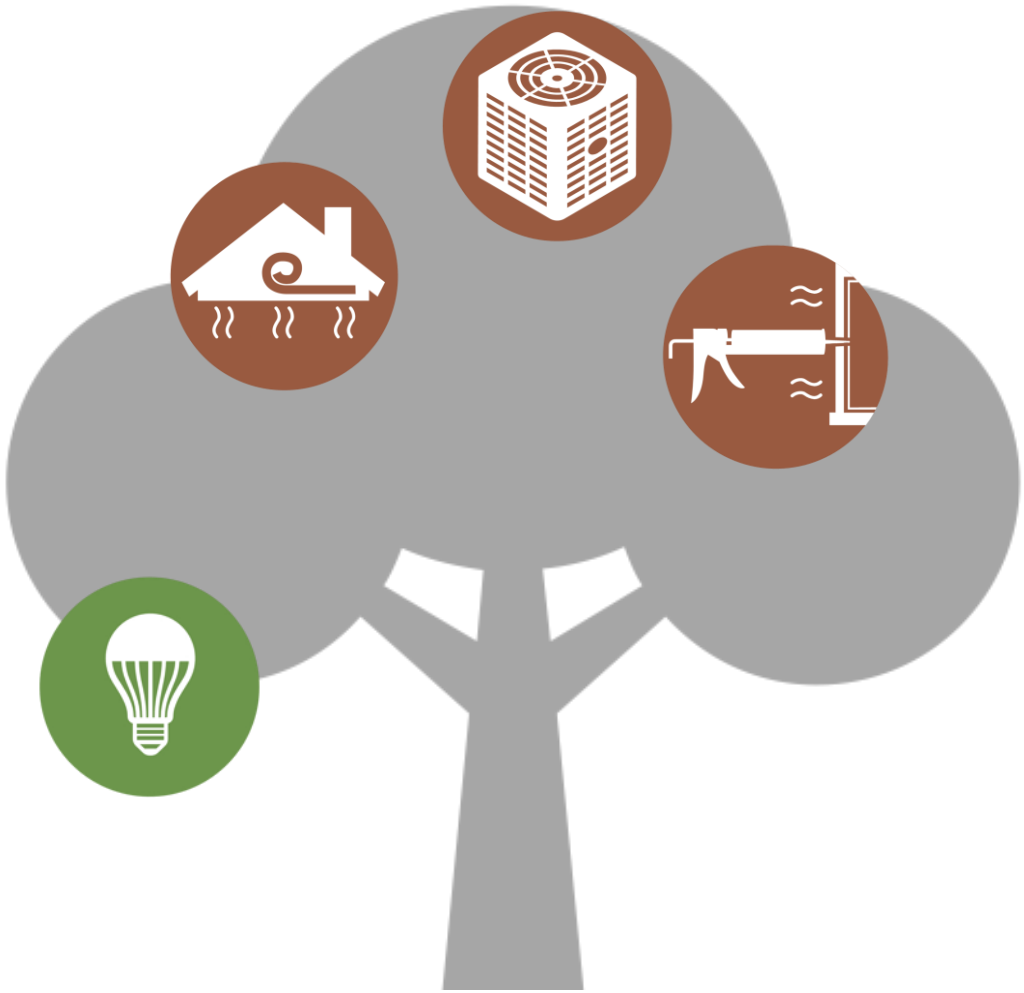



ResStock

Harnessing Data to Identify the Best Opportunities in Existing Buildings

Eric Wilson, National Renewable Energy Laboratory

November 16, 2017



Tree icon by Tjaša Kimovec
from Noun Project (creative commons)

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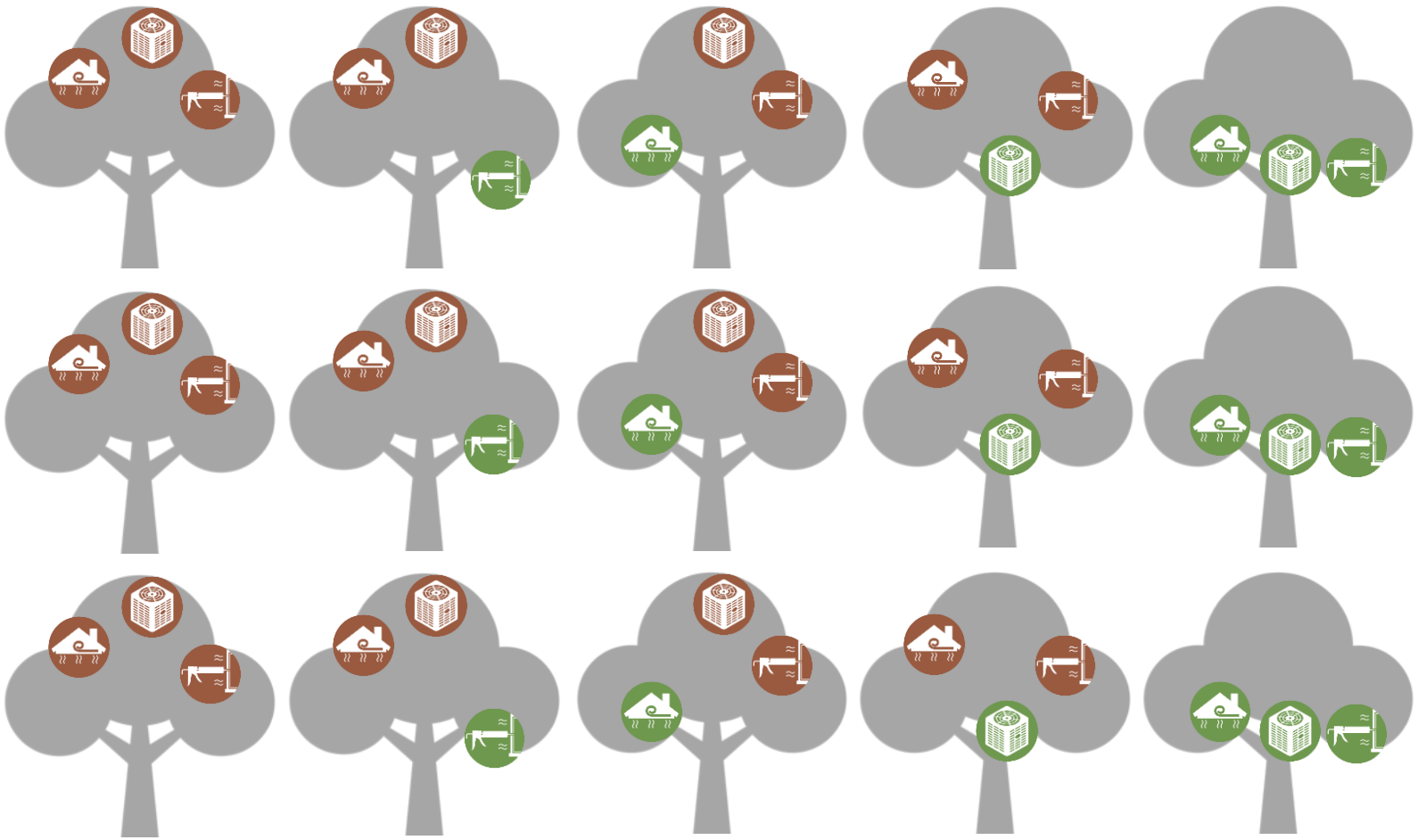

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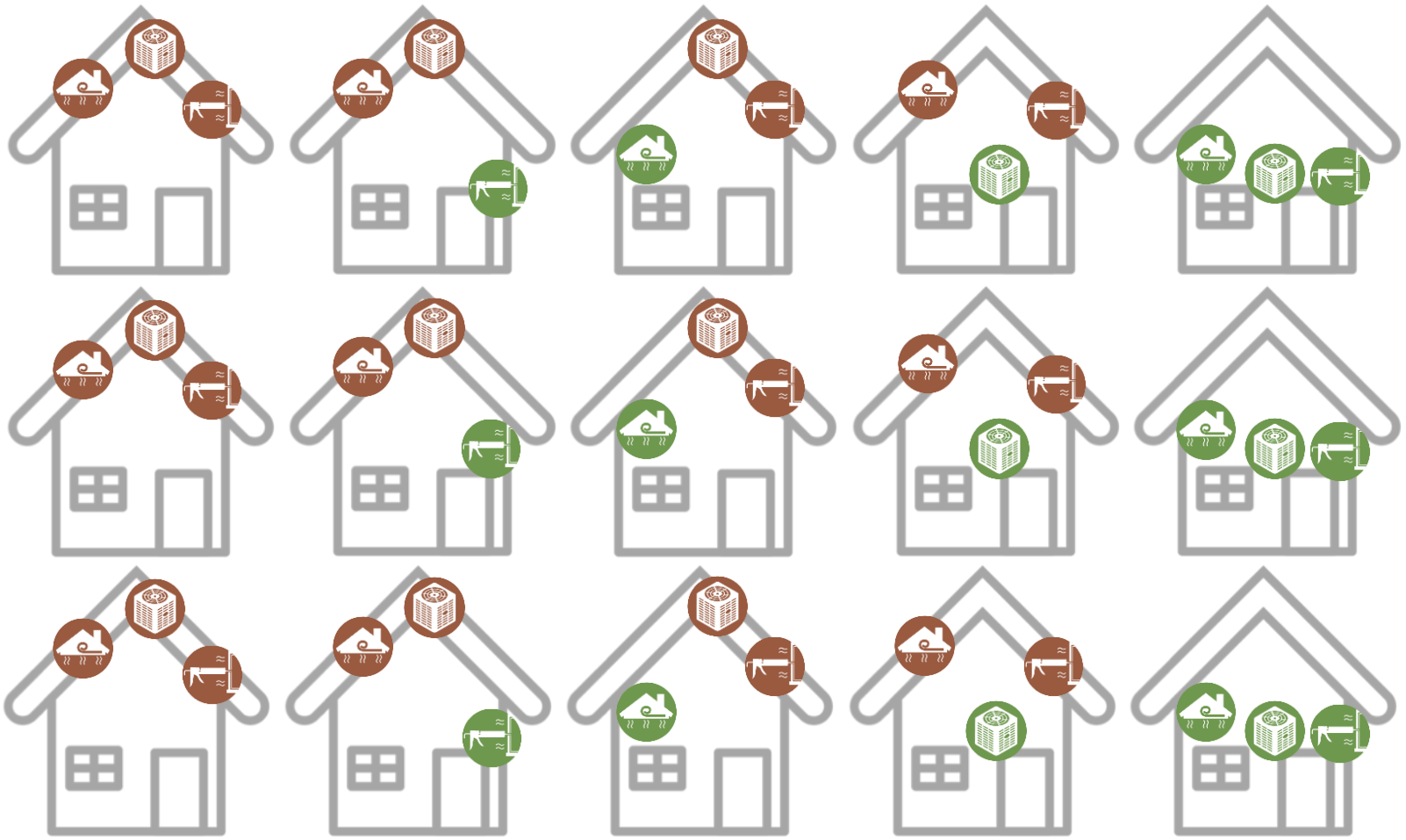

House icon by UNiCORN
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How do we find the best opportunities?

House icons by HAWRAF
via autodraw.com

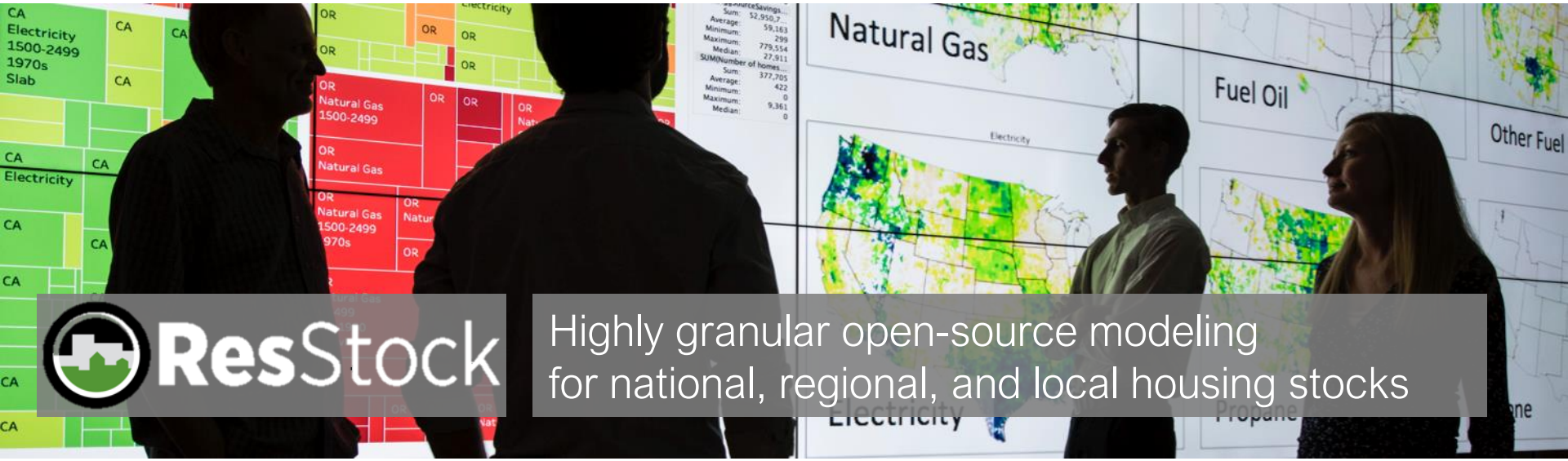
Housing stock characteristics database

+

Physics-based computer modeling

+

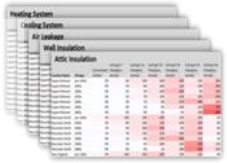
High-performance computing



Housing stock characteristics database

+ Physics-based computer modeling + High-performance computing

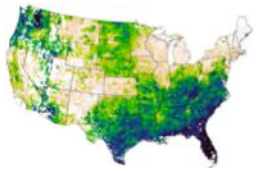
Building Characteristics



EIA	**Res. Energy Consumption Survey (RECS)**
NAHB	**Homebuilder Surveys**
IECC	**Historical Energy Codes**

Other national, regional, and local audit databases

Census Data



Census	**American Community Survey (ACS)**

Costs

EIA	**Electricity and fuel costs**
NREL	**OpenEI.org Utility Rate Database**
NREL/Navigant	**Measure Cost Database**

Climate Locations

NREL	**TMY3 weather data**

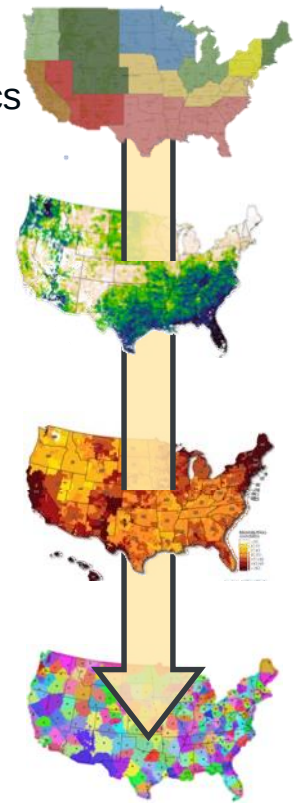
Housing stock characteristics database + Physics-based computer modeling + High-performance computing

Building Characteristics

Census Data

Costs

Climate Locations



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Housing stock characteristics database

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Physics-based computer modeling

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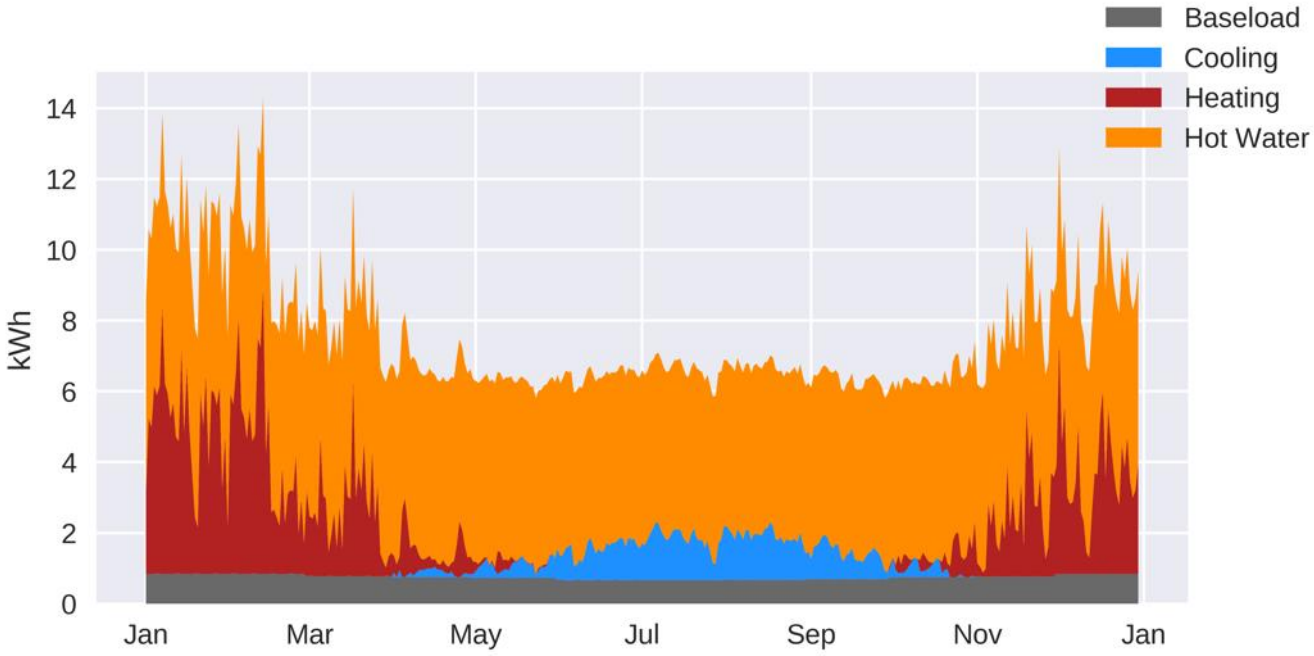
High-performance computing

U.S. DOE Tools

OpenStudio

EnergyPlus

Detailed sub-hourly energy simulations



Housing stock characteristics database

+

Physics-based computer modeling

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High-performance computing

U.S. DOE Tools

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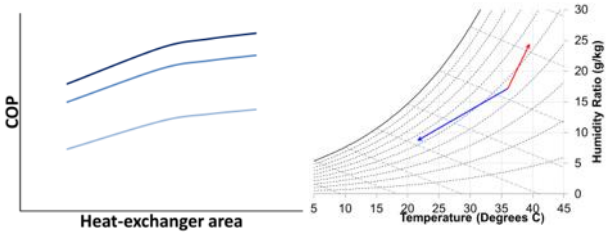
Ability to simulate emerging technologies

Emerging technology



System performance characterization

ResStock

Detailed open-source component models

Housing stock characteristics database

+

Physics-based computer modeling

+

High-performance computing

U.S. DOE Tools

OpenStudio

EnergyPlus

Many Partners: Shared Development Resources

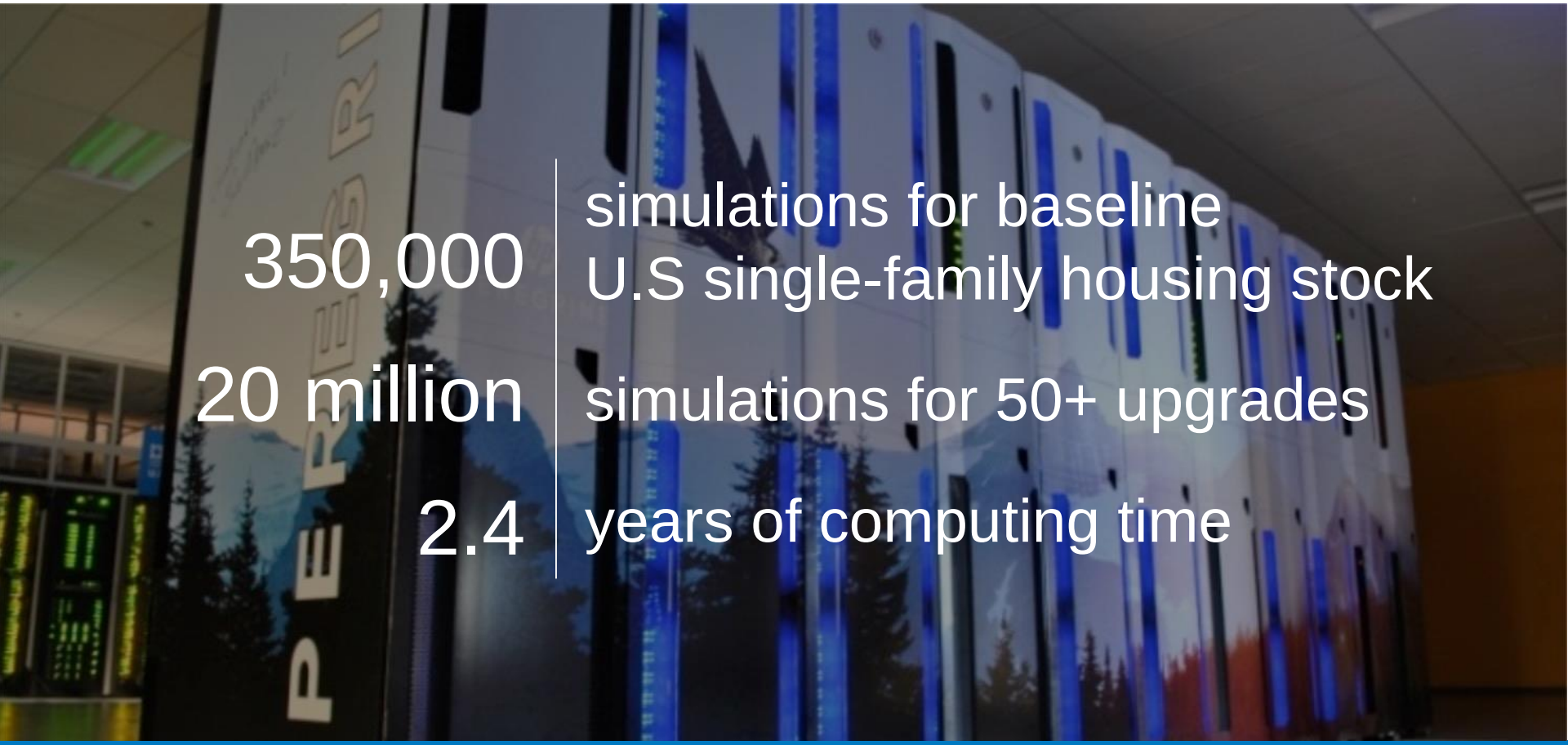
Housing stock characteristics database

+

Physics-based computer modeling

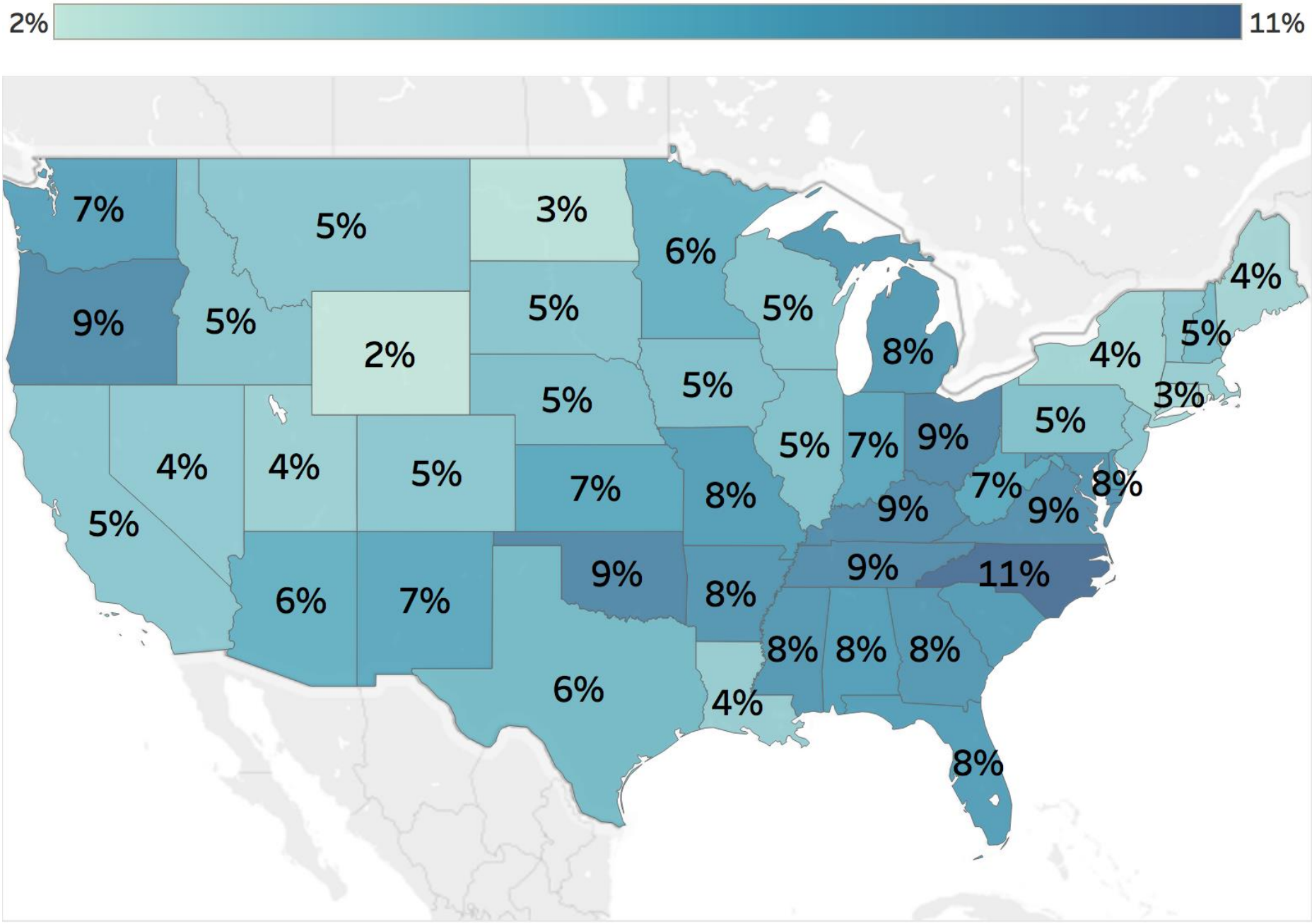
+

High-performance computing



350,000	simulations for baseline U.S single-family housing stock
20 million	simulations for 50+ upgrades
2.4	years of computing time

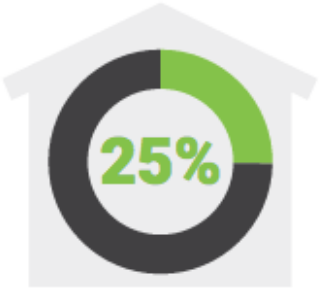
Cost-Effective Residential Electric EE Potential (% of annual kWh sales)



48 State Factsheets

MICHIGAN

Residential Energy Efficiency Potential



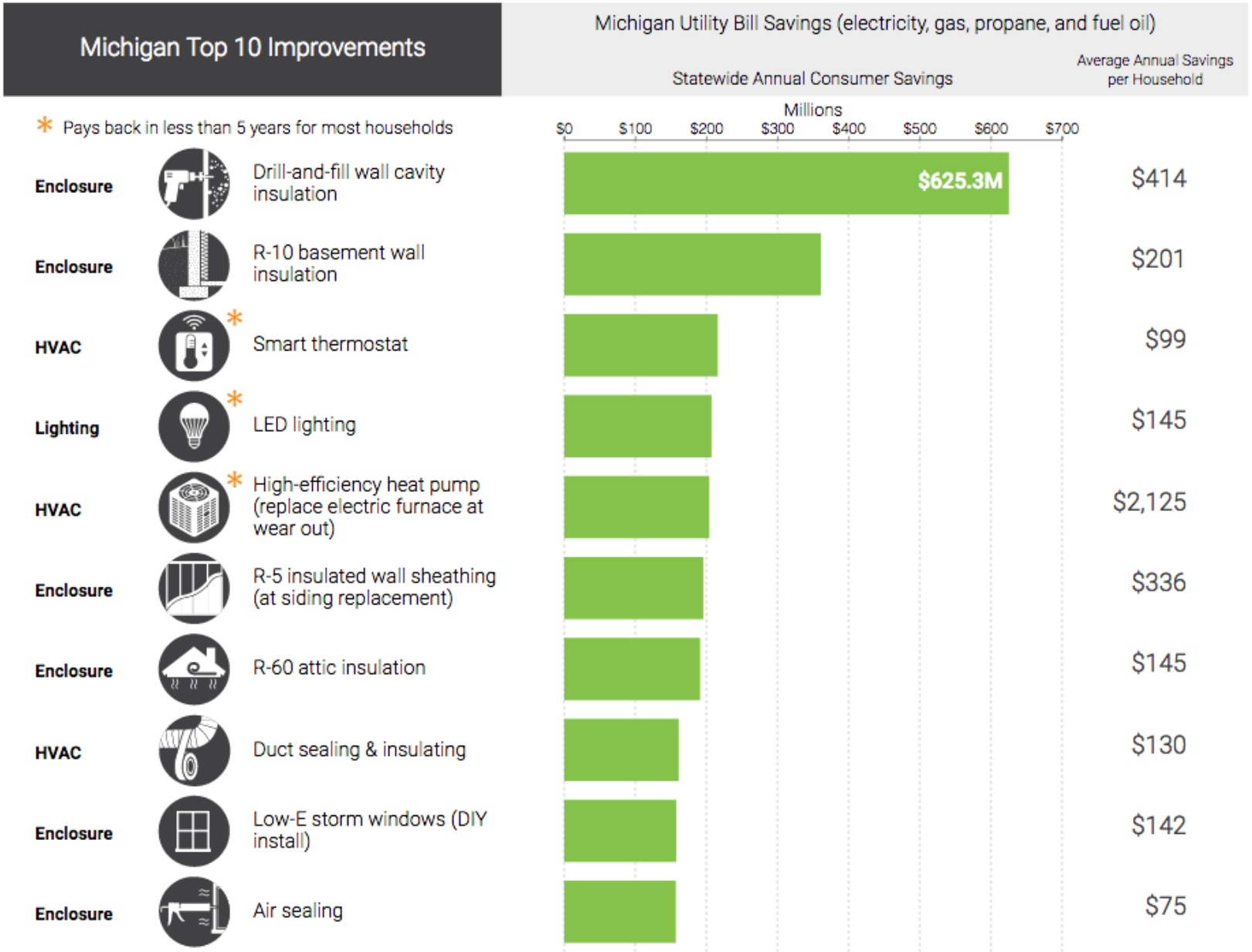
Energy used by Michigan single-family homes that can be saved through cost-effective improvements

Michigan existing jobs in energy efficiency (2016)[1]

Cost-effective package savings potential in Michigan single-family homes

- **2.3 billion** dollars per year utility bill savings
- **109.8 trillion** Btu per year gas, propane, and fuel oil savings
- **8.2 billion** kWh per year electricity savings
- **2.7 million** cars of pollution reduction

48 State Factsheets



48 State Factsheets

Michigan Top 10 Improvements

Michigan Utility Bill Savings (electricity, gas, propane, and fuel oil)

Statewide Annual Consumer Savings

Average Annual Savings per Household

HVAC

Duct sealing & insulating

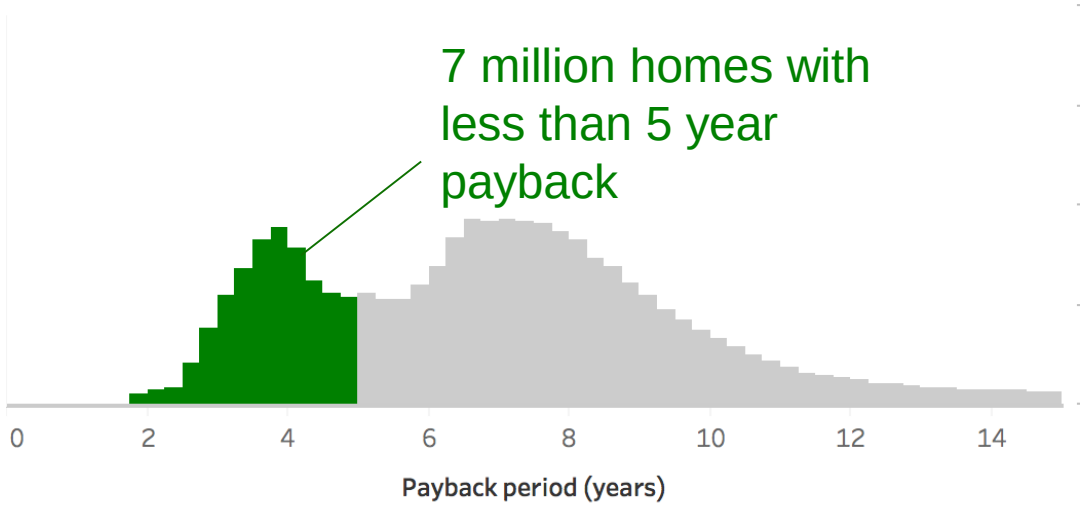
Applicable to 42% of homes

Cost-effective in 38% of homes

Per House Average (where cost effective)	Statewide (cost-effective savings)
$130 annual savings	$161.1 million annual savings
$1,226 average cost of improvement	11.4 trillion Btu gas, propane, and fuel oil savings
9 years, 5 months payback	279.0 million kWh electricity savings

Evaluate incentives – Drill-and-Fill Wall Insulation

With no rebate



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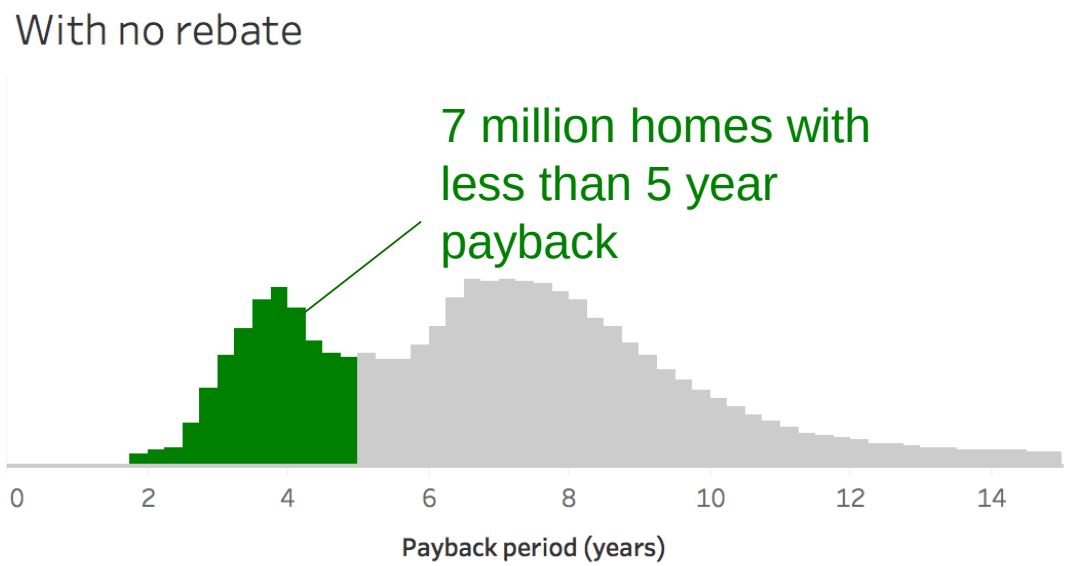

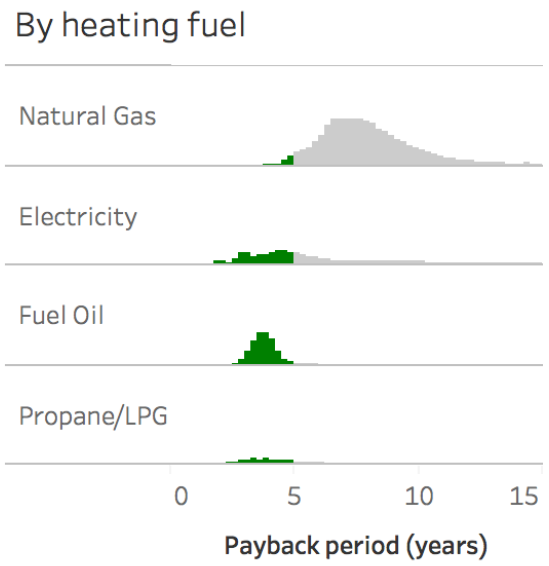

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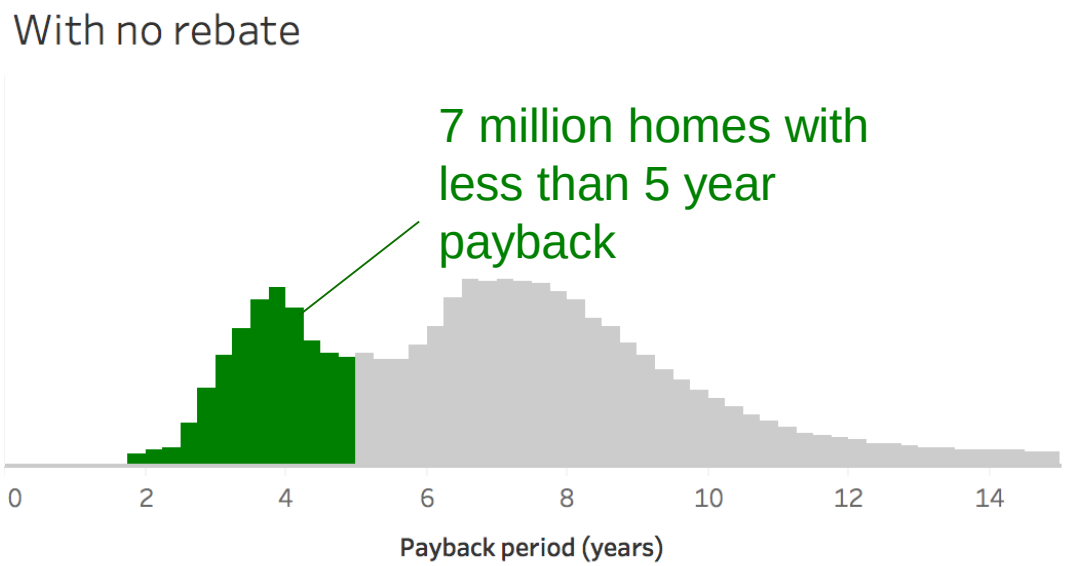
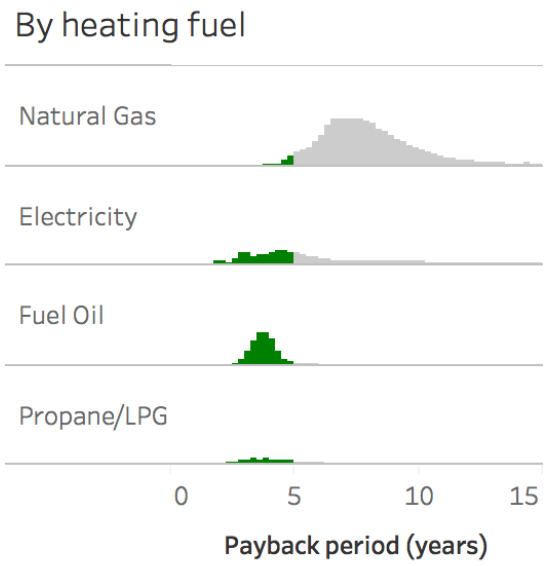
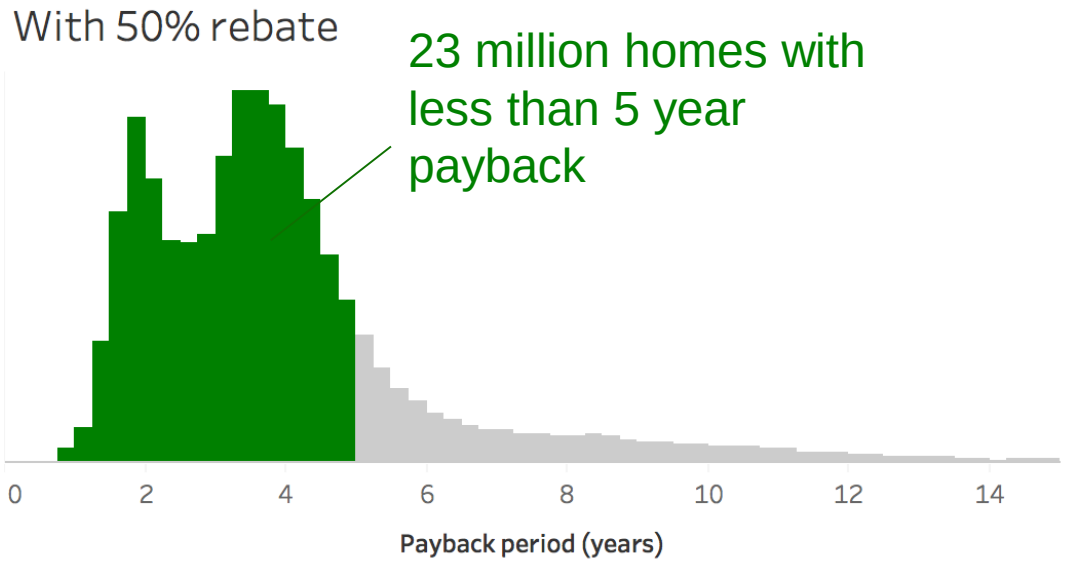
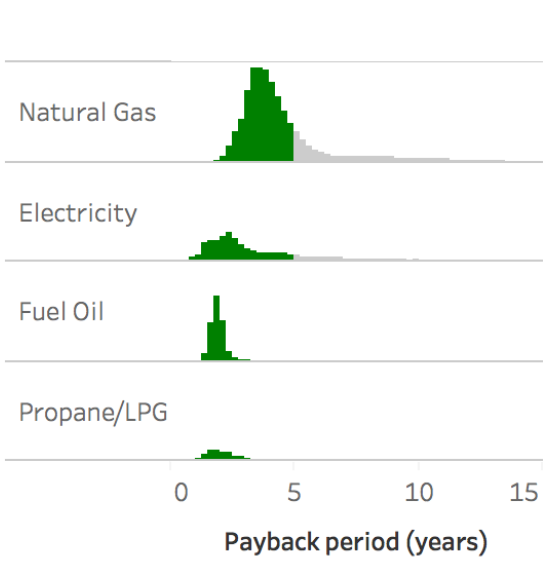


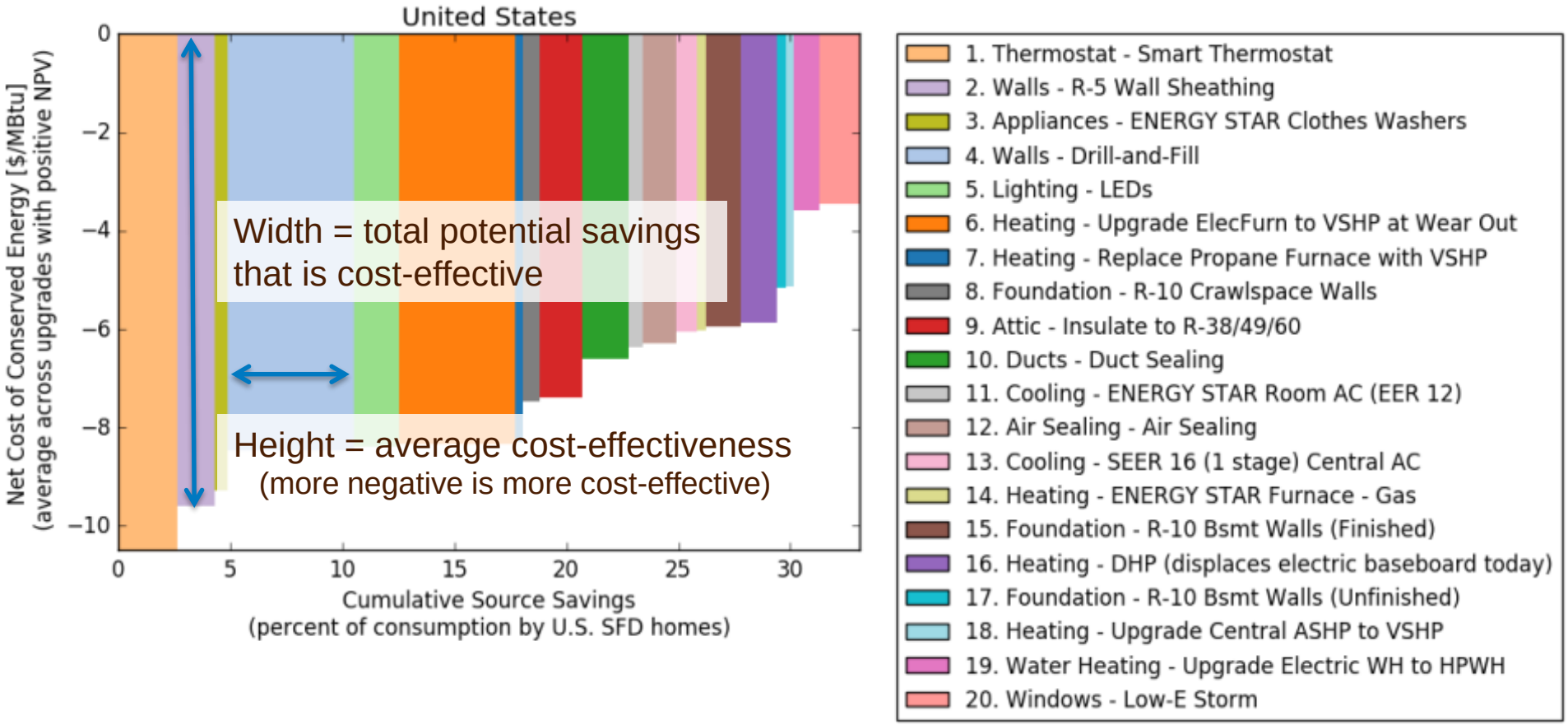






Economic Potential (NPV > 0) Supply Curve

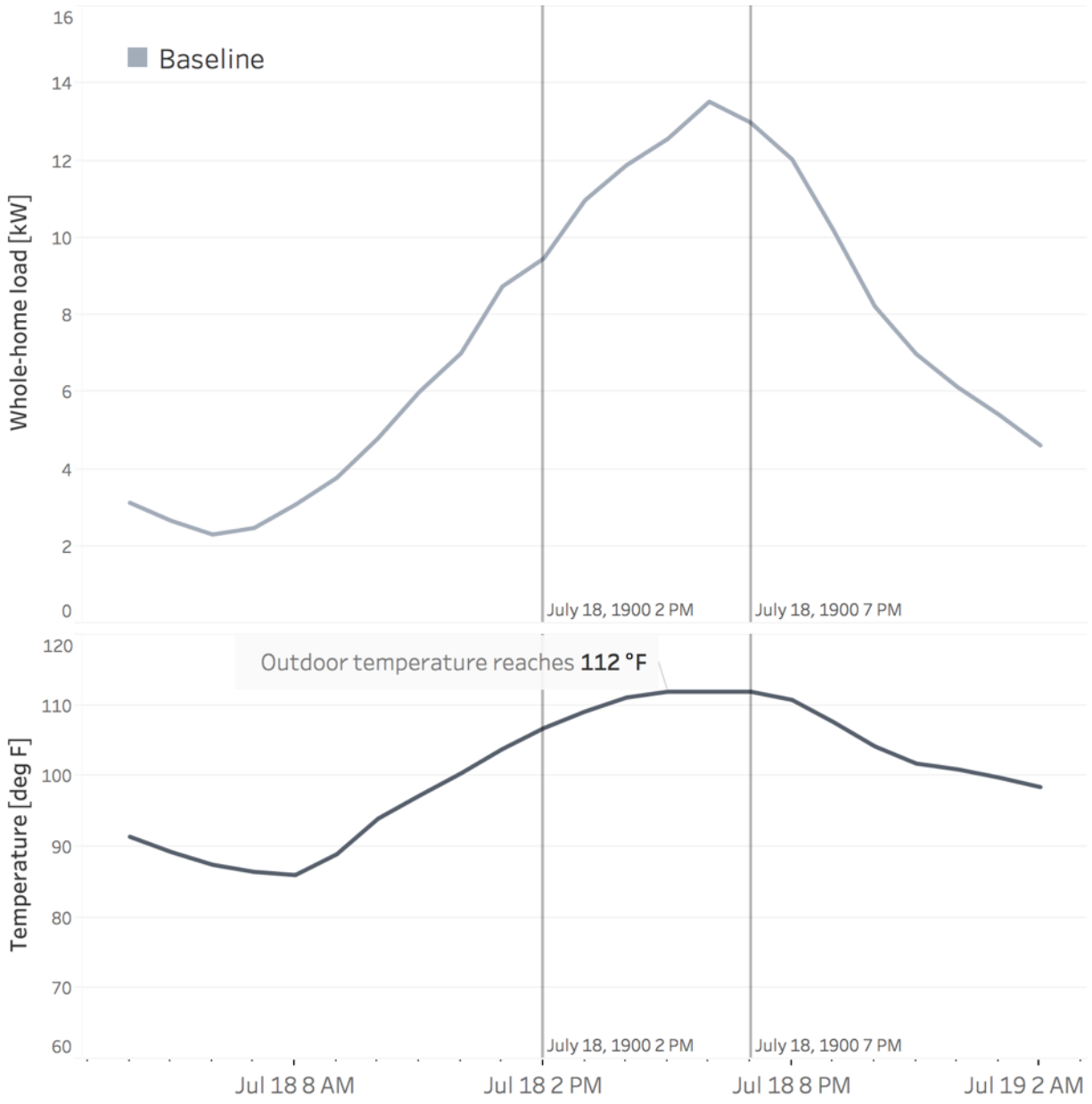
Supply Curves



All values are primary/source energy (i.e., raw fuel burned to create heat and electricity).

Application: Buildings-to-Grid Analysis

Simulated **peak shifting potential** across a segment of housing stock (1950s homes in Phoenix)



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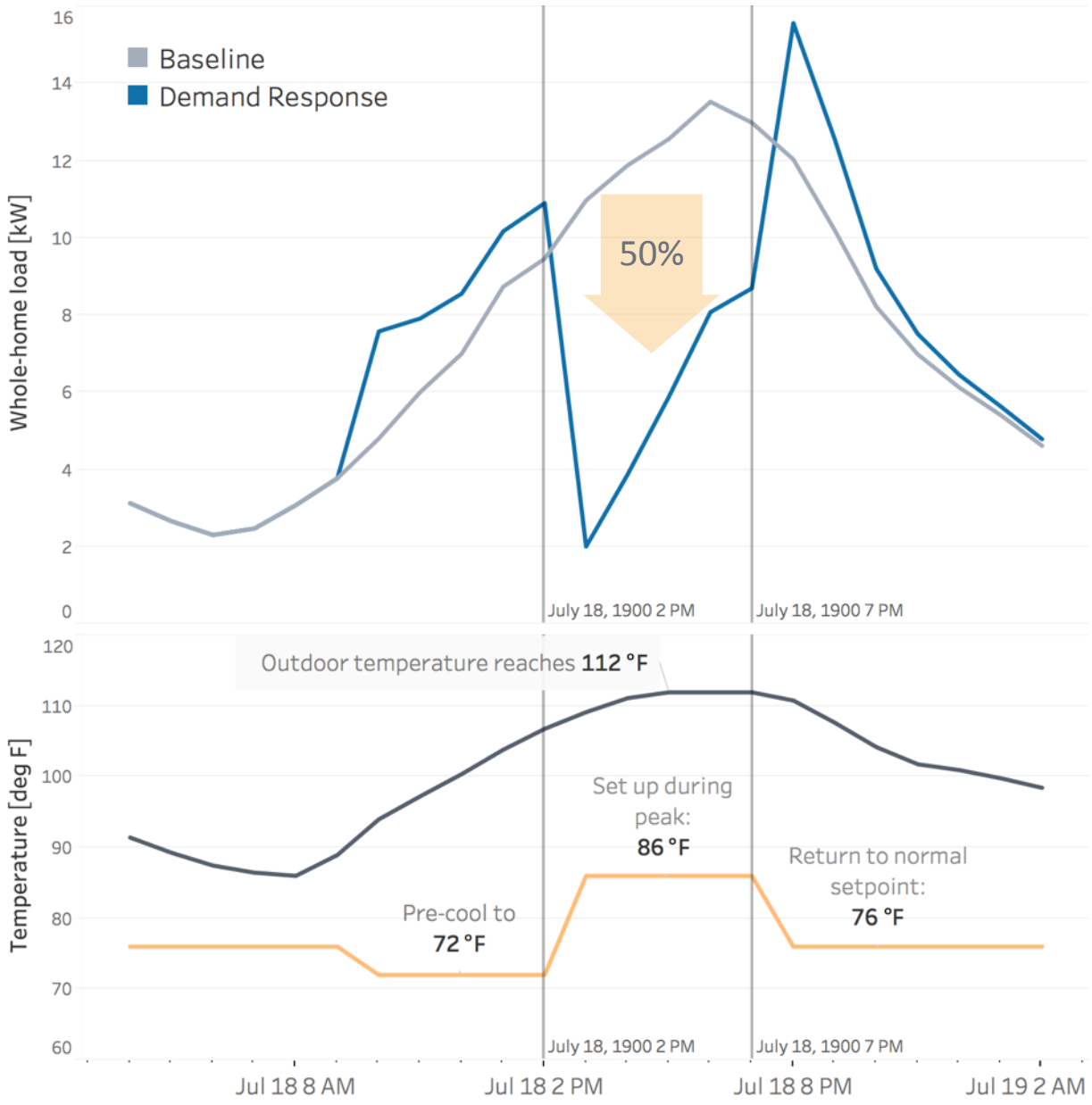

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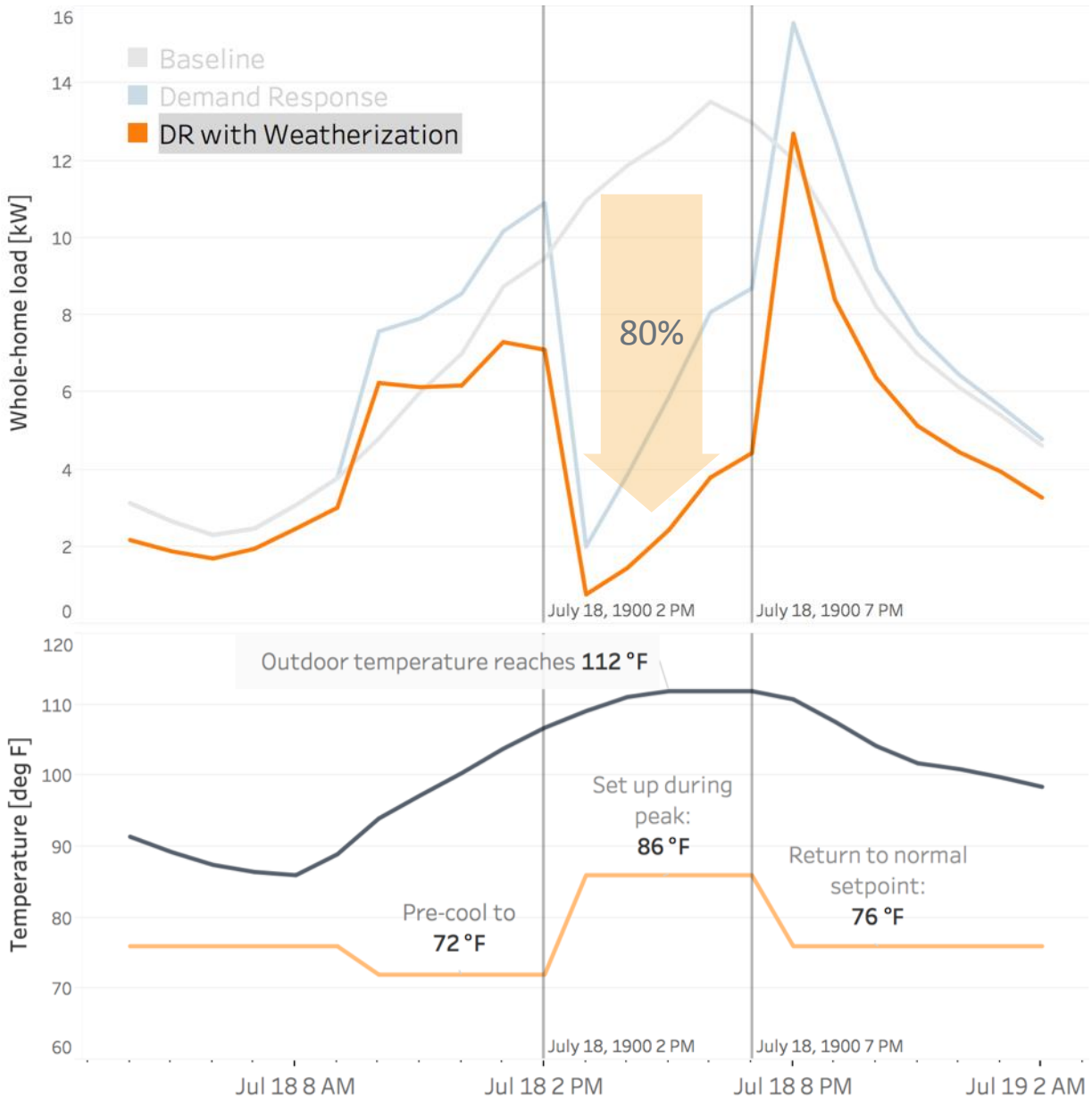

Application: Market engagement

Hyperlocal data
e.g., assessors' databases, utility bills

ResStock workflow and regional characteristics

Market engagement tools & analytics

City of Boulder

Radiant Labs

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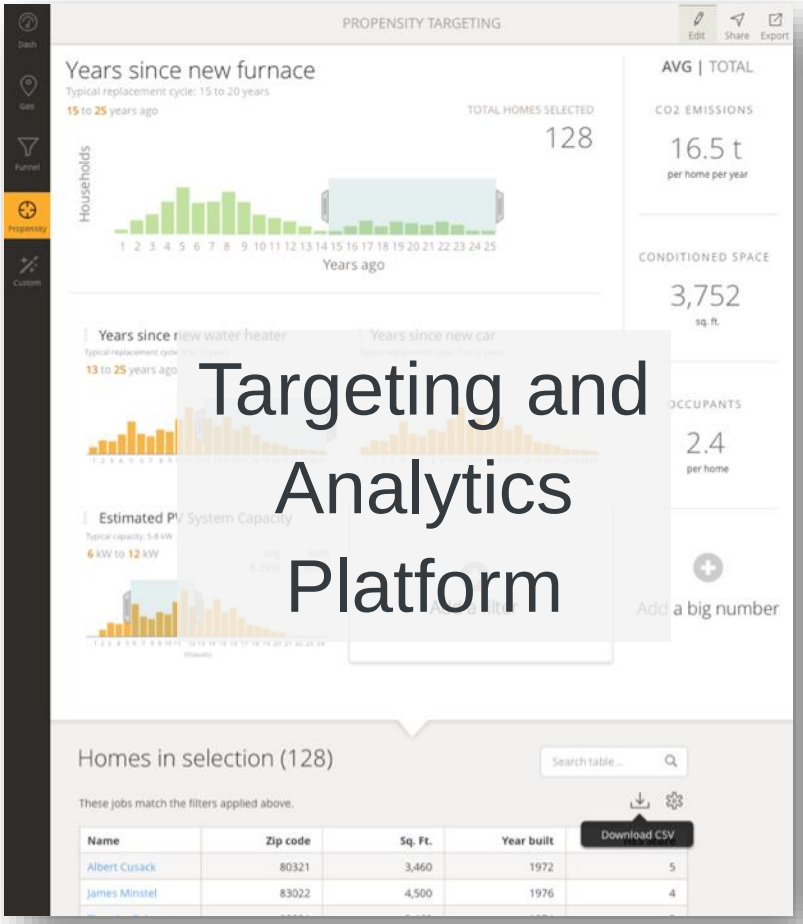
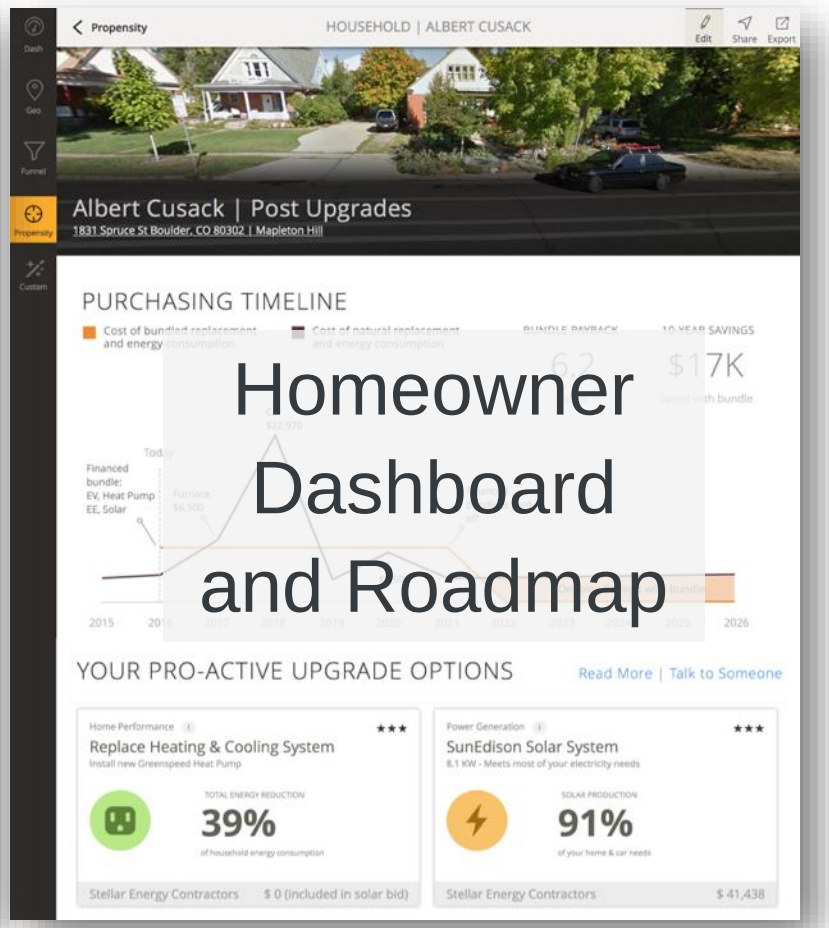


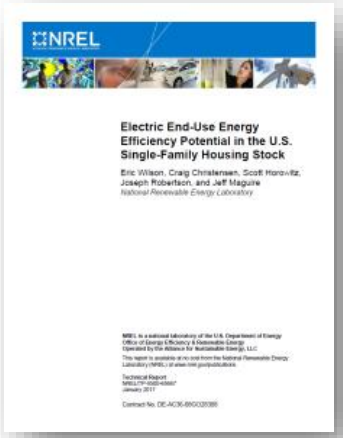
Targeting and Analytics Platform



Homeowner Dashboard and Roadmap

Ways to benefit from ResStock

Read the Report



Energy Efficiency Potential in the U.S. Single-Family Housing Stock

Download State Factsheets

Explore Results

Interactive Data Viewer

Analyze Your Scenario BETA

Use the open-source software yourself or work with NREL or other trained consultants

Visit resstock.nrel.gov to get started

Acknowledgements

EERE Building Technologies Office
EERE Office of Strategic Programs
Office of Energy Policy and Systems Analysis
Office of Electricity

Regions 8 & 10

Contact Eric.Wilson@nrel.gov

to learn how ResStock can benefit your organization.