

# Residential Electrification the Boulder Case Study

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# City of Boulder Climate & Energy Goals

80 X  
2050

COMMUNITY  
EMISSIONS  
REDUCTION

80 X  
2030

CITY  
ORGANIZATION  
EMISSIONS  
REDUCTION

100 X  
2030

PERCENT  
CLEAN  
ELECTRICIT  
Y

100 X  
2030

MEGAWATT  
S LOCAL  
GENERATIO  
N

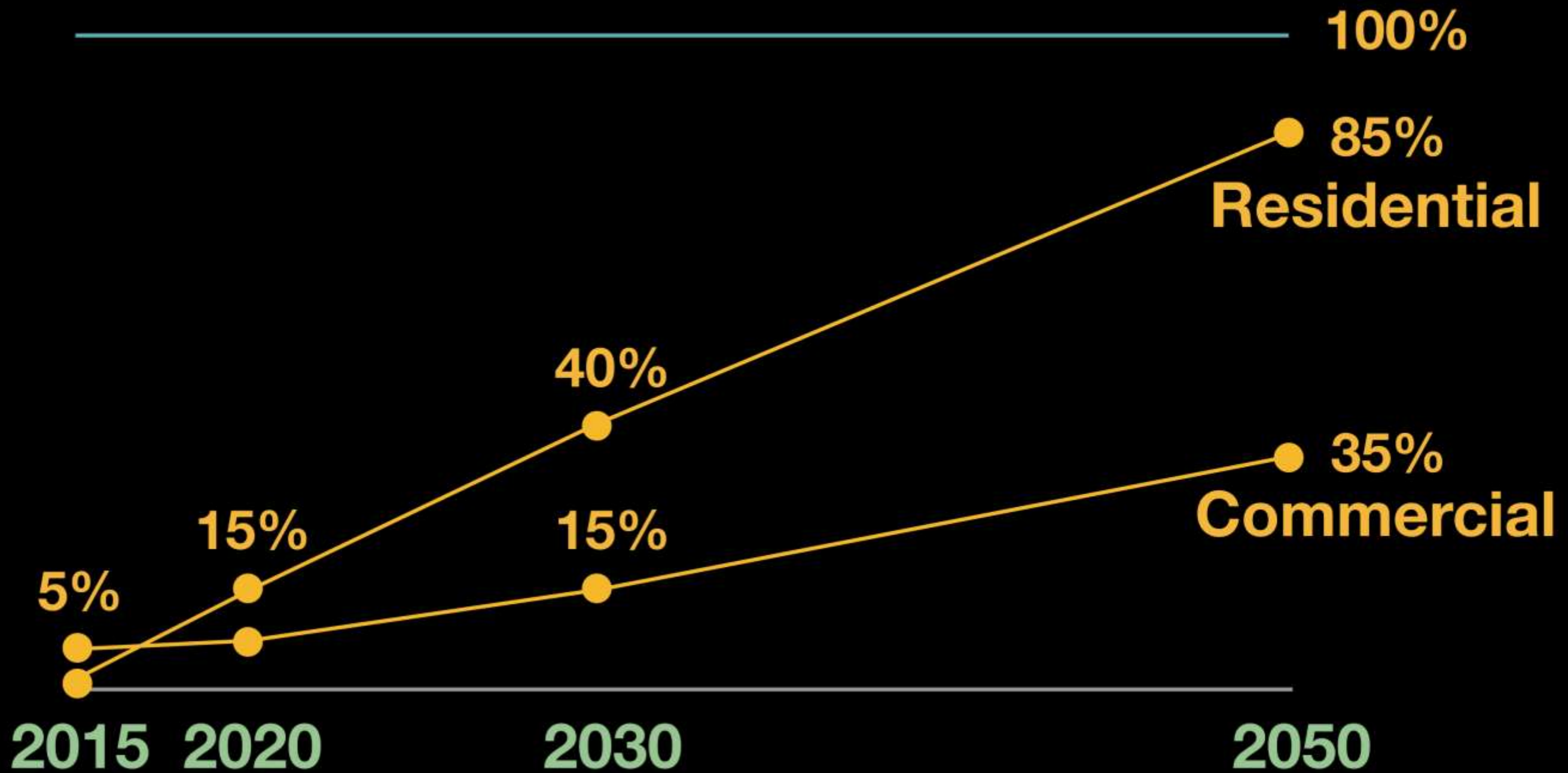
# City of Boulder Climate & Energy Goals

**Achieve  
100%  
Renewable  
Electricity  
Supply**

**Electrify  
vehicles &  
buildings**

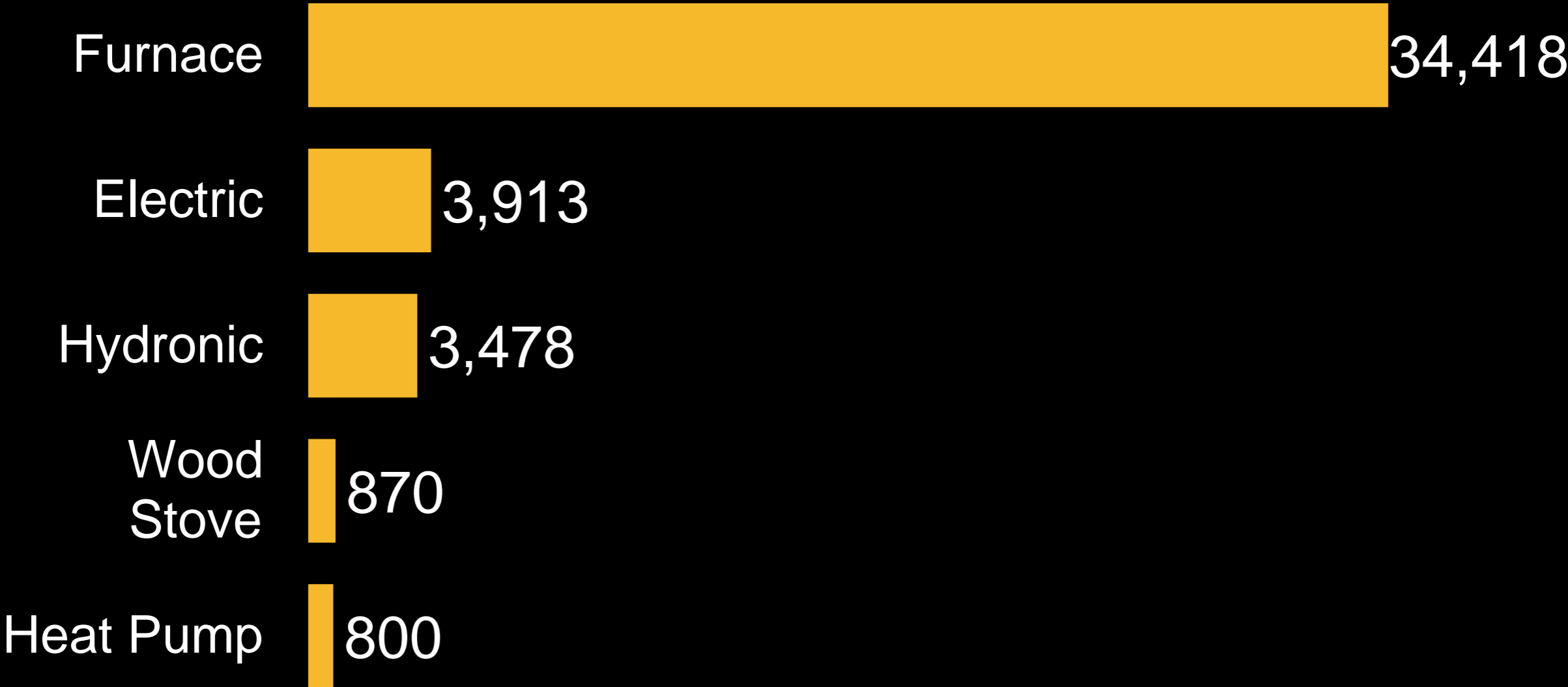
**Maximize  
Building &  
Vehicle  
Efficiency**

# Boulder's Natural Gas Reduction Goals



# Boulder's Heating Equipment

Number of Homes



# **Boulder's electrification**

## **What we're learning**

- 1. Bundling**
- 2. Create a meaningful value proposition**
- 3. Natural replacement timeline**
- 4. Learn from installers**

# 1. Bundling

**Air seal + insulation + furnace**

# 1. Bundling

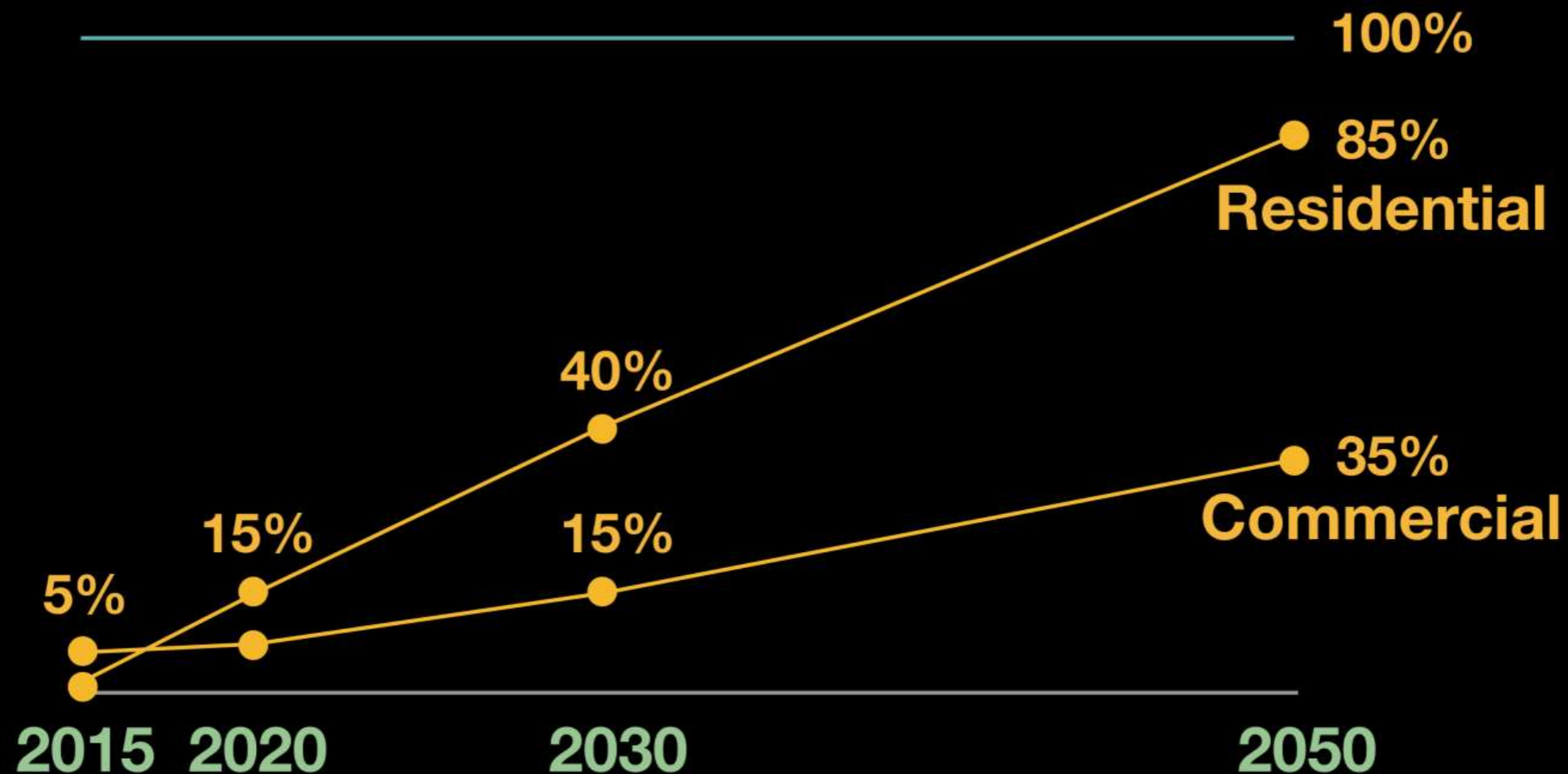
**Air seal + insulation + ~~furnace~~**

**+ heat pump + PV**

**+ electric vehicle**



## 2. Create a meaningful value proposition



➔ thousands of individual decisions

## **2. Create a meaningful value proposition**

**Don't:**

- \* Air sealing or insulation by itself**
- \* Heat pump for heating only**

# 2. Create a meaningful value proposition

Thinking of buying a Toyota Camry?

Car + Home Energy  
Monthly Expenses: \$715



Instead, consider a Nissan Leaf (EV), Solar (PV), Heat Pump, Energy Efficiency (EE)  
(Net Zero Home + Transportation)

Car + PV + EE + Home energy  
Monthly Expenses: \$715



Monthly total of loan payments  
**\$715**  
(4% for 6.2 yrs)

■ Approx. Loan Costs    
 ■ Car Monthly Fuel Cost    
 ■ Home Monthly Energy Costs

EV + PV + EE  
Paid off in  
**6.2 years**

Savings over 10 years\*  
**\$17,370**

Savings over 25 years\*  
**\$96,820**

Yearly CO<sub>2</sub> reduction  
**18.5 t**

\*Minus extra loan payments until paid in full. Includes a 3% energy escalation rate.

Leaf: \$10,961 after rebates  
Solar PV: \$18,032 after rebates  
Solar PV Capacity: 8.4kW  
Efficiency Upgrade: \$18,032

2400 SqFt home  
10,000 car miles/yr  
Camry: \$22,970

DENVER, CO



# 3. Natural Replacement Timeline

Equipment with a natural lifetime:

- \* Car
- \* HVAC
- \* Hot water heater
- \* Roof

# 3. Natural Replacement Timeline

## Reactive replacements

- \* 80% Heating, DHW emergency replaced
  - \* Replaced with the cheapest or easiest
  - \* Stuck with it for 12-20 years
- ➔ Switch to a pro-active replacement cycle

## **4. Learn from installers**

**Thousands of decisions = thousands of sales**

# **Boulder's electrification**

## **What we're doing**

**0. Awareness**

**1. Bundling + singles**

**2. Creating a meaningful value proposition**

**3. Natural replacement timeline**

**4. Supporting installers**

# How do we do this?

- 1. Tap into your data**
  - 2. Model every building**
  - 3. Build “Roadmaps” for each home**
  - 4. Identify best candidates**
  - 5. Send leads to local installers**
- Repeat...**



# Tap into your data

Activity:	14B-0002	Type:	BUILD-M	Sub Type:	Windows	Status:	ISSUED
Parcel:	00770-90-01			DATE_B:	01/03/2014	Sq Feet:	
Site Address:	[REDACTED] LSVL						
Description:	Replace 6 windows size for size						
Applicant:	PELLA WINDOWS AND DOORS			Phone:	[REDACTED]		
Contractor:	PELLA WINDOWS AND DOORS			Phone:	[REDACTED]		
Owner:	[REDACTED]			Phone:	[REDACTED]		
Occupancy:		Use:		Class:		Insp Area:	
Valuation:	\$14,073.00	Fees Req:	\$384.58	Fees Col:	\$384.58	Bal Due:	\$0.00
Activity:	14B-0003	Type:	BUILD-M	Sub Type:	Windows	Status:	FINAL
Parcel:	00964-31-01			DATE_B:	01/03/2014	Sq Feet:	
Site Address:	[REDACTED] LSVL						
Description:	Install 4 windows size for size						
Applicant:	PELLA WINDOWS AND DOORS			Phone:	[REDACTED]		
Contractor:	PELLA WINDOWS AND DOORS			Phone:	[REDACTED]		
Owner:	[REDACTED]			Phone:	[REDACTED]		
Occupancy:		Use:		Class:		Insp Area:	
Valuation:	\$7,134.00	Fees Req:	\$235.39	Fees Col:	\$235.39	Bal Due:	\$0.00
Activity:	14B-0004	Type:	BUILD-M	Sub Type:	Windows	Status:	ISSUED
Parcel:	01099-60-01			DATE_B:	01/07/2014	Sq Feet:	
Site Address:	[REDACTED] SVL						
Description:	Install 28 windows and 1 patio door size for size						
Applicant:	DAWN WINDOWS			Phone:	[REDACTED]		
Owner:	[REDACTED]			Phone:	[REDACTED]		
Contractor:	DAWN WINDOWS			Phone:	[REDACTED]		
Occupancy:		Use:		Class:		Insp Area:	
Valuation:	\$16,794.00	Fees Req:	\$443.08	Fees Col:	\$443.08	Bal Due:	\$0.00
Activity:	14B-0005	Type:	BUILD-M	Sub Type:	Roof	Status:	FINAL
Parcel:	01098-89-01			DATE_B:	01/10/2014	Sq Feet:	
Site Address:	[REDACTED] SVL						
Description:	Reroof 25 sq's						
Applicant:	COMPANY ROOFING AND EXTERIORS			Phone:	[REDACTED]		
Owner:	[REDACTED]			Phone:	[REDACTED]		
Contractor:	COMPANY ROOFING AND EXTERIORS			Phone:	[REDACTED]		
Occupancy:		Use:		Class:		Insp Area:	
Valuation:	\$4,200.00	Fees Req:	\$172.31	Fees Col:	\$172.31	Bal Due:	\$0.00
Activity:	14B-0006	Type:	BUILD-M	Sub Type:	Siding	Status:	FINAL
Parcel:	00194-00-02			DATE_B:	01/10/2014	Sq Feet:	
Site Address:	[REDACTED]						
Description:	Re-siding to include soffit						
Applicant:	MOUNTAIN ROOFTOPS INC.			Phone:	[REDACTED]		
Contractor:	MOUNTAIN ROOFTOPS INC.			Phone:	[REDACTED]		
Owner:	[REDACTED]			Phone:	[REDACTED]		

# Tap into your data

## *City*

**Permits**

**Renter/Owner**

**GIS Building Footprints**

**Rooftop Solar Potential**

## *County*

**Assessor**

**Energy Modeling (NREL)**

**Predictive Profiles**

**Efficiency Upgrade Data**

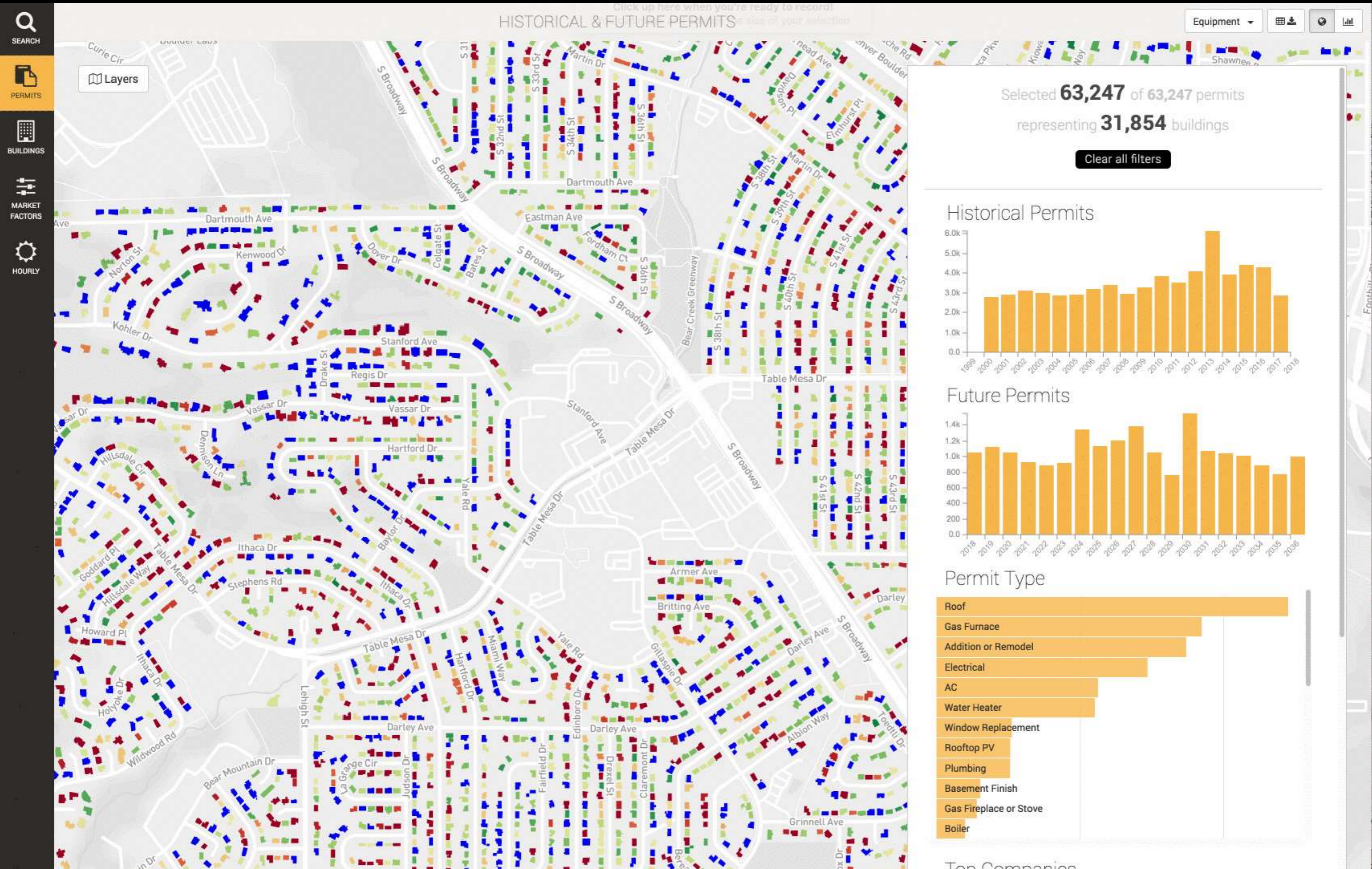
## *Country*

**Geocoding**

**Census**

**Zillow**

# Tap into your data



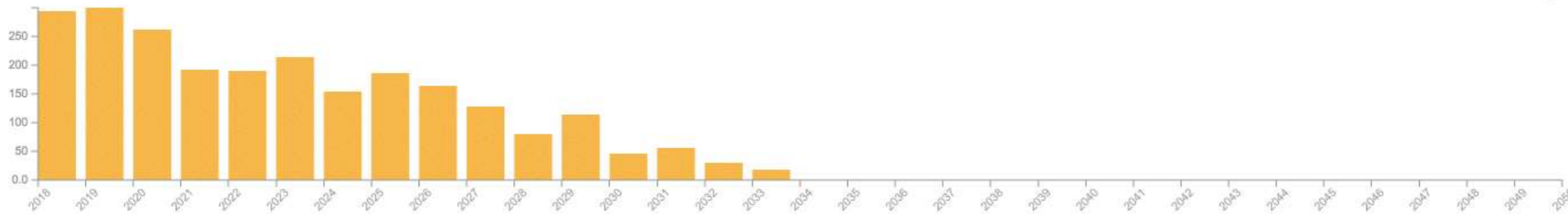
# Model every building & identify candidates

- SEARCH
- PERMITS
- BUILDINGS
- MARKET FACTORS
- HOURLY

## RESIDENTIAL BUILDINGS

Add Chart Profiles & Cohorts

Combined Water Heater & Gas Furnace & Ac (earliest permit years)

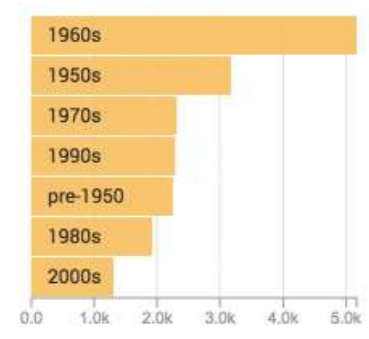


Selected  
**18,406**  
of 18,406 buildings  
[Clear all filters](#)

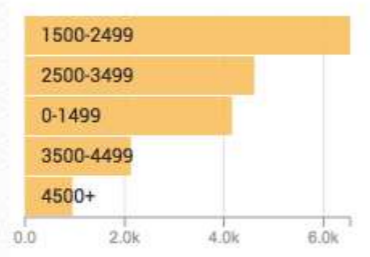
### Market Factors

Price per kWh	\$0.12
Price per therm	\$0.85
PV Price per Watt	\$3
kWh per PV Watt	1.4
Cost Adjustments	1.2
Incremental costs	\$6000
Interest Rate	4.5%
Number of payments	240

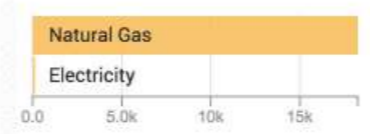
Vintage



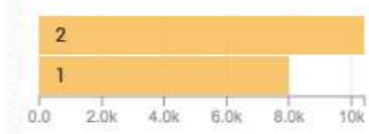
Size



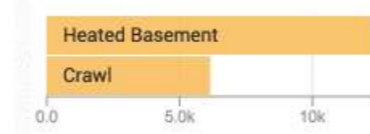
Heating Fuel



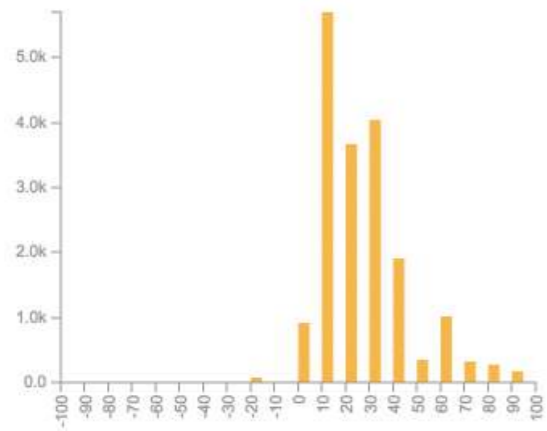
Stories



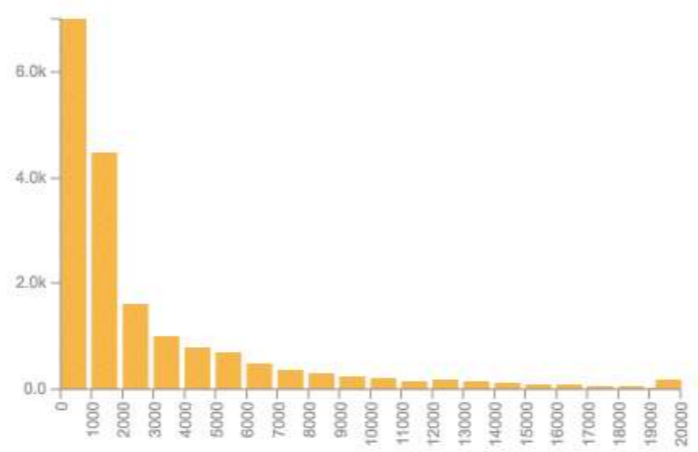
Foundation



MF Set 3 - Estimated EE & HVAC Plus Net Zero PV Improvement Cash Flow

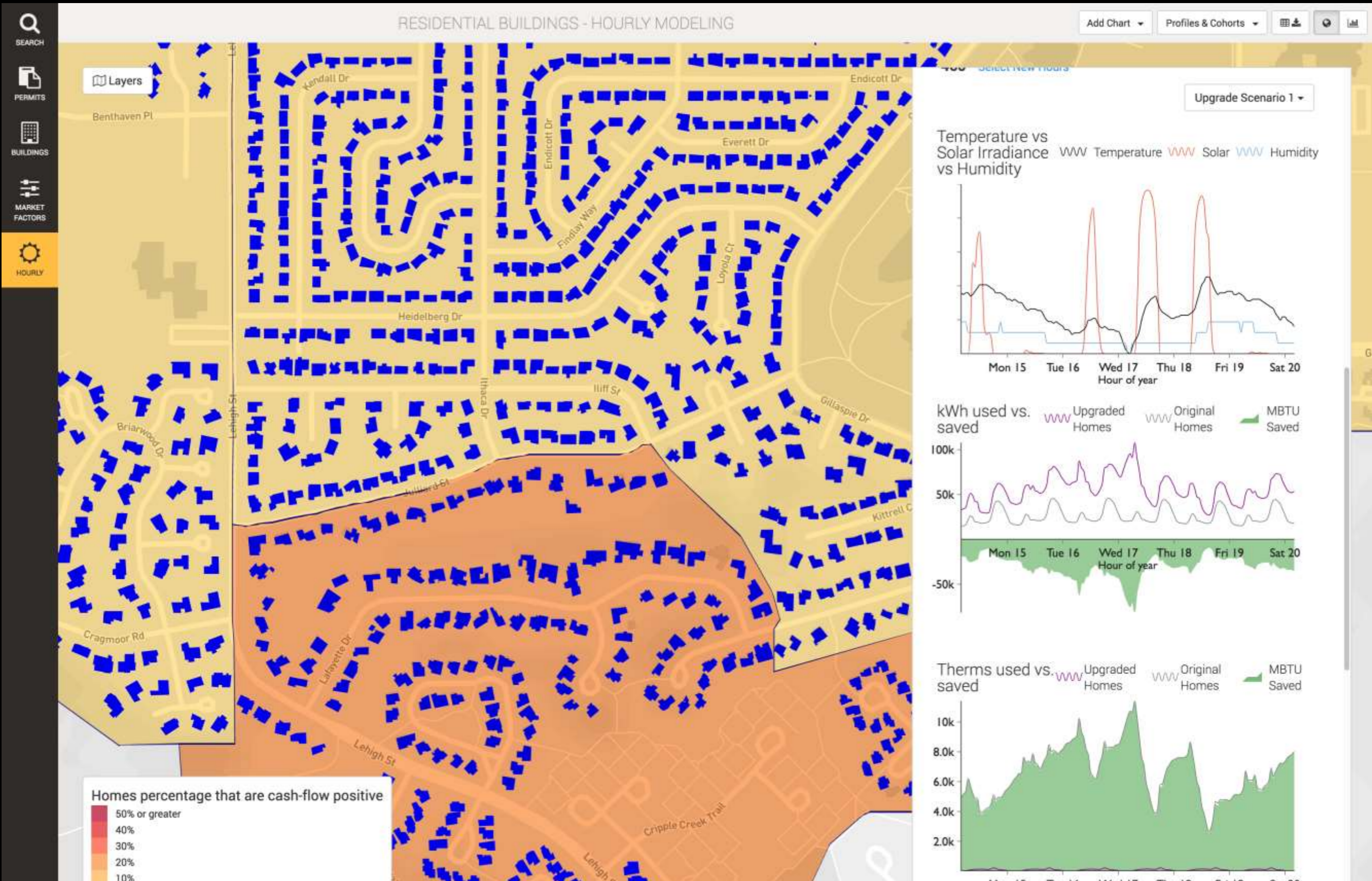


PV potential in kWh/yr



Save current filter set as a [profile](#) or as a [cohort](#)

# Hourly energy models




# Roadmaps for every home


## Residential Roadmap to Renewable Energy Living

Upgrading your household energy system towards a sustainable energy future

ELECTRIFY HEATING & COOLING




IMPROVE ENERGY EFFICIENCY




**4 ACTIONS WITH IMPACT**

GET SOLAR POWER



DRIVE ELECTRIC



Kencairn Brett  
119 20th St, Boulder, CO 80302

## Upgrade Options

Recommended Replacements	Your Home's Current Status	Bronze	Silver	Gold
<b>Improve your Energy Efficiency</b> - Sealing & Insulation	✓	●	●	●
<b>Electrify your Heating &amp; Cooling</b> - Heat Pump add on to furnace and Electric swater heater	✓	●	●	●
<b>Get Solar Power</b> - Silver add to east roof. Gold build a patio cover			●	●
<b>Drive Electric</b> - Charge your car at home			●	●
<b>Energy Efficiency Costs</b>	\$0	\$2,400	\$0	\$0
<b>Heating &amp; Cooling Costs</b>	\$11,600	\$9,360	\$0	\$0
<b>Solar PV Costs</b>	\$0	\$0	\$8,841	\$17,500
<b>Car Costs</b>	\$0	\$0	\$0	\$0
<b>Total Estimated Upgrade Costs</b>	<b>\$11,600</b>	<b>\$11,760</b>	<b>\$8,841</b>	<b>\$17,500</b>

Loan Template	Current Status	Bronze	Silver	Gold
Home Equipment	Cash	Energy Smart Loan	Energy Smart Loan	Energy Smart L
Car	Car 0% 5 year	Car Loan 5% 6 year	Car Loan 5% 6 year	Car Loan 5% 6

### Cumulative Costs 20 years

<b>\$39,083</b> on annual energy bills + <b>\$11,600</b> on unexpected replacements = <b>\$50,683</b> Total	<b>\$406</b> on energy bills + <b>\$26,581</b> on Gold package replacements financing (including interest payments) = <b>\$26,988</b> Total	<b>\$23,695</b> Total 20 yr Savings Engaging the roadmap
Business as usual	Engaging the roadmap	

# Tools for installers

- Editor
- Table
- PDF
- New
- Save As
- Save
- Load
- Auto Sync
- Share

STATUS QUO
BRONZE SILVER **GOLD**

Car 1

Nissan Leaf, zero cost ev

Toyota Camry

Energy Efficiency 0

Insulate Crawl Space

Insulate Attic

Heating & Cooling 0

Electric Water Heater

Bosch ASHP-Add on to existing Furnace

PV 1

Additional PV system with Patio Cover

<b>Yearly Electric kWh</b> 7133 kWh <small>edited</small>	<b>Yearly Electric Cost</b> \$ 855
<b>Yearly Natural Gas Therms</b> 155	<b>Yearly Natural Gas Cost</b> \$ 117
<b>Miles Driven Per Year</b> 10000	<b>PV System Annual Production</b> 10988 kWh
<b>PV System Size In Watts</b> 8080 <small>edited</small>	<b>PV Panel Wattage</b> 330
<b>PV Number Of Panels</b> 0	<b>PV kWh per Peak Watt</b> 1.36 <small>edited</small>
<b>PV Installed Cost Per Watt</b> \$ 3.09	

**Loan Templates**

Home Equipment Car
ADD LOCAL LOAN TEMPLATE

Default	Available Custom	Available Combine	Category	Name	Loan Rate (%)	Loan Term (Mo)	Created	Use #	Local
<input type="radio"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Home	CASH	0	1	February 26, 2018	0	<input type="checkbox"/>



- Summary
- Charts
- Table
- Preview PDF

# National Renewable Heating & Cooling

Developing collaborative, nationwide effort

7 Leading Cities - 22 Getting Ready

Manufacturers

