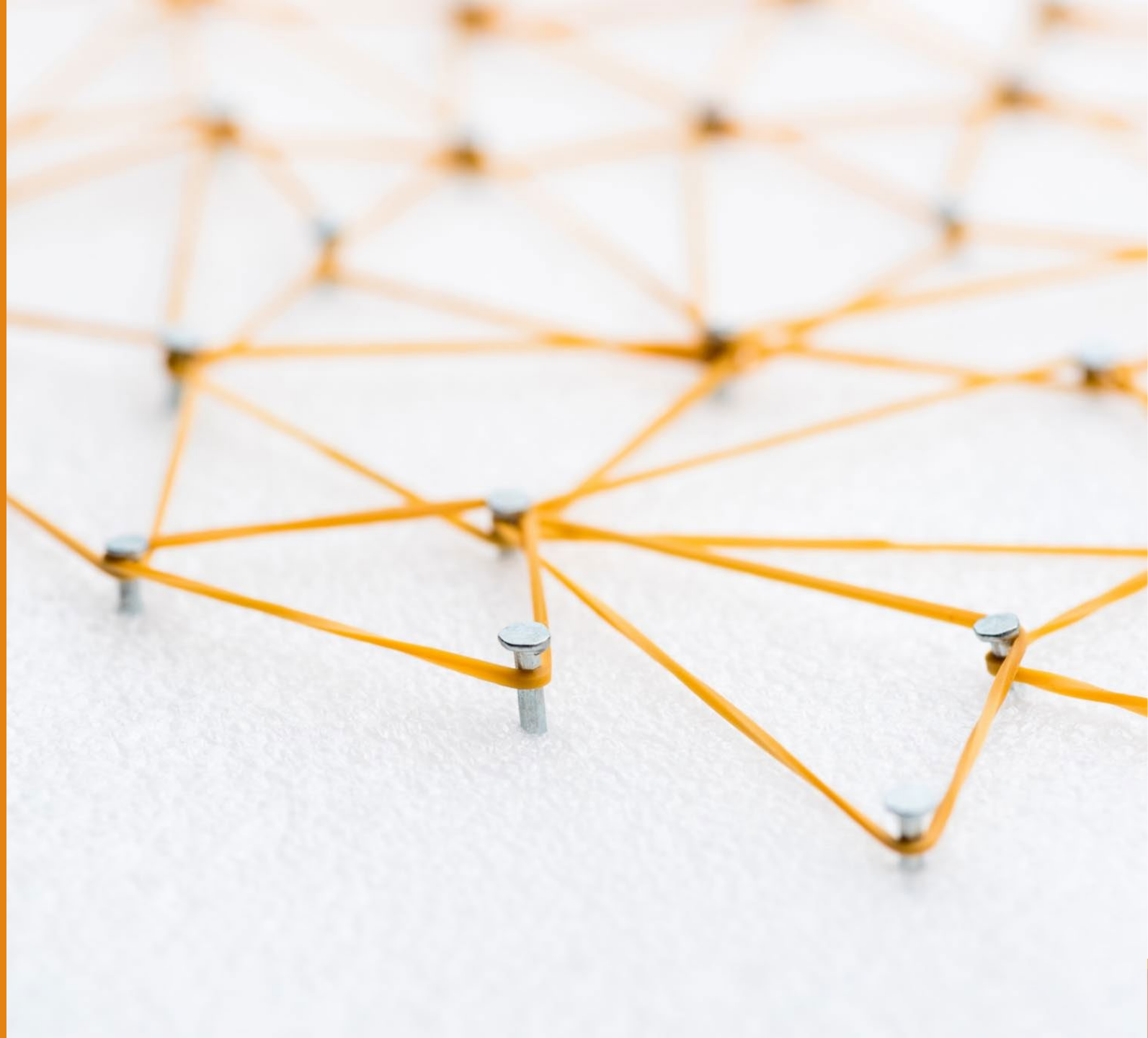
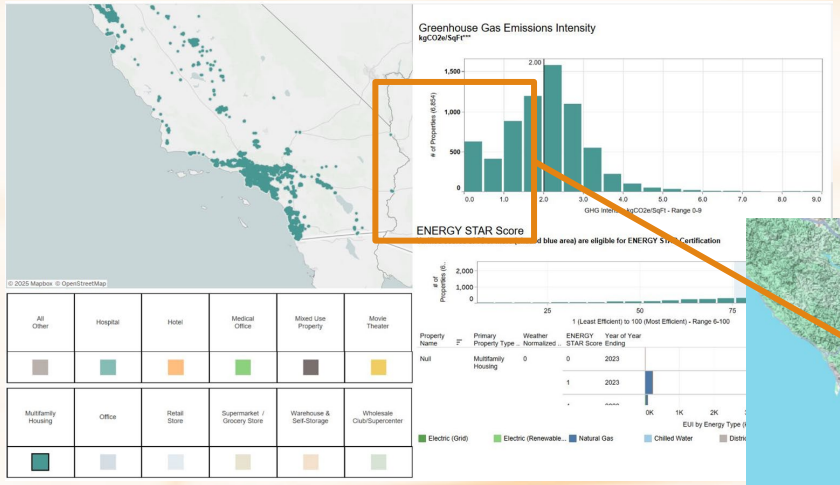
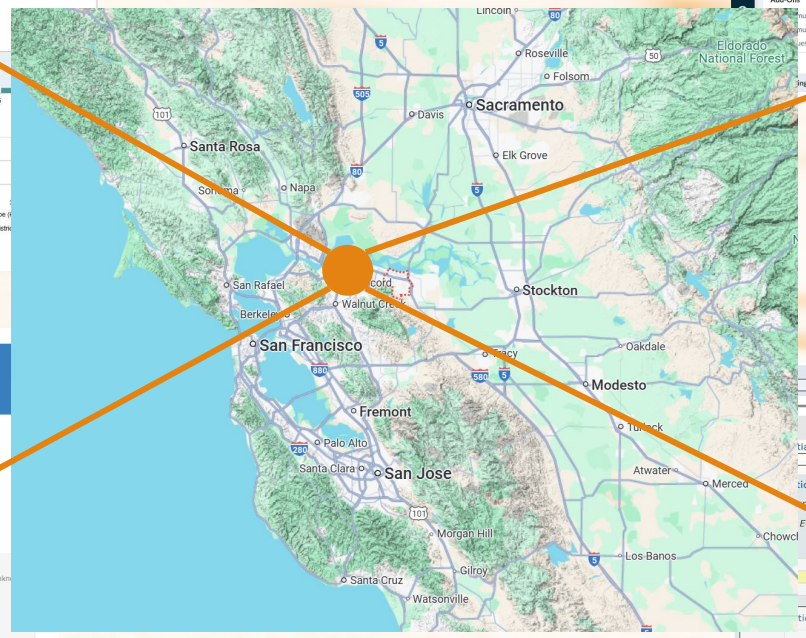
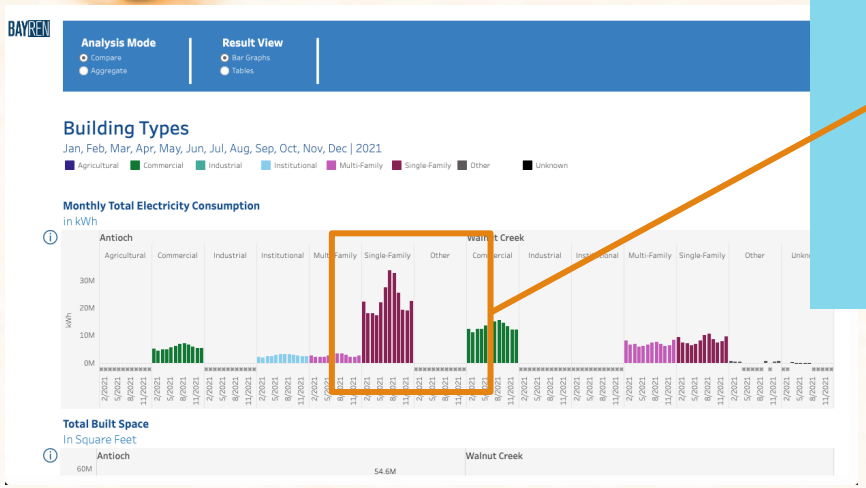
Connecting the Data Dots

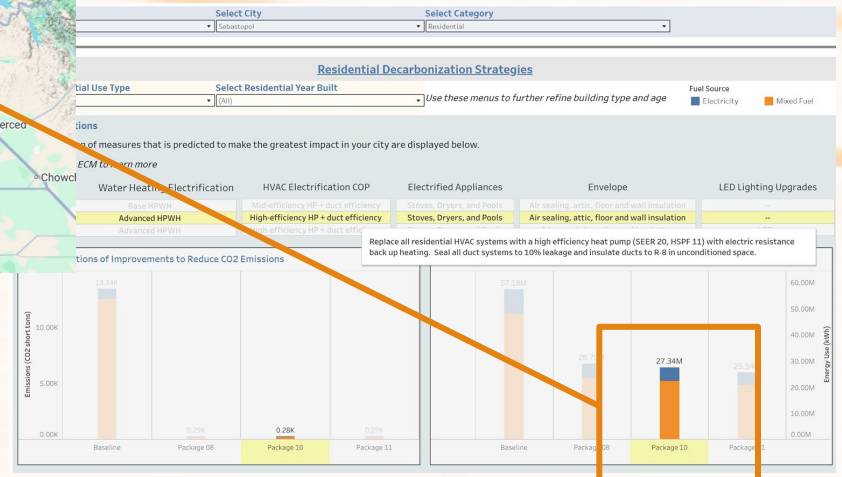


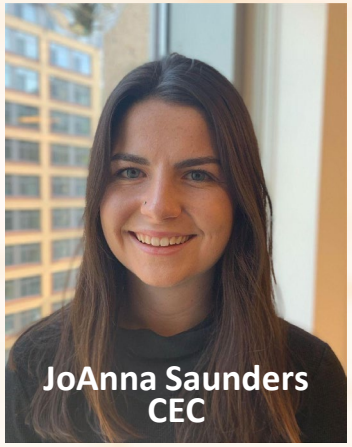
Four Data Tools and a City







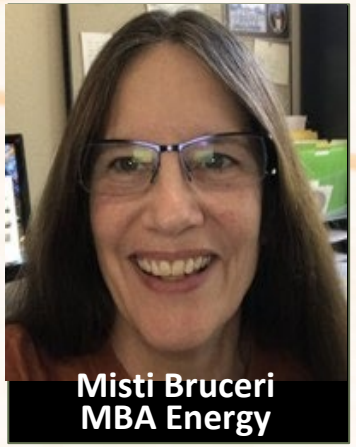


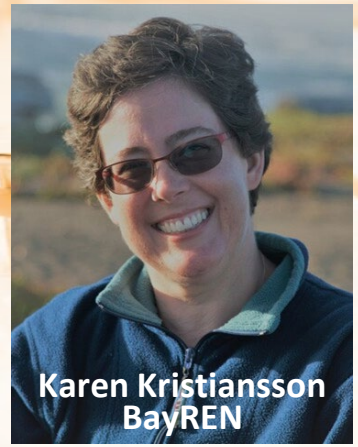

JoAnna Saunders
CEC


Jasmine Krause
Policy Studio


Spencer Mathews
UCLA


Emily Miller
Arup

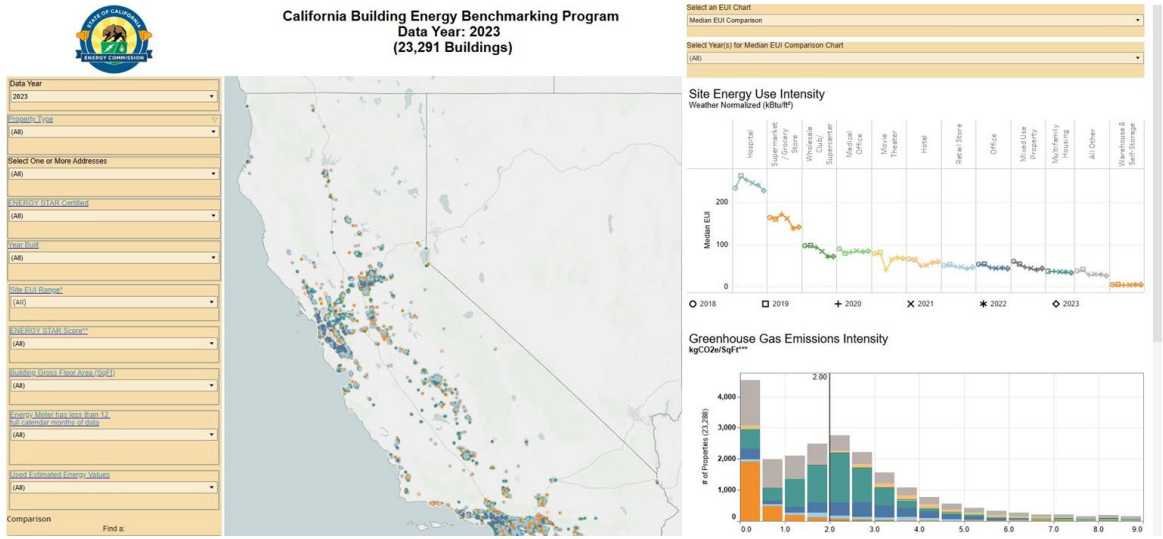

Misti Bruceri
MBA Energy


Karen Kristiansson
BayREN


Kelly Cunningham
PG&E

CEC Benchmarking Data

California's Energy Benchmarking Program: Public Disclosure Dashboard



JoAnna Saunders
California Energy Commission
Efficiency Division, Existing Buildings Branch

Outline:

- Overview of AB 802 (energy benchmarking program)
- Intro to Public Disclosure Dashboard
- How to use the tool
- Data insights
- Limitations and opportunities

AB 802 – Statewide Energy Benchmarking Program

- AB 802 requires **commercial buildings >50,000 ft^2** and **multifamily buildings >50,000 ft^2 and 17 or more units** to annual report **energy use** to CEC
- Data is submitted by **June 1** every year, since 2018
- All reporting is done through the US EPA's ENERGY STAR Portfolio Manager®
- Requires monthly energy use and key operational building details

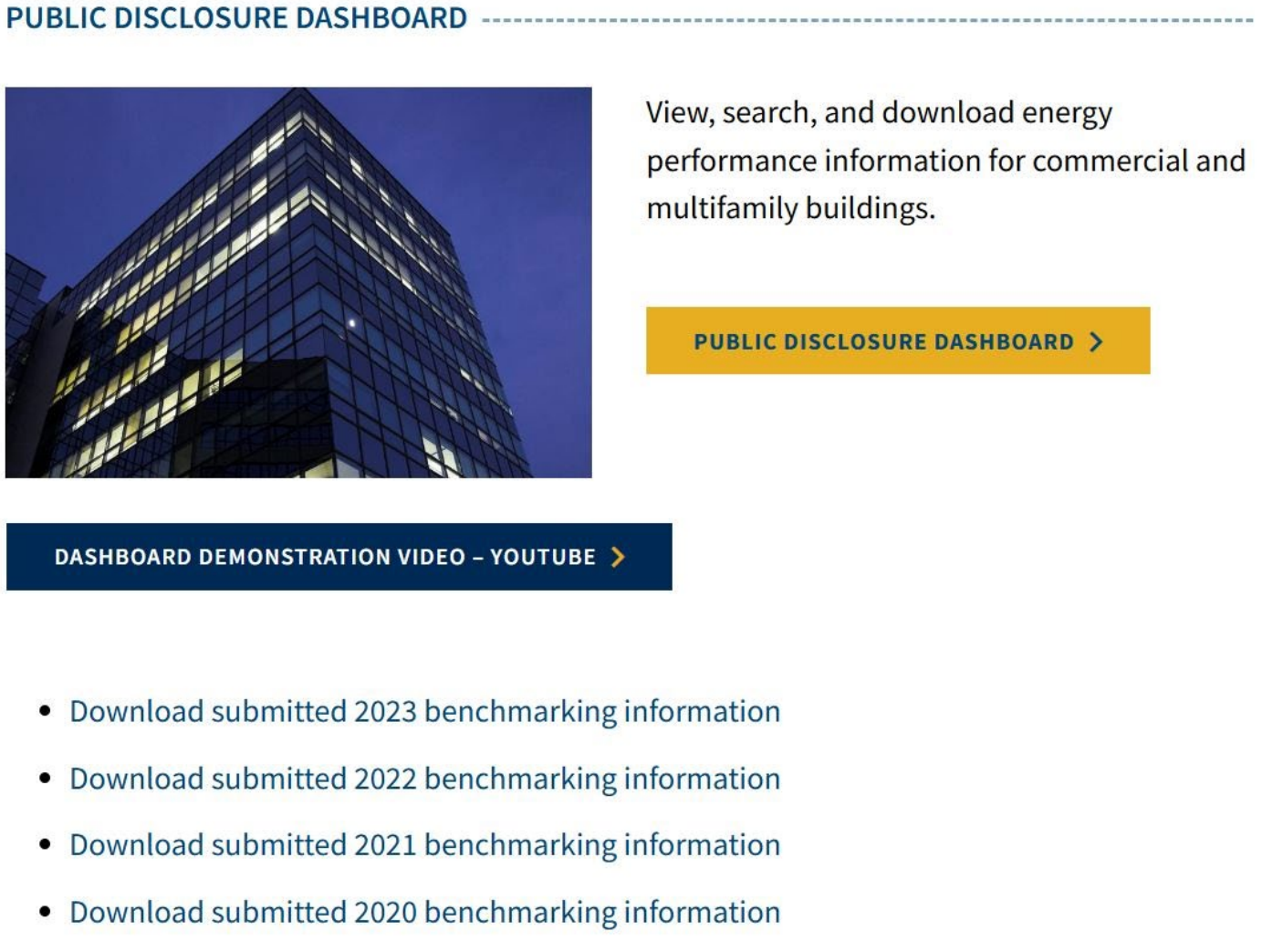
Data Disclosed

CEC has authority to disclosure building-level data on public website per benchmarking regulations including:

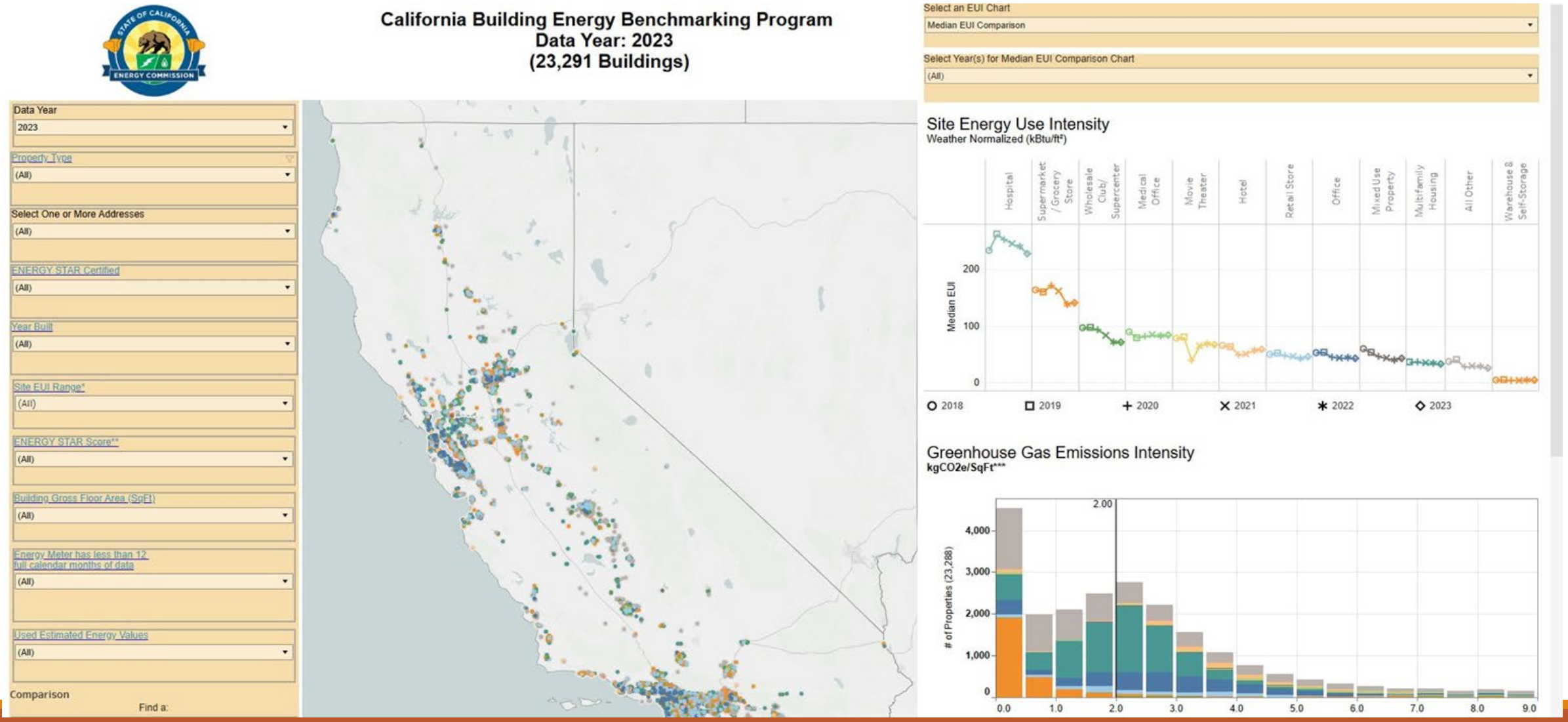
- Building address
- Year built
- Gross floor area
- Property type
- ENERGY STAR Score, for eligible buildings.
- Monthly and/or annual site energy use by energy type
- Monthly and/or annual weather-normalized site and/or source energy use intensity
- Total greenhouse gas emissions

Public Disclosure Dashboard

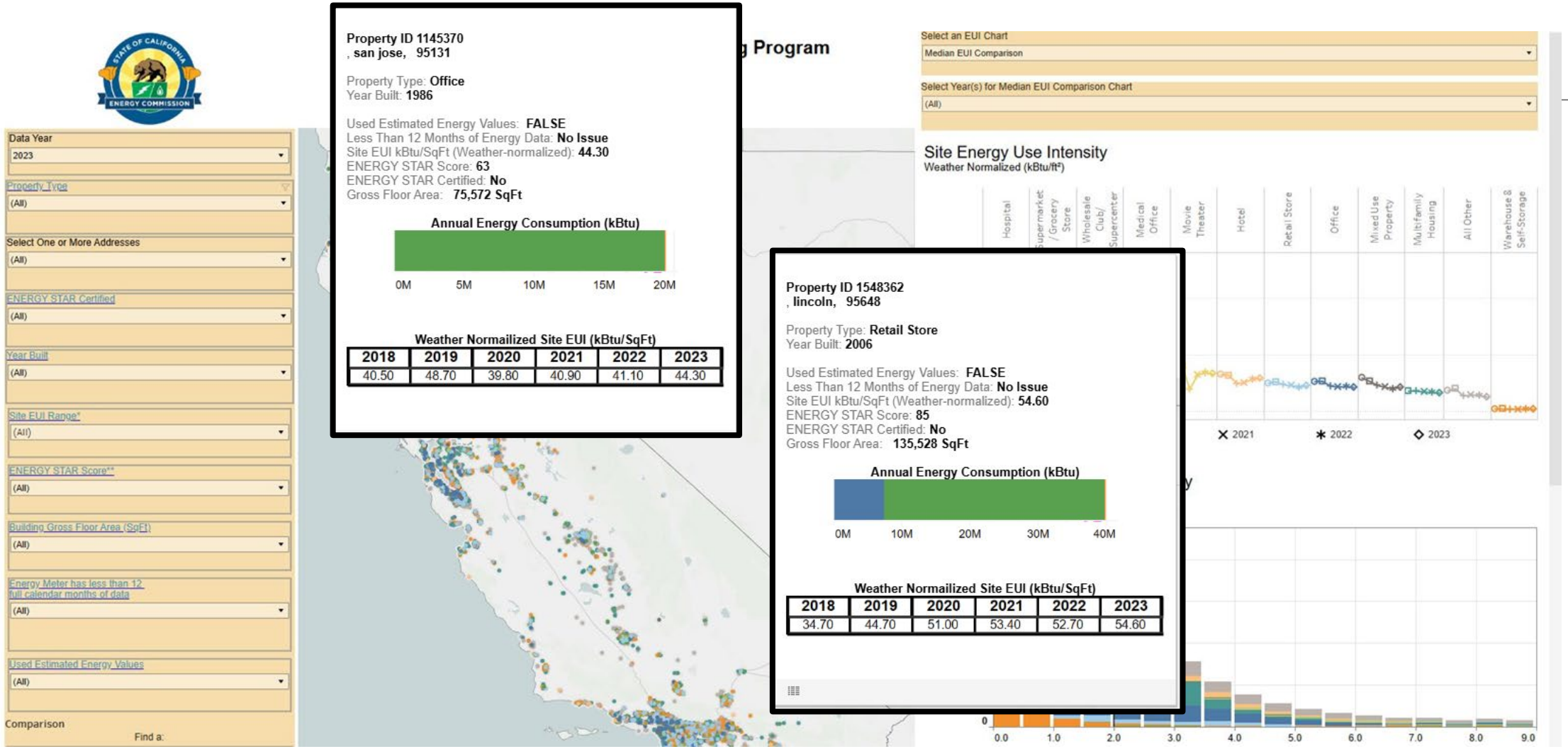
- Data can be accessed from CEC benchmarking website
- Users can go to interactive dashboard or download data directly



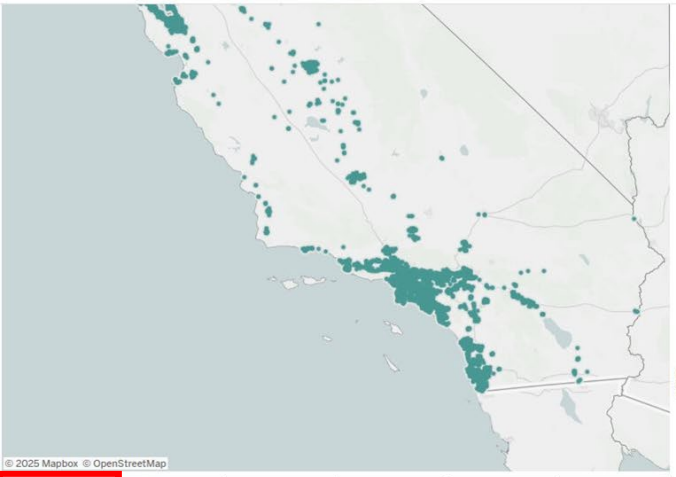
Public Disclosure Dashboard

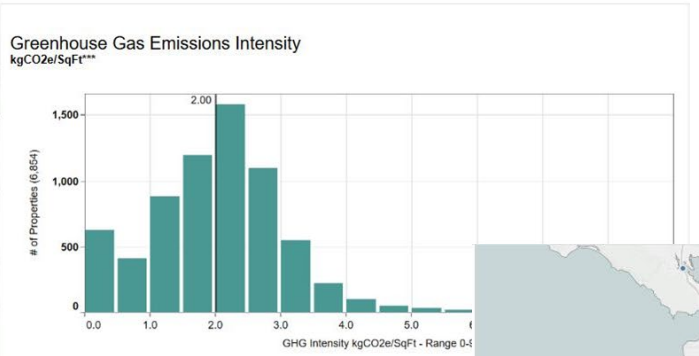


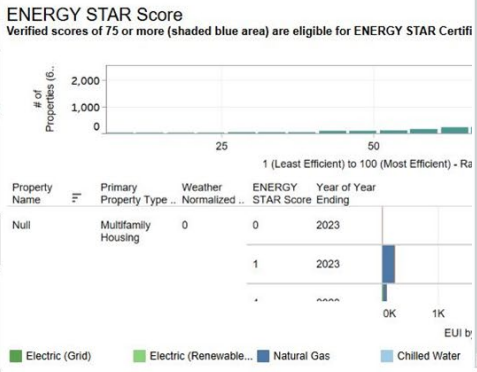
Explore Building-level Data

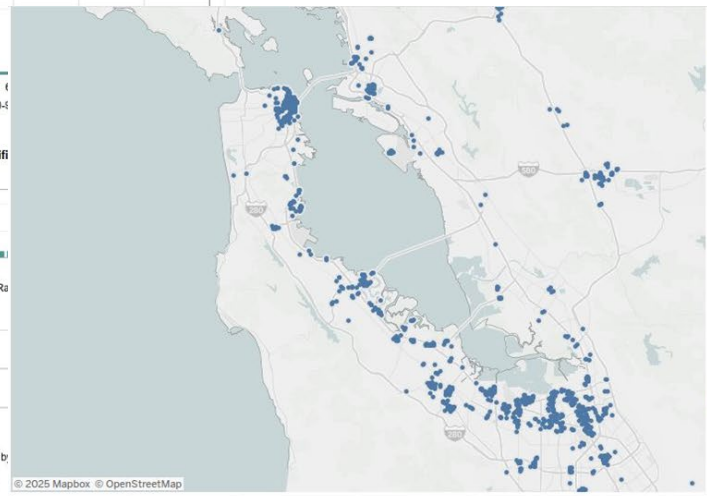


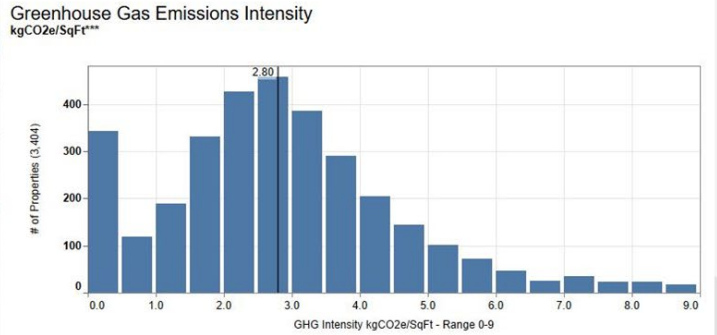
Building Performance Trends

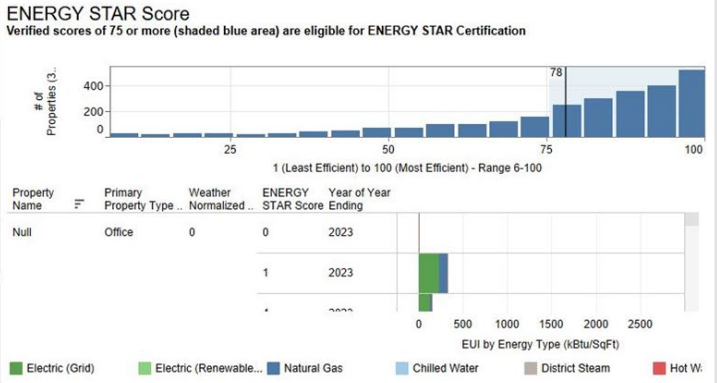












Building Performance Trends

ENERGY STAR Score**
(All)

Building Gross Floor Area (SqFt)
(All)

Energy Meter has less than 12 full calendar months of data
(All)

Used Estimated Energy Values
(All)

Comparison
Find a:
City
Search:
San Francisco
Compare to:
San Jose

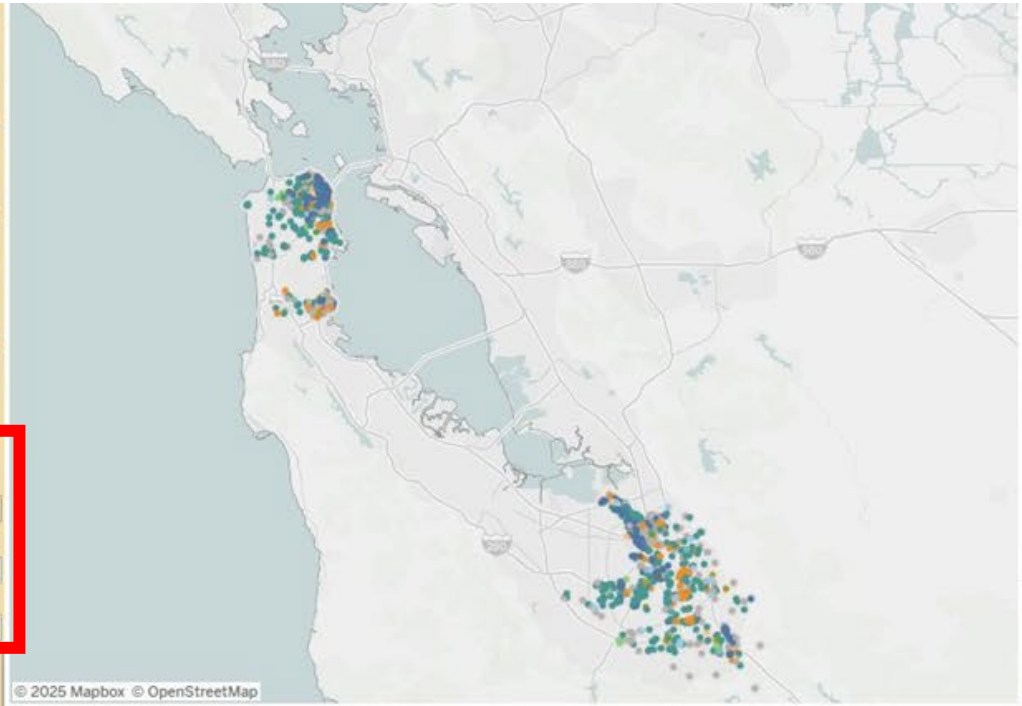
Results (Check to Exclude)
- [x] san francisco
- [x] san jose
- [x] south san francisco

Data downloaded February 27, 2025. Data are displayed as received from building owners, and include buildings reported with incomplete and estimated energy use data. To hide these buildings, please use the appropriate filters above. Please refer to the Portfolio Manager Glossary for definitions of terms used in the filters.

*Weather normalized

**Not all building types are eligible for an ENERGY STAR Score

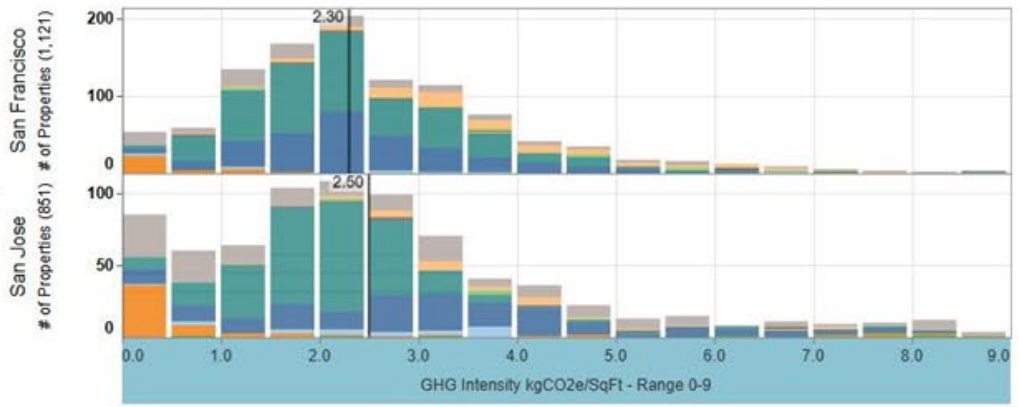
***Greenhouse gas emissions are calculated by ENERGY STAR Portfolio Manager Portfolio Manager methodology .



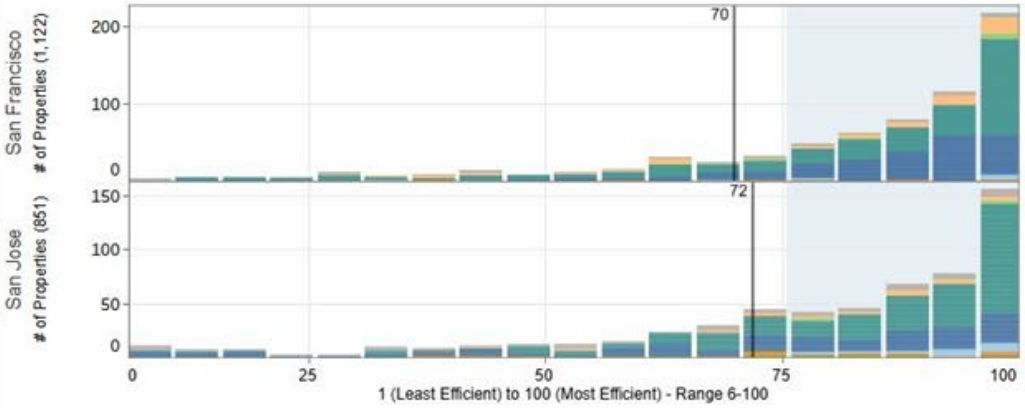
All Other	Hospital	Hotel	Medical Office	Mixed Use Property	Movie Theater

Multifamily Housing	Office	Retail Store	Supermarket / Grocery Store	Warehouse & Self-Storage	Wholesale Club/Supercenter

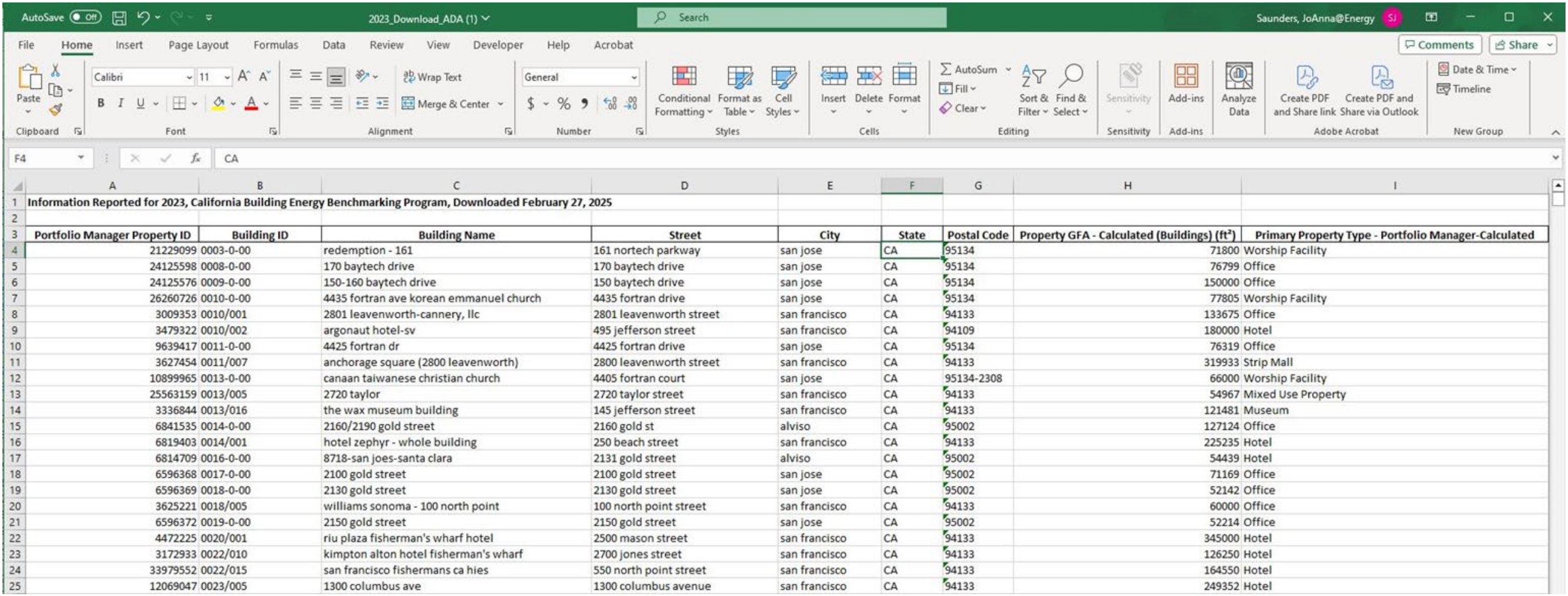
Greenhouse Gas Emissions Intensity
kgCO2e/SqFt***



ENERGY STAR Score
Verified scores of 75 or more (shaded blue area) are eligible for ENERGY STAR Certification



Public Disclosure Spreadsheet



Information Reported for 2023, California Building Energy Benchmarking Program, Downloaded February 27, 2025								
Portfolio Manager Property ID	Building ID	Building Name	Street	City	State	Postal Code	Property GFA - Calculated (Buildings) (ft²)	Primary Property Type - Portfolio Manager-Calculated
21229099	0003-0-00	redemption - 161	161 nortech parkway	san jose	CA	95134	71800	Worship Facility
24125598	0008-0-00	170 baytech drive	170 baytech drive	san jose	CA	95134	76799	Office
24125576	0009-0-00	150-160 baytech drive	150 baytech drive	san jose	CA	95134	150000	Office
26260726	0010-0-00	4435 fortran ave korean emmanuel church	4435 fortran drive	san jose	CA	95134	77805	Worship Facility
3009353	0010/001	2801 leavenworth-cannery, llc	2801 leavenworth street	san francisco	CA	94133	133675	Office
3479322	0010/002	argonaut hotel-sv	495 jefferson street	san francisco	CA	94109	180000	Hotel
9639417	0011-0-00	4425 fortran dr	4425 fortran drive	san jose	CA	95134	76319	Office
3627454	0011/007	anchorage square (2800 leavenworth)	2800 leavenworth street	san francisco	CA	94133	319933	Strip Mall
10899965	0013-0-00	canaan taiwanese christian church	4405 fortran court	san jose	CA	95134-2308	66000	Worship Facility
25563159	0013/005	2720 taylor	2720 taylor street	san francisco	CA	94133	54967	Mixed Use Property
3336844	0013/016	the wax museum building	145 jefferson street	san francisco	CA	94133	121481	Museum
6841535	0014-0-00	2160/2190 gold street	2160 gold st	alviso	CA	95002	127124	Office
6819403	0014/001	hotel zephyr - whole building	250 beach street	san francisco	CA	94133	225235	Hotel
6814709	0016-0-00	8718-san joes-santa clara	2131 gold street	alviso	CA	95002	54439	Hotel
6596368	0017-0-00	2100 gold street	2100 gold street	san jose	CA	95002	71169	Office
6596369	0018-0-00	2130 gold street	2130 gold street	san jose	CA	95002	52142	Office
3625221	0018/005	williams sonoma - 100 north point	100 north point street	san francisco	CA	94133	60000	Office
6596372	0019-0-00	2150 gold street	2150 gold street	san jose	CA	95002	52214	Office
4472225	0020/001	riu plaza fisherman's wharf hotel	2500 mason street	san francisco	CA	94133	345000	Hotel
3172933	0022/010	kimpton alton hotel fisherman's wharf	2700 jones street	san francisco	CA	94133	126250	Hotel
33979552	0022/015	san francisco fishermans ca hies	550 north point street	san francisco	CA	94133	164550	Hotel
12069047	0023/005	1300 columbus ave	1300 columbus avenue	san francisco	CA	94133	249352	Hotel

Uses and Benefits of Dashboard

- Provides key energy performance metrics to the public
- Allow building tenants and owners to understand how their building is operating
- Can help identify opportunities for savings
- Could inform prospective tenants or buyers in lease/purchase decisions
- Recognizes high performing buildings
- Can be downloaded in excel for deeper analysis

Dashboard Limitations

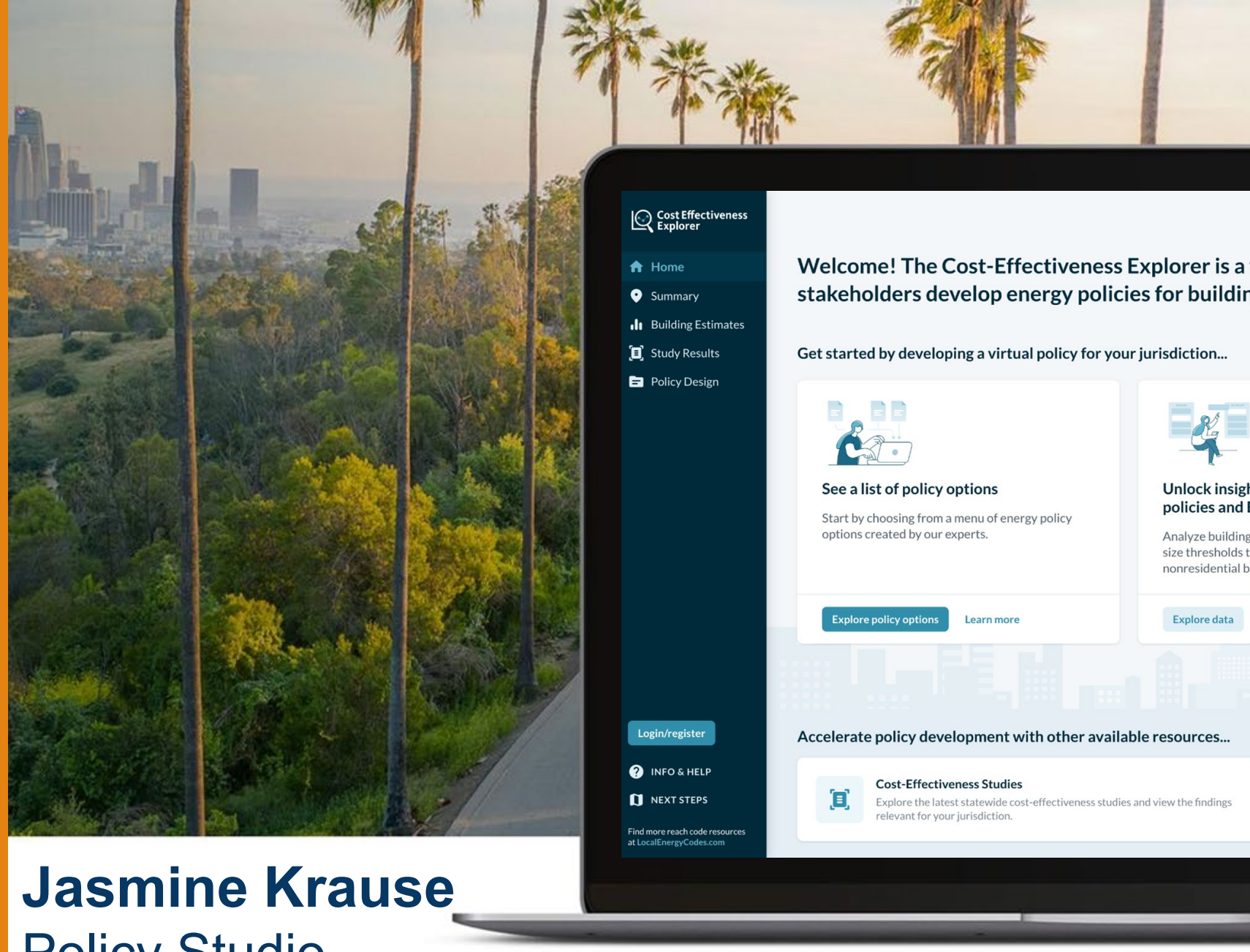
- Only includes data from submitted buildings, does not show all possible disclosable buildings
- Data is self-submitted and not verified
- Limited to what is allowed to be disclosed per regulations

Thank You!

JoAnna Saunders
California Energy Commission
Efficiency Division, Existing Buildings Branch

Cost-Effectiveness Explorer

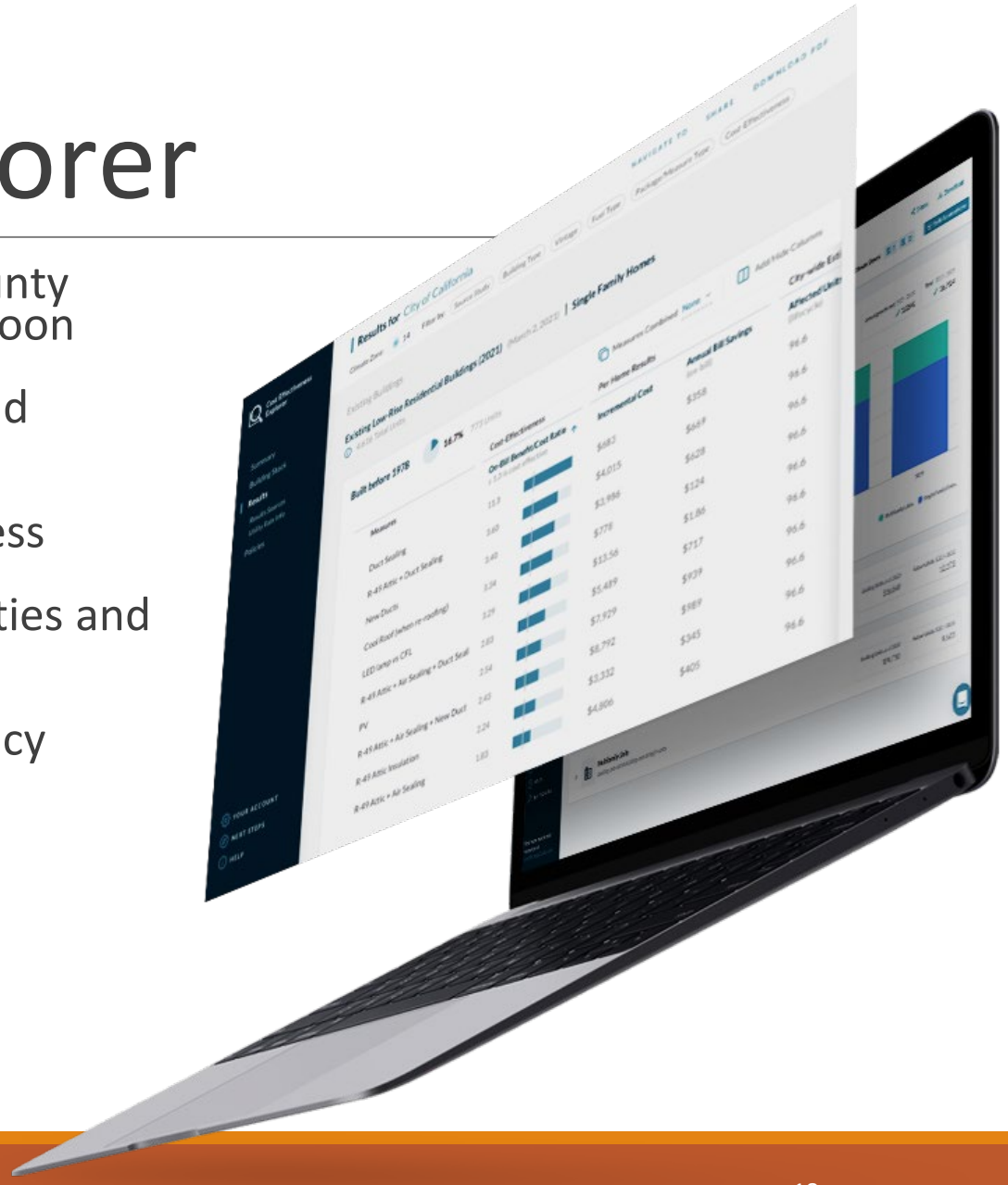
explorer.localenergycodes.com



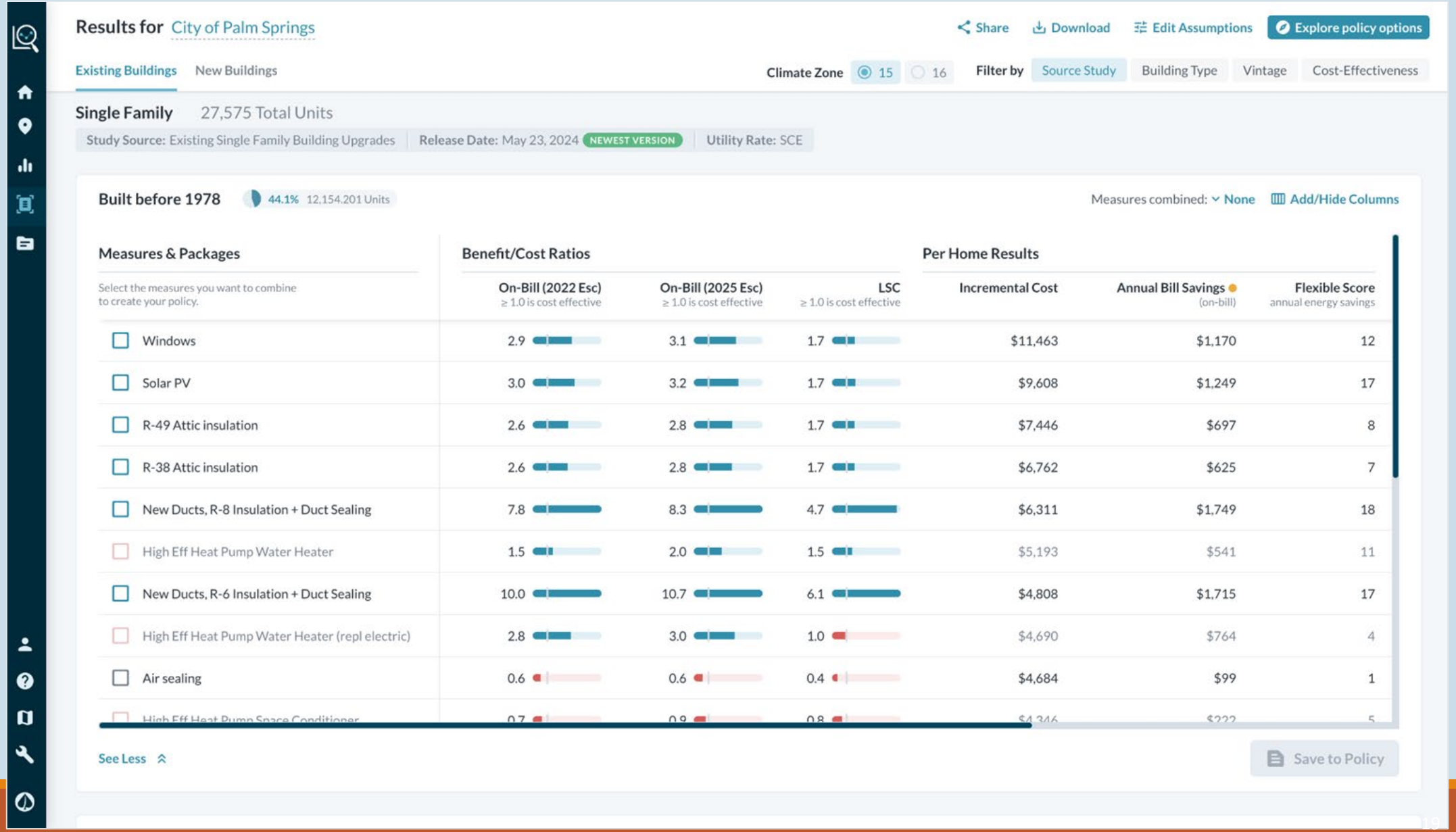
Jasmine Krause
Policy Studio

Cost-Effectiveness Explorer

- Free Web-based software for California city and county staff, expanding to include other geographic areas soon
- Designed to help accelerate reach code adoption and support better data-driven decision-making
- Aggregates findings from statewide cost-effectiveness studies and estimates building stock and future construction forecasts for each of 500+ California cities and counties
- Helps users evaluate and develop cost-effective policy options



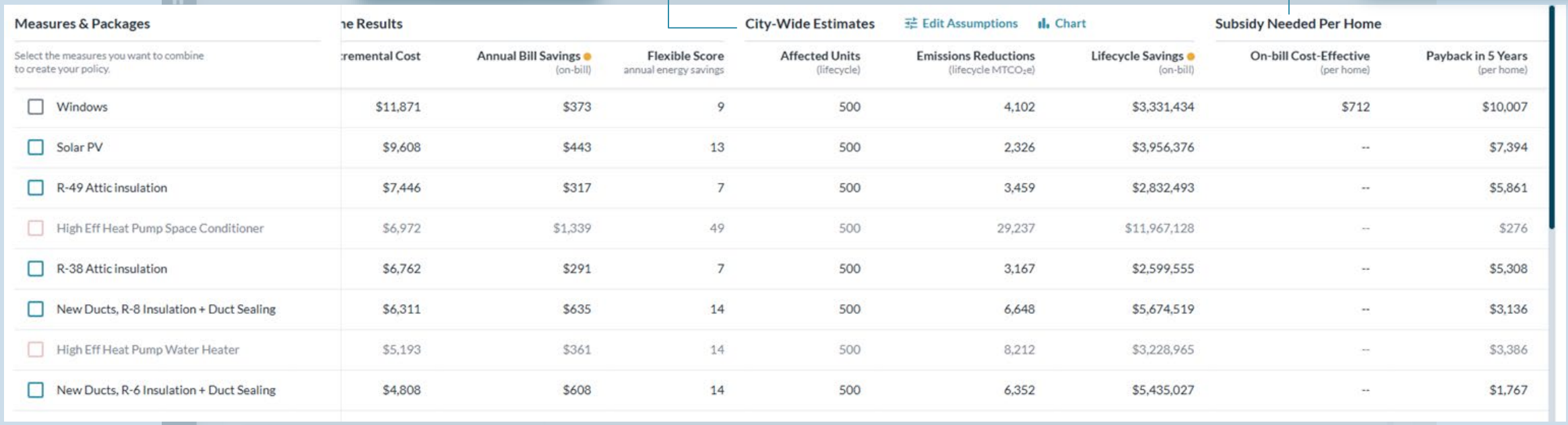
Review study results for your jurisdiction



Review study results for your jurisdiction

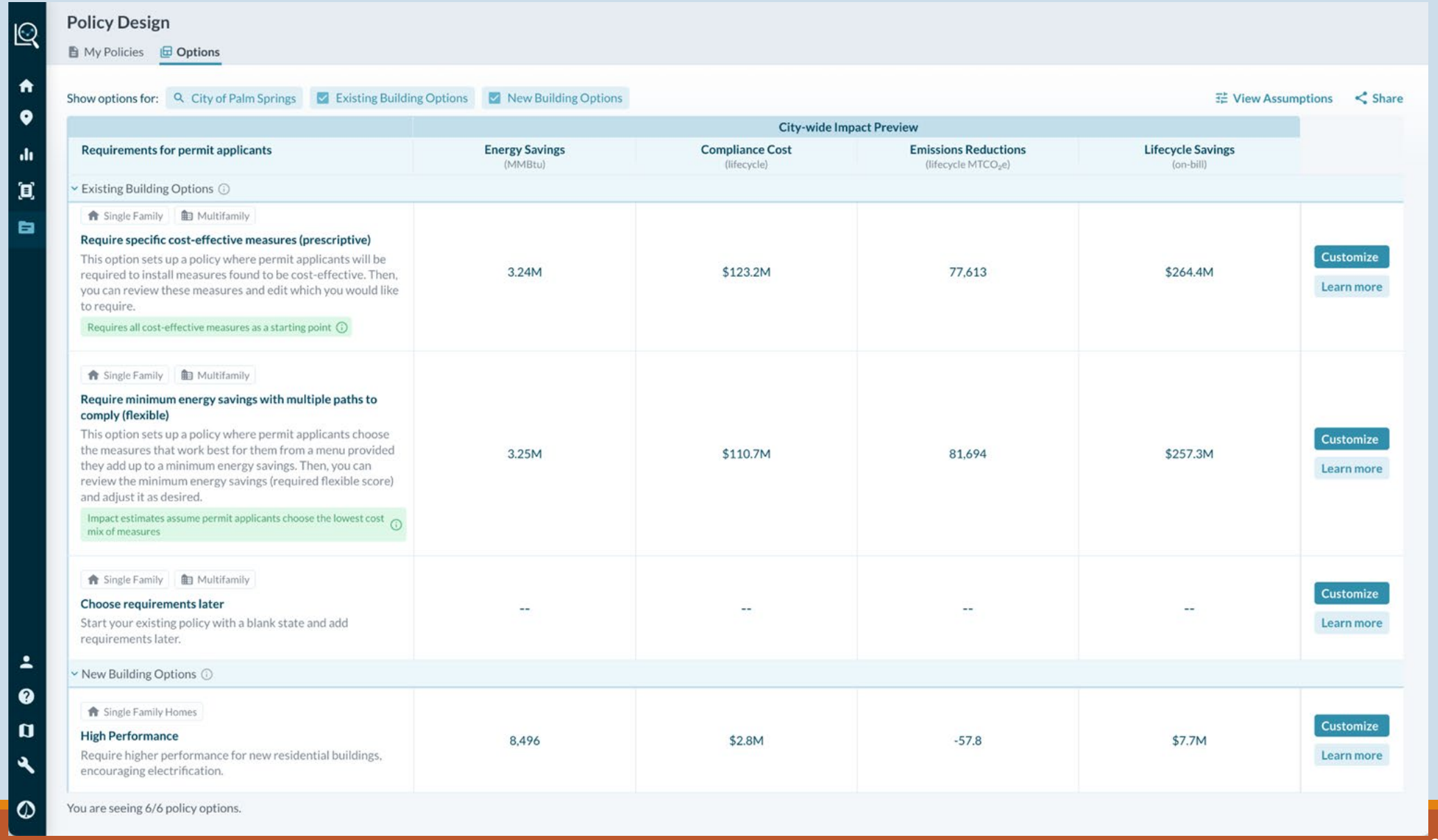
Per home Results and City-Wide Impact Estimates

Additional subsidy calculations

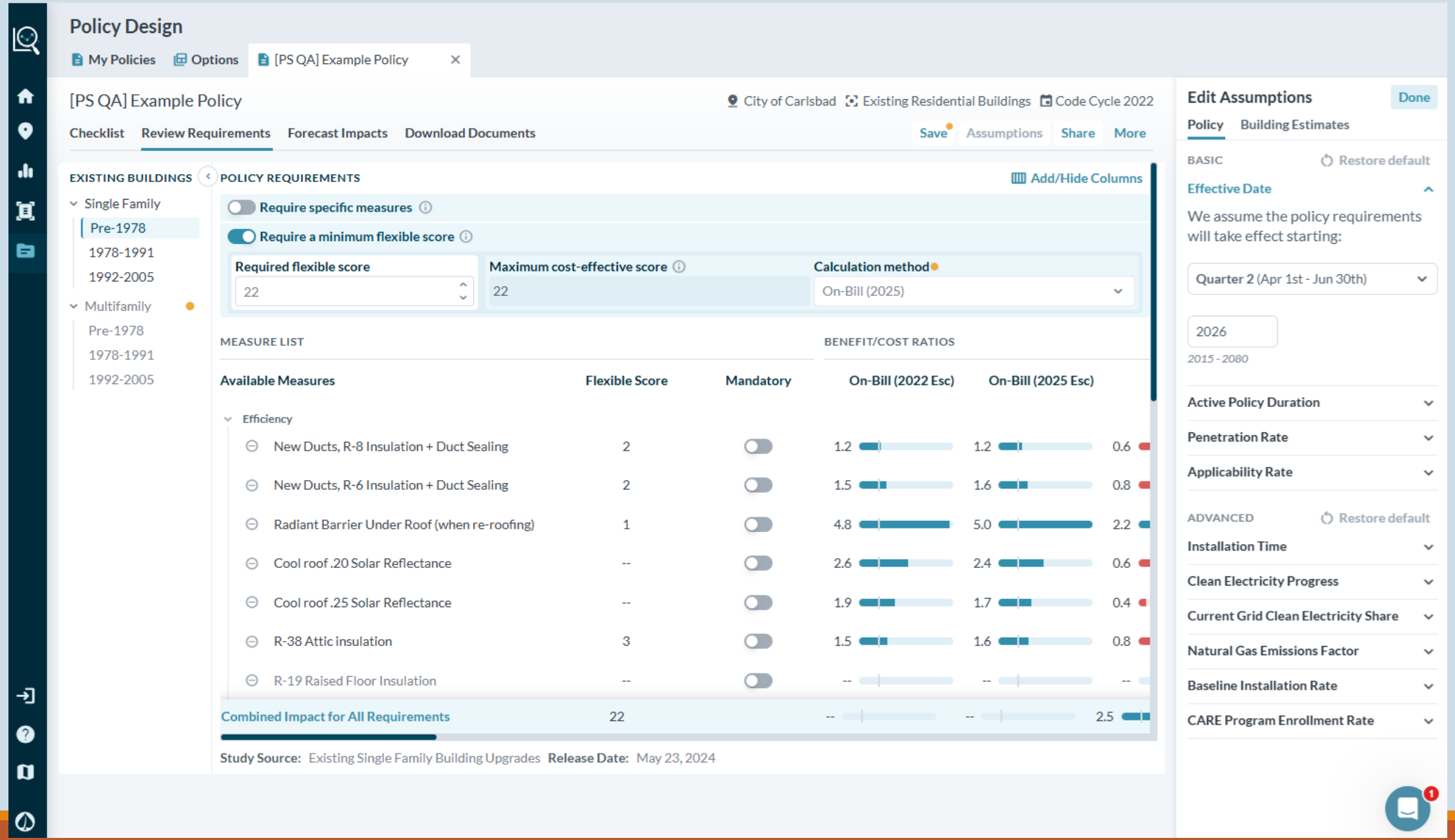


Measures & Packages	Incremental Cost	Annual Bill Savings (on-bill)	Flexible Score annual energy savings	City-Wide Estimates: Affected Units (lifecycle)	Emissions Reductions (lifecycle $MTCO_2e$)	Lifecycle Savings (on-bill)	Subsidy Needed Per Home: On-bill Cost-Effective (per home)	Payback in 5 Years (per home)
Windows	$11,871	$373	9	500	4,102	$3,331,434	$712	$10,007
Solar PV	$9,608	$443	13	500	2,326	$3,956,376	--	$7,394
R-49 Attic insulation	$7,446	$317	7	500	3,459	$2,832,493	--	$5,861
High Eff Heat Pump Space Conditioner	$6,972	$1,339	49	500	29,237	$11,967,128	--	$276
R-38 Attic insulation	$6,762	$291	7	500	3,167	$2,599,555	--	$5,308
New Ducts, R-8 Insulation + Duct Sealing	$6,311	$635	14	500	6,648	$5,674,519	--	$3,136
High Eff Heat Pump Water Heater	$5,193	$361	14	500	8,212	$3,228,965	--	$3,386
New Ducts, R-6 Insulation + Duct Sealing	$4,808	$608	14	500	6,352	$5,435,027	--	$1,767

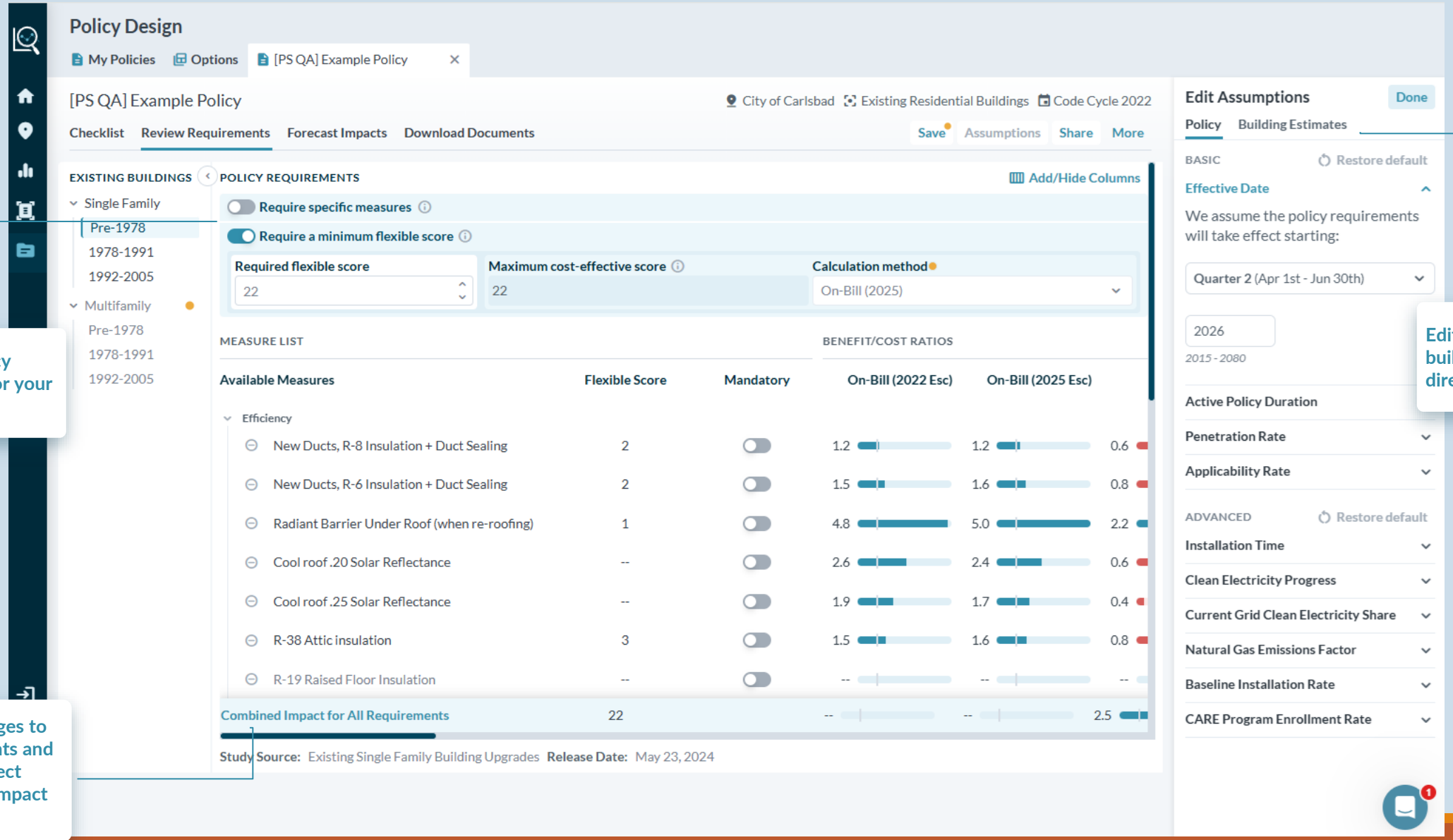
Access policy options



Refine Policy Requirements and Assumptions



Refine Policy Requirements and Assumptions

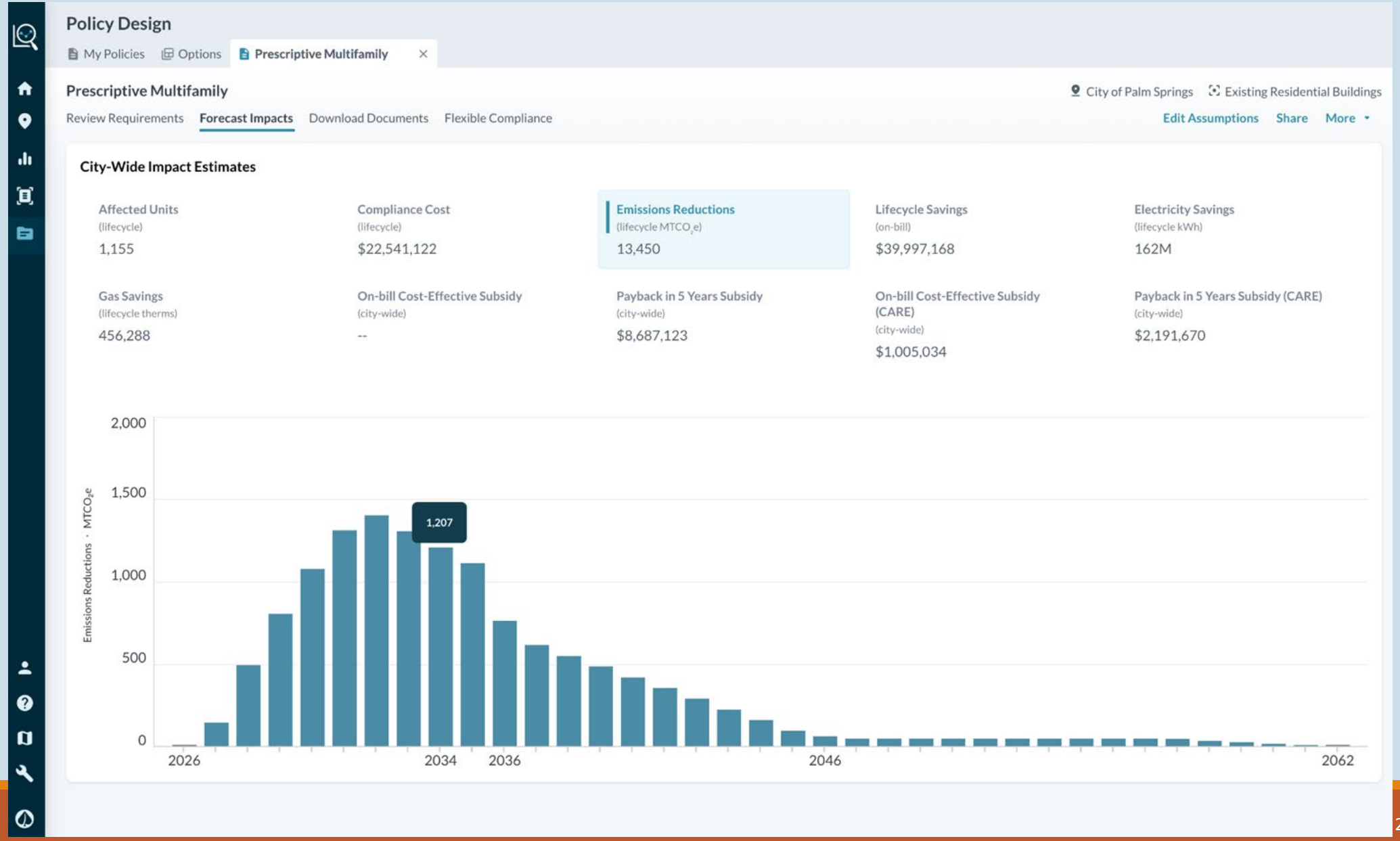


Customize policy requirements for your jurisdiction

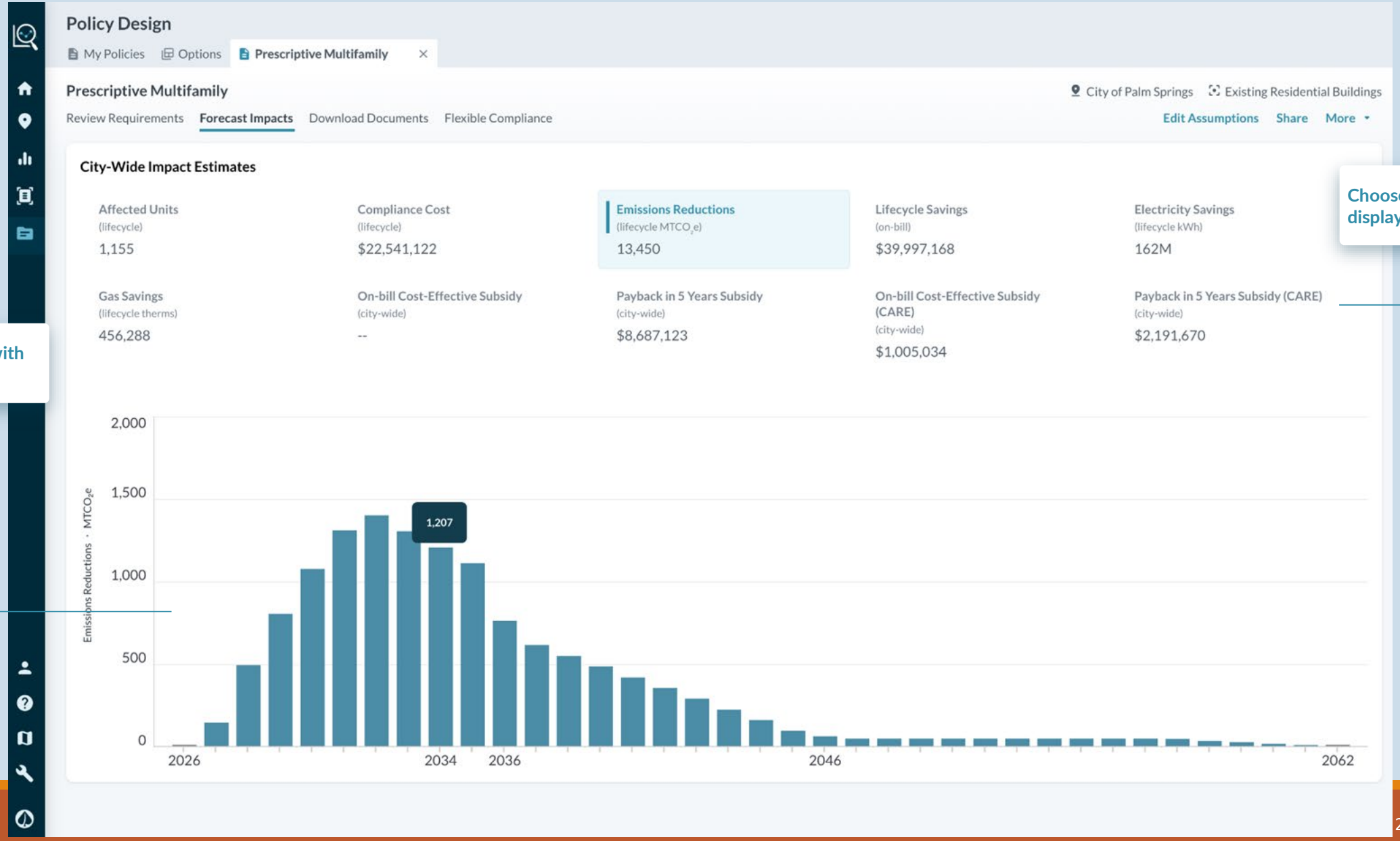
View how changes to your requirements and assumptions affect your projected impact in real time

Edit key policy and building assumptions directly in your policy

Review your policy's impact estimates



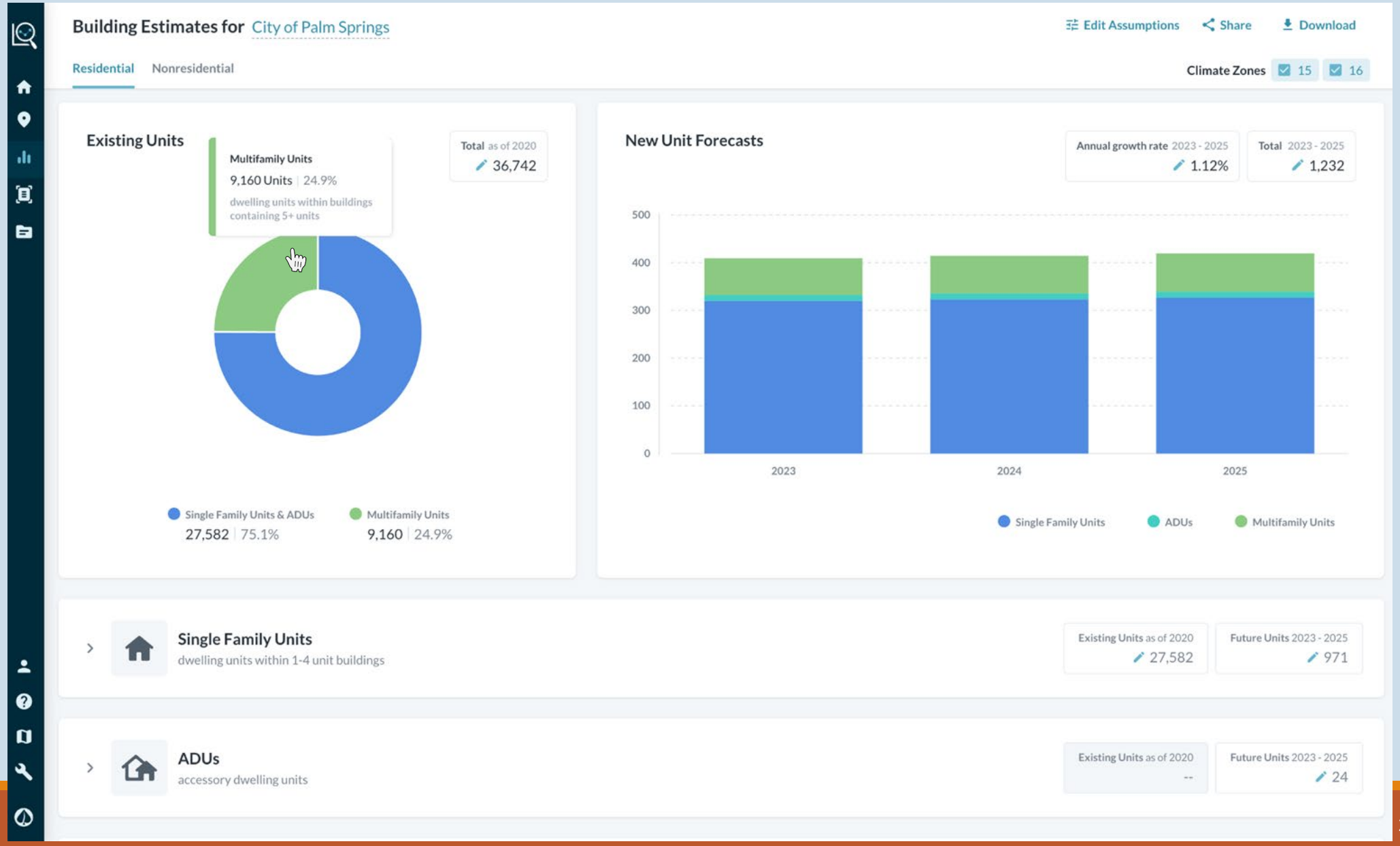
Review your policy's impact estimates



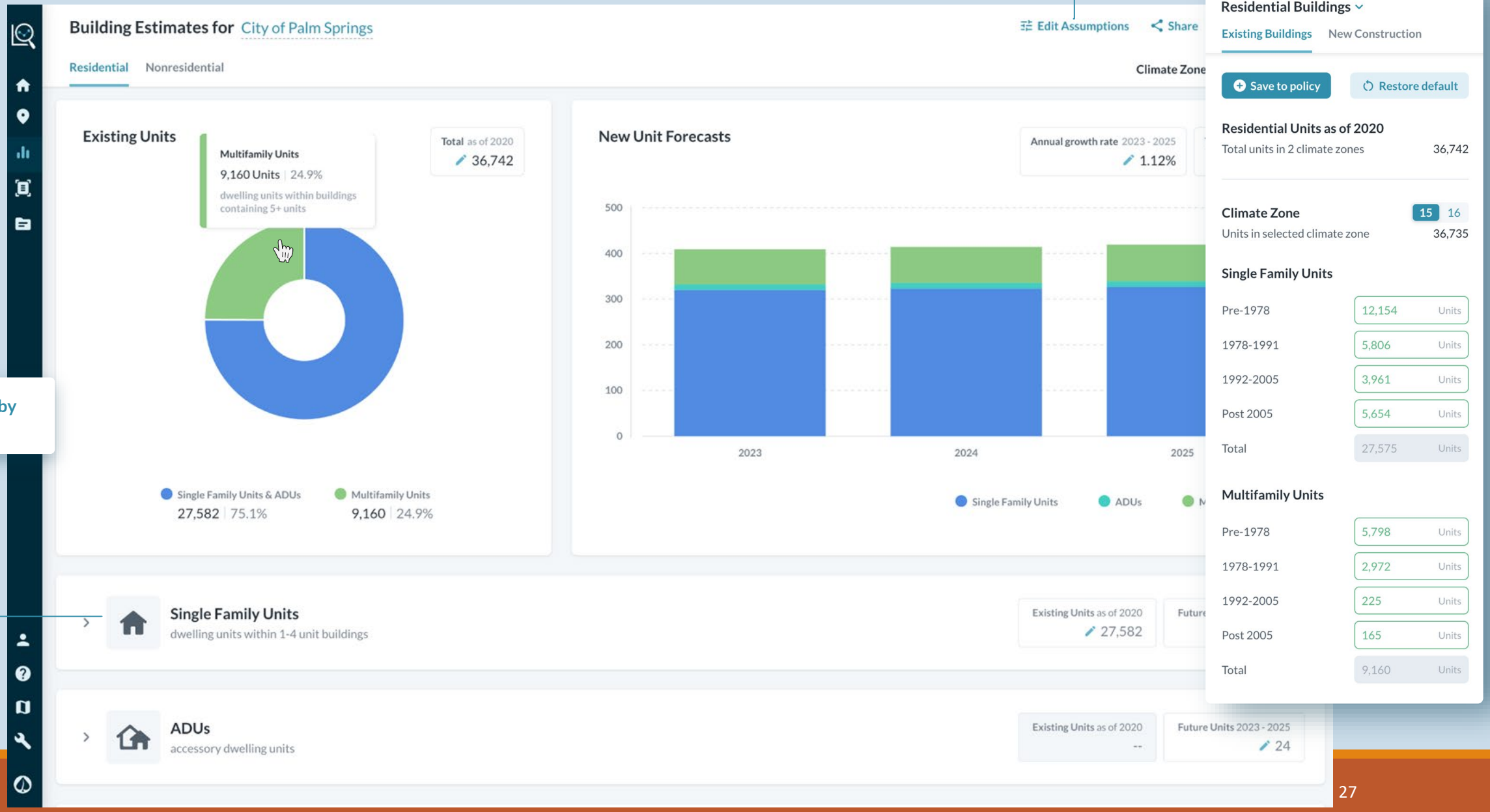
Choose which metric to display in the chart

Interactive chart with lifecycle forecast

Review and edit your residential building estimates



Review and edit your residential building estimates

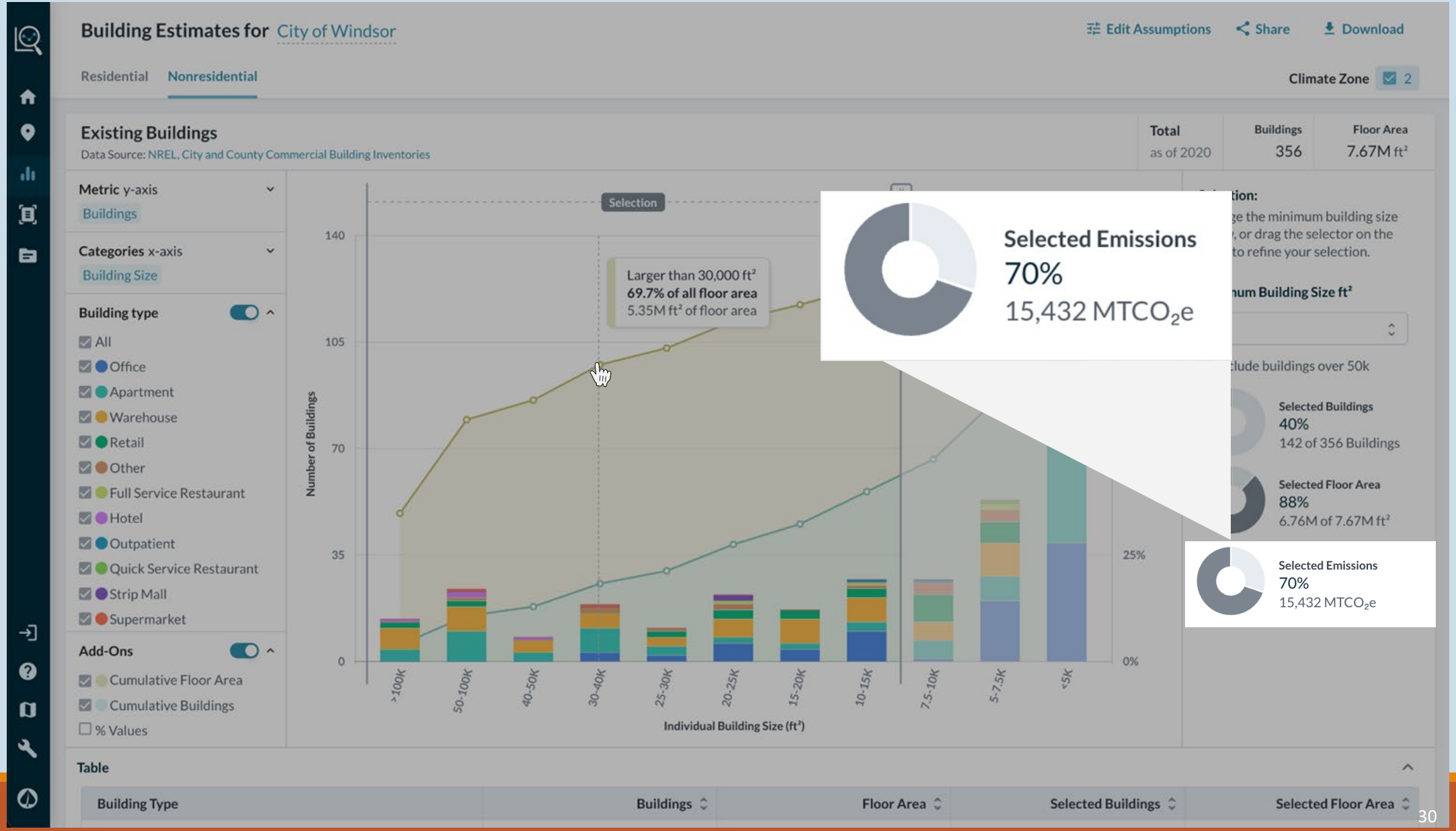


Data breakdown by building type

Visualize nonresidential building stock

Visualize nonresidential building stock

Visualize nonresidential building stock (coming soon)



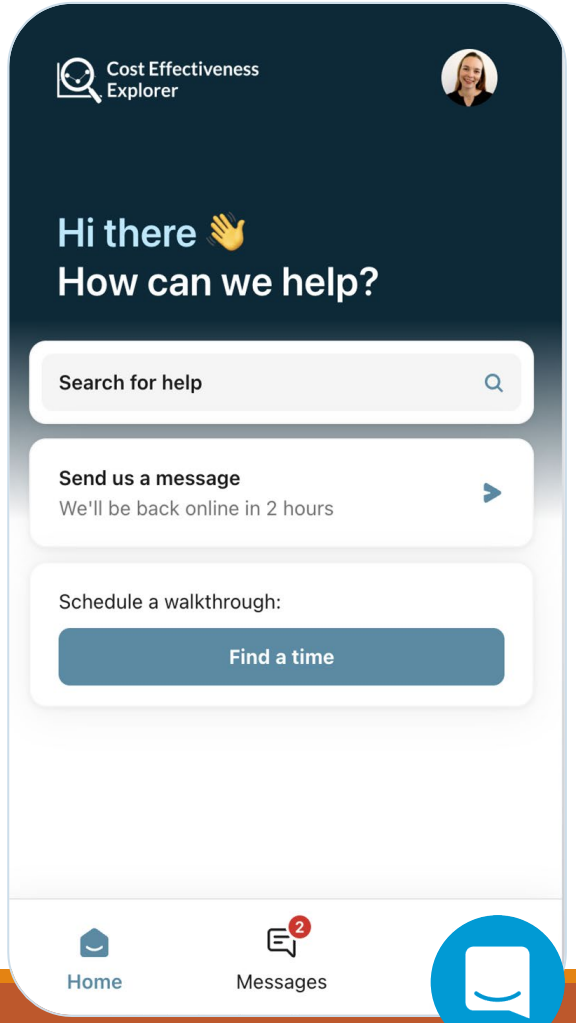
Data & Methodology

Data Type	Source	Things to Be Aware Of
Existing Residential Data	CA Department of Finance building stock, with census data as needed	Does not account for renovations, tear-down replacements, or destruction of housing units Multifamily data is shown in units.
Existing Nonresidential Data	NREL City and County Commercial Building Inventory	Buildings that aren't sold very often are underrepresented (schools, hospitals, religious buildings) due to the base dataset (CoStar). Apartment data is shown in buildings.
New Residential Data	CEC new construction forecasts	Your jurisdiction's growth rate may vary compared to the statewide growth rate
New Nonresidential Data	CEC new construction forecasts	Your jurisdiction's growth rate may vary compared to the statewide growth rate

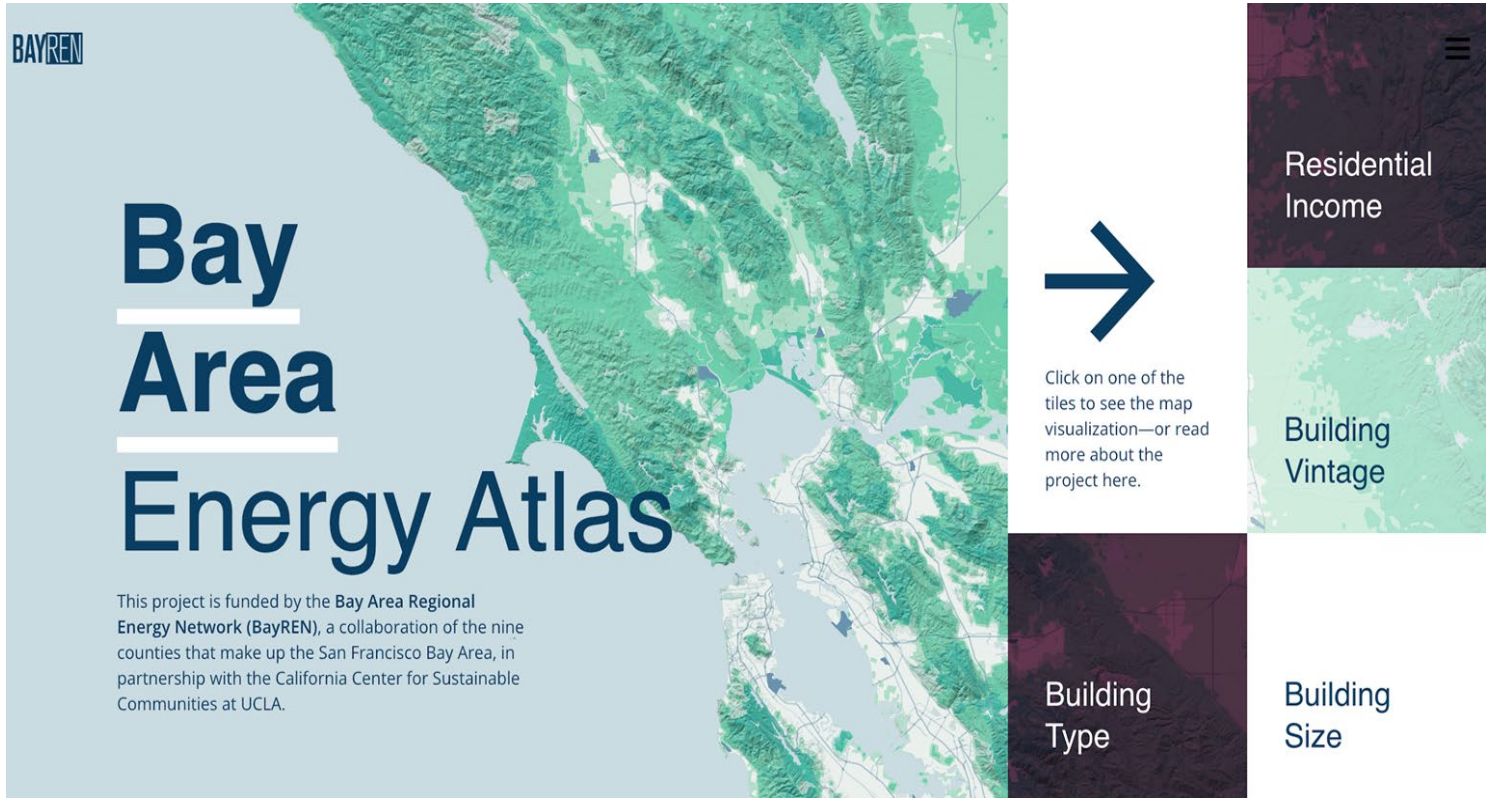
Thank you

explorer.localenergycodes.com

jasmine@policystudio.co



Energy Atlas



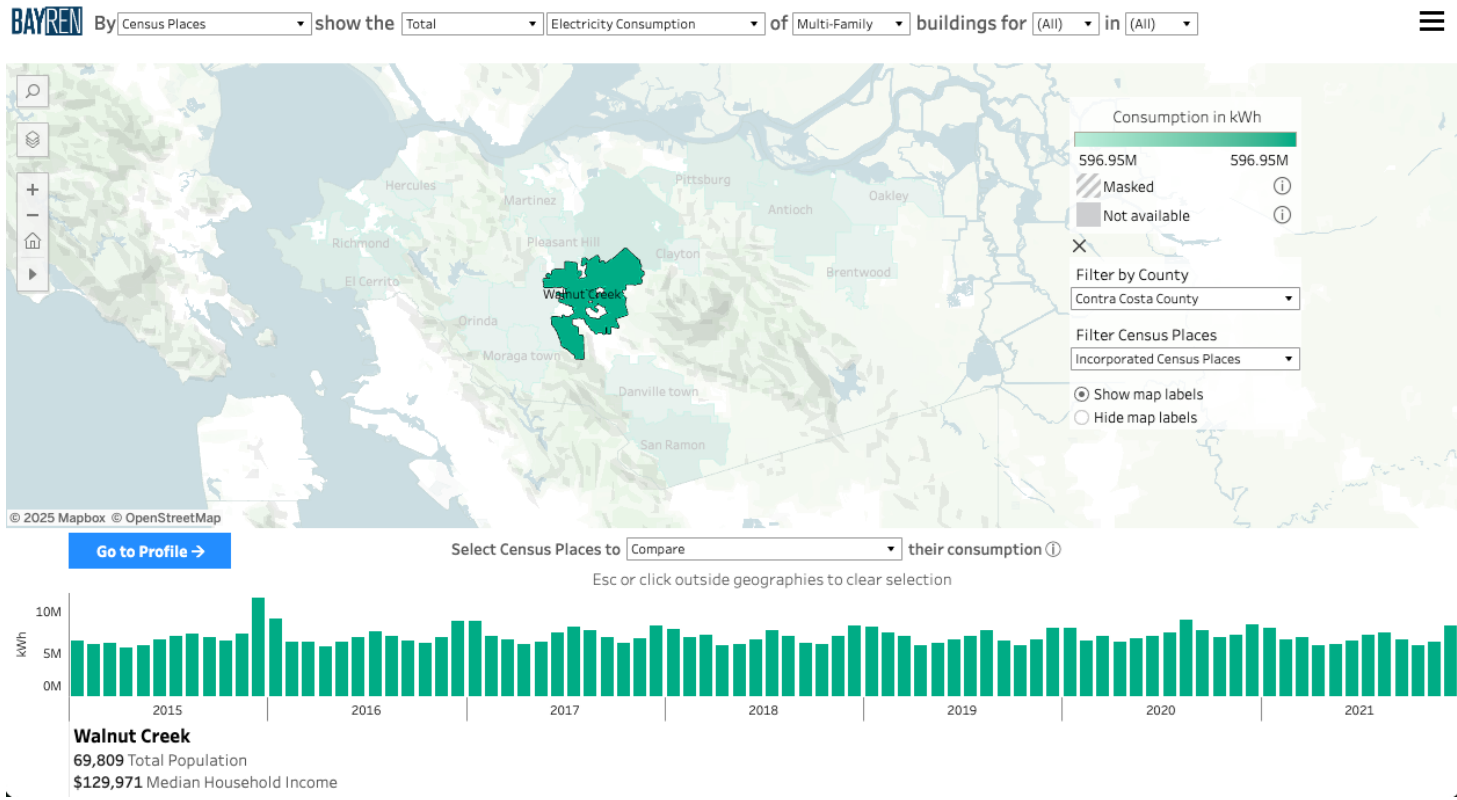
Spencer Mathews
California Center for Sustainable Communities at UCLA

Introduction

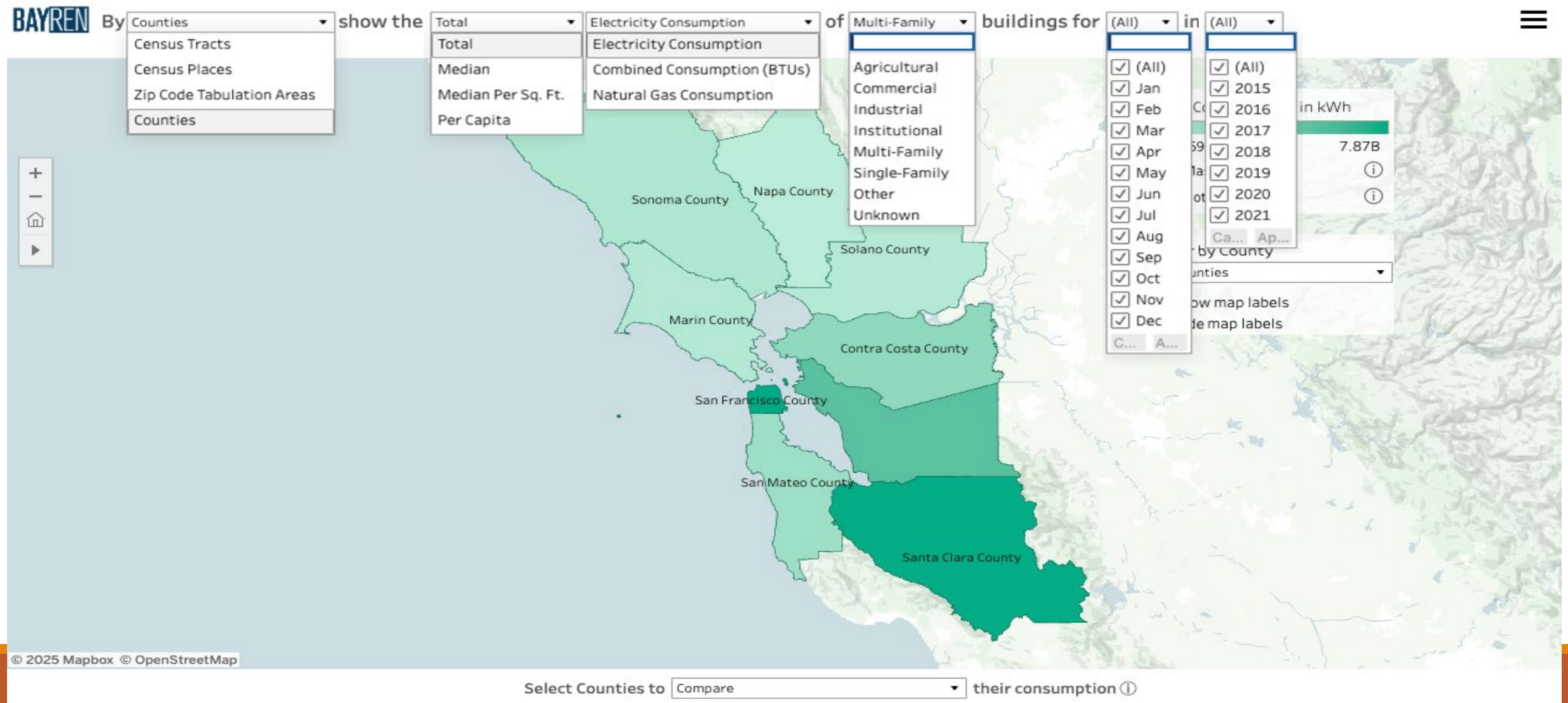
- The Bay Area Energy Atlas is a large, interactive database of account-level electricity and natural gas consumption that is linked spatially to building characteristics and sociodemographic data
- Collaboration between ABAG/BayREN and the California Center for Sustainable Communities at UCLA
- First released in 2020, followed by periodic updates

What Can You Do With The Energy Atlas?

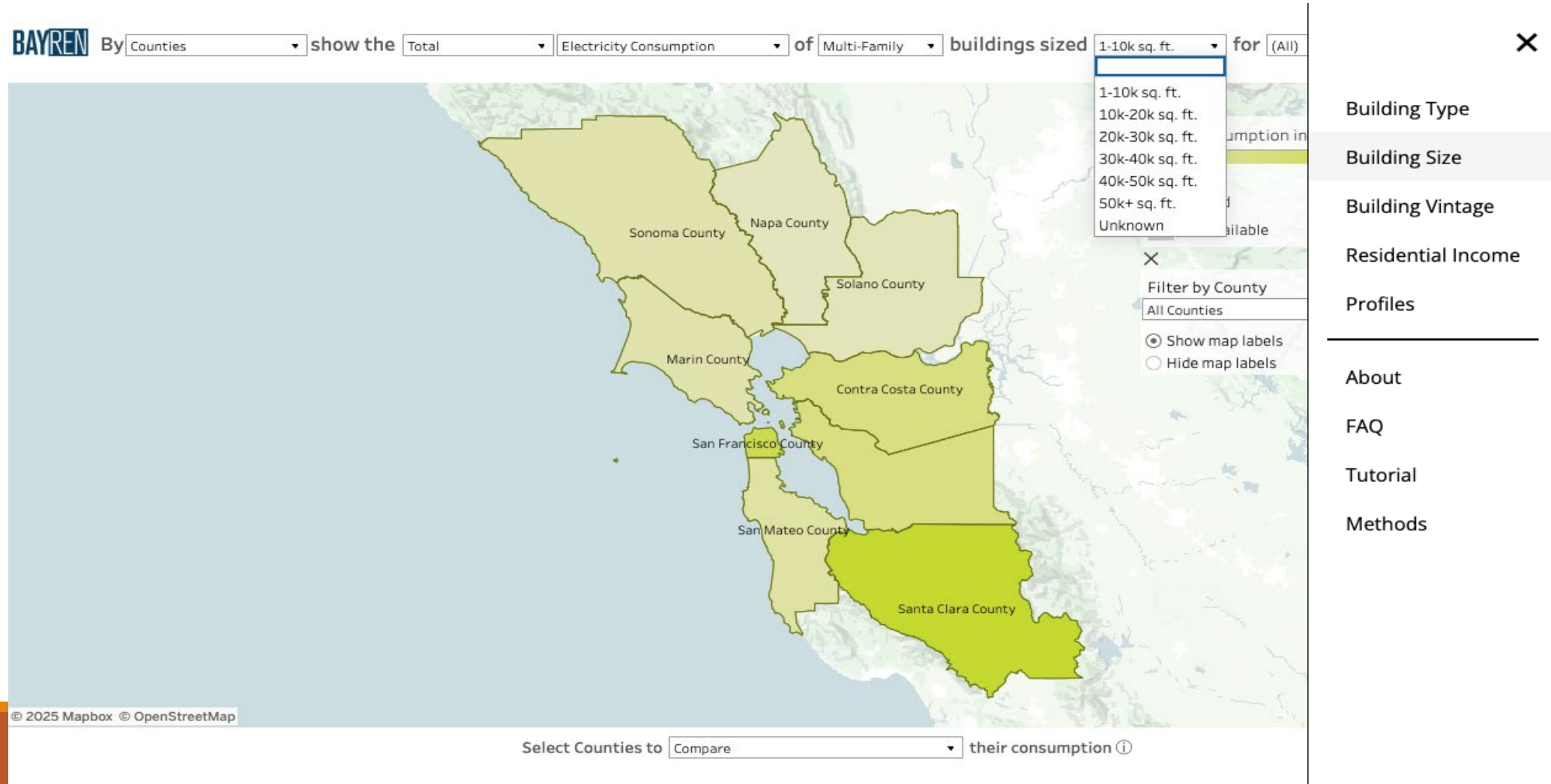
- Map PG&E electricity and gas consumption at multiple geographic levels
- Explore consumption by parcel use type, building size, and building vintage
- View statistics such as per capita energy use and energy use intensity (EUI)



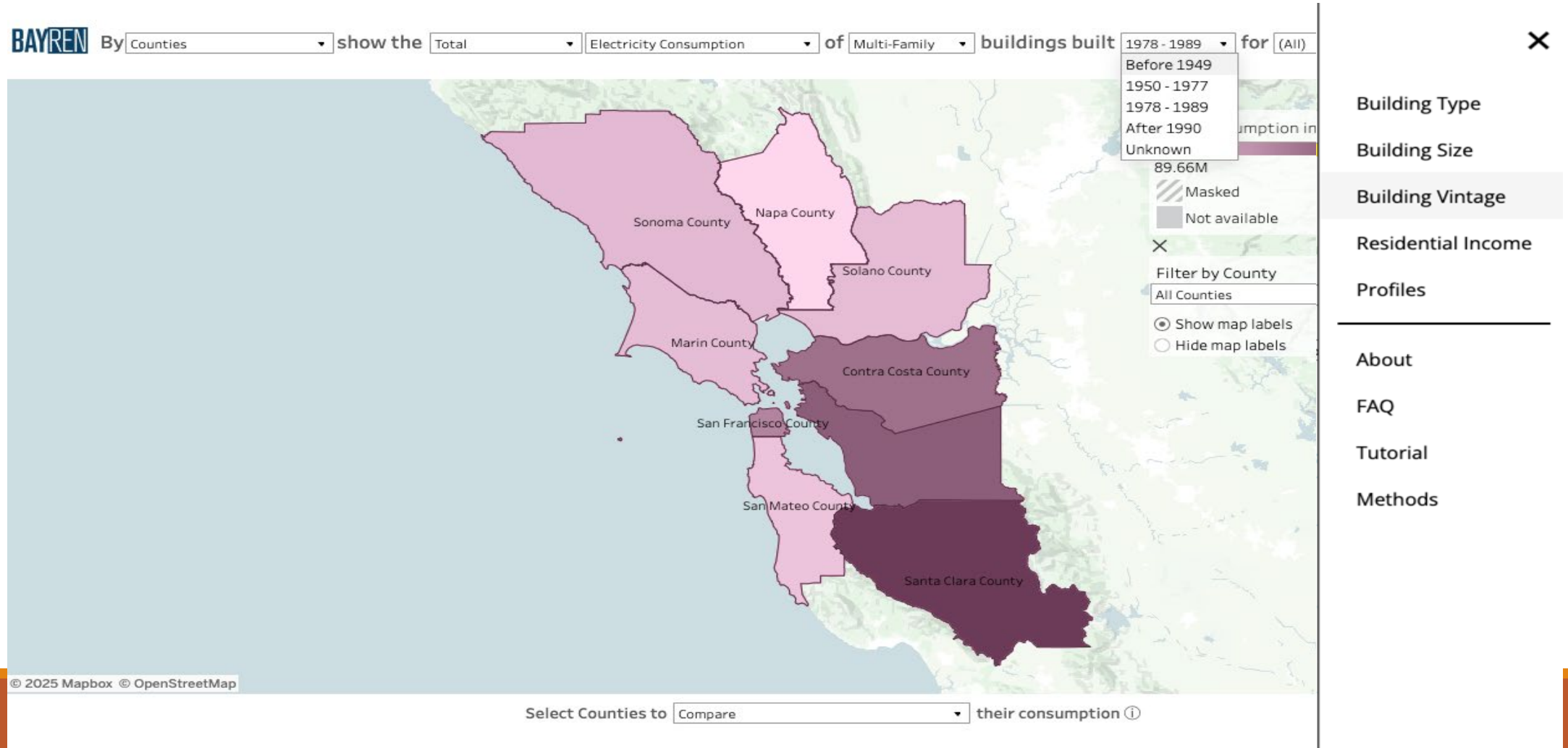
Using the Energy Atlas



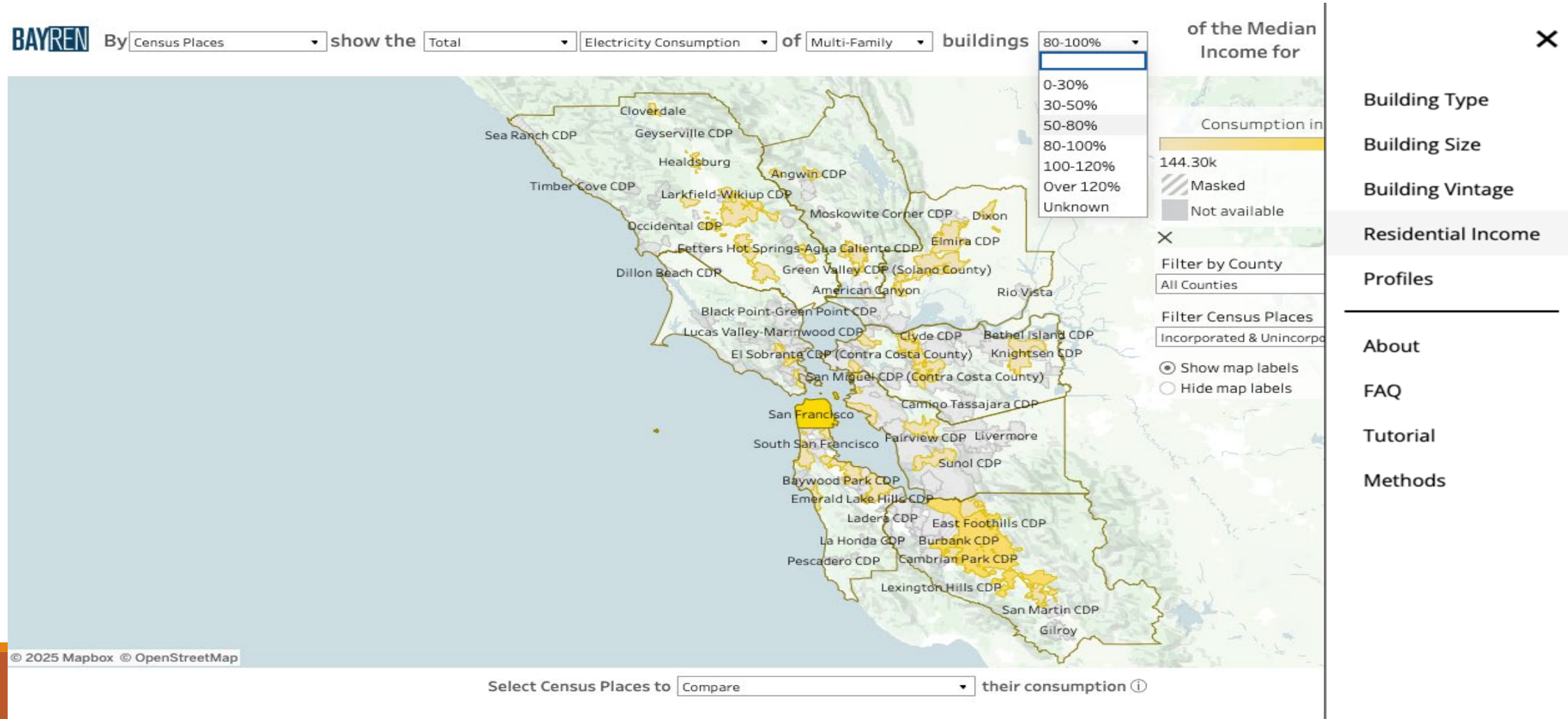
Using the Energy Atlas



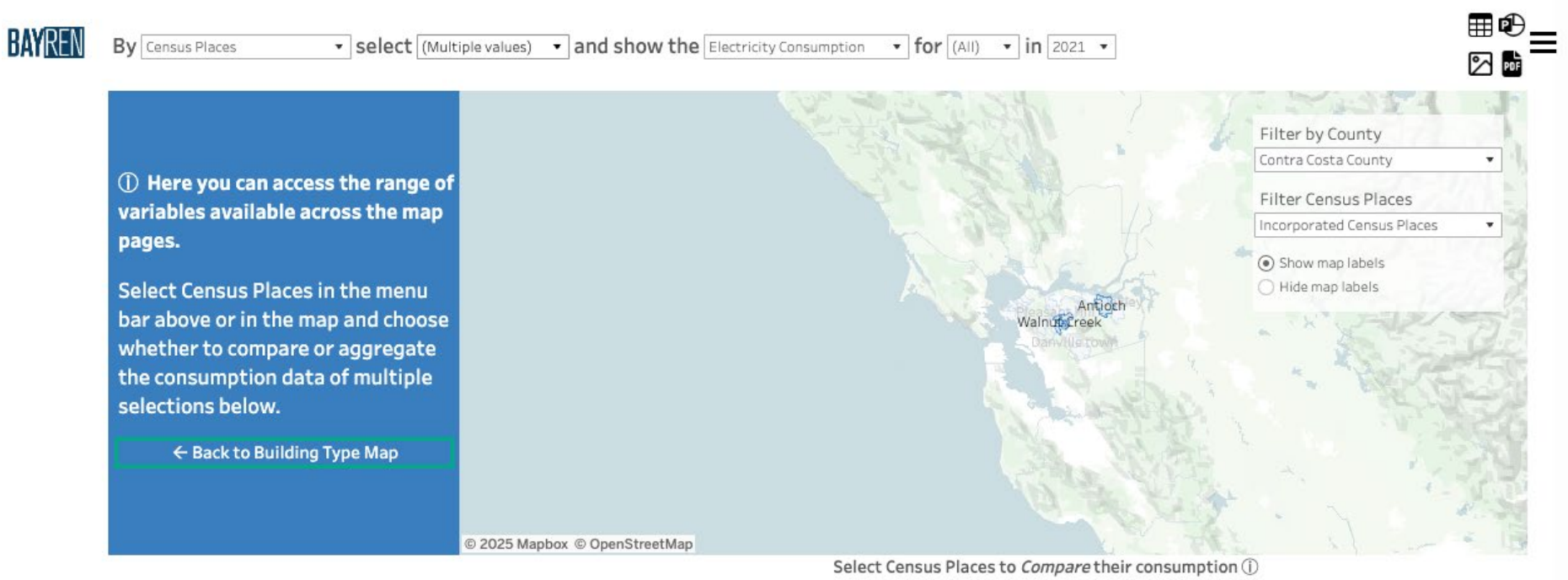
Using the Energy Atlas



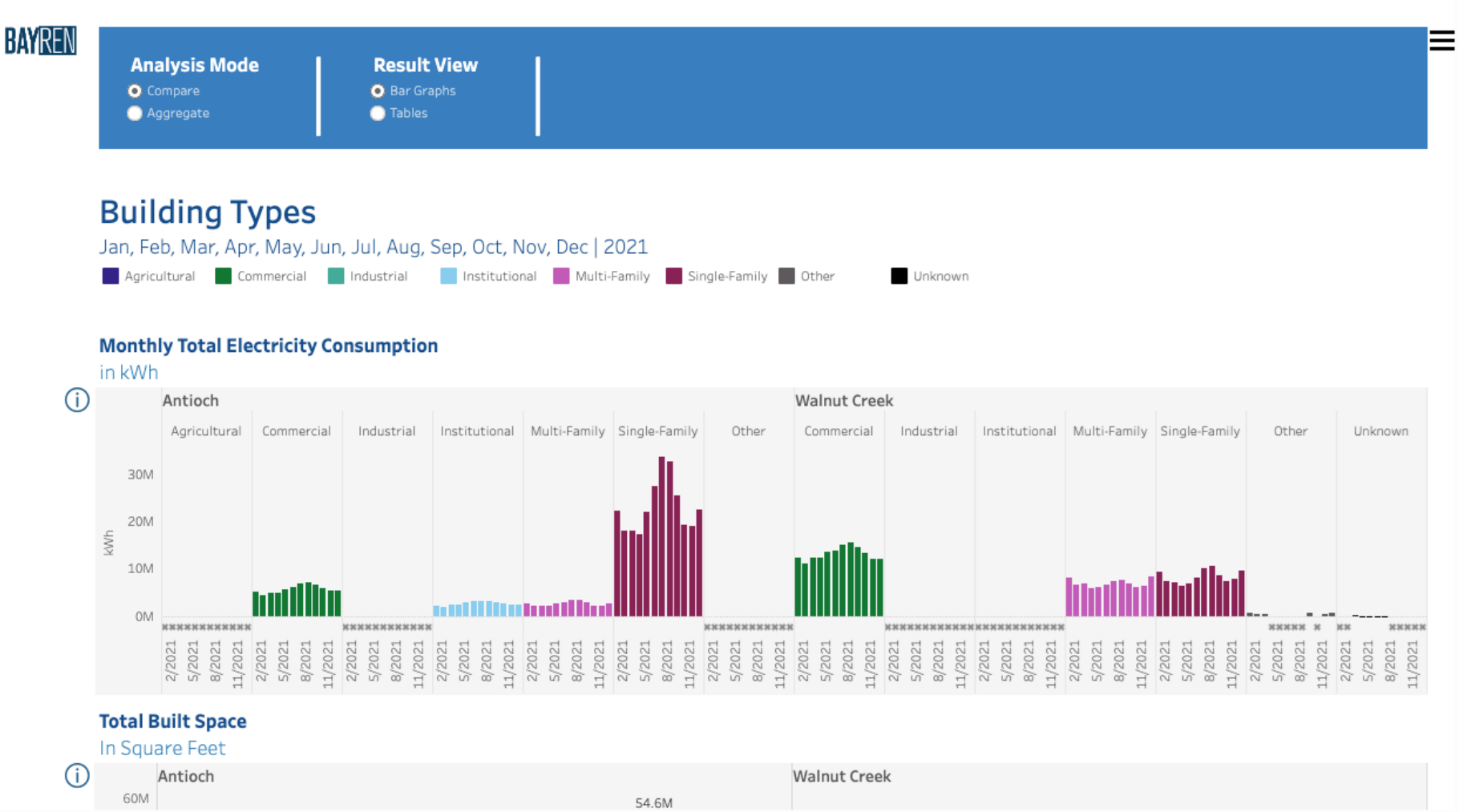
Using the Energy Atlas



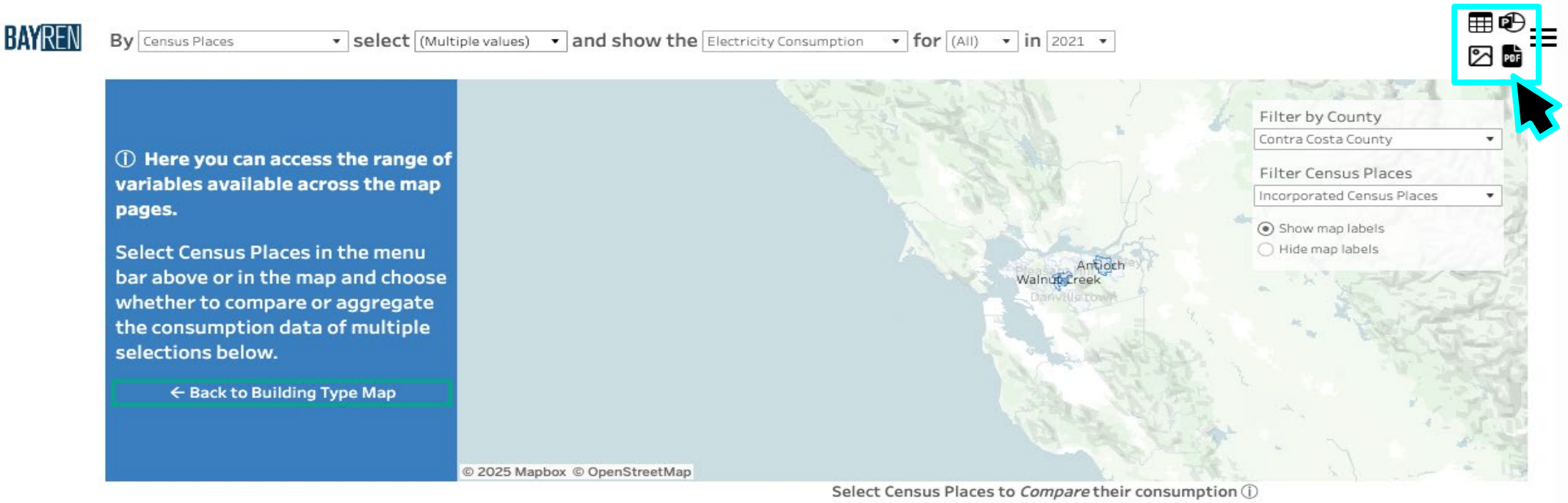
Using the Energy Atlas



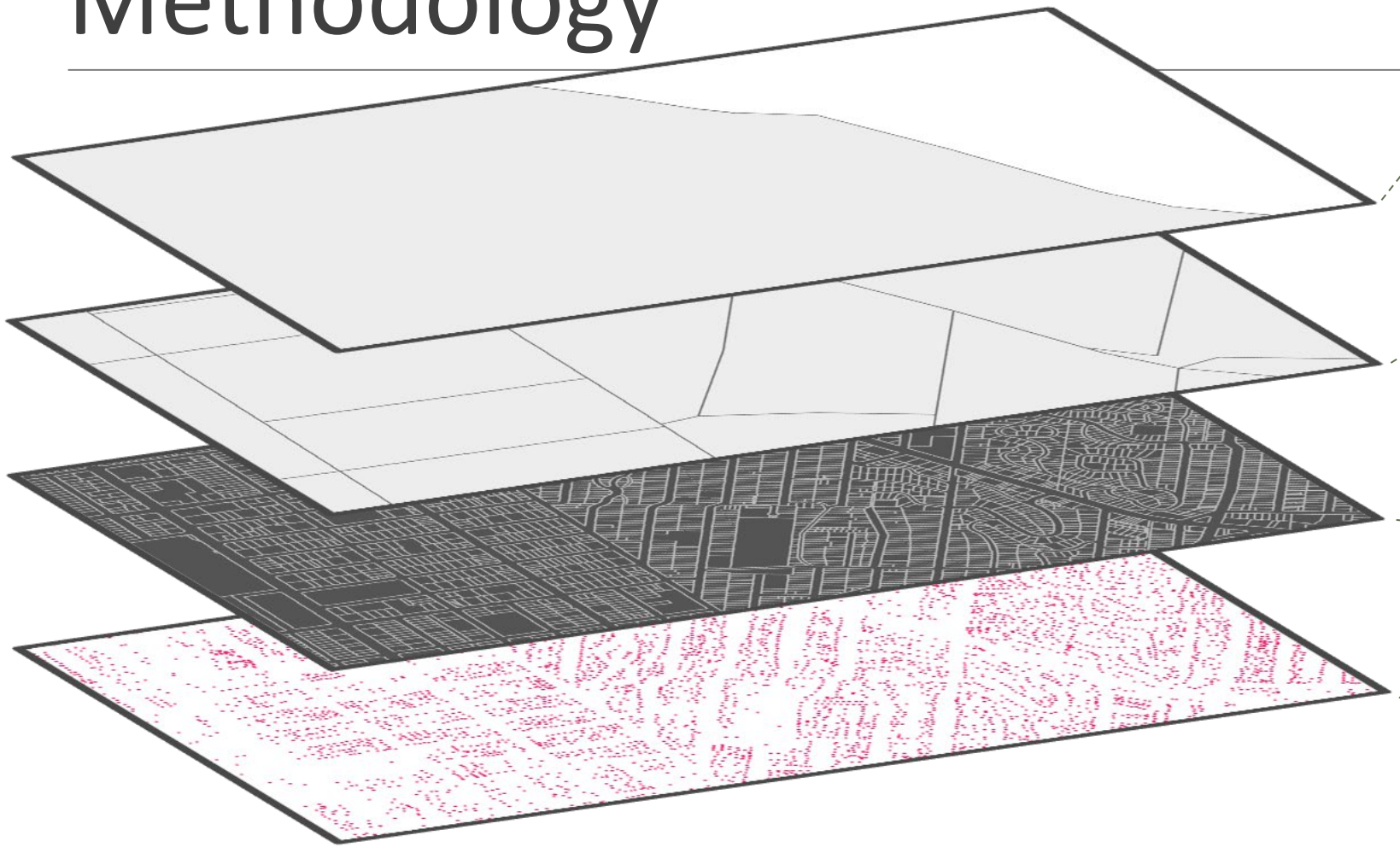
Using the Energy Atlas



Using the Energy Atlas



Data & Methodology



CalEnviroscreen 4.0

- Census Tract score
- DAC Status Boundaries

Census Data

- Boundaries
- Population
- Median Household Income

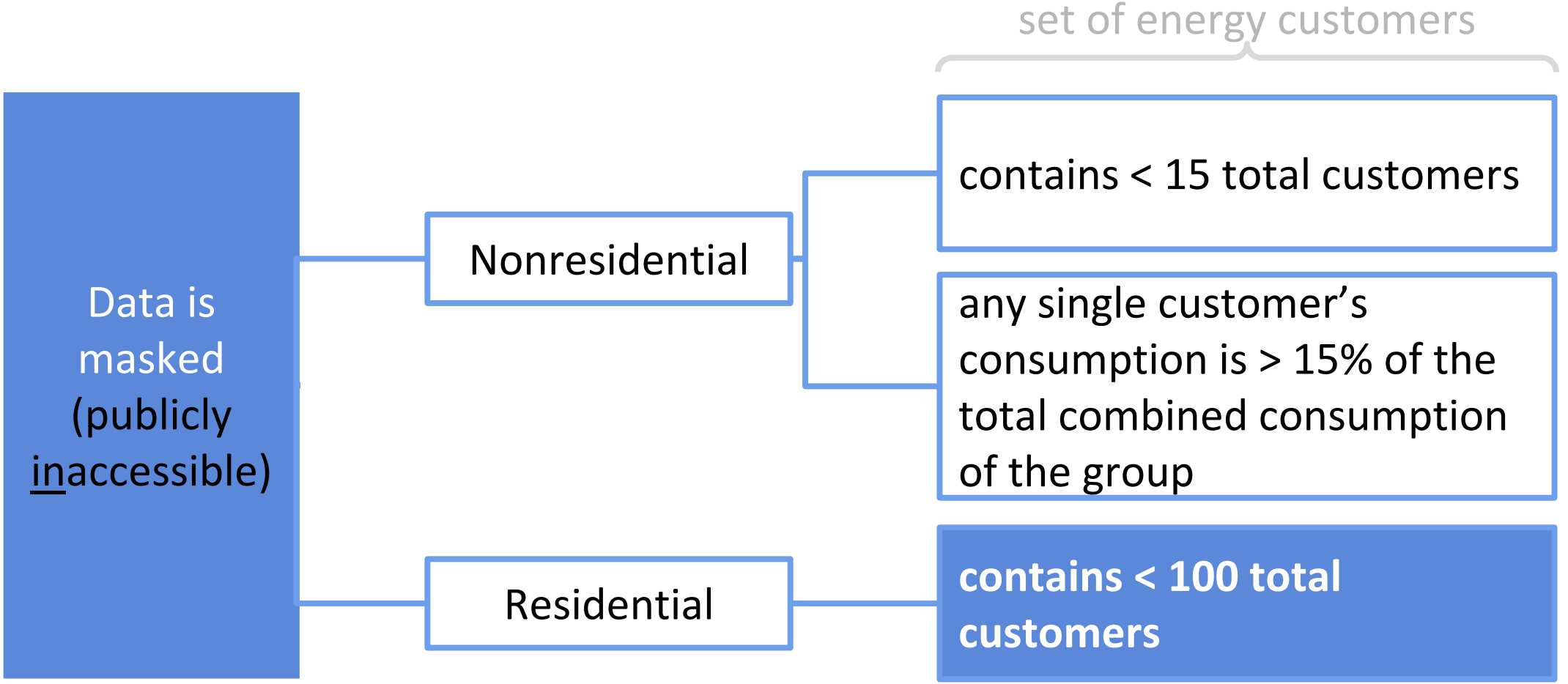
Assessor Parcels

- Use type
- Building size
- Building vintage

PG&E Data

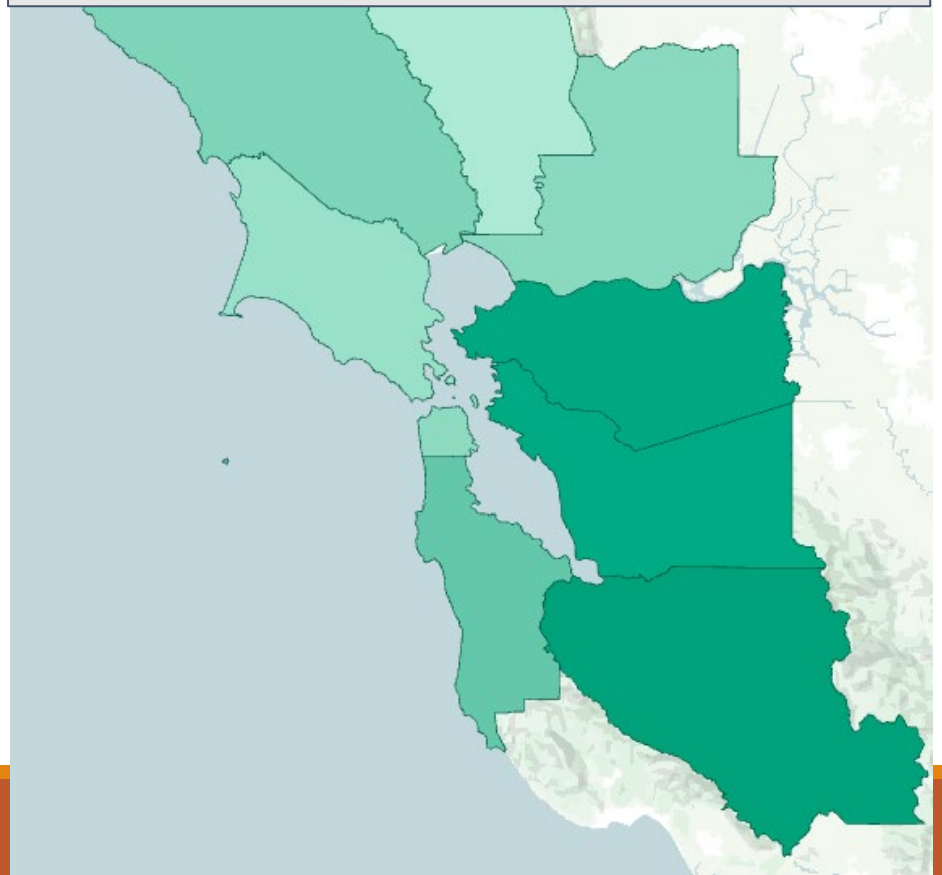
- Account-level electricity & gas bill data
- Customer addresses

Data Masking

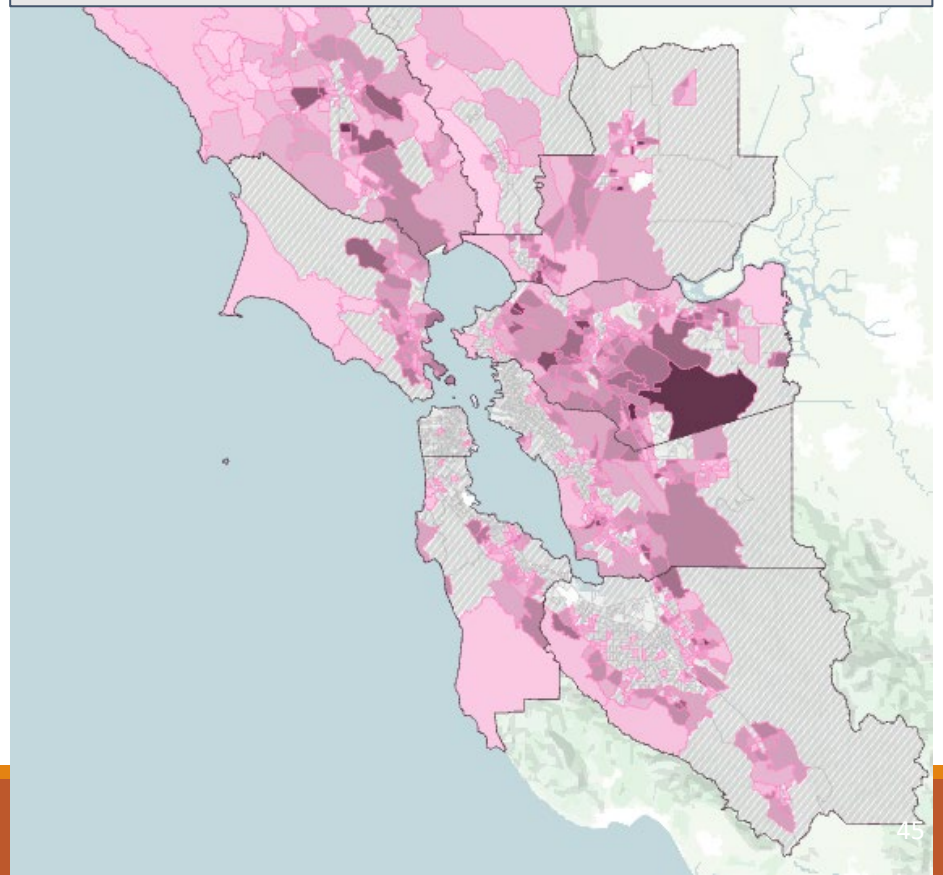


Data Masking Example

County, Single family



Census tracts, Single family, Vintage 1978-1989



Strengths

- Real energy consumption data, not modeled
- Linked to parcel, building, and sociodemographic data
- Reported at multiple Census Geography levels
- Monthly resolution exposes seasonal variation

Challenges

- Utility data is messy and sometimes incomplete
  - Utility databases are designed for billing, not analysis
  - Consumption skewed by net metering
  - Billing periods not aligned with calendar months and sometimes long
  - Address data not standardized
- Assessor parcel data varies in quality and information
  - Repeated and overlapping parcel boundaries
  - Buildings are difficult to quantify
- Privacy rules limit the public release of data
  - Per California Public Utilities Commission Decision (D.14-05-016)
  - Residential: 100 or more residential customers
  - Commercial or Agricultural, Industrial: 15 or more customers, with no single account constituting more than 15% of the total consumption

Thank you!

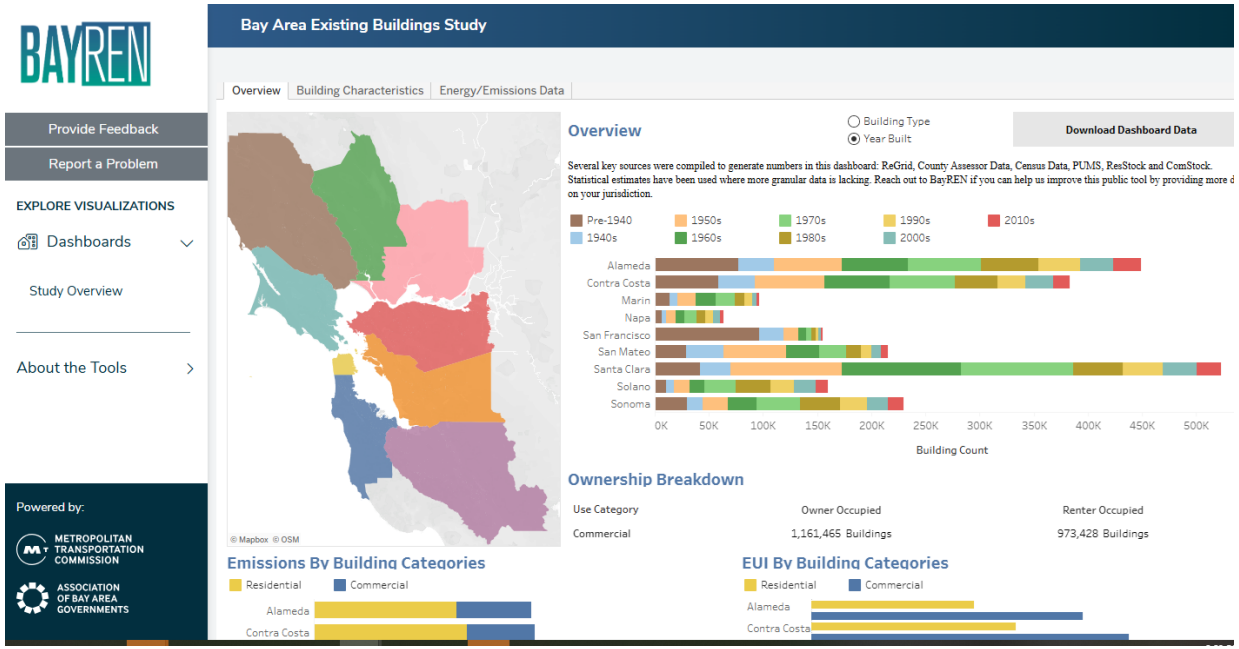
Website: ioes.ucla.edu/ccsc

Bay Area Atlas: https://bayarea.energyatlas.ucla.edu/

Contact: ccsc@ioes.ucla.edu

ARUP

BayREN Existing Buildings:
Decarbonization Study and Dashboard



Emily Miller
Building Energy Engineering Specialist

BayREN Existing Buildings Study

https://bayren-existing-buildings.mtcanalytics.org/

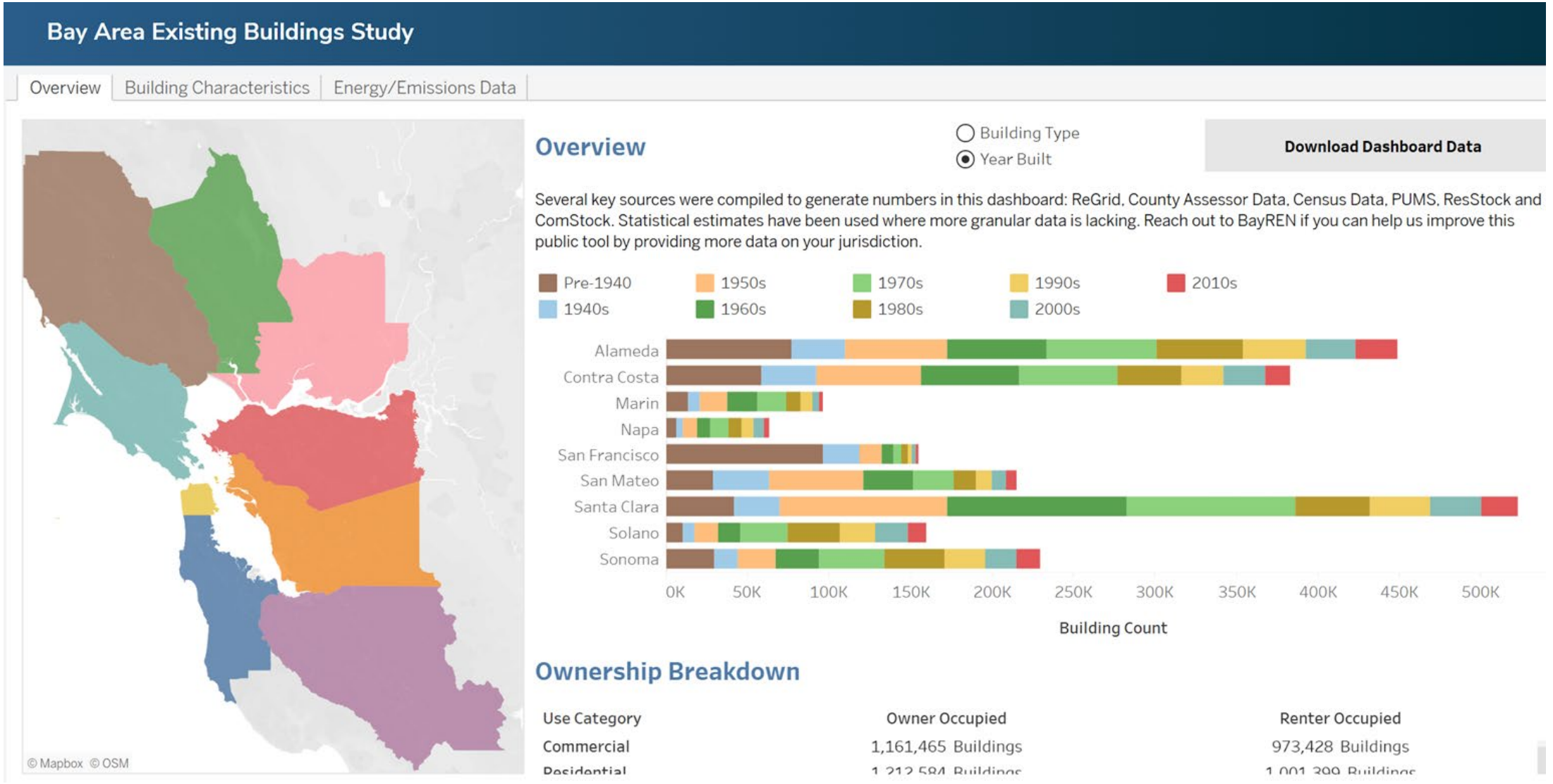
Purpose:

- Give local governments a place to start in understanding their existing building stock.
- Help inform policy and incentive programs to hit local decarbonization goals

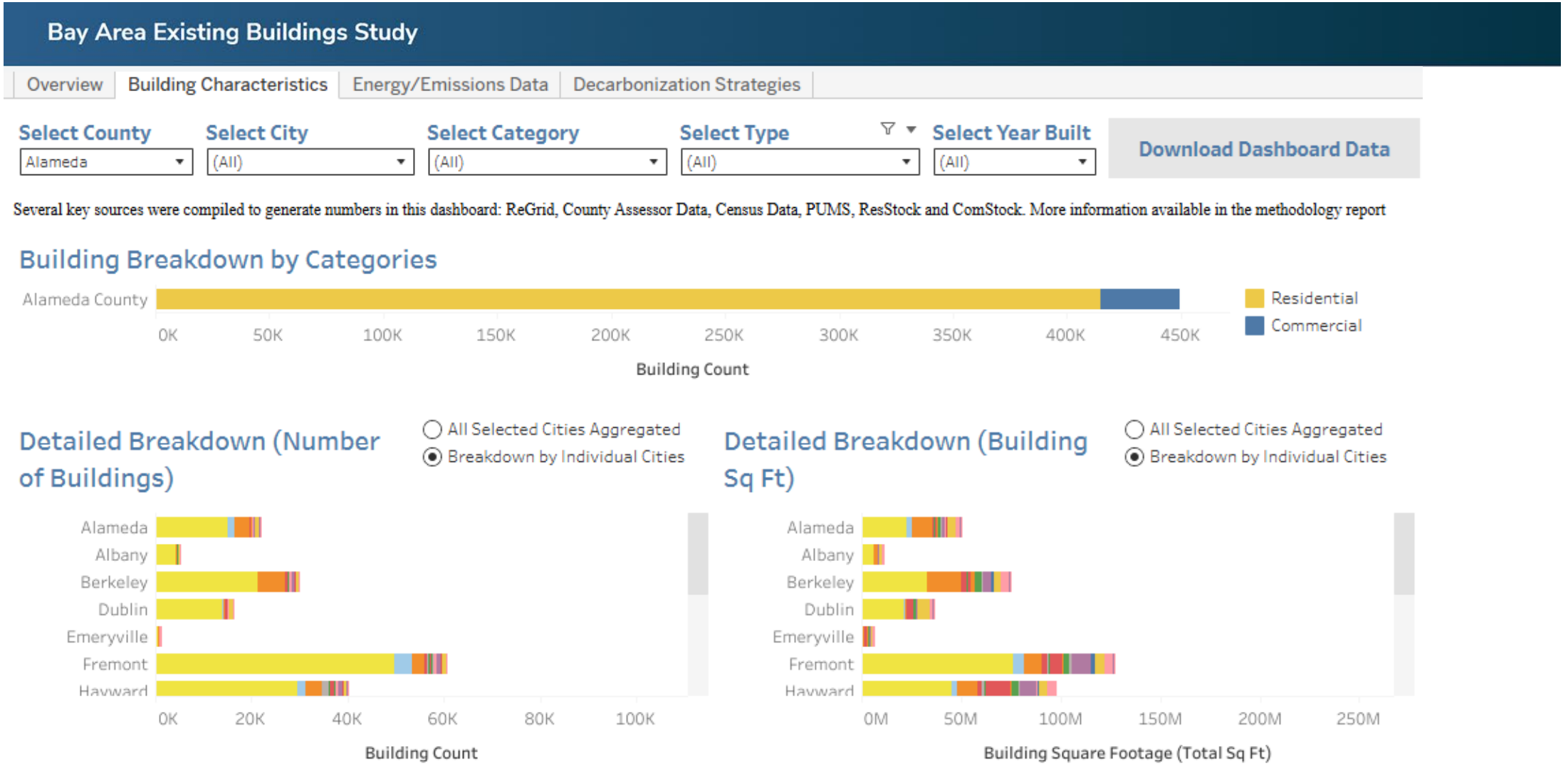
Per city figures on:

- Building Type (e.g. single family detached, office, municipal)
- Building vintages, total square footage, rent/own
- Energy and carbon estimate per subcategory
- Impact of various energy conservation and electrification measures on energy and carbon.

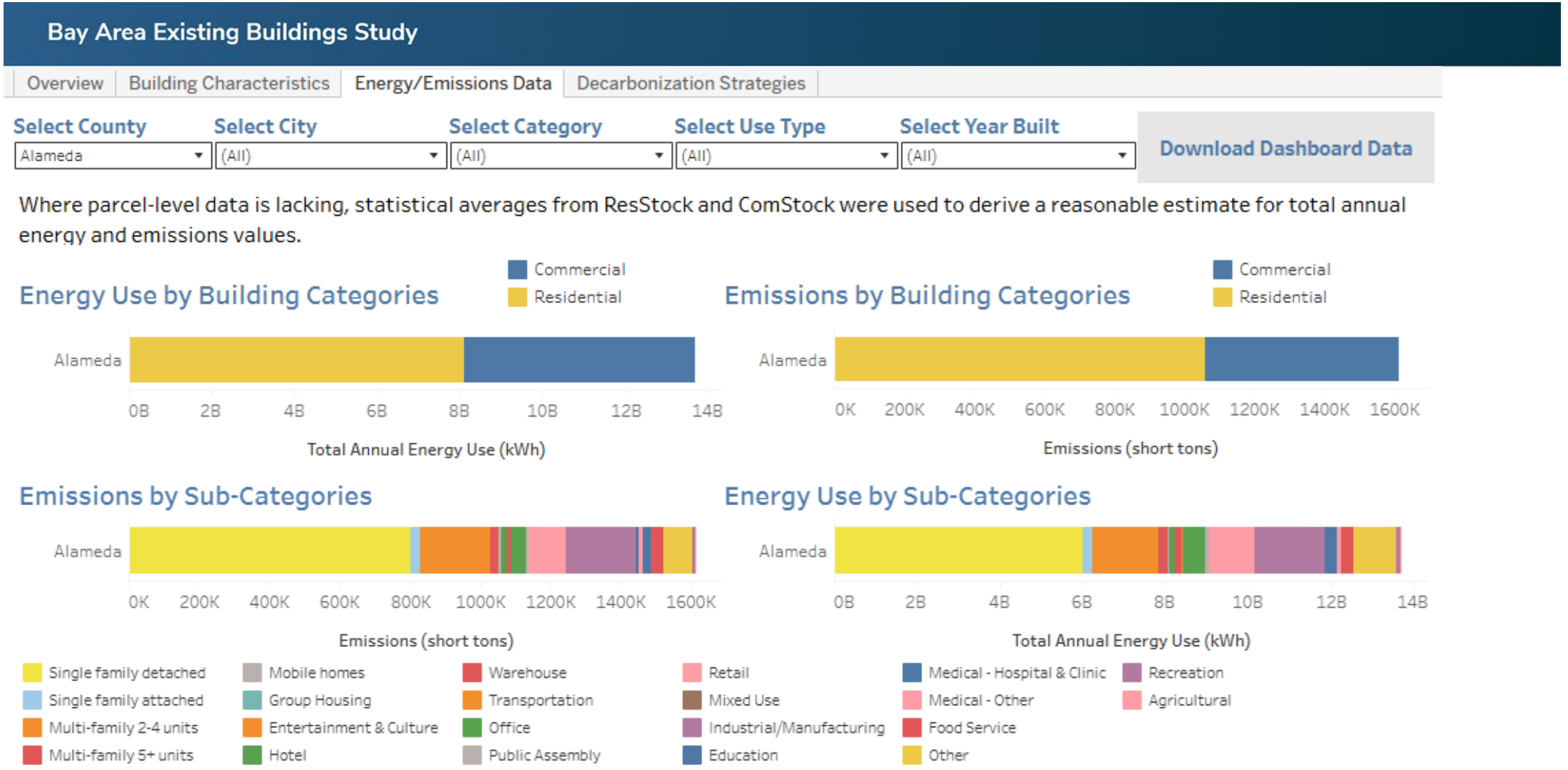
County Data Overview



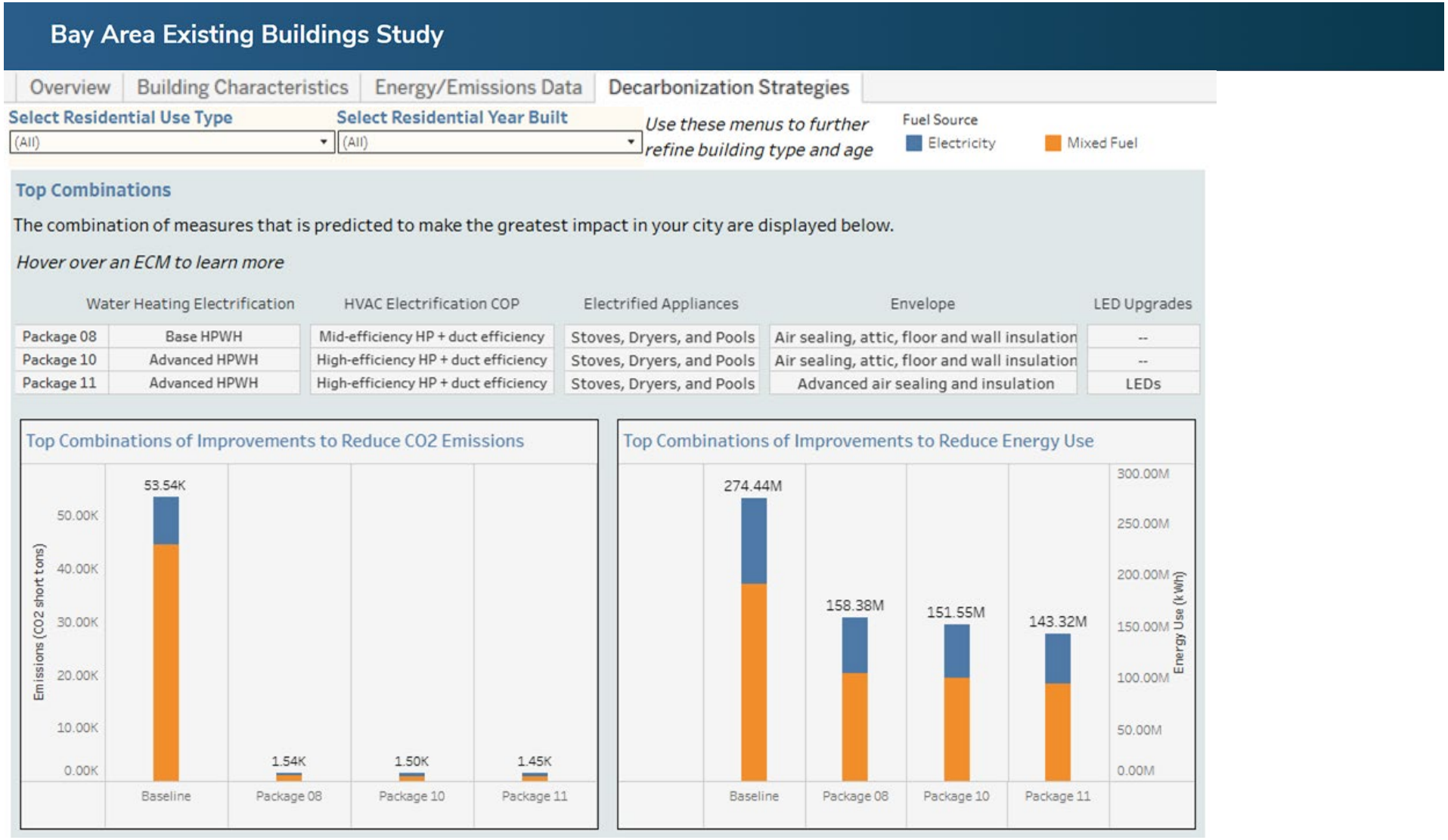
Detailed Building Type Data by City



Energy Use by Building Type per



Top Performing Measures per City



Potential Decarbonization Measures

Residential

DHW
Standard HPWH
Advanced HPWH

HVAC
Mid-efficiency HP + duct efficiency
High-efficiency HP + duct efficiency

Envelope
Light upgrade
Medium upgrade
Advanced upgrade

Plug loads/Lighting
LED Lighting Upgrades
Electrified Appliances

Commercial

DHW
Water Heating Electrification

HVAC
HVAC Electrification Base COP
HVAC Electrification Advanced COP

Envelope
Light Upgrade
Advanced Upgrade

Plug loads/Lighting
Plug load optimized controls
LED Lighting Upgrades
Electrified Cooking Equipment

Reviewed Data Sources

Building Stock Information

- ReGrid Data
- GIS Assessor Parcel Data
- PUMS from ACS
- BOE Jurisdiction Assignment
- Housing Elements Reports
- OpenStreetMap Building Footprints

Energy + Carbon Benchmark Data

- City of SF Benchmarking Data
- LBL Building Performance Database
- BayREN Green Home Labeling Data
- BAMBE Multifamily Evaluation

Electrification Inputs

- Panel Sizes and Peaks (HEA/RE and LBNL Datasets)
- NEC Cutoff Years
- Building Equipment Turnover
- Rebate Program Data

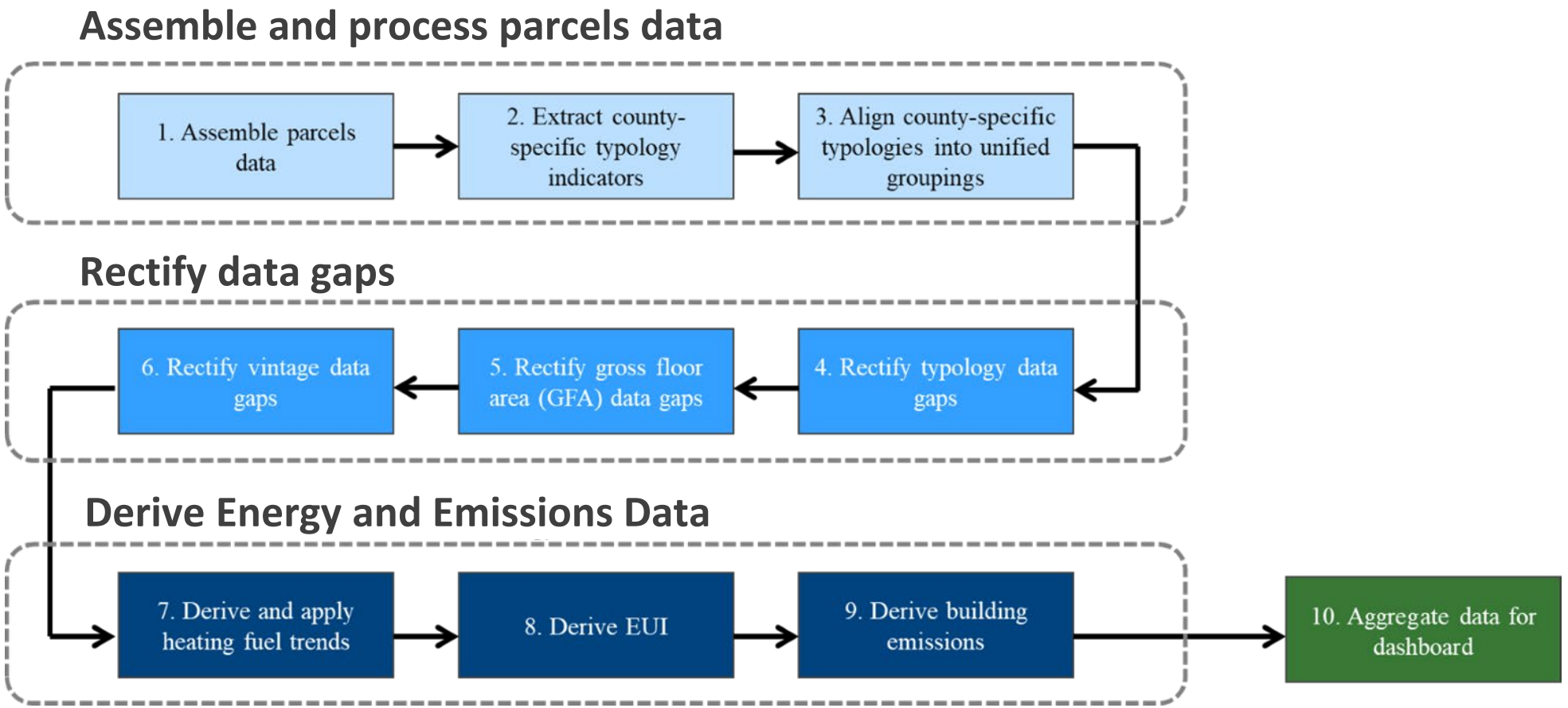
Model Prototypes

- ResStock + ComStock Databases and Prototypes
- CBECS/RECS
- Residential Appliance Saturation Survey
- Commercial Saturation Survey

Weather Data

- 5 California Climate Zones Found in Bay Area
  - 1, 2, 3, 5, 12

Existing Building Methodology Overview



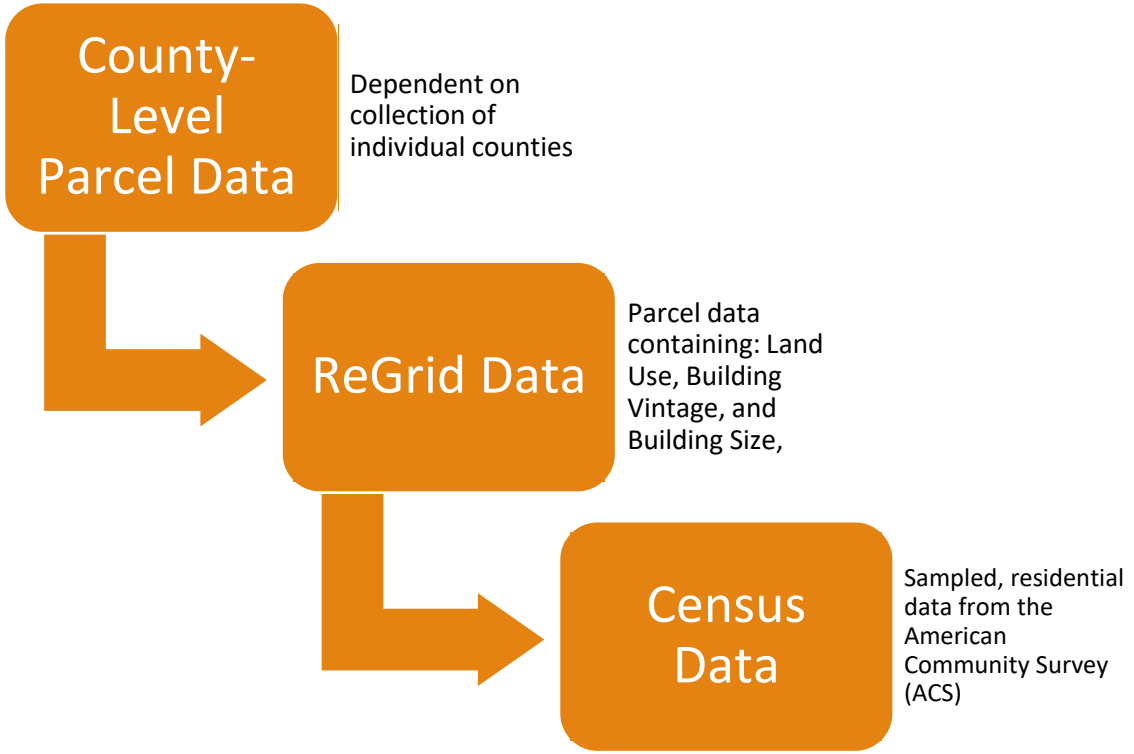
Combining and Leveraging Data

Ensuring that the Right Data is Used to Answer Each Question

What is in My Jurisdiction?

- Number of Stories/Height
- Use
- Year Built
- Building Footprint Area
- Jurisdiction: City/County

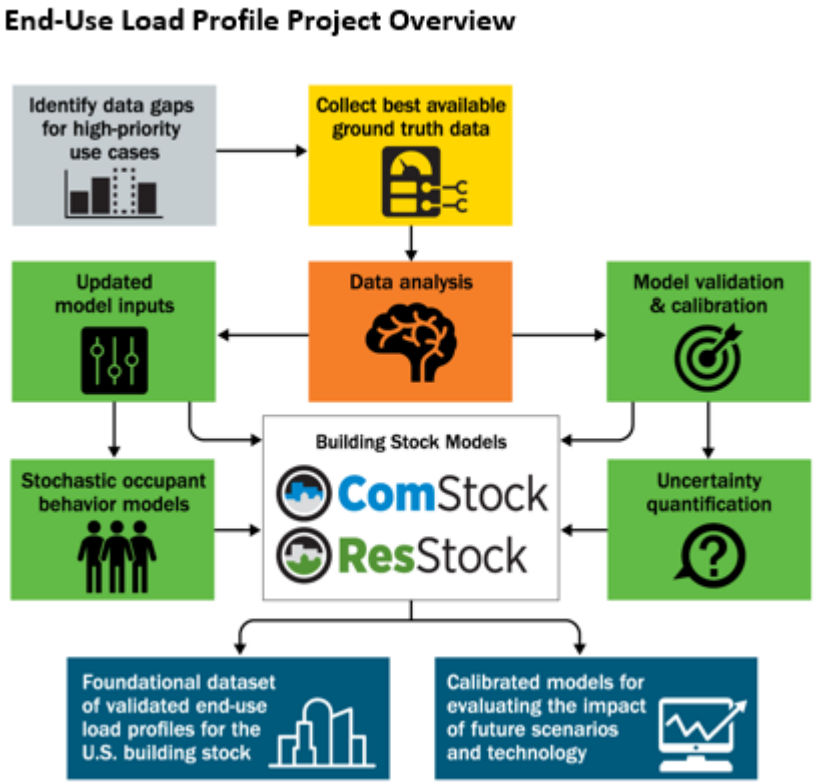
- Parcel data first: ReGrid, OpenStreetMap, Assessor Data, etc.
- Filling gaps and providing context using Census data (not parcel level)
- Gaps in data
  - Commercial
  - Multi-family homes
  - Consistent building ages



ResStock and ComStock Model Database

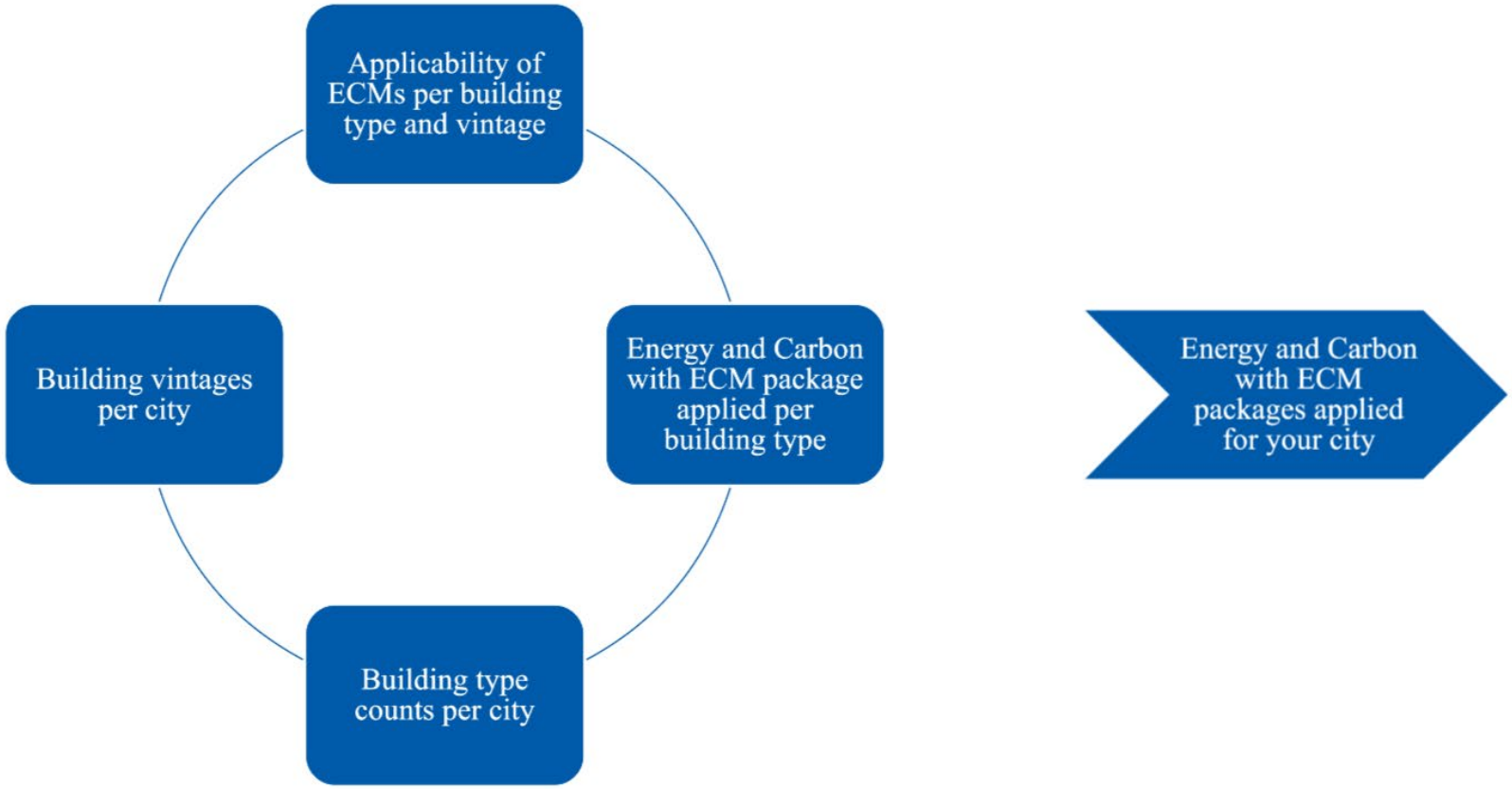
ResStock and ComStock is an extensive database of **thousands of models** run in EnergyPlus.

Data from these models are combined with our existing buildings estimates to predict current EUI and show the impact of various ECM packages on the Bay Area Building Stock.



Creating a Cohesive Picture

Layering existing building characteristic data with modeled ECM energy and GHG savings statistics



Discussion

Process:

- Many available local data sources layered in GIS
- The best local data was selected for each parcel and data type
- Where data does not exist, infilled with the best available statistics
- Sample tested to add logic streams that correct poor base data.

Result: Most locally accurate city-level estimates to date

Restrictions:

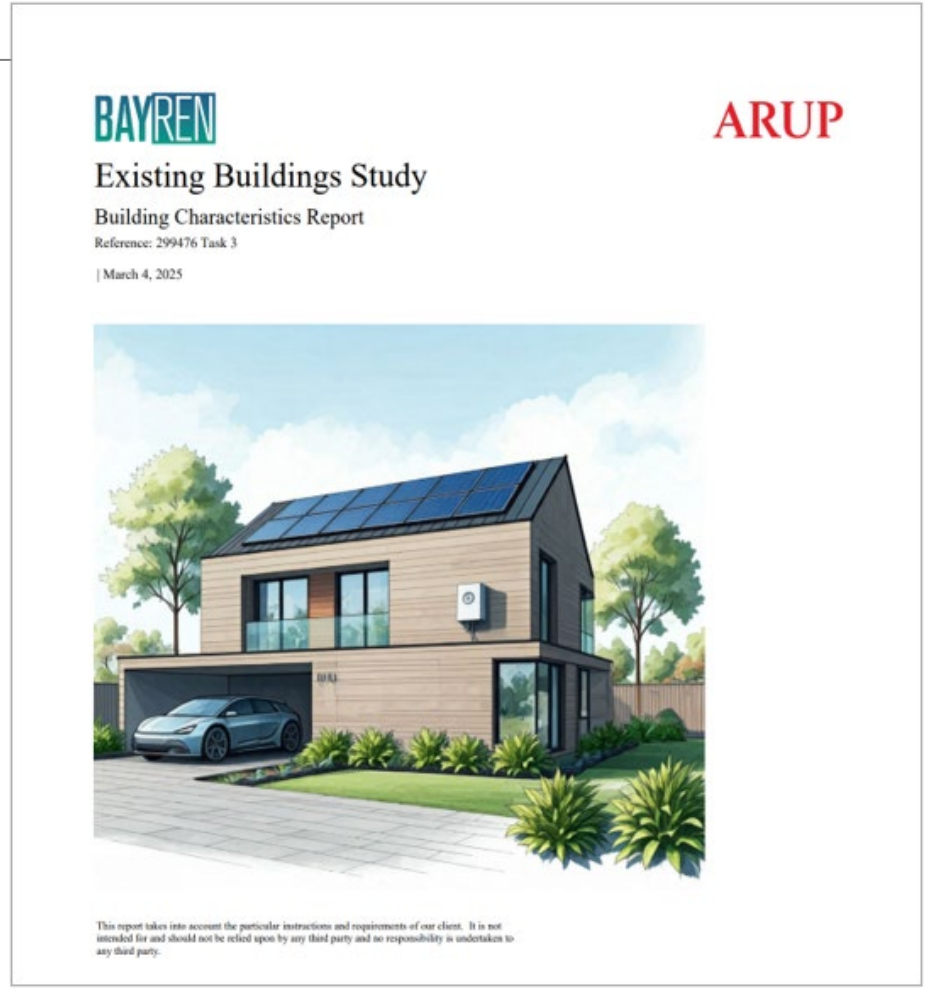
- Data is not precise per building, certain building types may be off
- Certain local data affecting policy does not exist comprehensively (e.g. water heater location)

Resources Available on BayREN Website

Read about all available building characteristics data and our methodology on the BayREN website.

- "Existing Buildings Characterization Report"
- "Energy Conservation Measure Analysis Methods"
- Commercial and Residential "Explainers"
- "Dashboard Data FAQ"

We have built a **robust local backend data set**, which can be used as a starting point to answer more specific questions about buildings in your city. Reach out to Arup to start a conversation.

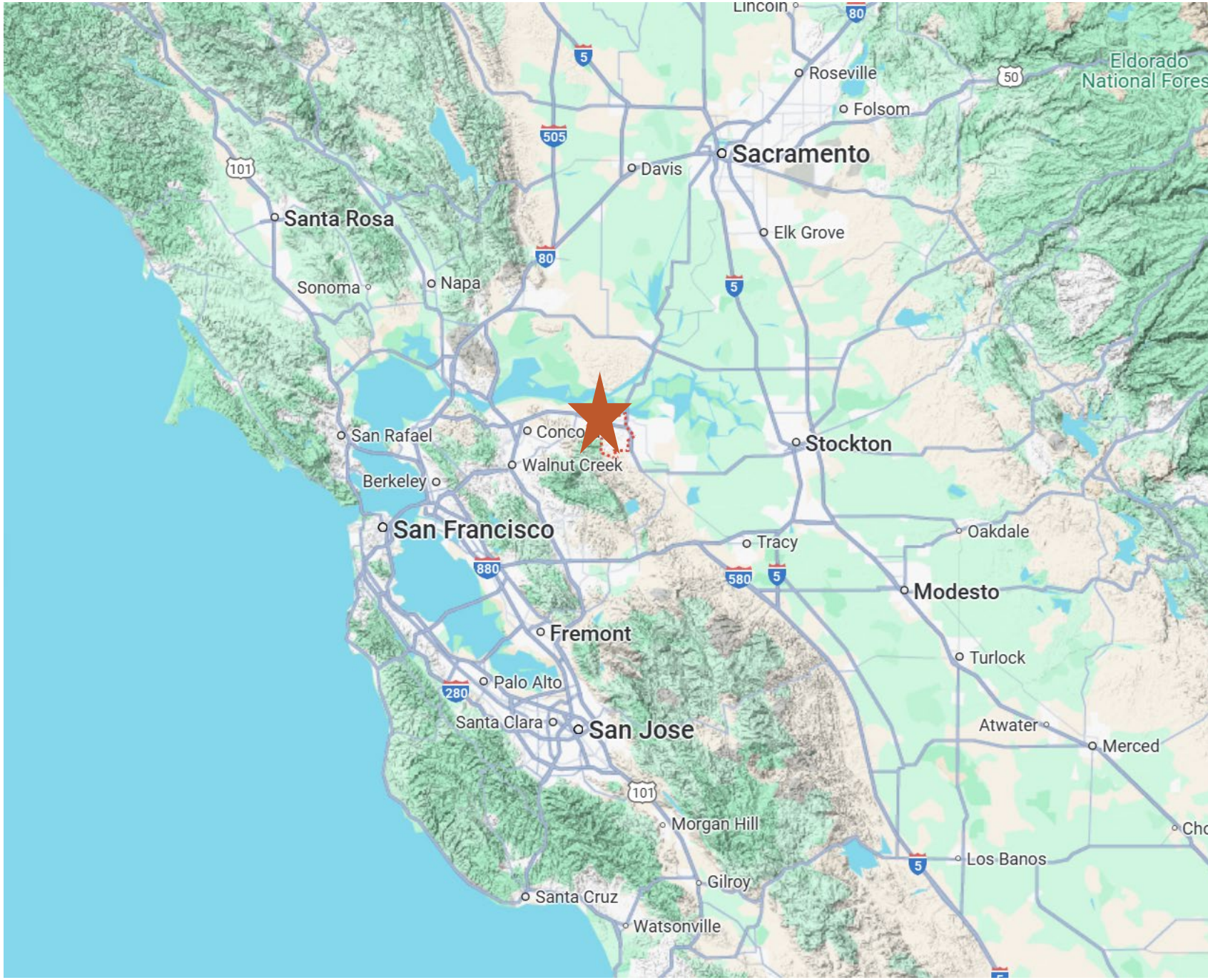


ARUP

Q&A / Stretch Break

Pulling it All Together

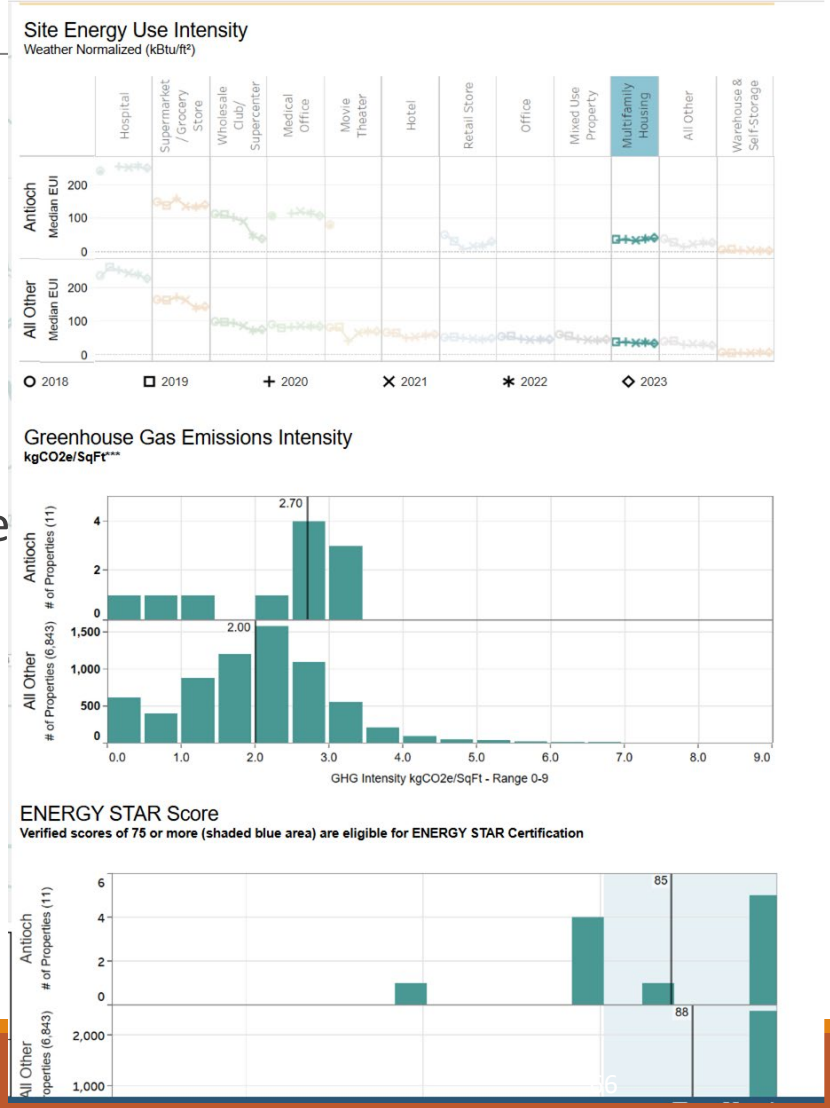
Example
City of Antioch



CEC Benchmarking Data

Out of 47 buildings in Antioch with data in CEC's Benchmarking database, 11 are multifamily buildings

- The 11 buildings have a total floor area of 1,434,034 sf
- 10 of the 11 buildings have Energy Star ratings of 73 or higher
  - 5 of those buildings have Energy Star ratings of 97 or above
- The one building that does not:
  - Has an Energy Star rating of 50
  - Was built in 2003
  - Has 225,840 sf
  - Uses approximately 40M kBTU in energy



Energy Atlas

Profile page

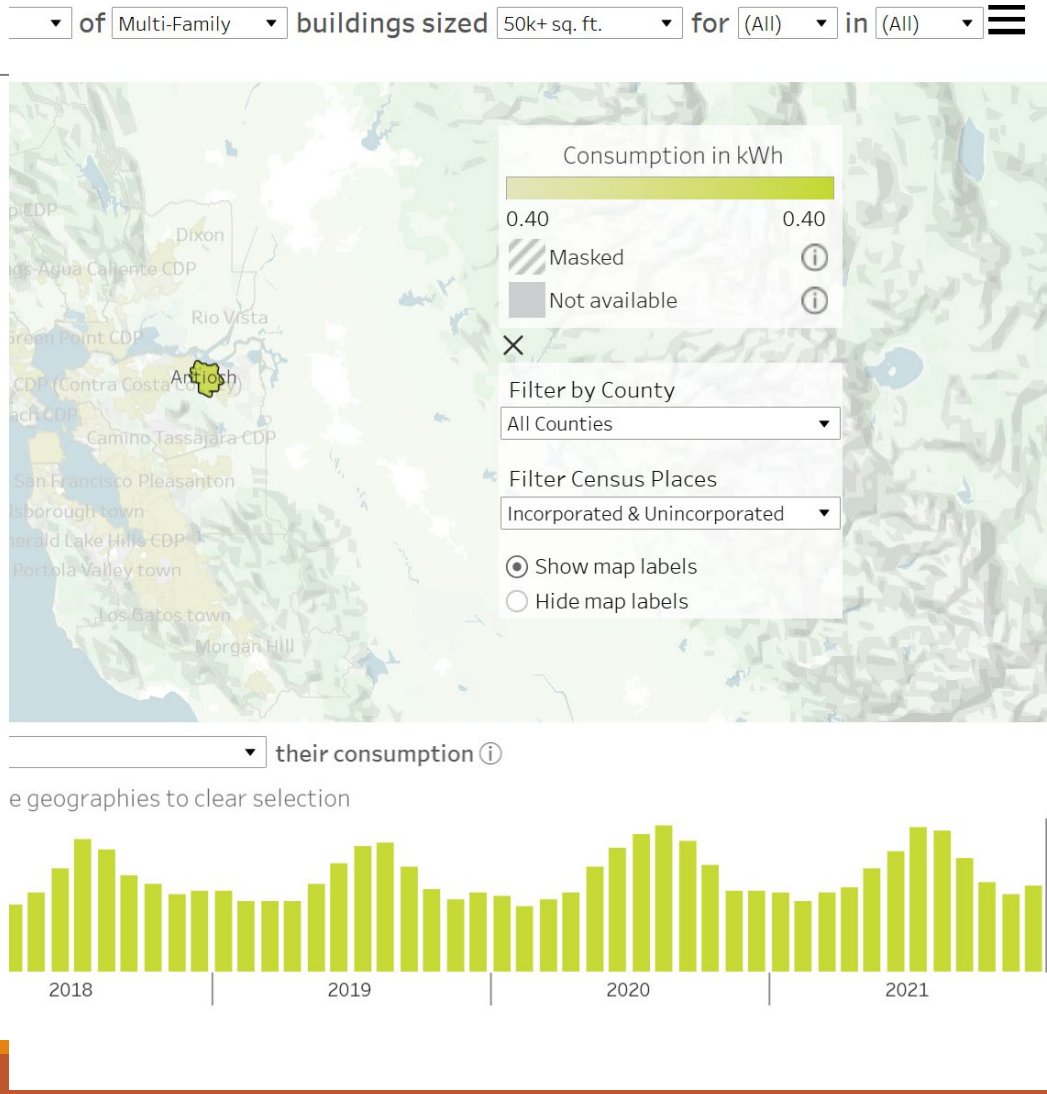
- Total population = 115,016
- Median HH income = $90,709
- By square footage, most of Antioch's buildings were built after 1990
- Antioch has 3.3M sf of multifamily buildings

Building Size page

- Multifamily buildings over 50k sf use less electricity per sf than smaller buildings
- A number of multifamily buildings 40k-50k are all-electric (can infer this)

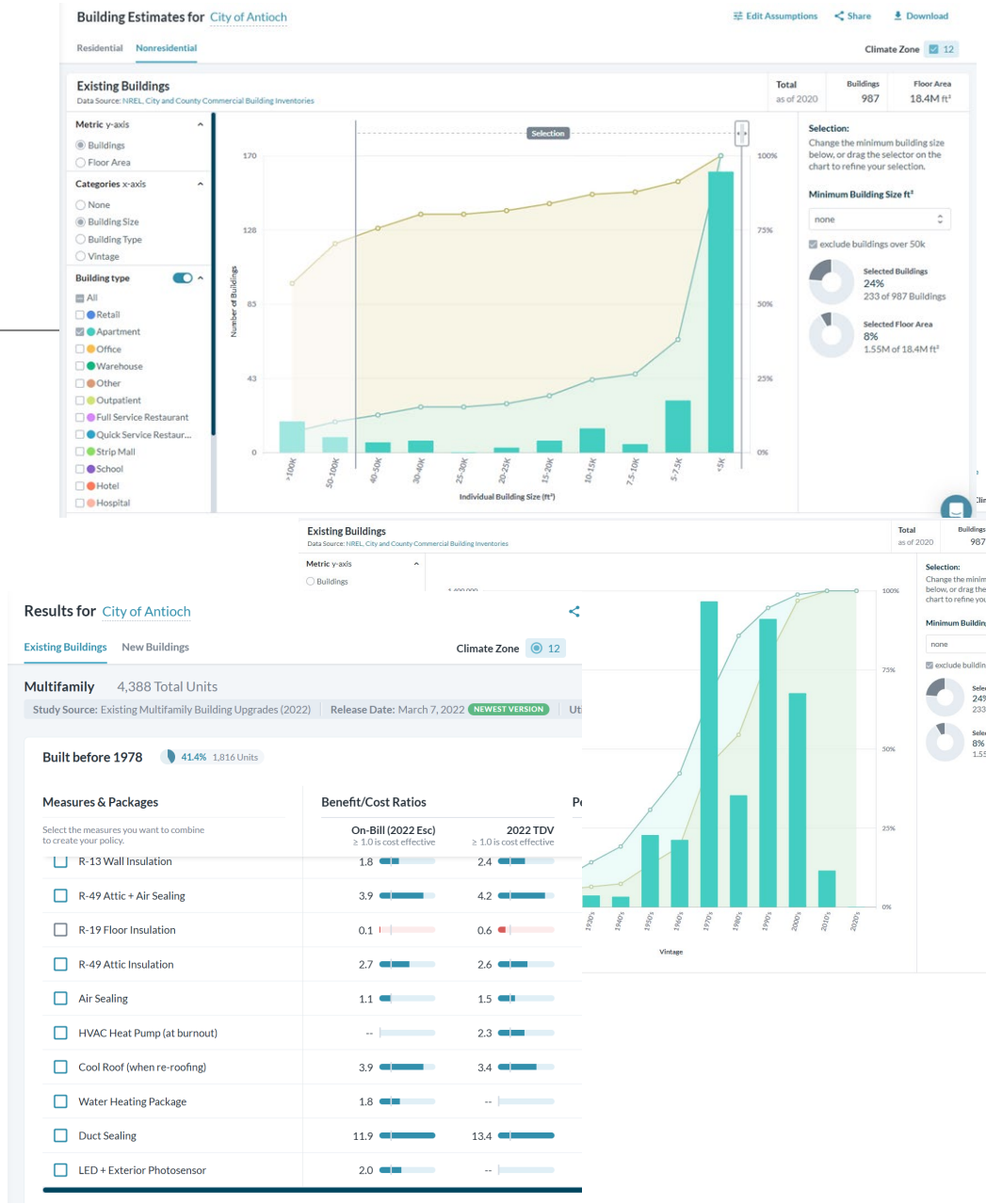
Building Vintages page

- The multifamily buildings that use the most energy per sf are those built 1950-1977, followed by those built before 1950



Cost-Effectiveness Explorer

- 260 multifamily buildings, with ~5M sf in area
- Most multifamily floor area was built in the 1970s, 1990s, and 2000s
- ~10% of buildings covered by CEC benchmarking
- Many measures may be cost-effective for multifamily buildings built before 1978, including:
  - Solar PV
  - PV + HPWH at burnout
  - R-13 Wall insulation
  - R-49 attic insulation
  - Air sealing
  - Duct sealing
  - HP space conditioner
  - Cool roof when re-roofing



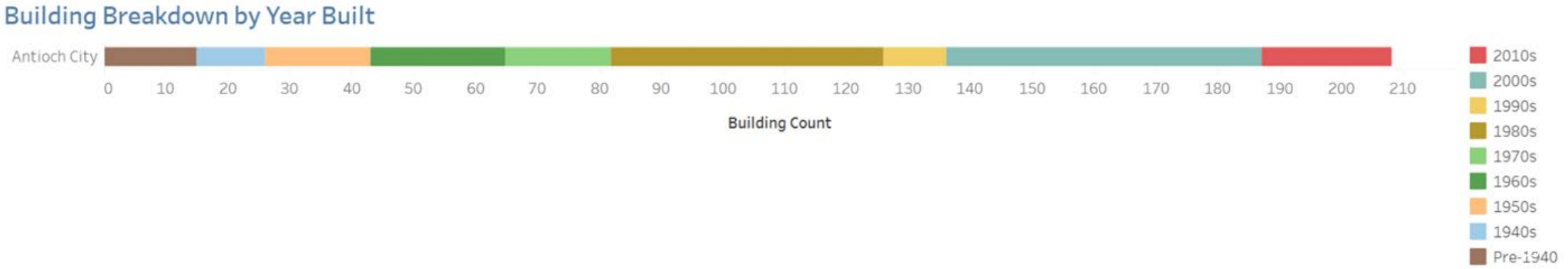
Existing Building Study

Most multifamily buildings in Antioch:

- Have 5+ units (about 5% of multifamily buildings have less than 4 units)

Most effective Decarbonization strategies for multifamily buildings:

- Water heating electrification would be the single measure with the largest impact on both energy use and GHG emissions
- A package that includes water heating electrification, space heating electrification, and building envelope improvements would nearly eliminate GHG emissions



Synthesizing the Detailed Information

Key facts/trends revealed:

- Multifamily is a small slice of the residential emissions pie; single family dominates
- More buildings were built in the 1970s and 1980s than any other decade
- The multifamily buildings constructed prior to 1978 use the most energy per sf
  - These buildings also have the most options for cost-effective retrofits
- Antioch has small and large apartment buildings, but not much in between
  - 10% of apartment buildings have about 70% of the multifamily floor area
  - 75% of apartment buildings are smaller than 10,000 sf
- Water heating electrification would be the single measure with the largest impact on both energy use and GHG emissions
- Some buildings over 50,000 sf may be missing from the CEC database
- One multifamily building over 50,000 sf is performing poorly or data was entered incorrectly

What would be some good options for the City of Antioch to consider?

For all multifamily buildings:

Focus on multifamily buildings built prior to 1978 for the biggest impact

Educate building owners about:

- Energy efficiency and building decarbonization
- Technical assistance and incentive programs available, especially direct install programs
- Avoiding service upgrades
- Pending Air District or CARB Zero NOx rules
- EV charging programs

Encourage building owners to make energy-related improvements

- Waive fees or otherwise incentivize equipment changeouts
- Simplify permitting processes

What would be some good options for the City of Antioch to consider?

For larger buildings (over 50,000 sf):

Educate about state's pending Building Performance Standard

Identify any building owners NOT shown on the CEC Dashboard:

- Contact to see why they are not participating
- Consider offering assistance collecting and/or reporting data – these can be barriers, especially for properties without professional property managers

Contact owner of large building with the Energy Star score of 50

- Did they make a mistake when submitting their data to the state?
- If not, they could likely save a lot of money through retrocommissioning

For smaller buildings (less than 50,000 sf):

Consider encouraging electrification of water heaters in particular

Provide information about technical assistance and incentives available

Lessons Learned/Conclusions

- Data about existing buildings can be challenging
  - Local datasets are often incomplete
  - National datasets are not as accurate for smaller areas like cities
  - Some of the data we want just doesn't exist anywhere

- Numbers in the tools are not precise
  - All of the tools are based on available data – but some use different sources and some process data differently
  - Don't expect numbers to match

- You should be able to see consistent trends across the tools, even when the numbers may be different

Lessons Learned/Conclusions

Invest	• Time working with each tool
Focus	• On patterns and trends
Consult	• Tool documentation, help files and developers
Confirm	• Everything with local data

	CEC Benchmarking Data	Cost-Effectiveness Explorer	Energy Atlas	BayREN Existing Building Study
Geography	CA	CA	Bay Area & SoCal	Bay Area
Measures & Impacts	--	Yes	–	Yes
Occupancy Types	~50	13	8	22
Year Built	Yes	By decade	By decade	By decade
Floor area	50,000sf +	By size interval	By size interval	By size interval
Exclude 50k+ sf	–	Yes	–	–
Specificity	Street address	City	City, Census Tract	City
Energy Use, by fuel	Reported	Estimated	Metered	Estimated
Energy Star Score	Yes	–	–	–
Site EUI (kBtu/sf)	Yes	Yes	Yes	Yes
Total Emissions	Yes	Yes	–	Yes
Emissions per square foot	Yes	Planned	–	–
Income	–	–	Percent of median	–
Own/Rent	–	–	–	Yes

Q&A / Stretch

Wrap Up

- Are there features for a tool that you would like to see but were not included?
  - Ask! Sometimes there are resources to expand functionality.
- Other tools are in development
  - Reach out to the presenters to keep track of the evolving options
- Spend time exploring, but ask for a tutorial as needed:
  - CEC Benchmarking Public Disclosure Dashboard
  - Cost Effectiveness Explorer
  - Bay Area Energy Atlas
  - BayREN Existing Buildings: Decarbonization Study and Dashboard

Thank you!

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