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Webtool To Evaluate Emissions Impacts of Heating and Cooling Loads in Large Buildings

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CBE

Project overview

Objective

- Reduce emissions in existing large buildings through heat recovery and storage
- Use ultra-low global warming potential refrigerants

Methods

- Simulation
- Demonstration
- Web tool
- Case studies and data analysis

Funding

- \$6M over 5 years
- California Energy Commission
- Match: Kaiser Permanente, CBE



Image: Kaiser Permanente South San Francisco Medical Center
Source: Kaiser Permanente

Context

Background

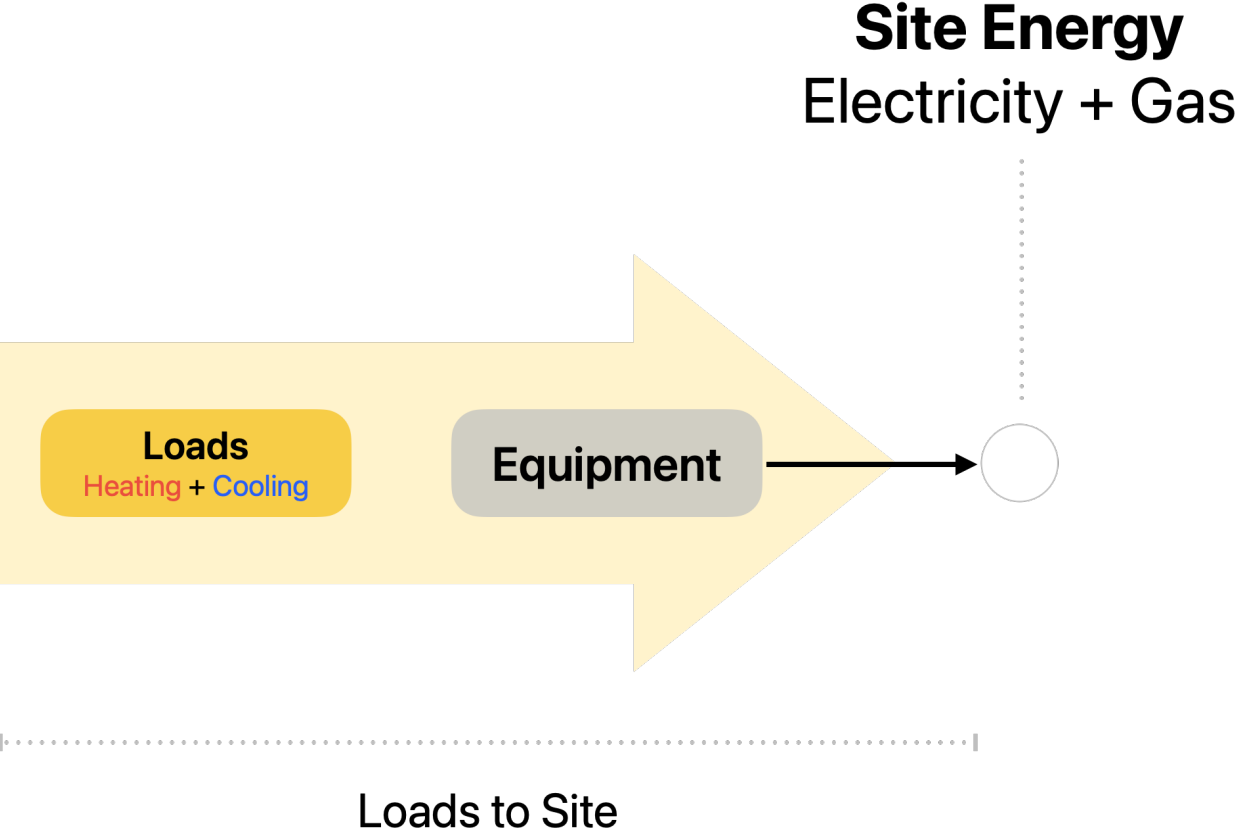
- Large building HVAC decarbonization is complex.
- Current methods are fragmented and inconsistent.

Objective

- Develop a web tool for decarbonization analysis in early design stage
- Users can map hourly building heating and cooling loads to emissions under different equipment and emissions scenarios.



Calculations: From site energy to source emissions



Heating and cooling loads



User selects:

- Location for climate and grid region
- Building type, size, vintage
- Load from library of simulated or measured data

ALPHA VERSION

LOADS

Building Location
Select the building location. This will set the corresponding ASHRAE climate zone used for the analysis.

LOAD DATA

Select the type of load data you want to use for analysis.

Select From Library

Upload Custom Data

SUMMARY

Building Characteristics	
Location	Berkeley
Building Type	Lab
Vintage	1988
Climate Region	3C (CA Region 3)
GEA Grid Region	CAISO
Building Area (m ²)	7869.16

Load Characteristics	
Load Type	measured
Annual H/C Ratio	2.33
Peak Heating Load [W]	853444.71
Peak Cooling Load [W]	663570.59
Max. Outdoor Temp. [°C]	37.5
Median Outdoor Temp. [°C]	14.4
Min. Outdoor Temp. [°C]	4.7

LOAD VISUALIZATION

Monthly peak heating (HHW) and cooling (CHW) loads

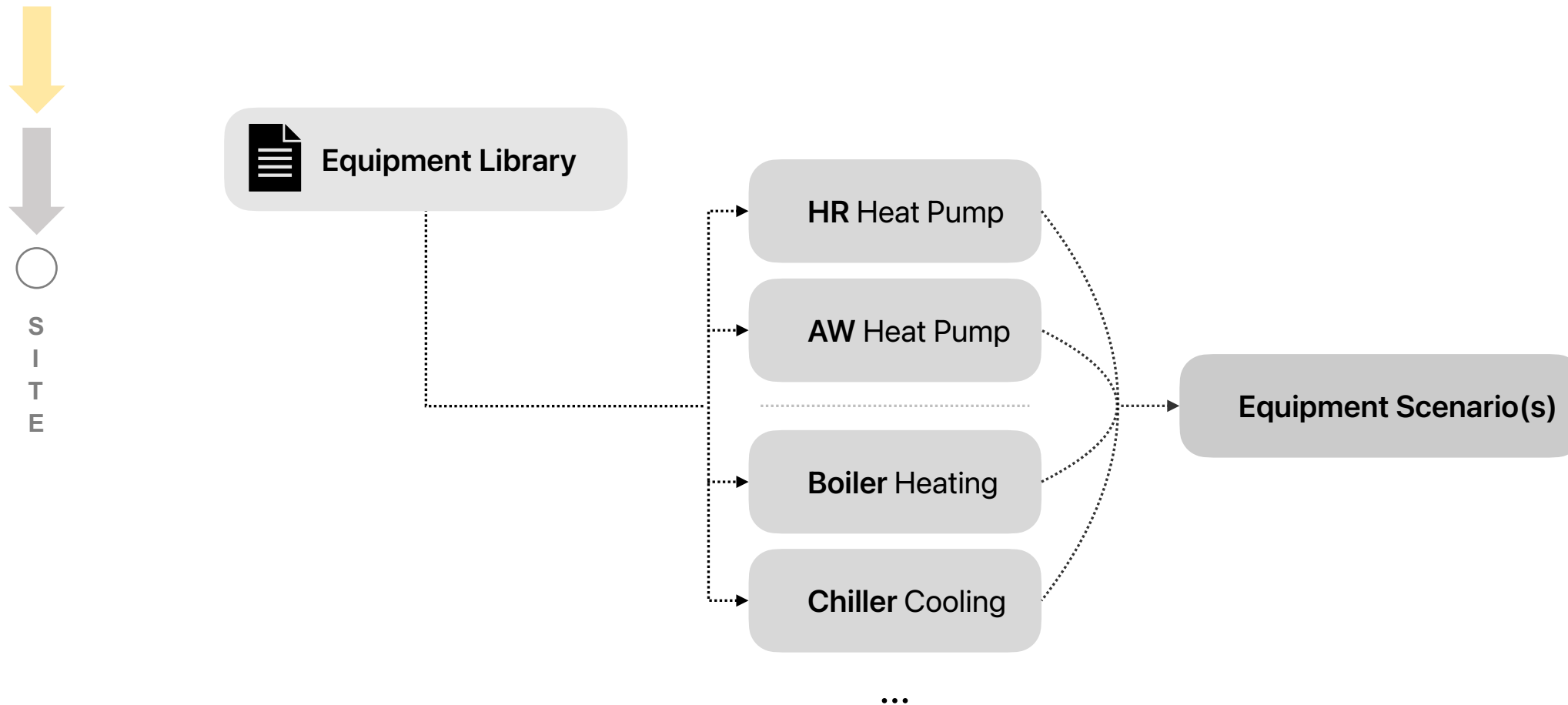
Month	HHW (kW)	CHW (kW)
Jan	750	50
Feb	850	100
Mar	700	150
Apr	850	150
May	650	450
Jun	350	500
Jul	450	350
Aug	450	600
Sep	450	650
Oct	450	550
Nov	850	400
Dec	650	50

Average heating and cooling vs outdoor temperature bins (5°C)

Outdoor temperature (°C)	HHW (kW)	CHW (kW)
5 °C	600	0
10 °C	400	0
15 °C	200	100
20 °C	150	200
25 °C	100	350
30 °C	50	500
35 °C	50	550

[Specify Equipment →](#)

Equipment scenarios



Equipment scenarios



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Property	EQ_SCENARIO_1	EQ_SCENARIO_2	EQ_SCENARIO_3	EQ_SCENARIO_4	EQ_SCENARIO_5
Selected	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Scenario ID	eq_scenario_1	eq_scenario_2	eq_scenario_3	eq_scenario_4	eq_scenario_5
Scenario Name	Gas Boiler+AC Chiller	Elec Boiler+AC Chiller	20% AWHP (H+C)+Gas Backup	100% AWHP (H+C)+Elec Backup	HR WWHP+100% AWHP (H+C)+Elec Backup
HR WWHP Model	—	—	—	—	hr01
AWHP Model	—	—	hp01	hp01	hp01
AWHP Sizing Mode	integer_sizing_peak_load	integer_sizing_peak_load	integer_sizing_peak_load	integer_sizing_peak_load	integer_sizing_peak_load
AWHP Sizing Value	1.0	1.0	0.2	1.0	1.0
AWHP Redundancy	1	1	1	1	1
AWHP Use Cooling	False	False	True	True	True
Backup Heating	bo02	res01	bo02	res01	res01
Backup Cooling	ch03	ch03	ch03	ch03	ch03





Specify Emissions →

Grid emission settings



EMISSIONS

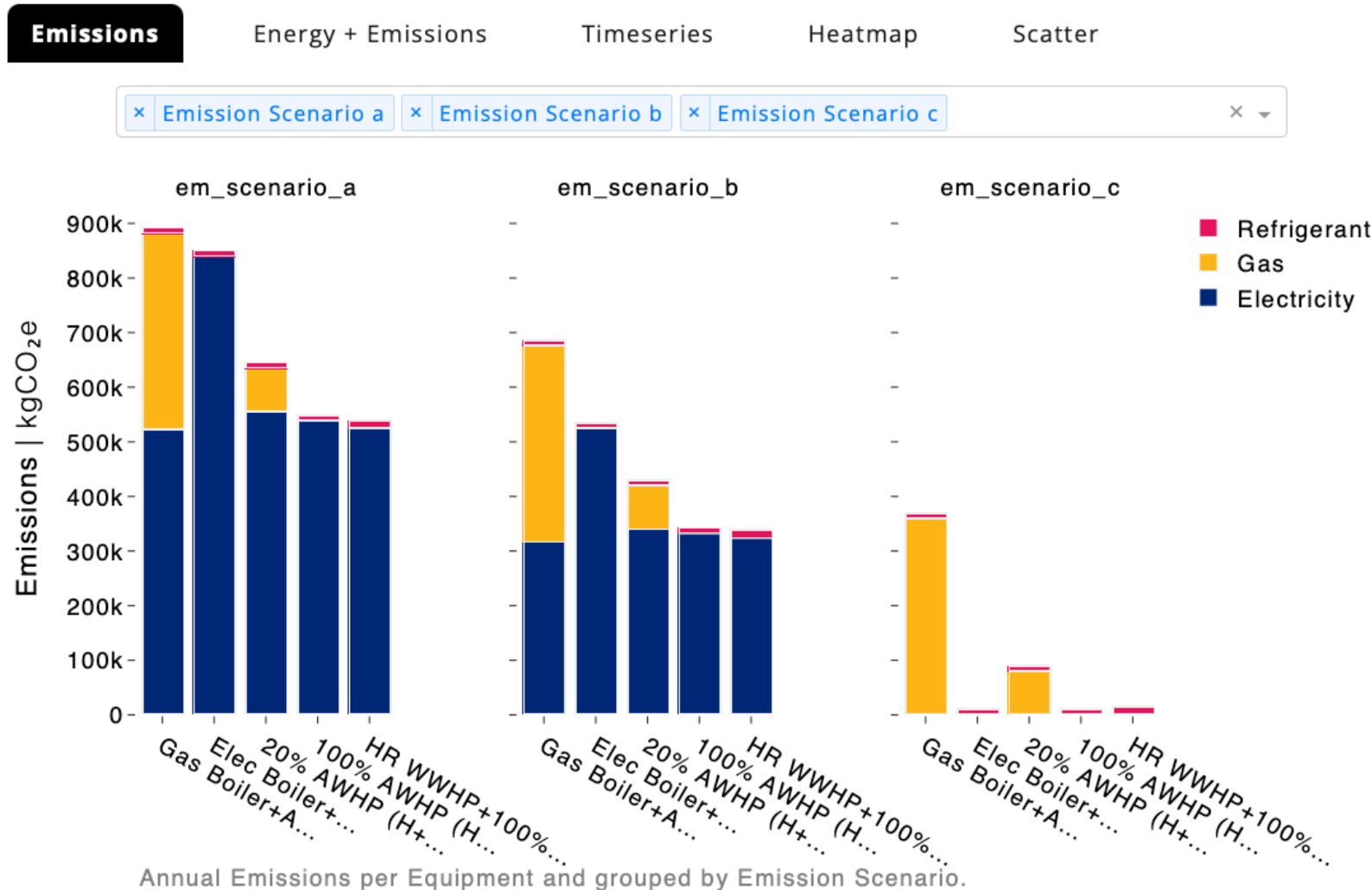
Specify and select emission scenarios to include in the analysis.

Property	EM_SCENARIO_A	EM_SCENARIO_B
Selected	<input checked="" type="checkbox"/>  	<input checked="" type="checkbox"/>  
Scenario ID	em_scenario_a	em_scenario_b
Grid Scenario	MidCase	MidCase
GEA Grid Region	CAISO	CAISO
Emission Type	Includes pre-combustion	Includes pre-combustion
Short-run weighting	0	0
Refrigerant leakage (frac)	0.05	0.05
NG leakage (g/kWh)	239.2	239.2
Year	2025	2035

Analysis and results



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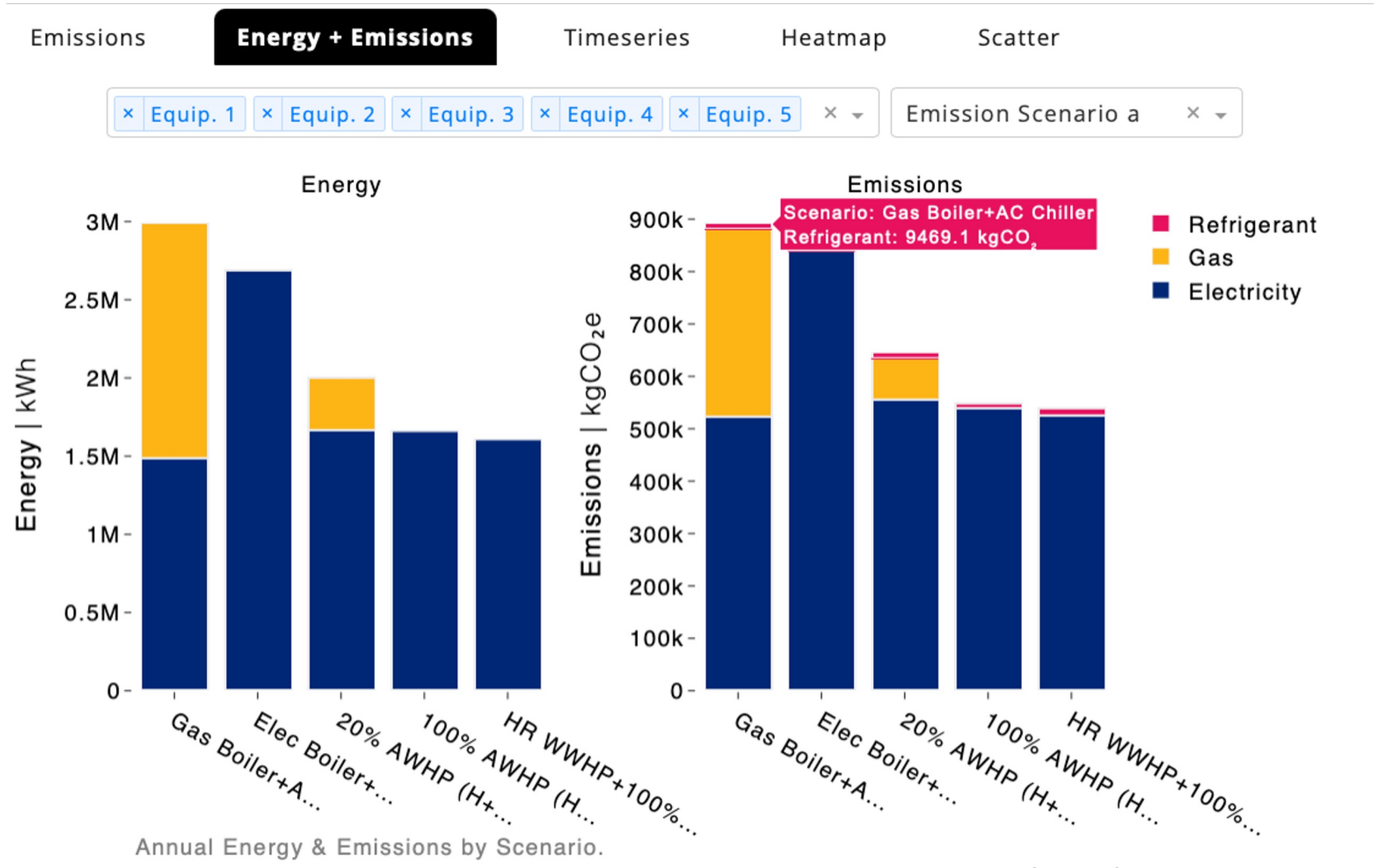


Analysis and results

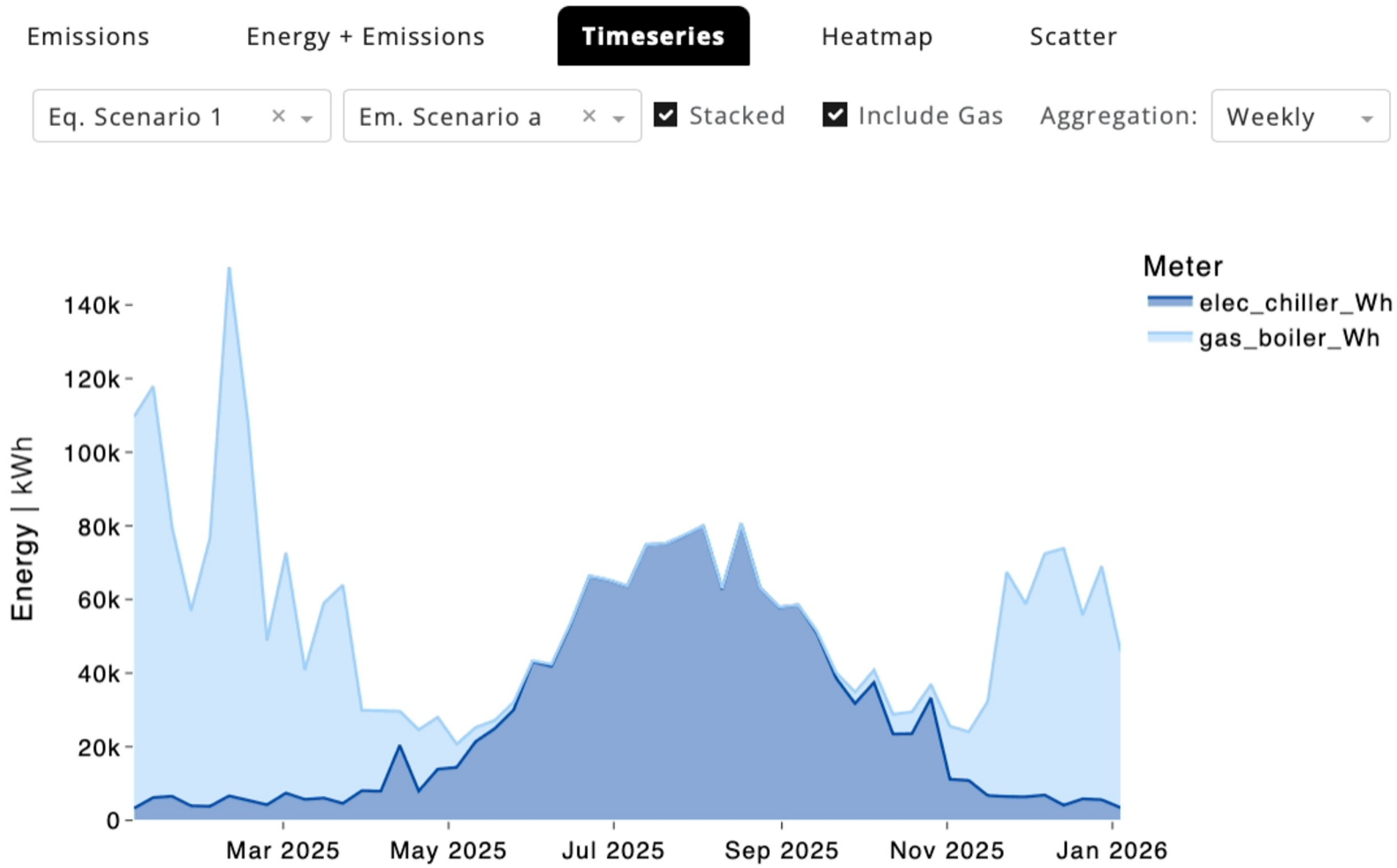


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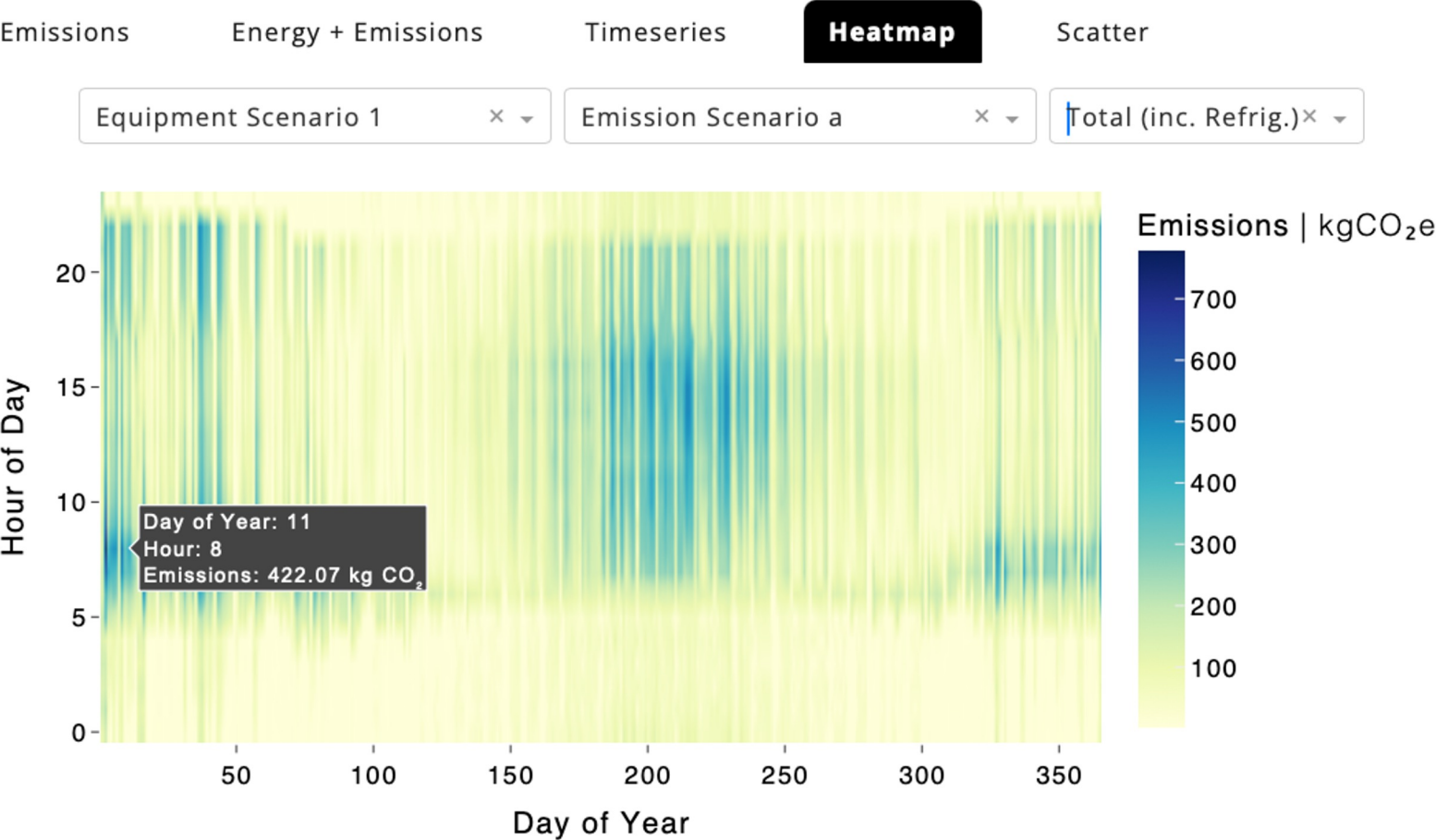


Analysis and results



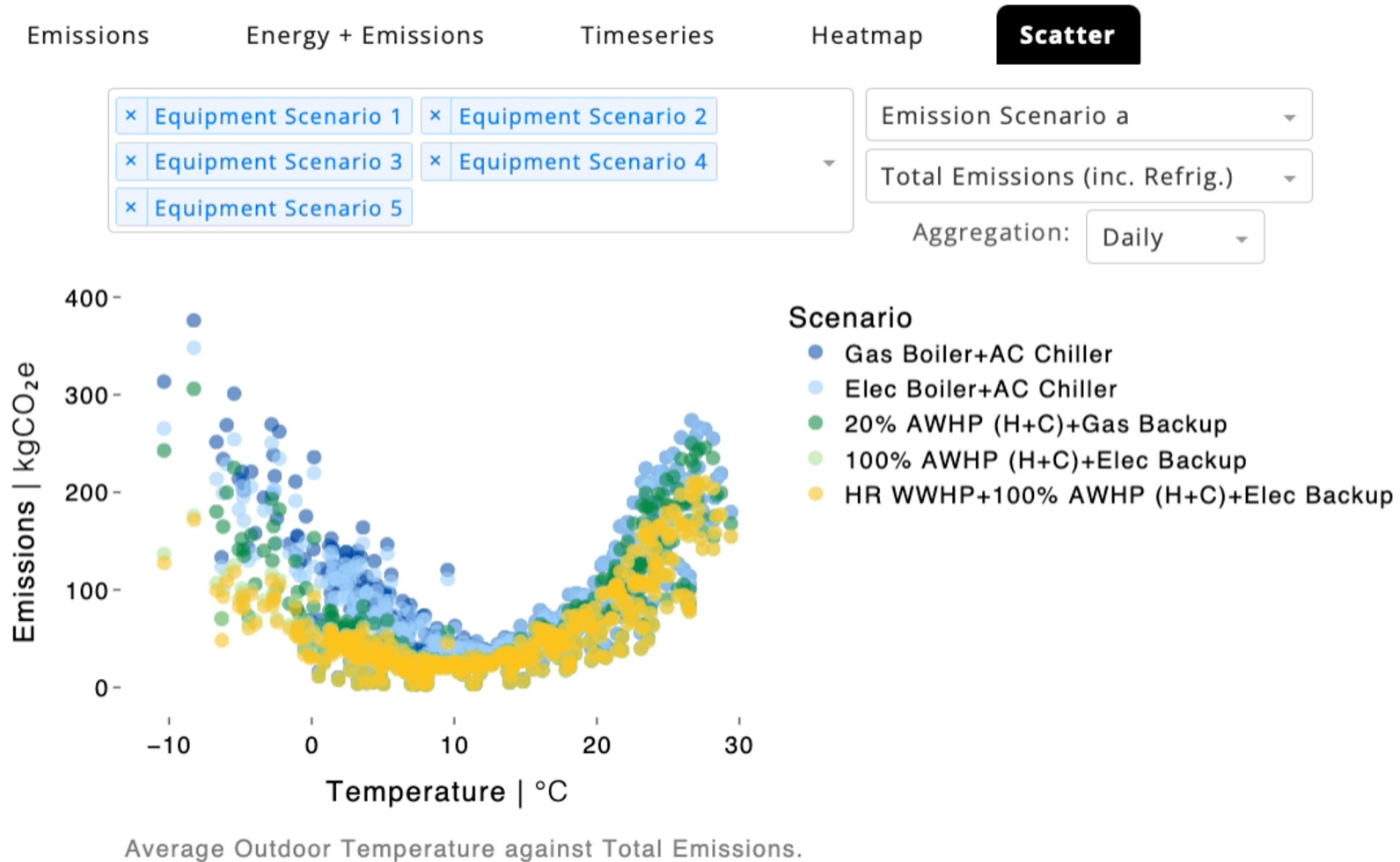
Stacked Meter Usage, aggregated over time.

Analysis and results



Annual heatmap of hourly emissions for total_emissions.

Analysis and results



Project status

- Addressing known bugs
- Integrating feedback on Alpha version
- Improving usability and documentation
- Aim to launch Beta version in Q2 2026
- Continuously improve tool through 2027
- Implement new feature requests
- Enhance visualization and reporting capabilities



Q&A

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The screenshot displays the Berkeley DECARB web application interface. The top left features the Berkeley DECARB logo and a close button. The top right corner has an 'ALPHA VERSION' badge. The interface is divided into several sections:

- Left Sidebar:** Contains navigation links for 'Loads', 'Equipment', 'Emissions', and 'Results'. At the bottom, there are 'SI' and 'IP' unit selection buttons and a 'Documentation' link.
- LOADS Section:** Includes a 'Building Location' dropdown menu with a search prompt 'Search by city or zip...'. Below it is the 'Load Data' section with 'Select From Library' and 'Upload Custom Data' options.
- SUMMARY Section:** A table of 'Building Characteristics' for a Lab in Berkeley, CA, built in 1988. It lists 'Building Area (m²)' as 7869.16. Below this is a 'Load Characteristics' table with the following data:

Load Type	Value
Load Type	measured
Annual H/C Ratio	2.33
Peak Heating Load [W]	853444.71
Peak Cooling Load [W]	663570.59
Max. Outdoor Temp. [°C]	37.5
Median Outdoor Temp. [°C]	14.4
Min. Outdoor Temp. [°C]	4.7
- LOAD VISUALIZATION Section:** Features two charts. The top chart, 'Monthly peak heating (HHW) and cooling (CHW) loads', is a line graph showing peak load (kW) from January to December. The bottom chart, 'Average heating and cooling vs outdoor temperature bins (5°C)', is a bar chart showing average load (kW) for temperature bins from 5°C to 35°C.