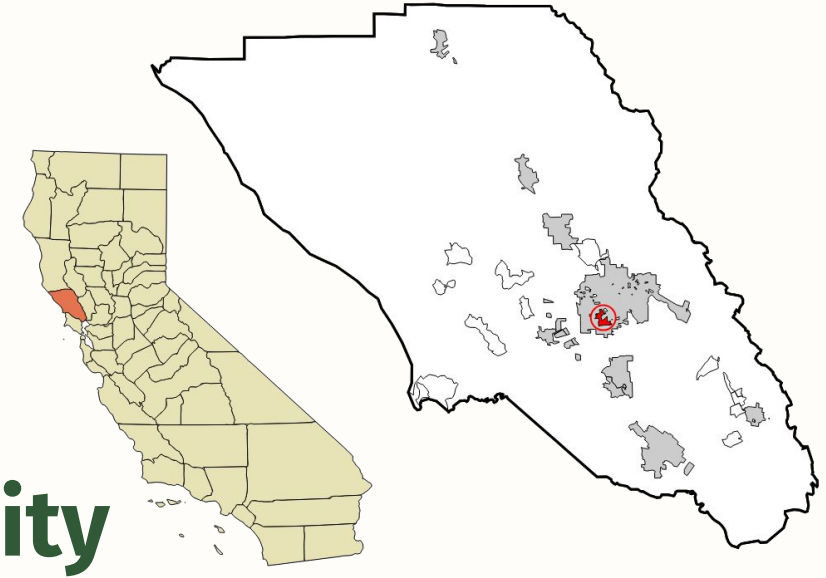
Enabling Neighborhood-Scale Electrification in a Disadvantaged Community



Source: Arkyan (2007), Wikimedia Commons.

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Sonoma Clean Power

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Objectives and Goals for Sonoma Clean Power

Evaluate the barriers, needs, impacts, and opportunities associated with the full electrification of Roseland

- **Electrification of**: single and multi-family homes, small and large businesses, industry, and vehicles.
- **Infrastructure changes**: electrical grid upgrades, decommissioning of localized natural gas distribution lines.
- **Anticipated barriers**: financial, technological, community buy-in required to execute full electrification.
- **Anticipated opportunities**: improved health outcomes, lower emissions, lower AQI scores.

Project Timeline: Current Status with future goals

Spring 2025

- ☑ Work plan Draft
- ☑ Secure external advisors
- ☑ First literature review
- ☑ Final work plan
- ☑ Secure data sources (client and external)
- ☑ Spring review meeting

Summer 2025

- ☑ Internships
- ☑ Non-market impacts research
- ☑ **Model subroutines**
  - ☑ Residential
  - ☑ Begin commercial
  - ☑ Define data needs for transportation

Fall 2025

- ☑ Fall flashtalks
- ☑ Interim report
- ☑ Decide on UI
- ☑ Fall review meeting
- ☑ Final report outline
- ☑ **Detailed model working**

Winter 2026

- ☑ Final report Drafts
- ☑ Faculty reviews
- ☐ Final Report
- ☐ **Model testing**
- ☐ **Policy analysis**

Spring 2026

- ☐ Executive summary
- ☐ **Final presentation**
- ☐ **Present to SCP?**

Our Approach to Residential Electrification

Purpose of model is to understand changes to

- Load magnitude and distribution
- Utility costs for ratepayers
- Carbon intensity of energy use
- Done on a unit and community scale

Electrified end-uses:

Air Heating

Range

Water Heating

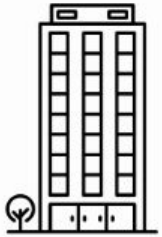
Clothes Dryer

Unit Types:

Single Family Home Detached

Single Family Home Attached

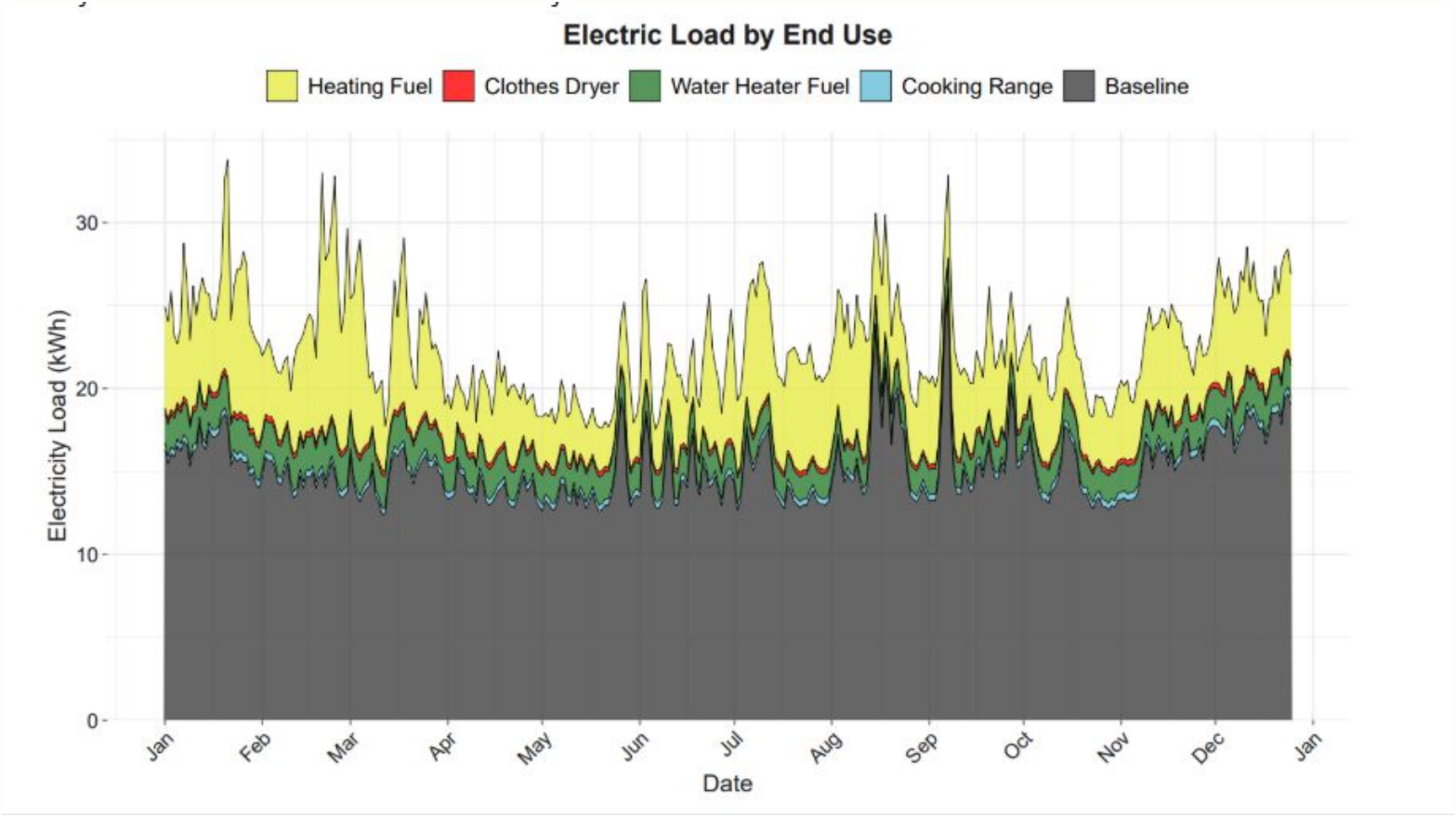
Apartment 2-4 Units



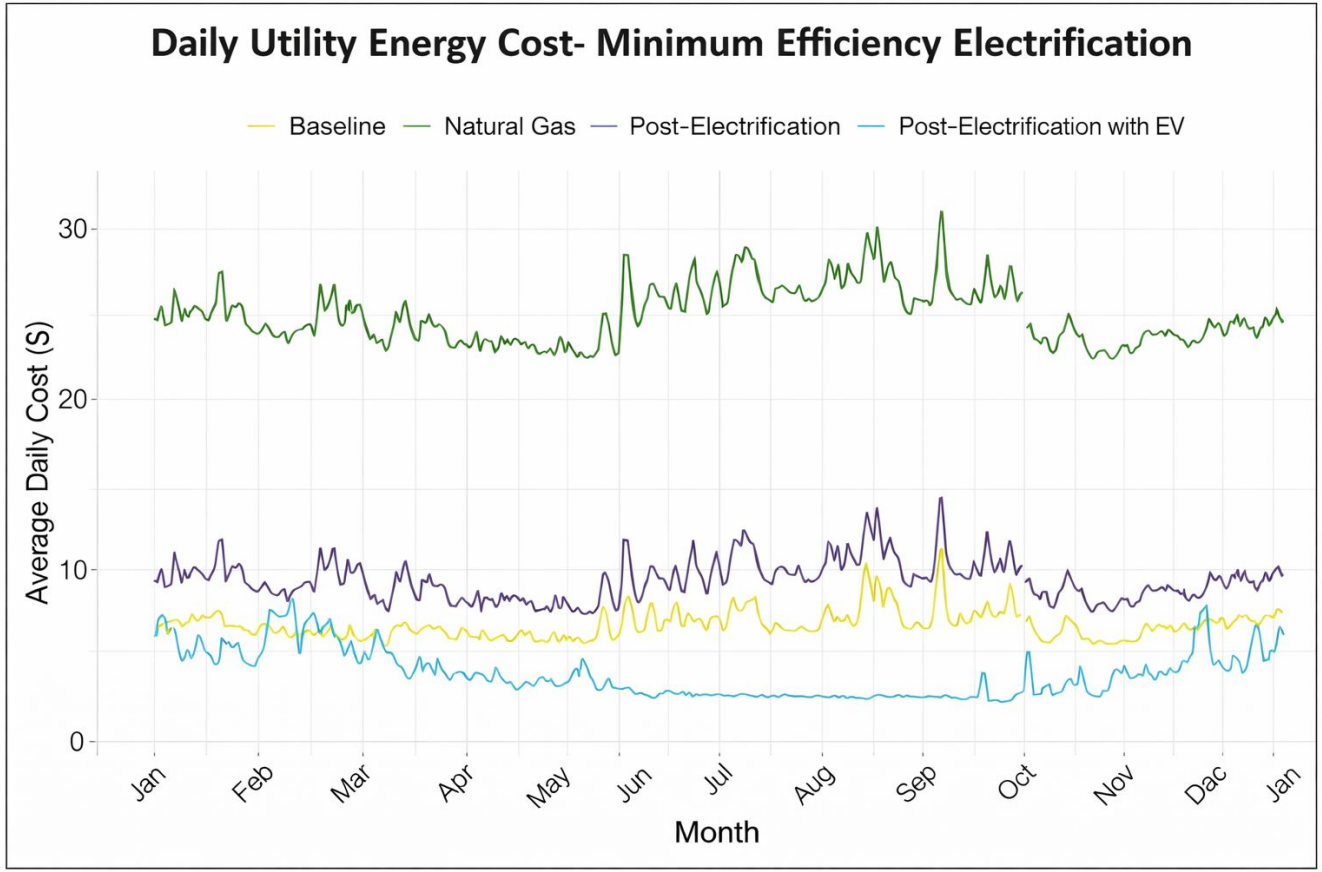
Apartment 5+ Units

Mobile Home

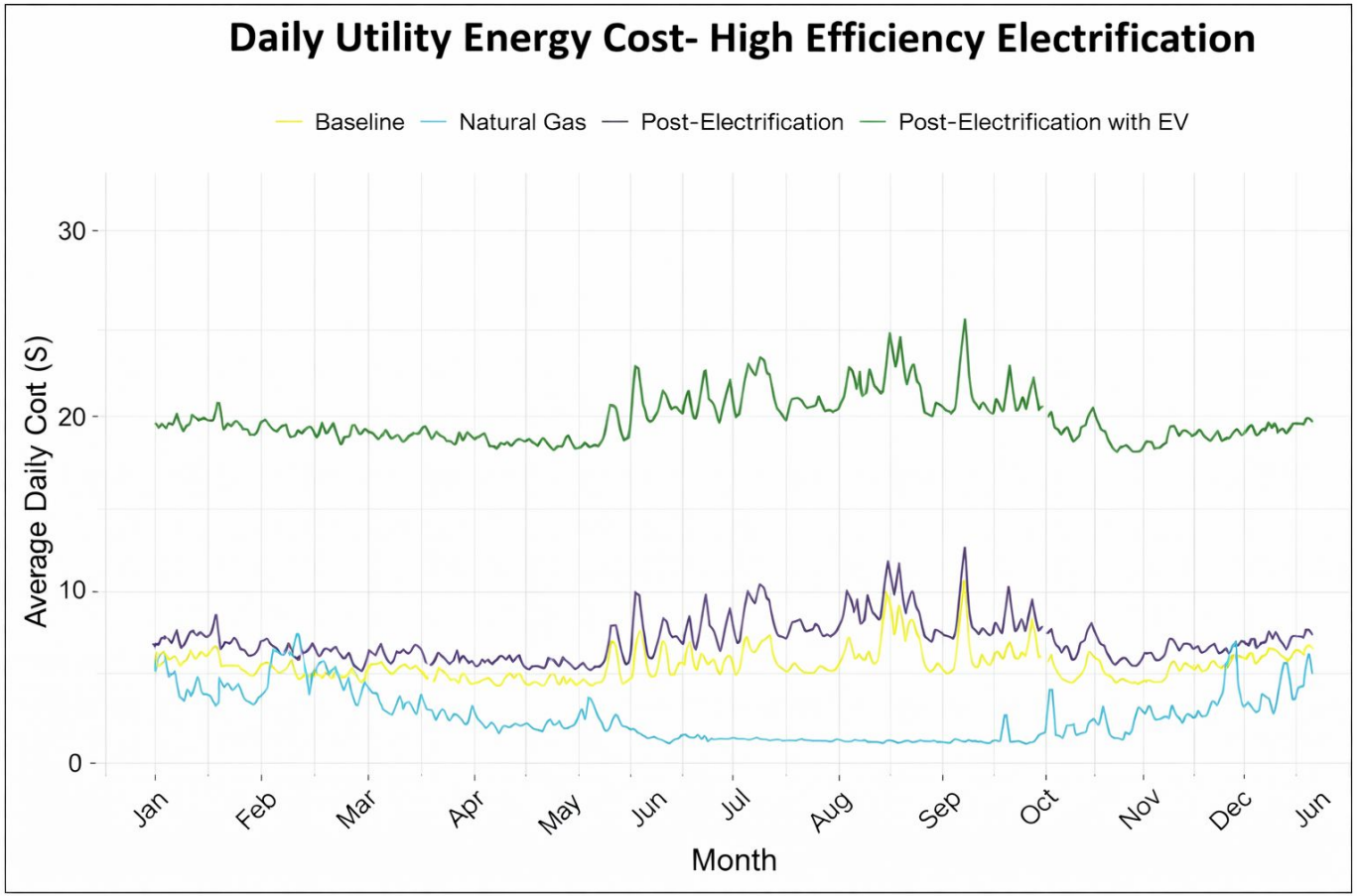
Residential Outputs by end use



Residential Utility Price Increases

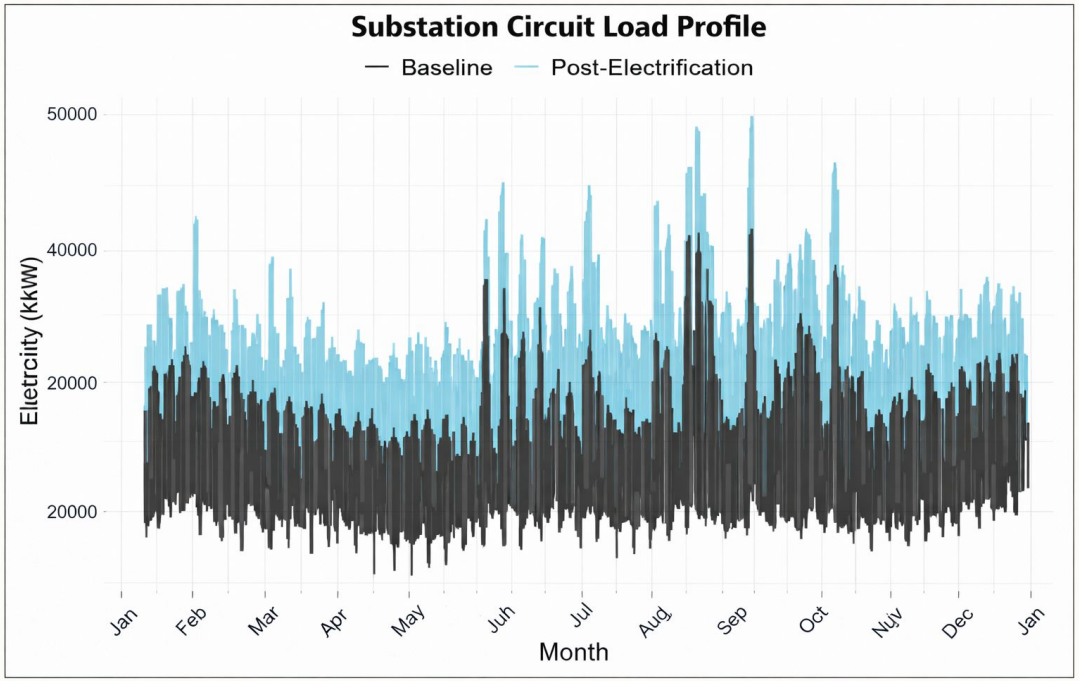


Residential Utility Price Increases



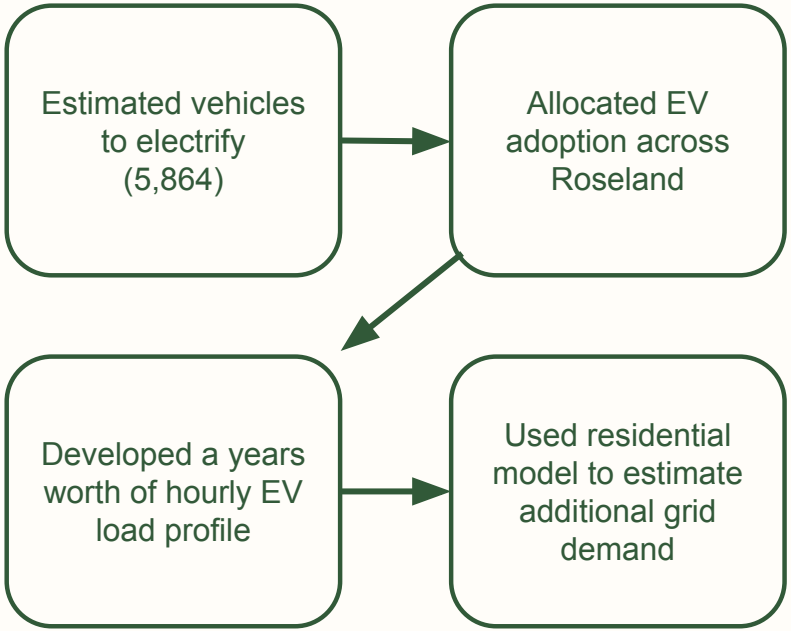
Residential Outputs for low efficiency options

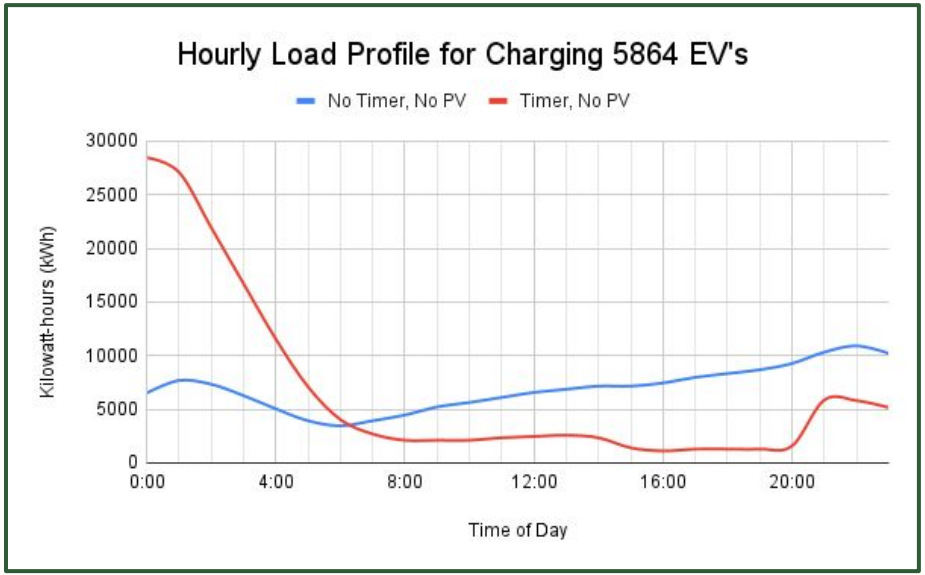
- **Net Average Unit Curve:**
  - Unique load curves generated for each efficiency scenario, unit type, and feeder group
- **Net Total Community Curve:** Hourly load, cost, and CO_2-eq before and after electrification for entire Roseland area
  - Min and high efficiency scenarios



Community-wide load increase due to electrification in Roseland

Personal Vehicle Numbers and Load additions





Commercial Methodology

1. Identify the relevant electrification scenario models and primary elec & gas uses

2. Calc. elec & gas energy intensity per ft^2 and avg. % of energy consumed by each technology within each building type

3. Divide SCP non-res hourly load data into estimated load by building type, subdivide by technologies within each building

♺ *Repeat for scenarios 0, 4 and 14*

4. Compare baseline load with modeled increased load to determine new load after electrification

5. Multiply Δ electricity load and existing gas usage to calculate environmental, financial, and social costs and benefits

Top electricity uses across building stock

Electricity Uses	Small Office [1]	Retail Stripmall [2]	Medium Office [3]	Retail Standalone [4]	Warehouse [5]	Full Service Restaurant	Secondary School	Large Hotel	Quick Service Restaurant	Small Hotel	Primary School	Outpatient	Large Office
Interior Equipment	21%	25%	28%	16%	38%	33%	21%	33%	36%	20%	14%	33%	29%
Fans	26%	24%	24%	31%		23%	16%	8%	22%	4%	21%	18%	14%
Heating	21%	19%	15%	20%	12%	11%	7%	21%	16%	20%	33%	18%	16%
Cooling	13%	14%	11%	17%		14%	20%	20%	12%	16%	11%	10%	18%
Interior Lighting	10%	9%	13%	11%	21%	4%	10%	6%	3%	20%	8%	13%	11%
Exterior Lighting	6%	4%	4%	4%	27%	2%	3%	4%	3%	17%	2%	4%	3%
Water Systems	3%	5%	3%	0%	2%	10%	21%	3%	3%	4%	9%	4%	3%
Refrigeration						3%	2%	4%	4%		2%		
Pumps			1%					1%			0%	0%	5%
Heat Rejection			0%					0%					1%

Electrical Energy Intensity per kWh/ft^2

Building Type	% of Total Electricity Use	Electricity Energy Intensity (kWh / sqft)	Average building size (sqft)
Secondary School	14%	23	78,823
Primary School	13%	21	86,252
Retail Stripmall	13%	23	55,588
Retail Standalone	12%	20	61,663
Small Office	11%	14	63,267
Full Service Restaurant	9%	92	16,435
Medium Office	9%	13	55,015
Warehouse	6%	3	174,005
Large Hotel	5%	13	69,691
Outpatient	4%	14	49,365
Quick Service Restaurant	3%	107	6,231
Small Hotel	2%	7	45,222
Large Office	0%	15	19,723

Our selected upgrade scenarios to replace gas appliances from NREL's comstock

ComStock Upgrade Scenario	Relevant Electric technologies	Notes	Replacing relevant Gas technology
4	Standard Performance Heat Pump RTU, Electric Backup	Direct rooftop unit replacement Maintains existing ductwork and distribution Electric resistance backup for extreme conditions	RTU Furnace Direct Expansion, Zone terminal equipment Furnace_DX
14	Heat Pump Boiler, Electric Backup	Direct boiler replacement Maintains existing hydronic piping and terminal units Electric resistance backup for extreme conditions	RTU Boiler Direct Expansion, RTU Boiler Air-Cooled Condenser, RTU Boiler water-cooled chiller
41	Electric kitchen Equipment	This measure replaces gas commercial cooking equipment with electric equipment where applicable. The specific equipment types modeled include broilers, fryers, griddles, ovens, ranges, and steamers	Natural gas broiler, Fryers, Gas countertop griddle, Natural gas convection oven, Natural Gas Range

Why Non-Energy Impacts Matter

Created by M. Oki Orlando
from Noun Project

- Some NEIs (bill stability, appliance education) require **supportive program design** for full benefit realization.
- NEIs are a **critical factor** in designing community-scale electrification strategies—especially in disadvantaged neighborhoods like Roseland.

Created by bsd studio
from Noun Project

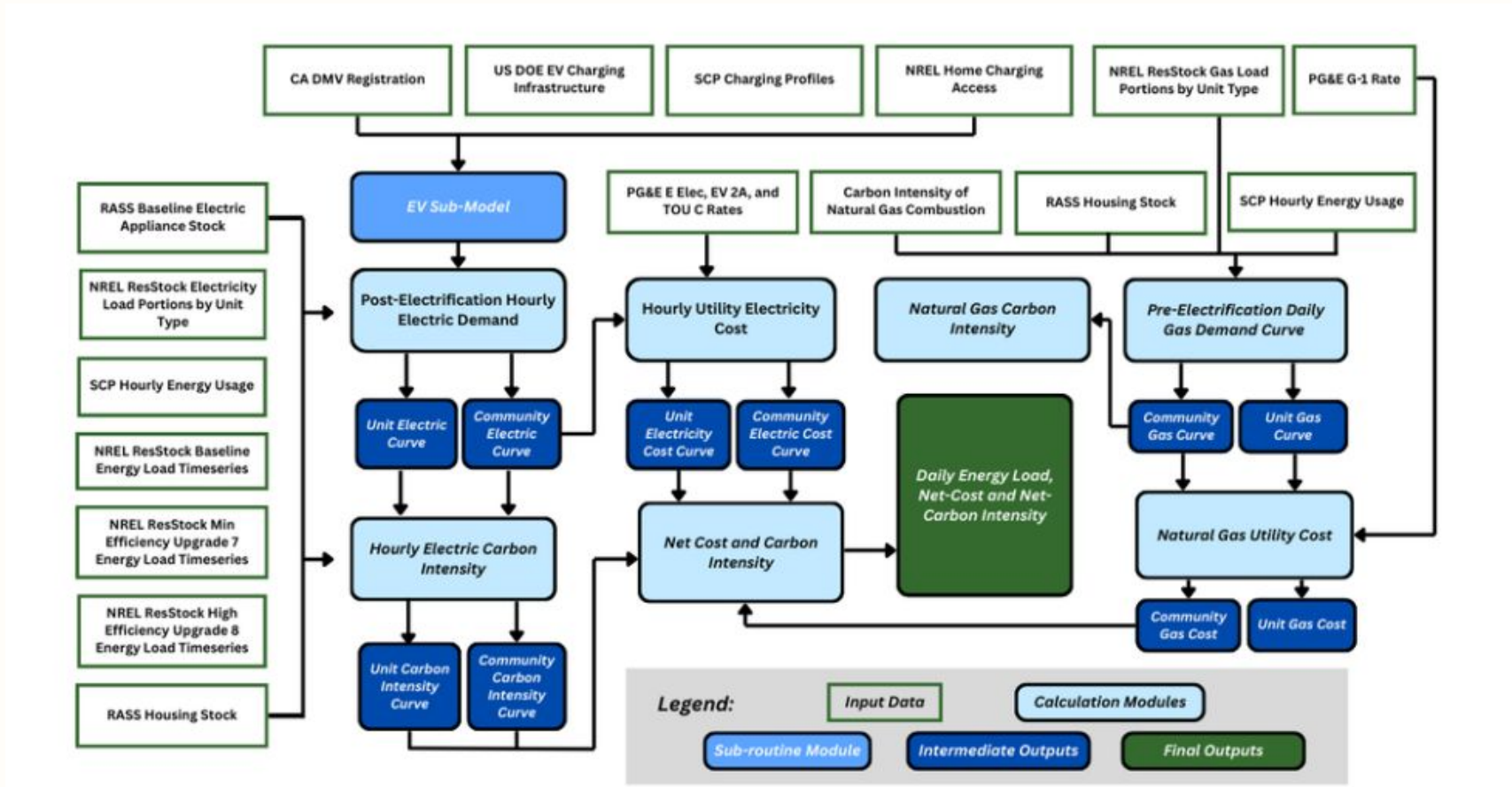
- Many NEIs show **strong, well-supported benefits** and are essential to equitable electrification.
- NEIs have **compounding effects**—thermal comfort, IAQ, and safety reinforce each other.

Sonoma Clean Power

Thank you!

Appendix

Residential Model



Characterizing Post-Electrification Carbon Intensity