DOCKETED

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Project Title:	2025 Energy Code Pre-Rulemaking
TN #:	244139
Document Title:	Presentation - 2025 Energy Accounting Workshop Presentations and Retail Rate Adder Analysis
Description:	This document contains the presentations from the 2025 Energy Accounting Workshop held on July 18, 2022, as well as the retail rate adder analysis prepared by E3.
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Organization:	California Energy Commission
Submitter Role:	Commission Staff
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California Energy Commission

Energy Accounting for the 2025 Energy Code

July 18, 2022

Energy Accounting for the 2025 Energy Code

Good morning. We will begin shortly.

Welcome and Workshop Logistics

Erik Jensen, California Energy Commission

Workshop Participation

- Workshop is being recorded and transcribed.
- Public comment period after each section and at workshop end.
- Comments limited to three minutes per person or organization.
- Start with name and affiliation.
- Last date to submit written comments is August 1, 2022.

Workshop Agenda

1) Opening remarks by Commissioner Andrew McAllister.
2) Workshop scope and energy accounting overview.
3) Building energy prototypes and period of analysis.
4) Weather files.
5) Lunch break.
6) Explanation of life cycle costing (TDV) and source energy.
7) Recommendations for 2025.
8) Public comments.

Opening Remarks

Commissioner Andrew McAllister, California Energy Commission

Energy Accounting Overview

Erik Jensen, California Energy Commission

Energy Accounting Purpose and Background

- Warren Alquist Act

PRC 25402(b)3: The standards… shall **be cost-effective when taken in their entirety** and when amortized **over the economic life of the structure** compared with historic practice. When determining cost-effectiveness, the commission shall consider the **value of the water or energy saved**, impact on product efficacy for the consumer, and the **life-cycle cost of complying with the standard.**

- Receive input on approach and best available data to determining cost effectiveness.

- Additional pre-rulemaking workshop to finalize hourly factors.

2025 Energy Code Timeline

- August 2022 – April 2023: Utility-sponsored workshops.
- Q4 2022: CEC workshop to finalize hourly factors.
- April – August 2023: CASE reports to CEC.
- June – October 2023: CEC pre-rulemaking.
- October 2023 – January 2024: File and open rulemaking.
- January – June 2024: CEC rulemaking.
- June 2024: 2025 Energy Code adopted.
- January 1, 2026: 2025 Energy Code goes into effect.

Outside Scope of Workshop

- Construction inventory data sources.
- Compliance software.
- Energy Code proposals.
- Utility rates.

Building Prototype Updates

Prototypes are representative model buildings used for simulating predicted energy savings and determining measure cost effectiveness.

- Updating prototypes to reflect construction trends.
- Creating new prototype building types that previously were not analyzed.

Period of Analysis

- 2022 and previous code cycles:
  - 30 years for residential measures and nonresidential envelope.
  - 15 years for all other nonresidential measures.
- 2025: Recommending 30 years for all measures.

Weather Files

Three main updates from 2022:

- Changed period of weather data from 1998 – 2017 to 2000 – 2020.
- Revised dataset to incorporate data processing differences.
- Changed data source for Climate Zones 4 and 6 to different weather stations.

Life Cycle Costing (TDV) and Source Energy

- Forecast infrastructure demand and fuel mix of electricity grid over next 30 years.
- Account for costs to meet statewide GHG emission reduction requirements.
- Produce the following for each hour of the year (8760):
    - Hourly Life Cycle Cost (TDV) multiplier.
    - Hourly Source Energy multiplier.

Making Comments

- Comments limited to three minutes per person or organization.

- Start with name and affiliation.

- On computer: Use the “raise hand” feature so we can announce your name and call on you. You will need to unmute yourself.

- On phone: Press *9 to “raise your hand” and *6 to mute and unmute.

Public Comments on Energy Accounting Overview and Workshop Scope

Erik Jensen, California Energy Commission

Session 1: Building Energy Prototypes and Period of Analysis

Rahul Athalye, NORESCO
Eric Shadd, NORESCO

2025 Prototypes Update

Objectives

1. Present prototypes to be used for 2025 code cycle
2. Improve area weighting for individual prototypes
3. Answer questions from the public

Building Prototype Models

- Intended to represent building stock, hence called "prototypes"
- Enable modeling of proposed measures and estimation of energy and other impacts
- Enable capturing of interactive effects between measures
- Helps estimate the statewide impacts of a measure

Building Category	Prototype
Healthcare	Hospital
Lodging	Small Hotel
	Large Office
Office	Medium Office
	Small Office
Laboratory	Lab -- Medium Office
Restaurant	Fast-food Restaurant
	Large Retail
Retail	Mixed-use Retail
	Standalone Retail
	Strip Mall Retail
School	Primary School
	Secondary School
Non-refrigerated Warehouse	Warehouse
Assembly	Assembly
High-rise Residential	High-rise Residential
	Mid-rise Residential
Low-rise Residential	Loaded Corridor
	Garden-style

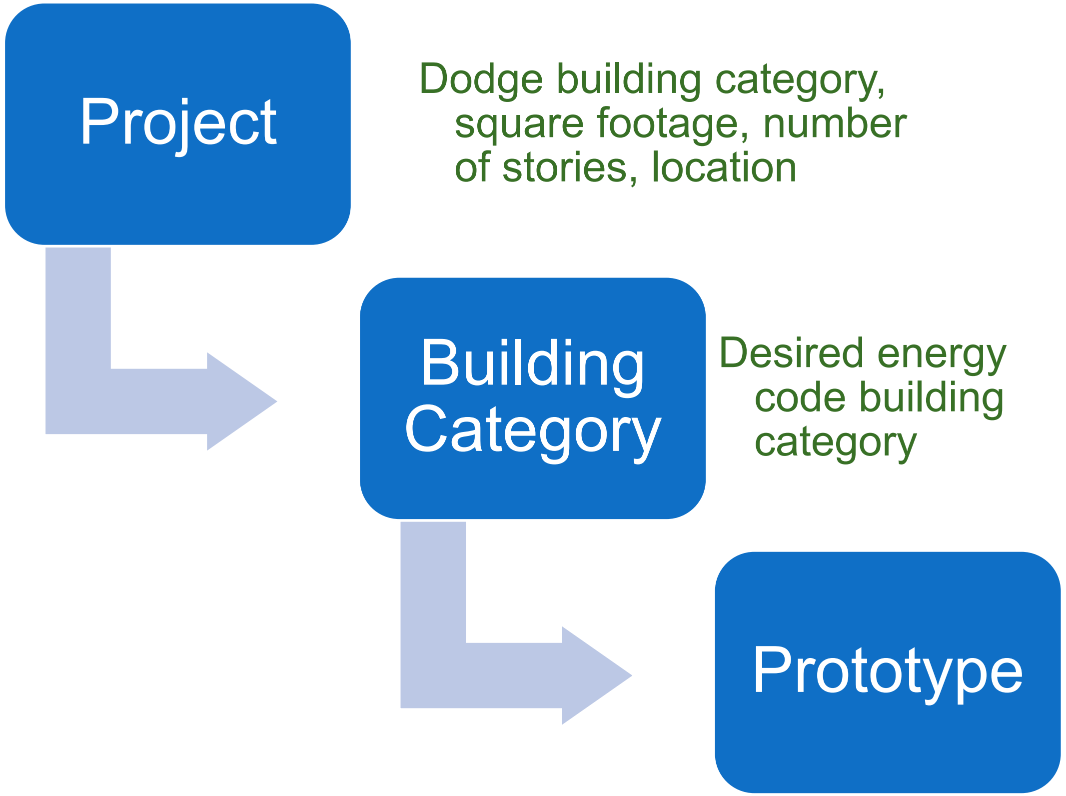
Current Building Forecast

- CEC Demand Analysis Office the construction forecast
- Based on an econometric model that uses jobs and other economic parameters
- Uses Dodge data as the basis!

Forecast Building Category	2023 Forecast, million sf	2023 Forecast, %
Small Office	8.38	5.1%
Large Office	29.47	18.1%
Restaurant	4.41	2.7%
Retail	25.76	15.8%
Grocery Store	6.79	4.2%
Non-Refrig. Warehouse	24.24	14.9%
Refrig. Warehouse	1.32	0.8%
Schools	10.01	6.1%
Colleges	5.26	3.2%
Hospitals	7.54	4.6%
Hotel/Motels	8.66	5.3%
Miscellaneous	30.95	19.0%

New Approach to Mapping

- Use same underlying data as that used by the CEC DAO
- Map individual data entries to desired building categories
- Develop direct mapping from project starts data to prototype



Dodge Mapping

- 189 Dodge Structure Codes (STC)
- Mapped to 13 Building Categories
  - STC Name
  - DOE analysis guidance
  - Not prototype specification
- Portion of buildings accounted
  - 97 – 100% from 2011 – 2020

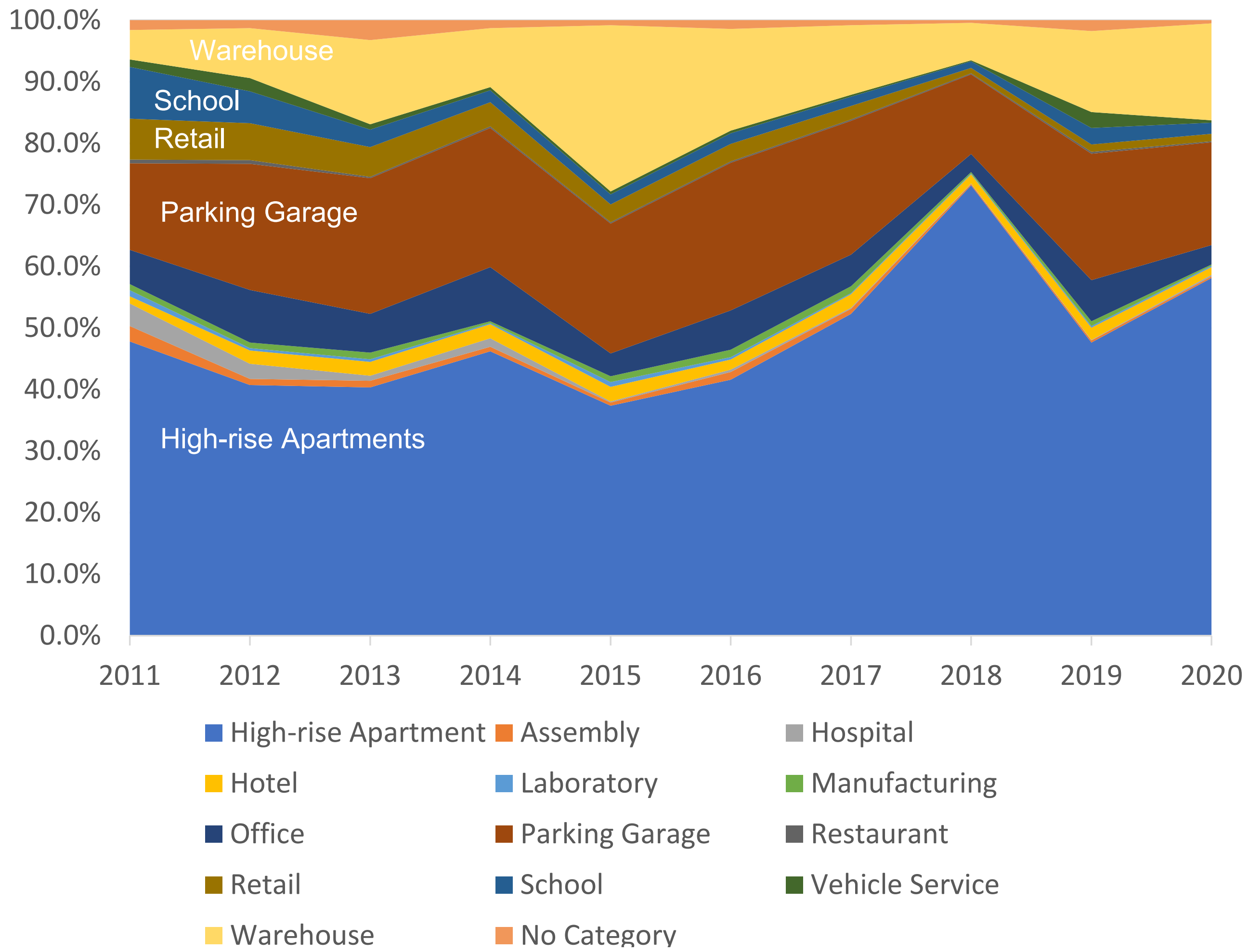
Building Categories
High-rise Apartment
Assembly
Hospital
Hotel
Laboratory
Manufacturing
Office
Parking Garage
Restaurant
Retail
School
Vehicle Service
Warehouse

Dodge Mapping

Building Categories	STC Name
High-rise Apartment	Apartments 5+ Units, 4+ Stories
Assembly	Auditoriums, Clubs and Lodges, Exhibition Halls, Museums, Arenas/Coliseums, Airline Terminals, Bus, Truck and Railroad Terminals, Libraries
Hospital	Hospitals
Hotel	Hotels/Motels 4+ Stories, Hotels/Motels 1-3 Stories, Hotels/Motels (Stories Unknown or Alts)
Laboratory	Laboratories/Testing/R&D
Manufacturing	88 STCs of Manufacturing: Plants, Manufacturing: Labs and Manufacturing: War
Office	Offices, Capitols/Court Houses/City Halls, Police/Fire Stations, Banks/Financial, Post Offices
Parking Garage	Parking Garages
Restaurant	Food/Beverage Service
Retail	Stores, Shopping Centers
School	Primary Schools, Junior High Schools, Senior High Schools, Colleges/Universities Except Community, Community Colleges, Special Schools, Vocational Schools
Vehicle Service	Auto Service, Bus and Truck Service, Railroad/Boat/Other Vehicle Service, Aircraft Service
Warehouse	Warehouses (Non-Refrigerated)

New Construction Composition

Building Categories	2016 - 2020	2013-2020	2011 - 2020
High-rise Apartment	58.1%	55.1%	53.5%
Assembly	0.5%	0.5%	0.6%
Hospital	0.2%	0.3%	0.5%
Hotel	1.7%	1.8%	1.8%
Laboratory	0.2%	0.3%	0.3%
Manufacturing	0.6%	0.6%	0.7%
Office	4.5%	4.8%	5.0%
Parking Garage	18.1%	18.8%	18.9%
Restaurant	0.2%	0.2%	0.2%
Retail	1.6%	1.9%	2.3%
School	1.6%	1.6%	2.0%
Vehicle Service	0.6%	0.6%	0.7%
Warehouse	11.3%	12.7%	12.3%



Statewide Impacts

- 2013 - 2020
- Better to evaluate on impact than on square footage
- Parking garages captured in HR Apartments, but 19% in stock and only 10% in prototypes

Statewide (SW) Square Footage		Statewide LCC impact			
Building Category	% SW sf	Building Category	% SW sf	2022 TDV EUI	% SW 2022 TDV
High-rise Apartment	54%	High-rise Apartment	54%	195.00	63%
Parking Garage	19%	Office	5%	278.40	8%
Warehouse	12%	Warehouse	12%	86.50	6%
Office	5%	Retail	2%	297.50	4%
Hotel	2%	Vehicle Service	1%	898.10	4%
School	2%	Parking Garage	19%	26.50	3%
Retail	2%	Hotel	2%	228.80	3%
No Category	1%	School	2%	210.20	3%
Manufacturing	1%	Restaurant	0%	1185.20	2%
Vehicle Service	1%	Assembly	1%	439.70	2%
Assembly	1%	Laboratory	0%	656.70	1%
Restaurant	0%	Manufacturing	1%	237.60	1%
Laboratory	0%	Hospital	0%	313.40	1%

Proposals for Prototypes

- Considerations
  - Statewide impact – from floor area and impact
  - Savings potential – high savings measure applied to lower impact
- New or modified prototypes
  - Previously unrepresented space types → potential new measures
  - Unique combo of building features → more accuracy on impacts of broad measures (e.g. LPD)
  - Prototype characteristics TBD from further investigation

Proposal for New Prototypes

- Vehicle Service
  - High statewide impact from high exhaust fan requirement
  - The savings potential is unclear
- Manufacturing – not at this time
  - Low statewide impact
  - Unregulated and unknown process loads dominate so savings potential is unclear

Proposal for New Prototypes

- Hospital
  - Verify/improve model created for 2022
  - Low statewide impact
  - Foreseeable efficiency measures
- Assembly
  - Verify/improve model created for 2022
  - Low statewide impact
  - Foreseeable efficiency measures
- Controlled Environment Horticulture (CEH) and Grocery need further investigation

Proposal for Current Prototypes

- Warehouse – add cooling to fine storage space
- Offices
  - Add conference rooms and private offices to better capture
    - Space-type-specific measures
    - Government and financial gathering spaces
  - Add above-ground parking garages
    - Improves proportion in stock
    - Could be significant lighting and daylighting savings
- Schools
  - Large School - Add laboratory
  - College – From campus to just Large School
  - Rename MediumOfficeLab to Laboratory

Proposed 2025 Prototypes

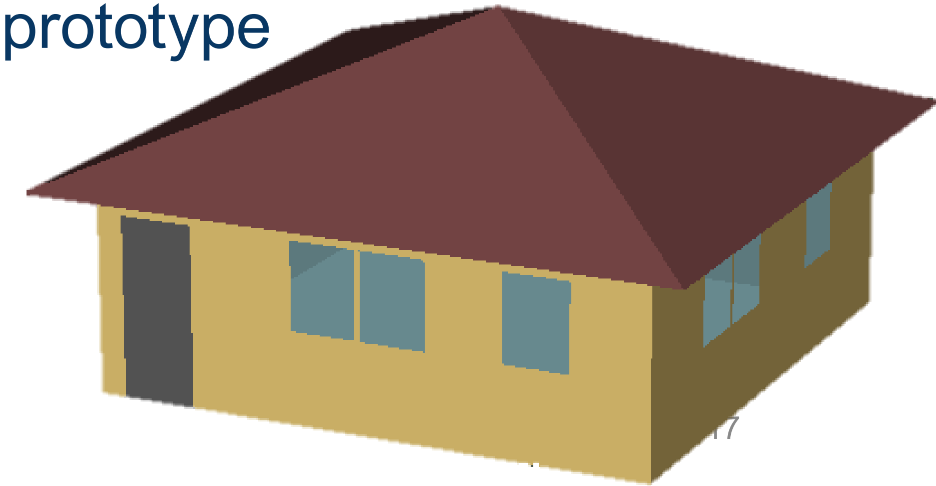
Building Category	2022 Prototypes	Proposed 2025 Prototypes
High-Rise Apartment	5-story Apartment	5-story Apartment
	10-story Apartment	10-story Apartment
Assembly	Assembly (CASE Team)	Assembly
Hospital	Hospital (CASE Team)	Hospital
Hotel	Small Hotel	Small Hotel
Laboratory	Medium Office Laboratory	Laboratory (renamed)
Office	Small Office	Small Office
	Medium Office	Medium Office
	Large Office	Large Office
Manufacturing		
Parking Garage	in Apartments	in Apartments and Large Office
Restaurant	Small Restaurant	Small Restaurant
Retail	Medium Retail	Medium Retail
	Large Retail	Large Retail
	Stripmall	Stripmall
	Mixed-use	Mixed-use
School	Small School	Small School
	Large School	Large School
Vehicle Service		Vehicle Service
Warehouse	Warehouse	Warehouse (cooling in Fine Storage)

Next Steps

- Collect and incorporate feedback
- Refine characteristics of prototypes
    - Investigation and measure analysis needs
- Develop 2025 construction weights
    - Square footage, number of stories, sub-types (e.g., Stripmall)
    - New construction
    - Existing construction (for alterations)

New Single Family Prototype

- New 500ft^2 small home prototype
  - Addresses growing trend of small homes, including accessory dwelling units
  - Useful in evaluating cost-effectiveness for this subset of homes
- 2022 code provides exceptions for homes 500 ft^2 or less
  - Whole house fan not required
  - Allowance for electric point-of-use water heater
  - No PV requirement in most climate zones
- Ongoing research to better characterize this prototype
  - Looking for feedback on the proposal
  - What challenges have you experienced?



Period of Analysis

Period of (Life Cycle Cost) Analysis

For a proposed measure, the *period of analysis* is the number of years over which cost and benefit cash flows are computed and discounted to the present value (PV).

LCC (NPV) = net present value of measure life cycle cost

n = period of analysis

d = discount rate

$$LCC\ (NPV) = \sum_{0}^{n} \frac{(Benefits\ - Costs)}{(1+d)^n}$$

2022 Code Cycle (Current Approach)

- Single Family Residential and Multifamily buildings
  - 30-year period for all measures
- Nonresidential buildings
  - 30-year period for envelope measures
  - 15-year period for all other measures

Table 16. TDV Conversion Factors, NPV $/kBtu

	NPV (30-year)	NPV (15-year)
Low-Rise Residential	$0.1732	n.a.
Nonresidential & High-rise Residential	$0.1540	$0.0890

Source: 2022 TDV Methodology Report

Limitations of the Current Approach

- 15-year period does not fully incorporate California's long-term outlook
  - Energy prices
  - Mandates and goals
  - Projected efficient electrification of the building sector
  - Projected electrification of the transportation sector
- Longer horizon provides more immunity from short-term trends and fluctuations
- Mixed-use buildings can be problematic to evaluate
- Different measures are evaluated over different study periods

Proposed Approach for 2025

Use 30-year period of analysis to calculate cost-effectiveness of any proposed measure

- LCC analysis steps
    1. Calculate benefits:
        - Use 30-year LCC factors
    2. Calculate incremental measure costs:
        - Incremental first cost
        - Incremental maintenance cost
        - Incremental replacement cost
        - Incremental residual value
    3. Calculate benefit to cost ratio (B/C ratio)

Example Cash Flow Calculation

- Period of analysis = 30 years
- Measure life = 20 years
- Replacement cost may be be less than first cost
- Estimate residual value (straight line depreciation used in the example)
- When B/C > 1, measure is cost-effective

Year	Incr. First Cost	Incr. Replacement	Incr. Maintenance	Incr. Residual	Total Incr. Costs	Present Value Total Costs
0	$1,000				$1,000	$1,000.00
1			$50		$50	$48.54
2			$50		$50	$47.13
3			$50		$50	$45.76
4			$50		$50	$44.42
5			$50		$50	$43.13
19			$50		$50	$28.51
20		$1,000	$50		$1,050	$581.36
21			$50		$50	$26.88
29			$50		$50	$21.22
30			$50	($500)	($450)	($185.39)
					Total Present Value Costs	**$ 2,327.70**

Public Comments on Session 1: Building Energy Prototypes and Period of Analysis

Rahul Athalye, NORESCO
Eric Shadd, NORESCO

Session 2: Weather Files

Danny Tam, California Energy Commission

Weather Files for the 2025 Energy Code

Background

- Weather files are used for all energy calculations in Energy Code development

- Major update to weather files for the 2022 Standards
  - New Typical Meteorological Year (TMY) using 20 years historical data (1998-2017)

2025 Weather File Update

- Evaluate impact of 3 additional years of data (2018-2020)
- Clean up existing dataset
- Scope feasibility of incorporating future/projected weather data
    - Setting stage for 2028 Energy Code
    - Possible alignment with CA priority climate model

Changes to Weather Dataset

- New weather location for 2 zones due to data availability
  - **Climate Zone 4** changed to **Paso Robles** from Reid-Hillview Airport San Jose
  - **Climate Zone 6** changed to **LAX** from Torrance
  - Old weather stations no longer maintained by National Weather Service
  - New locations still representative and will continue to be maintained in the future

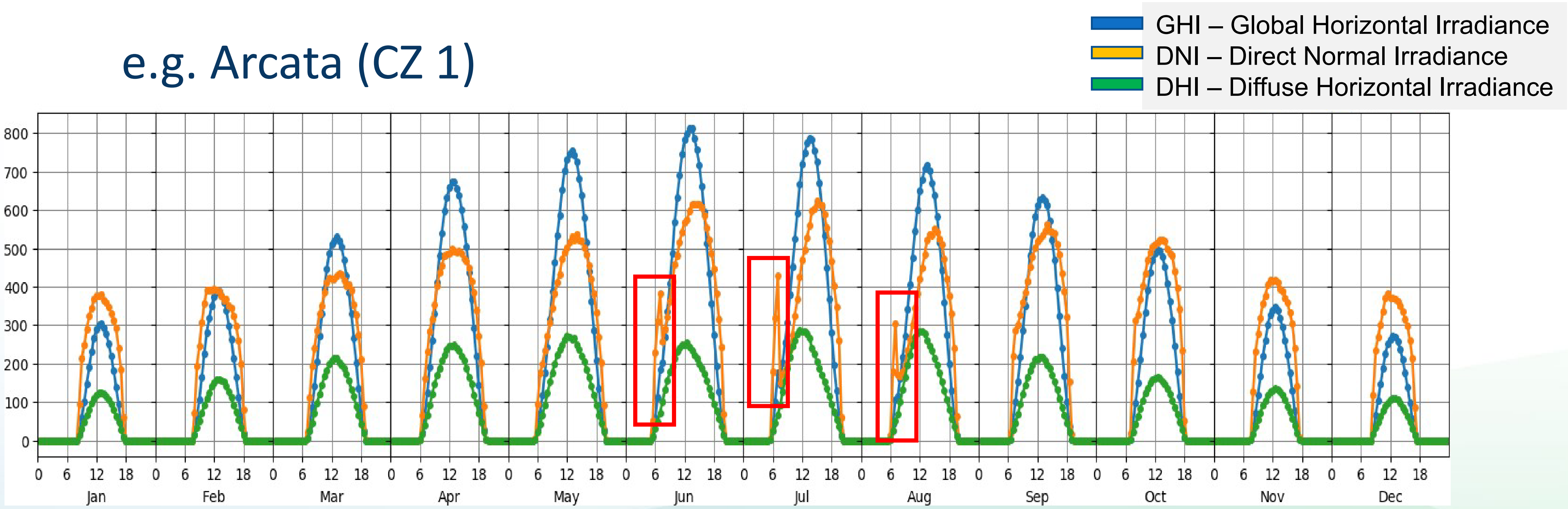
Changes to Weather Dataset

- Revised dataset to address data processing differences
  - Early-morning coastal solar
  - Additional cloud information
  - Updated data extrapolation method for missing information
  - Hourly data extraction differences

Early-Morning Coastal Solar

Problem: Anomalous clear-sky solar imposed by NREL during early morning hours

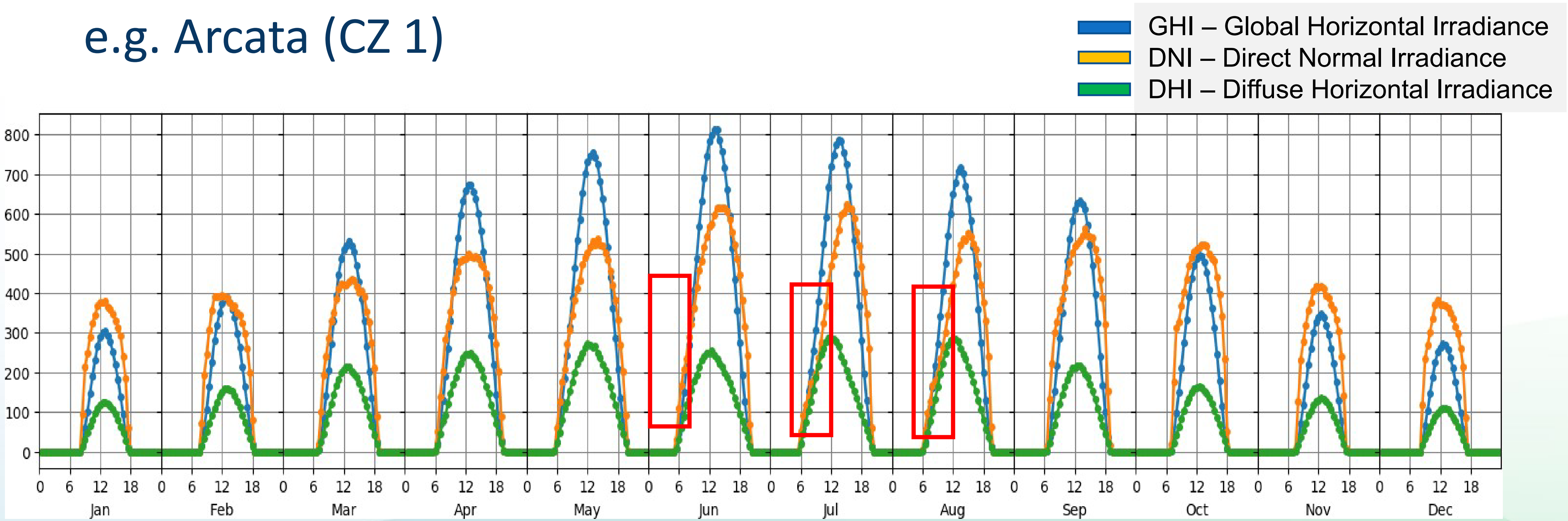
e.g. Arcata (CZ 1)



Early-Morning Coastal Solar

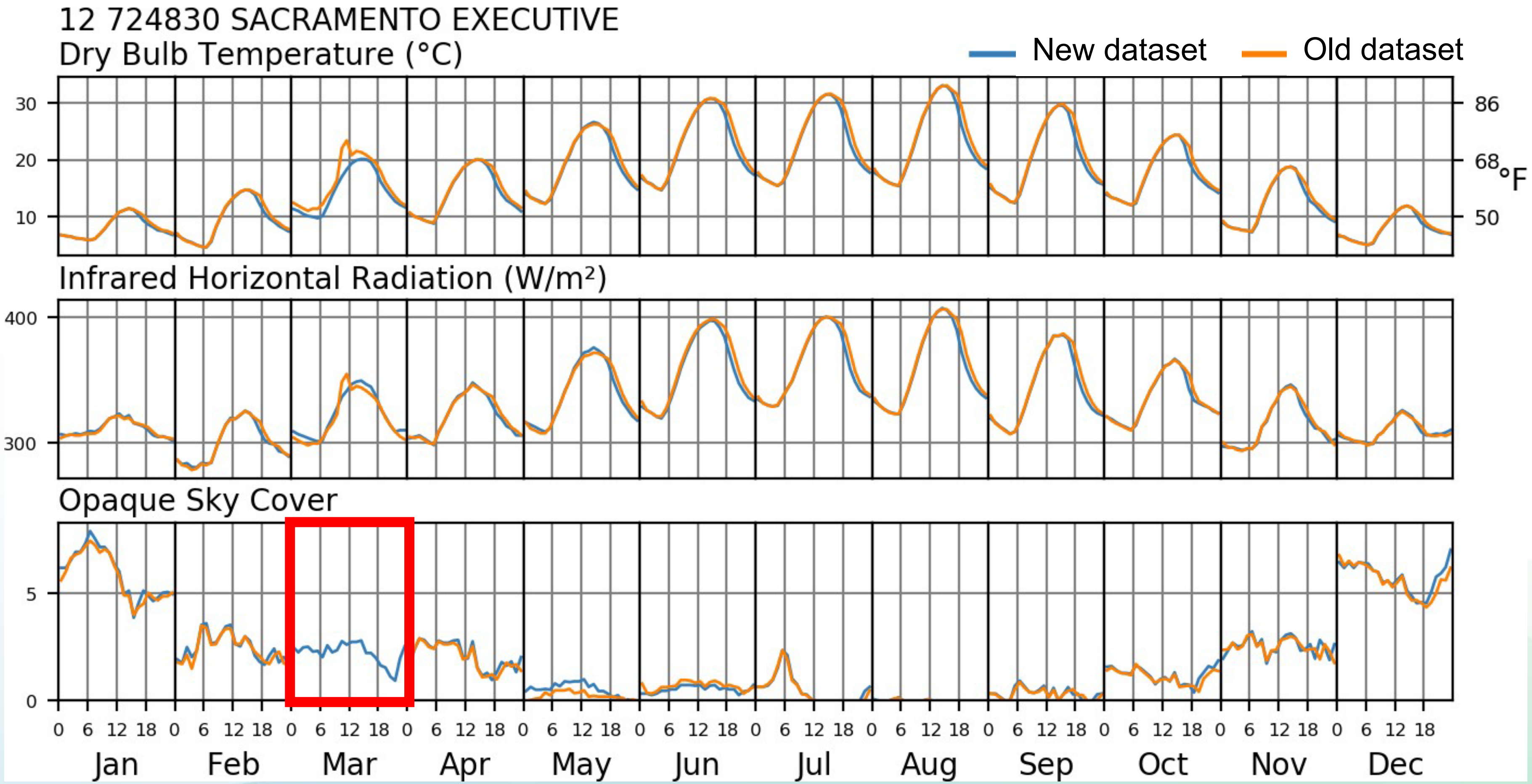
Fix: If late morning is cloudy and early morning is clear, back-propagate cloudy conditions to early morning

e.g. Arcata (CZ 1)



Additional Cloud Information

Cloud information can be difficult to extract, e.g. March, which impacts long-wave radiation

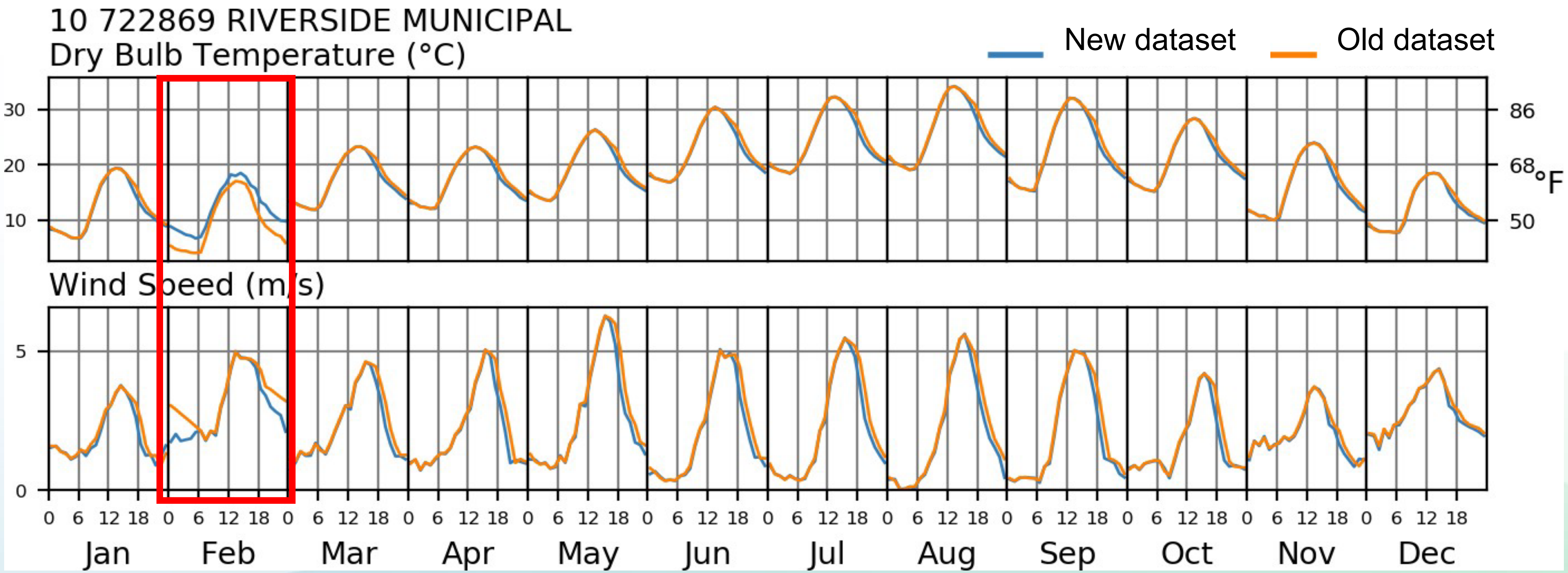


Bias-Corrected Reanalysis Data for Infilling

Problem: Some year/months have little to nil meteorological information.

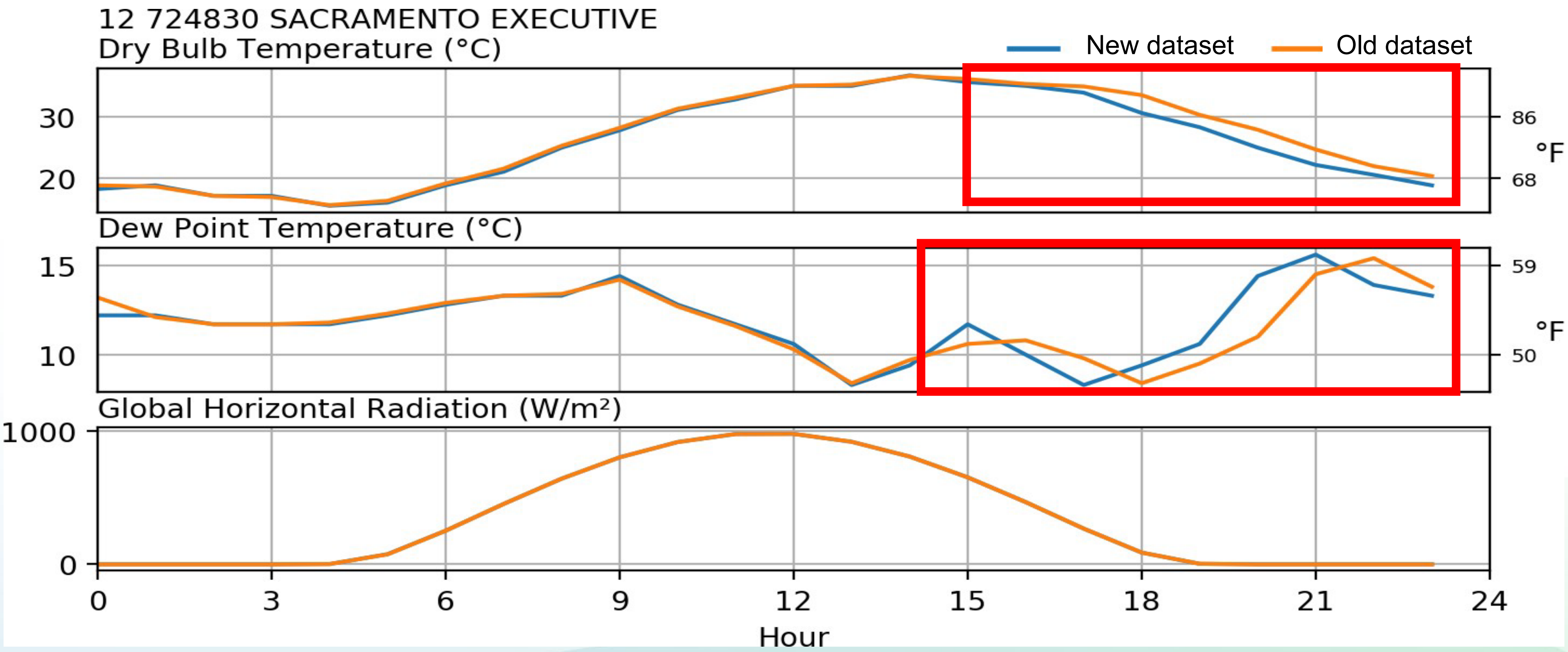
Old fix: Missing information derived from nearby stations

New fix: Extract equivalent reanalysis data and bias-correct it to the station's observations

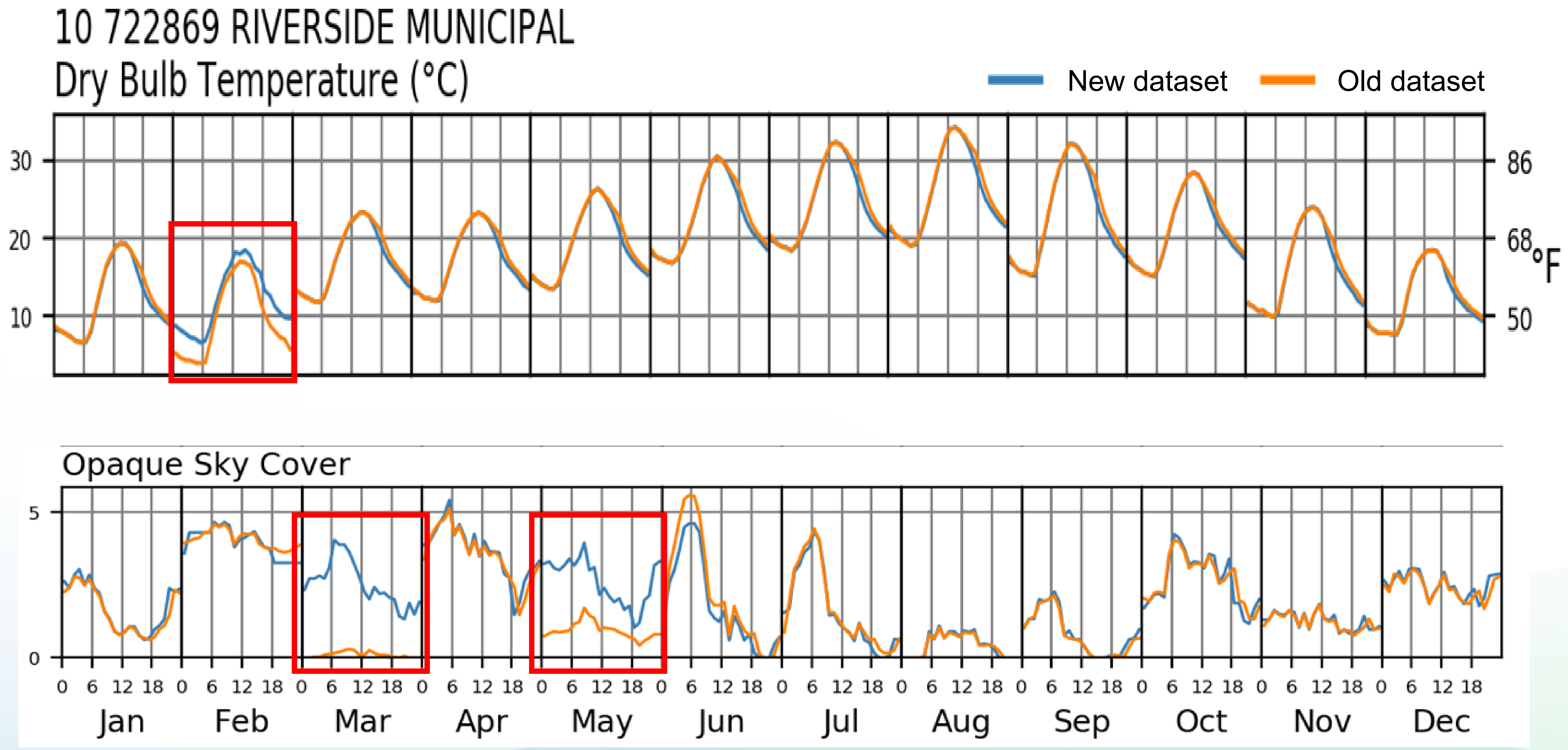


Hourly Data Extraction Differences

Mismatch between old version hourly data and latest data extract

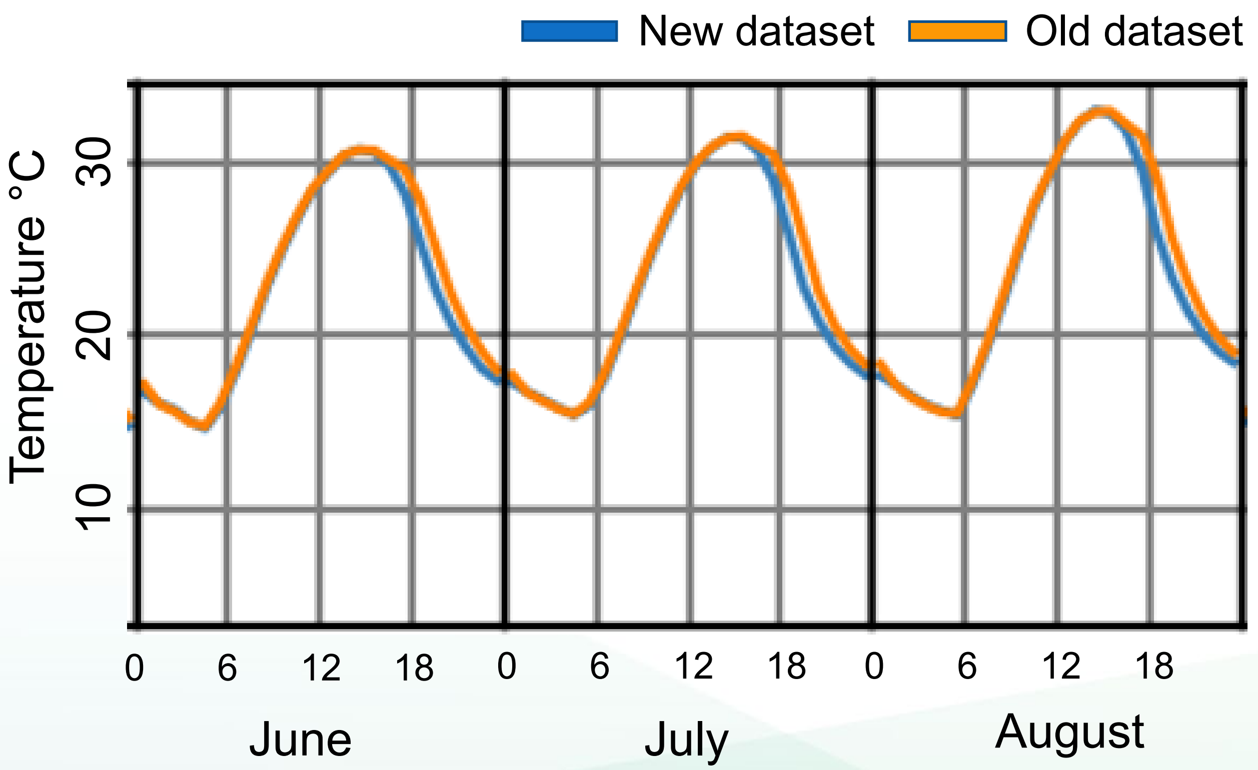


Example of Hourly Data Difference



Climate Zone 12 Average Hourly June, July, August

- In the new dataset, temperature in late afternoon cools off slightly faster
- This impact energy use throughout the night to the next morning



Comparison of Statewide TMY Months

Month	Current TMY (1998-2017)	Proposed TMY (2000-2020)
1	2004	2011
2	2008	2008
3	2014	2000
4	2011	2018
5	2017	2017
6	2013	2016
7	2011	2007
8	2008	2005
9	2006	2016
10	2012	2012
11	2005	2005
12	2004	2004

Red represents different year selected for the month

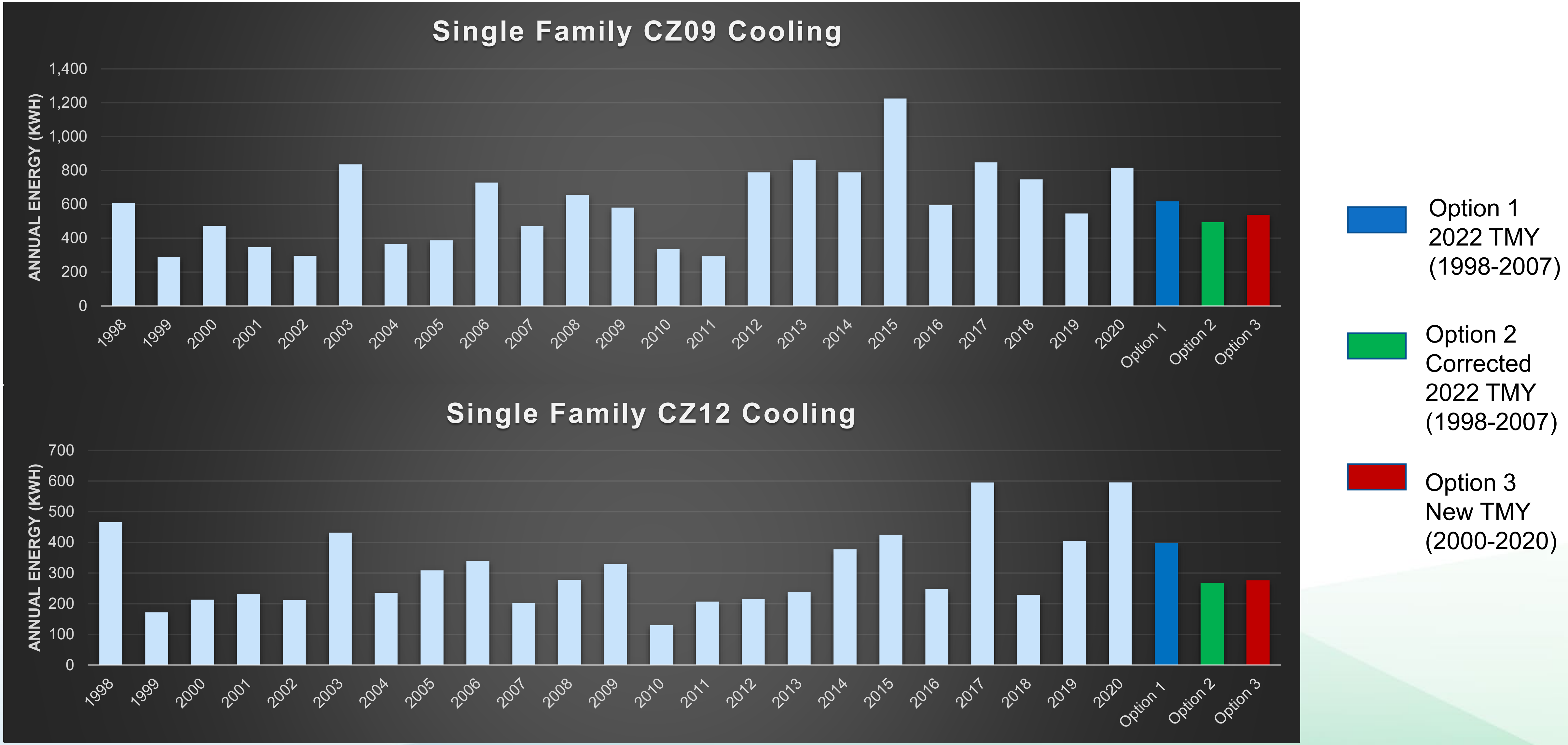
Options for 2025 Energy Code

1) Keep 2022 Energy Code dataset (1998-2017)

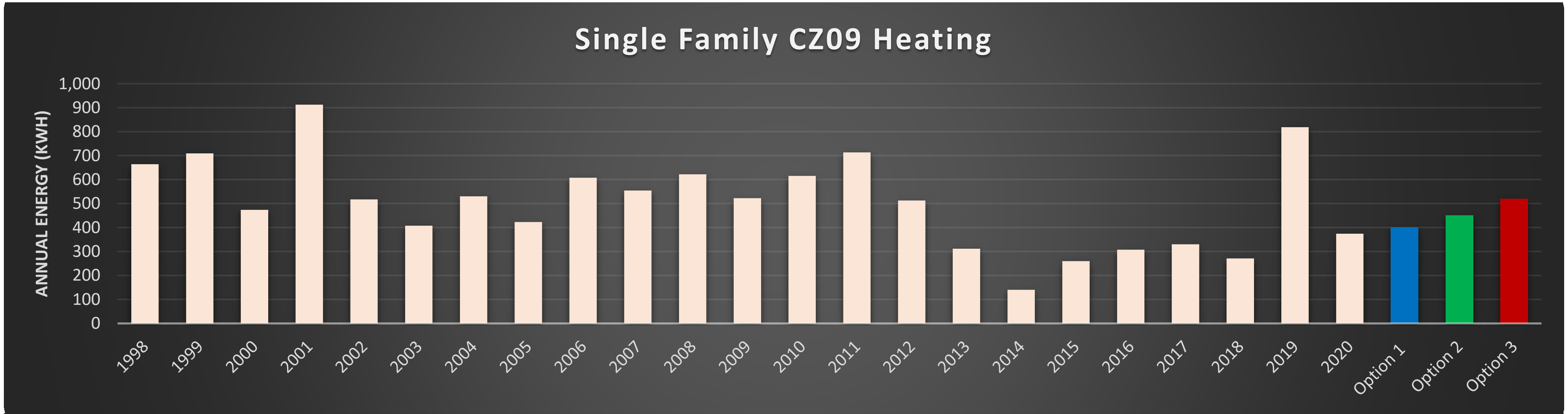
2) Use revised dataset without changing TMY months (1998-2017)

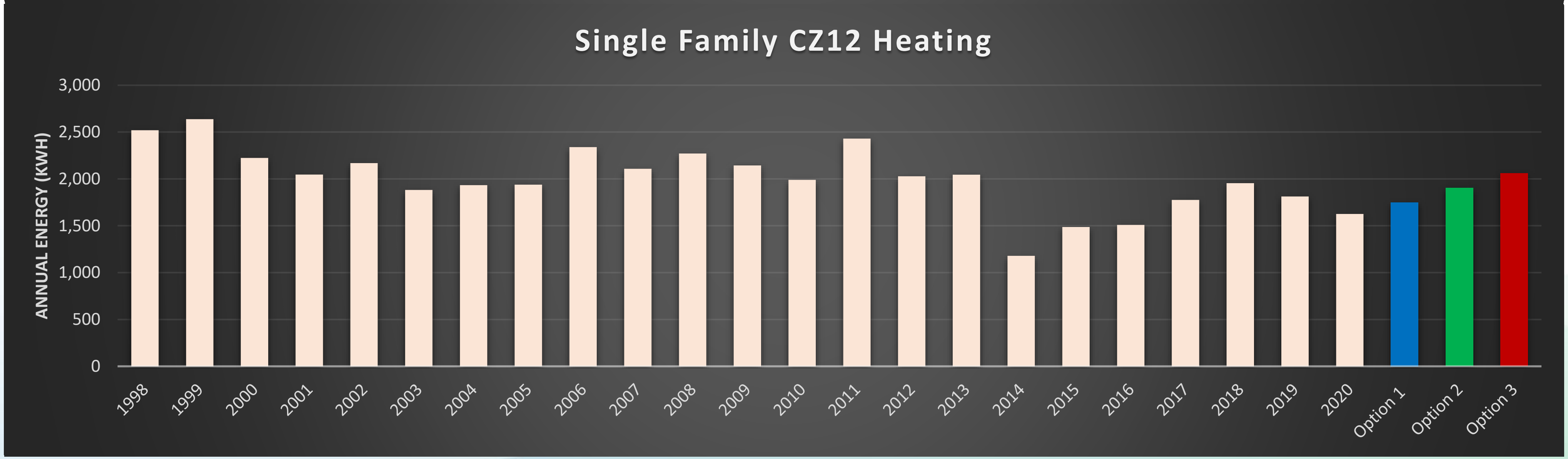
3) New TMY (2000-2020) as described in previous slide, red year changes

Comparison of Cooling Load



Comparison of Heating Load





Option 1
2022 TMY
(1998-2007)

Option 2
Corrected
2022 TMY
(1998-2007)

Option 3
New TMY
(2000-2020)

Comparison of Cooling Energy

Single Family, 2,700 sf Prototype, All-Electric, No WHF

	Annual Cooling Energy Use (kWh)			Effect of Change			
Option	1	2	3	1 → 2		1 → 3	
Years of Weather Data	1998 - 2017	1998 - 2017	2000 - 2020	kWh	%	kWh	%
Data Points	Previous	Corrected (Same TMY Months)	Removed 1998 - 1999				
Climate Zone							
1	0	0	0	0	0%	0	0%
2	47	18	0	-29	-62%	-47	-100%
3	0	0	4	0	0%	4	0%
4	203	145	144	-58	-29%	-58	-29%
5	7	6	6	-1	-16%	-1	-14%
6	105	12	89	-93	-89%	-16	-15%
7	100	80	159	-20	-20%	60	60%
8	690	564	629	-126	-18%	-61	-9%
9	617	493	539	-124	-20%	-78	-13%
10	999	829	908	-171	-17%	-91	-9%
11	1,502	1,307	1,474	-195	-13%	-28	-2%
12	398	268	275	-130	-33%	-122	-31%
13	2,063	1,817	1,846	-246	-12%	-218	-11%
14	1,350	1,183	1,274	-167	-12%	-76	-6%
15	4,762	4,431	4,709	-332	-7%	-53	-1%
16	160	111	95	-50	-31%	-65	-41%

Medium Office

	Annual Cooling Energy Use (kWh)			Effect of Change			
Option	1	2	3	1 → 2		1 → 3	
Years of Weather Data	1998 - 2017	1998 - 2017	2000 - 2020	kWh	%	kWh	%
Data Points	Previous	Corrected (Same TMY Months)	Removed 1998 - 1999				
Climate Zone							
1	5	5	7	-0.3	0%	1	30%
2	57	53	54	-4.3	-8%	-3	-5%
3	35	33	34	-2.2	-6%	-1	-4%
4	72	71	76	-1.2	-2%	4	6%
5	44	42	41	-2.3	-5%	-3	-7%
6	89	71	74	-18.4	-21%	-16	-18%
7	77	75	76	-1.8	-2%	-1	-1%
8	105	101	102	-4.1	-4%	-3	-3%
9	98	94	97	-4.2	-4%	-1	-1%
10	110	105	110	-4.5	-4%	0	0%
11	103	99	104	-4.7	-5%	0	0%
12	83	77	79	-6.2	-7%	-4	-5%
13	116	111	111	-4.9	-4%	-4	-4%
14	102	97	102	-4.6	-5%	0	0%
15	190	183	189	-6.3	-3%	0	0%
16	37	35	36	-1.7	-5%	-1	-2%

Comparison of Heating Energy

Single Family, 2,700 sf Prototype, All-Electric, No WHF

	Annual Heating Energy Use (kWh)			Effect of Change			
Options	1	2	3	1 → 2		1 → 3	
Years of Weather Data	1998 - 2017	1998 - 2017	2000 - 2020	kWh	%	kWh	%
Data Points	Previous	Corrected (Same TMY Months)	Removed 1998 - 1999				
Climate Zone 1	3,659	3,785	3,594	126	3%	-64	-2%
2	2,140	2,300	2,424	159	7%	283	13%
3	1,001	1,101	1,104	100	10%	103	10%
4	1,001	1,983	1,964	982	98%	963	96%
5	840	960	960	120	14%	120	14%
6	344	243	316	-101	-29%	-29	-8%
7	191	219	248	27	14%	56	29%
8	206	236	310	31	15%	104	51%
9	401	450	520	49	12%	119	30%
10	654	525	553	-128	-20%	-100	-15%
11	1,968	2,109	2,033	141	7%	66	3%
12	1,750	1,904	2,060	154	9%	310	18%
13	1,367	1,430	1,532	63	5%	165	12%
14	1,838	2,054	2,059	216	12%	221	12%
15	103	129	174	26	25%	71	68%
16	4,305	4,370	3,782	65	2%	-523	-12%

Medium Office

	Annual Heating Energy Use (therms)			Effect of Change			
	1	2	3	1 → 2		1 → 3	
Years of Weather Data	1998 - 2017	1998 - 2017	2000 - 2020	therms	%	therms	%
Data Points	Previous	Corrected (Same TMY Months)	Removed 1998 - 1999				
Climate Zone 1	5,032	5,134	4,976	102	2%	-56	-1%
2	3,260	3,480	3,638	220	7%	377	12%
3	2,465	2,635	2,611	170	7%	146	6%
4	2,088	3,329	3,334	1,241	59%	1,246	60%
5	2,572	2,757	2,870	186	7%	298	12%
6	953	786	906	-167	-18%	-47	-5%
7	613	644	701	30	5%	88	14%
8	857	953	1,045	96	11%	188	22%
9	1,141	1,216	1,280	75	7%	139	12%
10	1,518	1,410	1,485	-108	-7%	-34	-2%
11	3,274	3,453	3,394	179	5%	120	4%
12	2,870	3,052	3,231	182	6%	361	13%
13	2,393	2,471	2,561	78	3%	168	7%
14	3,146	3,383	3,391	237	8%	245	8%
15	663	730	826	68	10%	164	25%
16	6,057	6,034	5,314	-23	0%	-743	-12%

Summary

- Staff evaluated the impact of 3 most recent years of weather data
- Staff identified number of minor issues with current dataset
- Staff recommends using brand new TMY (2000-2020) for the 2025 Standards

Acknowledgements

- Bruce A. Wilcox, P.E.
- Michael Roth, PhD, PEng
- Dimitri Contoyannis, P. E.
- Alea German, P. E.

Public Comments on Session 2: Weather Files

Danny Tam, California Energy Commission

Energy Accounting for the 2025 Energy Code

We will resume at 12:20 p.m.

Session 3: Life Cycle Costing and Hourly Source Energy

Jared Landsman, Snuller Price, Michael Sontag
Energy and Environmental Economics, Inc.

E3 Presentation Team

Snuller Price

Overall E3 Lead

Jared Landsman

Lead Presenter &
Project Manager 2025 Cycle

Michael Sontag

Project Manager 2022 Cycle

Terminology

- Two metrics are used for Title 24 Part 6

1. 'Life Cycle Cost Hourly Factors' = TDV = Time Dependent Valuation

- The CEC is considering changing the name of 'TDV' to improve clarity for the range of stakeholders that use the metric that it is a cost metric
- This presentation uses the term 'Life Cycle Cost Hourly Factors'

2. 'Source Energy Hourly Factors'

- This is the new metric introduced in the 2022 Code Cycle to measure hourly source energy, which is strongly correlated to emissions

Agenda

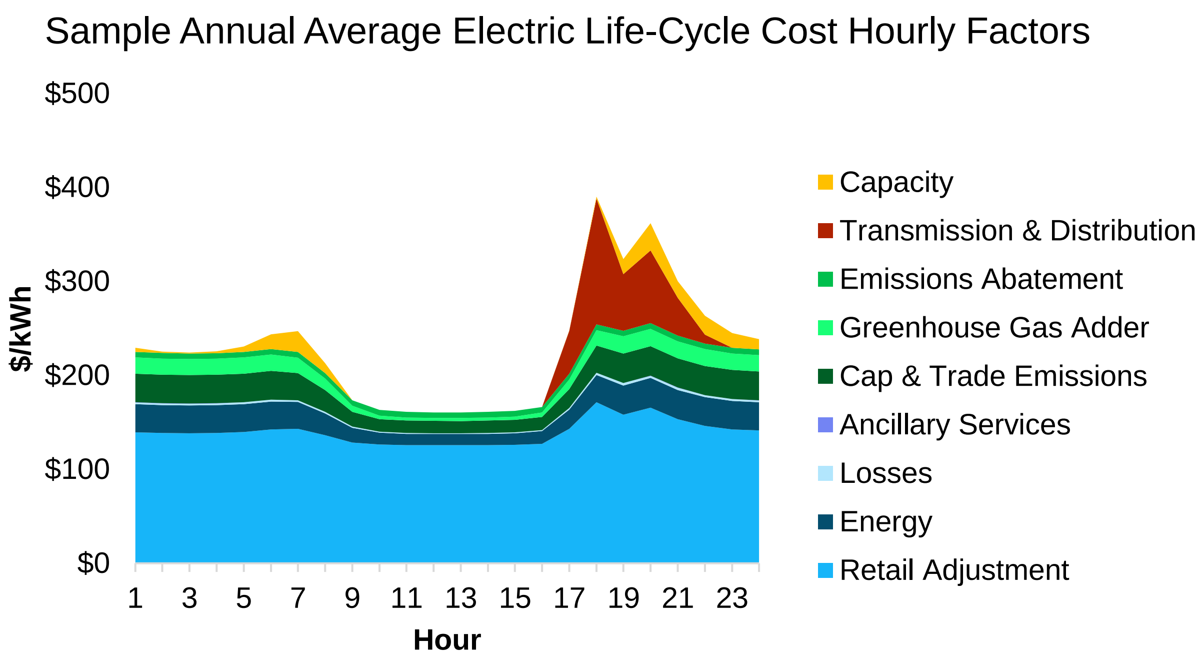
- Background & Frequently Asked Questions
- Life Cycle Cost Hourly Factor Modeling Framework
- Electric Life Cycle Cost Hourly Factor Development
- Gas/Propane Life Cycle Cost Hourly Factor Development
- Source Energy Hourly Factor Development

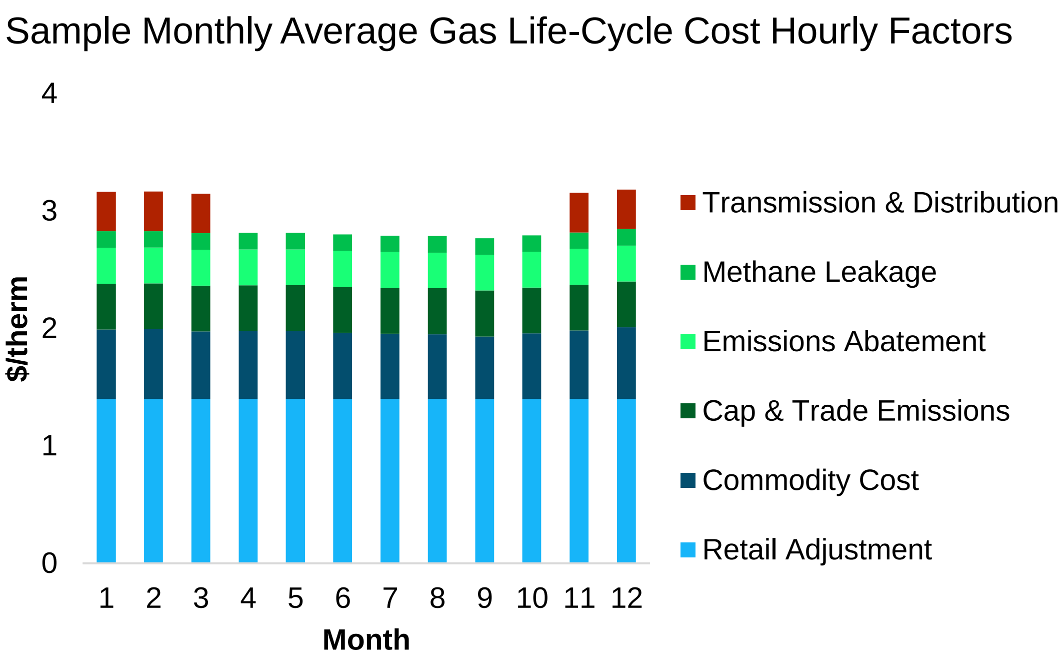
Background & Frequently Asked Questions

Life Cycle Cost Hourly Factors

Life-cycle cost hourly factors are used to convert predicted site energy use to **long-term dollar savings to California's energy system.**

Since the timing of energy consumption is as important as the magnitude of energy consumption, these factors are generated on an **hourly basis** for a representative year and created for **each of California's diverse climate zones.**

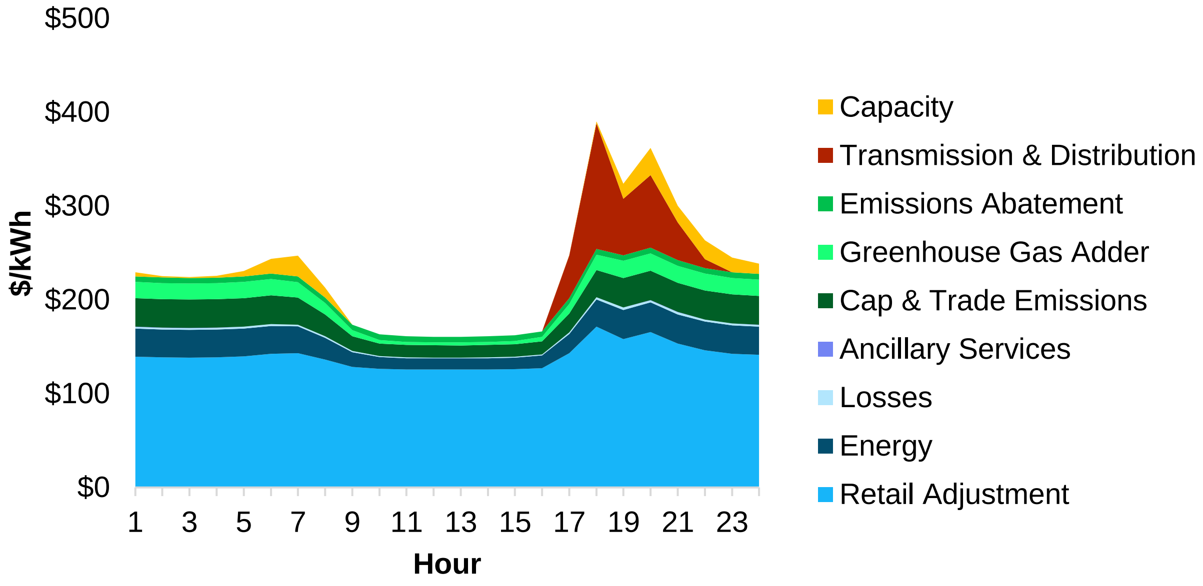




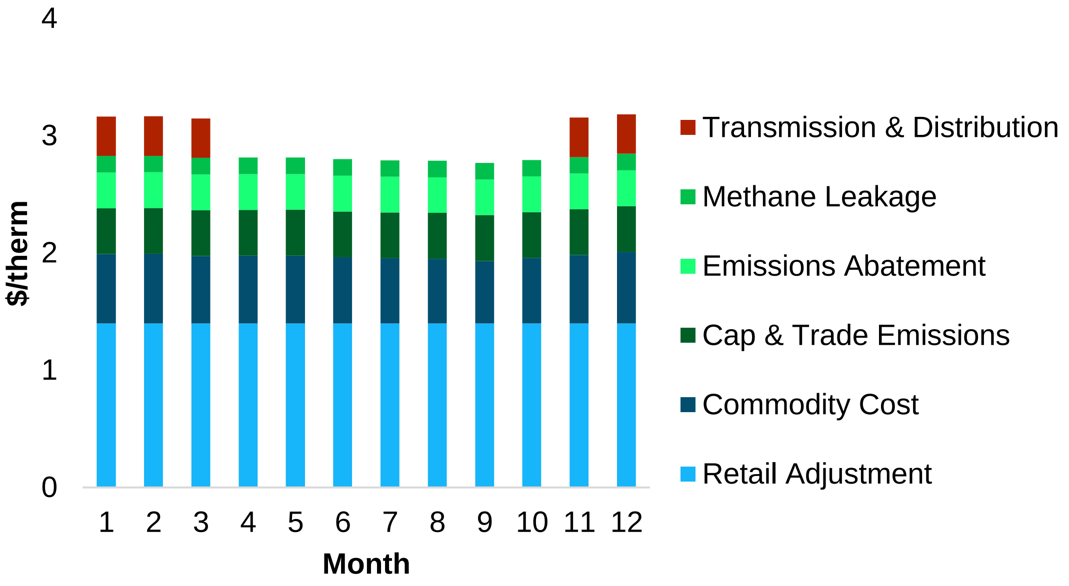
Uses of Life Cycle Cost Hourly Factors

1. Cost-effectiveness analysis of **measures proposed for inclusion in building energy efficiency standards**
2. Cost-effectiveness analysis of **individual projects demonstrating compliance with building energy efficiency standards using the performance approach** (embedded in California Building Energy Code Compliance software)

Sample Annual Average Electric Life-Cycle Cost Hourly Factors



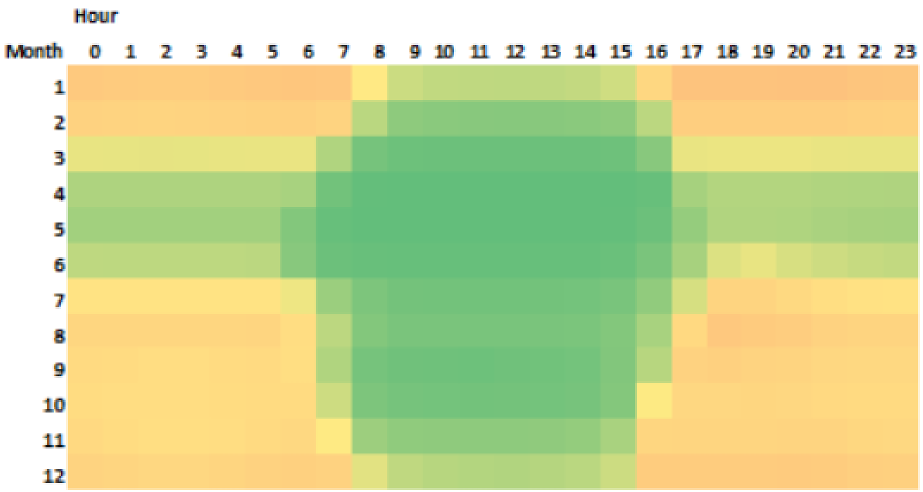
Sample Monthly Average Gas Life-Cycle Cost Hourly Factors



Source Energy Hourly Factors

Source energy hourly factors are used to convert predicted site energy use to source energy. Source energy accounts for **energy losses incurred in the production, transmission, and delivery of energy to the building**. Source energy correlates strongly with **greenhouse gas emissions.**

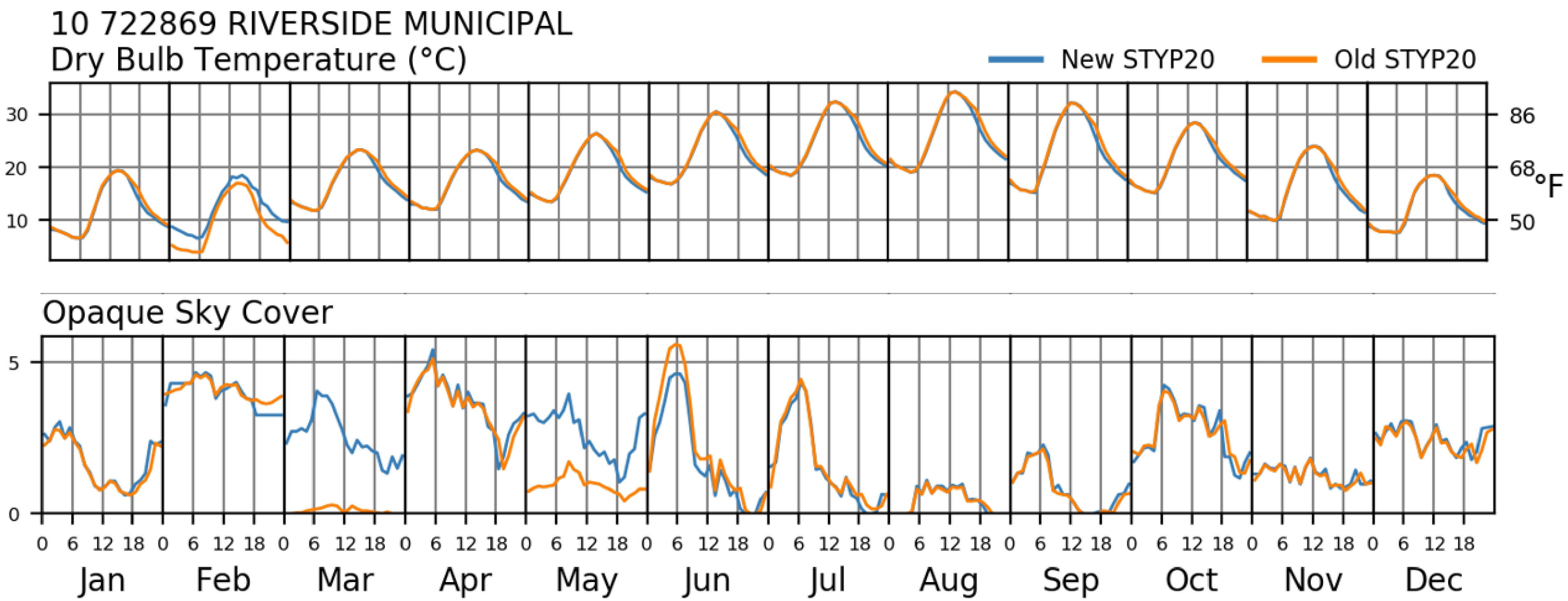
Long-Run Marginal Source Energy



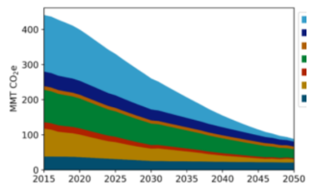
Life Cycle Cost Hourly Factor Modeling Framework

Weather File Generation

New weather files are generated for **each California climate zone**, based on **historical weather data**, reflecting a **typical meteorologic year** (TMY)

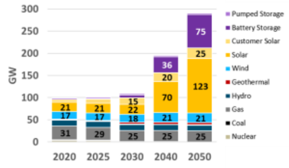


Modeling Methodology



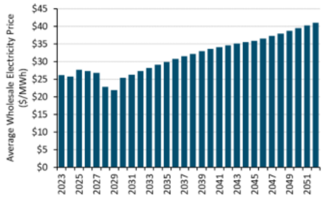
Scenario Analysis

Set major policy and investment requirements necessary to reach Economy-wide GHG targets to develop load forecast



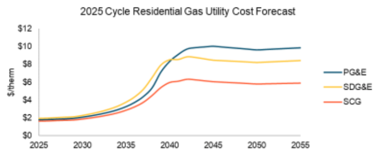
Resource Modeling

Identify optimal statewide electricity resource portfolio to achieve electricity sector goals (SB 100)



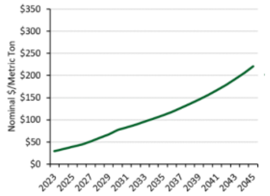
Energy Market Modeling

Simulate hourly electricity-sector operations given new building & EV loads and new weather



Gas/Propane Utility Costing

Develop gas/propane utility costs projections



GHG Accounting

Evaluate costs associated with achieving statewide GHG emissions reduction targets

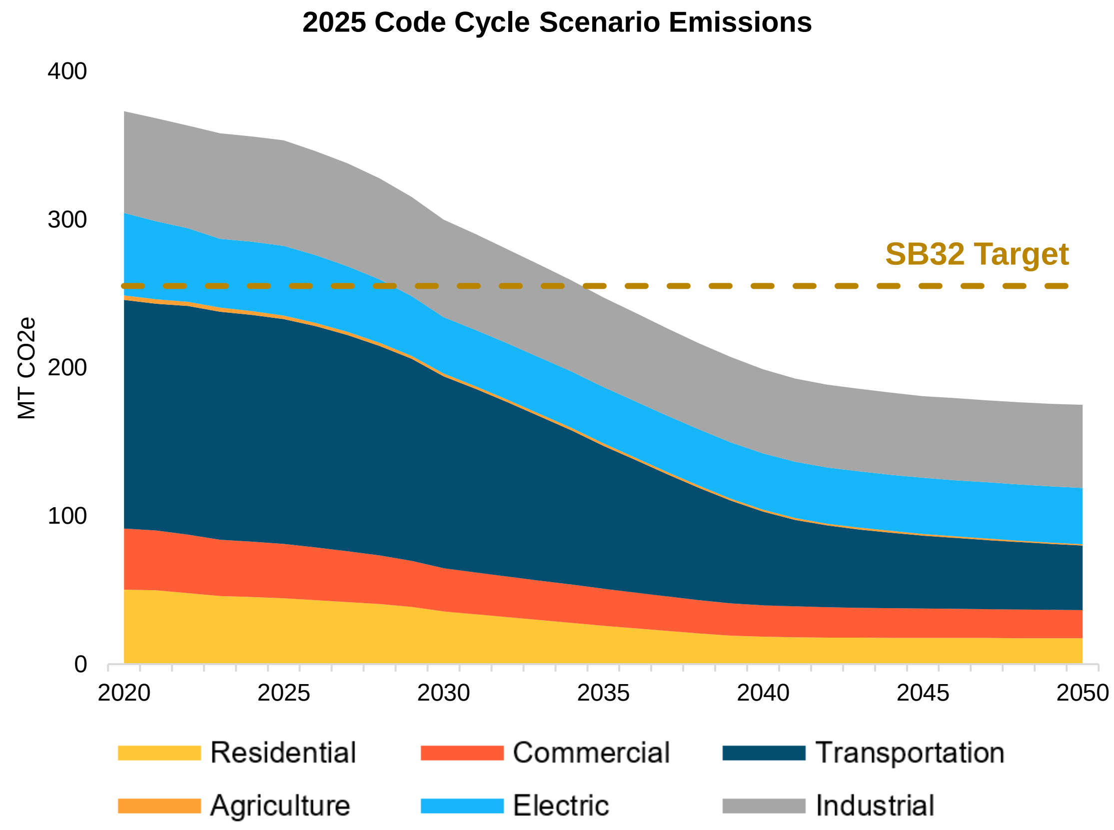
Develop Final Factors

Aggregate cost components and convert to net present value

Scenario Analysis

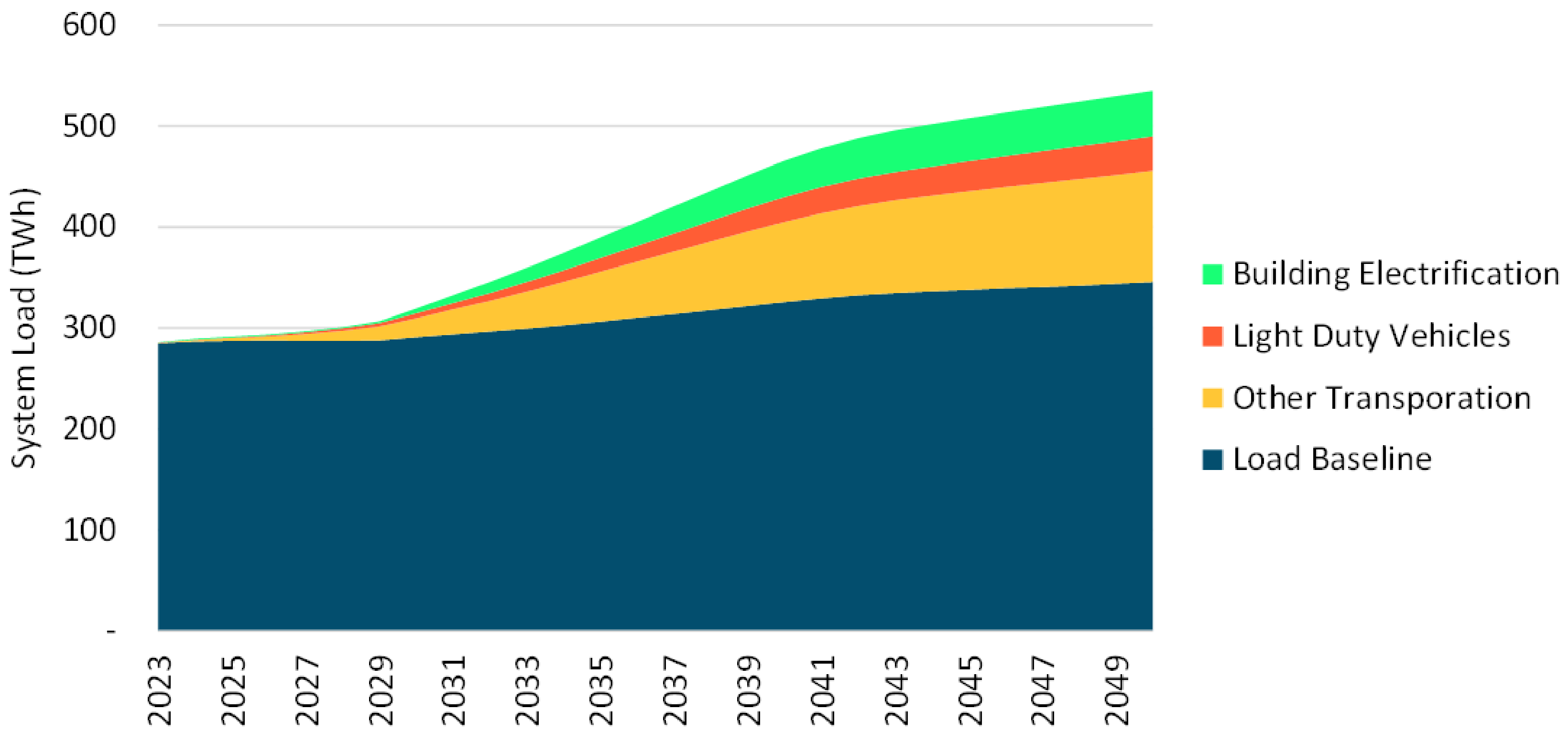
Demand scenarios represent potential futures with varying strategies to achieve **economy-wide decarbonization**, which dictate **sectoral emissions budgets** and policy landscape

Demand scenarios directly impact **building electrification load, electric vehicle load, decarbonized gas, and renewable generation procurement**



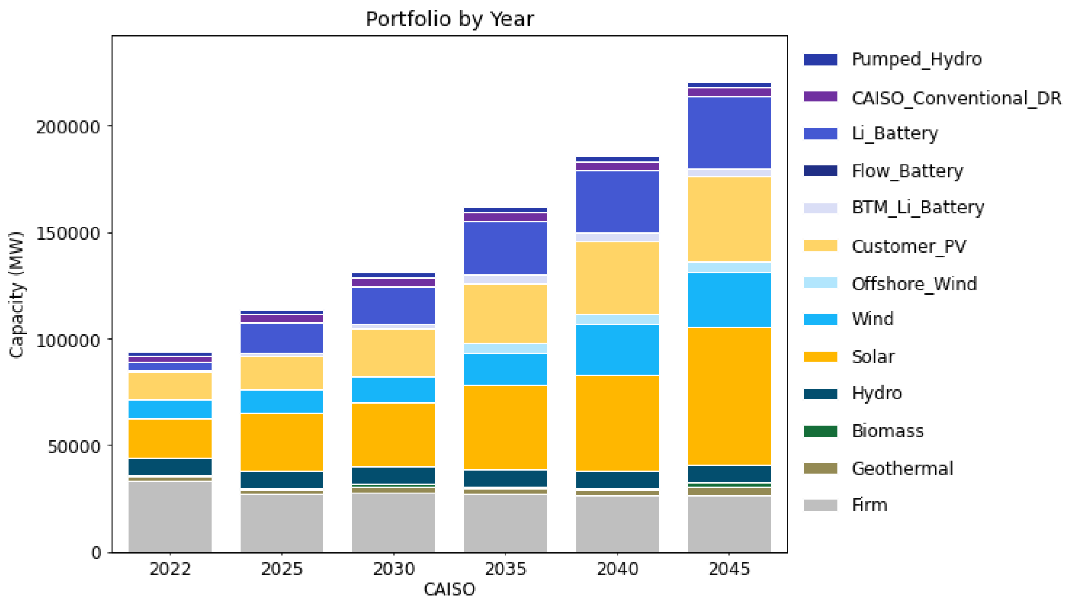
Annual Load Forecast

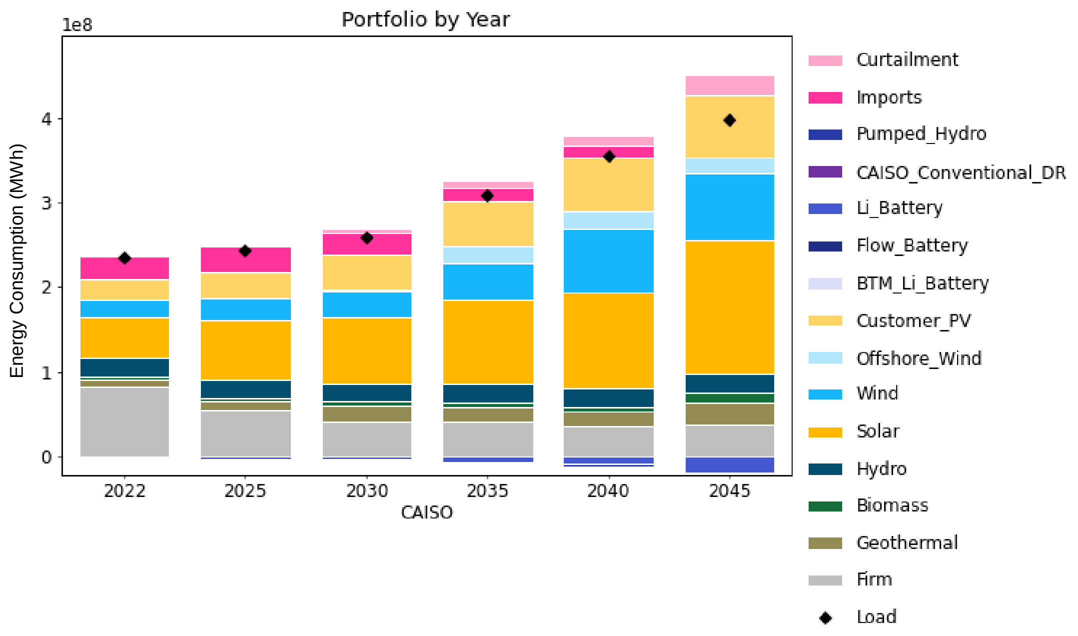
Annual load forecast developed using **weather regression of historical electric load** plus new hourly **transportation and building electrification** load from selected demand scenario



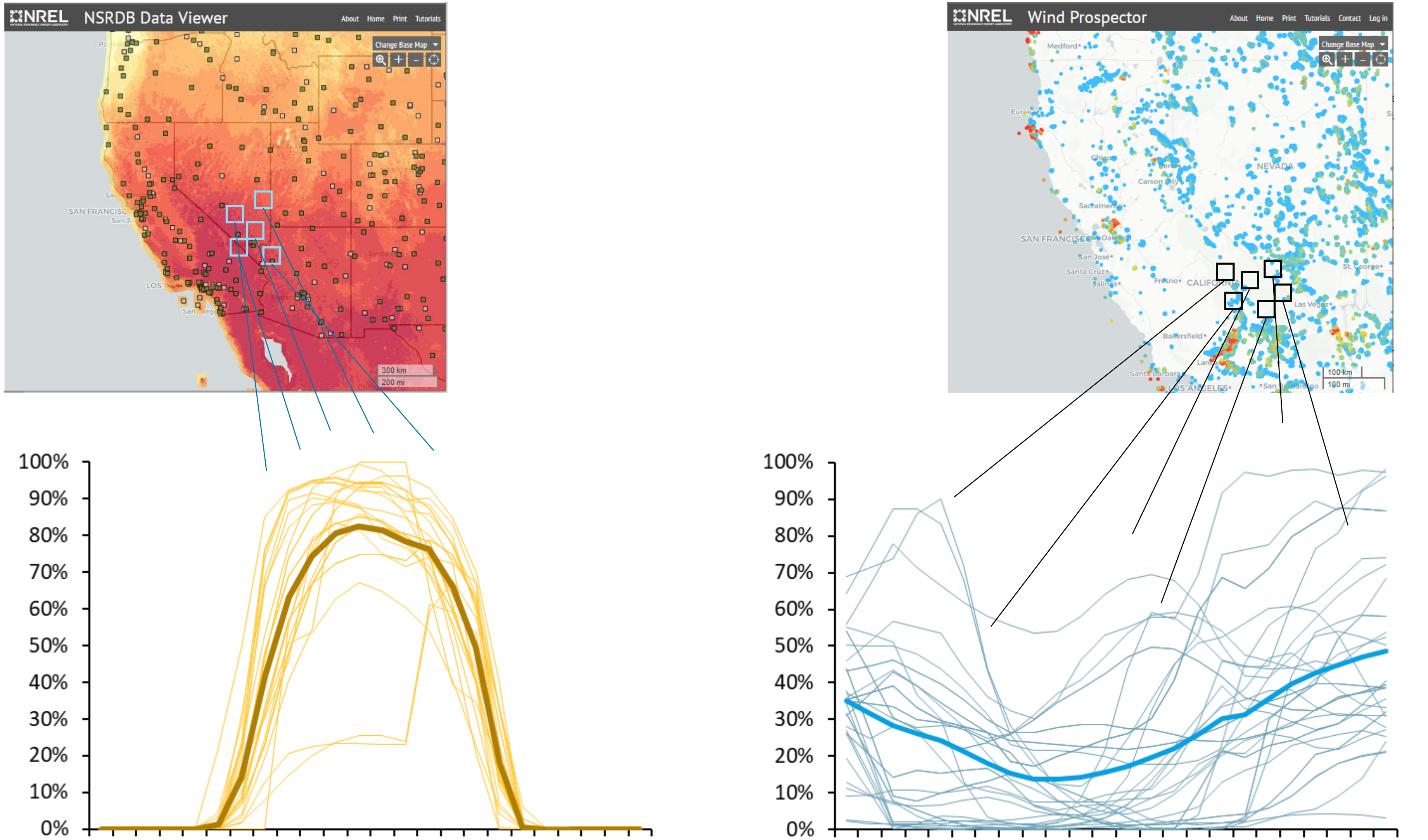
Resource Modeling

Optimal electricity generation plan to meet statewide energy procurement targets developed using resource procurement model and **Load Serving Entities (LSE) Plans Filing Requirements**, consistent with **SB 100** and electricity sector GHG emissions target of **38 MMT by 2030**





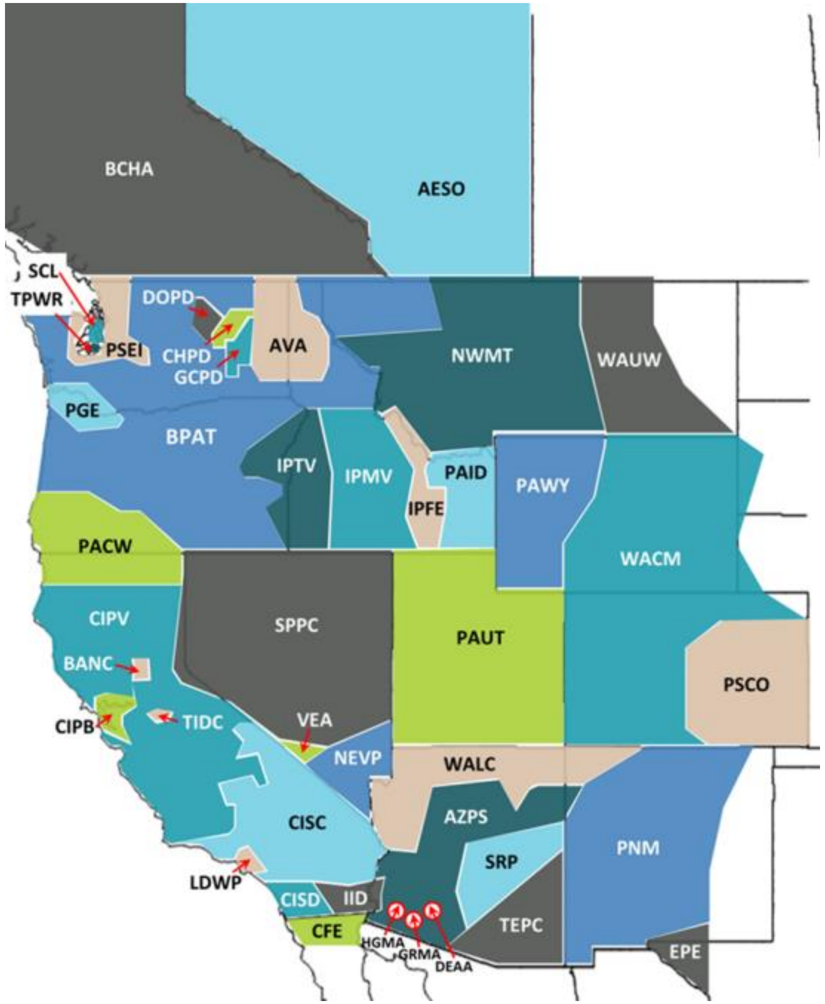
Weather-Matched Renewable Generation



Energy Market Modeling

Marginal energy price calculated using energy market modeling, covering **entire Western Interconnection** to reflect impacts of interzonal trade, transmission, and generation on California energy prices

Energy market modeling uses **IEPR production simulation** with adjusted load projections, supply-side generation mix, and renewable generation shape



wecc.org

Cost Component Aggregation

Life cycle cost hourly factors consist of **aggregated "cost components"** that contribute to **marginal cost** of electricity, gas, and propane **to California's energy system**

Gas/Propane cost components

- A) Commodity Cost
- B) Transmission & distribution
- C) Cap & trade
- D) Emission abatement
- E) Retail rate adder

Electric cost components

- A) Avoided energy cost
- B) Generation capacity
- C) Transmission & distribution capacity
- D) Cap & trade
- E) GHG adder
- F) Emission abatement
- G) Ancillary services
- H) Losses
- I) Retail rate adder

Net Present Value Calculations

Life cycle cost hourly factors converted to **net-present value of energy cost over building lifetime**

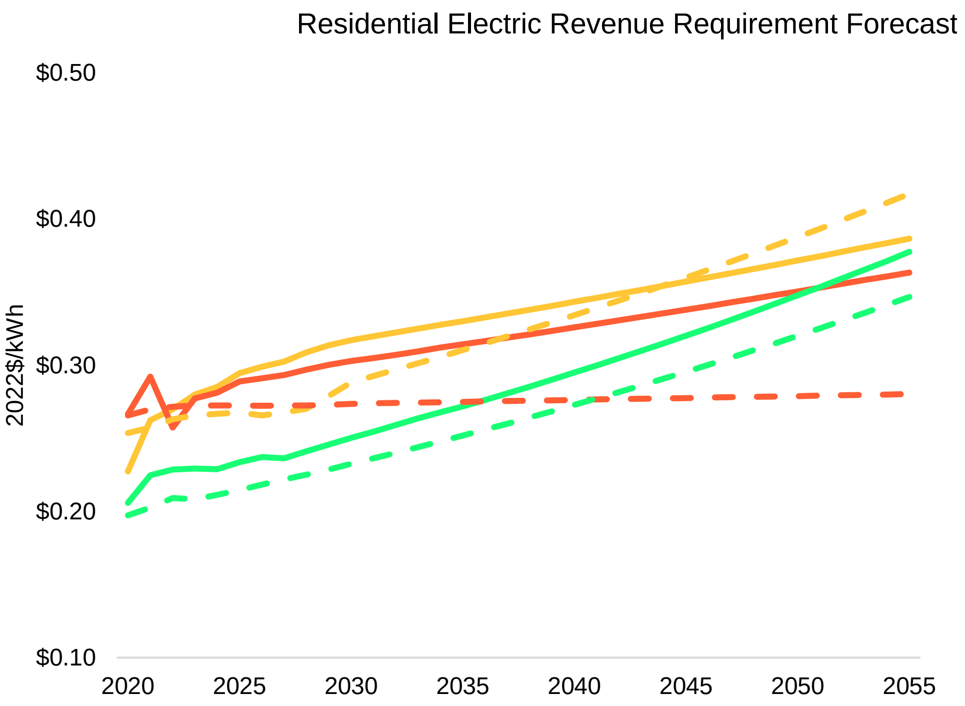
Current practice is **30-year** economic life for **residential** measures and **nonresidential envelope** measures and **15-year** economic life for **other non-residential** measures

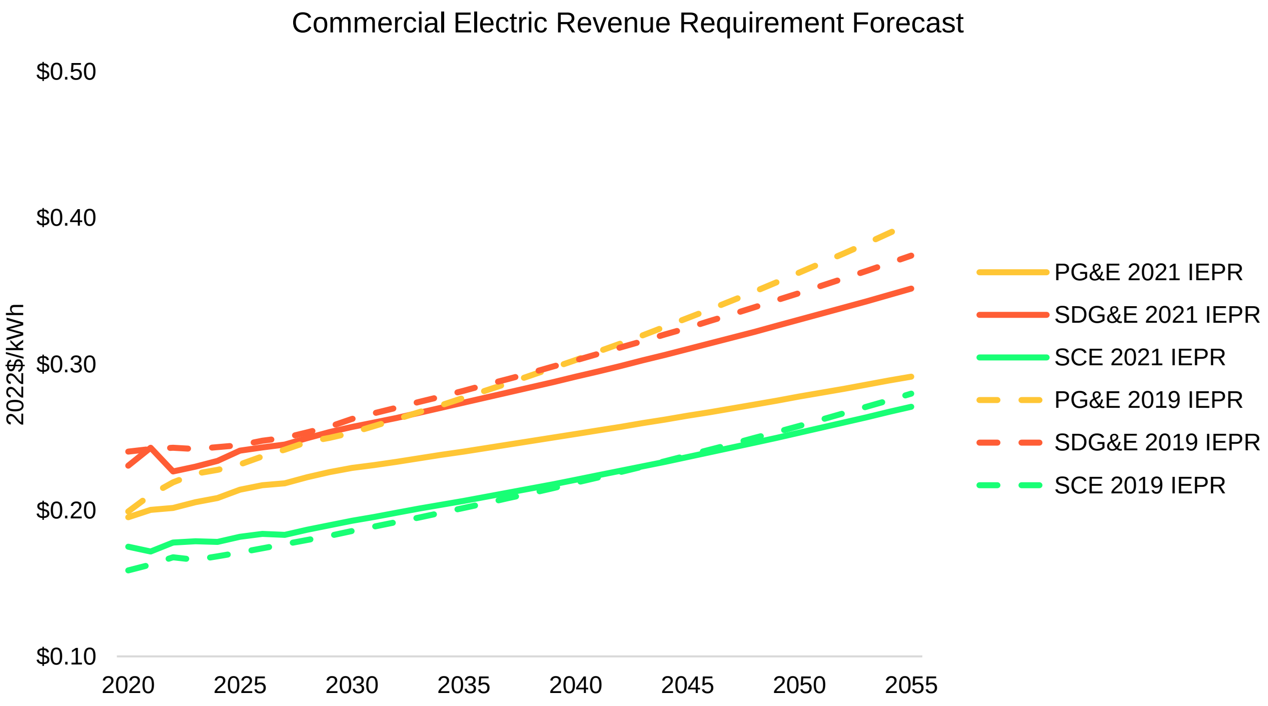
Proposal to move to **30-year** economic life for **all measures**

Electric Life Cycle Cost Hourly Factor Development

Electricity Revenue Requirement Forecast

Electric revenue requirement for 2020-2035 pulled from **IEPR Mid-Demand case** and projected for future years





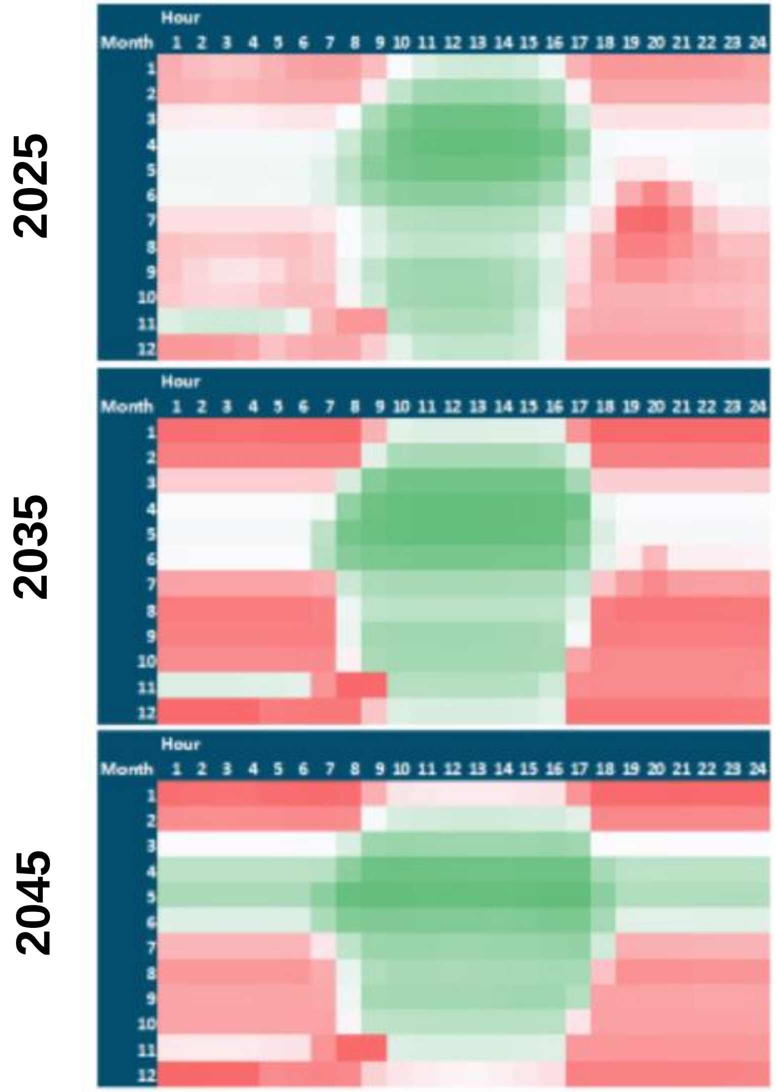
Electric Life Cycle Factor Cost Components

A) Avoided energy cost
B) Generation capacity
C) Transmission & distribution capacity
D) Cap & trade
E) GHG adder
F) Emission abatement
G) Ancillary services
H) Losses
I) Retail rate adder

A) Avoided Energy Costs

The avoided cost of energy reflects the **marginal cost of generation** needed to meet load in each hour, or the **wholesale electricity price**

Suppressed mid-day prices and decreasing summer evening prices occur from **increased renewable and battery penetration**

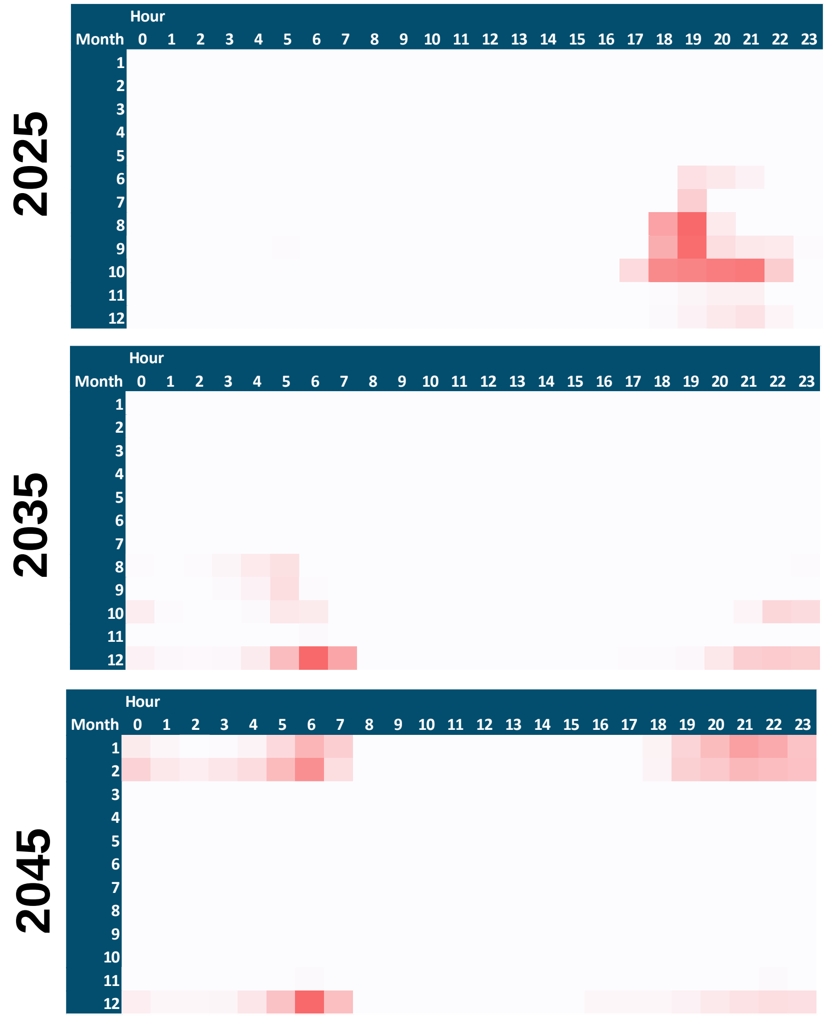


B) Generation Capacity

Generation capacity cost captures cost of **maintaining generator fleet** with enough capacity to meet each year's **peak loads**

System Net Peak expected to transition as **renewable penetration increases**

- 2025 – summer evenings
- 2035 – mornings after batteries dispatch
- 2045 – winter periods of low renewable energy availability

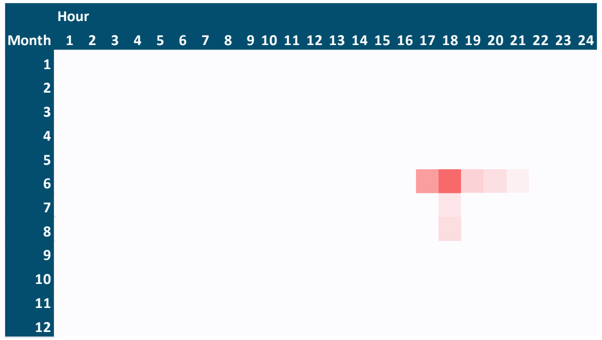


C) Transmission & Distribution Capacity

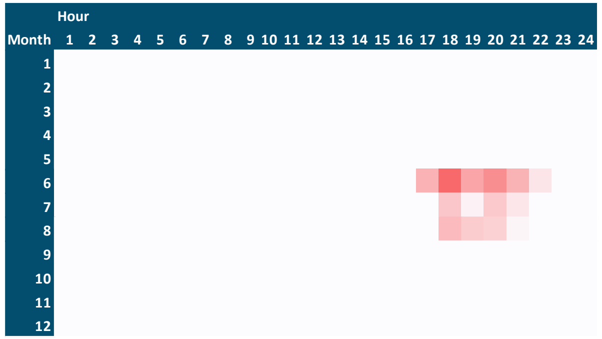
Hourly transmission & distribution (T&D) capacity cost is allocated to the hours of the year during which the system is most likely to be **constrained and require upgrades -** the hours of **highest local load**

T&D allocation developed using latest **regional rooftop PV penetration forecasts** and **substation data**

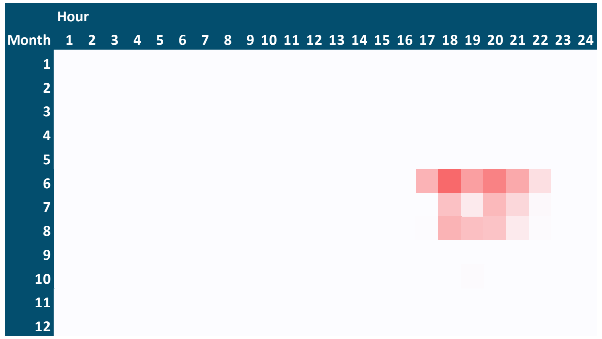
2025



2035



2045

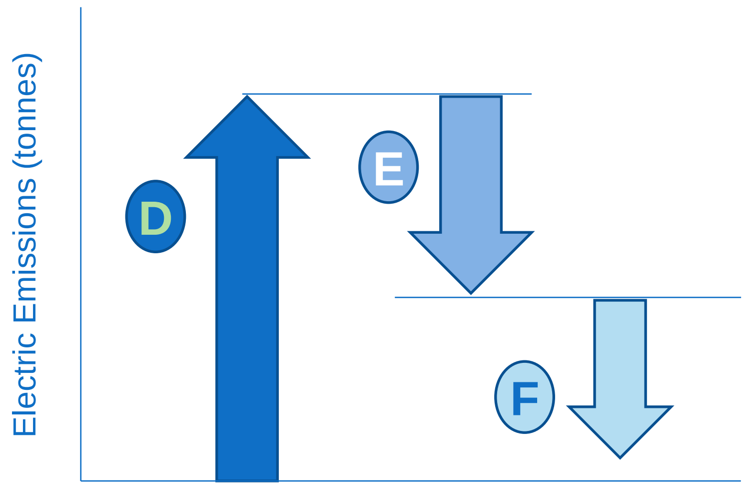


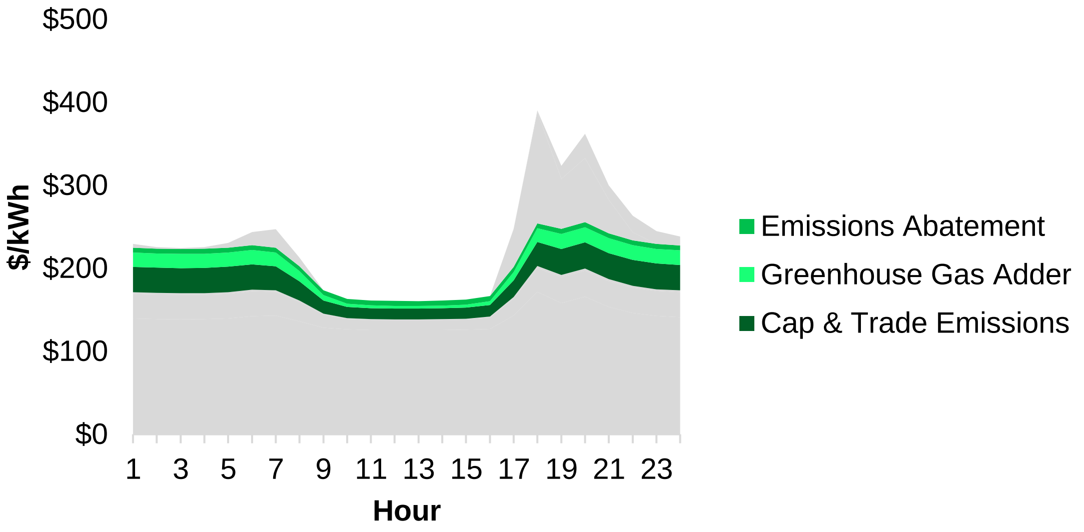
Greenhouse Gas Emissions Accounting

D) Cap and Trade: Cost applied to plant emissions from directly serving new building load

E) GHG Adder: Additional cost of procuring necessary supply-side resources to achieve electricity-sector long run emissions target (SB 100 RPS target)

F) Emissions Abatement: Economy-wide cost of abating remaining emissions after supply-side actions have been taken to meet statewide 80x50 GHG cap

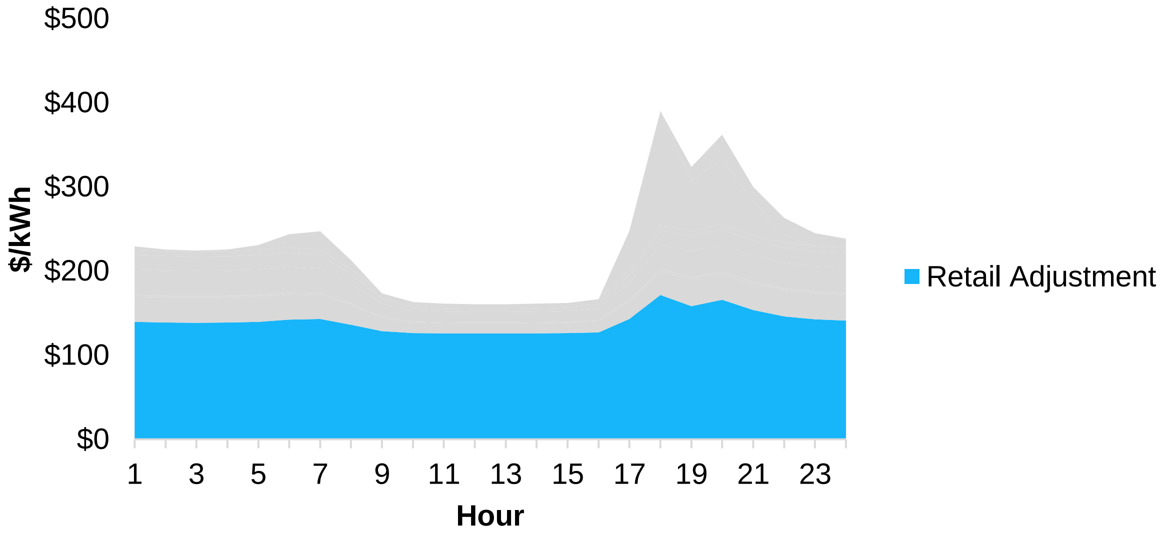




I) Retail Rate “Adder”

Retail rate “adder” is added to marginal cost components to ensure that total “life cycle cost” hourly factors reflect **long-term dollar savings to California’s energy system**

Some adder is **flat** representing fixed charges and some adder is **time-dependent**, following shape of other cost components



Gas/Propane Life Cycle Cost Hourly Factor Development

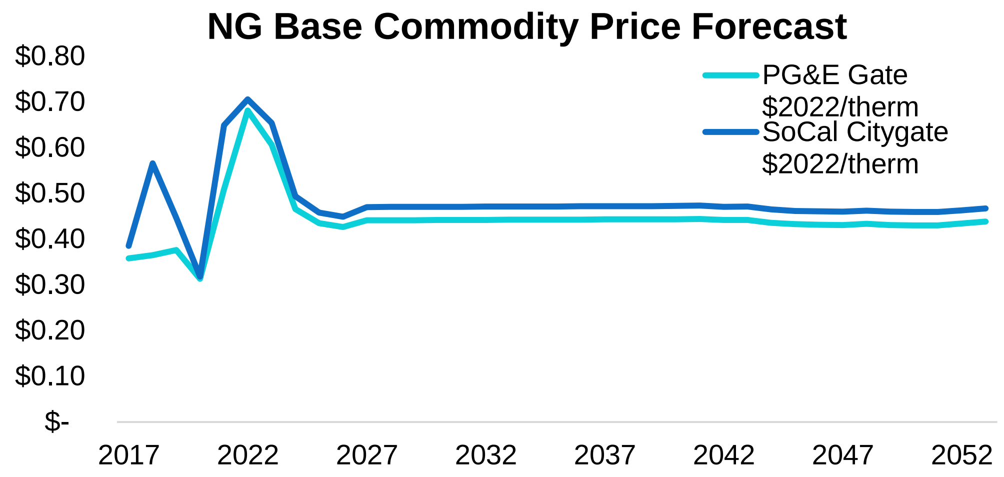
Gas Life Cycle Factor Cost Components

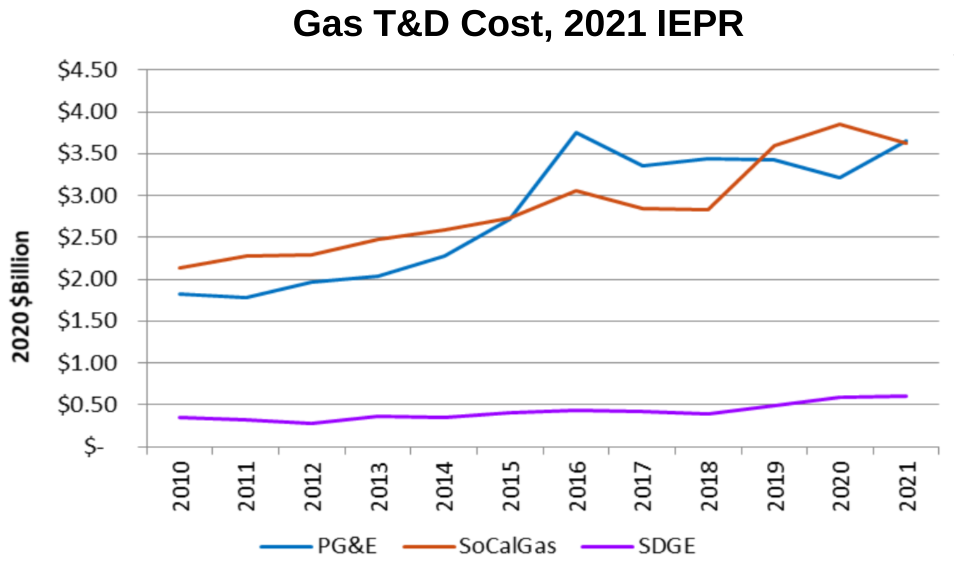
A) Commodity Cost
B) Transmission & distribution
C) Cap & trade
D) Emission abatement
E) Retail rate adder

Gas Utility Costs

A) Commodity costs reflect projected **wholesale value of natural gas**

B) T&D costs reflect marginal cost of **expanding and maintaining gas distribution infrastructure**

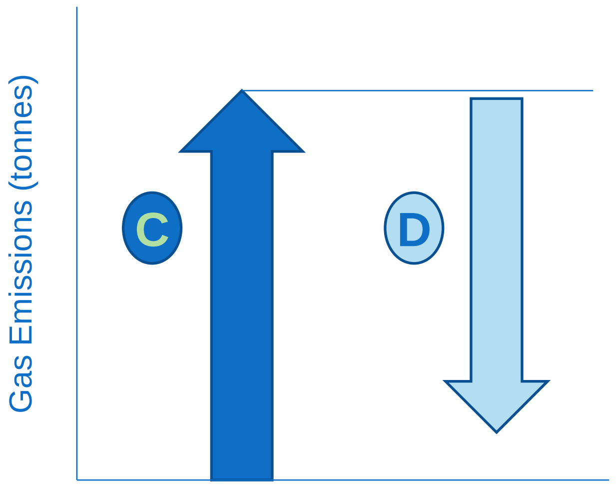


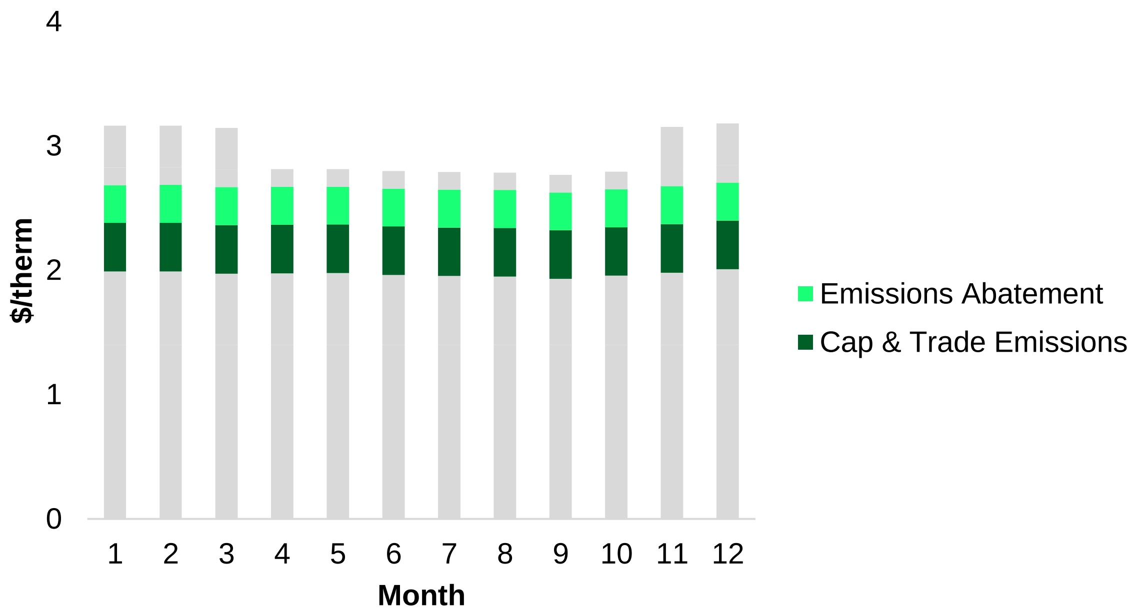


Greenhouse Gas Emissions Accounting

C) Cap and Trade: Cost applied to plant emissions from directly serving new non-renewable gas load

D) Emissions Abatement: Economy-wide cost of abating remaining emissions after supply-side actions have been taken to meet statewide 80x50 GHG cap





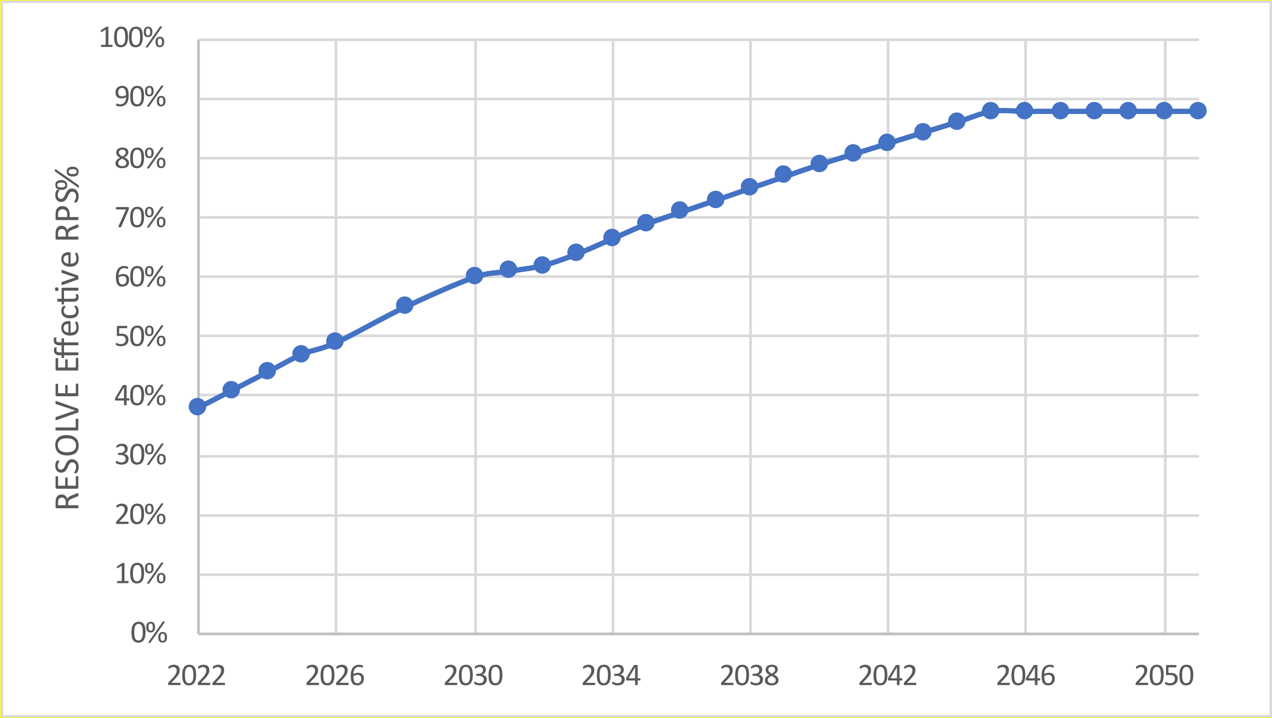
Source Energy Hourly Factor Development

Source Energy Calculations

Source energy hourly factors represent **lifetime average hourly source energy** (not explicitly emissions factors, but correlated)

Current practice is **30-year** economic life for **residential** measures and **nonresidential envelope** measures and **15-year** economic life for **other non-residential** measures (proposal to move to **30-year** economic life for **all measures**)

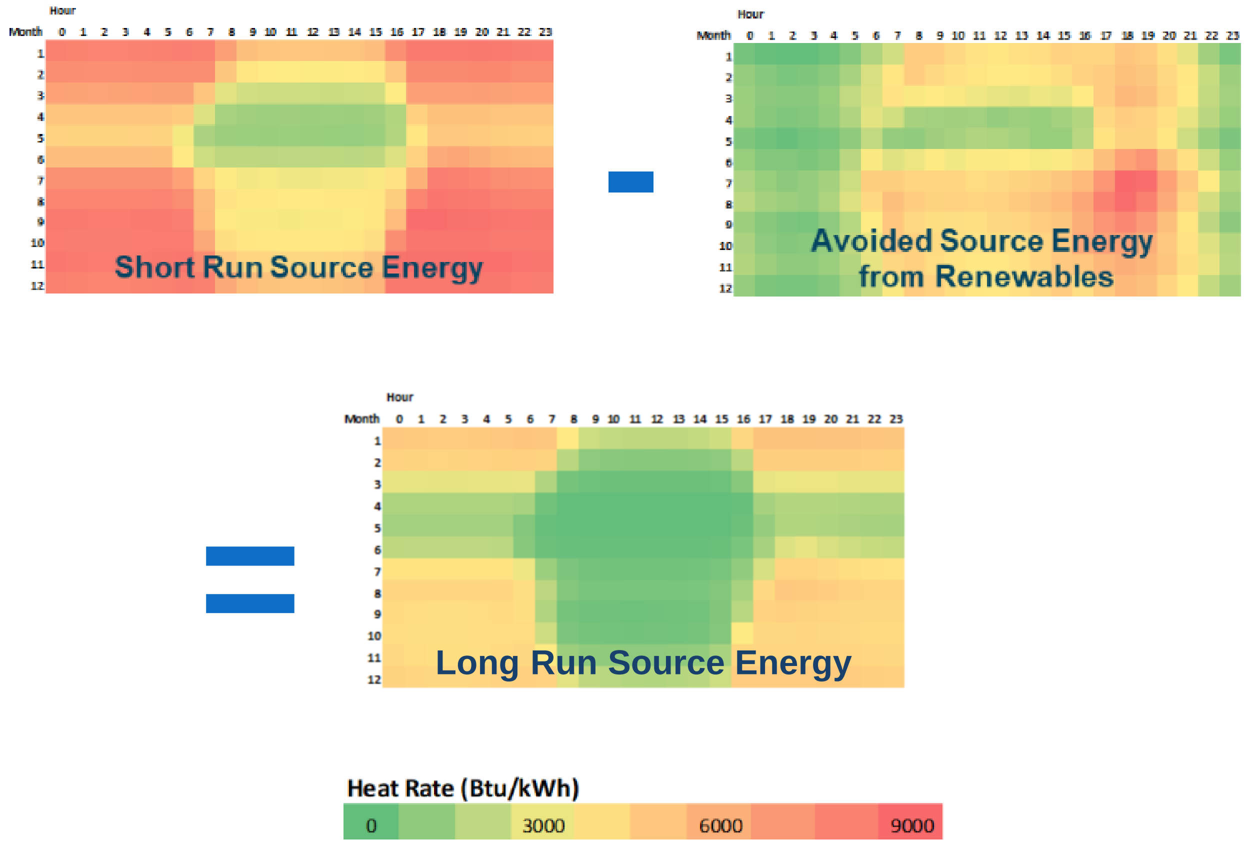
Factors calculated using **sector projections to meet state targets** from selected demand scenario



Source Energy Calculations

Electric source energy factors use **long-run marginal energy**

Gas source energy factors incorporate the impact of future **decarbonized gas in the pipeline**



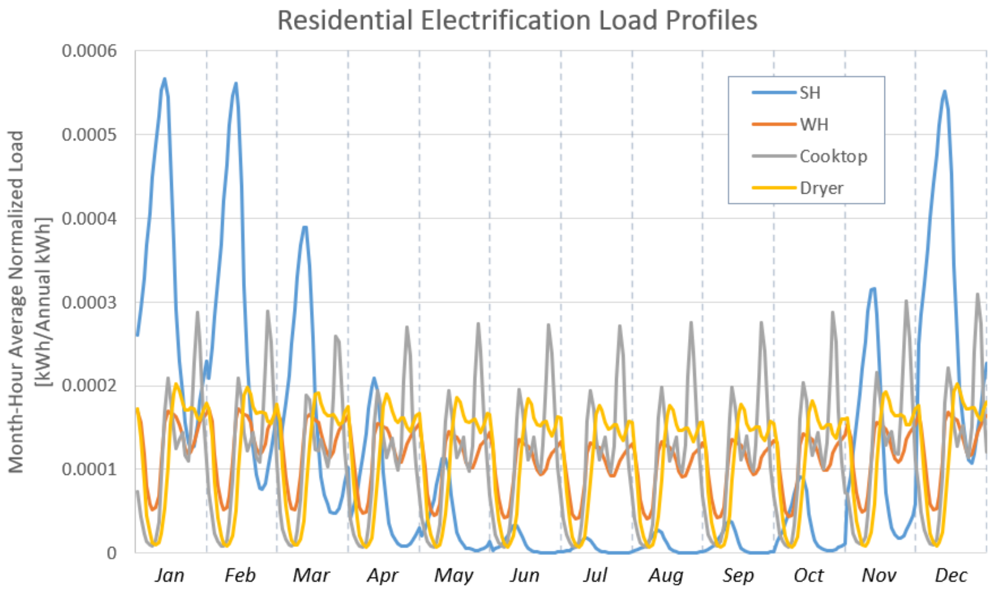
Public Comments on Session 3: Life Cycle Costing and Hourly Source Energy

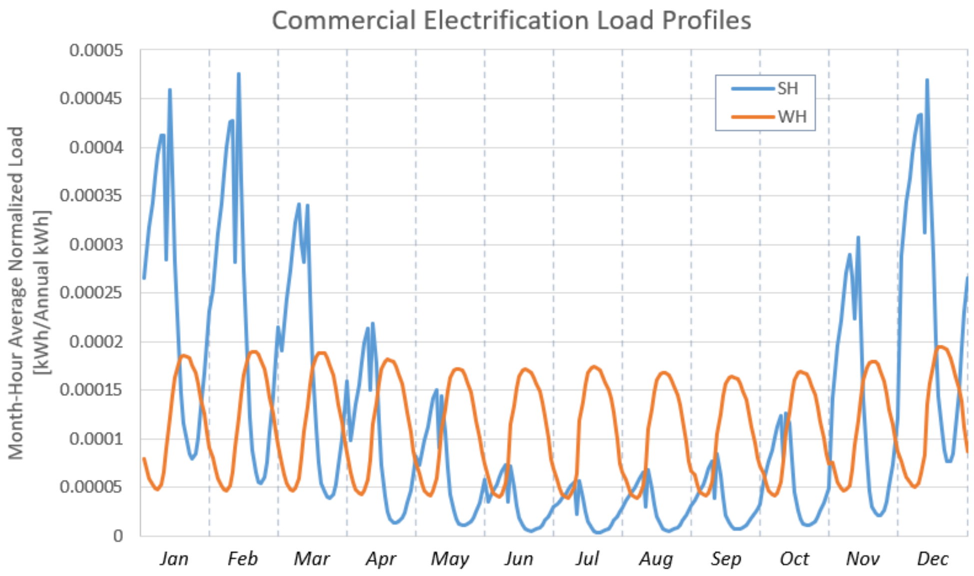
Jared Landsman, Energy and Environmental Economics, Inc.

Appendix

Building Electrification Load Profile

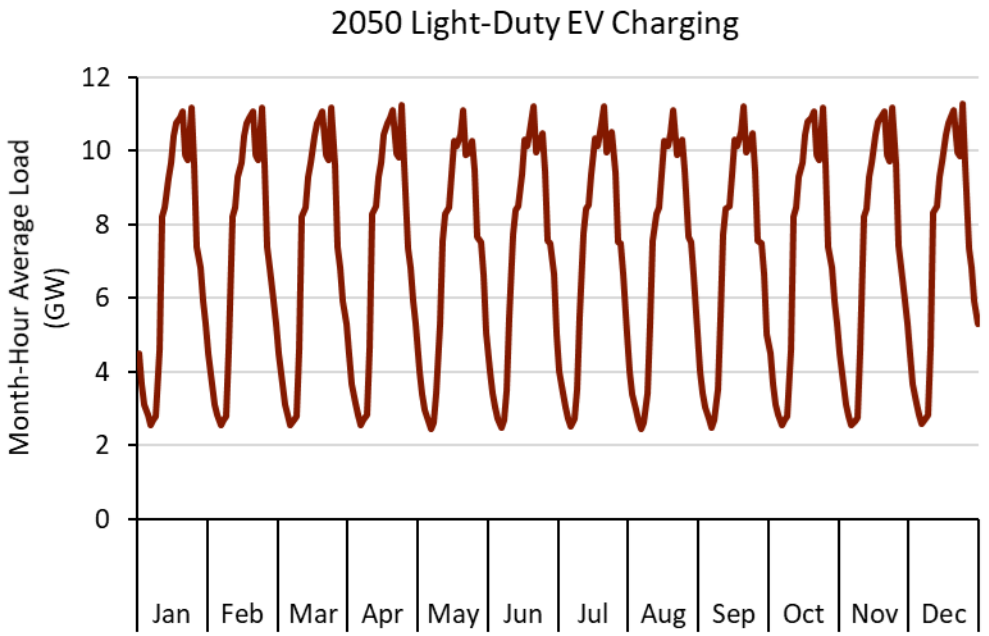
- Hourly building electrification load shapes developed using building simulation data across 16 climate zones from **ResStock and ComStock databases**
- Scaled up by end-use, using **demand scenario annual forecasted load**





Electric Vehicle Charging Load Profile

- Load shape pulled from **2021 IEPR** for LDV & MDV/HDV
- Scaled up using **demand scenario annual forecasted load**



Session 4: 2025 Energy Code Life Cycle Costing Updates

Jared Landsman, Energy and Environmental Economics, Inc.

Agenda

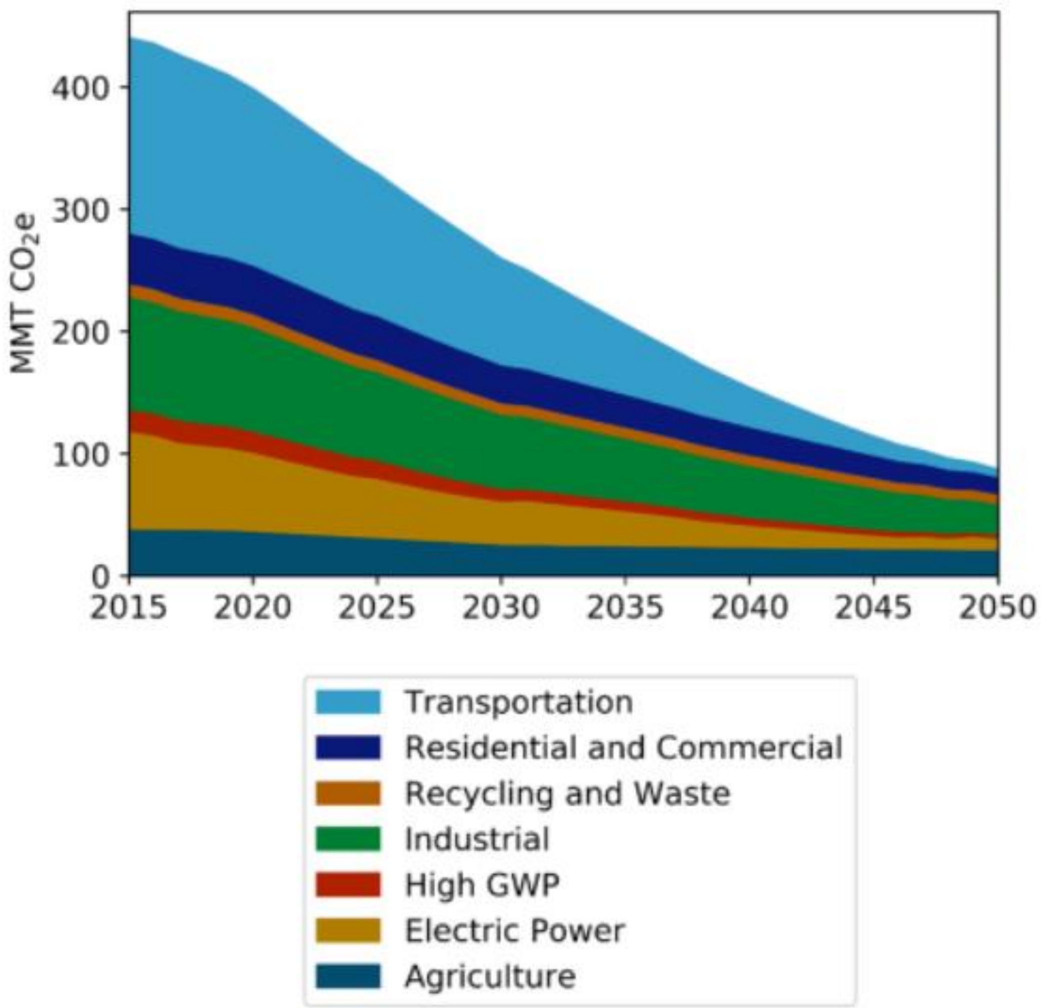
- Scenario Selection & Policy Assumptions
- Electric Revenue Requirement Forecast
- Electric Retail Rate Adders
- Gas Utility Cost Forecast

Scenario Selection & Policy Assumptions

What are Demand Scenarios?

Demand scenarios represent potential futures with varying strategies to achieve **economy-wide decarbonization**, which dictate **sectoral emissions budgets** and policy landscape

This, in turn, impacts **building electrification load, EV load, decarbonized gas, and renewable generation procurement**



California's Deep Decarbonized Future

By 2020: Return to 1990 levels

(AB 32, 2006)

By 2030: 40% below 1990 levels

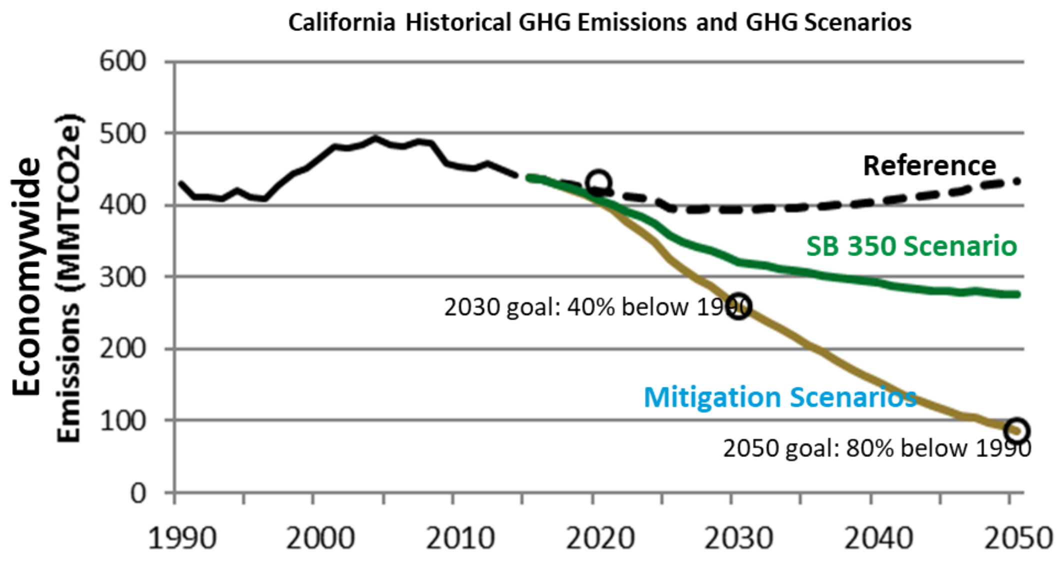
(SB 32, 2015)

By 2045: Carbon neutrality

(EO B-55-18)

By 2050: 80% below 1990 levels

(EO B-30-15 and EO S-3-05)



4 Pillars of Energy Decarbonization

New buildings will exist in the **future energy system** which is fundamentally changing

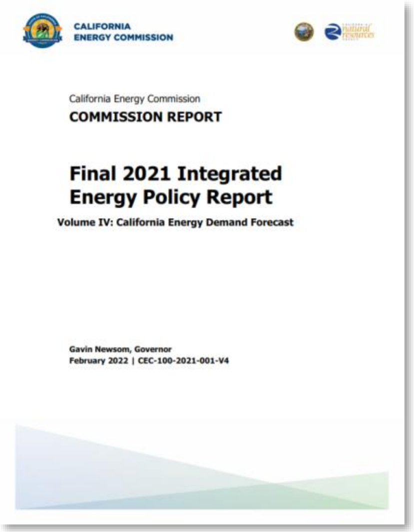
- Demand-side: **efficiency, electrification, storage**
- Supply-side: **renewable generation, decarbonized fuels**

Energy Demands		Energy Supply	
Energy efficiency & conservation	**Electrification**	**Low carbon electricity**	**Low carbon fuels**
✓ Appliance EE ✓ Building shells ✓ Urban infill / transport mode-shift	✓ Heat pumps ✓ ZEV cars and trucks ✓ Industry & off-road vehicles	✓ Renewables & integration ✓ Nuclear, fossil with CCS	✓ Biofuels ✓ Electrolytic fuels (H_2 and P2X) ✓ CCS

How to Select Demand Scenarios?

Demand scenarios should be selected based on **publicly available scenario analysis**

- CEC Demand Scenarios Project
- CARB Scoping Plan
- Integrated Energy Policy Report (IEPR)
- Low Carbon Future study



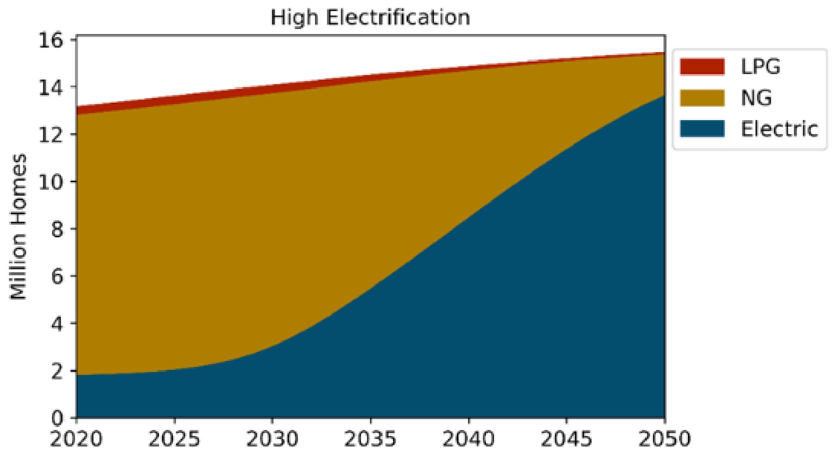
Selected scenario should represent realistic load forecast based on

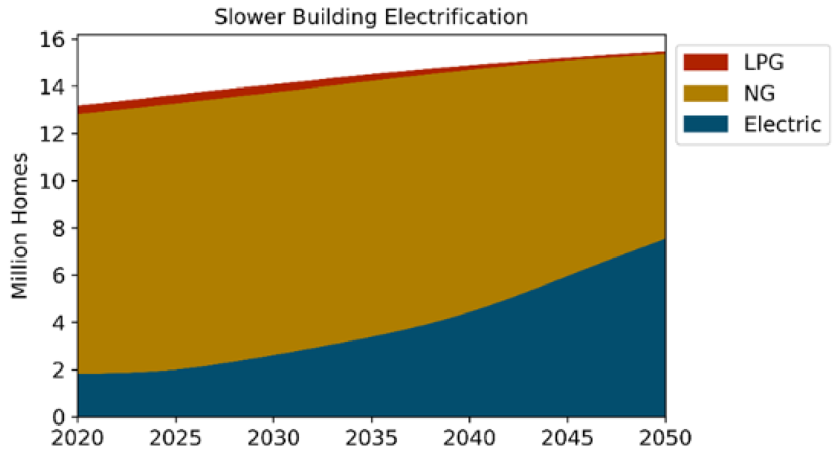
- **“On-the-books” existing policies**
- **Expected future policies**

Scenario Analysis for 2022 Cycle

Two demand scenarios were considered for 2022 code cycle

- **High Electrification**: **Cheapest** pathway to achieve reduction goals, characterized by **high gas rates** from stranded gas assets
- **Slower Building Electrification**: **More expensive** pathway to achieve reduction goals, with deeper reductions in other sectors, characterized by **lower gas** rates and **more RNG** in buildings





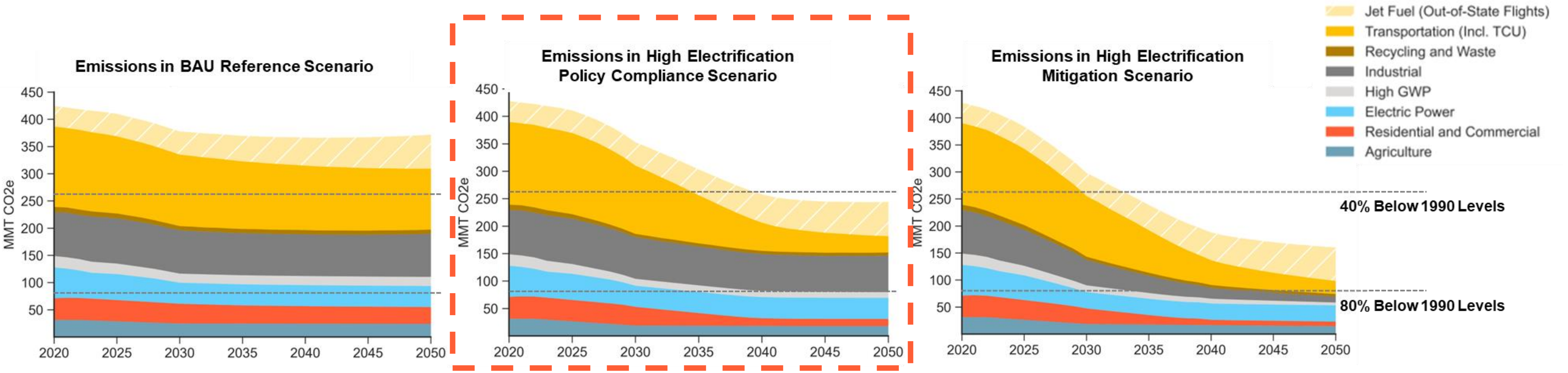
Selected Case

Scenario Analysis for 2025 Cycle

CEC Demand Scenarios Project evaluated for potential scenarios

- **Business-As-Usual Reference**: "On-the-books" policy only
- **High Electrification Policy Compliance**: Aligned with current policy AND moderate electrification
- **High Electrification Mitigation**: Accelerated policy AND high electrification

Selected Case

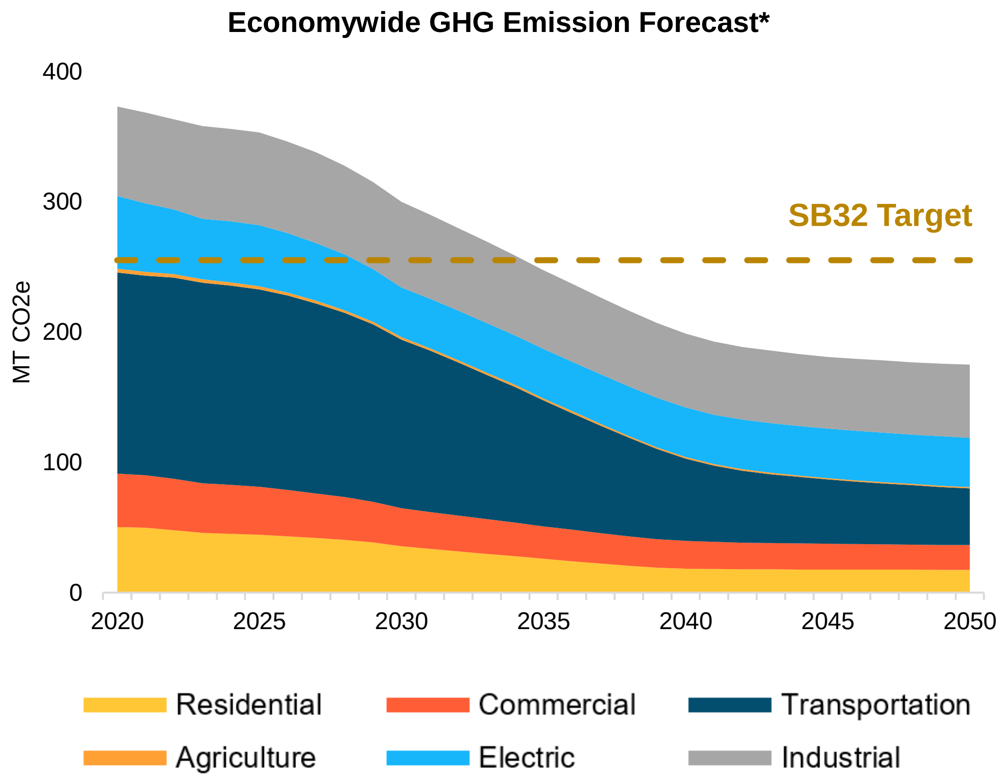


Scenario Selection for 2025 Cycle

CEC High Electrification Policy Compliance selected for 2025 life-cycle cost hourly factor calculations as a **realistic future scenario** aligned with existing policy and anticipated future policy

Major policy included in proposed scenario includes

- Electricity sector targets set by **SB 100**
- Misses emissions reductions goals **SB 32 & 80 x 50**

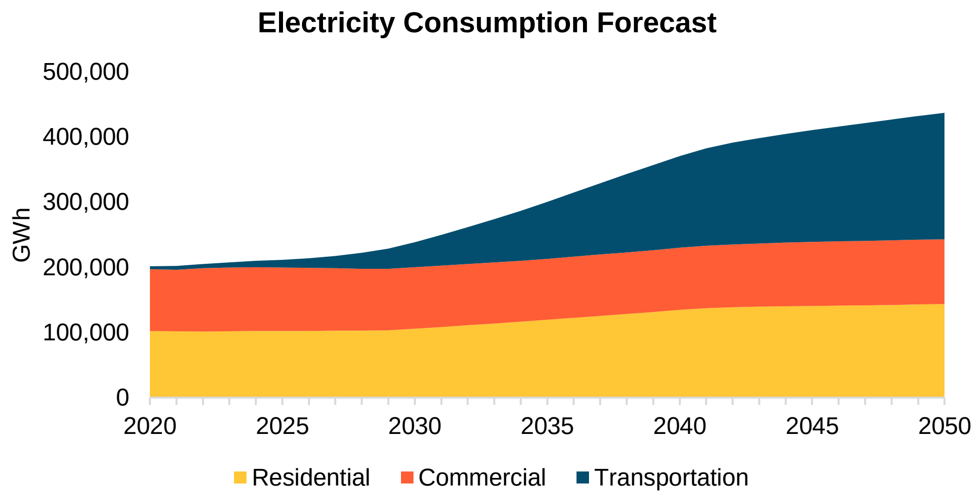


**Note that electricity sector emissions for "life-cycle-cost" analysis will be lower than electricity sector emissions in graph above due to detailed capacity expansion modeling*

Scenario Characteristics for 2025 Cycle

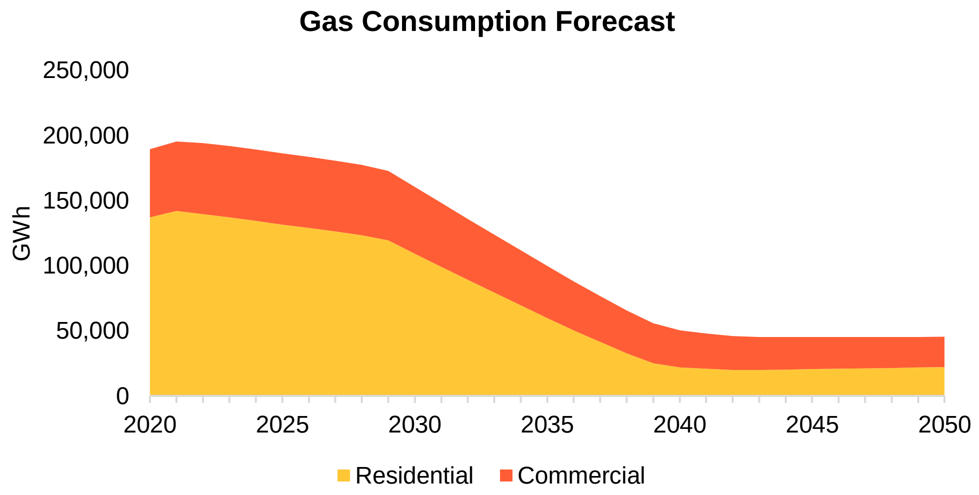
Significant transportation electrification and moderate building electrification from 2020-2050

- **4,300% increase** in transportation electricity
- **40% increase** in residential electricity
- **5% increase** in commercial electricity



Steep decline in building gas consumption from 2030-2040

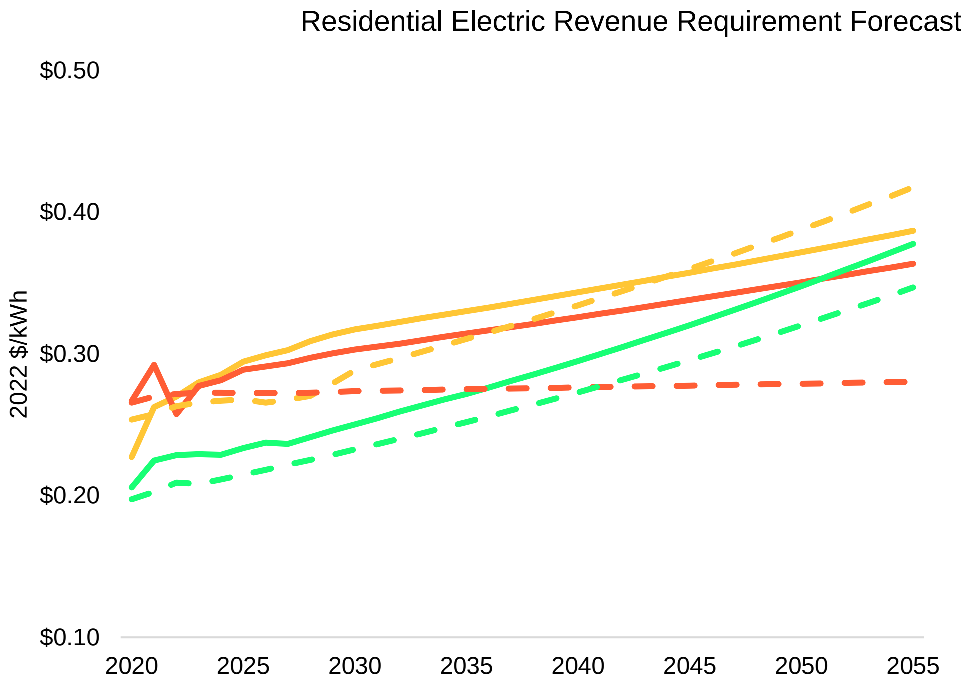
- **80% decrease** in residential gas
- **55% decrease** in commercial gas
- **No RNG** in pipeline

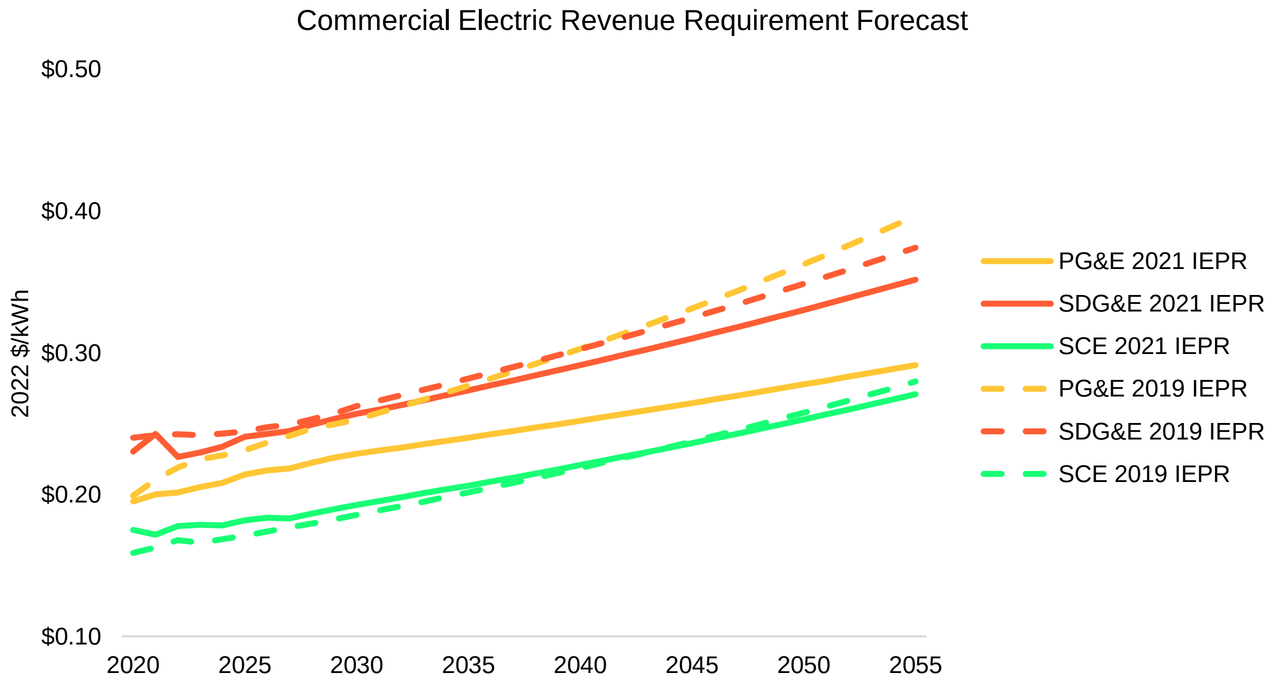


Electric Revenue Requirement Forecast

Electricity Revenue Requirement Forecast

Electric revenue requirement forecast from **2021 IEPR Mid-Demand case**, which incorporates recent volatility in gas price (forecast does not directly reflect customer rates)





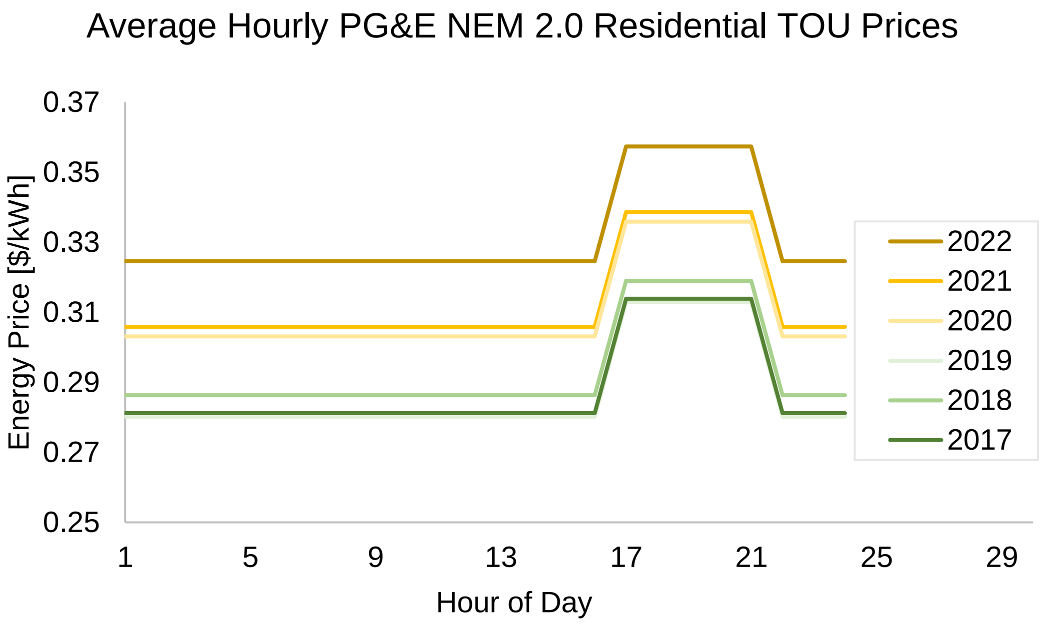
Electric Retail Rate Adders

Retail Rate Adder Time-Dependence

To develop **“time-dependent” requirements** for retail rate adder

- Identify **most extreme current and proposed TOU rates** to project future TOU rates
- Calculate revenue coming from “time-dependent” hours (including **demand charges** and **energy charges during on-peak periods**)

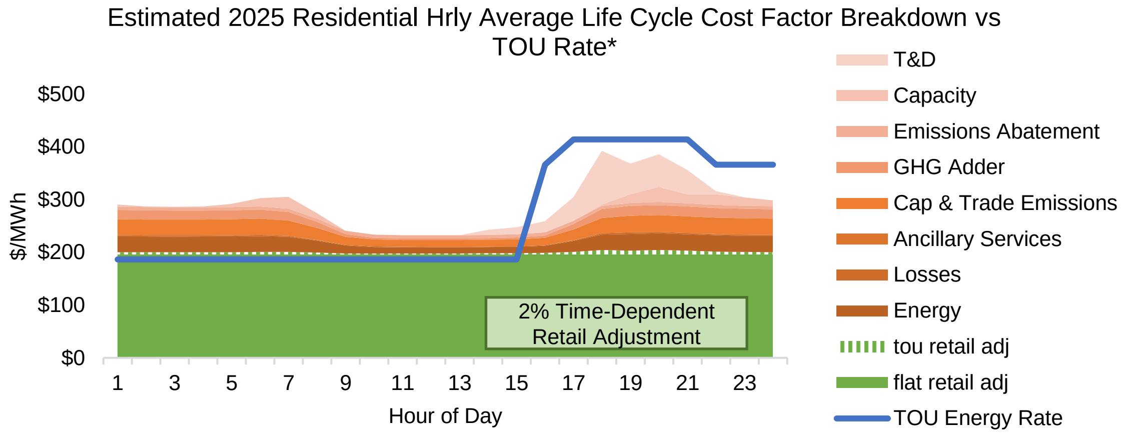
“Time-dependence” percentage of “life cycle cost” hourly factor retail rate adder calculated to yield **equivalent “time-dependent” revenue as TOU rates**

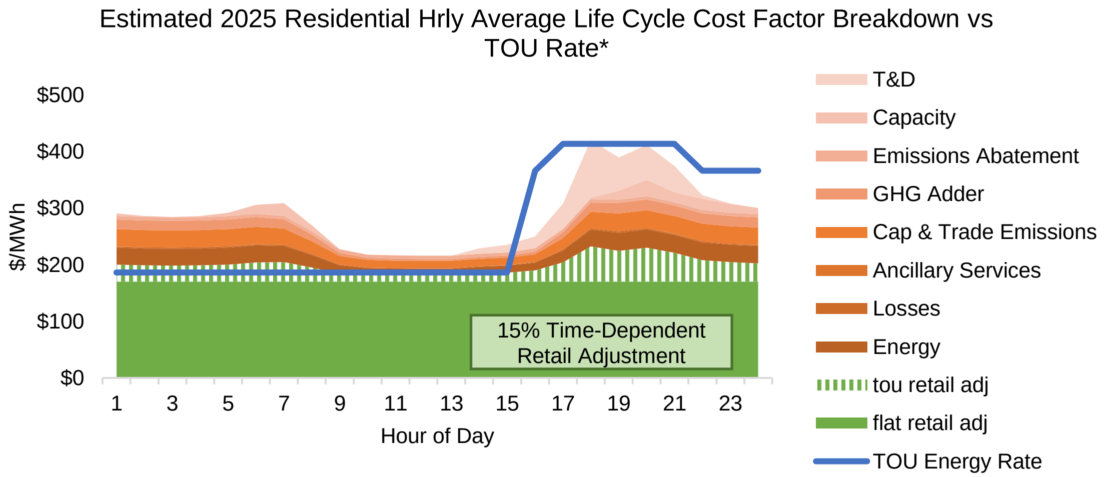


Residential Retail Rate Adder Time-Dependence

To achieve equivalent **"time-dependent" revenue** to projected future TOU rates, retail-rate adder must be **2% "time-dependent"** for **residential** buildings (almost no time-dependence necessary)

2025 code cycle will likely use **15% time-dependent** retail rate adders for **residential** factors (remain the same as 2022 code cycle)



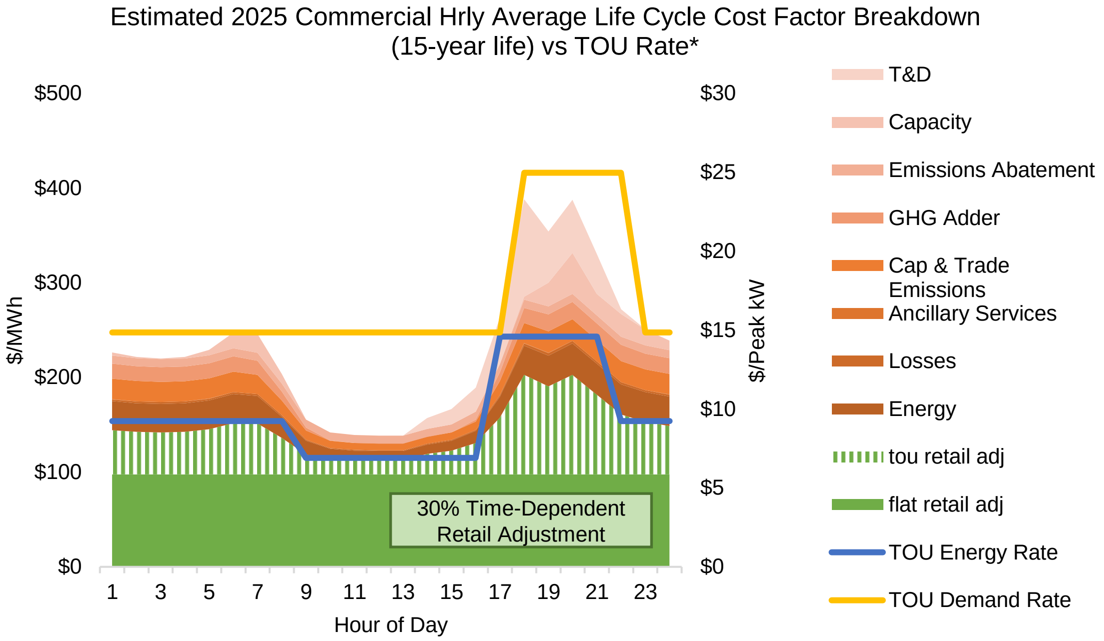


**Note that 2022 life cycle cost hourly factors have been adjusted to match electricity retail rate forecast from 2021 IEPR as an estimate for 2025 life cycle cost hourly factors*

Commercial Retail Rate Adder Time-Dependence

To achieve equivalent **“time-dependent” revenue** to projected future TOU rates, retail-rate adder must be **30% “time-dependent”** for **commercial** buildings with a **15-year life**

2025 code cycle will likely use **30% time-dependent** retail rate adders if commercial continues to use **15-year** life (100% increase from 2022 code cycle)

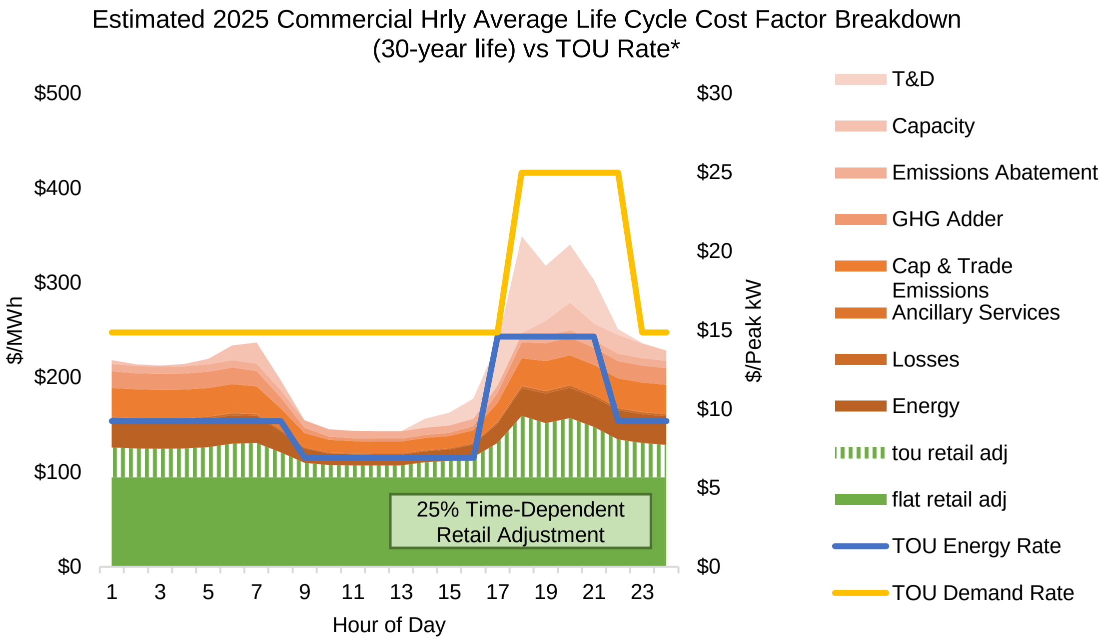


**Note that 2022 life cycle cost hourly factors have been adjusted to match electricity retail rate forecast from 2021 IEPR as an estimate for 2025 life cycle cost hourly factors*

Commercial Retail Rate Adder Time-Dependence

To achieve equivalent **"time-dependent" revenue** to projected future TOU rates, retail-rate adder must be **25% "time-dependent"** for **commercial** buildings with a **30-year life**

2025 code cycle will likely use **25% time-dependent** retail rate adders if commercial switches to **30-year** life (66% increase from 2022 code cycle)



**Note that 2022 life cycle cost hourly factors have been adjusted to match electricity retail rate forecast from 2021 IEPR as an estimate for 2025 life cycle cost hourly factors*

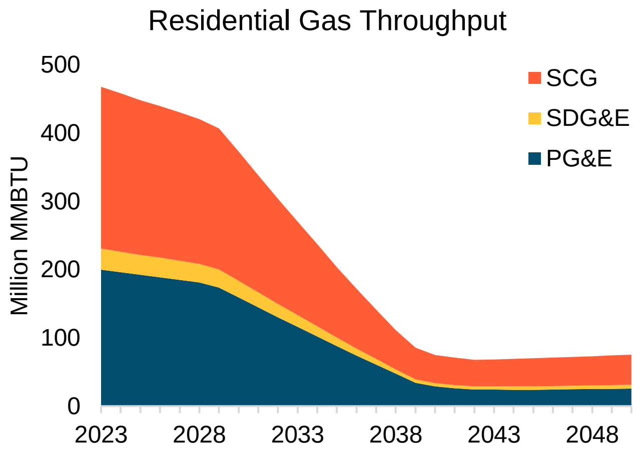
Gas Utility Cost Forecast

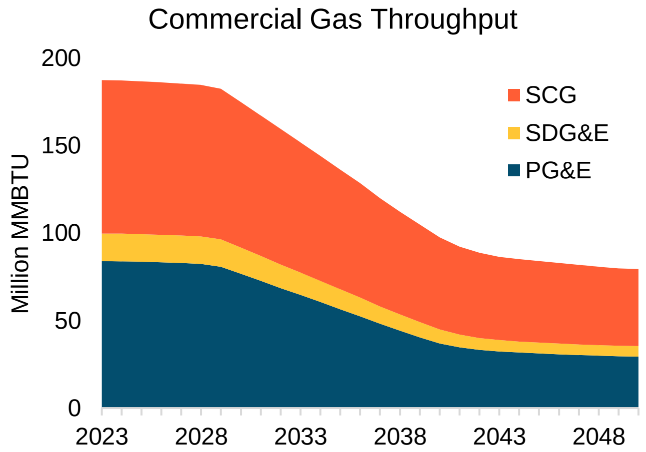
Gas Throughput & Revenue Requirement Forecast

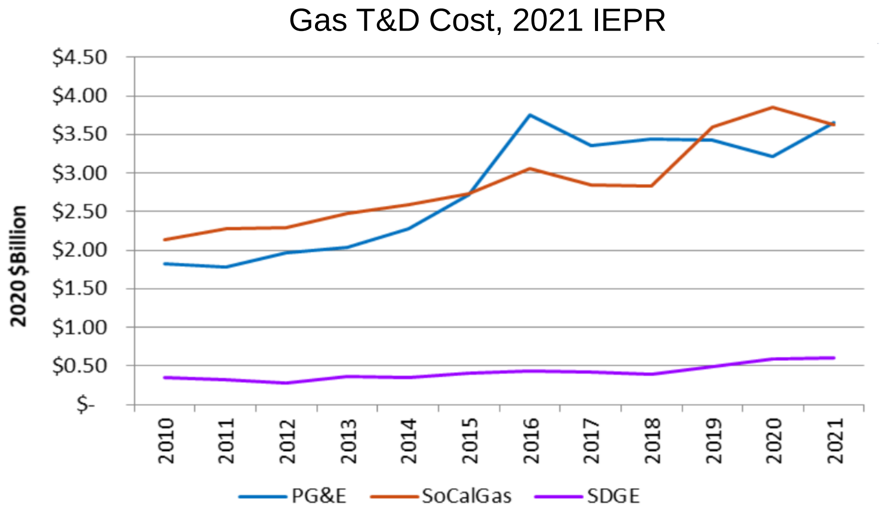
Gas throughput forecast from **selected demand scenario**

Gas revenue requirements from latest **utility general rate cases**

Gas revenue requirement **annual escalation rates** from **2021 IEPR**



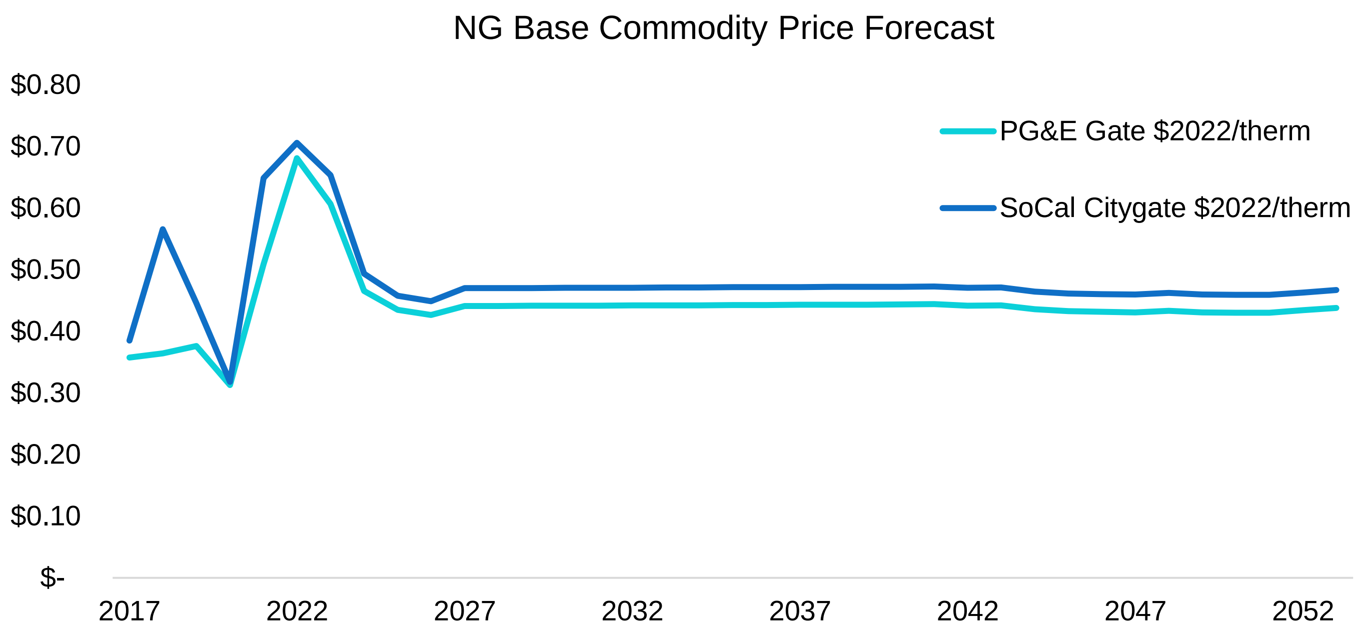




Gas Commodity Costs

Commodity costs generated from **NYMEX forwards & EIA long-term forecast**

- NYMEX forwards incorporate recent volatility in gas costs
- EIA long-term forecast assumes rates return to stability by 2027

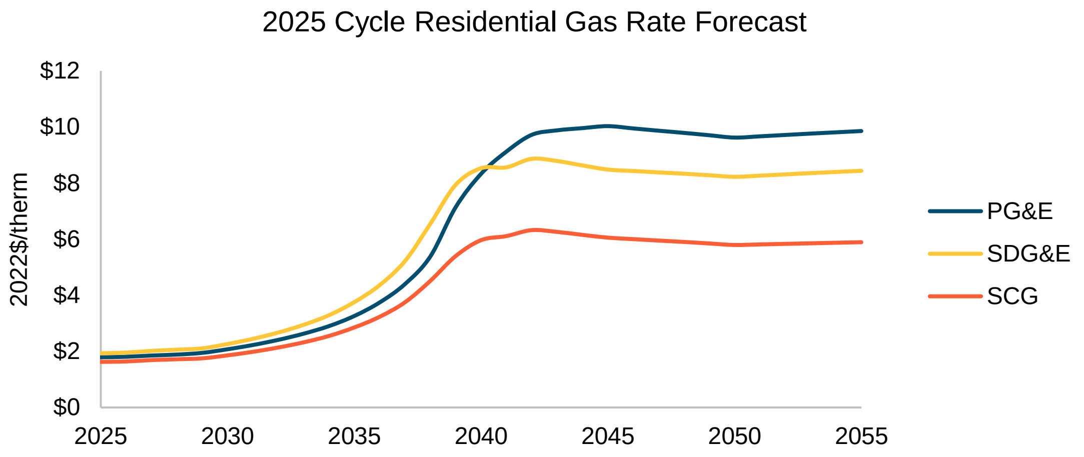


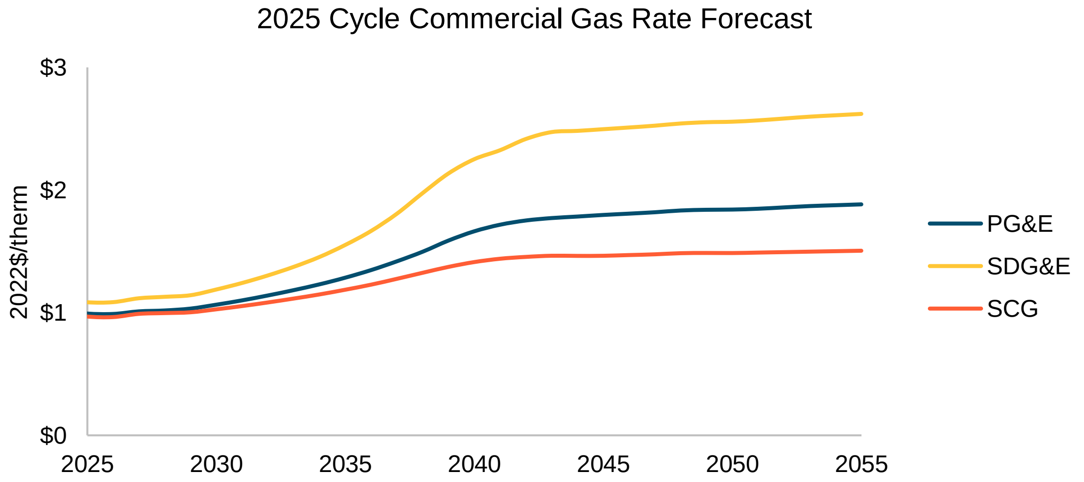
Gas Utility Cost Forecast

Current **residential** gas cost forecast goes to **$5.80-$9.60/therm** by 2050

Current **commercial** gas cost forecast goes to **$1.50-$2.60/therm** by 2050

Additional analysis being conducted to evaluate **potential reductions in gas revenue requirement** as gas throughput decreases





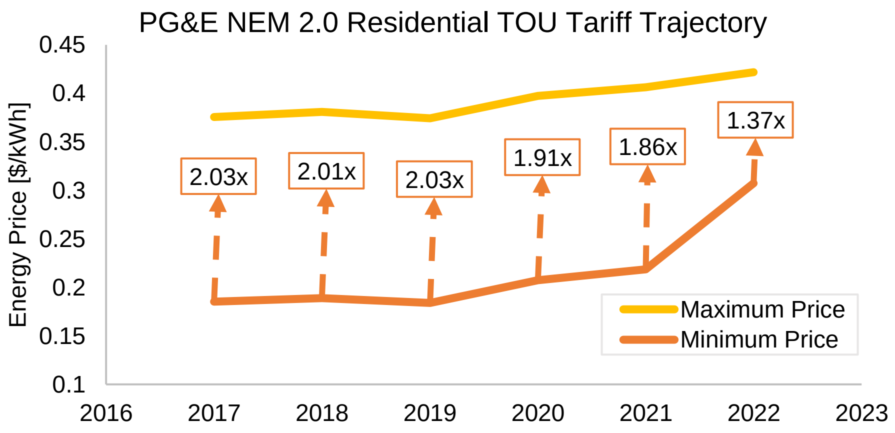
Public Comments on Session 4: 2025 Energy Code Life Cycle Costing Updates

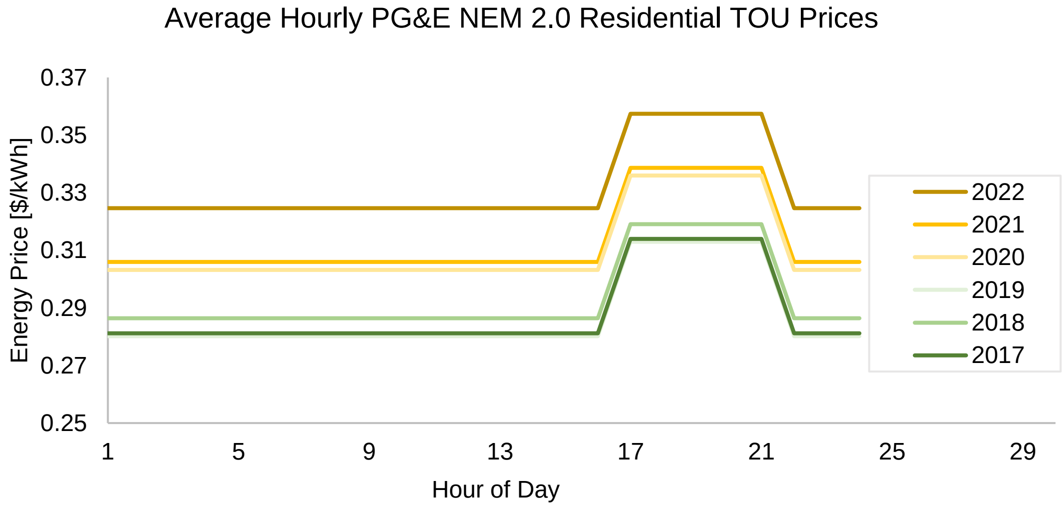
Jared Landsman, Energy and Environmental Economics, Inc.

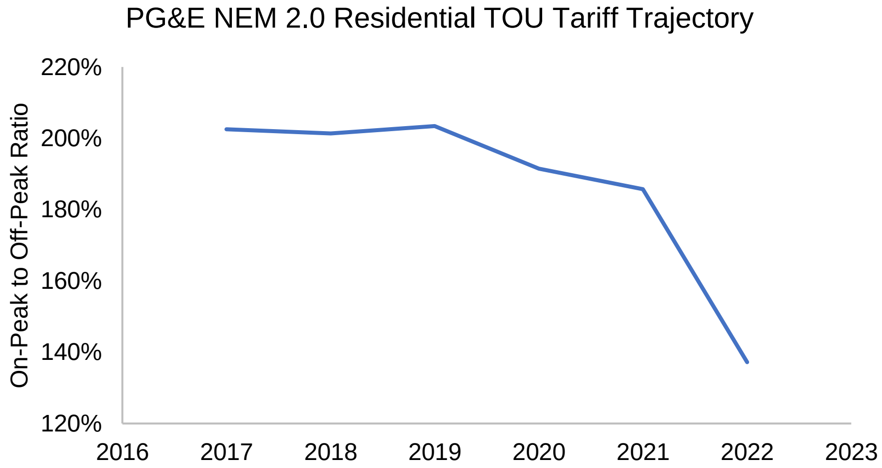
Appendix

Historical Residential Electric TOU Rate

- Historical residential TOU rates evaluated to determine projected future rates
  - Over the last 5 years, ratio of on-peak to off-peak rates for residential TOU rate has DECREASED from 200% in 2017 to 140% in 2022
- Future residential rates projected to be equivalent to NEM 3.0 rate with 270% on-peak to off-peak ratio



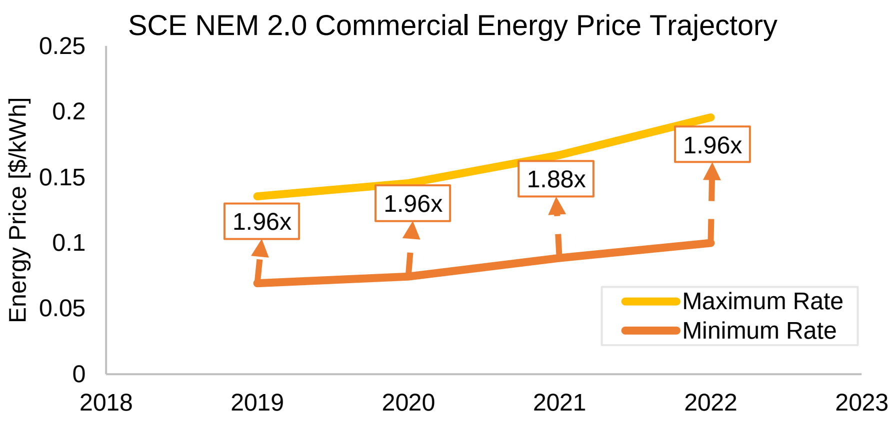


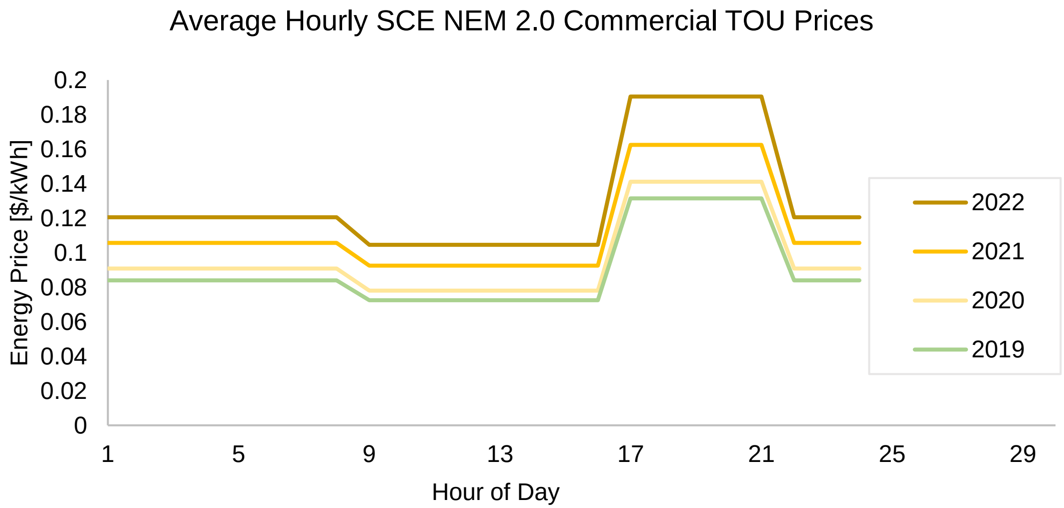


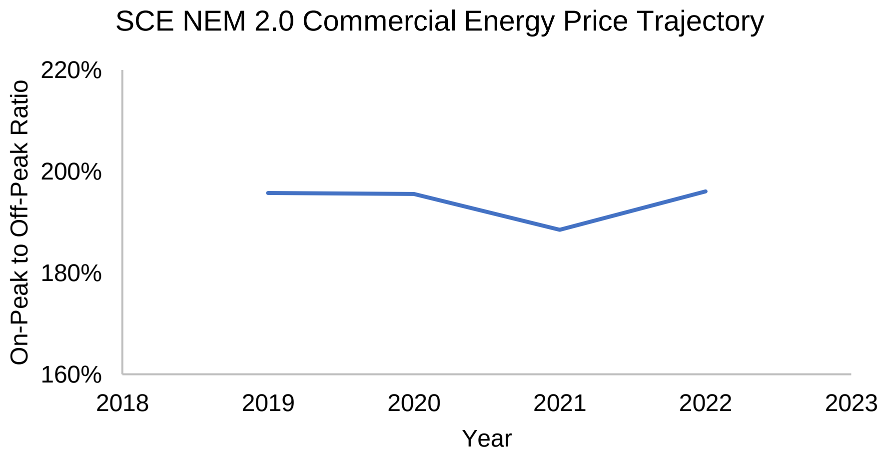
**Note that PG&E Residential TOU rates represent most extreme current TOU rates in practice*

Historical Commercial Electric TOU Rate

- Historical commercial TOU rates evaluated to determine projected future rates
  - Over the last 3 years, ratio of on-peak to off-peak rates for commercial TOU rate has REMAINED at about 200%
- Future residential rates projected with 250% on-peak to off-peak ratio







**Note that SCE Commercial TOU rates represent most extreme current TOU rates in practice*

2022 Energy Code

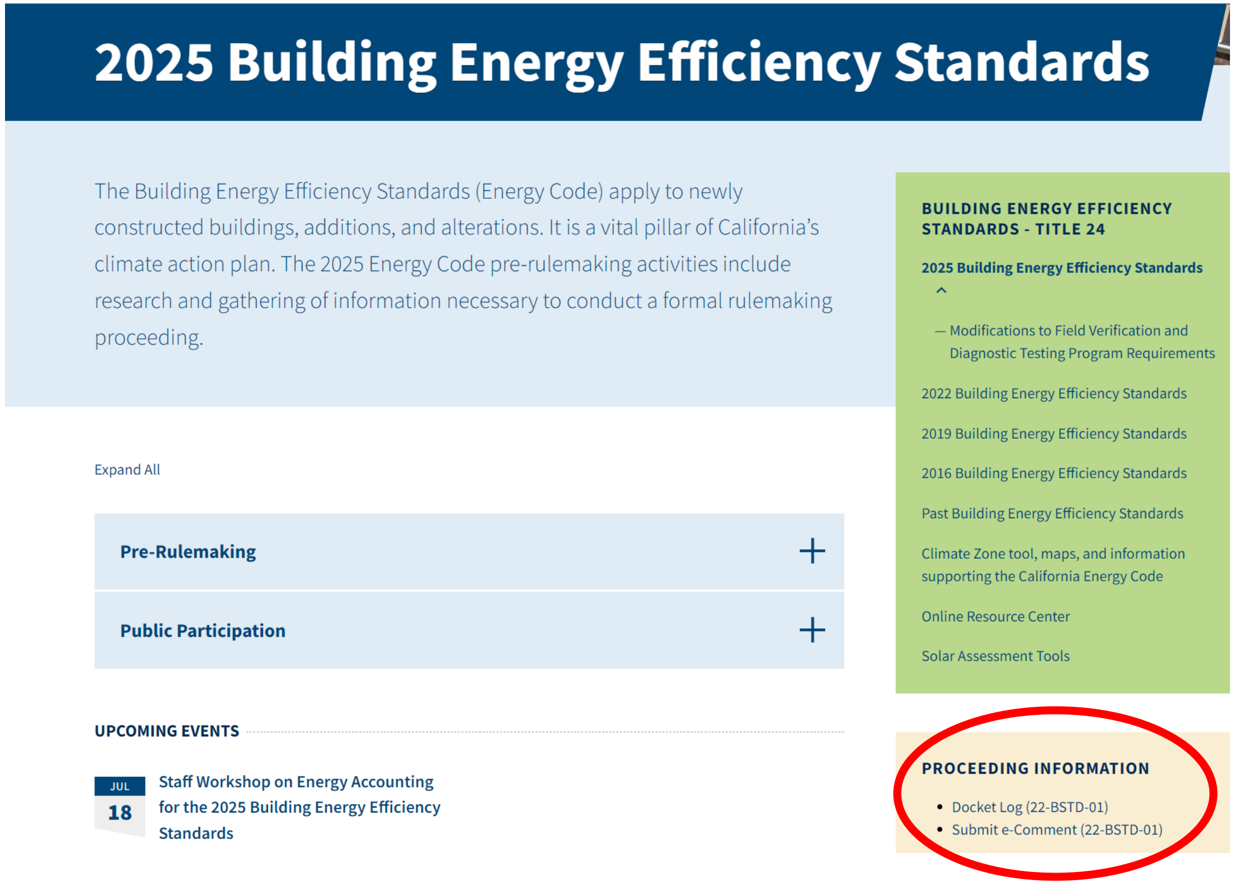
- Effective January 1, 2023.
- 2022 Energy Code website updated.
- Documents available:
  - Energy Code
  - Reference Appendices
  - Compliance Manuals

https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency

2025 Energy Code Page

2025 Energy Standards page is live

- 2025 Energy Code events and documents.
- Docket 22-BSTD-01



https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2025-building-energy-efficiency

Submitting Comments

- Efiling: https://efiling.energy.ca.gov/Ecomment/Ecomment.aspx?docketnumber=22-BSTD-01
- Email: Include docket number 22-BTSD-01 and "2025 Energy Code Accounting" in the subject line and email to docket@energy.ca.gov.
- Paper mail: California Energy Commission Docket Unit, MS-4 Docket No. 22-BSTD-01 715 P Street Sacramento CA 95814

2025 Energy Code Development

- Javier Perez – Project Manager
- Payam Bozorgchami – Technical Lead, Envelope, Additions and Alterations, ADUs
- Haile Bucaneg – Demand Response, Covered Process, Nonresidential and Residential ACM
- Muhammad Saeed – Solar Photovoltaic and Energy Storage Systems
- Bach Tsan – HVAC Systems, Refrigeration
- Erik Jensen – Energy Accounting
- Will Vicent – Manager, Building Standards Office
- Peter Strait – Supervisor, Building Standards Development Unit
- Che Geiser – Supervisor, Standards Tools Development Unit
- Chris Olvera – Supervisor, Outreach and Education Unit
- **Energy Commission email convention:** firstname.lastname@energy.ca.gov

Open Comment Period

Erik Jensen, California Energy Commission
Erik.Jensen@energy.ca.gov

Thank You!

7/20/2022

Retail Rate Adder Time Dependence Analysis

Prepared for the California Energy Commission

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Energy+Environmental Economics

The retail rate adder for electric TDV factors is intended to cover all additional costs to operate the electric system that are not already covered by the other avoided cost components. Historically, the retail rate adder was included as a flat adder, with the assumption that all costs covered by the adder are fixed and not "time-dependent". In the 2022 code cycle, the California Energy Commission decided to make 15% of the adder "time-dependent" and follow the shape of the other avoided cost components.

The purpose of this report is to highlight the analysis conducted by E3 on the "time-dependence" of the retail rate adder for the 2025 TDV factors. The report first presents the methodology used for the analysis. The report then presents the process taken to select an appropriate time-of-use (TOU) rate for comparison purposes. Finally, the report presents the recommended retail rate adder "time-dependence" that resulted from the aforementioned analysis.

Methodology

For the 2025 TDV factors, the California Energy Commission decided that an appropriate "time-dependence" of the retail rate adder would meet the following criteria:

Percent of annual revenue associated with the "time-dependent" portion of TDV should be equal to the percent of annual revenue collected from the "time-dependent" portion of anticipated TOU rates.

For the purposes of this analysis, the "time-dependent" portion of TDV comes from

- the avoided cost components and
- the time-dependent fraction of the retail-rate adder.

For the purposes of this analysis, the "time-dependent" portion of TOU rates comes from

- demand charges and
- energy charges during on-peak periods.

As a first step to this analysis, an evaluation was completed of the current landscape of time-of-use rates being implemented across the state. Because it is assumed that future TOU rates will get "peakier", the "peakiest" current and proposed TOU rates were investigated further. As a proxy for the "peakiness" of TOU rates, E3 measured the historical trend in on-peak to off-peak ratio occurring in the selected TOU rates. From there, estimates of future TOU rates were developed based on the historical trend in "peakiness".

The next step was to develop estimates of the TDV factors for the 2025 code cycle. For the 2022 code cycle, TDV factors were generated using an electricity rate forecast from the 2019 IEPR. To generate estimates for the 2025 TDV factors, the avoided cost components from the 2022 TDV factors were kept the same, but the overall TDV factors were normalized to the electricity rate forecast from the 2021 IEPR, rather than the 2019 IEPR. Because the net-present value of forecasted electricity rates has increased between the 2019 and 2021 IEPR, this means the retail-rate adder has also increased in magnitude. As a starting point, the retail rate adder was kept flat with 0% "time-dependence".

Once estimates for future TOU rates and 2025 TDV factors were generated, the final step was to evaluate "time-dependence" of the TDV revenue and TOU revenue for residential and non-residential customers. To calculate this metric, the TDV factors and TOU rates were multiplied by historical electric loads from each investor-owned utility. The percentage "time-dependence" for the TDV retail rate adder was then adjusted to ensure the "time-dependent" revenue percentage using TDV factors yielded the same time-dependent" revenue percentage using TOU rates.

TOU Rate Forecast

To develop estimated future TOU rates, the last five years of NEM2 TOU rates and proposed NEM3 TOU rates for SCE, PG&E, and SDG&E were evaluated using the Genability rate database. It was determined that the "peakiest" residential rate is the PG&E NEM 2.0 TOU rate and the "peakiest" non-residential rate is the SCE NEM 2.0 TOU rate. These two rates were then evaluated for the 5-year historical trajectory of on-peak to off-peak ratio.

Figure 1 shows the residential PG&E NEM 2.0 TOU energy prices from 2017-2022. The graphs indicate that both the on-peak and off-peak energy prices have increased over the last five years. Interestingly, the ratio of on-peak to off-peak price has actually decreased a bit in the last few years from about 200% in 2017 to about 135% in 2022. To be conservative, it has been assumed that the future residential TOU rate would have double the ratio of on-peak to off-peak ratio seen in 2022, yielding a ratio of **270%**. The proposed residential PG&E NEM 3.0 rate has a very similar on-peak to off-peak ratio, so this rate structure was used for analysis.

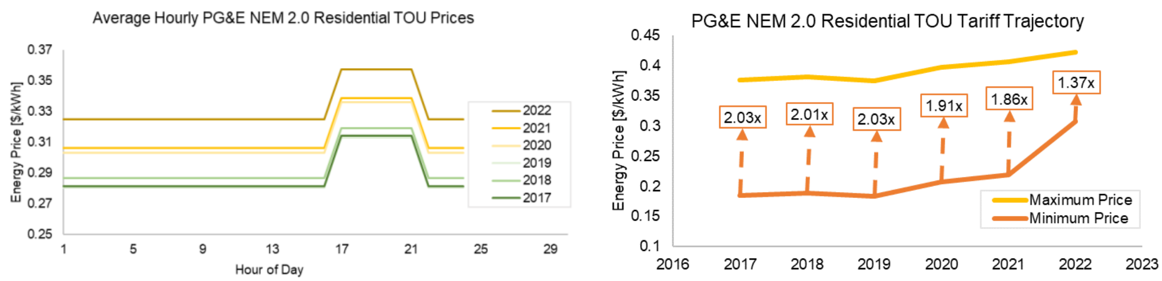


Figure 1. A) Average hourly PG&E NEM 2.0 residential TOU energy prices from 2017-2022. B) PG&E NEM 2.0 residential TOU minimum and maximum energy prices from 2017-2022

Figure 2 shows the non-residential SCE NEM 2.0 TOU energy prices from 2019-2022. The graphs indicate that both the on-peak and off-peak energy prices have increased over the last three years. With that said, the ratio of on-peak to off-peak price has actually remained fairly flat just under 200%. To be conservative, it has been assumed that the future non-residential TOU rate ratio of on-peak to off-peak ratio will increase by about 25%, yielding a ratio of **250%**. The future non-residential rate uses equivalent off-peak energy price to the 2022 value, with an increase in on-peak energy price.

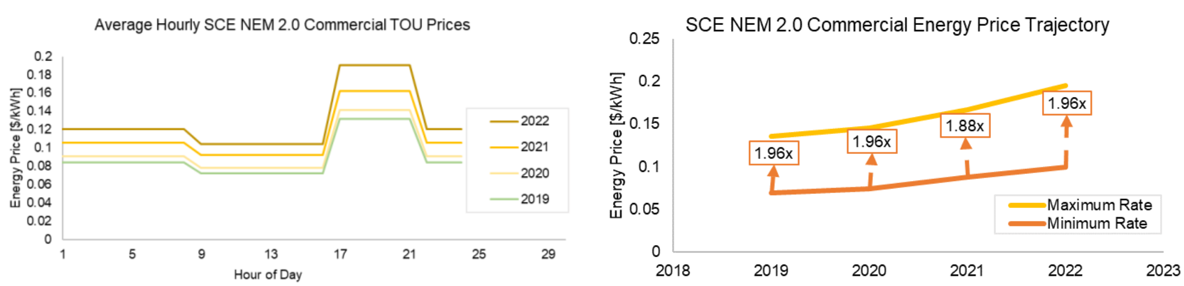


Figure 2. A) Average hourly SCE NEM 2.0 non-residential TOU energy prices from 2019-2022. B SCE NEM 2.0 non-residential TOU minimum and maximum energy prices from 2019-2022

Retail Rate Adder Results

The projected future residential TOU rate yields a “time-dependent” revenue percentage of **35%**. To achieve equivalent “time-dependent” revenue to the projected residential TOU rate, the residential TDV retail rate adder would need to be **2% “time-dependent”**. This is actually significantly lower than what was used in the 2022 code cycle. For the purposes of consistency, and as a conservative measure, it is recommended that the 2025 residential TDV factors use a **15% “time-dependent”** retail rate adder. Figure 3 shows the comparison of projected residential TOU energy price and average hourly residential TDV using a 2% and 15% “time-dependent” retail rate adder.

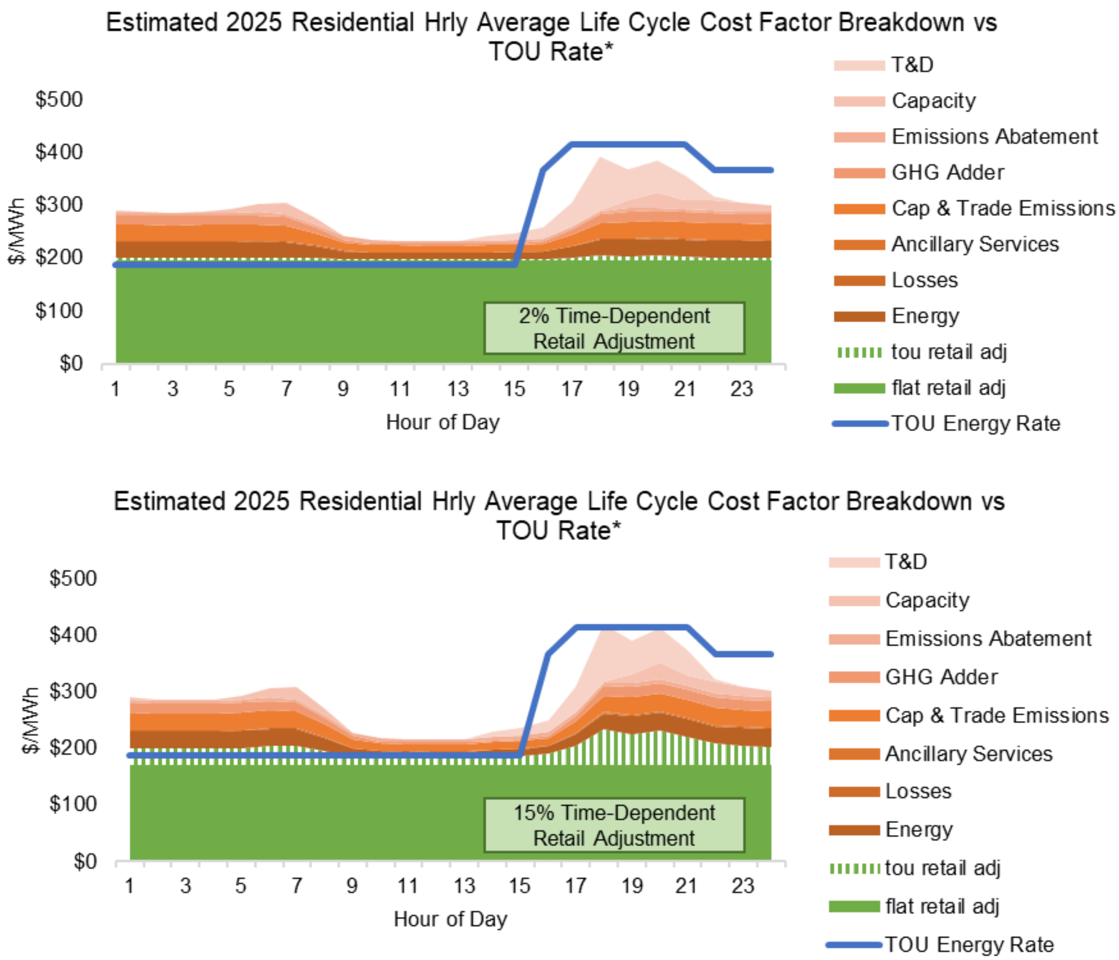
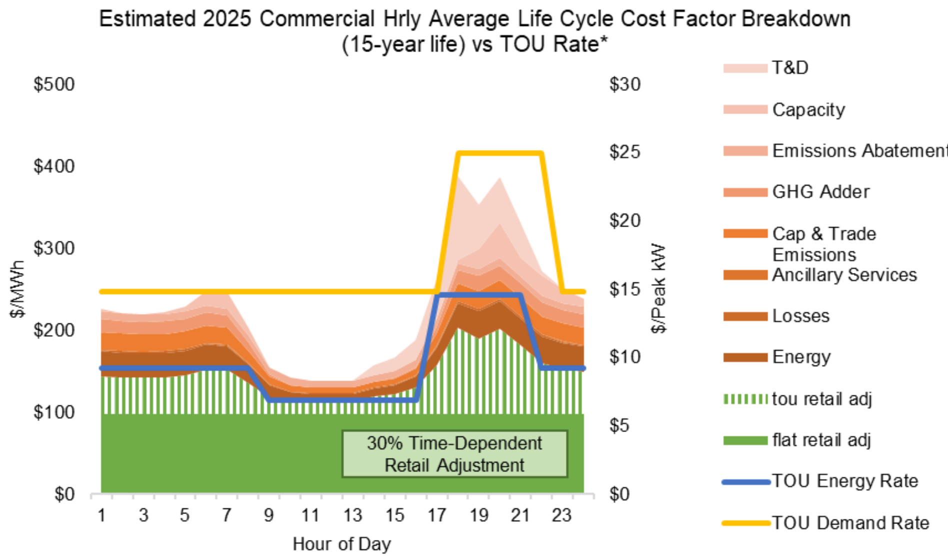


Figure 3. A) Hourly average estimated residential TDV factors with 2% “time-dependent” retail rate adder compared to projected residential TOU energy price. B) Hourly average estimated residential TDV factors with 15% “time-dependent” retail rate adder compared to projected residential TOU energy price

For the 2025 code cycle, a change in economic life is being considered for non-residential TDV factors. Current practice is to use a 15-year economic life for non-residential TDV factors. The proposed change would use a 30-year economic life for non-residential TDV factors. Therefore, two sets of “time-dependence” recommendations have been developed, for each economic life option.

The projected future non-residential TOU rate yields a “time-dependent” revenue percentage of **58%**. To achieve equivalent “time-dependent” revenue to the projected non-residential TOU rate with a 15-year economic life, the non-residential TDV retail rate adder would need to be **30% “time-dependent”**. This is double the “time-dependence" used in the 2022 code cycle. To achieve equivalent "time-dependent" revenue to the projected non-residential TOU rate with a 30-year economic life, the non-residential TDV retail rate adder would need to be **25% "time-dependent"**. This is a 66% increase in the "time-dependence" used in the 2022 code cycle. It is recommended that the 2025 non-residential TDV factors use either **30% or 25% "time-dependent"** retail rate adder, depending on the selected economic life. Figure 4 shows the comparison of projected non-residential TOU energy price and demand price to the average hourly non-residential TDV using a 30% "time-dependent" retail rate adder with 15-year economic life and a 25% "time-dependent" retail rate adder with 30-year economic life.



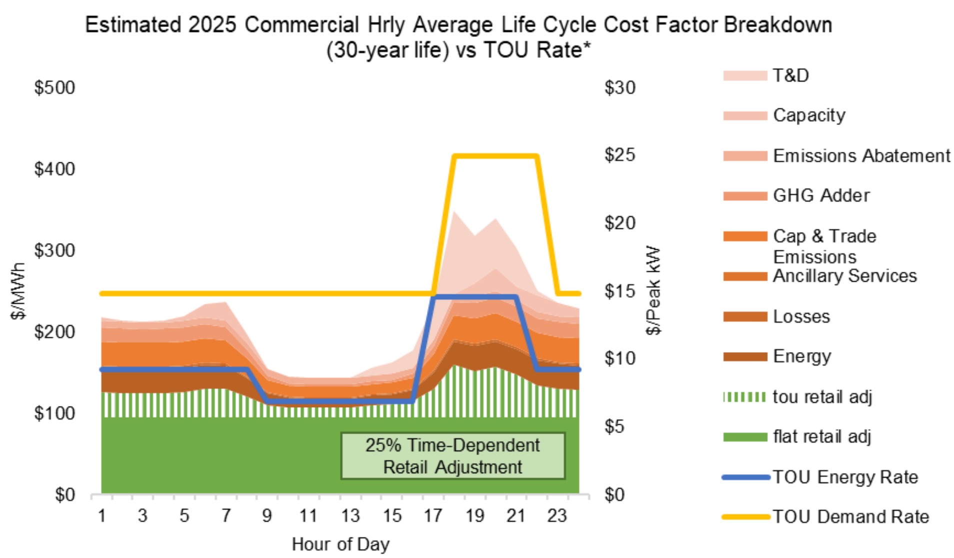


Figure 3. A) Hourly average estimated non-residential TDV factors with 30-year economic life and 30% "time-dependent" retail rate adder compared to projected non-residential TOU energy price and demand price. B) Hourly average estimated non-residential TDV factors with 15-year economic life and 25% "time-dependent" retail rate adder compared to projected non-residential TOU energy price and demand price