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EXECUTIVE SUMMARY

The purpose of this document is to summarize how the Energy Performance approach reach code ordinance provides Hourly Source Energy compliance margins that are achievable for new construction buildings in Cupertino (Climate Zone 4) while meeting two criteria:

1) Cost-effective, for approval by the California Energy Commission (CEC).
2) Technically feasible, using appliances with efficiencies set at the minimum federal requirements.

The Energy Performance approach encourages new construction buildings to reduce their emissions, and improve outdoor and indoor air quality. This is achieved by requiring new construction buildings utilizing the performance pathway to meet an Hourly Source Energy compliance margin which is stricter than that set by the state in the 2022 Energy Code, Title 24, Part 6. The reach codes mitigates legal risk with the Energy Policy and Conservation Act (EPCA) as a result of the California Restaurant Association vs. City of Berkeley ruling by remaining fuel neutral through providing cost-effective pathways to compliance for both mixed-fuel and all-electric buildings utilizing appliances with efficiencies set at the minimum federal requirements.

Table 1. Summary of EDR1/Source Energy Compliance Margins and Cost-Effectiveness Data for Climate Zone 4

Building Type	Metric	Reach Code Compliance Margin	Package	Package Details	Achieves Compliance Margin?	Is it Cost Effective?	Links
Single Family	EDR1	9 or greater	All-electric	Both major appliances are heat pumps (water heating and space heating & cooling).	Yes	Yes	Report SFNC Study Data
			Mixed-fuel	Combustion equipment is used with building efficiency measures, additional PV, and a battery.	Yes	Yes	
Multifamily (3-stories and less)	Source Energy	9% or greater	All-electric	Both major appliances are heat pumps (water heating and space heating & cooling).	Yes	Yes	Report MFNC Study Data
			Mixed-fuel	Combustion equipment is used with building efficiency measures, additional PV, and a battery.	Yes	Yes	
Multifamily (4-stories and more)	Source Energy	1% or greater	All-electric	Both major appliances are heat pumps (water heating and space heating & cooling).	Yes	Yes	
			Mixed-fuel	Combusting equipment is used with building efficiency measures and additional PV.	Yes	Yes	
Nonresidential	Source Energy	10% or greater	All-electric	Both major appliances are heat pumps (water heating and space heating & cooling).	Yes*	Yes*	Report NRNC Study Data
			Mixed-fuel	Combustion equipment is used with building efficiency measures.	Yes*	Yes*	

*Source Energy compliance margins and cost-effectiveness results vary by prototype building, see the nonresidential report for the full set of results in more detail.

MEMORANDUM

September 9, 2024

To: Christopher Jensen (Cupertino)

From: Taylor Taylor, Farhad Farahmand (TRC)

Re: Energy Performance Approach for Cupertino Reach Code

OVERVIEW

TRC provides this memo to direct readers to the references of the Hourly Source Energy margins used in the reach code ordinance. Hourly Source Energy is a compliance metric introduced in 2022 California Building Energy Efficiency Standards representing, among other things, transmission, delivery and production losses from the underlying fuel sources used to power building systems and equipment. A more thorough description of Hourly Source Energy compliance metric and relationship with other metrics is included in this Energy Code Ace document, excerpted at the end of this memo.

Cost-effectiveness studies produced by the California Investor-Owned Utilities Codes and Standards Program serve as the primary source of information. For various measure packages, these studies demonstrate Hourly Source Energy compliance margins that are achievable for new construction in Cupertino (Climate Zone 4) while meeting two criteria:

3) Cost-effective, for approval by the California Energy Commission (CEC).
4) Technically feasible, using appliances with efficiencies set at the minimum federal requirements.

Single Family

In single family only, the Hourly Source Energy metric is instead referred to as Energy Design Rating 1 (EDR1). EDR1 margins meeting the two criteria listed above are contained in the 2022 Cost-Effectiveness Study: Single Family New Construction Study (Report) and workbook (SFNC Study Data) for a 2,400 square foot single family building. Per Figure 1 below:

- The All-Electric Code Minimum package achieves an EDR1 margin equal to 8.8 (cell S230).
- The All-Electric Efficiency package that includes efficiency measures as well as the market baseline heat pump water heater, achieves 10.4 (cell S337).
- The All-Electric Efficiency + Equipment package that includes efficiency measures as well as the market baseline heat pump water heater (which performs well above federal minimum efficiency requirements), achieves 11.9 (cell S339).
- The Mixed Fuel Efficiency, PV, + Battery package achieves 13.2 (cell S347).

An **EDR1 compliance margin of 9** reflects a cost-effective baseline achievable by an all-electric code minimum new construction single family building, that is also technically feasible by a mixed-fuel building with appliances efficiencies at minimum federal requirements.

	F	H	I	S
6	measure	fuel_type	baseline_fuel_type	EDR1total_margin
230	All-Electric Code Minimum	All Electric	Mixed-fuel	8.8
337	All-Electric Efficiency	All Electric	Mixed-fuel	10.4
339	All-Electric Efficiency + High Efficiency Equipment	All Electric	Mixed-fuel	11.9
347	Mixed Fuel Efficiency, PV, + Battery (Basic)	Mixed-fuel	Mixed-fuel	13.2

Figure 1. Single Family (2400 square foot prototype) source energy margin results

Small Homes

Information on small new construction single family homes, such as ADUs, can also be found in the single-family home sources listed above by filtering for the 625 square foot single family building. Single family homes that are less than 1,500 square feet can have difficulties meeting the margins listed above for single family homes. This is because smaller homes use less energy overall and therefore the amount of energy savings potential is diminished. In order to prevent frequent cases of technical infeasibility, an exception is offered for homes less than 1,500 square foot, set at the target where a 625 square foot home can achieve it. Per Figure 2 below:

- The All-Electric Code Minimum package achieves an EDR1 margin equal to 2.4 (cell S56).
- The All-Electric Efficiency package that includes efficiency measures, achieves 3.9 (cell S58).
- The All-Electric Efficiency + High Efficiency Equipment package that includes efficiency measures as well as the market baseline heat pump water heater (which performs well above federal minimum efficiency requirements), achieves 5.5 (cell S60).
- The All-Electric Efficiency + PV package achieves 6.8 (cell S62).
- The Mixed Fuel Efficiency + High Efficiency Equipment package achieves 3.7 (cell S66).
- The Mixed Fuel Efficiency, PV, + Battery package achieves 13.3 (cell S215).

The all-electric efficiency + PV package is cost-effective and achieves an EDR1 of 6.8. Therefore, a small homes reach code compliance margin could be set as high as 6.8. The margin can be set lower, **such as at a compliance margin of 4,** to align with an all-electric building with a market baseline water heater, and also with the all-electric efficiency package. This encourages emissions reductions while reducing construction cost burden on smaller sized homes.

	F	H	I	S
6	measure	fuel_type	baseline_fuel_type	EDR1total_margin
56	All-Electric Code Minimum	All Electric	Mixed-fuel	2.4
58	All-Electric Efficiency	All Electric	Mixed-fuel	3.9
60	All-Electric Efficiency + High Efficiency Equipment	All Electric	Mixed-fuel	5.5
62	All-Electric Efficiency + PV	All Electric	Mixed-fuel	6.8
66	Mixed Fuel Efficiency + High Efficiency Equipment	Mixed-fuel	Mixed-fuel	3.7
215	Mixed Fuel Efficiency, PV, + Battery (Basic)	Mixed-fuel	Mixed-fuel	13.3

Figure 2. Single Family (625 square foot prototype) source energy margin results

Multifamily

Hourly Source Energy margins meeting the two criteria listed above are contained in the 2022 Cost-Effectiveness Study:
Multifamily New Construction (Report) and workbook (MFNC Study Data) for two multifamily family buildings (3-story, 39,372 ft^2 and 5-story, 140,925 ft^2). Per Figure 3 below:

- For the 3-story prototype
  - The All-Electric Code Minimum package achieves an Hourly Source Energy margin equal to 9% (cell AI30).
  - The Mixed Fuel Efficiency, PV, + Battery package achieves 17% (cell AI36)
- For the 5-story prototype
  - The All-Electric Code Minimum package achieves an Hourly Source Energy margin of 6% (cell AI51).
  - The Mixed Fuel Efficiency + PV package achieves 1% (cell AI156)

An **Hourly Source Energy compliance margin of 9% for 3-stories and less, and 1% for 4-stories and more,** reflects a cost-effective baseline achievable by an all-electric code minimum new construction multifamily building, that is also technically feasible by a mixed-fuel building with appliances efficiencies at minimum federal requirements.

	A	E	F	H	I	AI
5	row index/lookup/unique identifier	prototype	measure	fuel_type	baseline_fuel_type	Total Source Energy Margin
30	ae-code2.0	39372	all-electric prescriptive	All Electric	Mixed-fuel	9%
32	ae-pv2.0	39372	all-electric prescriptive & PV	All Electric	Mixed-fuel	18%
36	mf-effpvb2.0	39372	mixed fuel efficiency & PV & battery	Mixed-fuel	Mixed-fuel	17%
51	ae-codenew2.0	140925	all-electric prescriptive	All Electric	Mixed-fuel	6%
72	ae-newpv2.0	140925	all-electric prescriptive & PV	All Electric	Mixed-fuel	13%
156	mf-effpv2.0	140925	mixed fuel efficiency & PV	Mixed-fuel	Mixed-fuel	1%

Figure 3. Multifamily source energy results. Under the "prototype" column, the 3-story building is 39,372 ft^{2}and the 5-story building is 140,925 ft^2.

Nonresidential

Hourly Source Energy margins meeting the two criteria listed above are contained in the 2022 Nonresidential New Construction Reach Code Cost-effectiveness Study (Report) and workbook (NRNC Study Data) for four nonresidential prototypes (Medium Office, Retail, Quick-Service Restaurant, and Small Hotel). Per Figure 4 below:

- For the Medium Office ('MO' tab in the workbook)
  - The All-Electric Code Minimum package achieves an Hourly Source Energy margin equal to 5% (cell T29).
  - The Mixed Fuel + Efficiency package achieves 10% (cell T6).
- For the Medium Retail ('RE' tab in the workbook)
  - The Mixed Fuel Code Minimum package achieves -29% (cell T6).
  - The All-Electric + Efficiency package achieves 12% (cell T52).
- For the Quick Service Restaurant ('QSR' tab in the workbook)
  - The All-Electric Code Minimum package achieves 42% (cell T121).
  - The Mixed Fuel + Efficiency package achieves 12% (cell T6).
- For the Small Hotel ('SH' tab in the workbook)

- The All-Electric Code Minimum package achieves 29% (cell T29).
- The Mixed Fuel + Efficiency package achieves 7% (cell T6).

For nonresidential buildings, **an Hourly Source Energy compliance margin of 10%** reflects the average performance of mixed-fuel buildings with appliances efficiencies at minimum federal requirements and additional non-preemptive efficiency measures. Nonresidential buildings with all-electric heat pumps at minimum federal requirements will achieve this target without any additional efficiency measures.

A subset of nonresidential buildings which utilize small rooftop HVAC, like Retail, already have heat pump as the prescriptive code minimum, which achieves the same objective as the reach code applied to the nonresidential buildings. To account for this, an exception is included for nonresidential buildings that reduces the Hourly Source Energy compliance margin to 0% (the state minimum requirement) when nonresidential occupancies are designed with single zone space-conditioning systems complying with Section 140.4(a)2.

	B	T
2	Package	Source kBtu Margin (CBECC)
6	mo-mf-eff	10%
29	mo-ae-code	5%
52	mo-ae-eff	10%
75	mo-ae-effIf	18%

	B	T
2	Package	Source kBtu Margin (CBECC)
6	re-mf-code	-29%
29	re-mf-eff	-15%
52	re-ae-eff	12%

	B	T
2	Package	Source kBtu Margin (CBECC)
6	qsr-mf-eff	12%
29	qsr-ae-hs	37%
52	qsr-ae-hseff	45%
75	qsr-ae-hseffIf	50%
98	qsr-ae-hseffpv	52%
121	qsr-ae-code	42%
144	qsr-ae-eff	49%

	B	T
2	Package	Source kBtu Margin (CBECC)
6	sh-mf-eff	7%
29	sh-ae-code	29%
52	sh-ae-eff	14%
75	sh-ae-effpv	23%
98	sh-ae-codept	31%

Figure 4. Source energy margin results for Medium Office (MO), Retail (RE), Quick Service Restaurant (QSR), and Small Hotel (SH)

Appendix: Single Family Building Summary of Source Energy and Other Metrics

Evolving Compliance Metrics

The 2022 Energy Code continues improvements in energy efficiency ratings in order to pivot new residential buildings toward technologies that will help the state meet its critical long-term climate and carbon neutrality goals.

Energy Code	New Construction	Additions	Alterations
2016	TDV	TDV	TDV
2019	EDRe, EDRt	TDV	TDV
2022	EDRs*, EDRe, EDRt	TDV	TDV

***EDRs** = source energy design; **EDRe** = efficiency energy design rating; **EDRt** = total energy design rating; **TDV** = time dependent valuation.*

The source EDR metric is new for 2022 and enables measure of emissions in some form.

***Table 1.** Evolving Building Energy Efficiency Ratings for Residential Construction*

The 2016 Energy Code used time dependent valuation (TDV) energy as a compliance metric in the Performance Approach for New Construction, Additions and Alterations. TDV energy is the time varying energy used by the building to provide space conditioning, water heating and specified building lighting. It accounts for the energy used at the building site and consumed in producing and delivering energy to a site, including, but not limited to, power generation, transmission and distribution losses.

The 2019 Energy Code replaced TDV with energy design rating (EDR) metrics for New Construction to express the energy performance of a home. In the EDR scoring system 100 represents the energy performance of a reference design building meeting the envelope requirements of the 2006 International Energy Conservation Code (IECC). A score of 0 represents the energy consumption of a building that has zero net energy consumption. The lower the score, the better. For a New Construction project to comply using the performance approach, the proposed Efficiency EDR and Total EDR must be lower than or equal to the standard Efficiency EDR and Total EDR.

The 2022 Energy Code adds a third metric to EDR for New Construction: source energy design rating ERD1 is a separate EDR metric based on hourly source energy which establishes a carbon-proxy analysis of the building in kBTU/sf-yr units to support decarbonization and electrification policy goals

Source Energy Design Rating (EDR1)	Efficiency Energy Design Rating (EDR2)	Total Energy Design Rating (EDR Total)
A score representing the building energy efficiency expressed in terms of an **hourly source carbon-based metric**	A score representing the building energy efficiency expressed in terms of a **TDV energy-based metric**	A score representing the building's **total TDV energy while also factoring in photovoltaics (PV) and flexibility**
EDR1 includes: ✦ Envelope ✦ IAQ ✦ HVAC ✦ DHW ✦ Unregulated loads	EDR2 includes: ✦ Envelope ✦ IAQ ✦ HVAC ✦ DHW ✦ Unregulated loads	EDR Total includes: ✦ Efficiency measures ✦ Photovoltaics ✦ Batteries ✦ Precooling

***DHW** = domestic hot water; **HVAC** = heating, ventilation and air conditioning; **IAQ** = indoor air quality; **TDV** = time dependent valuation.*

***Table 2.** Energy Design Rating (EDR) as a Compliance Metric*

A building complies only if all three compliance scores are met, which means that each proposed design score is lower than or equal to the standard design score.

Source: Energy Code Ace – Single Family Buildings: What's New in 2022?