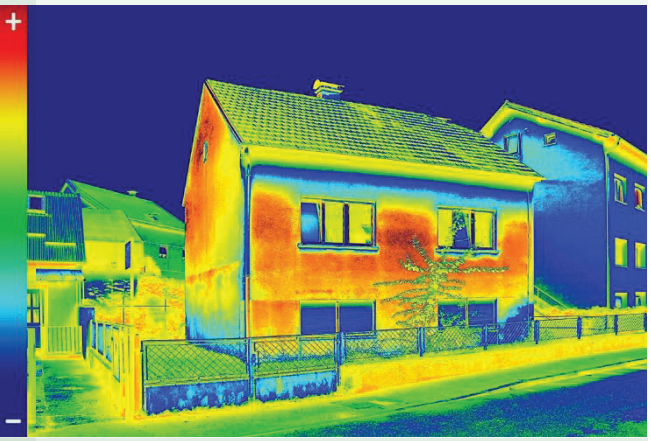
E-1. Exceed 2019 Title 24 Building Envelope Energy Efficiency Standards



GHG Mitigation Potential

Up to 99% of GHG emissions from building electricity and/or natural gas use

Co-Benefits (icon key on pg. 34)

Climate Resilience

Increased energy efficiency can reduce the strain on the overall grid, particularly the risk of power outages during peak loads. Increased efficiency can also reduce energy costs, particularly if extreme heat would otherwise increase these costs.

Health and Equity Considerations

More energy efficient buildings can help residents to save money on utility costs and reduce exposure to extreme heat, supporting greater resilience to climate health impacts. This can be especially critical for low-income and vulnerable residents.

Measure Description

This measure requires new buildings to exceed the energy efficiency requirements of the building energy standards of the 2019 version of Title 24. GHGs are emitted because of activities in residential and commercial buildings that use electricity and natural gas as energy sources. By committing to a percent improvement over Title 24, the building's energy use is reduced, thereby reducing GHG emissions. Title 24 Part 6 regulates energy uses including space heating and cooling, hot water heating, ventilation, and integrated lighting. End use categories not subject to Title 24 requirements include appliances, electronics, and miscellaneous "plug-in" uses.

Subsector

Energy Efficiency Improvements

Scale of Application

Project/Site

Implementation Requirements

Reduce energy use from any of the following end uses: space heating and cooling, hot water heating, ventilation, and integrated lighting.

Cost Considerations

In order to make buildings even more energy efficient, developers will face greater upfront costs to purchase higher-quality materials, which may be passed on to the property owner. However, property owners will realize cost savings from reduced energy use. Property owners will also avoid potential retrofitting costs in the future if efficiency standards are made more stringent.

Expanded Mitigation Options

Pair with Measure E-2, *Require Energy Efficient Appliances*, to reduce energy use from both end use categories that are subject to Title 24 requirements and those that are not to yield increased GHG reductions.

GHG Reduction Formula

$$A = -C \times E$$

GHG Calculation Variables

ID	Variable	Value	Unit	Source
Output				
A	Percent reduction in GHG emissions from building electricity and/or natural gas consumption	[ ]	0–99%	calculated
User Inputs				
B	Building/housing type	[ ]	text	user input
C	Percent improvement beyond 2019 Title 24	0–100	% expressed as a whole number	user input
Constants, Assumptions, and Available Defaults				
D	Electricity Demand Forecast Zone	Figure E-1.1 Table E-1.1	integer	CEC 2017
E	Percent reduction in building electricity or natural gas consumption for 1% improvement over 2019 Title 24 Standards	Tables E-1.2 through Table E-1.5	%	CEC 2020, 2021

Further explanation of key variables:

- (A) – The output provides the percent reduction in GHG emissions from either building electricity or natural gas consumption, depending on which energy source the user is interested in calculating (E). To determine the percent reduction in GHG emissions from building energy (i.e., electricity plus natural gas), the user would need to know the percent of total GHG emissions from each energy source. For example, if 40 percent of building energy emissions come from electricity and 60 percent come from natural gas consumption, the percent reduction in GHG emissions from building energy could be calculated as follows.

  $$A_{energy} = (40\% \times A_{electricity}) + (60\% \times A_{natural\ gas})$$

  Further, to determine the percent reduction in GHG emissions for a project with multiple buildings, the user would need to know the percent of total building energy emissions from each building. For example, if 67 percent of building energy emissions come from Building 1 and 33 percent come from Building 2, the percent reduction in GHG emissions from all building energy could be calculated as follows.

  $$A_{energy\_total} = (67\% \times A_{energy\_1}) `+ (33\% \times A_{energy\_2})$$

- (B) – The building and housing types are needed to lookup the percent reduction in electricity or natural gas consumption over 2019 Title 24 Standards (E).
- (D) – The California Energy Commission (CEC) has specified 28 distinct Electricity Demand Forecast Zones (EDFZs) in California. Users should refer to Figure E-1.1 in

Appendix C to determine the EDFZ for their project. This measure relies on energy consumption data from the year 2019 tied to the CEC's 2018-2030 Uncalibrated Commercial Sector Forecast (Commercial Forecast) and the 2019 RASS (CEC 2020, 2021). Because data from all 28 EDFZs are not included in the Commercial Forecast and RASS, representative data from similar EDFZs may need to be used. Users should refer to Table E-1.1 for the proxy EDFZ that corresponds with those listed in Tables E-1.2 through E-1.5.

- (E) – See Tables E-1.2 through E-1.5 for the percent reduction in building electricity and natural consumption by EDFZ and land use type. There are two tables for residential land uses and two for non-residential land uses. This information is based on the percent of total building energy that comes from end use categories subject to Title 24 requirements (e.g., space heating and cooling, hot water heating, ventilation) (CEC 2020, 2021).[20, 21] For example, for a general office building in EDFZ 1, 65 percent of electricity and 79 percent of natural gas consumption come from end use categories subject to Title 24 requirements. Thus, a 1 percent improvement in building energy efficiency standards results in a 0.65 percent reduction in electricity use and a 0.79 percent reduction in natural gas consumption.

GHG Calculation Caps or Maximums

Measure Maximum

(C_{max}) The percent improvement beyond 2019 Title 24 standards is capped at 100.

It is assumed that the energy demand of the user's project is currently being met by grid electricity that requires *some* amount of fossil fuel–based energy generation and/or onsite natural gas, both of which emit GHGs from fuel combustion. In other words, the local electricity provider has an energy intensity factor (lb of CO_2e per MWh) greater than zero and/or the project consumes natural gas onsite for building energy. For all-electric projects that are served by electricity providers already with a renewable portfolio of 100 percent, this measure could have no reduction in GHG emissions. If the electricity provider is using renewable energy credits (REC) to meet a 100 percent renewable portfolio goal, then some emissions reductions may be achieved. This measure would still result in the co-benefits of reduced electricity use and enhanced energy security.

Mutually Exclusive Measures

If the user selects Measure E-15, *Require All-Electric Development*, they may not also take credit for any natural gas–related efficiency gains under this measure. In other words, ($A_{natural\ gas}$) should be zeroed out in the above equation.

Example GHG Reduction Quantification

The user reduces building energy by exceeding energy efficiency standards. In this example, the user commits to a 10 percent improvement over 2019 Title 24 requirements (C) for

[20] End use categories not subject to Title 24 requirements include appliances, electronics, and miscellaneous "plug-in" uses.

[21] Hardwired lighting is part of Title 24 Part 6. However, it is not part of the building envelope energy and, therefore, not considered as part of this measure.

their project located in EDFZ 3 (D). The project includes Building 1, a day-care center, and Building 2, apartments (mid-rise) (B). The user would reduce GHG emissions from the day-care center from electricity and natural gas by 8.1 percent and 9.9 percent, respectively. GHG emissions from the apartment from electricity and natural gas would be reduced by 2.4 percent and 9.5 percent, respectively.

$A_{electricity\_1} = -10 \times 0.81\% = -8.1\%$ day care electricity emissions

$A_{natural\ gas\_1} = -10 \times 0.99\% = -9.9\%$ day care natural gas emissions

$A_{electricity\_2} = -10 \times 0.24\% = -2.4\%$ apartment electricity emissions

$A_{natural\ gas\_2} = -10 \times 0.95\% = -9.5\%$ apartment natural gas emissions

The percent reduction in GHG emissions from building energy (i.e., electricity plus natural gas) per building can also be calculated if the user knows the percent of total GHG emissions from each energy source. In this example, 40 percent of the day-care building's energy emissions come from electricity and 60 percent come from natural gas consumption, while 45 percent of the apartment building's energy emissions come from electricity and 55 percent come from natural gas consumption. Energy sector GHG emissions from the day-care and apartment would be reduced by 9.2 percent and 6.3 percent, respectively.

$A_{energy\_1} = (40\% \times -8.1\%) + (60\% \times -9.9\%) = -9.2\%$ day care energy emissions

$A_{energy\_2} = (45\% \times -2.4\%) + (55\% \times -9.5\%) = -6.3\%$ apartment energy emissions

Further, the percent reduction in GHG emissions for the project can be calculated if the user knows the percent of total building energy emissions from each building. In this example, 33 percent of building energy emissions come from the day-care and 67 percent come from the apartment. The percent reduction in GHG emissions from all building energy would be 7.9 percent.

$A_{energy\_total} = (33\% \times -9.2\%) + (77\% \times -6.3\%) = -7.9\%$ building energy emissions

Quantified Co-Benefits

Improved Air Quality

Electricity supplied by statewide fossil-fueled or bioenergy power plants generates criteria pollutants. However, because these power plants are located throughout the state, the reduction in electricity use from this measure will not reduce localized criteria pollutant emissions at the project site.

The reduction in natural gas consumption from this measure would result in local improvements in air quality because the building natural gas combustion regulated under Title 24 Part 6 occurs on the project site (e.g., space heating, water heating).

The percent reduction in criteria pollutants from natural gas ($A_{naturalgas}$) is the same as the percent reduction in building natural gas consumption achieved by the measure.

Energy and Fuel Savings

The percent reduction in electricity use achieved by the measure is the same as the percent reduction in GHG emissions from electricity ($A_{electricity}$). The percent reduction in natural gas consumption achieved by the measure is the same as the percent reduction in GHG emissions from natural gas ($A_{naturalgas}$).

Sources

- California Energy Commission (CEC). 2017. *California Electricity Demand Forecast Zones*. Available: https://cecgis-caenergy.opendata.arcgis.com/datasets/86fef50f6f344fabbe545e58aec83edd_0/data?geometry=-165.327%2C31.004%2C-72.427%2C43.220. Accessed: June 2021.
- California Energy Commission (CEC). 2020. Excel database with the 2019 Residential Appliance Saturation Study (RASS), provided to ICF. November 13, 2020.
- California Energy Commission (CEC). 2021. Excel database with the 2018–2030 Uncalibrated Commercial Sector Forecast, provided to ICF. January 21, 2021.