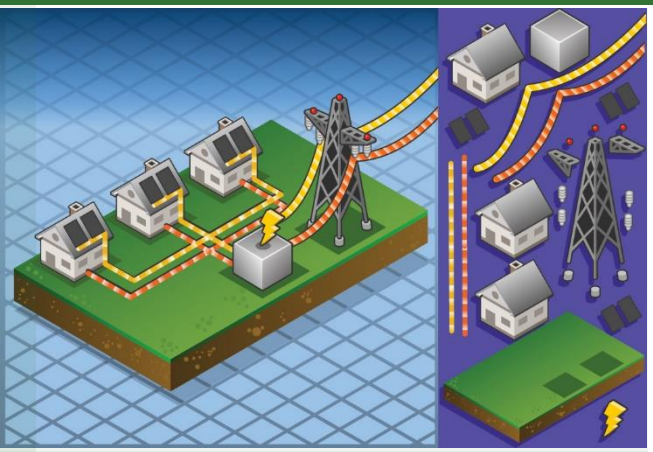
E-17. Require Renewable Surplus Buildings



GHG Mitigation Potential

Potentially large reduction in GHG emissions from building energy use

Co-Benefits (icon key on pg. 34)

Climate Resilience

Requiring renewable surplus buildings can add generation capacity to the overall grid, reducing energy costs and risk of outages.

Health and Equity Considerations

Providing surplus energy back into the grid can reduce the risk of power outages, which underserved communities are more vulnerable to because of disinvestment and historical redlining.

Measure Description

This measure will require that proposed development install onsite renewable energy in an amount that offsets more emissions than the amount generated from the development's electricity use and onsite fuel consumption. Installing zero-emission renewable energy displaces emissions from grid electricity that would otherwise be used, thereby reducing GHG emissions. Implementation of this measure would result in buildings that reduce more GHG emissions than they generate through surplus generation of energy from renewables, sometimes known as *carbon-negative buildings*. The amount of renewable energy required for a building to have net negative GHG emissions is largely determined by the number of emissions from onsite fuel consumption and the carbon intensity of the local electricity provider.

Subsector

Building Decarbonization

Scale of Application

Project/Site and Plan/Community

Implementation Requirements

Onsite renewable energy should be installed in an amount that offsets more emissions than the amount generated from the development's electricity and onsite fuel consumption. The excess renewably energy must be sold to displace non-zero emission grid electricity.

Cost Considerations

The costs associated with building only renewable-surplus structures are very high, as each building will need to be maximally energy efficient and generate renewable energy on site. However, by definition, energy costs would be entirely eliminated, and surplus energy would be sold back to the electricity provider. This is not only a cost savings, but also an additional revenue stream for each building.

Expanded Mitigation Options

When requiring development with surplus renewable generation, a best practice is to also electrify the building (see Measure E-15, *Require All-Electric Development*) so that emissions from onsite fuel consumption, such as natural gas, are eliminated.

GHG Reduction Formula

$$A = B + [(C - D) \times E \times F \times G]$$

$$A_{\%} = \frac{A - (B + C \times E \times F \times G)}{(B + C \times E \times F \times G)}$$

GHG Calculation Variables

ID	Variable	Value	Unit	Source
Output				
A	GHG emissions from building energy	[ ]	MT CO_2e per year	calculated
$A_{\%}$	Percent reduction in GHG emissions from building energy	>100	%	calculated
User Inputs				
B	Emissions from building onsite fuel consumption	[ ]	MT CO_2e per year	user input
C	Building electricity use	[ ]	kWh per year	user input
D	Onsite renewable energy production	[ ]	kWh per year	user input
Constants, Assumptions, and Available Defaults				
E	Carbon intensity of local electricity provider	Tables E-4.3 and E-4.4	lb CO_2e per MWh	CA Utilities 2021
F	Conversion from lb to MT	0.000454	MT per lb	conversion
G	Conversion from kWh to MWh	0.001	MWh per kWh	conversion

Further explanation of key variables:

- (B) – Emissions from building onsite fuel combustion may come from natural gas, propane, or other fuels. The user should take care to properly quantify these emissions using accepted methodologies (such as CalEEMod). If the project would be an all-electric development (see Measure E-15), then there would be no onsite fuel consumption, and the value for this variable would be zero.
- (C) – It is assumed that the building electricity comes from a non–zero-emission source (e.g., grid electricity with fossil fuel mix). However, if a project would be all-electric, and the local electricity provider supplying the project's electricity sources 100 percent of its electricity from renewable energy sources, then this measure would not reduce building energy emissions, as they would already be zero. The measure would still result in the co-benefit of enhanced energy supply because it adds its energy surplus as additional capacity back to the grid.
- (D) – It is assumed that the onsite renewable energy comes from a zero-emission source (e.g., solar, wind, geothermal, biomass, eligible hydroelectric). See Measures E-10-A through E-10-C for discussion of how to calculate the energy generated from various renewable energy systems. This value should be greater than the value for (C) because the renewable energy generated will need to more than offset the electricity consumed and onsite fuel consumption.

- (E) – GHG intensity factors for major California electricity providers are provided in Tables E-4.3 and E-4.4 in Appendix C. If the project study area is not serviced by a listed electricity provider, or the user is able to provide a project-specific value (i.e., for the future year not referenced in Tables E-4.3 and E-4.4), the user should use that specific value in the GHG calculation formula. If the electricity provider is not known, a user may elect to use the statewide grid average carbon intensity.

  Note that the GHG intensity factor of electricity providers will decrease in future years as the electricity providers continue to improve their energy mix to meet the requirements of SB 100 for 50 percent carbon-free electricity by 2025, 60 percent by 2030, and 100 percent by 2045. Accordingly, this measure will reduce fewer and fewer emissions in future years as the energy it displaces becomes cleaner.

GHG Calculation Caps or Maximums

Measure Maximum

($A_{\%}$) The percent reduction in GHG emissions from building energy for this measure should be greater than 100 percent. This is based on the requirement that the displaced electricity emissions from the onsite renewable sources must exceed the combined building energy emissions from electricity and onsite fuel consumption.

Mutually Exclusive Measures

If the user selects this measure, they may not also select Measure E-16, *Require Zero Net Energy Buildings*, which represents a unique scenario in which the project produces an amount of renewable energy that displaces an equal number of emissions from building electricity and onsite fuel consumption (i.e., ZNE).

Example GHG Reduction Quantification

The user constructs onsite renewable energy infrastructure that displaces more emissions than the amount generated from electricity and onsite fuel consumption. In this example, a single-family home would be constructed in Roseville Electric's service territory and would begin operation by 2022. It would therefore have an electricity carbon intensity of 473 lb CO2e per megawatt-hour (E). If the emissions from building onsite fuel consumption are 0.1 MT CO_2e per year (B), the building electricity use is 9,000 KWh per year (C), and the onsite renewable energy production is 16,000 KWh per year (D), the mitigated emissions would be -1.4 MT CO_2e per year, or a reduction of 169 percent.

$$A = \frac{0.1\ \text{MT CO}_2\text{e}}{\text{yr}} + \left[\left(\frac{9{,}000\ \text{kWh}}{\text{yr}} - \frac{16{,}000\ \text{kWh}}{\text{yr}}\right) \times \frac{473\ \text{lb CO}_2\text{e}}{\text{MWh}} \times \frac{0.000454\ \text{MT}}{\text{lb}} \times \frac{0.001\ \text{MWh}}{\text{kWh}}\right] = \frac{\text{-1.4 MTCO}_2\text{e}}{\text{yr}}$$

$$A_{\%} = \frac{\frac{\text{-1.4 MT CO}_2\text{e}}{\text{yr}} - \left(\frac{0.1\ \text{MT CO}_2\text{e}}{\text{yr}} + \frac{9{,}000\ \text{kWh}}{\text{yr}} \times \frac{473\ \text{lb CO}_2\text{e}}{\text{MWh}} \times \frac{0.000454\ \text{MT}}{\text{lb}} \times \frac{0.001\ \text{MWh}}{\text{kWh}}\right)}{\frac{0.1\ \text{MT CO}_2\text{e}}{\text{yr}} + \frac{9{,}000\ \text{kWh}}{\text{yr}} \times \frac{473\ \text{lb CO}_2\text{e}}{\text{MWh}} \times \frac{0.000454\ \text{MT}}{\text{lb}} \times \frac{0.001\ \text{MWh}}{\text{kWh}}} = -169\%$$

Quantified Co-Benefits

Energy and Fuel Savings

This measure, while not resulting in a net reduction in electricity consumption per se, would completely displace the building electricity from the grid (C) and provide surplus generation capacity from onsite renewable sources (D).

Sources

- California Utilities. 2021. Excel database of GHG emission factors for delivered electricity, provided to the Sacramento Metropolitan Air Quality Management District and ICF. January through March 2021.