# E-26. Biomass Energy

## GHG Mitigation Potential

Large

Potentially large reduction from electricity generation

## Co-Benefits (icon key on pg. 34)

## Climate Resilience

Increasing biomass energy generation enhances energy resilience and diversifies fuel supply chains if extreme weather events result in widespread power outages.

## Health and Equity Considerations

New biomass processing facilities should be planned in consultation with local members of vulnerable or sensitive communities to ensure that impacts or disbenefits from biomass production and processing are addressed before installation. Non-combustion biomass energy projects, including those that create clean hydrogen, should also be considered.

## Measure Description

This measure requires installing new biomass or biofuel electricity generation (or cogeneration). Although the direct combustion emissions for biofuels are generally on-par with other forms of fossil fuel energy, biofuels have a lower life-cycle carbon intensity due to the uptake of carbon from plants used to produce that fuel. A reasonable reference point for this carbon intensity would be the average carbon intensity of the electricity in the utility that would receive power from this new biomass plant.

## Subsector

Renewable Energy Generation

## Scale of Application

Project/Site or Plan/Community

## Implementation Requirements

See measure description.

## Cost Considerations

Installation costs for biofuel power generation infrastructure vary greatly depending on the type of biomass or feedstock (i.e., the raw materials needed to produce biofuels), the technology used, and the size of the installation. Overall, installation costs can be high, but initial costs can be partially offset by credits or rebates meant to encourage renewable energy generation. In the long term, using biofuels to generate electricity may result in cost savings due to reduced operational costs and more stable fuel pricing than fossil fuel energy.

## Expanded Mitigation Options

Best practice is to site biofuel electricity generation infrastructure in areas where sustainable feedstock is available and can be obtained efficiently. By installing biomass energy generation locally, the carbon intensity of the electricity supply would decrease, reducing GHG emissions from local electricity consumption.

## GHG Reduction Formula

A=**B**×C×D×[E-F]×G

## GHG Calculation Variables

| ID | Parameter | Value | Unit | Source |
|---|---|---|---|---|
| **Output** | | | | |
| A | Annual emissions reduction from biomass plant generation | [ ] | MT $CO_2e$ | calculated |
| **User Inputs** | | | | |
| **B** | Rated peak generation power | [ ] | MW | user input |
| **Constants, Assumptions, and Available Defaults** | | | | |
| C | Hours in a year | 8,760 | hours | conversion |
| D | Capacity factor of generation type | Table E-26.1 | % | U.S. EIA 2023 |
| E | Lifecycle carbon intensity of biomass sources | Table E-26.2 | lb $CO_2e$ per MWh | EPRI 2013 |
| F | Lifecycle carbon intensity of CA electricity | 642.9 | lb $CO_2e$ per MWh | CARB 2022 |
| G | Conversion from lb to MT | 0.000454 | MT per lb | conversion |

Further explanation of key variables:

- (B) – This is the rated peak power output of the generators used by the power plant. This is often referred to as the nameplate value.
- (C) – This is the number of hours per year for which the utility intends to operate, not including normal operational breaks, such as maintenance.
- (D) – The capacity factor corrects for the fact that power plants do not always operate at their rated peak power due to a variety of operational and economic factors in order to estimate the actual amount of electricity generation at a utility-scale power plant.
- (E) – The lifecycle carbon intensity of each biomass power source may be available using data from the Low Carbon Fuel Standard program. For generic projects with known fuels, this can be found using the data provided from the Electric Power Research Institute report provided.
- (F) – This value represents the carbon intensity of electricity displaced by the biomass power plant.

## GHG Calculation Caps or Maximums

None.

## Example GHG Reduction Quantification

In this example, a user installs a new 1-MW (B) biomass plant which burns dedicated woody crops that they intend to operate year-round. In 2023, the lifecycle carbon intensity of power for California is estimated to be 642.9 lb $CO_2e$/ MWh (F). The new plant, because it will burn wood, is estimated to have a capacity factor of 59 percent (D) and a mean carbon intensity of 189.6 lb $CO_2e$/MWh (E).

$$A=1\ \text{MW}\times 8{,}760\ \text{hrs}\times 59\%\times\left[189.6\ \frac{\text{lb}\ CO_2e}{\text{MWh}}-642.9\ \frac{\text{lb}\ CO_2e}{\text{MWh}}\right]\times 0.000454\ \frac{\text{MT}}{\text{lb}}=-1{,}063.6\ \frac{\text{MT}\ CO_2e}{\text{year}}$$

## Quantified Co-Benefits

*Energy and Fuel Savings*

The energy savings of traditional fossil fuels (H) can be calculated as follows.

**Natural Gas Reduction Formula**

$$H=\frac{-B\times C\times D\times I}{J}$$

## Electricity Reduction Calculation Variables

| ID | Parameter | Value | Unit | Source |
|---|---|---|---|---|
| **Output** | | | | |
| H | Natural gas saved | [ ] | therms | Calculated |
| **Constants, Assumptions, and Available Defaults** | | | | |
| I | Heat Rate | 7,728,000 | BTU/MWh | CEC 2020 |
| J | Conversion from BTU to therms | 100,000 | BTU/therm | Conversion |

Further explanation of key variables:

- (I) – This value represents the average amount of energy needed to produce a MWh of electricity across all natural gas power plants in the state of California as of 2019.

### Sources


- California Air Resources Board (CARB). 2022. 2023 Carbon Intensity Values for California Average Grid Electricity Used as a Transportation Fuel in California and Electricity Supplied Under the Smart Charging or Smart Electrolysis Provision. Available: https://ww2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/fuelpathways/comments/tier2/2023_elec_update.pdf. Accessed: December 2023.
- California Energy Commission (CEC). 2020. Thermal Efficiency of Natural Gas-Fired Generation in California: 2019 Update. Available: https://efiling.energy.ca.gov/getdocument.aspx?tn=233380 Accessed: December 2020.

- Electric Power Research Institute (EPRI). 2013. Literature Review and Sensitivity Analysis of Biopower Life-Cycle Assessments and Greenhouse Gas Emission. Available: https://www.epri.com/research/products/000000000001026852. Accessed: August 2023.
- U.S. Energy Information Administration (U.S. EIA). 2023. Capacity Factors for Utility Scale Generators Primarily Using Non-Fossil Fuels. Electric Power Monthly. Available: https://www.eia.gov/electricity/monthly/ Accessed: August 2023.