

# GHG and Criteria Pollutant Emission Reduction Estimates

## 1.0 GHG Reduction Estimate Method

Emission reductions are estimated based on:

- The volume of renewable natural gas (RNG) anticipated to be supplied and displacing conventional compressed natural gas (CNG).
- Life-cycle emission factors for conventional and renewable natural gas.
- Emissions from trucks used to transport RNG as a temporary measure until the pipeline can be activated.

## 2.0 Models/Tools Used

Emissions reductions are estimated in a spreadsheet using data and assumptions from various sources as documented below.

## 3.0 Measure Implementation Assumptions

The City of San Leandro estimates that approximately 96-million British thermal units (mmBTU) of renewable natural gas will be available per day, or 35,000 mmBTU per year.

- The Port will be ready to accept this fuel by truck beginning in 2027, with the pipeline anticipated to open in 2029.
- RNG will be generated from waste materials from a local milk processing plant (mostly milk solids) and a local beverage manufacturer (mostly sugar).

## 4.0 GHG Reduction Estimate Assumptions

Table 1 shows the key assumptions used to estimate the emissions benefits and the sources of those assumptions.

**Table 1 Key Assumptions for Emissions Estimates**

Data Item/Assumption	Value	Source/Notes
Volume of RNG	35,000 mmBTU/year	Hayes Morehouse, City of San Leandro, correspondence, March 2024
Energy content of CNG/RNG	1,036 BTU/standard cubic foot (scf)	<a href="https://www.eia.gov/energyexplained/units-and-calculators/british-thermal-units.php">Energy Information Administration<sup>1</sup></a>

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Data Item/Assumption	Value	Source/Notes
Life-cycle carbon intensity of conventional CNG	80.59 g/MJ	California Air Resources Board LCFS <a href="#">Certified Fuel Pathway Table<sup>2</sup></a> , North American natural gas
Life-cycle carbon intensity of RNG	0.00 g/MJ	See discussion in text
Volume of RNG carried per truck	336,000 scf	<a href="https://www.qtw.com/product/virtual-pipeline-cng/">https://www.qtw.com/product/virtual-pipeline-cng/</a> , based on 84,000 scf for a 10-foot container trailer, expanded to a 40-foot trailer
Distance traveled per truck trip	2.4 mi	Approximate 1.2 miles one-way from San Leandro wastewater treatment plant to Port of Oakland airport receiving point
Fuel economy of a truck	8.16 miles per gallon diesel	Annual Energy Outlook 2023 Reference Case, for “freight truck” in year 2028
Carbon content of diesel fuel	0.01019 metric tons CO <sub>2</sub> per gallon	U.S. EPA

A critical assumption in this analysis is the carbon intensity of the RNG that would be produced. The California Air Resources Board LCFS [Certified Fuel Pathway Table<sup>3</sup>](#) provides certified life-cycle carbon intensities for numerous fuel types and sources. No sources were identified that were an exact analogy to the proposed source. However, two examples were identified of RNG produced in California from food scraps and other waste and transported by pipeline. These examples include:

- California producer, landfill-diverted food scraps transported by pipeline: -28.2 g/MJ (B042001)
- California producer, landfill-diverted food scraps & urban landscaping waste transported by pipeline: -38.8 g/MJ (B048501)

Both of these fuels are certified at less than zero lifecycle emissions. To be conservative, for this analysis, zero emissions were assumed for the San Leandro waste source.

Offsetting diesel truck emissions were estimated for the interim years of 2027 and 2028 before the pipeline is active. Based on the data shown in Table 1, there will be approximately 101 truck trips per year, generating 240 truck VMT and consuming 30 gallons of diesel fuel. This truck-generated emissions are a small fraction of the estimated emissions benefits of the RNG.

## 5.0 Reference Case Scenario

The reference case is the baseline emissions associated with the CNG that is being replaced. Applying the CARB life-cycle factor of 80.59 g/MJ provides an estimate of 3,000 metric tons of CO<sub>2</sub> per year associated with this fuel production and combustion.

<sup>2</sup> <https://ww2.arb.ca.gov/resources/documents/lcfs-pathway-certified-carbon-intensities>

<sup>3</sup> [LCFS Pathway Certified Carbon Intensities | California Air Resources Board](#)

## 6.0 Measure-Specific Activity Data

As noted above, emission reductions are estimated based on the volume of RNG being supplied.

## 7.0 GHG Emissions Reduced

Table 2 shows the total GHG emissions reduced and the components of the emissions changes including displaced natural gas emissions and added emissions from trucks.

**Table 2 GHG Emission Reductions (metric tons CO<sub>2</sub>e)**

	2027 & 2028 (Annual)	2025 – 2030	2025 - 2050
Displaced CNG emissions	2,982	11,928	71,566
Diesel truck emissions	0.3	0.6	0.6
Net emissions reduced	2,982	11,927	71,565

## 8.0 Criteria and Hazardous Air Pollutant Reductions

Criteria Air Pollutants (CAP) will be reduced since gas produced at the San Leandro Water Pollution Control Plant (WPCP) will be transported to Oakland Airport and combusted for on-site energy needs rather than flared at the WPCP.

The WPCP currently produces biogas from the anaerobic digestion of received waste, and a portion of the biogas is used to heat on-site boilers while excess biogas is flared. San Leandro plans to expand the WPCP to accept high strength waste (HSW) from food processors and install a biogas upgrading system to produce renewable natural gas (RNG). The current flare is unpermitted and therefore, no emissions information is available. However, the City plans to construct a new enclosed flare as part of the Biogas Upgrading System. The San Leandro WPCP Biogas Upgrading Project Air Permit Application (Brown and Caldwell for City of San Leandro, 2022) includes emissions estimates with the system offline for oxides of nitrogen (NO<sub>x</sub>), precursor organic compounds (POC), particulate matter (PM<sub>10</sub>), and sulfur dioxide (SO<sub>2</sub>), as well as various hazardous air pollutants. These are for a volume of 150 scf per minute annual average, or 78.8 million scf/year. At 1,036 BTU/scf this is a flare volume of 81,700 mmBTU/year. The diversion of gas to the Port would reduce this volume by 43 percent. It was therefore assumed that air pollutant emissions would also be reduced by 43 percent. The baseline future emissions and anticipated reductions are shown in Table 3.

**Table 3 Criteria Air Pollutant Emissions and Reductions (tons)**

	NO <sub>x</sub>	POC	PM <sub>10</sub>	SO <sub>2</sub>
Biogas Upgrading System offline, Biogas Flared	1.51	0.10	0.29	0.56
Avoided Flare Emissions	0.65	0.04	0.29	0.56