

**Staff Summary: ARB LCFS Internal Pathway for the
Production of Biomethane from the
High Solids Anaerobic Digestion (HSAD) of
Organic (Food and Green) Wastes**

Pathway Summary

Staff is proposing a Low Carbon Fuel Standard (LCFS) pathway for the production of biomethane from high solids anaerobic digestion (HSAD) of organic (food and green) wastes. The HSAD process would be based on a multi-stage, mesophilic destruction of the food and green wastes, with accommodations for small proportions of food-contaminated, non-recyclable (soiled) paper, and fats, oils, and greases (FOG) in the feedstock. Staff assumes for the purposes of this analysis that the HSAD facility would be sited adjacent to a landfill, or local transfer station, minimizing any transportation distance differentials between feedstocks delivered to the HSAD facility, and wastes delivered for disposal, transfer, or recovery.

Biogas produced from the anaerobic digestion of the organic matter (mostly methane (CH₄) and carbon dioxide (CO₂) in equimolar proportions) would be purified and made available on-site at the facility to fuel transit buses and other compressed-natural-gas-fueled vehicles, or would be refined to pipeline quality natural gas standards. Additionally, the process solid residue (digestate) would be composted using either in-vessel composting (IVC), covered aerated static pile (CASP), or open windrow composting processes. The result would be a high-quality compost co-product that could be marketed as a fertilizer or soil amendment.

Staff assumed that grid-based electricity would power the anaerobic digestion, and biogas purification and compression processes. The electricity consumed would be generated from an energy portfolio mix consisting of 78.7 percent natural gas, and 21.3 percent renewables (excluding large hydro-electric and biomass based generation). Equipment such as front-end loaders and windrow turners will consume additional fossil-fuel-based energy to load and transfer materials, and to manage composting operations.

Proposed CI for Biomethane Produced from the HSAD Pathway

Under the proposed pathway, biomethane would be produced from a feedstock consisting of 40 percent food waste and 60 percent green waste (comprised of equal proportions of leaves, grass, and brush). The following emissions and credit categories

were included in the proposed pathway:

- All well-to-tank process emissions, including upstream, fuel cycle emissions;
- Carbon credits for avoided landfilling and composting emissions;
- Compost co-product credit for displacing synthetically produced fertilizer or soil amendment material; and
- Tank-to-wheels tailpipe GHG emissions.

As shown in Table 1, staff estimates that the well-to-wheels (WTW) CI of the biomethane fuel produced under the proposed HSAD Pathway is -15.29 g CO₂e / MJ of energy.

Table 1: Proposed Lookup Table Entry for Biomethane Fuel Produced from the High Solids Anaerobic Digestion of Organic (Food and Green) Wastes

Fuel	Fuel Pathway Code	Lookup Table Description	Carbon Intensity Value (g CO ₂ e / MJ)		
			Direct Emissions	Land Use or Other Indirect Emissions	Total Emissions
Compressed Natural Gas	CNG005	Biomethane produced from the high-solids (greater than 15 percent total solids) anaerobic digestion of food and green wastes; meets California standards for pipeline quality biomethane; co-production of a compost/soil amendment. Use of electricity generated from a marginal energy mix with a CI at or below the CI associated with 78.7 percent natural gas and 21.3 percent renewables (excluding large hydro-electric and biomass-based generation).	-15.29	0.00	-15.29

Staff Analysis and Recommendations

Use of the proposed HSAD pathway is contingent upon the following set of operational conditions. These conditions are not only based on model parameters, but are also intended to provide the biofuel producer with some operating flexibility.

- The organic waste feedstock stream must consist of food and green wastes in an approximate 40:60 ratio. Small quantities of food-contaminated non-recyclable (soiled) paper, and fats, oils, and greases (FOG) may also be present.
- The pathway applies only to fuel produced by a multi-staged, mesophilic, dry fermentation (high solids anaerobic digestion or HSAD) process. It cannot be used by producers using a wet fermentation (wet AD or low solids) process.
- The annual organic waste throughput of the HSAD process must be equal to or greater than 30,000 tons.
- The process uses grid-based electricity with a marginal generation mix of 78.7 percent natural gas, and 21.3 percent renewables (excluding large hydro-electric and biomass).
- The biomethane produced must conform to prevailing California¹ pipeline quality compositional and performance standards, including any specifications imposed by the regulated utility and transmission companies on parameters such as the Wobbe Index, and trace impurity levels of compounds such as hydrogen sulfide (H₂S).
- The product gas discharge pressure must be no greater than 800 psig for tie-into the utility company's transmission system.
- The facility must employ biofilters during the active phase of the digestate composting process.

¹ As mandated by the California Public Utilities Commission (PUC), California Energy Commission (CEC), California Air Resources Board (ARB), or any other applicable State law.

Staff recommends that this LCFS pathway for the production of biomethane from the high solids anaerobic digestion of organic (food and green) wastes be approved with a CI of $-15.29 \text{ g CO}_2\text{e} / \text{MJ}$, for the use of production facilities meeting the operating conditions enumerated above.