Staff Summary
Method 1 Fuel Pathway

California-Modified GREET Pathways: North American Landfill Gas to Compressed Natural Gas, Liquefied Natural Gas, and Liquefied-Compressed Natural Gas (Pathway Codes: CNG006, LNG021, and CNG024)

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Pathway Summary

California Air Resources Board (ARB) staff has appended two new pathways to the existing North American landfill-gas-to-compressed-natural-gas (LFG-CNG) pathway document.[1] The first is a liquefied natural gas (LNG), and the second a liquefied-compressed natural gas (L-CNG) pathway. All three pathways cover the production of biomethane from landfill gas (LFG) anywhere in North America.

The original North American LFG-CNG pathway (fuel pathway code CNG006) was certified on January 28, 2013. The pipeline-quality biomethane produced under the North American pathways described in this summary would be injected into the interstate natural gas pipeline system, extracted in California, and dispensed as motor vehicle fuel. The three pathways described in this summary differ according to how the biomethane is processed in California following extraction from the interstate pipeline system. If it is compressed and dispensed as CNG, it will be covered under the LFG-CNG pathway. If it is liquefied and dispensed as LNG, it will be covered by the LFG-LNG pathway. If it is liquefied, re-gasified, compressed, and dispensed as L-CNG, it will be covered by the LFG-L-CNG pathway.

These pathways will be available via the Method 1 provisions of the Low Carbon Fuel Standard (LCFS) to all North American LFG-based biomethane producers who can demonstrate that their pathways are substantially similar to the pathway described in this summary and the accompanying life cycle analysis report.

Consistent with the existing LFG-CNG pathway, staff based the two new pathways described in this Summary on a previously certified LFG-LNG pathway.[2] Most of the CA-GREET inputs used to develop these prior LFG-to-CNG and LFG-to-LNG pathways[3] were left unchanged in these new North American pathways. The

[1] ARB Staff, January 28, 2013. LCFS Life Cycle Fuel Pathway Report: North American Landfill Gas to Compressed Natural Gas. Fuel pathway code CNG006. http://www.arb.ca.gov/fuels/lcfs/2a2b/internal/nalfg-cng-rpt-031513.pdf

[2] ARB Staff, September 23, 2009. Detailed California-Modified GREET Pathway for Liquefied Natural Gas (LNG) from North American and Remote Natural Gas Sources, Version 2.0. Fuel pathway code LNG007 http://www.arb.ca.gov/fuels/lcfs/092309lcfs_lng.pdf

[3] ARB Staff, November 6, 2014. California-Modified GREET Pathways: North American Landfill Gas to Compressed Natural Gas, Liquefied Natural Gas, and Liquefied-Compressed Natural Gas, Version 2.0: http://www.arb.ca.gov/fuels/lcfs/2a2b/internal/nalfg-lng-lcng-rpt-110714.pdf

LFG-L-CNG pathway appended LNG vaporization and recompression steps to the LFG-LNG pathway.

The following inputs were used to develop these North American pathways. All inputs were selected in order to make the North American pathway CIs high enough to cover most North American LFG-to-biomethane producers.

- The pipeline distance was assumed to be 3,600 miles. The longest interconnected pipeline route between Southern California and another North American location is approximately 3,600 miles.
- The LFG processing equipment used is capable of extracting 84 percent of the methane in the LFG. LFG processing is assumed to be 77.2 percent efficient and to utilize fuel shares consisting of 76.2 percent LFG and 23.8 percent electricity.
- The electricity used to process the LFG was assumed to be generated entirely from coal.
- The transportation and distribution leakage rate assumed for this pathway was the CA-GREET default of 0.15 percent for the North American pipeline grid.

Carbon Intensity of the Fuel Produced

The carbon intensities of the three North American pathways described in this summary are shown in the following table. The LFG-CNG CI (pathway CNG006) is unchanged from the 33.02 gCO_2e/MJ value published in the original January 28, 2013, pathway document. The LFG-LNG and LFG-L-CNG pathways are based on the same upstream LFG extraction and processing inputs used in the LFG-CNG pathway, but replace the downstream CNG inputs with LNG inputs from the prior LNG pathway. The LFG-L-CNG pathway appended LNG vaporization and recompression steps to the LFG-LNG pathway.

Biomethane Pathways Lookup Table Entries for North American LFG

Fuel	Pathway Identifier	Pathway Description	Carbon Intensity Values (gCO_2e/MJ)		
			Direct Emissions	Land Use or Other Indirect Effects	Total
CNG from LFG	CNG006	North American landfill gas to pipeline-quality biomethane; delivered via pipeline; compressed to CNG in CA	33.02	0	33.02
LNG from LFG	LNG021	North American landfill gas to pipeline-quality biomethane; delivered via pipeline; liquefied to LNG in CA	48.71	0	48.71
L-CNG from LFG	CNG024	North American landfill gas to pipeline-quality biomethane, delivered via pipeline, liquefied in CA; transported by trucks; re-gasified and compressed to L-CNG in CA	66.45	0	66.45

Operating Conditions

- Actual energy consumption values shall remain at or below the levels specified in this document for the CNG, LNG, and L-CNG pathways. The recovery and processing efficiency levels shall remain at or above the ones specified in the pathway document. In addition, the liquefaction efficiency at the LNG plant and the compression efficiency level at the L-CNG stations in California shall remain at or above the levels specified in this document.

- Because the biomethane supplied under these pathways is commingled with fossil natural gas, both when it enters into the interstate pipeline system and when it enters into the LNG plants in California, applicants must maintain an accounting system that will enable them to demonstrate unequivocally at any time that every unit of biomethane-based transportation fuel reported under the LCFS can be associated with an equal unit of biomethane purchased from a landfill in North America and injected into the interstate pipeline system.

- Volumes of biomethane reported under the LCFS pathways described in this document cannot be used by the LCFS regulated party or any other entity to obtain credits of any type under any other GHG reduction program except for the U.S. Environmental Protection Agency's Renewable Fuels Standard (RFS2).

- The LNG pathway described in this document applies to, and may only be used for, LNG used in LNG-powered vehicles. It would not apply, for example, to LNG that is vaporized, compressed into CNG, and used in CNG vehicles.

Staff Analysis and Recommendations

The previously approved North American LFG-to-CNG pathway (CNG006) was developed using an existing LFG-to-CNG pathway. Staff used the same approach to develop two new North American LFG-biomethane pathways. These new pathways—a LFG-LNG and a LFG-L-CNG pathway—were based on an existing LFG-LNG pathway. These new pathways were appended to the original CNG006 pathway document. In each case, the upstream LFG processing and biomethane transport steps from the original North American LFG-CNG pathway were combined with the downstream LNG processing and dispensing steps from the precursor pathway. The LFG-L-CNG pathway appended LNG vaporization and recompression steps to the LFG-LNG pathway. Most CA-GREET input parameters from the precursor LFG-biomethane pathways were left unchanged. Consistent with LCFS Method 1 pathway development goals, inputs at the upper ends of their respective ranges were used in order to allow these pathways to be used by as many North American producers as possible. Thus, the additional two North American LFG-biomethane pathways are consistent with the existing LFG-to-CNG pathway.

On the basis of these findings, staff recommends that pathways CNG024 and LNG021—North American LFG-to-L-CNG and LFG-to-LNG—be certified for inclusion in the LCFS Lookup table.