

Staff Summary
Method 2B Application
Element Markets Renewable Energy, LLC
Landfill Gas from Blue Skies Energy, Michigan to Liquefied Natural Gas,
and Liquefied Natural Gas to Compressed Natural Gas
in Clean Energy LNG Plant
(LNG019 and CNG018)

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Pathway Summary

Element Markets Renewable Energy, LLC (hereinafter, Element Markets), a marketer of renewable natural gas and environmental asset management services, has applied for Low Carbon Fuel Standard (LCFS) fuel pathways for the production of Liquefied and Liquefied-Compressed Natural Gas (LNG and L-CNG) from landfill gas (LFG) originating in Michigan.

Element Markets purchases LFG from Blue Skies Energy (BSE), an operator of LFG processing facilities at the Richfield landfill in the town of Davison in eastern Michigan. BSE began operating an LFG processing facility at Richfield in 2008. Element Markets takes title to the resulting biomethane after it is injected into the interstate pipeline system by BSE. This system primarily collects and conveys natural gas from North American wells in the region. Gas is withdrawn from the interstate pipeline system at Clean Energy's Boron, California liquefaction plant. The biomethane from BSE is transported a total of 2,250² miles to the Boron facility.

Element Markets has applied for two landfill-gas-to-biomethane fuel pathways from BSE Michigan. One pathway covers the liquefaction of the resulting biomethane at Boron facility, and the dispensing of the fuel as liquefied natural gas (LNG); the other pathway covers the liquefaction of the resulting biomethane at Boron facility, and the subsequent vaporization and compression of the liquefied natural gas into compressed natural gas (CNG). All fueling stations covered by these pathways are located in California. Both pathways were modeled combinations of existing LCFS pathways that were certified in August 2013 (LNG014¹¹ and CNG011¹⁵) and in October 2013 (LNG017¹⁰). The LNG pathway combines the landfill gas production phase of pathway LNG017¹⁰ with the LNG production phase of pathway LNG014¹⁵. Similarly, the L-CNG pathway combines the landfill gas production phase of LNG017¹⁰ with the evaporation and re-compression phases of pathway CNG011¹⁵.

² Pipeline distance from Michigan to California is shorter than to Topock, Arizona, because Clean Energy maintains a direct transmission pipeline system rather than a reroute pipeline as in ANGF pathway (LNG017)

The BSE facility collects, processes, and compresses LFG to pipeline quality biomethane. The resulting biomethane is transmitted by pipeline from the landfill to a central collection point for injection into a primary interstate pipeline. It is subsequently withdrawn at Clean Energy's Boron plant. The carbon intensities (CIs) of the LFG extraction, processing, and pipeline injection phases of this pathway were calculated using data for the U. S. EPA's eGRID electrical energy generation database. BSE operations are located in northeastern Michigan, which is within the RFCM eGRID region⁵. The liquefaction CI was calculated using California marginal electricity.

The biomethane Clean Energy purchased from Element Markets is commingled with fossil natural gas when it enters the interstate pipeline system and when it is liquefied at Clean Energy's Boron facility. As such, Element Markets and Clean Energy will be obligated to retain records that unequivocally demonstrate that the credits Element Markets earns under the pathways described in this Summary correspond directly with the volumes of biomethane Clean Energy purchased from Element Markets.

Element Markets supplies the California transportation fuels market with LNG and CNG derived from landfill gas under several existing LCFS pathways:

1. CNG007⁶ - LFG originating in Pennsylvania to CNG.
2. LNG015⁷ - LFG originating in Pennsylvania to LNG.
3. LNG016⁸: LFG in Pennsylvania to ANGF in Arizona for LNG.
4. CNG013⁹: LFG in Pennsylvania to ANGF in Arizona for L-CNG.
5. LNG017¹⁰: LFG in Michigan to ANGF in Arizona for LNG.
6. CNG014¹¹: LFG in Michigan to ANGF in Arizona for L-CNG.

Similarly, Clean Energy currently supplies the California transportation fuels market with biomethane and fossil natural gas under several existing LCFS pathways:

⁵The eGRID database reports *average* electrical energy generation mixes when *marginal* electricity is more appropriate. eGRID average mixes are converted to marginal mixes because additional demand would be met primarily by new natural gas rather than hydroelectric or nuclear generation capacity.

⁶ (CNG007) Pennsylvania LFG to CNG pathway: <http://www.arb.ca.gov/fuels/lcfs/2a2b/apps/jre-040913.pdf>

⁷ (LNG015) Pennsylvania LFG to LNG pathway: <http://www.arb.ca.gov/fuels/lcfs/2a2b/apps/em-jre-083013.pdf>

⁸ (LNG016) Pennsylvania LFG to ANGF in Arizona for LNG: <http://www.arb.ca.gov/fuels/lcfs/2a2b/apps/bse-angf-101813.pdf>

⁹ (CNG013) Pennsylvania LFG to ANGF in Arizona for L-CNG: : <http://www.arb.ca.gov/fuels/lcfs/2a2b/apps/bse-angf-101813.pdf>

¹⁰ (LNG017) Michigan LFG to ANGF in Arizona for LNG: <http://www.arb.ca.gov/fuels/lcfs/2a2b/apps/bse-angf-101813.pdf>

¹¹ (CNG014) Michigan LFG to ANGF in Arizona for L-CNG: : <http://www.arb.ca.gov/fuels/lcfs/2a2b/apps/bse-angf-101813.pdf>

1. LNG002¹² - fossil NG to LNG from liquefaction facilities in California
2. LNG010¹³ - fossil NG to LNG from Clean Energy's Ehrenberg, Arizona facility
3. CNG002¹⁴ - fossil NG to CNG compressed in California.
4. LNG013¹⁵ - LFG originating in Michigan to LNG.
5. LNG014¹⁶ - LFG originating in Washington to LNG.
6. CNG009¹⁷ - LFG originating in Washington to CNG.
7. CNG011¹⁸ - LFG originating in Washington to L-CNG.
8. LNG018¹⁹ - LFG originating in Texas to LNG.
9. CNG017²⁰ - LFG originating in Texas to L-CNG.

Carbon Intensity of LNG and L-CNG Produced

As shown in the following table, the applicant has calculated the CIs of its LNG, and L-CNG pathways to be 21.68, and 23.77 gCO₂e/MJ, respectively. Element Markets' LFG-to-LNG pathway CI is higher than the corresponding California LFG-to-biomethane pathway CIs. California LFG-based LNG (LNG007²¹) has a CI of 15.56 gCO₂e/MJ.

The CIs of Element Markets pathways are higher than the CIs of the corresponding California pathways (LNG007) for the following reasons:

- The sources of the electricity used at the LFG processing and pressurization plants: The plant consumes electricity generated from a Michigan area

¹² (LNG002) North American fossil natural gas delivered to California by pipeline; liquefied in California at 90 percent efficiency: http://www.arb.ca.gov/fuels/lcfs/092309lcfs_lng.pdf

¹³ (LNG010) North American fossil natural gas delivered to a liquefaction plant in Ehrenberg, Arizona; LNG trucked to California: (<http://www.arb.ca.gov/fuels/lcfs/2a2b/apps/cle-ehr-ncbi-011011.pdf>)

¹⁴ (CNG002) North American fossil natural gas delivered to California by pipeline for compression to CNG: http://www.arb.ca.gov/fuels/lcfs/022709lcfs_cng.pdf

¹⁵ (LNG013) Michigan LFG to LNG pathway: <http://www.arb.ca.gov/fuels/lcfs/2a2b/apps/ce-sth-051713.pdf>

¹⁶ (LNG014, CNG009, and CNG011) Washington LFG to CNG, CNG and L-CNG pathways: <http://www.arb.ca.gov/fuels/lcfs/2a2b/apps/ce-ch-083013.pdf>

¹⁷ (CNG009) Washington LFG to CNG pathway: <http://www.arb.ca.gov/fuels/lcfs/2a2b/apps/ce-ch-083013.pdf>

¹⁸ (CNG011) Washington LFG to L-CNG pathway: <http://www.arb.ca.gov/fuels/lcfs/2a2b/apps/ce-ch-083013.pdf>

¹⁹ (LNG018) Texas LFG to LNG pathway: <http://www.arb.ca.gov/fuels/lcfs/2a2b/apps/ce-mcc-121713.pdf>

²⁰ (CNG017) Texas LFG to L-CNG pathway: <http://www.arb.ca.gov/fuels/lcfs/2a2b/apps/ce-mcc-121713.pdf>

²¹ (LNG007) California LFG liquefied in California: http://www.arb.ca.gov/fuels/lcfs/022709lcfs_lfg.pdf

energy mix (as defined in eGRID system²²). LFG processing plants operating under LNG007 and CNG003 consume California marginal electricity.

- Pipeline transportation distance: Biomethane from the BSE plant is transported 2,250 miles by pipeline to the Boron liquefaction plant, while biomethane from California processing plants moves only 50 miles by pipeline.

These two factors are slightly offset by two factors that reduce the CI of the Clean Energy BSE fuel pathways relative to the California LFG pathways:

- Trucking technology: Ten percent of the trucks that deliver LNG from Clean Energy's Boron plant are natural gas powered and use high pressure direct injection (HPDI) technology²³, which is more efficient. The remaining 90 percent of the Clean Energy fleet consists of standard heavy-duty diesel trucks. Pathway LNG007 assumes that all LNG is transported by standard heavy duty diesel trucks.
- The liquefaction efficiency of the Boron plant exceeds the 90 percent value assumed for pathway LNG007. Clean Energy demonstrated this efficiency advantage by providing electricity consumption data covering the years 2011-2013.

Operating Conditions

1. Actual pathway energy consumption values shall remain at or below the levels specified in Element Markets' application. The recovery and processing efficiency levels at the BSE shall remain at or above the ones specified in the Element Markets' application²⁴. In addition, the liquefaction efficiency at the Boron LNG plant and the compression efficiency level at the L-CNG stations in California shall remain at or above the levels specified in the application. Energy consumption values for these facilities are classified by the applicant as confidential business information.
2. Because the biomethane supplied under this pathway is commingled with fossil NG both when it enters the interstate pipeline system and when it enters Clean Energy's Boron facility, Element Markets must maintain an accounting system that will enable it to demonstrate unequivocally at any time that every unit of biomethane-based transportation fuel and reported under the LCFS can be associated with an equal unit of biomethane purchased from BSE.

²² The U.S. EPA's Emissions and Generation Resource Integrated Database (eGRID) can be found at http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2012V1_0_year09_SummaryTables.pdf. The BSE plant falls within the eGRID RFC Michigan region. California marginal electricity use NG and Renewables mainly in the mix.

²³ HPDI: High Pressure direct injection technology uses NG as fuel in the heavy duty trucks

²⁴ Clean Energy assumed recovery and processing efficiencies equivalent to those used in pathway LNG007: http://www.arb.ca.gov/fuels/lcfs/022709lcfs_lfg.pdf

- The total LFG supplied by BSE to all gas purchasers shall not exceed BSE's maximum LFG production capacity in the same accounting period. Because Element Markets maintains accrued storage biogas inventory, it is possible for Element Markets' biomethane sales to Clean Energy's Boron facility to exceed the maximum yield of the BSE facility in any given period. Element Markets' direct purchases from BSE, however, must not, in combination with all other purchases occurring in the same period, exceed the maximum yield of the BSE facility.

Proposed Lookup Table Entries

Fuel	Pathway Identifier	Pathway Description	Carbon Intensity in gCO ₂ e/MJ (Including Indirect Effects)		
			Direct Emissions	Land Use or Other Indirect Effect	Total
LNG from LFG	LNG019	2B Application*: Michigan landfill gas to pipeline-quality biomethane; delivered via pipeline; liquefied in CA.	21.68	0	21.68
L-CNG from LFG	CNG018	2B Application*: Michigan landfill gas to pipeline-quality biomethane, delivered via pipeline, liquefied in CA; transported by truck; re-gasified and compressed to CNG in CA.	23.77	0	23.77

*Specific Conditions Apply

Staff Analysis and Recommendation

Staff has reviewed Element Markets' application for the production of LNG and L-CNG from LFG originating in Michigan. Staff has replicated, using the CA-GREET spreadsheet, the CI values calculated by Element Markets. Element Markets and Clean Energy have provided documentation in support of the key components of its pathways: energy consumption at the Michigan LFG processing plant, the California liquefaction plant, and Clean Energy's California CNG fueling stations. Clean Energy has also provided the volumes of LNG and L-CNG produced. Staff is satisfied that the energy consumption levels reported in Element Markets' application accurately represent the actual usage for the

time period for which records were submitted, and that Element Markets is capable of maintaining CIs that are at or below those shown in the table above. Therefore, staff recommends that Element Markets' application for Method 2B LFG-to-LNG, and LFG-to-L-CNG pathways be approved.