Staff Summary
Method 2B Application:
Gaseous H₂ via Methane Cracking
LytEn, Sunnyvale, California
(Pathway Codes: HYGN007, HYGN008, HYGN009, HYGN010)
Deemed Complete Date: November 23, 2015
Posted for Public Comment Date: December 17, 2015
Certified Date: December 30, 2015

Pathway Summary

LytEn has submitted an application for a fuel pathway which produces hydrogen from the cracking of methane through a proprietary process. The feedstocks being proposed for this pathway include fossil natural gas and renewable biomethane (for the current application it is derived from landfill gas). LytEn proposes dual hydrogen production-delivery systems: one will include a facility with a hydrogen production system that will fill tube trailers for delivery of hydrogen to stations in the Bay Area in California, and the second will include installing on-site hydrogen production systems. As a co-product, the hydrogen process produces carbon black, which could displace the use of carbon in the commercial production of electrodes (additional uses for the carbon from this process are still being explored). The hydrogen production system is anticipated to generate 200 kg H₂/ day or about 6000 kg of compressed H₂ per month. LytEn proposes to use either 33.3% renewable biomethane and the balance fossil natural gas or 100% renewable biomethane as feedstocks for the production of hydrogen.

The applicant is requesting CIs of 15.29 and -46.91 g CO₂e/MJ for 33.3% and 100% renewable biomethane pathways respectively generated from on-site systems. For tube trailers pathways, the applicant is requesting CI values of 29.84 and -32.36 g CO₂e/MJ for the 33.3% and 100% renewable biomethane pathways respectively. The CI values for these pathways are based on lifecycle analysis conducted using the CA-GREET 1.8b model.

Carbon Intensity of H₂ Produced

Hydrogen and solid carbon are produced from the cracking of methane. The gaseous hydrogen pathway utilizes the CA-GREET1.8b calculation approach for hydrogen for on-site production except that almost all of the carbon in the feedstock is converted to carbon black, which is not emitted as CO₂. The applicant has indicated a 100% product yield, i.e. all of the methane would be converted to hydrogen and elemental carbon. Efficiency inputs are modified to reflect the applicant’s process. The upstream emissions for natural gas and renewable biogas are based on CA-GREET1.8b default values. CA-GREET1.8b default values also provide the compression efficiencies and tube trailer delivery.
energy inputs. The calculated values for the four pathways are shown in the table below.

Table 1
Proposed Lookup Table Entries

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Pathway Identifier</th>
<th>Pathway Description*</th>
<th>Carbon Intensity Values (gCO₂e/MJ)</th>
<th>Direct CI</th>
<th>Indirect LUC</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-Site Pathways</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methane to Gaseous Hydrogen</td>
<td>HYGN007</td>
<td>2B Application*: 33.3% Renewable Biogas, On-Site Hydrogen</td>
<td>15.29</td>
<td>0</td>
<td></td>
<td>15.29</td>
</tr>
<tr>
<td>Methane to Gaseous Hydrogen</td>
<td>HYGN008</td>
<td>2B Application*: 100% Renewable Biogas, On-Site Hydrogen</td>
<td>-46.91</td>
<td>0</td>
<td></td>
<td>-46.91</td>
</tr>
<tr>
<td>Tube Trailer Delivery Pathways</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methane to Gaseous Hydrogen</td>
<td>HYGN009</td>
<td>2B Application*: 33.3% Renewable Biogas, Tube Trailer</td>
<td>29.84</td>
<td>0</td>
<td></td>
<td>29.84</td>
</tr>
<tr>
<td>Methane to Gaseous Hydrogen</td>
<td>HYGN010</td>
<td>2B Application*: 100% Renewable Biogas, Tube Trailer</td>
<td>-32.36</td>
<td>0</td>
<td></td>
<td>-32.36</td>
</tr>
</tbody>
</table>

* Conditions Apply

Operating Conditions

Due to limited data provided by the applicant for their process, staff cannot determine all the necessary inputs for hydrogen production. Staff therefore imposes constraints on production of H₂ from this prospective pathway which are listed below. LytEn shall submit commercial production data to obtain an updated provisional CI for this pathway prior to generating LCFS credits. This data shall include one calendar quarter of operational production data once commercial production is initiated.
• The company shall provide an agreement/contract for sourcing of renewable biomethane in sufficient quantities to demonstrate that all reported renewable hydrogen is generated from this feedstock. Data supporting the CI of the renewable biomethane shall be submitted to ARB.
• The company shall provide evidence that the assumptions regarding process operating conditions and yields are valid as described in the application or reflecting different values as applicable.
• Applicant will be required to provide evidence for the end-use of carbon generated during this process.
• The company shall provide quarterly receipts for eight quarters to support quantity of H₂ produced from the LytEn process including natural gas consumed, electric power consumed, H₂ produced, total compression energy at the facility and fuel station, and carbon black production.
• Any additional lifecycle inventory data, process information, etc. should also be made available if requested prior to certifying a provisional CI.

Staff Analysis and Recommendation

ARB staff has reviewed the LytEn application and has replicated, using the CA-GREET 1.8b model, the carbon intensity values calculated by the applicant. LytEn provided documentation for the facility’s energy inputs based on process modeling. Based on preliminary assessment using limited process information, staff has estimated carbon intensity values for each of the four different configurations of H₂ delivery as proposed by LytEn. Because the applicant provided only process data that is consistent with a material balance, staff recommends that the LytEn Method 2B application be approved as prospective with the CIs for each of the four pathways as listed in the table above.

Fuels with prospective CIs are not eligible to claim credits under the LCFS. To claim credits, the applicant must provide one quarter of operational data once commercial production has commenced. ARB will then complete an updated lifecycle analysis and make necessary adjustments to the originally certified prospective CI if warranted and approve a provisional CI for each of the pathways being considered in this application. To confirm compliance with updated operating conditions, the Executive Officer may reevaluate any aspect of the review at any time and revise the certification to reflect new information. At any time after certification, the Executive Officer may increase the CI values upon determination that the provisional CIs underestimate fuel life carbon intensity. (Cal. Code Regs. tit. 17, § 95486, subd. (e)(3)(K) (original LCFS); Cal. Code Regs. tit. 17, § 95488, subd. (c)(5)(L) (from January 1, 2016).)