

Application No. D0005

Staff Summary**Red Trail Energy, LLC
Richardton, North Dakota
Starch Ethanol Pathways with
Carbon Capture and Sequestration (CCS)**

Posted for Comment: 02/04/2020

Approved and Posted: 2/27/2020

Pathway Summary

Red Trail Energy (RTE) operates an ethanol production facility located at Richardton, North Dakota with annual production of about 60 million gallons per year. The facility has been in operation since 2007. RTE has two certified starch ethanol pathways under the Low Carbon Fuel Standard (LCFS) (ETHC218 and ETHC219) for DDGS¹ ethanol and MDGS ethanol. The ethanol fermentation process produces high purity CO₂ and is an ideal candidate for carbon capture and sequestration. This ethanol facility is expected to produce approximately 181,000 metric tons of CO₂ annually from starch fermentation.

RTE is proposing sequestration of CO₂ produced from starch fermentation. RTE is requesting approval of two design-based starch ethanol pathways which take into account sequestration of CO₂. According to section 95488.9(e), applicants may submit a design-based pathway application for novel fuel pathways that rely on a fully engineered and designed facility without actual operational data. Such pathways however, are not eligible for credit generation under the LCFS program.

RTE has carried out a preliminary assessment to establish the technical and economic feasibility of CCS at the RTE site including a site-specific geologic evaluation. In addition, RTE recently performed a detailed assessment of engineering designs for capturing, transporting and storing CO₂, and integrating CCS with ethanol production. The planned facility for CCS sits atop the Broom Creek Formation which is the proposed CO₂ storage site. The applicant has stated that significant progress has been made on this project and is currently in the advanced stage of planning and engineering.

¹ Distillers grain solubles (DGS) is a co-product of starch ethanol production. DDGS and MDGS refer to dry and modified DGS streams respectively.

CCS Process Description

RTE will capture the high purity CO₂ stream (>99%) from the ethanol fermentation tank via a commercially available liquefaction system. The liquefaction system includes compression, dehydration, refrigeration, distillation and a booster pump. The high purity stream will enter the liquefaction system which will remove moisture and other non-condensable gases such as nitrogen while liquefying CO₂. The liquefaction system will be designed to minimize CO₂ losses. The liquefaction system is expected to achieve a capture efficiency close to 99%. The liquefied CO₂ will be transported to a sequestration and storage site located two miles away via an underground pipeline and injected into the Broom Creek Formation.

CO₂ Storage

The intended sequestration zone for the RTE CCS Project is the Broom Creek Formation, a saline formation that lies approximately 6,500 ft. directly beneath the RTE facility. The formation extends over southwestern North Dakota, southeastern Montana, and northwestern South Dakota. The thickness of the formation beneath the injection site is approximately 270 ft. Shales and salts of the Opeche, Piper, and Swift Formations overlying the Broom Creek Formation form primary, secondary, and tertiary confining zones of over 1000 ft. in combined thickness.

Feasibility studies suggest that this formation exhibits favorable petrophysical properties, appropriate formation water chemistry, and a robust confining system, which make this a good candidate sequestration zone for the RTE CCS Project. Thus, the proposed injection site has the potential to meet the minimum site selection criteria as required by the CCS Protocol (subsection C.2.1).

Carbon Intensity of CCS ethanol

The applicant has estimated the carbon intensities (CIs) for both starch ethanol pathways when CO₂ is sequestered. The analysis used a detailed engineering design and reasonable assumptions for operational parameters. RTE has considered each individual piece of equipment involved in CO₂ capture, transport, injection, and well monitoring and has estimated power requirements based on design specifications. Some examples of equipment include blowers, heaters, compressors, battery backup, regulators, meters, gauges, etc. The GHG emissions associated with the CCS process are expected to be primarily from electricity. The applicant has assumed a CO₂ capture efficiency of 99%. In addition, CARB has added a margin of safety to the CI Score of this design-based pathway equivalent to one percent of the CO₂ injection rate.

For this application, previously certified starch ethanol pathways (corresponding to FPCs ETHC218 and ETHC219) are included in the modified Starch and Fiber Ethanol Tier 1 calculators. Emissions and appropriate sequestration benefits of CCS operations are included in the lifecycle analysis of starch ethanol pathways. Since the energy input to the CCS operation is primarily electrical, total estimated electricity demand for CCS is included as grid electricity for ethanol production. Staff has estimated that electricity used for the CCS system will contribute about 5 gCO_{2e}/MJ to the ethanol pathways. Staff has checked power requirements for a liquefaction system by conducting a literature review and has found the RTE estimate to be reasonable. The net CI

reduction for CCS is about 32 gCO₂e/MJ after including incremental emissions from electricity use.

Table 1 lists the estimated CIs for starch ethanol pathways when CCS is included in the evaluation. These CIs are calculated using the current certified CIs for starch ethanol pathways (ETHC218 and ETHC219) for the ethanol production facility and accounting for incremental emissions and credits associated with CCS.

Table 1. Estimated Pathway CIs for Starch Ethanol Pathways when CCS is considered in CI Evaluation

Fuel	Pathway FPC	Pathway Description	CI (gCO ₂ e/MJ)
Starch ethanol	ETH009D00050100	Midwest Corn, Dry Mill; Dry DGS, Corn oil and Syrup; Natural Gas and Grid Electricity; Starch Ethanol with CCS produced in Richardton, North Dakota; Ethanol transported by rail to California	43.00
Starch ethanol	ETH009D00050200	Midwest Corn, Dry Mill; Modified DGS, Corn oil and Syrup; Natural Gas and Grid Electricity; Starch Ethanol with CCS produced in Richardton, North Dakota; Ethanol transported by rail to California	37.00

Operating Conditions

Approval of CIs for this design-based pathway does not permit generation of credits under the LCFS. When the CCS project is operational, the applicant shall submit a pathway application to include operational data for both the starch ethanol plant and the CCS operations for review by CARB staff per section 95488.7. Appropriate operational conditions will be included prior to certification.

Staff Analysis and Recommendation

Staff has reviewed the RTE application, replicated the CI values calculated by the applicant, and approved this design-based pathway for public posting. Upon close of the comment period, applicant shall provide responses to all substantive comments received. This pathway will be approved only if the responses to comments are deemed satisfactory by the Executive Officer.