Draft Guidance

October 2017

<u>Low Carbon Fuel Standard (LCFS) Guidance 17-03</u>

Guidance on Data Collection/Generation to Quantify Fuel Volumes and Calculate Corresponding Carbon Intensities (CI) for Low Carbon Fuels Produced from Co-processing in Hydrotreaters or Hydrocrackers in Petroleum Refineries

SCOPE

This document provides data generation/collection requirements for co-processing in hydrotreaters or hydrocrackers. This document is intended to provide guidance to applicants who wish to apply for a fuel pathway under the LCFS program. Stakeholders should review the guidance and provide feedback so staff may consider refining the requirements detailed in the document.

The objective of the stated data requirements is to facilitate the quantification of low carbon fuel volumes using either the mass balance method or the carbon mass balance method, and energy use in co-processing. The energy use and low carbon fuel volume data would be subsequently used to calculate GHG emissions of producing low carbon fuels from co-processing. This has been detailed in the staff discussion paper published as part of the third Co-processing Work Group meeting on June 2, 2017 and available at: https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/lcfs_meetings.htm

Figure 1 provides a schematic of co-processing in a typical hydrotreater of a petroleum refinery. The inputs include a stream of low carbon feedstock (i.e., tallow, vegetable oil, other low carbon feedstock) and middle distillate which are injected separately into this unit. Other inputs include hydrogen, electricity, fuel gas, natural gas and steam. The outputs include gaseous streams containing propane, CO, CO_2, methane, ethane, and other gases plus liquid streams (i.e., diesel, naphtha, jet). Details of data requirements to quantify co-processed volumes attributable to the biogenic/low carbon feedstock and the methodology to calculate a carbon intensity of the co-processed fuel is provided in sections below.

The quantification of low carbon fuel volumes and corresponding CI require detailed operational data from the unit co-processing the low carbon feedstock together with the fossil inputs. The overall approach includes providing operational data prior to co-processing to determine baseline performance and energy use. Once co-processing has been initiated, operational data to assess unit performance and energy use should be provided. The difference in fuel volumes produced or carbon mass of inputs and outputs hydrogen consumption, and energy use provides a framework to calculate low carbon fuel volumes and corresponding CIs. There are general and specific requirements to establish performance and energy use with and without co-processing and they are detailed below.

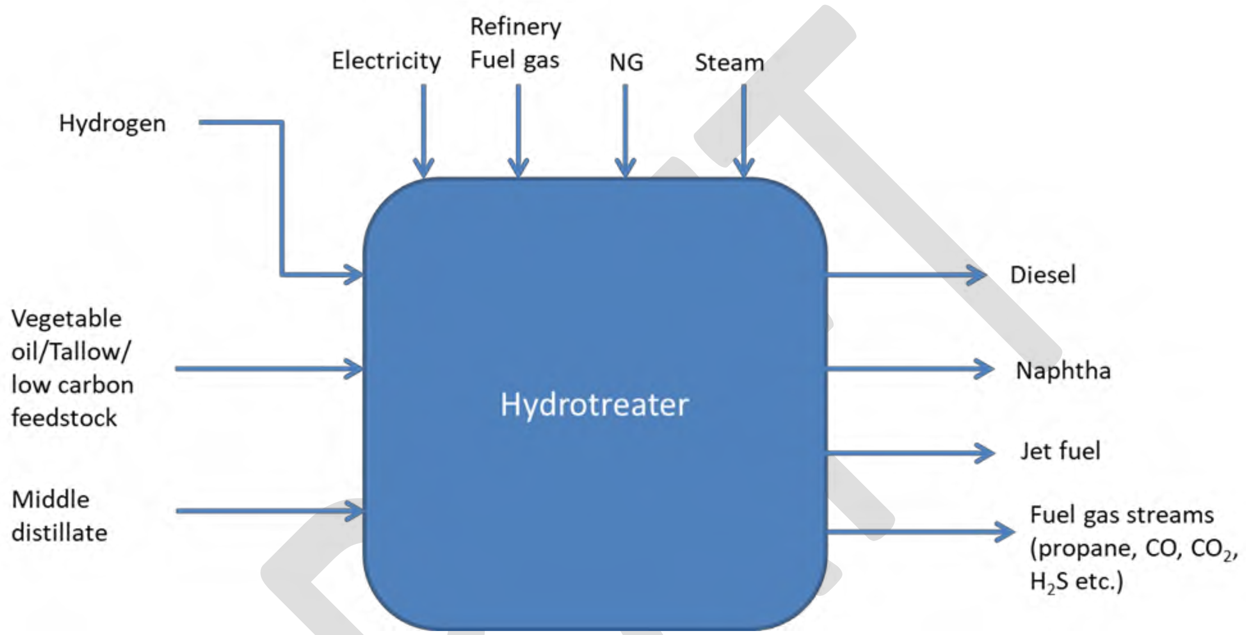

Figure 1: Schematic of co-processing in a hydrotreater

1. General requirements

All co-processing pathways will be treated as Tier 2 pathways and will need to conform to requirements for such pathways (section 95488) in the LCFS regulation. Pathway applications should be submitted using the Alternative Fuels Portal (AFP) with all data and information uploaded through the secure portal.

1.1 Input and output data

Primary data to establish a baseline footprint (i.e., without co-processing) should include operational quantities of input fossil feedstocks, hydrogen consumption, total energy use by type and quantity, and quantity of output liquid and gaseous streams. Data after co-processing should include similar data inclusive of input co-processed feedstock. All data for feedstock and energy use should be corroborated with invoices, receipts or other third-party generated documents where possible.

For input feeds generated internally from other refinery operations, dedicated meters or analyzers should be used to corroborate the use of such inputs. If dedicated meters are currently unavailable, applicants should provide alternate approaches to estimate consumption of a resource in the unit. If metered hydrogen consumption cannot be demonstrated, a hydrogen mass balance method that involves flow measurements and GC analysis (or equivalent) of the H_2-containing stream(s) entering and exiting the unit may be considered to estimate hydrogen use. The measured flow data and GC traces should be included as part of the application. Detailed calculations to support the estimated consumption should be included with the pathway application. In addition, process information such as temperature and pressure of the operating unit(s) for both the baseline period and the co-processing period should be included with the application.

1.2 Calibration and measurement accuracy requirements

Calibration of instruments used to collect co-processing data should be performed per manufacturer specifications and should be traceable to a National Institute of Standards and Technology or comparable standard. A detailed log of calibration should be included with the application. Details of calibration, accuracy, and other measurement metrics should be included with the application including repeatability of measurements. The applicant is required to submit sample calculations per the draft guidance and quantify uncertainty in these calculations by calculating a mean and standard deviation for each measurement in the calculation from actual plant data for evaluation by staff. For Gas Chromatography (GC) or similar analytical methods, the co-processing facility should develop and validate a method to enable accurate quantification of all species in the gaseous streams. Repeatability and reproducibility should be determined as part of method development.

1.3 Theoretical calculations to support calculations from operational data

Theoretical estimates for fuel yield, carbon balance, mass balance and hydrogen consumption should be included with the application to support fuel yield and hydrogen consumption measurements. The calculations should be based on stoichiometric calculations using chemical structure(s) of the input feedstock(s). The application should include detailed calculations including any assumptions or factors used. A sample calculation should be included for each set of computational values included with the application.

1.4 Carbon balance

To facilitate carbon mass balance, elemental composition (C, H, N, O, S, ash content) and moisture content analysis of the input and output liquid streams should be performed. The analysis should ideally be conducted by an external certified laboratory. The data and analysis should be included with the application. For gaseous species, analysis using a Gas Chromatograph (GC) or equivalent should be used.

In general, staff suggests that dedicated meters and analyzers should be installed to measure all required inputs and outputs. If dedicated meters are unavailable, the applicant should propose alternate approaches to quantify mass, volume or energy measurements.

2 Specific guidelines to establish baseline footprint

Prior to introduction of a low carbon feedstock the facility should ideally complete a comprehensive measurement of inputs and outputs to the unit to establish a baseline data set for the unit.

2.1 Measurement of inputs and outputs for baseline operation

Staff suggests that at least three months of continuous commercial production data prior to initiation of co-processing should be included with the application. Data would include the quantity of middle distillate (or other fossil feedstock inputs) and liquid fuels outputs in barrels/day and gaseous products in standard cubic feet per day, which should be corroborated with measured data and included with the application.

2.2 Hydrogen consumption for baseline operation

Hydrogen use for the unit should include daily total hydrogen consumption (flow and temperature for a minimum of three months to correspond to the same period for other submitted data). Hydrogen use should be measured using dedicated meters if supplied directly from a hydrogen production unit or using analyzers and dedicated meters if other refinery streams containing hydrogen are used. The application should clearly specify the source and quantity of hydrogen used from one or more sources.

2.3 Carbon balance for baseline operation

The gas composition data should be used to quantify all gaseous components produced for carbon balance analysis. Gas chromatography traces should be included with the application (staff suggests a minimum of 50 traces from sampling over multiple days over a three month period). Carbon balance should be based on elemental composition of input and output liquid streams and composition analysis of gaseous products for a minimum of three months.

2.4 Energy use for baseline operation

Quantities of natural gas, electricity, refinery fuel gas, steam and other external sources of energy used for processing of petroleum feedstock in the unit from dedicated meters should be provided. If an alternate approach is included with the application, details of this approach including a process flow diagram should be provided to expedite staff review.

3 Specific guidelines for co-processing data

3.1 Time period for data collection

Once co-processing is initiated, the facility should complete measurements of inputs and outputs to the unit to establish an operational data set for the unit. The application should include continuous commercial production data for a minimum of three months after initiation of co-processing (such applications will be processed as “provisional,” per Section 95488(d)(2) of the LCFS rule). Varying blend percentage of low carbon feedstock co-processed during the three months of commercial production may be considered to meet the three month provisional requirement. Measurement data and calculations however, should be presented for each particular blend percentage separately.

3.2 Carbon balance for co-processing

The gas composition data should be used to quantify all gaseous components produced for carbon balance analysis. Gas chromatography traces should be included with the application (staff suggests a minimum of 50 traces from sampling over multiple days over a three month period). Carbon balance should be based on elemental composition of feedstock inputs and output liquid streams and composition analysis of gaseous products for a minimum of three months.

3.3 Hydrogen consumption for co-processing operation

Hydrogen use should include daily total hydrogen consumption (flow and temperature for the period to correspond to all the other co-processing data). To corroborate the H_2 consumption estimate obtained from measured data, theoretical H_2 consumption for the low carbon feedstock should be estimated based on stoichiometric calculations. Details of calculations should be provided including a sample calculation. If metered hydrogen consumption cannot be demonstrated, a hydrogen mass balance method that involves flow measurements and GC analysis of the H_2-containing stream(s) entering and exiting the unit may be considered to estimate hydrogen use during co-processing. The measured flow data and GC traces should be included as part of the application. If theoretical estimates are included for consideration, conservative estimates of hydrogen consumption should be used in calculating such estimates (i.e., assume that vegetable oil/tallow undergoes hydro-deoxygenation rather than decarboxylation). An illustration of differences in hydrogen consumption based on reaction pathways is shown in Figure 2. Detailed calculations to support the estimated hydrogen consumption should be included with the pathway application.

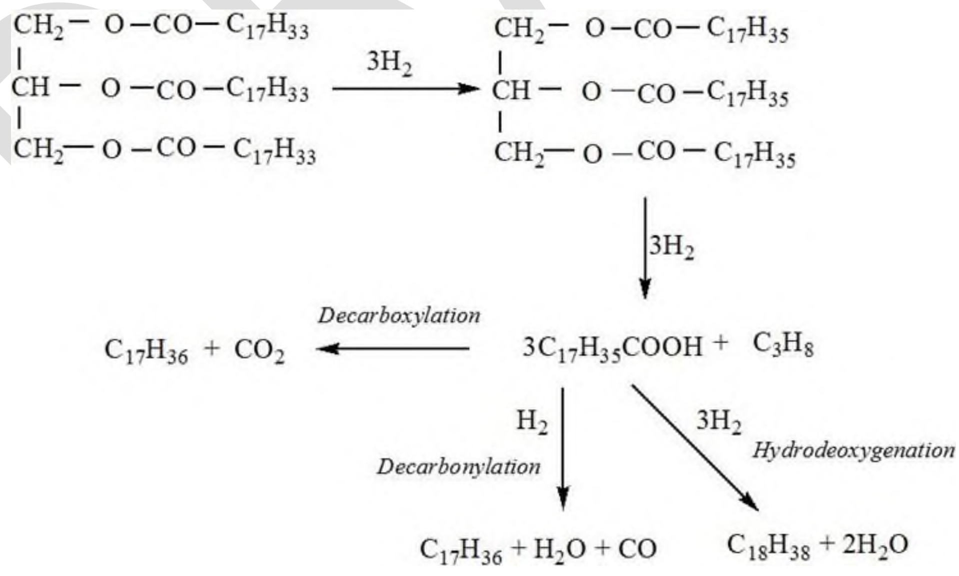

Figure 2: Illustration of hydrogen consumption by vegetable oil/tallow for different reaction pathways

3.4 Energy use for co-processing

Quantities of natural gas, electricity, and refinery fuel gas, steam and other external sources of energy used for processing in the unit should be measured using dedicated meters. If dedicated meters are currently unavailable, stakeholders should provide alternate approaches to estimate energy use in the unit. Complete details of an alternate approach including an appropriate process flow diagram should be included to expedite staff review.

3.5 Carbon balance for co-processing

For the carbon balance method, applicants should provide the measured compositions of all species including CO, CO_2, propane, methane, ethane and other hydrocarbon species in the gaseous output streams and any recycled gaseous stream from the co-processing unit. This should be based on GC or similar analytical quantification methods. Gas chromatography traces (or similar traces from other analytical methods) should be provided along with the application. The gas composition data should be used to estimate the amounts of gaseous components produced for the purpose of carbon mass balance analysis.

3.6 Mass balance for co-processing

For consideration of the mass balance method to estimate renewable fuel volumes, liquid and gaseous products including LPG should be measured daily and reported using flow meters and gas chromatography over the period considered in the application. The measured data and GC traces should be included as part of the application. Appropriate data to quantify moisture in output streams, including baseline moisture to determine the difference between the two modes of operation should be supplied.

4 Calculation of GHG Emissions

The energy use data should be entered into the CA-GREET model (or a co-processing GHG emissions calculator developed by staff to estimate GHG emissions of renewable fuel produced from the co-processing step of a fuel pathway if available). In the absence of appropriate emission factors in the CA-GREET model, other models such as PRELIM may be used to obtain such factors. Emission factors from non-CA-GREET sources should be based on a well-to-wheel basis and should be detailed in the application. The GHG emissions from the co-processing step should then be integrated into the CA-GREET model (or a comparable model approved by the Executive Officer) to estimate total well-to-wheel life cycle GHG emissions.

4.1 GHG emissions attributable to hydrogen consumption

To estimate GHG emissions associated with hydrogen use, lifecycle GHG emissions associated with the hydrogen production method should be included. Typical sources include methane reforming (co-located renewable natural gas production may be considered, non-co-located RNG should be credited through the Renewable Hydrogen Refinery Credit provision), naphtha reforming and electrolysis. If hydrogen is supplied from a steam methane reforming unit, the lifecycle GHG emissions associated with onsite hydrogen production from an SMR unit should be assigned to hydrogen. Likewise, if hydrogen comes from a naphtha reformer and diverting the hydrogen to co-processing results in additional natural gas use at the refinery, lifecycle GHG emissions of additional natural gas use should be assigned to the hydrogen consumed for co-processing. Applicants should provide evidence to confirm sourcing of additional hydrogen from the naphtha reformer for co-processing does not shift hydrocarbon composition of finished fuel (or blendstocks) compared to the baseline production. For hydrogen from electrolysis, emission factors either for grid generated or site-specific (for co-located power generation unit) electricity consumed to produce the hydrogen should be used in the lifecycle analysis.

4.2 GHG emissions attributable to additional energy used for co-processing

Additional energy use from natural gas, refinery fuel gas, electricity and other energy use should be matched to corresponding GHG emissions using respective emission factors from the CA-GREET model.

CONTACT INFORMATION

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