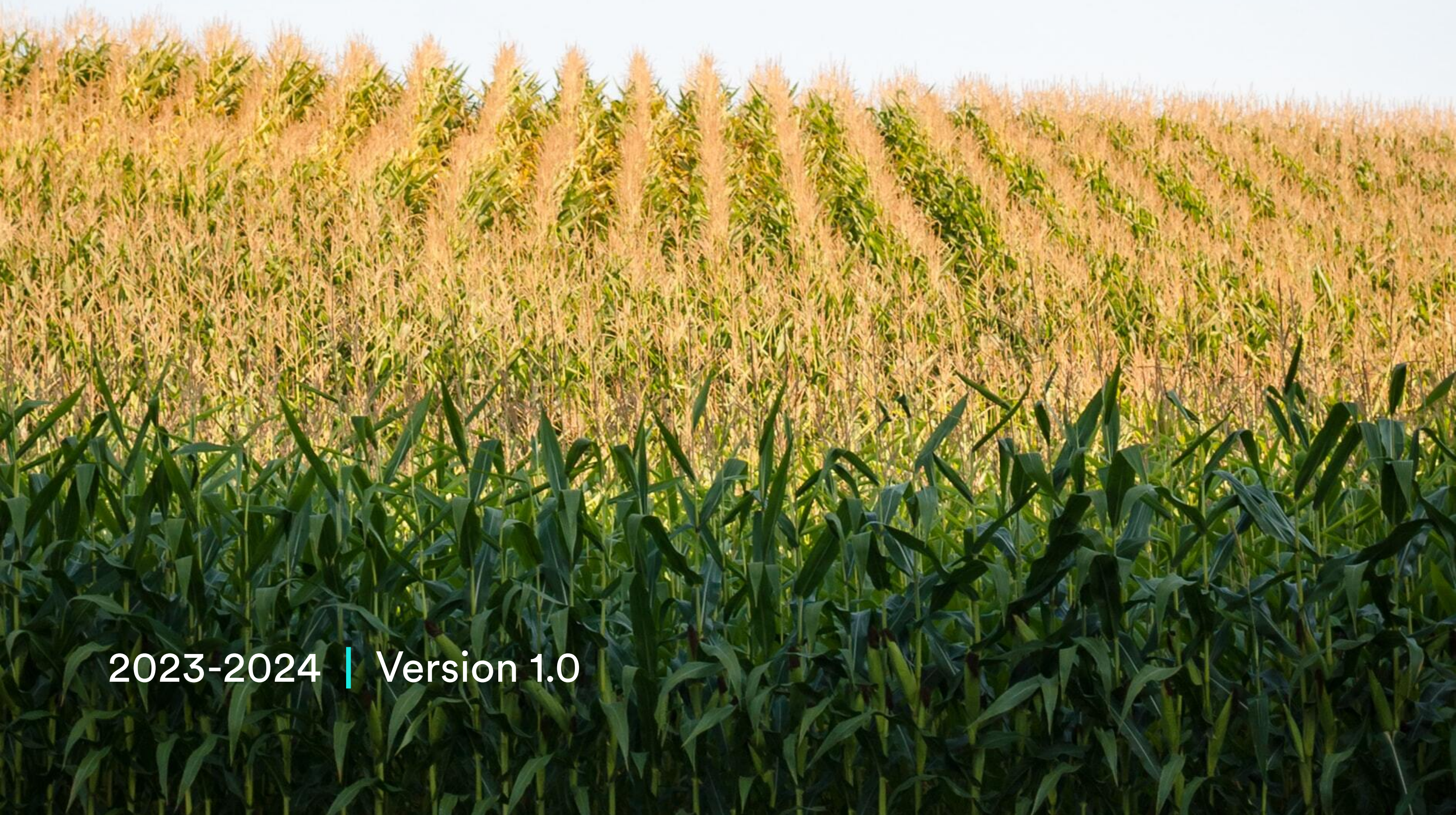
Xpansiv

Digital Monitoring, Reporting, and Verification for Digital Ethanol

ASSET SPECIFICATION



2023-2024 | Version 1.0

Digital Monitoring, Reporting, and Verification for Digital Ethanol

2023-2024 Asset Specification

Version 1.0 | January 2023

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1.0 BACKGROUND AND APPLICABILITY

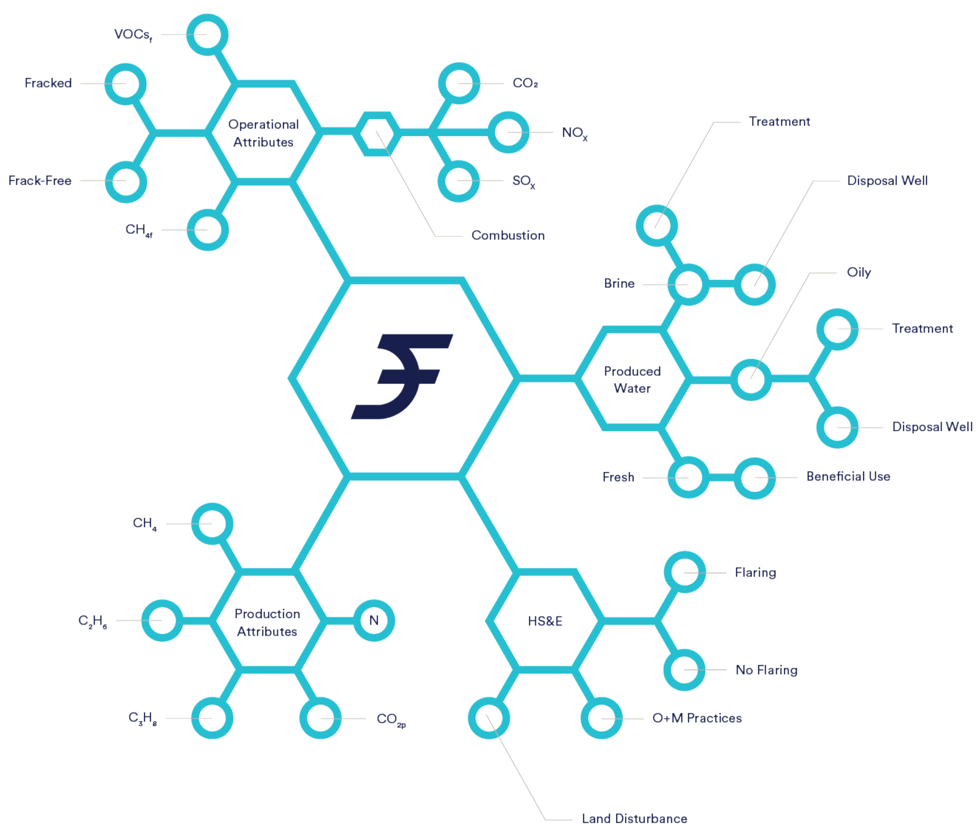
Xpansiv created the Digital Fuels Program™[2] to enable producers, operators, consumers, and other market participants to define, register and transact the environmental attributes of ethanol, natural gas, crude oil, aviation fuel, hydrogen and other energy fuels. As part of the Digital Fuels Program, Xpansiv has developed standardized digital asset specifications to claim the environmental impacts and risks associated with energy production, movement, refining and use.

Each Digital Fuel Asset has a standardized structure, two parts, starting with the digital measurement, reporting and verification (MRV) requirements for that commodity group (i.e., natural gas, crude oil, aviation fuel, hydrogen and other energy fuels) along with a schedule of specifications for Products converted from Payload Datasets.

Digital Ethanol ("DE")

"An immutable digital record representing the complete physical and energy profile of a specific production or operations unit of ethanol through an immutable provenance chain back to the source."

Digital Ethanol Attributes (sample)



- Commodity
- Producer
- Feedstock source
- Facility Lat/Long
- Production process
- Marketed Ethanol
- Production Period
- Carbon Intensity
- 3rd Party Certification
- Emission quantification framework

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[2]https://xpansiv.com/resources/

1.1 Use of this Document

This document supports the **Digital Fuels Program Governance Framework** by specifying the minimum Measurement, Reporting and Verification standards and required data for the base commodity asset (in this case DE) and all convertible Products.

1. Collecting and verifying a standardized set of environmental attributes from each unit of commodity production, storage, transport, refining and use.
2. Rules for conversion of Payload Datasets into digital assets.

1.2 Periodic Reviews and Revisions

Pursuant to the guidance and input from market stakeholders under the Digital Fuels Program, Xpansiv as market operator will continue to update the standards and methodologies used to generate and register digital assets. Xpansiv is engaging with experts to exceed encouraging best practices. We welcome all participation in the Market Stakeholder Committee under the Digital Fuels Program to continuously improve and build the market.

2.0 DIGITAL MRV FOR ETHANOL

2.1 Monitoring and Onboarding of Operations

Digital Ethanol assets are generated from assessments of the environmental performance attributes of specific units of ethanol production (e.g., greenhouse gas emissions associated with corn production and refining) and/or operations, grounded in continuously metered operations data, supplemental data (e.g., production of seed and fertilizer, land use change, direct air monitoring of N2O and CO2), 3rd party certifications, analytics and modeling. High quality data can be captured from multiple technologies and monitoring systems[3] and verified to substantiate and authenticate property rights in environmental claims derived from physical ethanol production and other lifecycle components.

2.1.1 Operations Data

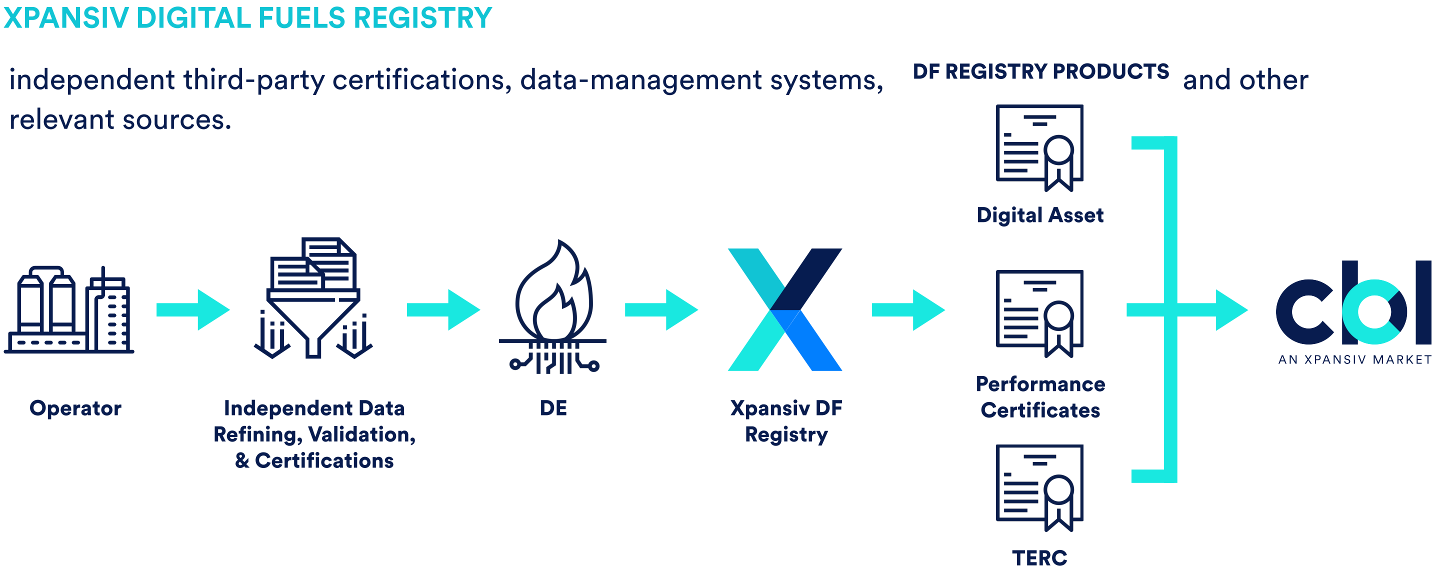
- Operations data are captured from meters, scales, certified chemical analysis, sales records and other primary sources that are auditable/verifiable by a 3rd party, and from monitoring equipment calibrated to meet regulatory/technical specifications.
- Operations data should be measured using equipment calibrated to regulatory specifications, industry standards, and production accounting principles, along with any certified chemical analyses being regularly updated.
- Operations data that includes greenhouse gas emission intensity calculations should align with industry best practices and international protocols for site level measurements such as US DOE GREET model, CA LCFS program, and other regulatory Renewable Fuel Standard schemes.

2.1.2 Supplemental Environmental Data

In addition to systems that capture and validate monitored primary data directly from meters and other

[3]See for example, “Methane Quantification: Toward Differentiated Gas, An assessment of methane measurement and monitoring technologies. Coefficient, March 2022.

instrumentation at facilities, primary production data can be supplemented by site-specific environmental monitoring, satellite measurements, modeling using established emission factors, independent third-party certifications, data-management systems, and other relevant sources.



Required Base DE Attributes

This section identifies and details the required base DE attributes. From the base DE digital asset, owners can transact as-is bi-laterally or convert that digital asset into scheduled Products assuming the Attributes and performance needed for that Product are met within the digital asset. The base DE digital asset minimum data requirements do not include all optional attributes required to meet all Product specifications, as consideration should be given to target Attributes for specific Product needs (see Schedule of Available D

Attributes defining base DE:

Attribute Name	Attribute Description	Reference Data: Reporting source, inputs, models, protocol
Operator Name	Legal name of operator entity	Retrieved from MSA
Facility Name	Common name of the operational facility	Defined by client and data integration team to reflect operational and accounting boundaries
Facility ID	Unique ID for operational facility	Determined by data integration team
Country	Country of origin	Operator provided or public source
State or Province	State or Province of origin	Operator provided or public source
Production Start	Start date/time for given data set	Operator provided
Production End	End date/time for given data set	Operator provided

Commodity Type	DE	Defined in data integration
UOM	Energy, Unit or Volume measure of the commodity	Operator provided
Marketed volume	Quantity of commodity units (Gallons) within the given data payload	Sales volume to match physical marketing
Type and Source of Feedstock	Description of the content and location of feedstock used for given facility	Operator provided purchase proof
Assessment Boundary	Indication of the physical environmental boundary scope included in asset	Description of physical emissions assessment scope

Optional DE Attributes:

Distinct from the minimum required Attributes are the Attributes representing the environmental claim(s) associated to each unit of marketed volume, and the inherent value of the digital asset and converted Products. Given the array of environmental impacts across the energy chain, the DFP provides flexibility in the form of "additional extensible attributes" to create digital assets having Product optionality across an array of environmental claims or value.

Attribute Name	Attribute Description	Reference Data: Reporting source, inputs, models, protocol
Methane Emission Intensity	Amount of CH_4 emission for a given dataset, calculated as (emission kgs / marketed ethanol kgs) expressed as a %.	Third party quantification, method and independent verification
Methane Emission Inventory	Absolute value of CH_4 emissions associated with the given data set. (Numerator in 'intensity' calculation)	Third party quantification, method and independent verification
CO_2 Emission Inventory	Absolute value of CO_2 emissions associated with the given data set, expressed in kgs	Third party quantification, method and independent verification; fertilizer,
CO_2 Emission Intensity	Amount of CO_2 emission for a given dataset, calculated as (emission kgs / marketed ethanol kgs) expressed as a %.	Third party quantification, method and independent verification
CO_2 Emission Inventory - Feedstock	Absolute value of CO_2 from feedstock creation, including applicable fertilizers, chemicals, seeds, machinery energy use and land use change	A sub-component of overall CO_2 Emission Inventory, allocation of CO_2 Emission Inventory specific to production of feedstock used for ethanol production given impact

CO2 Emission Inventory - Production	Absolute value of CO2 from production of ethanol from given feedstock	A sub-component of overall CO2 Emission Inventory, allocation of CO2 Emission Inventory specific to production of ethanol from feedstock
Other VOC Inventory	Absolute value of other VOC emissions associated with the given data set, expressed in kgs	Third party quantification, method and independent verification
ISO Certification	Indication that the Facility or wells within that Facility have an ISO Certification and type	URL or file attachment to ISO certificate corresponding to Facility and/or well(s)
Other Certification(s) not already mentioned	Extensible fields to indicate the dataset represents production certified by other standards, presented as: True or False; or grade and score	URL or file attachment to certificate corresponding to Facility and/or well(s)
Carbon Capture and Sequestration Inventory	Absolute value of CO2 that was captured and sequestered in association with the marketed volume	Third party quantification and independent verification
Associated Carbon Offsets	Absolute value (CO2eq) of retired carbon offsets associated with the marketed volume	Retirement certificate provided by client or integrated Offset registry
Facility Build Emission Factors	Absolute value of CO2eq associated with Facility construction	Building Facility components
Transport Emission Factors	Absolute value of CO2eq associated with transportation to delivery point	Mileage or point based indication of delivery legs
Storage Emission Factors	Absolute value of CO2eq associated with storage over Production/Delivery period	Time based emissions factors corresponding to storage type and activity level

Reporting Source
Digital asset Attributes, Carbon Emission Intensity for example, supporting reference data should conform to established protocols and standards such as:

- US EPA Greenhouse Gas Reporting Program (GHGRP)[4]
- CARB LCFS Model[5]
- ISO 14044:2006 Environment Management LCA[6]

2.2 Data Management

See Digital Fuels Registry data onboarding guide for detailed information on data management in the context of the Xpansiv Proof of State (POS) subsystem outlined in Section 2.4.

- Operations data and secondary data must be managed, configured, processed, stored/secured, linked, and recorded to meet veracity/provenance requirements specified in relevant energy, environmental or climate MRV standards.
- Data management software must conform to an approved or certified data governance system or inter-operable data architecture with automatic and verifiable data reconciliation.
- Data is stored and where permitted, distributed, in an immutable format that ensures transparency and information security.
- The data file format should enable asset registration and property right claims on approved platforms that do not compromise confidentiality, trade secrets, or personal privacy.

2.3 Verifications

Digital Ethanol may be identified as independently verified provided that onboarding and processing of data includes the following[8]:

- Sources for each data item are identified including sources of cross-validation within the data set, or available from additional primary data, and confirmation of the timescale for all available data.
- Data gaps are analyzed and plugged based on receipts or conservative assumptions.
- Methods for receiving ongoing data are optimized based on a balance between timeliness and accuracy, e.g., automation, alerts on potential outliers.
- Operations data and digitized production infrastructure can be used in established Product specification to determine path-based[9] emissions intensities (e.g.,methane).
- Quantification models should conform to foundational frameworks such as *ISO Quantification and reporting of greenhouse gas emissions and removals* (ISO 14064), *Greenhouse Life Cycle Assessment standards* (ISO 14040, 14044), The Greenhouse Gas Protocol[10], IFC Performance Standards on Environmental and Social Sustainability[11], and the World Bank Group Environmental, Health and Safety Guidelines[12].
- Measurements from stationary devices, drone-based sensors, aerial laser scanning, and satellite

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[4] https://www.epa.gov/ghgreporting/subpart-j-ethanol-production
[5] https://ww2.arb.ca.gov/resources/documents/lcfs-life-cycle-analysis-models-and-documentation
[6]https://www.iso.org/standard/38498.html

monitoring are used where available to verify emission intensity calculations.

- Where a reasonable level of assurance is required[13], the verification process should include the following:
  1. Examine the accuracy and reasonableness of the applied methodological approach for each source type, and perform calculation checks to either confirm correct application of the selected methodology or determine emissions based on a more appropriate (refined) methodology for comparison.
  2. Identify and assess emission contributions for any unaccounted for sources.
  3. Determine the materiality of the sum of the absolute values of all the identified discrepancies and unaccounted for emission contributions.

For each Attribute being assessed, operators should specify the entity that is providing quantification determinations and if an independent audit of that quantification has been performed.

Below are general reference data parameter examples required in verification of attribute values to achieve reasonable level of assurance. This list is for guidance only and is not exhaustive.

For data based Operational Attributes:

- Refining Facility and Data Network map
- Equipment types and specifications
- Monthly facility receipts and dispositions
- Ethanol quality analysis
- Other optional Reference Data points could include: factors used against network map, calculation assumptions made, uncertainty factors, etc.
- Scope of measurement fidelity
- Temporal references if not continuous monitoring and/or data aggregation methods used

In the absence of package-level information (meaning multiple biofuels forms flowing though the same path) where it is possible to divide and allocate total emissions inventory across multiple ownership and energy streams, as a conservative emissions intensity assessment assumption, all emissions should be attributed to the owned (working interest) Marketed ethanol volume for each respective payload.

2.4 Data Ingestion Auditability

Registry data ingestion: a) establishes standard protocols for how data is collected, contextualized, and

[8]For example, the ISO 14064 Part 3 verification process requires that the principles of impartiality, evidence-based approach, fair presentation, documentation, and conservativeness be applied. The program under which the verification is to be performed needs to establish the required type of engagement, level of assurance, objectives, criteria, scope and materiality threshold. ISO 14065 specifies principles and requirements for bodies performing validation and verification of environmental information statements.

[9]For example, specific volumes of produced ethanol, tracked from feedstock to sales custody point.

[10]ghgprotocol.org

[11]www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/Sustainability-At-IFC/Policies-Standards/Performance-Standards

[12]www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines

[13]In defining a reasonable level of assurance, independent verifiers should conform to ISO 14064-3, 3.6.6.

transferred; and b) records the full lifecycle of the digital assets in an ecosystem-wide, immutable digital provenance chain, referenced on the retirement certificate, providing a forensic trail to how the ESG attributes and other assets are derived.

Any firm involved in the workflow of data creation, collection, assessment and contextualization (e.g., producer, operator, assessment firm, monitoring system provider, auditors, etc.) contribute according to a consistent set of APIs and standardized data model, enabling visibility for permissioned participants, including the registry operator or 3rd party auditors. The contributions of all firms operating at each stage of the DE asset lifecycle are available via the Xpansiv platform.

Registration of DE Units enables the owner to reserve and convert the packaged attributes into issuance of Products (e.g., Transport Emission Reduction Certificates). With the flexibility in conversion of standardardized Products from digital assets, licensed owners of purchased Products inherit data visibility rights to supporting to allowed reference data captured in the data ingestion workflow.

2.6 DE Conversions

- An eligible facility operator may request conversion by the independent market operator (1) an amount of DE units to one or more Product(s) or (2) an amount of Products(s) back into DE Units, in either case in accordance with the terms of the applicable Product Schedule[15], provided that in either case, such DE Unit or Products has not been transferred, canceled, retired or otherwise used at the time of conversion on any interconnected Registry.
- Upon conversion and verified issuance of Products, all corresponding DE Units substantiating such Products shall be reserved and locked in the eligible operators' applicable Interconnected Registry Account and may not be transferred, canceled, retired or otherwise claimed or used by any entity except as part of the transfer, cancellation, retirement or other property right claim to the applicable Product.
- Each converted Product shall be given a unique digital identifier traceable to the underlying DE Units and verified attributes.

Schedule of Available Products from DE Digital Assets

Every Product will have a detailed Quantification Method specifying additionality, deviation and/or extension required beyond base digital assets. This will include specifications for minimum MRV standards, Product data model, and required Reference Data. For example, Transport Emission Reduction Certificates are derived DE products (See **Appendix A**).

[15]Products may be derived and issued from certain DE Units and authenticated by application of a standardized quantification methodology as further identified and described in the applicable Product Schedule. The Products of an amount of DE Units is calculated based on the applicable Standard & Benchmarks for such Products as contained and described in the Eligible Fuel Digital Fuel Asset.

APPENDIX A

Quantification Methodology for Transport Emission Reduction Certificates

Version 1.0 | January 2023

A.1 Introduction

Transport Emission Reduction Certificate™ (TERC)

"Transport Emissions Reduction Certificate that is a qualified, 3rd party verified, unbundled, un-retired 1 metric ton CO2e derived from the production of qualifying low carbon fuels modeled after the California Low Carbon Fuel Standard ("LCFS")."

Each TERC seeks to capture the greenhouse gas ("GHG") emission reduction represented by low carbon fuels in the form of a marketable emissions credit. A fuels' lifecycle GHG emissions will be represented in a "carbon intensity" ("CI") score measured in units of grams of carbon dioxide-equivalent per megajoule of energy ("gCO2e/MJ"). The CI will be quantified using a version of the "Greenhouse gases, Regulated Emissions, and Energy use in Technologies Model" (GREET) in effect under U.S. California Air Resources Board Low Carbon Fuel Standard (CA-LCFS) program against a yearly CI benchmark that reduces over time. The resulting difference is reflected as total volume CO2e reduced relative to the CA-LCFS CI benchmark.

The initial scope of the TERC program will cover ethanol produced by U.S. production facilities. The program is expected to evolve over time, incorporating new fuel types and producers.

A.2 Framework

TERC leverages the LCFS framework for the following criteria:

- Generation of CI scores based on the lifecycle analysis ("LCA") of the fuel
- Annual benchmarks
- Credit generation calculation as appearing in the CA-LCFS regulations at 17 CCR 7 CCR §95486.1(a)
- Third-party verification methodology

A.2.1 Generation of Carbon Intensity Scores

Under the TERC registry, the LCA GHG emissions will be represented in a CI score measured in units of grams of carbon dioxide equivalent per megajoule of energy ("gCO2e/MJ").

Each participating producer's fuel pathway(s) will be scored using a version of the GREET[16] model in effect under California's LCFS program. Where possible, a simplified calculator published by the California Air Resources Board ("CARB") and applicable to the fuel pathway will be used. CIs will be calculated bi-annually for each participating producer; the data period used for CI modeling will be the same as required under the LCFS program (i.e., up to 24 months of actual production data, and not less than 3 months of actual production data). Finished fuel transportation distances used in CI modeling will be based on a weighted average of distances to final destinations during the data period, based on knowledge or reasonable belief by the participating producer. If unknown, then a conservative default distance will be used in CI modeling. A fuel's CI score will be compared against a yearly benchmark; fuels with a CI below the benchmark will be eligible to generate TERCs.

A.2.2 Annual Benchmark and Vintage Year

The CI benchmark used in TERC generation calculations will be as published and in effect for the applicable fuel type under the LCFS program. Baselines as of document publication appear in Table 1 and

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[16]See CA-GREET 3.0 for example
https://ww2.arb.ca.gov/resources/documents/lcfs-life-cycle-analysis-models-and-documentation

can be found on CA-LCFS website. TERC vintage will correspond to the year as set under CA-LCFS carbon intensity benchmarks. As CA-GREET model and LCFS CI benchmark values are updated, Xpansiv will reflect both as used for given qualified fuel and TERC issuance.

Table 1. LCFS Carbon Intensity Benchmarks for 2011 to 2030 for Gasoline and Fuels Used as a Substitute for Gasoline

Year	*Average Carbon Intesity (gCO_2e/MJ)*	*Year*	*Average Carbon Intesity (gCO_2e/MJ)*
2010	Reporting Only		
2011*	95.61	2021	90.74
2012	95.37	2022	89.50
2013**	97.96	2023	88.25
2014	97.96	2024	87.01
2015	97.96	2025	85.77
2016***	96.50	2026	84.52
2017	95.02	2027	83.28
2018	93.55	2028	82.04
2019****	93.23	2029	80.80
2020	91.98	2030 and subsequent years	79.55

*The benchmarks for years 2011 and 2012 reflect reductions from base year (2010) CI values for CaRFG (95.85) calculated using the CI for crude oil supplied to California refineries in 2006.
**The benchmarks for years 2013 to 2015 reflect reductions from revised base year (2010) CI values for CaRFG (98.95) calculated using the CI for crude oil supplied to California refineries in 2010.
***The benchmarks for years 2016 to 2018 reflect reductions from revised base year (2010) CI values for CaRFG (98.47).
****The benchmarks for years 2019 to 2030 reflect reductions from revised base year (2010) CI values for CaRFG (99.44).

A.2.3 TERC Generation Calculation

The formula appearing in the LCFS regulations at 17 CCR §95486.1(a), including all incorporated references, shall be used to calculate the quantity of TERCs generated bi-annually. The volume input for this formula will be the volume of eligible low carbon fuel produced and sold by a participating producer during:

- Calendar Q1 - Q4 of Year X, for the annual credit generation of Year Y

One metric ton of carbon dioxide-equivalent ("MT CO2e") calculated as described above will be equivalent to one TERC. Only whole credits will be issued, meaning calculation remainders are rounded down to whole credit number.

Credits = [(CARB LCFS baseline year CI – CARB LCFS alternative fuel pathway CI) * 81.51 (CARB LCFS MJ/gal energy density of ethanol) * 0.000001 (conversion factor) * verified gallons of ethanol]

Example:

1732 Credits = (88.25 - 67) * 81.51 * 0.00001 * 100,000 gallons

Where: CARB LCFS 2023 CI baseline = 88.25 gCO2e/MJ and AFP CI for given plant = 67 gCO2e/MJ

Table 2. Energy Densities and Conversion Factors for LCFS Fuels and Blendstocks

Fuel (units)	*Energy Density*
CARBOB (gal)	119.53 (MJ/gal)
CaRFG (gal)	115.85 (MJ/gal)
Diesel fuel (gal)	134.47 (MJ/gal)
LNG (gal)	78.83 (MJ/gal)
CNG (Therms)	105.5 (MJ/Therm)
Electricity (KWh)	3.60 (MJ/KWh)
Hydrogen (kg)	120.00 (MJ/kg)
Undenatured Anhydrous Ethanol	80.53 (MJ/gal)
Denatured Ethanol (gal)	81.51 (MJ/gal)
FAME Biodiesel (gal)	126.65 (MJ/gal)
Renewable Diesel (gal)	129.65 (MJ/gal)
Alternative Jet Fuel (gal)	126.37 (MJ/gal)
Propane (LPG) (gal)	89.63 (MJ/gal)

Exemptions

TERCs will be generated only for fuels produced or imported for sale outside of a jurisdiction that provides a regulatory mandate or direct incentive for the use of low carbon fuels. TERCs generated must be based on environmental performance claims of corn or other feedstock input that have not been otherwise claimed (whether voluntarily or regulated jurisdiction).

A.2.4 TERC Verification Methodology

TERCs will be generated annually only after independent, third-party verification of the following elements:

1. Calculation of CI score for participating Producers' products
2. Product volumes produced and distributed to qualifying jurisdictions (outside of states/regions with a regulatory mandate or direct incentive for the use of low carbon fuels)

A system for third-party verification is needed to ensure accuracy and completeness of reported GHG data.

The framework and methodology for the verification will be an attestation engagement consistent with the statements on Standards for Attestation Engagements ("SSAE"), developed by the American Institute of Certified Public Accountants ("AICPA"), under the "agreed-upon procedures" model of SSAE 19.

The entity providing verification services must be qualified, and trained verifier under the CARB accreditation program.

A.2.4.1 Verification of Carbon Intensity Scores

Below verification procedures will be followed:

- Fuel producer will engage directly with third-party verification body
- Verifier will issue engagement letter and protocols to fuel applicant
- Verification process will consist of the following data checks:
    - Transactional verification: Renewable fuel production and shipment records
    - Operational verification: Feedstock and process energy consumed, RF and co-product production, and transportation distances
- Site visit: Participating fuel producers with no existing LCFS facility ID may be required to have a site visit by verifier
- Upon completion of verification, verifier will issue a TERC CI score statement report
- CI score verification my take up to 3 months

Documentation Required

- Tier 1 SFE LCFS calculator containing 12 months of data
    - Fuel applicant to calculate and provide CI score using most recent/updated version calculator found/posted on CARB website
    - Supplemental information - fuel applicant must provide supporting evidence for specified inputs to CI calculator.
        - If applicable, annual fuel pathway verification statements and reports completed by independent third-party verifier
- All information required per engagement letter and protocols specified by third party verifier must be provided

A.2.4.2 Verification of TERC Eligible Gallons

- Verifier to confirm eligible fuel gallons
- Verifier to apply TERC established formula (**A.2.3**) to the eligible verified fuel gallons to authenticate TERC credit generation
- Upon completion of verification of eligible gallons and TERC calculation, verifier will issue an eligible fuel gallons and calculation application statement report

A.2.4.3 TERC Registry Issuance

Upon Xpansiv registry receipt of eligible fuels containing all required data, including, but not limited to verified CI score, fuel volume, and production period, fuel units will be registered and TERCs generated based on **A.2.3** credit generation formula. The credits are deposited to the account holder in accordance to the registry rulebook terms of use.

TERC Generation Timeline

Fuel applicants are eligible to generate credits for the following production periods, under a retroactive process (prior year fuel production):

Year of Verified Transactions	TERC - Earliest to Latest Eligible Fuel Production Date
2022	1.1.2021 - 3.31.2022
2023	4.1.2022 - 12.31.2022
2024	1.1.2023 - 12.31.2023
2025	1.1.2024 - 12.31.2024
2026	1.1.2025 - 12.31.2025
2027	1.1.2026 - 12.31.2026
2028	1.1.2027 - 12.31.2027
2029	1.1.2028 - 12.31.2028
2030 and beyond	Prior Year

APPENDIX B

Quantification Methodology for Placeholder Net-Zero Bundled Products

ANNEX I

DEFINITIONS & ACRONYMS

Please reference **Digital Fuels Program Governance Framework** for terms in this document not defined below.

Carbon intensity (CI) is the quantity of life cycle GHG emissions, per unit of fuel energy, expressed in grams of carbon dioxide equivalent per megajoule (gCO2e/MJ).

Emissions intensity outlines the volume of emissions associated with a unit of energy or dataset, expressed as a percentage or absolute value.

Ethanol (C2H5OH) is a clear, colorless, flammable alcohol. Ethanol is typically produced biologically from biomass feedstocks such as agricultural crops and cellulosic residues from agricultural crops or wood. Ethanol can also be produced chemically from ethylene.

Internet of Things (IoT) refers to the network of physical objects ("things") that can be embedded with sensors, software and other technologies to connect and exchange data over the internet.

Lifecycle GHG Emissions is the aggregate quantity of greenhouse gas emissions (including direct emissions and significant indirect emissions, such as significant emissions from land use changes), related to the full fuel life cycle, including all stages of fuel and feedstock production and distribution, from feedstock generation or extraction through the distribution and delivery and the use of finished fuel to the ultimate consumer, where the mass values for all greenhouse gases are adjusted to account for their relative global warming potential.