Pre-Rulemaking Public Meeting to Discuss 2018 LCFS Preliminary Draft Regulatory Amendment Text

INDUSTRIAL STRATEGIES DIVISION
TRANSPORTATION FUELS BRANCH
NOVEMBER 6, 2017
SACRAMENTO, CA
Meeting Participation

• Posted materials can be found on the LCFS Meetings webpage
  o https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/lcfs_meetings.htm

• Watch and listen via the Webcast:
  o https://video.calepa.ca.gov/

• Ask questions or provide feedback during the working meeting
  o Email sierrarm@calepa.ca.gov.
  o Participate via conference call
    • Toll Free: 888-566-5916
    • Toll/Outside the United States: 1-773-756-4816
    • Participant Code: 9886883

• Feedback should be sent to:
  o LCFSworkshop@arb.ca.gov by December 4, 2017
Agenda Outline

• Potential Amendments to the Low Carbon Fuel Standard:
  o Protocol for carbon capture and sequestration projects
  o Buffer accounts and updates to credit provisions
  o Renewable electricity and hydrogen
  o Updates to lifecycle analysis modeling tools and related pathway issues
  o Crediting provisions for refineries
• Miscellaneous updates
• Rulemaking Timeline
• Next Steps
• Open Discussion
Supporting Information and Draft Materials

• Draft CCS Protocol
• Draft CA-GREET3.0
• Draft Lookup Table Pathway Documents
• Updated Draft Simplified CI calculators and their respective Tier 1 Manuals
  o Corn Ethanol
  o Sugar Ethanol
  o Biodiesel and Renewable Diesel
  o Landfill Gas to RNG
• New Preliminary Draft Regulatory language, including
  o Carbon Intensity Benchmarks
  o Lookup and Temporary Fuel Pathway Tables
  o Other segments related to today’s discussion topics

Posted materials can be found on the LCFS Meetings webpage
https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/lcfs_meetings.htm
Accounting and Permanence Protocol for Carbon Capture and Geologic Sequestration under the LCFS (CCS Protocol)
CCS Discussion Outline

- Background
- Review Preliminary Draft of CCS Protocol
  - CCS Permanence Requirements
  - CCS Accounting Requirements
- Open Discussion
Background
Potential for CCS in California

- CO$_2$ storage potential in CA
  - Offshore sub-seabed offers additional capacity
2018 LCFS Amendments for CCS

- **Existing provisions for potential CCS generation of LCFS credits:**
  - Refinery investment credits
  - Innovative crude production credits, and
  - Provisions for fuel pathways

- **Staff is considering proposing to include provisions for crediting direct air capture CCS projects**
CCS Projects in LCFS

• Credits go to capture facility
• Current proposal: storage facility must be co-applicant
• Capture and storage facilities do not need to be co-located
• Must comply with CCS protocol
• No credits issued until CCS Protocol is approved and project meets all protocol requirements
Lessons Learned from Underground Natural Gas Storage Leaks

- High quality site selection that minimizes leakage risk is important
- Well integrity requirements need to be strong
- Rigorous monitoring is necessary
- Best practices need to be followed
  - DOE’s National Energy Technology Lab published several best practice manuals
Draft CCS Protocol is Available

- Draft CCS Protocol made available publically (including accounting and permanence requirements)
  
  https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/lcfs_meetings.htm

- CCS Protocol anticipated to be proposed to be incorporated into the LCFS as part of 2018 amendment rulemaking
- Staff continues to refine the CCS Protocol
CCS Permanence Requirements
General Process for CCS Protocol Adoption and Implementation

1. CCS protocol (includes accounting and permanence requirements)
2. LCFS amendment (incorporates CCS protocol by reference)
3. Project application pursuant to CCS protocol and LCFS
4. Project crediting
Project Process Under CCS Protocol

1. Application for site certification
2. Injection site certification
3. Well Construction
4. Injection operation and crediting
5. Injection start and crediting certification
6. Application for injection start and crediting
7. Injection completion
8. Post-injection monitoring
9. Site closure

[Diagram showing the flow of processes]
Overall Permanence Requirements

• Permanence certification
  o Sequestration site certification
  o Injection start and crediting certification
• Well construction
• Operating requirements
• Monitoring requirements
• Financial, post-injection, and other requirements
Permanence Certification

• Application for sequestration site certification
  o Includes site characterization
  o Includes all necessary plans (e.g. well construction, monitoring, financial instruments, emergency response)
  o Must be reviewed by third-party, independent, professional geologist prior to submittal

• CARB certification of sequestration site

• Application for injection start and crediting
  o Submitted after well construction
  o Must be reviewed by third-party, independent, professional petroleum engineer prior to submittal

• CARB certification for crediting of injected CO$_2$
Site Characterization: Focus Areas

- Minimum site selection criteria
- Site-based risk assessment
- Geologic and hydrogeologic evaluation of the proposed site
- Area of review delineation
- Corrective action requirements
- Baseline surface and near-surface measurement
Site Characterization: Minimum Site Selection Criteria

• Sequestration reservoir:
  ◦ Sufficient areal extent, thickness, porosity, permeability, and injectivity

• Minimum injection depth:
  ◦ 800 m (~2,600 ft)

• Primary confining layer:
  ◦ Free of transmissive faults or fractures and of sufficient areal extent, integrity, thickness, and ductility
Site Characterization: Minimum Site Selection Criteria (continued)

- Dissipation intervals above the storage complex
  - At least one permeable stratum and a secondary confining layer above storage complex
- Dissipation interval(s) below the storage complex
  - CARB may require this to lower the potential for induced seismicity
Site Characterization: Site-based Risk Assessment

- Site-based risk assessment demonstrates that the site is appropriate for sequestration:
  - Evaluation of potential pathways for CO₂ leaks or migration
  - Classification of risk probability and consequence, accompanied by a sufficient explanation
- Risk management plan required
- If any risk scenarios show high probability of occurrence and high magnitude of adverse impacts, then risks must be mitigated prior to CARB approval
Site Characterization: Geologic and Hydrogeologic Evaluation

• Protocol requires each site to undergo a geologic study to show that all minimum site selection requirements are met
• Existing site characterization data can be used to fulfill the site characterization requirements if sufficient
• Protocol establishes formation and well testing requirements
Site Characterization: Area of Review (AOR) and Corrective Action

• AOR encompasses:
  • The region overlying the free phase CO₂ plume, and
  • The CO₂ pressure front

• AOR and corrective action requirements ensure:
  • Potentially impacted areas are delineated,
  • Wells receive corrective action when appropriate, and
  • The AOR is updated as conditions warrant

• The protocol sets forth the AOR and corrective action requirements
Site Characterization: Relationship Between Activities
Site Characterization: Baseline Surface and Near-surface Measurement

- Baseline monitoring and data collection
  - A minimum of 1 year prior to injection
- Properties that affect baseline data must be evaluated:
  - Soil type, soil organic carbon, vegetation type/density
- Repeated measurements at several fixed sites
  - Capture seasonal or diurnal variations
- Sample locations must represent
  - A reasonable grid size and potential point sources
Well Construction: General Requirements

• Must prevent movement of fluids into or between any unauthorized zones
• Must permit continuous pressure monitoring
• Well materials must be compatible with injection and formation fluids
Well Construction: General Requirements (continued)

- Surface casing must:
  - Extend through base of lowermost freshwater aquifer
- One long string casing must extend from surface to the injection zone
- All casing must be cemented to the surface
Pre-injection Testing Requirements

- Logs, surveys, and tests during drilling and construction of wells
- Core samples of sequestration zone and confining layer
- Representative samples of sequestration zone formation fluids

Required Tests:
- Pressure fall-off, pump, and injectivity
- Must provide CARB with the opportunity to witness all logging and testing activities
Operating Requirements:
General

• Injection pressure must not:
  • Exceed 90% of the fracture pressure of the injection zone
  • Initiate fractures in the confining layer

• Mechanical integrity in the injection well must be maintained at all times
Operating Requirements: Required Shutdowns

- When loss of well mechanical integrity is suspected, operator must immediately and quickly investigate the cause
- If investigation and monitoring indicate that the well lacks mechanical integrity:
  - Immediately cease injection
  - Restore and demonstrate mechanical integrity
  - Obtain CARB approval prior to resuming injection
Monitoring Requirements: Testing and Monitoring Plan

• CARB approved Testing and Monitoring Plan is required, which must include:
  • Continuous monitoring of wells during injection
    o Pressure, injection rate, and volume
  • Quarterly corrosion monitoring
  • Mechanical integrity testing
  • Project monitoring during injection
    o Emissions
    o Verification of containment
Monitoring Requirements: Mechanical Integrity Testing

- **General requirements on mechanical integrity testing:**
  - Perform testing to demonstrate mechanical integrity of wells annually
  - Casing wall thickness and integrity must be inspected at least once every 24 months
  - CARB may request the operator demonstrate mechanical integrity
Monitoring Requirements: Containment Monitoring

- **Plume tracking**
  - Pressure front
  - Free-phase CO$_2$ plume

- **Surface and near-surface monitoring**
  - Surface air monitoring of point and other targeted sources to quantify CO$_2$ or other gases (e.g. CH$_4$)
  - Soil vapor monitoring of the vadose zone
  - Annual vegetation surveys to monitor ecosystem stress
Monitoring Requirements: Seismicity

- Deploy and maintain downhole seismic monitoring system
- Continuously monitor any induced microseismic activity
- Continuously monitor for earthquakes of magnitude 2.7 or greater within a radius of 1 mile
  - Notify CARB when an earthquake occurs
  - Implement the Emergency Remedial Response Plan If:
    - An earthquake has caused a failure of the mechanical integrity of wells, facility, or pipeline
Financial, Post-injection, and Other Requirements: Well Plugging

- A Well Plugging Plan is required
  - Prior to well plugging, the operator must determine bottomhole pressure and perform a final mechanical integrity test
- Written approval from CARB is required before plugging wells
- Within 24 months after injection completion, the operator must plug and abandon injection wells (and production wells, if applicable), unless approved otherwise by CARB
Financial, Post-injection, and Other Requirements: Post-injection Requirements

• A CARB approved Post-Injection Site Care and Site Closure Plan is required
• Monitor the position of the free-phase CO₂ plume and pressure front
• Monitoring for at least 15 years after injection completion and until plume stability occurs:
  • Continuous monitoring at monitoring wells
  • Periodic 3D seismic surveys at 1, 3, 5, and every subsequent 5 years after injection completion
  • Determine if leaks have occurred, if the plume is stable, and if remedial action is required
Financial, Post-injection, and Other Requirements: Post-injection Requirements (contd)

- Once monitoring and modeling shows plume stability has occurred
  - Must plug and abandon monitoring wells
- For 100 years post-injection
  - Must demonstrate that no fluids are leaking out of the sequestration zone
  - Annual leak detection testing at each well within AOR at wellhead, and near well surface
- After 100 years, site closure can occur
Financial, Post-injection, and Other Requirements: Site Closure

- After CARB site closure authorization:
  - Notify authorities to impose appropriate conditions on subsequent drilling
  - Record deed notation, or any other title search document, to inform buyers of property land use history:
    - Land was used to sequester CO₂
    - State agency and local authority with which further information is filed
  - Fluid volume injected, the sequestration zone, and period over which injection occurred
Financial, Post-injection, and Other Requirements: Financial Requirements

- Must demonstrate and maintain financial responsibility and resources using CARB-approved financial responsibility instrument
  - Trust funds, surety bonds, letters of credit, insurance, self-insurance, or escrow accounts
- Must maintain financial responsibility and resources until CARB approves site closure
- Must demonstrate sufficient funds to cover the cost of:
  - Corrective action on wells in the AOR
  - Well plugging, post-injection site care and site closure
  - Emergency and remedial response
CCS Accounting Requirements
Introduction

- Sets framework for quantifying GHG emissions reductions from carbon capture and sequestration under LCFS
- Applicable to CCS projects that capture CO$_2$ and sequester CO$_2$ in:
  - CO$_2$-EOR reservoirs
  - Saline formations and
  - Depleted oil and gas reservoirs without oil and gas recovery
- Covers any capture methods as long as CO$_2$ is geologically sequestered
  - Includes Direct Air Capture
Overview

• Designed to fit the LCFS GHG quantification framework
• Covers lifecycle GHG emissions
• Fits into fuel pathway CI determination for CCS projects involving alternative fuel production
Major Considerations

- Accounts for emissions during oil or brine production and CO₂ recycling processes
- Using detection limit to discount for possibility of small leaks that are below the detection limit
Lifecycle Concept: Electricity Used in Injection as Example

\[
\text{Lifecycle electricity GHG} = \text{NG production} + \text{NG Transport} + \text{NG use}
\]
System Boundary: Storage in Saline Formations
System Boundary: Storage in CO₂-EOR Reservoirs

Captured CO₂ → CO₂ capture, dehydration and compression (Equation 3) → CO₂ transport (Equation 4) → CO₂ injection and storage (Equation 5)

- Vented CO₂
- Fugitive CO₂
- Combustion GHG
- Embodied GHG_{electricity}
- Embodied GHG_{net}
- Embodied GHG_{chemical}

- Vented CO₂
- Fugitive CO₂
- Combustion GHG
- Embodied GHG_{electricity}
- Embodied GHG_{fuel}
- Land use

- Vented CO₂
- Fugitive CO₂
- Combustion GHG (CO₂ injection + separation and recycling)
- Embodied GHG_{electricity} (CO₂ injection + separation and recycling)
- Embodied GHG_{fuel} (CO₂ injection + separation and recycling)
- Atmospheric CO₂ Leakage
- Entrained GHG
- CO₂ transfer
- Land use

Emissions → CO₂ flow
Conceptual Design

CCS Credit = \( \text{CO}_2 \text{ Injected} - \text{Project GHG emissions} \)

Where,

Project GHG emissions = Capture GHG + Transport GHG + Injection GHG + Land use change
Description of Project Component GHG Emissions
GHG Emissions from Carbon Capture, Dehydration, and Compression

• Incorporates life cycle GHG emissions for:
  • Fuel and electricity use. Sum of upstream (embodied) emissions and on-site fuel combustion
  • Chemical use
  • Incorporates vented and fugitive CO₂ emissions
    o Event-based approach for vented CO₂ emissions & equipment count method for fugitive CO₂ emissions
    o Alternative: Staff seeks feedback on the reliability of the mass balance approach
    o Vented and fugitive CO₂ emissions would be zero if CO₂ is of biogenic origin or comes for Direct Air Capture
GHG Emissions from CO$_2$ Transport

- GHG emissions resulting from CO$_2$ transport by pipeline, truck or rail
  - Incorporates life cycle GHG emissions for fuel and electricity use
  - Incorporates vented and fugitive CO$_2$ emissions
  - If a CO$_2$ pipeline serves multiple sites or uses, allocate transport emissions on mass basis
GHG Emissions from CO₂ Injection

• Separate GHG accounting equations for CO₂ injection into CO₂-EOR reservoirs and saline formations/ depleted oil and gas reservoirs
  • For CO₂-EOR, there will be emissions allocation between CO₂ sequestration and oil production
    ▪ Emissions associated with CO₂ injection, separation and recycling are assigned to CCS on mass balance basis
    ▪ Remaining emissions from oil and gas extraction assigned to the crude/petroleum production
    ▪ Vented methane from CO₂-EOR assigned to crude production
GHG Emissions from CO₂ Injection

- Incorporates life cycle GHG emissions for:
  - Fuel and electricity use
  - Vented and fugitive CO₂ emissions for CO₂-EOR; injection into depleted oil and gas reservoirs also includes vented CH₄
    - CO₂-EOR: Vented and fugitive CO₂ emissions determined using the methods for oil and gas production described in MRR
    - Saline formations/depleted oil and gas reservoirs: event-based approach for vented CO₂/CH₄ emissions & equipment count method for fugitive CO₂ emissions
  - Incorporates CO₂ leakage
  - Incorporates intentional CO₂ transfer for CO₂-EOR
GHG Emissions from CO$_2$ Injection (continued):

- CO$_2$ leakage refers to the atmospheric leakage from the sequestration zone
  - Estimated using methods identified in the CARB approved monitoring plan
  - If no leak detected, CO$_2$ credits will be discounted by amount equal to the detection limit of the equipment
GHG Emissions from Direct Land Use Change

• Considering including GHG emissions from direct land use change (LUC) during pipeline installation and development of CO$_2$ injection site
  • May cause change in above-ground and below-ground carbon stock
  • Use LUC emission factors utilized in the GTAP model or similar ARB-approved land use change emission factors

• Considering omitting indirect LUC GHG emissions as they are considered small

• Staff seeks feedback on the inclusion of LUC emissions in the accounting requirements
Questions?
Buffer Accounts & Credit Provisions
Rationale for creating a Buffer Account

- Safeguard mechanism against risk of credit invalidation (including unintentional reversals from CCS projects)
- Reduces invalidation risk for credit buyers

Credit contributions to Buffer Account

- Credits representing real GHG emission reductions that may not be validly claimed pursuant to prohibition on retroactive credit claims [section 95486(a)(2)]
- Credits representing the real GHG emission reduction associated with the difference in the reported CI and the verified operational CI for each FPC in a compliance year
- Net credits remaining in any deactivated LRT-CBTS accounts
- Certain % of issuance to each CCS project
Buffer Account increases total credits in the system relative to the current rule, but does not take from any existing credit generators.

In response to the preliminary discussion of the buffer account concept on 9/22/17 we heard concerns from stakeholders, including the following:

<table>
<thead>
<tr>
<th>Feedback</th>
<th>Staff Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biofuel pathway holders who improve their operating CI score automatically lose out on any value generated between the lower operating CI and the certified CI</td>
<td>This occurs under the rule today (unless a new pathway is requested at a lower certified CI). The ability to request new pathways will be unaffected by the buffer account proposal.</td>
</tr>
<tr>
<td>Constitute a taking of real property in violation of the Takings Clause of the U.S. Constitution</td>
<td>Under the rule today biofuel pathway holders do not receive any value.</td>
</tr>
<tr>
<td>Would it be applied to electric vehicles?</td>
<td>It would be applied to EVs receiving credits under Tier 2 pathways (see discussion later today).</td>
</tr>
</tbody>
</table>
Concept of Buffer or Reserve in Other Programs

Forest Offset Protocol (CARB)
- Contribution based on risk rating of individual projects
- Weighted average contribution ~17% (range 10-21%)

Clean Development Mechanism (CDM)
- Fixed 5% contributions from all CCS projects
- No approved CCS methodologies or projects
- Provision to return unused credits upon project termination

American Carbon Registry (ACR)
- 10% of issued credit from CCS projects
- Can be replaced with appropriate insurance

Ontario Cap-and-Trade
- Proposed 3% contribution from of all offset projects
- Provides safeguard against invalidation risk
CCS Project Contribution to LCFS Buffer Account

A certain percentage of credits would be contributed in Buffer Account for each CCS project credit issuance. This percentage could be based on:

1. A framework for assessing risk for individual projects based on a risk-rating system
   ◦ Equitably accounts for the potential risks associated with CCS projects across the pool of all projects
2. A fixed % based on general risk associated with a CCS project
   ◦ Appropriate if most of the CCS projects carry similar risk profile

*Staff is seeking feedback on different approaches for determining potential CCS project contribution to the buffer account.*
Buffer Account – Specifics Related to CCS

Staff’s suggested approach to credit invalidation and emission reversal for CCS:

- In case of emission reversal from CCS projects, credits are retired first from the buffer account up the project’s historical contribution (if available)
- Next project operator is responsible to make up for any outstanding reversal (including through credit purchases)
- If any outstanding amount cannot be recovered from the project operator, then the Executive Officer retires other credits from buffer account
Clearing Services Providers in LCFS

Requirements for clearing service providers

◦ Registered Derivatives Clearing Organizations with CFTC pursuant to Commodities Exchange Act
◦ Register account in LRT-CBTS
◦ Can only temporary hold credits for clearing purposes between two LRT-CBTS registered entities

Benefits

◦ Allow LCFS participants to participate in a more structured futures market, which could:
  ○ Provide more compliance flexibility in the LCFS
  ○ Help mitigate investment risks resulting in increased investment in low carbon fuels
  ○ Help further standardize credit contracts
  ○ Lead to better price discovery in the LCFS credit market
95491(d)(1)(B): Temperature Correction of Fuel Volumes for LCFS Reporting

- For all liquid fuels, reported in LCFS, the volumes must be corrected to standard conditions (60° F)
- Staff is considering proposing methods used in the U.S. EPA Renewable Fuels Standard (RFS) for temperature correction of volumes of Ethanol and Biodiesel
- For all other liquid fuels, staff is considering proposing methods required under the Mandatory Reporting Regulation (MRR)
Improving Electric Vehicle and Hydrogen Crediting
Current EV Credit Generation Structure

Metered Residential Charging:
- kWh measured
- Credits generated using CA grid-average carbon intensity (105.16 gCO₂e/MJ)

\[(\text{CI}_{\text{std}} - 105.16 / \text{EER}) \times \text{Energy}_{\text{displaced}}\]

Non-Metered Residential Charging:
- kWh calculated assuming non-metered drivers behave like metered subpopulation
- ARB prorates total credit pool to utilities based on the number of LD EVs registered in their service territory

Non-Residential Charging:
- kWh measured
- Credits generated by charging providers

* Energy efficiency ratio (EER) is based on the improvement of electric vehicle drive trains compared to conventional vehicles. Currently 3.4 for LDVs.
Current State of Light Duty EV Crediting

Million Credits Generated (2016)

- Metered Residential
- Metered Non-Residential
- Non-Metered Residential
Considering Updates

Reasons to consider updates:

• Technology and electric vehicle applications have changed

• It is difficult to co-locate renewables with distributed charging infrastructure in urban areas

• Credit structure does not currently incentivize charging when grid CI is the lowest
  ○ Shifting the time of charging can help further reduce CO₂ emissions

Updates under consideration:

• Updates to EERs

• More frequent updates to CA grid average CI
  ◦ CA Grid Electricity pathway to be updated annually

• Encourage Tier 2 EV Credit Generation Pathways
  ◦ Renewable Electricity
  ◦ “Smart” Charging
**95486(b): Update Energy Economy Ratios (EERs) for Electric Vehicles (EVs)**

- Staff is considering adding EER for on-road electric motorcycles:
  
<table>
<thead>
<tr>
<th>Categories</th>
<th>Current EER</th>
<th>Proposed EER</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-Road Electric Motorcycles</td>
<td>NA</td>
<td>4.4*</td>
</tr>
</tbody>
</table>
  
  *Source: [https://www.arb.ca.gov/msprog/offroad/orrec/zem_eer_calcs_10_9_17.pdf](https://www.arb.ca.gov/msprog/offroad/orrec/zem_eer_calcs_10_9_17.pdf)*

- Off-road motorcycles not categorized separately (could use the existing 3.4 value for light-duty BEV/PHEVs)

- Feedback received on the proposed updated EER for heavy duty EVs:

<table>
<thead>
<tr>
<th>Feedback</th>
<th>Staff Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data selected represents “best-case” for EV’s</td>
<td>Staff considered data from all relevant studies and publications available</td>
</tr>
<tr>
<td>HVAC energy use not considered</td>
<td>Some of the EV data included accounts for HVAC. Test data for conventional fuel vehicles does not include AC load.</td>
</tr>
<tr>
<td>Duty cycle not representative of high-speed operation</td>
<td>Duty cycles considered is based on data reported by transit agencies and is most representative of average operational speed for all heavy duty EV types</td>
</tr>
</tbody>
</table>

*Source: [https://www.arb.ca.gov/msprog/offroad/orrec/zem_eer_calcs_10_9_17.pdf](https://www.arb.ca.gov/msprog/offroad/orrec/zem_eer_calcs_10_9_17.pdf)*
New Conceptual Structure for Incremental LCFS EV Crediting

**Unmetered**

- Credit zero-GHG portion using new lookup-table CI
- Incremental improvement goes to any party that can substantiate the charging is on a CARB-approved green tariff

- Credits for unmetered EV load are unchanged:
  - Only claimed by utility
  - Grid average CI Pathway
    (existing methodology w/updated grid CI)

**Metered**

- Credits for metered charging can be claimed by any party with the meter data (*use geographic and/or VIN checks to eliminate overlap in claims*):
  - Utilities, Charging companies, Auto-manufacturers

- For smart charging, establish times (charge windows) for low-CI charging
- Establish average grid mix for each charge window
- Incremental improvement from “smart” vs. “dumb” charging goes to party w/ metered data showing load is dispatched during the low-CI charging window.
Smart Charging (1 of 2)

Goals:
- Recognize the potential benefits of flexible EV load for integration of intermittent renewable supply

![Graph showing Relative CO₂ Emissions and Load with times indicating better, best, and worst charging times]
Emission Savings

<table>
<thead>
<tr>
<th>Charging Window</th>
<th>Quarter 1 emission savings (gCO₂e/MJ)</th>
<th>Quarter 2 emission savings (gCO₂e/MJ)</th>
<th>Quarter 3 emission savings (gCO₂e/MJ)</th>
<th>Quarter 4 emission savings (gCO₂e/MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 AM – 3:00 PM</td>
<td>26</td>
<td>45.4</td>
<td>NA</td>
<td>11.4</td>
</tr>
<tr>
<td>Midnight – 9:00 AM</td>
<td>NA</td>
<td>NA</td>
<td>7.5</td>
<td>NA</td>
</tr>
</tbody>
</table>

Note: numbers are for illustrative purposes only
Example if implemented today
1 gallon displaced (~30 miles) Assume $100/MT LCFS Credit price

Grid Average CI
105.16 g/MJ

Low-CI Electricity Supply
0 g/MJ

Smart Charging

Low-CI Charge Window

Default Credits:
(95.02 – 105.16/3.4) \times 115.83 \text{ MJ}

.0074 Credits ~ $0.74/GGE

Low-CI Credits:
(105.16/3.4 – 0/3.4) \times 115.83 \text{ MJ}

.0036 Credits ~ $0.36/GGE

Smart Charging:
Grid avg-CI from 9 AM to 3 PM for Q1:
70.9 gCO2e/MJ

Avg Grid CI for Q1:
96.9 gCO2e/MJ

(96.9/3.4 – 70.9/3.4) \times 115.83 \text{ MJ}

.0009 Credits ~ $0.09/GGE

Note: numbers are for illustrative purposes only
Other Key Questions About Smart Charging

• What source of data should be used for time-dependent grid carbon intensities?
  ◦ CPUC Avoided Cost Model
  ◦ CAISO Hourly GHG Emissions Tracking Reports
  ◦ Some other source?

• What timescale is appropriate to reward shifts between?
  ◦ Multi-hour time-of-use blocks by month, hourly, real-time?
  ◦ If multi-hour, should we consider matching to CAISO recommended TOU periods?
  Utility-specific TOU periods from ratemaking?

• What showing should an applicant have to make to a verifier/CARB staff to demonstrate a claimed shift in charging timing?
  ◦ Individual vehicles/charging FSE actual charging profile vs. baseline charging profile ("dumb charging")
  ◦ Profiles across all vehicles/FSEs controlled and a monitoring plan describing aggregation method across the fleet?

1 http://www.cpuc.ca.gov/General.aspx?id=5267
2 http://www.caiso.com/market/Pages/ReportsBulletins/DailyRenewablesWatch.aspx#ghgreport
Principles behind the Incremental Proposal

• Credits may be generated by any entity with access to the relevant data
  o Parties with information about what tariff the charging occurs under (including all Load
    Serving Entities), or with direct access to metered charging data, are able to derive the
    additional benefits of the incremental structure.

• EV load on a green tariffs allow for easy accounting of non-co-located renewables
  ◦ Ensures clarity about additionality relative to the renewable portfolio standard
  ◦ What other options should be considered to ensure non-co-located renewables
    are additional to the renewable portfolio standard?

• Once EV charging is controlled using “smart charging equipment,” additional actions
  become available to further reduce the CI, increasing credit generation potential
  o “Smarts” can be on the vehicles or on the electric vehicle supply equipment.
  o Analogous to non-co-located but coincident w/storage concept for other electric load in
    Tier 2 pathways (discussed later today).
Potential use of Standards for Metered Charging Claims

• Should metering equipment be required to meet the ISO/IEC 15118 Standard and NIST Handbook 44 Section 3.40 specifications* to qualify for credit claims?

• EV communicates with EVSE

• Allows for communication of vehicle information and Identification

• Allows for communication of, and confirmation for, charging data

*ISO 15118 specifies the communication between Electric Vehicles and the Electric Vehicle Supply Equipment. NIST Handbook 44, Section 3.40 specifies tolerances for measurements ensuring validity and accuracy in reporting.
Hydrogen
A Similar Incremental Structure Could Also Be Applied to Electrolytic H2 Producers

- Green Tariff CI stacks on to incentive that already exists for grid-average electricity

- Charging at the time of day where grid CI is lower provides additional incentives
Are Other Changes to LCFS Crediting Needed due to the Nascent State of Hydrogen Station Deployment?

• It may be difficult to co-locate renewables with distributed electrolysis in urban areas

• Unlike most low carbon fuels hydrogen has a separate requirement for minimum renewable content through SB 1505 (2006, Lowenthal)
  ◦ LCFS reporting will be the mechanism to track SB 1505 compliance moving forward

• There are 29 open hydrogen stations in California currently compared to over 7,000 charging stations, and 256 CNG/LNG stations, and 120 E85 stations
Fuel Pathways
Updated Draft Models and New CI Documentation

- Updated draft Lookup Table Pathways (Table 7)
  - New draft documentation of CI calculations posted
- Updated draft Temporary FPCs (Table 8)
- Updated draft Simplified CI Calculators with accompanying draft Tier 1 CI Calculation and Operating Conditions Manual:
  - Starch/Fiber Ethanol
  - Sugar Ethanol
  - Renewable Natural Gas from Landfills
  - Biodiesel and Renewable Diesel
- Updated draft CA-GREET 3.0 model
  - New draft documentation of changes from GREET_2016
Draft Lookup Table Pathways Update

- All pathways updated with CI values determined using the draft version of CA-GREET 3.0 released for this workshop
- The draft values are not final, pending stakeholder feedback on the model
- September draft version contained an error in the North American Natural Gas to CNG (using CA grid average electricity) pathway CI values
- Draft values for hydrogen produced by electrolysis are now included
- Stakeholder feedback is requested on both the table itself and the draft documentation
Temporary FPCs for Fuels with Indeterminate CIs

- Temporary Fuel Pathway Codes facilitate fuel reporting and credit generation for fuels while applications are being processed (or when a fuel is of unknown origin).

- The CI values are intended to be conservative.
  - The LCFS Dashboard provides annual volume-weighted averages for each fuel.

- Staff used the highest CI of each fuel type reported in 2016-2017, adjusted by +5% and rounded for convenience, to represent the highest likely emissions associated with the unknown fuel.

- Additions to the Temporary Table
  - In response to stakeholder feedback, staff has added Temporary FPCs for wastewater and food waste anaerobic digester biomethane pathways that will no longer appear in the Lookup Table.
  - Staff will add to the proposal the ability for the Executive Officer to approve new Temporary pathways without a rulemaking, similar to new Lookup pathways.
Refinery Project Credits
Background

- California refineries emitted about 31 million metric tons (MMT) of CO$_2$e in 2015
- Refineries have a set carbon intensity under LCFS and the program awards credits for refinery GHG reductions under:
  - Refinery Investment Credit Pilot Program (RICPP)
  - Renewable Hydrogen Refinery Credit Pilot Program
  - Low-complexity/low-energy-use Refinery Credit
Overview of the existing RICPP

- Recognizes GHG reductions from refinery projects
  - Provides credits for GHG reductions at refineries that lower carbon intensities of CARBOB and diesel
  - GHG reductions estimated for the refinery as a whole based on pre-project and post-project GHG emissions
- Minimum GHG reduction threshold of 0.1 g CO$_2$e/MJ CARBOB and diesel
- Limit on credit generation
  - No more than 20% of refiner’s annual obligation (deficits)
  - Credits can only be used towards the refiner’s obligation (deficits) and cannot be sold in the market or transferred to another party
Why amendments?

• GHG emissions reductions from a refinery investment project may be overshadowed by other changes in a refinery due to the magnitude of emissions at the “whole refinery” level

• Refinery-wide GHG changes may underestimate or overestimate reductions achieved by a refinery investment project

• Needs clarity on eligible refinery investment project types and the specific requirements for each project type (e.g., CCS protocol for CCS projects)
Objective

• Update the program to achieve the following:
  o Develop a robust GHG accounting guideline at the process level to estimate GHG reductions from individual refinery projects
  o Simplify and streamline the credit calculation methodology
  o Identify and list specific refinery investment credit project types that are eligible
<table>
<thead>
<tr>
<th>Include?</th>
<th>Project types</th>
<th>Comments/Concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔️</td>
<td>Carbon capture and sequestration</td>
<td>Permanence of sequestered CO₂</td>
</tr>
<tr>
<td>✔️</td>
<td>On-site renewable electricity</td>
<td>Footprint constraints</td>
</tr>
<tr>
<td>✔️</td>
<td>Process fuel switching to renewable fuels</td>
<td>Reporting and verification</td>
</tr>
<tr>
<td>✔️</td>
<td>Electrification</td>
<td>Overlap with renewable power provisions?</td>
</tr>
<tr>
<td>❌</td>
<td>Off-site renewable electricity</td>
<td>Possibly, if additional to RPS and with co-located battery storage?</td>
</tr>
<tr>
<td>❌</td>
<td>Waste heat recovery</td>
<td>Credit quantification. How different units are affected? Reporting and verification. Are projects additional?</td>
</tr>
<tr>
<td>❌</td>
<td>Efficient heat exchanger trains</td>
<td>Credits quantification. How different units are affected? Reporting and verification. Are projects additional?</td>
</tr>
<tr>
<td>❌</td>
<td>Reduced fired heater duty</td>
<td>Credits quantification. How different units are affected? Reporting and verification. Are projects additional?</td>
</tr>
<tr>
<td>❌</td>
<td>Co-generation upgrade</td>
<td>Credits quantification. How different units are affected? Reporting and verification. Are projects additional?</td>
</tr>
<tr>
<td>❌</td>
<td>Efficient hydrogen production</td>
<td>Minimal scope. Renewable hydrogen covered by RHRCPP</td>
</tr>
<tr>
<td>❌</td>
<td>Replacement or new installation</td>
<td>Lacks specificity. Better understanding required</td>
</tr>
</tbody>
</table>
Crediting threshold

- Transitioning from the carbon intensity threshold to a percent reduction threshold

- Eligible project should reduce GHG emissions by at least 1% from refinery-wide pre-project GHG emissions in metric tons
  - Provides equitable treatment for small and large refineries
  - Scale of this requirement is similar to prior threshold of 0.1 gCO$_2$e/MJ
Credit Issuance

• Unlike for fuel pathway crediting, refinery project credits will be issued ex-post of GHG reductions using verified actual performance
  o No need for conservatism and true-up discussed during buffer account slides from earlier today, but
  o Crediting is expected to be slower (greater lag between GHG reduction occurring and credit issuance) than credits issued under fuel pathways
Process Unit Level GHG Accounting

- The credit calculation method should rely on process unit level GHG accounting.
- Refineries are complex with many interconnected process units and equipment.
- Not all process units/equipment may have meters to estimate energy use and associated emissions.
  - Require direct measurements using dedicated meters or utility invoices/receipts.
  - In the absence of dedicated meters:
    - Should engineering/modelling estimates be considered if strong justification (such as small energy use or multiple sources sharing the same energy source) and supporting evidence provided for the accuracy of estimates.
    - Should this be subject to approval by the Executive Officer on a project-by-project basis?
Credit Calculation Method

• Project-specific credit calculation method that:
  ○ Incorporates changes in GHG emissions (direct and indirect) due to implementation of a project

• Credit Calculation
  ○ Draw a project system boundary
  ○ Should include direct effects and at least first order indirect effects if applicable
  ○ Estimate pre-project and post-project GHG emissions
  ○ Credits (MT CO$_2$e/yr) = Annual Pre-project GHG – Annual Post-Project GHG
  ○ Credits prorated based on the volumes of CARBOB and diesel sold, supplied, or offered for sale in California
“Pilot” Language and Prohibition on Trading of Refinery Project Credits

- Staff is open to removing “pilot” terminology and limitations on tradability of refinery project credits if this will help improve investment certainty

- Needs to be predicated on a clear understanding of each project-type and assurances that reductions are:
  - Real
  - Permanent
  - Quantifiable
  - Verifiable
  - Enforceable
Final Announcements, Questions, & Open Discussion
Rulemaking Timeline

Fuel-Specific Working Meetings

Workshops

2016
2017
Q1

Q2
LCFS Progress Report to Board

Q3
Workshops

Q4

2018

1st Board Hearing

2nd Board Hearing

Comment Periods & 15-day Changes

Regulation Notice, Staff Report, Environmental & Economic Analyses

Effective Jan 1, 2019
Update on Renewable Gasoline

- Joint statement on renewable gasoline issued by CARB and State Water Resources Control Board on Oct 24, 2017: [https://www.arb.ca.gov/fuels/gasoline/102417_rengas_jointstatement.pdf](https://www.arb.ca.gov/fuels/gasoline/102417_rengas_jointstatement.pdf)

- Clarifies that gasoline made from renewable blendstocks, and that meets CA gasoline regs and ASTM D4814, is fungible with and should be treated the same as conventional gasoline for all purposes including underground and aboveground storage tank requirements

- Mirrors joint statement on renewable diesel issued in 2013: [https://www.arb.ca.gov/fuels/diesel/altdiesel/07312013_RDjointstatement.pdf](https://www.arb.ca.gov/fuels/diesel/altdiesel/07312013_RDjointstatement.pdf)

- RD that meets CA diesel regs and ASTM D975 is fungible with and should be treated the same as conventional diesel for all purposes
THANK YOU!

Feedback should be sent to LCFSworkshop@arb.ca.gov by December 4, 2017

Posted information from today’s working meeting can be found at https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/lcfs_meetings.htm