

GENERATE REVENUE THROUGH RENEWABLE FUEL PROGRAMS Using your WWTP's Bio-Digester Gas

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Topics to Be Covered

- EPA Renewable Fuel Standard (RFS2)
- California Low Carbon Fuel Standard (LCFS)
- EPA RFS2 Registration Process
- CA LCFS Registration Process
- Benefits for WWTPs

Wastewater Treatment Plant Sludge Disposal

- Wastewater treatment processes generate sludge residues with high organic content
- Disposal treatment includes several options, including dewatering, drying/use as fertilizer, digestion, incineration
- Anaerobic digestion is a common solution, yielding methane rich biogas and biosolid residues
- Bio-digester gas must be flared to reduce methane emissions or can be used generate heat and electricity for process application or resale

Renewable Fuel Programs

- Bio-digester gas refined to transportation fuel specification: eligible for two renewable fuel programs
 - **EPA Renewable Fuel Standard (RFS2)**
 - **California's Low Carbon Fuel Standard (LCFS)**
- Both include mechanisms to generate tradable credits which can be sold to entities required to meet compliance under the respective federal and California renewable fuel programs

EPA RENEWABLE FUEL STANDARD

EPA's Renewable Fuel Standard

(CFR §80.1400) Mandates minimum volume of biofuels in U.S. transportation fuel supply each year

- Target: 36 billion gallons by 2022
- Annual targets are adjusted each year
- Fuel producers and suppliers have annual renewable volume obligations (RVO)

EPA's Renewable Fuel Standard

- A Renewable Identification Number (RIN) represents 1 ethanol-gallon-equivalent
- RINs are saleable or transferable to meet compliance with RVOs (with fuel or separated)
- RINs only generated from qualifying feedstocks and fuel production processes (D code)
- Different fuel codes have different market values
- Cellulosic Fuels (D3) have the highest market values
- RINs are claimed by fuel producers on monthly basis according to monthly fuel production and use reporting

EPA's Renewable Fuel Standard

- CNG/LNG must be used for transportation fuel
- Biogas can be converted to CNG/LNG on-site or transported by pipeline for final processing
- Biomethane injected in a commercial pipeline can be transferred to any location/end user in U.S. as long as:
 - There is a physical pipeline network connecting the source and the end user
 - Gas flow is continuously measured at both ends
 - Contractual agreements demonstrate the transfer of gas and environmental attributes



RFS2 WWTP Biodigester Gas RINs

- Cellulosic Fuels (D3 RINs) - biogas from landfills, WWTPs, and agricultural waste digesters used as feedstock for CNG/LNG production
- Non-Cellulosic (D5 RINs) - biogas from biodigesters processing mixed WWTP sludge, food waste, mixed waste

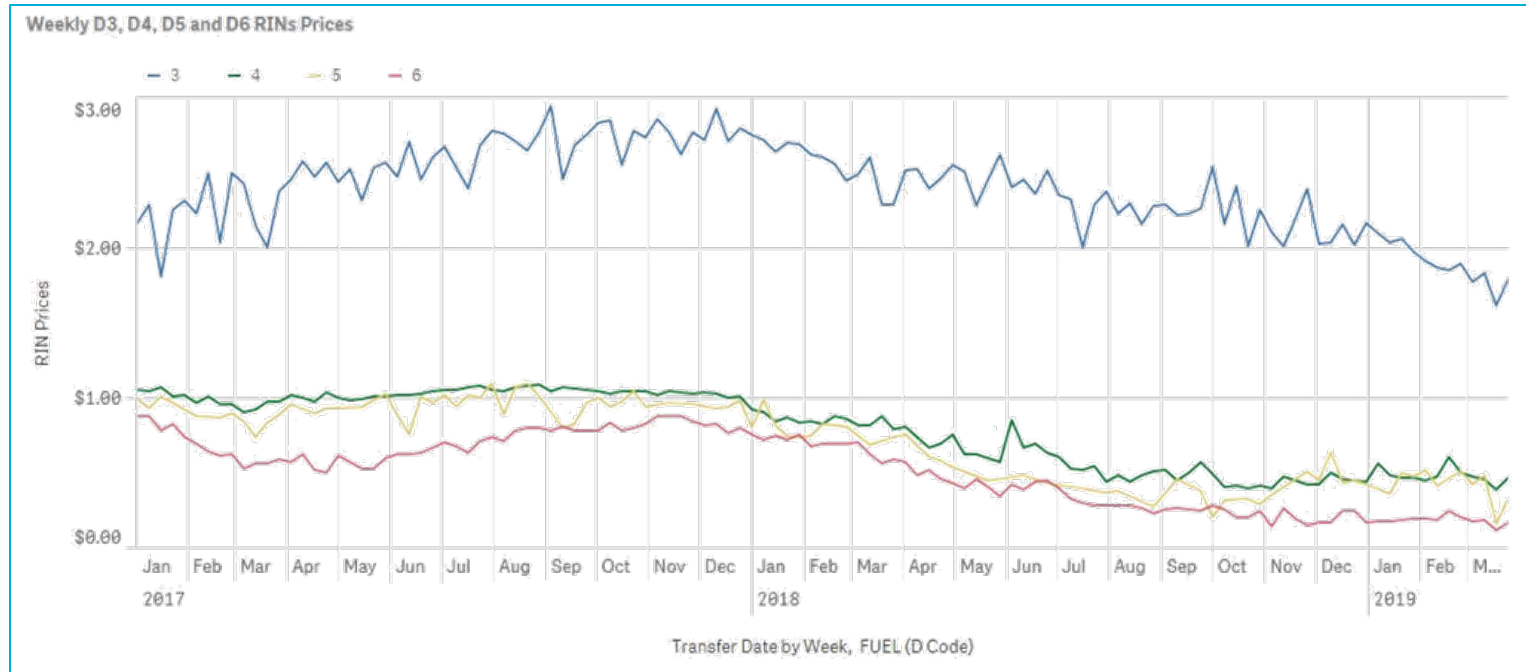
Facilities processing mixed feedstock (cellulosic/non-cellulosic) can maximize D3 vs. D5 fraction by segregating feedstock inputs to separate digesters and continuously measuring flow and methane content of separate streams' inputs to biogas treatment process

RFS2 RIN Pricing

1 dth biogas = 11.727 RINs

D5 RIN= \$ 0.35 → **\$4.11/dth**

D3 RINs = \$1.54 → **\$18.6/dth**



CALIFORNIA LOW CARBON FUEL STANDARD

California Low Carbon Fuel Standard

- California Global Warming Solutions Act of 2006 enacted California Air Resources Board (ARB) to develop Low Carbon Fuel Standard (LCFS), published in 2009, in effect January 1, 2011
- LCFS was re-adopted as of January 1, 2016 and amended in 2018, effective January 1, 2019
- Goal is to reduce carbon intensity (CI) in transportation fuels as compared to conventional petroleum fuels
- Reference petroleum fuels CIs are reduced over the years, incentivizing further reductions in renewable fuel CIs

California Low Carbon Fuel Standard

- Renewable transportation fuels used in California are eligible generate LCFS credits
- Renewable fuel can be produced anywhere in U.S., as long as it's delivered and consumed in CA
- Similar to RFS2, renewable natural gas can be delivered to California by “Book and Claim” methods (i.e., doesn't need to be physically transferred into CA, as long as contractual instruments demonstrate the transfer transactions)
- Unlike RFS2, fuel credits are not assigned according to fuel class (cellulosic, advanced, etc.), but on specific fuel/production facility lifecycle

California Low Carbon Fuel Standard

- Each LCFS fuel pathway is assigned a carbon intensity (gCO_2/MJ) depending on the lifecycle of the fuel pathway from production facility to fuel dispensing in CA
- LCFS credits are generated as metric tonnes of CO_2 according to difference between renewable fuel carbon intensity and the fossil fuel it displaces
 - CI Gasoline = $93.55 \text{ gCO}_2/\text{MJ}$
 - CI Diesel = $98.44 \text{ gCO}_2/\text{MJ}$
 - CI Biodigester Gas to CNG/LNG = 10 to $45 \text{ gCO}_2/\text{MJ}$ (depending on pathway)
 - HHV gasoline = $125,000 \text{ Btu/gallon} = 132 \text{ MJ/gallon}$
 - 1 dekatherm NG ~ 8 gasoline gallon equivalent (gge) $\sim 1000 \text{ MJ}$

LCFS Credits Market Trends



LCFS credits are claimed by fuel producers on quarterly basis, according to monthly fuel production and use reporting

Datasource OPIS*

LCFS Credits Market Trends

LCFS Weekly Snapshot	15 ^h April 2019 – 21 st April 2019
Average Price [3] (\$/MT)	\$188.41
Price Range (\$/MT)	\$180.00 - \$196.50
Total Volume (MT)	48,718
Total Value (\$)	\$9,178,995

Source: <https://www.arb.ca.gov/fuels/lcfs/credit/lrtweeklycreditreports.htm>

1 LCFS credit = \$180/t CO₂

1 Dekatherm CNG/LNG → 1000 MJ → 0.05 to 0.09 tCO₂ CI credit vs. gasoline

\$9 to \$16 LCFS credit value/dth biomethane

Comparison: RFS2 & LCFS

Similarities

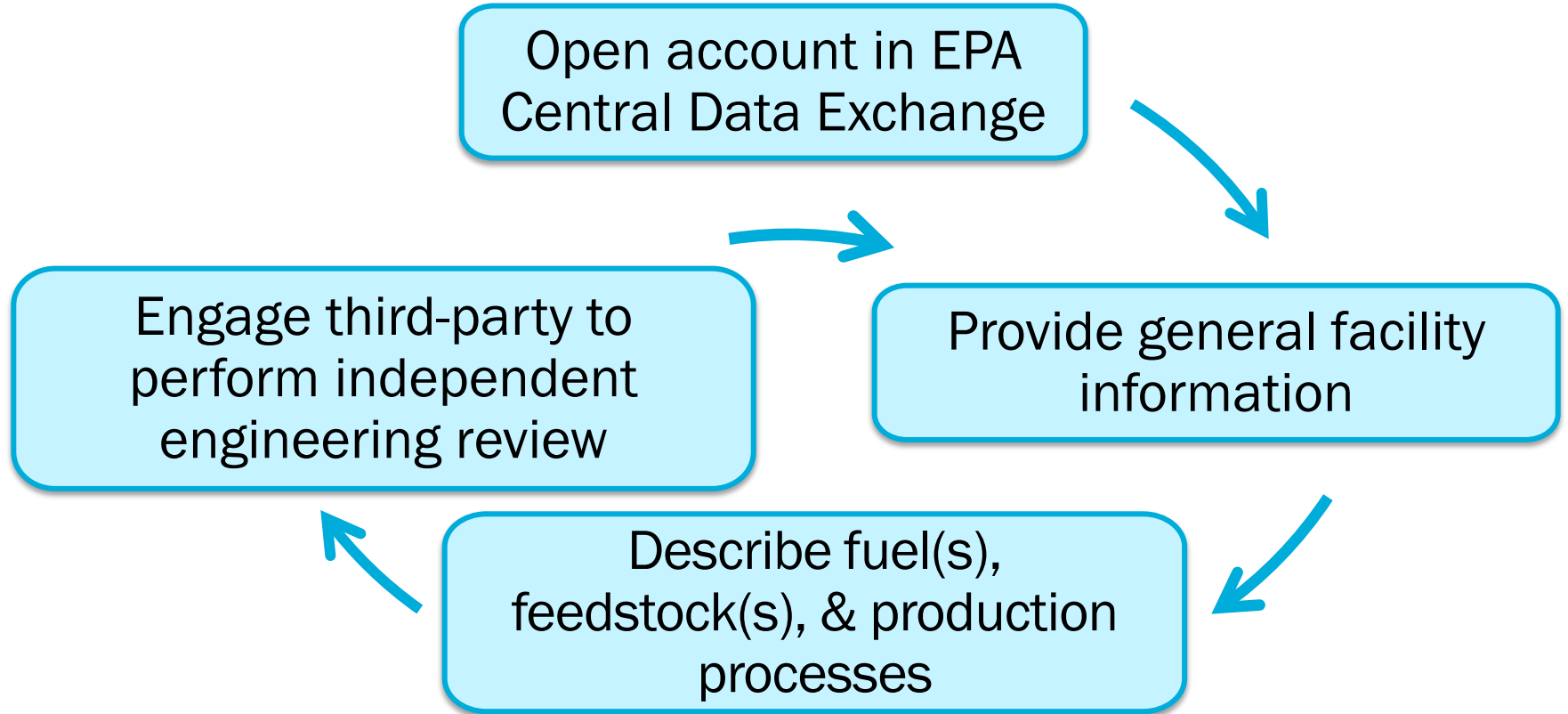
- Reward production of renewable fuel for transportation only
- Allow transfer of biomethane by contractual pathway
- Progressive increase of environmental targets built into regulation
- State/federal energy policies and politics could affect future, though risk for LCFS is lower

Differences

- RFS renewable fuel use is U.S.-wide; LCFS renewable fuel use must be in CA
- RFS credits based on fuel type and volume produced
- LCFS credits based on specific process/pathway carbon intensity
- RFS does not require mandatory verification
- LCFS requires mandatory verification

EPA RFS2 REGISTRATION PROCESS

EPA RFS2 Registration Process



RFS2: Registration & Engineering Review

- Engineering review
 - 2-4 weeks depending on data availability and number of facilities/site visits
- Complete RFS2 registration
 - No less than 8 weeks from submission
 - Depending on EPA load and project complexity, can be much longer
- Engineering review and submission can be concurrent, but may require re-assessment after EPA review

RFS2: Engineering Review

- Engineering review verifies accuracy of registration information
- Performed by licensed Professional Engineer
- Independent from fuel producer
- Requires site visit and records review



RFS2: Required Registration Information & Evidence

- Description of types of renewable fuels producer intends to produce at facility (e.g., fuel analysis reports)
- List of all feedstocks facility is capable of using for fuel production (e.g., feedstock analysis reports)
- Description of facility's renewable fuel production process (e.g., process plans, drawings, plant design specs, permits)

RFS2: Unique Considerations for Biogas

- Engineering review includes biogas production facility and processing plant when located on site
- Proper identification of fuel producer
- Must be written contract for sale of biogas
- Must designate for transportation fuel use
- In case of pipeline, must demonstrate physical pathway

Common Pitfalls in RFS2 Registration Process

- Contract arrangements not complete
- Fuel use not clearly designated
- Inadequate documentation of physical pathway
- Limited production data available

RFS2 - QAP Verification

- EPA established guidelines for Quality Assurance Program (QAP) offered by third party verifiers
- QAP audit verifies data underlying fuel producers' RINs claims
- Verification of RINs by a third party QAP is voluntary
- Adds credibility and can increase market price of RINs due to assurance of environmental attributes
- Provides flexibility for managing risk, though it adds cost to overall RFS2 participation
- QAP verification often a necessity for biogas producers participating in RFS2 due to small scale of facility and complex fuel transfer modalities

CA LCFS REGISTRATION PROCESS

LCFS Facility Registration Process

Open account for
LCFS Reporting Tool

Engage 3rd-party verifier
to validate LCFS
application, CI calculation

Provide general facility
information

Describe fuel(s), feedstock(s), &
production processes; submit carbon
intensity calculation for fuel pathway

LCFS Facility Registration Process

- Beginning in 2019, all existing facilities/pathways will have to re-apply for registration
- Pathway carbon intensity must be determined by fuel producer using ARB-approved method and software (CA GREET 3.0)
- Established pathway/technologies must use simplified version (Tier 1) of application and calculator, if available from ARB
- Beginning in 2019, Tier 1 calculator available for WWTP:
“Tier 1 Simplified CI Calculator for Biomethane from Anaerobic Digestion of Wastewater Sludge”
- **Use of Tier 1 specific calculator greatly simplifies application process and streamlines facility information required**

LCFS Pathway Validation/Verification

LCFS Validation

- Once LCFS pathway application and CI calculation is submitted, it must be validated by ARB-accredited 3rd party verifier*
- A Monitoring Plan is required describing fuel production data measurement and monitoring implemented by producer

LCFS Verification

- Beginning in 2020, fuel data monitoring is mandatory
- Beginning in 2021, verification by an ARB-accredited 3rd-party verifier is required
- Monitoring and verification covers process data used to determine carbon intensity and to claim fuel credits

BENEFITS TO WWTPs

Current Participation in Programs

Program	WWTPs Registered	Total Registered (landfills, WWTPs, biodigesters, etc.)
EPA RFS2	7	76
CA LCFS	3	117

Why so few?

- Alternative solutions to treat/dispose of sludge (compared to landfill gas)
- High cost for biogas digestion and treatment cost
- Alternative use of biogas on WWTP site (heat and power)
- Complex LCFS pathway carbon intensity (no longer with simplified Tier 1)
- RFS/LCFS programs not well known - unstable prices
- Besides digestion/treatment equipment, registration/program cost

Sample WWTP Facilities - Costs

Task	RFS	LCFS
Application	\$20,000 - 25,000	\$20,000 - 25,000
Validation	N/A	\$10,000 - 20,000
Annual Verification	\$25,000 - 35,000 (optional)	\$25,000 - 35,000
Data Monitoring (Annual)	\$10,000 - 20,000	\$10,000 - 20,000
TOTAL	\$20,000 - 25,000 + \$10,000-45,000 Annual	\$30,000 - 45,000 + 35,000-55,000 Annual

Sample WWTP Facilities - Revenue

Facility	Capacity (mgd)	Biomethane (MMBtu/year)	RFS RINs/year	D3 Revenue \$/year	LCFS Revenue (Potential) \$/year	RFS-LCFS Revenue \$/dth Biomethane
WWTP 1	8.5	11,000	140,000	\$224,000	\$101,426	\$29.58
WWTP 2	80	180,000	2,300,000	\$3,680,000	\$1,659,693	\$29.66
WWTP 3	140	700,000	8,000,000	\$12,800,000	\$6,454,363	\$27.51

Summary

- Main obstacles to participation in programs:
 - Gas treatment equipment costs
 - Structuring fuel pathway to transportation end user
 - Navigating regulations for application, reporting
- EPA and ARB striving to increase opportunities for WWTPs; LCFS simplified fuel pathway to increase participation
- When compared to revenue from fuel sales or renewable electricity, RFS and LCFS can add a significant premium
- Despite market volatility, value of RFS and LCFS biomethane credits continue to be well-supported
- Increased market transparency with verifications, voluntary for QAP and mandatory for LCFS

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