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Cleaner power for California communities:

Solving the state's diesel proliferation problem

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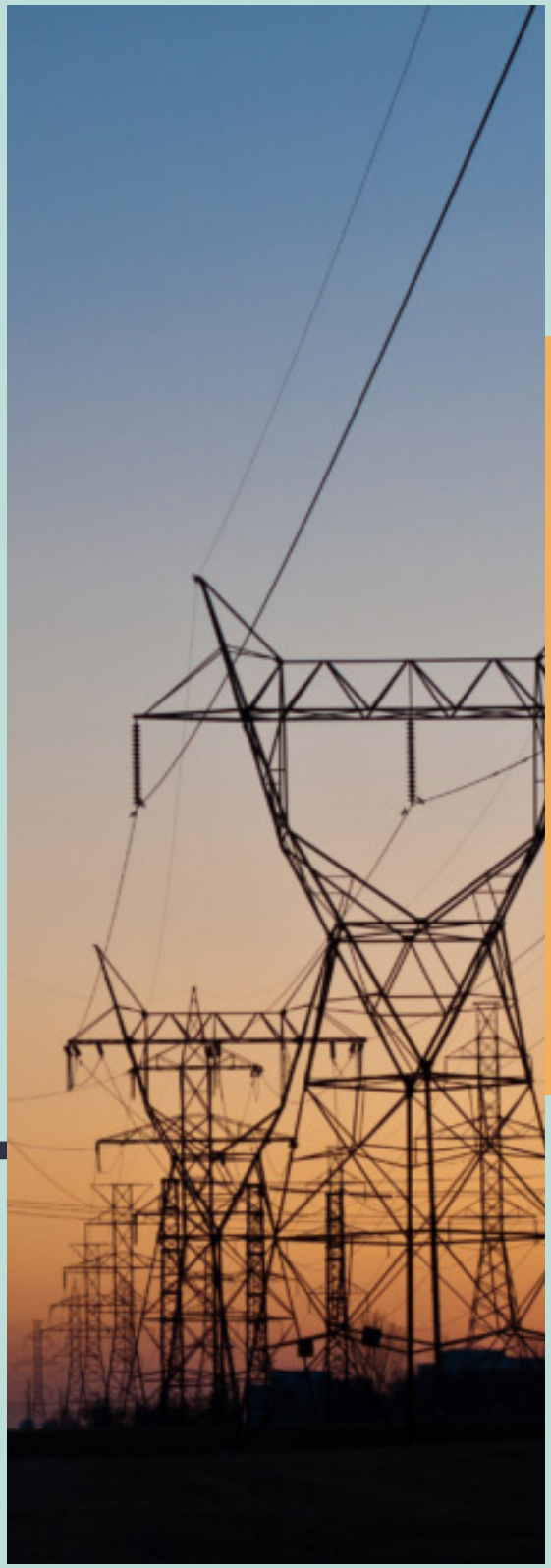

California, renowned for its ambitious climate leadership and strong focus on clean energy, seems like an unlikely place for rampant diesel fuel proliferation.

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Executive Summary

California, renowned for its ambitious climate leadership and strong focus on clean energy, seems like an unlikely place for rampant diesel fuel proliferation. Headlines were made when the California Air Resource Board (CARB) began setting new clean air standards for transportation – including diesel trucks, boats, and even cars. But a less visible and arguably more impactful diesel emissions problem lies elsewhere.

Behind hospitals, government buildings, manufacturing plants, and other critical infrastructure facilities, diesel generators continue to be permitted for routine testing and emergency operation, contributing significantly to air pollution and simultaneously harming communities already experiencing outsized impacts to their quality of health and life. In fact, diesel generators permitted in the San Francisco Bay Area and Los Angeles Basin emit the same smog-creating pollutants as more than 3,300 medium- and heavy-duty diesel trucks annually, even though most of their run hours are for testing and maintenance. Diesel exhaust emissions, according to CARB, are believed to be responsible for approximately 70% of California's estimated known cancer risk attributable to toxic air contaminants[1].

Despite California's strict environmental policies, diesel power generation remains a hidden yet growing threat to communities in the state's quest for cleaner energy. Generation technologies that utilize natural gas as a fuel source must be considered as a preferred alternative to diesel to reduce both local air pollution and global greenhouse gas emissions. California can do better. With natural gas power-generation technologies, the state can deliver on-demand power more cleanly than diesel, and when coupled with renewable natural gas, it has the potential to offer a net-negative impact to global greenhouse gas emissions.

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California's commitment to clean energy, strong environmental policies, and renewable power generation has set the bar for energy transition goals. But diesel generators, which currently power critical infrastructure during monthly testing, power outages, or sometimes during other grid emergencies in the state, contribute a significant amount of air pollution and disproportionately impact vulnerable communities. This reliance on diesel for backup power is a challenge to the state's environmental goals and adds to local health burdens, which according to the Centers for Disease Control and Prevention include increased risks of asthma, cardiovascular disease, and certain cancers[2]. We can and must do better, and that calls for technologies that mitigate community health risks, assist the state in meeting its ambitious greenhouse gas emission goals, and are additive to the grid.

Diesel generation continues to grow in California

In recent years, California's dependence on diesel backup generators came to light during a series of climate change-induced emergencies — heat waves and wildfires that resulted in hours- or days-long power shortfalls.

The California Energy Commission (CEC) estimates that approximately 15,000 megawatts (MW) of diesel backup generation are permitted across the state. As a comparative, the 2023 California Independent System Operator (CAISO) peak demand was 44,534 MW[3], meaning diesel backup generators represent approximately one-third of California's peak electricity demand.

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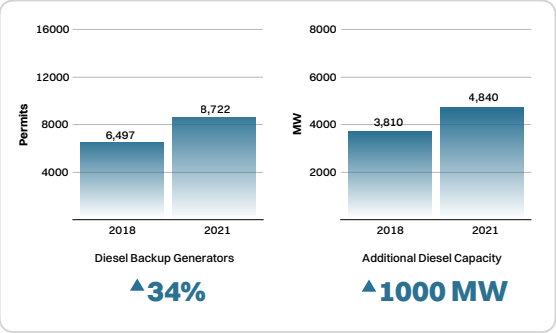
From 2020 to 2022, there was a marked increase in diesel generator permits across two of California's major air districts.

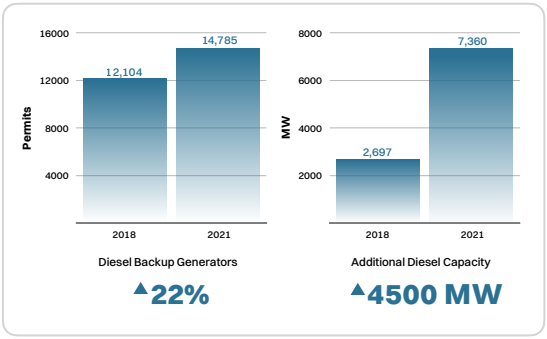
Bay Area Air District (BAAD)



- In 2018, there were 6,497 permitted diesel backup generators with a capacity of 3,810 MW.
- By 2021, this number had risen to 8,722 generators with a capacity of 4,840 MW — an increase of 34% and over 1,000 MW of additional capacity.

South Coast Air Quality Management District (SCAQMD):

- In 2018, there were 12,104 backup generators with a capacity of 2,697 MW.
- By 2021, this had increased to 14,785 generators with a capacity of 7,360 MW – a 22% increase, adding 4,500 MW of capacity[4].



Despite various efforts to limit its use, diesel generation remains an integral part of the commercial and industrial sectors' emergency energy strategy. Over the past six years, 1,160 MW of backup generation has been approved by the CEC across 13 sites in the San Francisco Bay Area. All but 96 MW of that is diesel fueled. Based on an analysis of the CEC Small Powerplant Exemption permitting data and the California Environmental Protection Agency CalEnviroScreen tool, all but 385 MW of this backup generation is sited in the City of Santa Clara[5]. Perhaps, more importantly, almost all of those installations are entirely located within California Environmental Protection Agency-designated disadvantaged communities.

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Record-setting demand for power results in increased diesel generation

In the summer of 2020, the West Coast experienced an unprecedented heat dome, stretching from British Columbia to Mexico and from the Pacific Ocean to the Mountain West. Simultaneously, wildfires ravaged California and the Pacific Northwest, devastating lives, homes, and critical grid infrastructure. These events not only strained the entire region's electrical grid, but the conditions created the perfect environment to reduce renewable energy production.

Summer 2020: Heat and wildfires

- Extreme heat significantly reduced wind generation.
- Solar energy production plummeted as ash and smoke from wildfires covered solar panels, blocking sunlight and further reducing output.
- Drought, which had persisted for half a decade, diminished California's hydroelectric power capacity, further exacerbating the state's energy shortage.
- Electrical imports from other states were reduced due to higher demand impacts of the heat dome across the entire western region.

Between mid-August and early September of 2020, CAISO forecasted a daily peak energy demand of 45,000 - 46,750 MW. While actual demand exceeded that forecast on August 14 (46,750 MW) and again on September 6 (47,236 MW)[6].

As temperatures soared throughout regions unaccustomed to such heat, power demand skyrocketed. To meet the increased demand, California leaned heavily upon every generation and demand response resource available throughout the state. Faced with the dual challenges of extreme heat and wildfires, Governor Gavin Newsom issued a series of executive orders, including one that lifted all statewide and local restrictions on diesel generators. This unprecedented move allowed thousands of MWs of diesel-powered electricity generation to operate over the span of six days[7] to help meet the state's climbing energy demands[8].

While this action partially mitigated the impacts of reduced power supply from the grid, it came at a significant environmental cost. Diesel generators emitted tons of carbon monoxide, nitrogen oxide, sulfur oxide, and particulate matter into the air, often just hundreds of feet or less from homes, schools, and hospitals.

Despite emergency measures, California still experienced rolling blackouts, underlining the fragility of its power grid during extreme conditions and further emphasizing the fact that diesel isn't the solution to the larger problem, nor should it be considered a safe short-term solution.

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September 2022: Record-setting demand for power

California's reliance on diesel generation escalated to the forefront again during the power emergency of September 2022. On September 6 of that year, CAISO forecasted a demand of 51,276 MW, surpassing the previous record of 50,270 MW set in 2006. However, actual demand exceeded this forecast, reaching 52,061 MW.

An unforeseen combination of public response to a one-time statewide alert requesting Californians to reduce power usage, an increase from 2020 of storage assets, and availability of behind-the-meter power generation allowed the state to avoid rolling blackouts. According to the California Public Utilities Commission (CPUC), a significant portion of the 1,216 MW[9] of non-market demand response resources utilized during the peak of the emergency was likely provided by behind-the-meter diesel generators. Once again, Governor Newsom lifted air quality permit restrictions to allow the use of diesel generators during the emergency[10], making the state's reliance on diesel even more apparent.

Statewide restrictions on diesel generation have failed to stem diesel proliferation

In response to a rising reliance on diesel generators, California has introduced various restrictions to curb their usage. These restrictions are part of broader efforts to reduce reliance on fossil fuels and address the negative environmental impacts associated with diesel.

One of the most prominent examples is the CPUC's Prohibited Resources policy for utility demand response programs such as the Base Interruptible Program (BIP). Diesel-fueled generation is prohibited under the Prohibited Resources policy, as it specifically bans distributed generation technologies that rely on diesel, gasoline, propane, or natural gas during a demand response event[11]. Some allowances are made for renewable fuels, which can potentially substitute for these more harmful fuels, but overall, the program is designed to minimize the use of polluting backup power sources. The commission's authorized BIP is an important program available in Pacific Gas & Electric (PG&E) and Southern California Edison (Edison) service territories, as it provides a means for the state's largest energy demand customers, who traditionally utilize diesel backup generation, to transition off diesel with a significant economic incentive while providing enhanced value back to the grid.

Another major step forward towards grid reliability and a pivot away from diesel was the passage of Assembly Bill 205 in 2022, which limited the role of diesel generation in the state's Electricity Strategic Reliability Reserve Program (ESRRP). The legislation, while acknowledging a short-term role for diesel in meeting summer reliability, prohibited the use of diesel backup generators from 2024 onward. As the organization in charge of this program, the California Department of Water Resources preemptively chose to stop securing additional diesel generation as of late 2022, well ahead of the statutory deadline.

Moreover, California's Renewable Portfolio Standard requires that 60% of the state's electricity must come from eligible renewable resources by 2030, which includes technologies like solar, wind, and small-scale hydroelectric projects. By 2045, the goal is to transition to 100% carbon-free energy. Diesel, along with other fossil fuels, is not considered an allowable power source for utilities aiming to meet these aggressive procurement targets. As a result, investor-owned and publicly owned utilities focus on procurement of clean energy sources and seek out renewable alternatives, like renewable natural gas (RNG), as traditional fossil fuels are phased out.

While the above rules and programs are available statewide, the permitting of diesel generators and their resultant air pollution impacts can vary across California's 35 local air districts. Each district establishes its own standards for acceptable levels of nitrogen dioxide, sulfur dioxide, volatile organic compounds, and particulate matter[12] ; those limits are tied to the areas' ability to meet the federal National Ambient Air Quality Standards and what level of non-attainment they may be in. Individual air districts, under their delegated authority from the CARB and U.S. EPA, set limits for diesel generator emissions, differentiating between emergency and non-emergency use.

These local regulations dictate the allowable hourly and annual criteria pollutant emissions, thereby restricting the total MW and the number of hours a generator can operate. More stringent federal permitting requirements are triggered if a site exceeds 100 tons of emissions for any individual pollutant annually. Additionally, stricter thresholds apply in districts designated as non-attainment areas-regions that consistently exceed federal air quality standards-including the San Francisco Bay Area, San Joaquin Valley, and Los Angeles basin, which struggle with particulate matter and ozone pollution[13].

Diesel exhaust emissions, according to the CARB, are believed to be responsible for approximately 70% of California's estimated known cancer risk attributable to toxic air contaminants[14]. Further, the estimated health effects of diesel particulate matter are wide ranging, including cardiopulmonary death, hospitalizations due to cardiovascular and respiratory issues, and emergency room visits for asthma[15].

Legislative and regulatory efforts to expand diesel

Despite efforts to reduce diesel permitting, there have also been legislative efforts to expand it. This has included a desire to raise the exemption threshold for the CEC's Small Power Plant Exemption attached to certain large energy users from less than 100 MW to less than 150 MW, after an initial proposal for a 200 MW limit faced objections. The effort relied upon existing limitations on total criteria air pollutant emissions as required under the local air district Best Available Control Technology standards, which only account for "emergency use" and do not take into consideration testing hours or the prevalent emergency executive orders that increase run hours beyond the rare power outage. The effort also did not include requirements to utilize cleaner generation assets like those certified by the CARB through their Distributed Generation (CARB-DG) certification program. Although this bill failed to pass due to concerns about increased emissions, it underscores the ongoing pressure to allow co-located power generation in specific, energy-intensive industries.

Regulatory efforts to reintroduce diesel into state programs have also been proposed. For instance, in 2023 PG&E submitted, as a part of its application to renew its BIP through 2027, language to effectively eliminate the CPUC's prohibited resources policy by allowing unfettered program access to diesel generators. However, the CPUC forcefully denied the request, emphasizing the importance of maintaining clean, reliable demand response (DR) resources in line with the state's renewable energy goals. In part, the CPUC stated, "is in contravention to the Commission's recent pronouncements that resource adequacy qualifying DR resources (such as BIP) must be clean...PG&E's proposal is therefore denied.[16]

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Role of natural gas and renewable natural gas in the energy transition

While energy storage solutions are often top of mind in discussions on resiliency, they remain decades away from being economically and technologically viable at scale. According to the Department of Energy's, "Pathway to Commercial Liftoff: Long Duration Energy Storage" report, the U.S will require up to 460,000 MW of storage capacity by 2050, representing a cumulative capital investment of $300 billion. The report further identifies that the supply chains, technological advancements, and utility market frameworks are not yet available to support that time frame[17].

In the meantime, communities, critical infrastructure, manufacturing, and commercial centers need immediate, reliable solutions to ensure resilient power access. This is where natural gas plays a crucial role, providing a proven, dependable energy source that can bridge the gap while alternative technologies continue to develop.

Near- and medium-term solutions such as natural gas must be considered as a pathway to reduce both local air pollution and global greenhouse gas emissions. Natural gas power generation technologies, when co-located with large demand assets such as healthcare facilities, clean technology manufacturing, data centers, logistics and distribution centers, and electric vehicle charging facilities, can deliver on-demand power with 99% fewer particulate emissions when compared to diesel generators of similar size[18].

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Further, that power is delivered with a net-negative impact to global greenhouse gas emissions using renewable energy credits derived from the delivery of RNG to the national pipeline network.

Pollutants	Diesel Emissions		CARB-DG Certified Natural Gas Reciprocating Engine Generator Emissions		
	Tier 2 Emissions	Tier 4 Emissions	Emission Factors	% Reduction vs Tier 2	% Reduction vs Tier 4
NMHC	14.11	0.42	0.020	99%	95%
NOx		1.48	0.070		95%
CO	7.72	7.72	0.100	99%	99%
PM	0.44	0.07	0.050	89%	29%

Figures based on CARB executive order DG-052

The natural gas system in the U.S. is a cornerstone of energy reliability, delivering uninterrupted service to millions of customers with an impressive 99.85% reliability rate. California faces a similar liability. Unlike other energy sources that may require onsite fuel storage or frequent refueling, natural gas is delivered continuously via an extensive pipeline network. Critical infrastructure and power generation facilities benefit from firm natural gas delivery contracts that are not subject to planned interruptions, ensuring a dependable energy supply even during extreme weather events or grid disruptions. This high level of reliability makes natural gas an essential component of resilient energy systems nationwide.

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Though natural gas remains a critical near- and medium-term transition fuel necessary to ensure energy system resiliency and reliability, RNG can play a significant role in substantially reducing the global greenhouse gas emissions associated with power generation. RNG, also known as biomethane, describes biogas that has been upgraded for use in place of conventional natural gas through a refinement process that includes the removal of water vapor, carbon dioxide, hydrogen sulfide, and other impurities. The RNG is then injected into and transported via existing natural gas pipeline infrastructure, displacing fossil fuel-based natural gas supplies requiring no additional technologies and with zero cost or operational impacts to the gas customer.

In addition to displacing traditional natural gas, RNG production significantly reduces global greenhouse gas emissions by capturing fugitive methane via an anerobic digester, otherwise emitted to the atmosphere by a landfill, waste water treatment facility, agricultural processing, and other unabated organic decomposition processes. Methane has a global warming potential at least 28 times greater than carbon dioxide[19].

Diesel proliferation is a critical problem but not unsolvable

California's significant diesel proliferation problem, driven by the state's power emergencies and grid vulnerabilities, isn't being adequately addressed in policy. Diesel backup generators have been the standard for backup power for decades, but that doesn't mean they should continue to be the standard. It is clear that California needs an alternative to diesel to provide local backup power AND support to the grid during power emergencies, as extreme weather and other threats to the power supply continue to escalate. As the state grapples with climate change and increasing energy needs, it is critical that commercially available, sustainable alternatives to diesel generation are supported for both energy reliability and environmental protection.

While state and local governments have enacted significant restrictions, such as implementation of renewable power standards, criteria pollutant air permitting thresholds, and local land use requirements, power emergencies of the past few years have shown that the current infrastructure still relies heavily on diesel to meet extreme peak demands. Permitting processes across the state continue to allow diesel generators to be installed across California, and emergency authorities may permit operation beyond their narrow backup power intended use. Legislative efforts to expand diesel use in industries such as data centers further complicate and conflict with the state's current and long-term climate goals.

This 48 MW microgrid installation for the California Department of Water Resources features 120 natural gas generators that provide fast-response dispatchable capacity to the grid during peak load shortfall.

If California is to successfully lead the nation in transitioning to a clean energy future, the state must prioritize support for reliable, cost-effective, and clean alternatives to diesel backup generation. Whether through advancements in renewable fuels, tighter emissions standards, or enhanced incentives for clean energy solutions, the time to act is now, before the next crisis forces California deeper into diesel dependency. By setting the example on proactively addressing the widespread diesel dependency issues that exist across the country, California will continue to be at the forefront of climate and environmental leadership.

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About Enchanted Rock

Founded in 2006, Enchanted Rock is a national leader in electrical resiliency-as-a-service, powering companies, critical infrastructure, and communities to ensure business continuity during unexpected power outages from extreme weather, infrastructure failures, cyberattacks and other grid disruptions. Enchanted Rock's electrical microgrids and generators use natural gas and renewable natural gas (RNG) to produce significantly lower carbon emissions and air pollutants than diesel generators, capable of achieving resiliency with net-zero emissions. Additionally, the company's end-to-end microgrid software platform, GraniteEcosystem™, provides real-time 24/7/365 system monitoring and optimization, including forecasting of electricity market conditions to ensure worry-free reliable power to customers. For more information, please visit www.enchantedrock.com.

[1] Based on estimated ambient statewide diesel PM levels in 2012, the current cancer risk is estimated to be 520 new cases of cancer projected to occur per million residents exposed. This estimate was calculated using a unit risk factor of 8.94 x 10-4 µg/m3 derived using methodology developed by the California Office of Environmental Health Hazard Assessment and assumes an ambient diesel PM concentration of 0.58 µg/m3. Derivation of both of these values are summarized in Propper et al. 2015. Environmental Science & Technology49(19):11329-11339

[2] Centers for Disease Control and Prevention (2024). "The effects of diesel exhaust inhalation on cardiovascular function"

[3] California ISO, "2023 Statistics"

[4] Steven Moss & Andy Bilich, M.Cubed Partner (2021). "Diesel Back-Up Generator Population Grows Rapidly in the Bay Area and Southern California"

[5] https://www.energy.ca.gov/programs-and-topics/topics/power-plants/power-plant-compliance-and-siting

[6] California Independent System Operator (2020) "Report on system and market conditions, issues and performance: August and September 2020"

[7] Governor Gavin Newsom, Proclamation of a State of Emergency, September 3, 2020 (CAP14-20200903171225)

[8] Governor Gavin Newsom, Executive Order N-74-20 (CAP14-20200817142014)

[9] California Independent System Operator Summer Market Performance Report for September 2022 (2022), Page 36. (SummerMarketPerformanceReportforSeptember2022.pdf (caiso.com))

[10] Governor Gavin Newsom, Executive Order N-15-22 (Newsom Executive Order N-15-22)

[11] California Public Utilities Commission Decision 16-09-053, (2016)

[12] National Ambient Air Quality Standards are determined by the United States Environmental Protection Agency under the authority set forth by The Clean Air Act.

[13] United States Environmental Protection Agency, "Who Has to Obtain a Title V Permit?" Who Has to Obtain a Title V Permit? | US EPA

[14] Based on estimated ambient statewide diesel PM levels in 2012, the current cancer risk is estimated to be 520 new cases of cancer projected to occur per million residents exposed. This estimate was calculated using a unit risk factor of 8.94 x 10-4 µg/m3 derived using methodology developed by the California Office of Environmental Health Hazard Assessment and assumes an ambient diesel PM concentration of 0.58 µg/m3. Derivation of both of these values are summarized in Propper et al. 2015. Environmental Science & Technology49(19):11329-11339.

[15] Overview: Diesel Exhaust & Health – Estimated Health Effects of DPM in California (https://ww2.arb.ca.gov/resources/overview-diesel-exhaust-and-health)

[16] Decision 23-12-005 (Adopted 12/14/23, Date of Issuance, 12/20/23). CPUC Application 22-05-002, Page 53

[17] "Pathways to Commercial Liftoff: Long Duration Energy Storage," United States Department of Energy, March 2023

[18] Distributed Generation Certification Program, DG-052. https://ww2.arb.ca.gov/our-work/programs/dgcert

[19] United States Environmental Protection Agency, Landfill Methane Outreach Program (LMOP), Renewable Natural Gas (https://www.epa.gov/lmop/renewable-natural-gas)