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see attached file

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California Air Resources Board

1001 I Street

Sacramento, CA 95814

Re: Public Comment on Proposed 2026 Amendments to the Regulation for the Mandatory Reporting of Greenhouse Gas Emissions (MRR) — Request to Require Methane Slip Reporting from Lean-Burn Natural Gas Engines

Dear CARB Staff and Board Members,

We respectfully submit the following comments in response to CARB's Proposed 2026 Amendments to the Regulation for the Mandatory Reporting of Greenhouse Gas Emissions (MRR). We strongly support CARB's efforts to expand and improve greenhouse gas data collection and offer the following recommendations regarding an important and currently underreported emission source: methane slip from lean-burn natural gas reciprocating engines operating at data centers, stationary power generation facilities, combined heat and power (CHP) plants, and other applicable market segments.

Addressing methane slip from these sources is one of the most cost-effective climate interventions available today — and, without explicit MRR reporting requirements, it remains one of the most overlooked.

I. Background: The Methane Slip Problem

Natural gas-fueled lean-burn reciprocating engines are increasingly deployed across California for data center power, commercial and industrial CHP, and distributed generation. These engines provide grid resilience and efficiency benefits, but they also emit a significant fraction of their fuel as unburned methane — a phenomenon known as "methane slip."

The scientific literature documents methane slip rates of 1–5% of fuel input for lean-burn engines, including lean-burn spark ignition (LBSI) engines that are common in stationary power applications. This slip occurs because the lean-burn combustion regime optimized to reduce NOx emissions produces exhaust temperatures that are insufficient to fully oxidize methane in conventional aftertreatment systems.

Methane slip is not a marginal emission. Because methane has a global warming potential (GWP) approximately 82 times that of CO2 over a 20-year time horizon (GWP20 per IPCC AR5) and 28 times that of CO2 over 100 years (GWP100), methane slip can represent:

- Approximately 50% of the total CO_2e footprint of a lean-burn engine over a 20-year horizon, and
- Approximately 25% of the total CO_2e footprint over a 100-year horizon.

These figures are not theoretical. They reflect real-world operational data corroborated by multiple independent assessments of lean-burn engine emissions profiles.

II. The Scale of the Emerging Problem in California

The deployment of lean-burn natural gas engines is accelerating, driven significantly by data center growth. The rapid expansion of AI workloads is driving explosive electricity demand growth, and grid constraints are pushing data center operators toward on-site natural gas generation. Reciprocating engine gensets — often lean-burn — are proliferating because gas turbines face multi-year lead times and cannot be procured quickly enough to meet demand.

Relevant scale indicators for California include:

- U.S. data center electricity consumption is projected to grow from 183 TWh in 2024 to over 426 TWh by 2030 — a 133% increase — with California hosting a share of this capacity.
- Natural gas is projected to supply over 60% of electricity for U.S. data centers by 2030, much of it from on-site reciprocating engines (behind-the-meter power).
- Beyond data centers, universities, hospitals, and CHP facilities throughout California operate lean-burn natural gas engines.
- The U.S. operates approximately 2.5 million miles of natural gas pipelines with ~650 compression stations, a significant fraction of which use lean-burn reciprocating engines.

Methane slip from these sources is estimated to total approximately 850 million metric tons CO_2e per year nationally in 2025 and is growing. Without reporting requirements, this emissions stream will continue to grow invisibly, eroding California's climate progress.

III. Current Gap in MRR Reporting

Under current MRR requirements, facilities must report CO_2, CH_4, and N_2O from stationary fuel combustion sources. However, for natural gas combustion, the methane emissions reported typically represent only combustion byproducts — not unburned methane slip from incomplete combustion in lean-burn engines. The default emission factors used in Subpart C methodologies assume nearly complete combustion and do not capture the 1–5% methane slip characteristic of LBSI and similar lean-burn architectures.

As a result:

- Facilities with lean-burn natural gas engines are systematically underreporting their methane — and thus their total CO_2e — emissions.
- CARB's statewide GHG inventory likely understates the methane contribution from this growing source category.
- California's Cap-and-Invest program may not be adequately capturing compliance obligations associated with these emissions.

IV. Specific Recommendations

A. Add Lean-Burn Natural Gas Engine Methane Slip as a Reportable Emission Source

We recommend that CARB amend the MRR to explicitly identify lean-burn reciprocating natural gas engines (including LBSI, two-stroke lean-burn, and low-pressure dual-fuel engines) as a distinct emission source category requiring separate methane emissions quantification. This should apply to:

- Stationary power generation facilities (including data center power gensets)
- CHP and cogeneration facilities
- Compressor stations and pipeline operations using lean-burn engines
- Any facility that operates lean-burn natural gas engines above a defined aggregate capacity threshold (e.g., 1 MW total installed capacity or 10,000 MT CO_2e/year threshold)

B. Require Measurement-Based Methane Slip Quantification

CARB should require that methane slip be quantified using measurement-based methods rather than relying solely on default emission factors derived from complete combustion assumptions. Options include:

- Continuous exhaust methane monitoring (e.g., flame ionization detectors or NDIR-based analyzers) for larger facilities or new installations above a defined threshold.
- Periodic source testing (e.g., annual stack tests) using EPA Method 25A or equivalent for methane in lean exhaust streams.
- Manufacturer-validated emission factors specific to engine model, load profile, and fuel composition — with disclosure of which engine-specific factors are used.

Default emission factors calibrated for conventional combustion sources are not adequate for lean-burn engines and should not be the sole permissible quantification method for these sources.

C. Report Methane Separately from CO_2, Using Both GWP20 and GWP100

We recommend that CARB require that methane slip emissions be reported as a separate line item — not aggregated into total CO_2e only — so that the magnitude and character of the emission is transparent. Additionally, we recommend that reported totals be expressed under both:

- GWP100 (100-year global warming potential, per IPCC AR5): 36 g CO_2e/g CH_4
- GWP20 (20-year global warming potential, per IPCC AR5): 86–87 g CO_2e/g CH_4

This dual-horizon reporting approach is consistent with leading scientific guidance (Balcombe et al., 2018, Environmental Science: Processes & Impacts) and reflects the fact that methane's near-term climate forcing — which manifests within California's planning horizons of 2030 and 2045 — is dramatically higher than the GWP100 value alone would suggest. Reporting solely on GWP100 may cause operators, regulators, and the public to significantly underestimate the near-term climate impact of methane slip.

D. Include Data Centers as a Covered Sector for On-Site Generation Emissions

Data centers with on-site natural gas generation should be explicitly covered under MRR as a distinct reporting category, ensuring that both prime-power and load-balancing generation are captured regardless of whether the data center is primarily classified as a commercial or industrial facility. The rapid growth of on-site generation at hyperscale and edge data centers represents a new and growing source of uncontrolled methane emissions that does not fit cleanly into existing MRR sector definitions.

V. Policy and Regulatory Basis

These recommendations are consistent with and supportive of:

- California's AB 1279 and SB 32 targets for carbon neutrality by 2045 and 85% reduction in GHGs below 1990 levels, which require a complete and accurate picture of all significant emission streams.
- CARB's own stated purpose for the 2026 MRR amendments: to collect emissions data from fuels and sectors not currently included in MRR reporting to give a more complete picture of GHG emissions in the State.
- The scientific consensus that methane slip from lean-burn engines is a material and growing source of GHG emissions that current monitoring frameworks do not adequately capture.

With the federal EPA considering rollback of the national GHG Reporting Program, California's MRR is increasingly the primary regulatory mechanism for ensuring comprehensive facility-level GHG transparency. Strengthening MRR's treatment of methane slip is therefore both timely and essential.

VI. Renewable Natural Gas

A. How Methane Slip Negates the CO_2e Benefit of RNG — the quantitative case: 3% slip at GWP100 adds ~50% to CO_2e footprint the RNG is offsetting; at GWP20 it's ~100% (equaling the RNG benefit).

B. The Net-Zero Implication — RNG cannot deliver its promised lifecycle reductions if slip goes unmeasured. California's RNG policy investment is generating phantom reductions: the upstream LCFS credit assumes complete combustion, but the methane escaping the exhaust is never counted. RNG has identical combustion chemistry to fossil gas — slip rates are the same.

C. Specific Recommendation — link RNG reporting to point-of-use methane slip measurement; condition LCFS pathway credits on measured slip performance; and flag that net-zero designations for RNG-using facilities are invalid without verified slip accounting.

VII. Conclusion

Methane slip from lean-burn natural gas engines is a significant, rapidly growing, and currently underreported source of greenhouse gas emissions in California. The 2026 MRR amendments represent a timely opportunity to close this gap. We respectfully urge CARB to:

- Establish lean-burn natural gas engines as a distinct, separately reportable emission source category within MRR.
- Require measurement-based methane quantification methods appropriate for lean-burn exhaust conditions.
- Mandate separate methane reporting (not just CO_2e aggregation) using both GWP20 and GWP100, following the progressive approach being taken by New York State.
- Explicitly cover data center on-site generation as a distinct source category.

These changes would materially improve the accuracy of California's GHG inventory, support the integrity of the Cap-and-Invest program, and ensure that one of the most cost-effective climate levers available — methane slip control — is properly visible to regulators, operators, and the public.

Thank you for the opportunity to submit these comments. We welcome any follow-up questions.

Respectfully submitted,

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