Certified Clean? Abatement and Non-abatement in Low Methane Certification*

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Extended Abstract

Markets for certification of low-methane oil and gas production have arisen over the last decade, prompted by concerns of emissions of this potent greenhouse gas from the supply chain. However, measurement is imperfect and gamable even under the strictest certification protocols. This paper proposes a model of the certification market. We first illustrate the gap between the distribution of emissions intensities implied by certification market outcomes versus distributions estimated by independent measurement campaigns and satellite data. We argue that this gap is consistent with significant amounts of both non-additionality and misreporting of abatement. We then discuss how certification protocols are gamable and propose a model of heterogeneous producers and adverse selection that generates these stylized facts in equlibrium. Comparative statics and simulations show how producers endogenously select into abatement categories. A key finding is that increases in certificate premia induce both abatement and misreporting on the margin.

Distributions of Emissions Intensities

Roughly a third of US natural gas production is now third-party certified for it's methane emissions intensity, and four-fifths of those certificates attest to production segment intensities below 0.05 percent of marketed natural gas. Meanwhile, independent

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aerial and satellite measurement campaigns covering most US onshore production estimated basin-level loss rates of 0.5 to 3 percent, following right-tailed distributions that are well-approximated by a lognormal. Using basin-level estimates from the measurement literature, raw data from measurement campaigns and satellites, and publicly reported certificate market data, we first show that these facts can be reconciled in some basins but not others. For example, in the Appalachian basin where gas is the target commodity and the distribution of intensities is fairly low, certified volumes are consistent with independently-measured distributions. In the Permian basin where oil is the target commodity and gas is a byproduct, by contrast, the distribution of intensities implied by certified volumes is implausible relative to independently measured distributions. Nearly all large emissions events in the Permian would have to occur among uncertified producers in order to reconcile these distributions, a likelihood that is vanishingly small given within-operator distributions of emissions. These facts suggest that a meaningful share of issued certificates in a low-emissions basin like the Appalachian may be non-additional to the certification market, while the true intensities of certified producers in a high-emissions basin like the Permian may exceed those represented by their certificates. Both are sources of oversupply in the certificate market relative to actual emissions. How does this happen, and what does it mean for abatement outcomes in these markets?

What Certification Actually Certifies

Measurement protocols in low-methane certification programs verify that measurement protocols are in place. They do not own or implement the measurement equipment or the data pipeline. They contain rules around data collection and sampling methods, within which producers have discretion over implementation. This discretion creates opportunities for producers to (1) stay within the "letter" of the protocol and still report lower-bound emissions estimates, and (2) misreport emissions in ways that have a low probability of detection. In either case there is a small but non-zero risk of having larger-than-certified emissions detected by third-party measurement campaigns or satellites, and losing the certification premium or paying additional costs to reduce emissions and re-certify.

Firms have many degrees of freedom under certification that do not violate certification protocols but can bias intensity estimates downward. They can adjust sampling stratification and timing can be designed to underweight large sources or to occur just

after maintenance or outside of known emissions events that happen during normal operations. Measurement technologies can be selected with higher detection thresholds, and non-detection can be replaced by engineering calculations rather than realistic distributional assumptions. Optical gas imaging cameras can be deployed at suboptimal distances under poor weather conditions by employees without training or incentives to detect plumes. Optimistic assumptions about background atmospheric levels or plume shapes can be imposed on quantification algorithms. Reconciliation between different measurement methods can take advantage of the largest possible estimation uncertainty.

Firms may also more directly manipulate measurement in ways that carry low risk of detection. They may impose temporary leak fixes during satellite overpasses or vent on cloudy days that are harder to measure in aerial and satellite campaigns. Onsite continuous monitoring equipment can experience downtime in data collection that generates missing data periods, and operators can attribute outlier measurements to instrumentation error, or miscategorize large but routine emissions events as non-routine and thus not representative. Measurement vendors may also be subject to soft capture through repeat business with producers.

A Model of Equilibrium Adverse Selection and Non-additionality in Methane Certification Markets

The implications for abatement are important not only for the growing voluntary market, but also for potential compliance markets in jurisdictions that impose intensity-based procurement standards. Examples include the EU Methane Regulation, which will decide whether these certificates count as compliance for imported LNG, potential U.S. state-level procurement standards or PUC rules, or a future reimagining of the US Waste Emissions Charge. We propose a model of adverse selection and non-additionality in these "responsible gas" (RG) methane certification programs that matches the stylized facts and can be applied to both voluntary and compliance markets. Certification agencies verify that producers have installed monitoring equipment and are collecting measurement data, but they do not independently verify accuracy. Firms control the monitoring equipment and the data pipeline. We show that this institutional design endogenously sorts firms into different abatement categories based on their type, and generates a wedge between certified and actual emissions that widens as downstream demand for certified gas grows.

Firms are heterogeneous in a type that jointly determines production costs and emissions intensity, capturing the empirical regularity that the largest, most productive operators tend to have the lowest methane leak rates. To access higher-value export markets subject to emissions performance standards, firms must obtain RG certification, paying a fixed cost and meeting (or appearing to meet) a binary emissions standard. Firms below the standard certify at no compliance cost but generate non-additional certificates — credentials that represent no behavioral change. Firms above the standard may comply through costly but observable abatement, or they may underreport emissions, exploiting the agency's inability to independently verify measurements. Detection probability is increasing in the gap between actual and reported emissions, reflecting satellite monitoring, statistical anomaly detection, and whistleblower risk.

In equilibrium, the type space partitions into four regions: naturally compliant (non-additional) firms that certify without abatement, compliant firms that abate to the standard, non-compliant firms that partially abate and misreport the residual gap, and non-participants that serve only the unregulated domestic market. All certified firms — whether genuinely compliant or not — hold identical credentials, and downstream buyers cannot distinguish among them. Certificate supply is inflated by both non-additionality (clean firms credited for unchanged behavior) and adverse selection (dirty firms certified despite having emissions that exceed the standard).

We endogenize the certification premium through market clearing between certificate supply and downstream certified demand. The central result is a "green lemons" dynamic: an outward shift in demand for certified gas raises the premium, which draws dirtier firms into the certified pool (extensive margin) and induces all non-compliant certified firms to expand output (intensive margin). Unlike Akerlof's classic lemons problem, where the presence of low quality goods reduces prices and drives out high quality goods, here the demand for high environmental quality pulls in low quality by bidding up the certificate price. Growing certificate demand through voluntary measures such as expanding ESG mandates or tightening foreign market regulations such as the EU Methane Rule induces more abatement along with more misreporting and more production of a fossil fuel with downstream combustion CO2 emissions. This results in significantly dampened net climate benefits of certification markets relative to the volume of certificate trade.