

Colorado Ongoing Basin Emissions (COBE): Measurement-informed inventory results

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Background – why did we do this study?

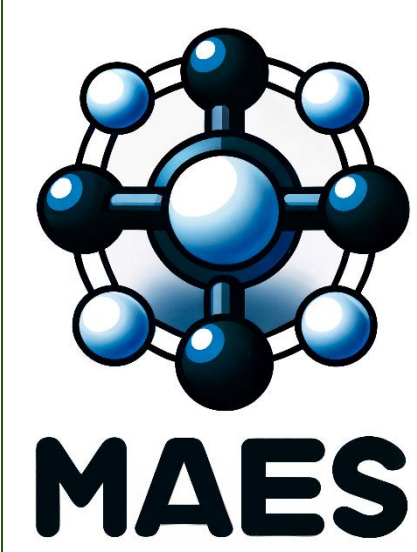
In 2024, the Air Pollution Control Division published a verification protocol establishing new requirements for operators reporting methane emissions from upstream oil and gas facilities. Under this protocol, operators must either create their own measurement-informed inventory (MII) or apply the state-developed default factor. This factor accounts for the differences between measured methane emissions and reported methane emissions for the upstream sector. To inform the 2026 default factor, this study, the Colorado Ongoing Basin Emissions (COBE) project, deployed three different aerial measurement technologies to quantify methane emissions from upstream oil and gas facilities across Colorado during 2024.

GOALS of this study:

- Collect representative methane measurements of upstream oil and gas facilities throughout Colorado
- Develop MII's using the aerial emissions data
- Compare MII's to operator-reported emissions

Methodology – how did we create a MII for the state of CO?!

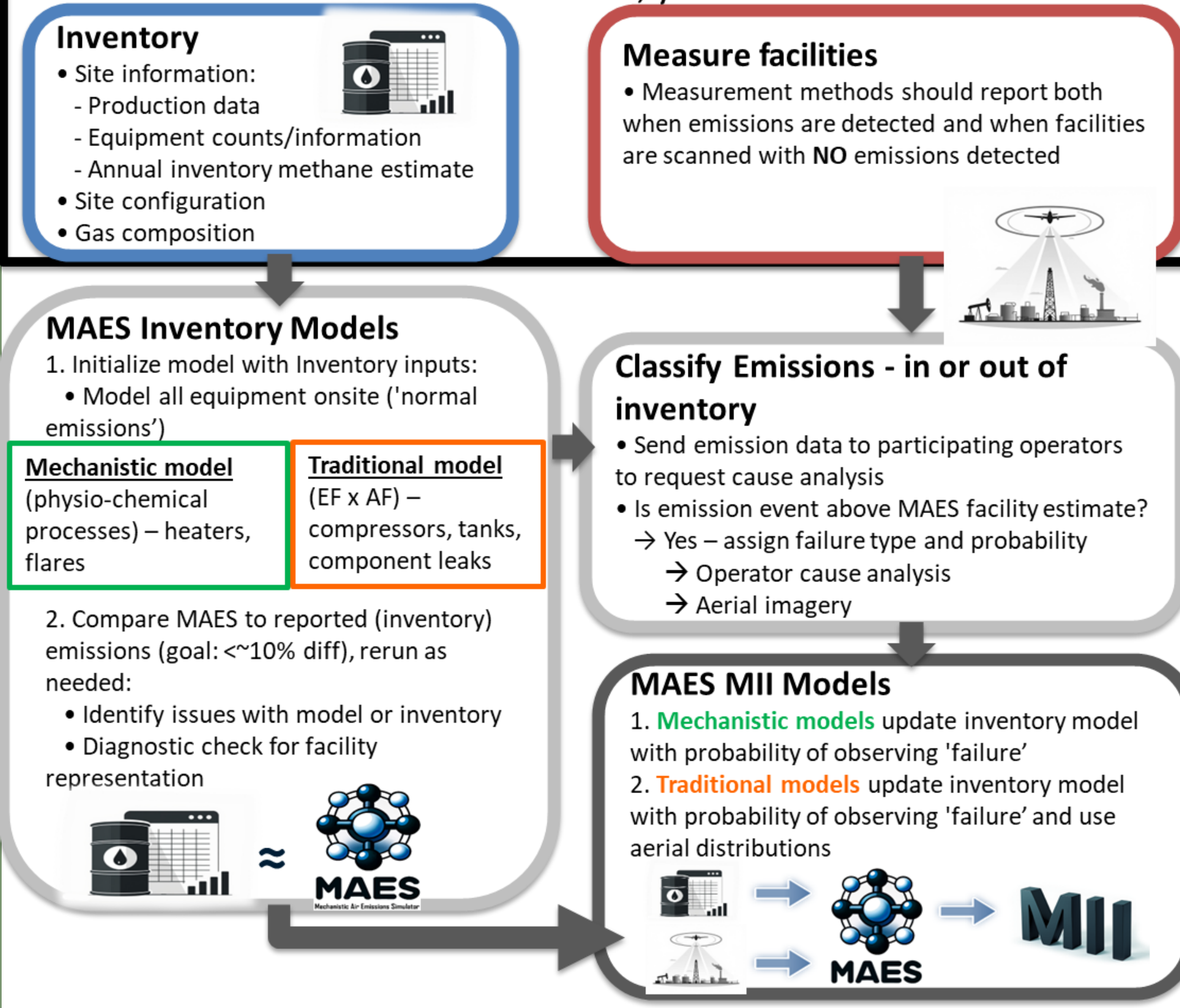
Inventory – In the state of Colorado, oil and gas operators report annual greenhouse gas emission estimates to the Oil and Natural Gas Annual Emissions Inventory Reporting (ONGAEIR) database, maintained by Colorado Department of Public Health and Environment (CDPHE). For this project, the ONGAEIR 2022 dataset was the most recent publicly available inventory.



To model emissions, we use our Mechanistic Air Emissions Simulator (MAES) which is more than just a bottom-up model..

- Uses Monte Carlo methods
- Gas composition analysis
- Inclusion of failure conditions
- Throughput variation

To create an MII, you need..



MAES MII Results – the cool science stuff!

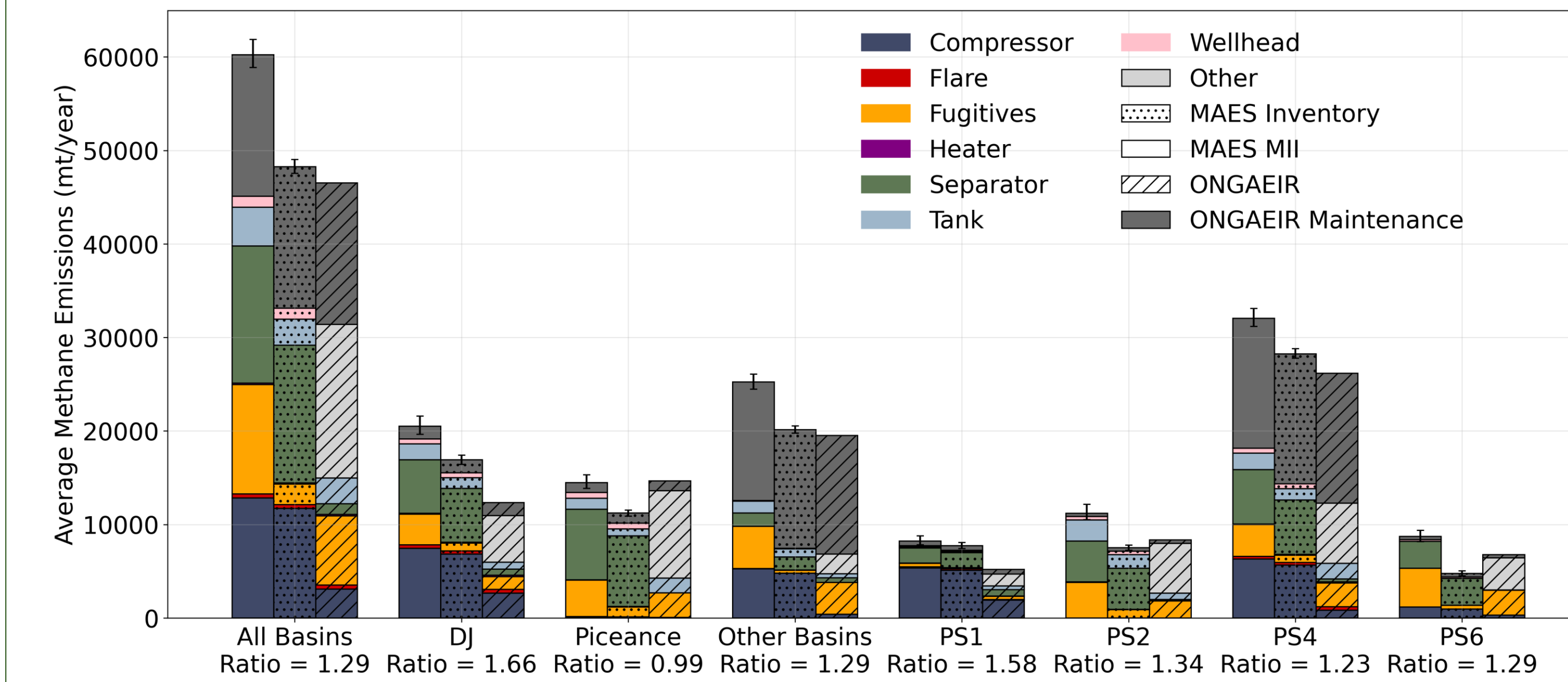


Figure 1: MAES MII and MAES inventory model results by basin and prototypical site compared to ONGAEIR values, all broken out by emission sources. These ratios are calculated by dividing the total MAES MII emissions by the total ONGAEIR emissions. Maintenance emissions are not modeled in MAES and are therefore taken from ONGAEIR and added onto MAES results.

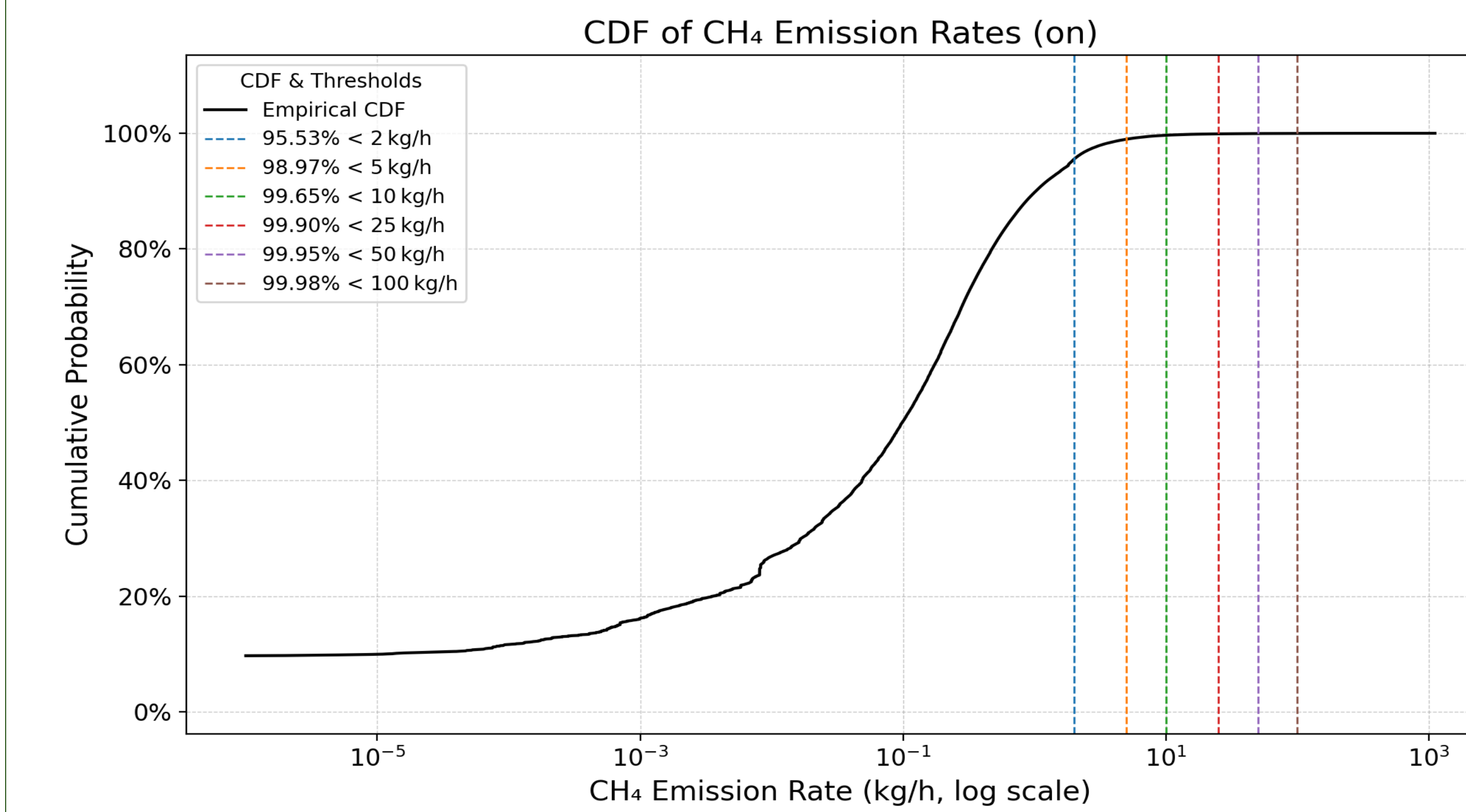


Figure 2: Aggregate cumulative distribution function (CDF) of instantaneous methane emission rates across 10,144 simulated facilities using MAES. The black line represents the empirical CDF. Vertical dashed lines mark commonly used detection thresholds, with annotations showing the fraction of emissions below each threshold.

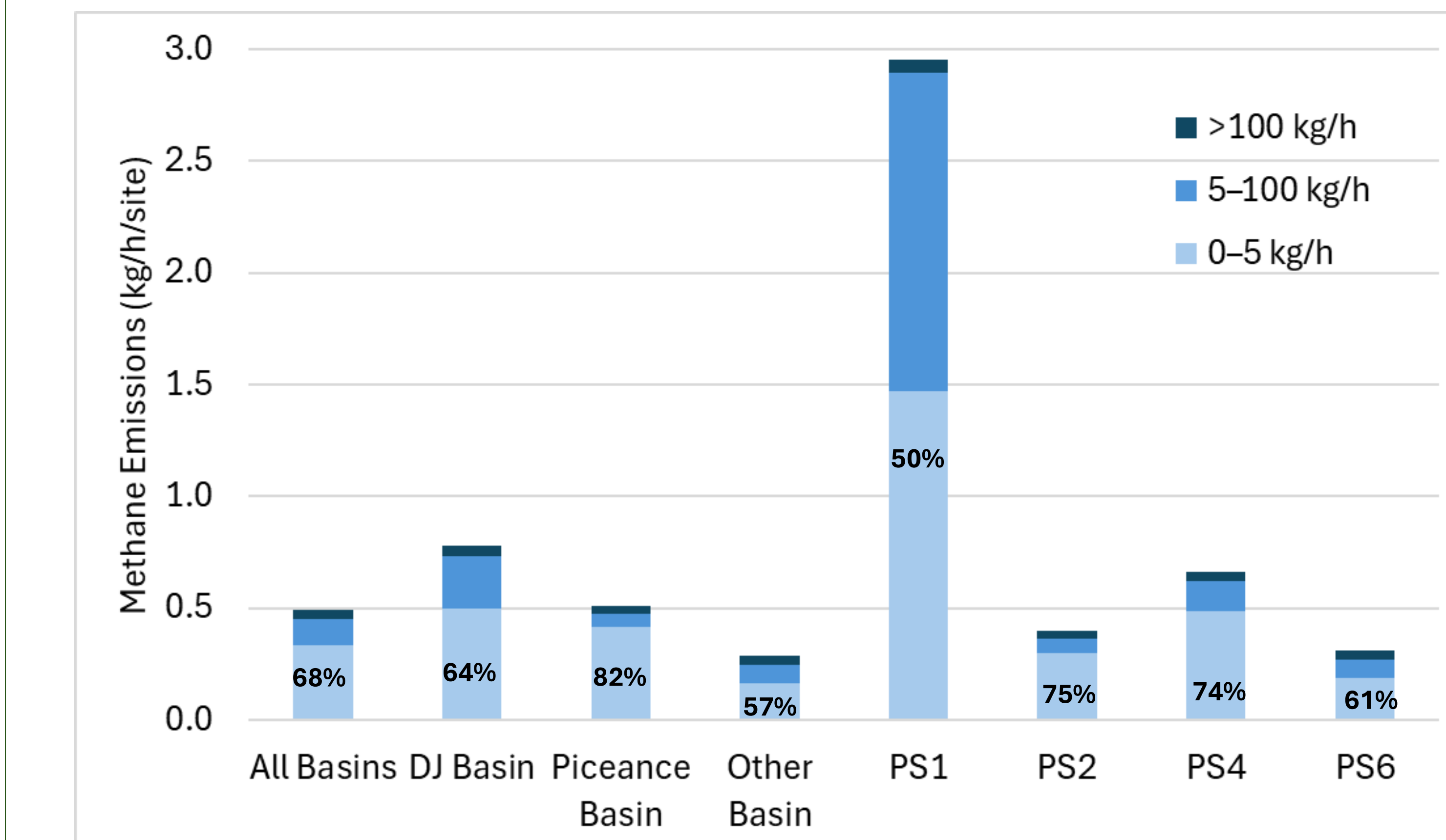
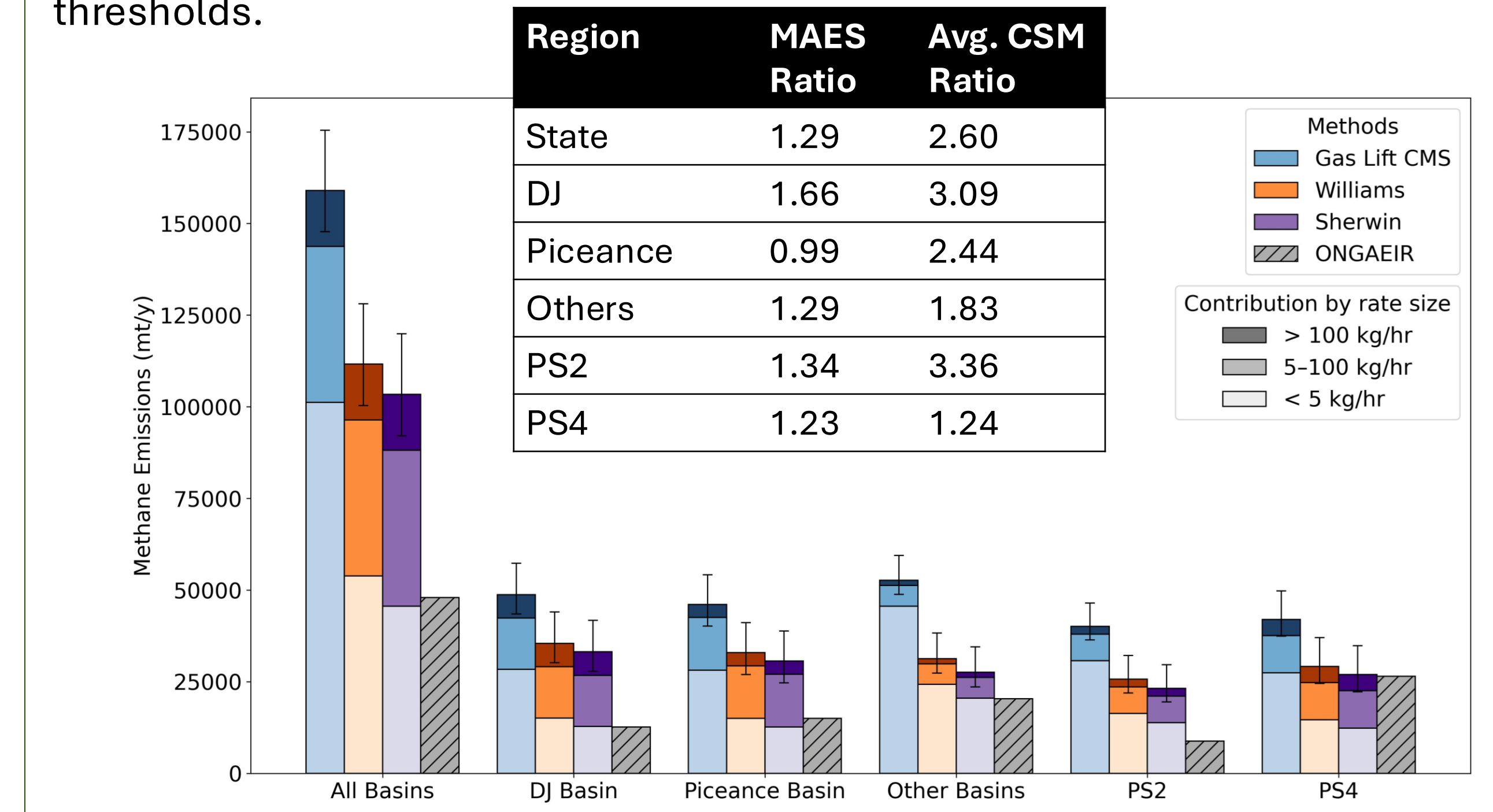


Figure 3: MAES MII broken out by average methane emission per site divided into the contribution from rates: 0 results-5 kg/h, 5-100 kg/h and above 100 kg/h.

But wait.. There is more!

Colorado School of Mines (CSM) was part of the modeling team and developed an independent statistical model to create a MII for the state of Colorado. The CSM team's model relies solely on rates estimated by measurement technologies, and separate distributions are used to model emissions below the aerial detection thresholds.



Conclusions and Future work – why these results matter!

Key takeaways:

- Colorado is often regarded as a leader in methane regulations, yet these measurements suggest that the statewide inventory underestimates emissions by **29%**.
- MII results show that **68% of total emissions are from rates < 5kg/h**, contrary to the common finding that large emitters are contributing disproportionately to a region/basin total emissions.
- Two independent models made different assumptions about incorporating the measurement data and produced varying sets of state-wide emissions totals and ratios.

Future work:

We are currently proposing a continuation of this to help inform the 2027 verification factor. This would allow us to further investigate the differences between CSU and CSM's results.

Funding and Contact Information

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References – to see more about this interesting study!

COBE final report:

Brown, J. A.; Moy, M.; Santos, A.; Rimelman, E.; Okenberg, C.; Daniels, W. S.; Hammerling, D. M.; Zimmerle, D.; Hodshire, A. L. Colorado Ongoing Basin Emissions (COBE) Final Report.

COBE anonymized dataset:

Brown, J. A.; Hodshire, A. Colorado Ongoing Basin Emissions Study (COBE) Anonymized Final Data Set of Emissions Measurements, 2025. <https://doi.org/10.5061/dryad.8kpr4z0p>.

For other COBE-related posters, see:

Ethan Rimelman – COBE: Measurement and Source Attribution

Michael Moy – COBE: Estimating Methane Emission Distributions from Aerial Measurements