GTI ENERGY

SAGE

STATISTICS, ANALYTICS, AND GIS IN ENERGY CONFERENCE

August 13-14, 2025 | Des Plaines, Illinois

Mind the Gap: Addressing Undetected Emissions in Measurement-Informed Inventories

Ellie Martinez
Associate Data Scientist
GTI Energy

Measurement-Informed Inventories

- A measurement-informed inventory (MII) is an emissions inventory that combines bottom-up inventory data with top-down measurements.
- Accurate accounting is critical for:
  - Identifying mitigation opportunities
  - Tracking progress toward goals
  - Regulatory compliance (EPA's GHGRP)
  - Voluntary initiatives (OGMP 2.0, Veritas, ONE Future, etc.)

ONE
OUR NATION'S ENERGY
FUTURE

VERITAS
GTI ENERGY'S METHANE EMISSIONS MEASUREMENT + VERIFICATION INITIATIVE

OGMP
Oil And Gas Methane Partnership 2.0

GTI ENERGY
SAGE
STATISTICS, ANALYTICS, AND GIS IN ENERGY CONFERENCE

Differences in Measurement Approach and Environments

Distribution

- Measuring miles of pipeline, metering and regulating stations, etc.
- Advanced mobile ground-based surveys are widely used, and other monitoring approaches are emerging
- Urban environments with numerous methane emitting sources

Upstream

- Measuring well pads, tanks, compressors, etc.
- Aerial surveys, drones, and satellites are widely used.
- Typically, rural environments with relatively isolated sources

Differences in Approach, Same Goal

Goal

- A comprehensive emissions inventory that has complete coverage spatially, temporally, and across the emissions rate distribution for the target scope

Reality

- Leak detection is stochastic
- Taking measurements costs money, impossible to measure everything, everywhere, all the time

How do we address the gap between our end goal and what we are able to measure in reality?

Case Study: Annual Emissions in the Haynesville Basin

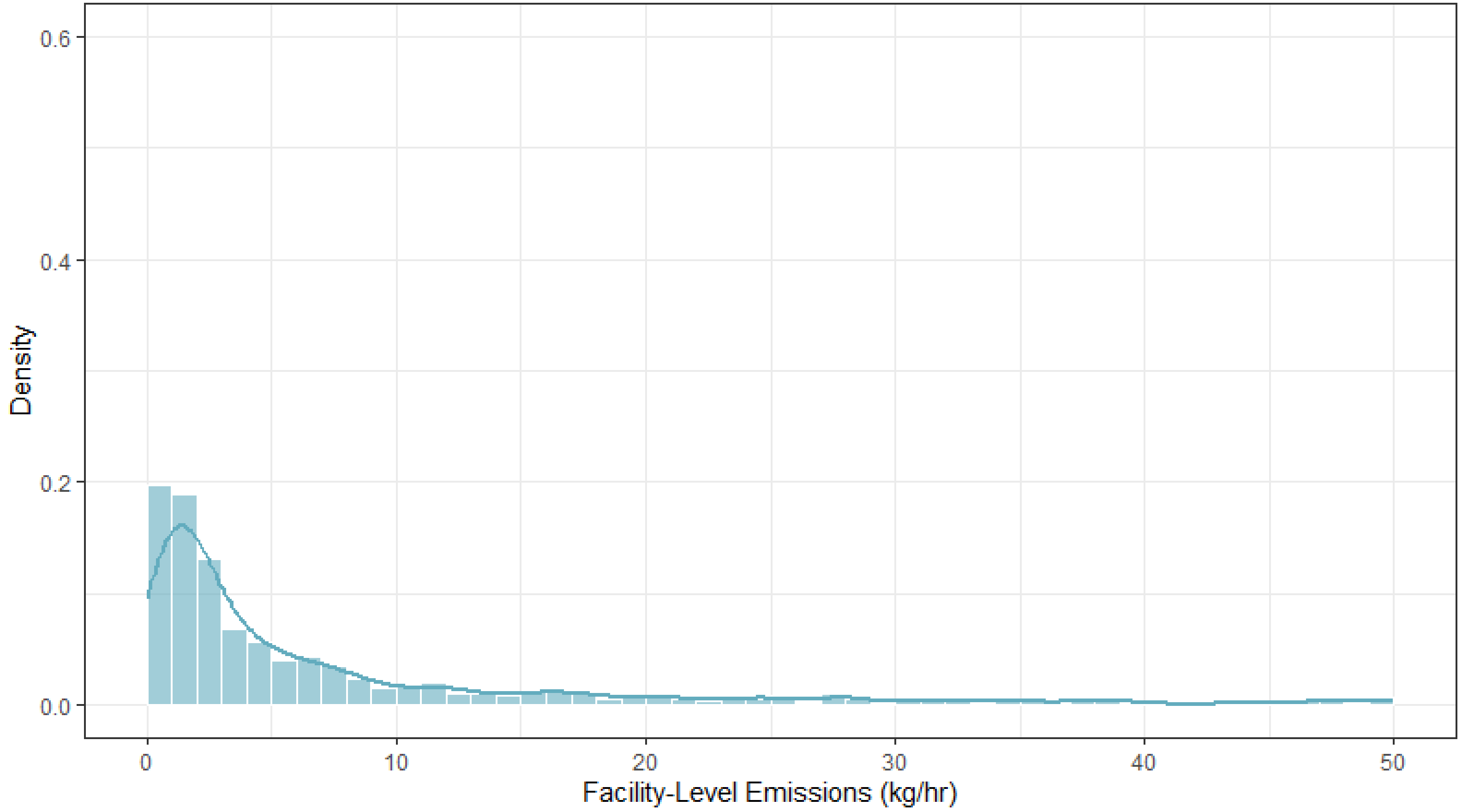
- Goal: Using a single aerial campaign, estimate total 2024 emissions for the Haynesville Basin.
- Three considerations
    1. Spatial
    2. Emissions Distribution
    3. Temporal

Spatial Coverage

- Estimated the total number of facilities in the basin
- Stratified facilities for sampling based on emission profiles
- Randomly selected facilities to sample
- Scaled results of observed facilities up to unobserved facilities

Stratum	Population	Surveyed	Fraction Surveyed	Fraction of Surveyed Emitting
Marginal Producing Well Facilities	22,834	1,090	5%	30%
Standard Producing Well Facilities	4,317	275	6%	37%
High Producing Well Facilities	1,250	289	23%	62%

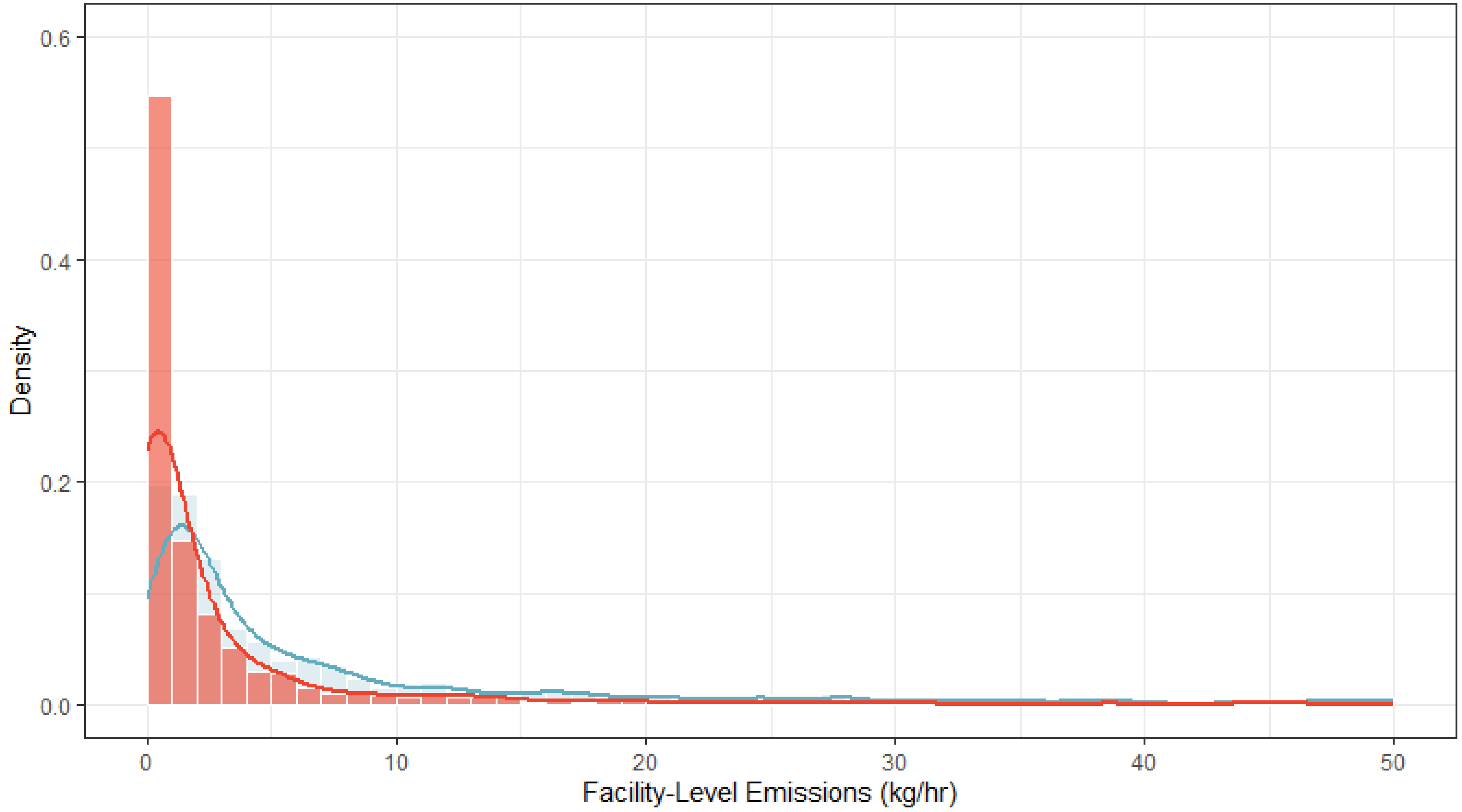
Emissions Distribution Coverage



Observed emissions from Bridger's Q3 campaign

GTI ENERGY SAGE
STATISTICS, ANALYTICS, AND GIS IN ENERGY CONFERENCE

Emissions Distribution Coverage

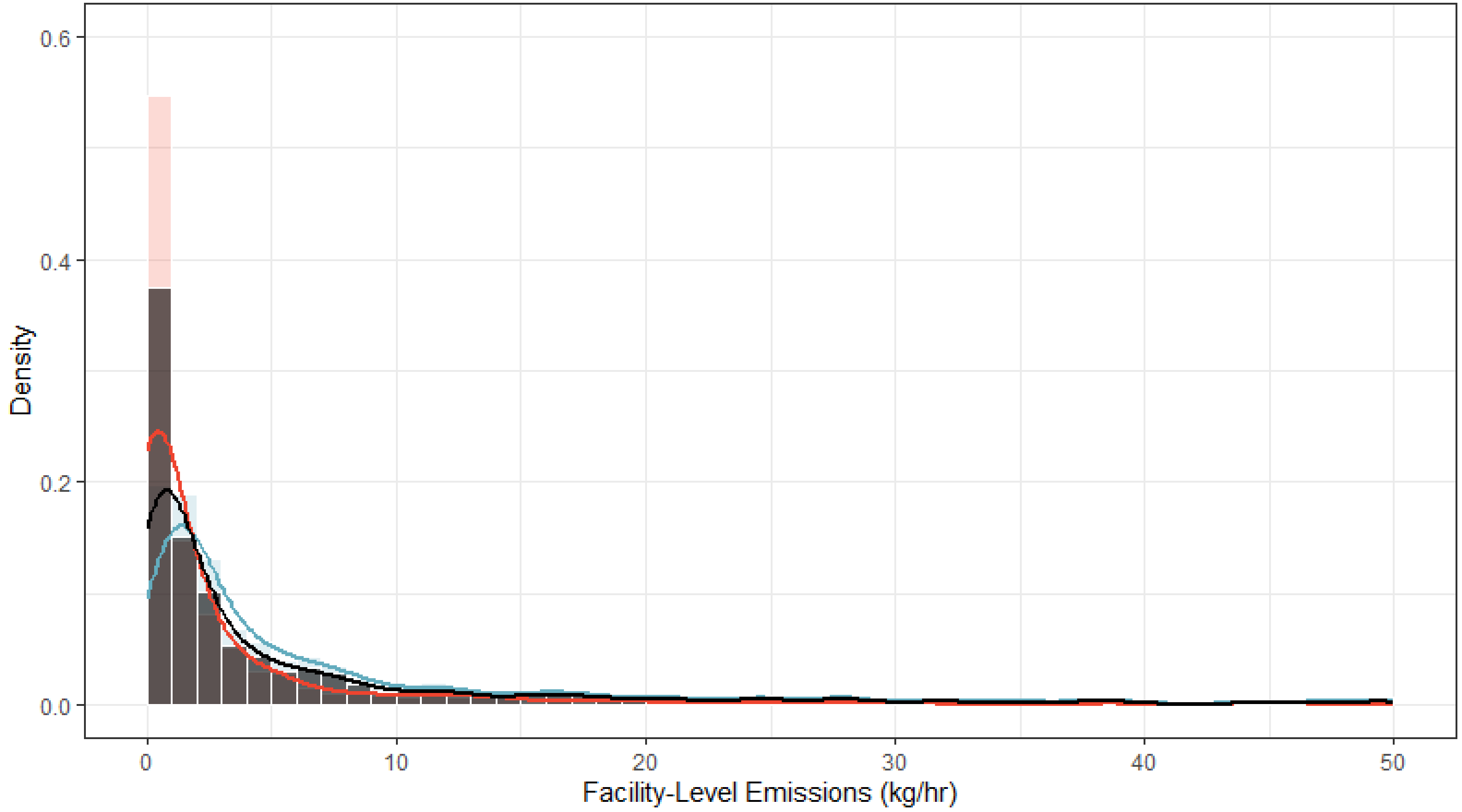


Observed emissions from Bridger's Q3 campaign

Observed emissions from Omara et al. 2018 and 2024

GTI ENERGY SAGE
STATISTICS, ANALYTICS, AND GIS IN ENERGY CONFERENCE

Emissions Distribution Coverage



Observed emissions from Bridger's Q3 campaign

Observed emissions from Omara et al. 2018 and 2024

Observed emissions from Bridger's campaign plus imputed emissions from Omara et al.

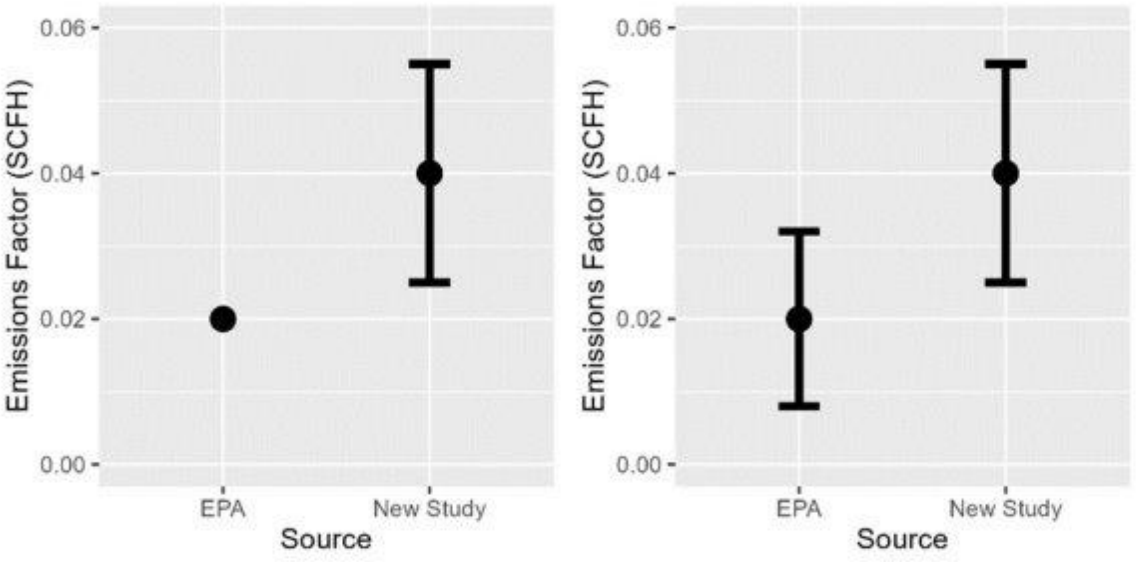
Temporal Coverage, Results and Uncertainty

- Scale each stratum's average emission rate (kg/hr) across the entire year (x 24 hours x 365 days)
  - The assumptions underpinning this approach are open questions that are the subject of ongoing research
  - A lot of room for future improvements
- Used a bootstrap resampling technique to quantify uncertainty

No Imputation (Treat Non-Detects as 0s)	With Imputation
1,022.6 (707.2, 1,520.8) Gg/yr	1,030.2 (714.8, 1,528.5) Gg/yr

Lessons Learned

- Importance of stratification
- Accounting for non-detected emissions
- Temporal considerations (how frequently are we surveying, duration assumptions, etc.)
- Uncertainty quantification enables comparison and accounts for variability



GTI ENERGY SAGE
STATISTICS, ANALYTICS, AND GIS IN ENERGY CONFERENCE