



# Measurement systems for livestock enteric methane emissions



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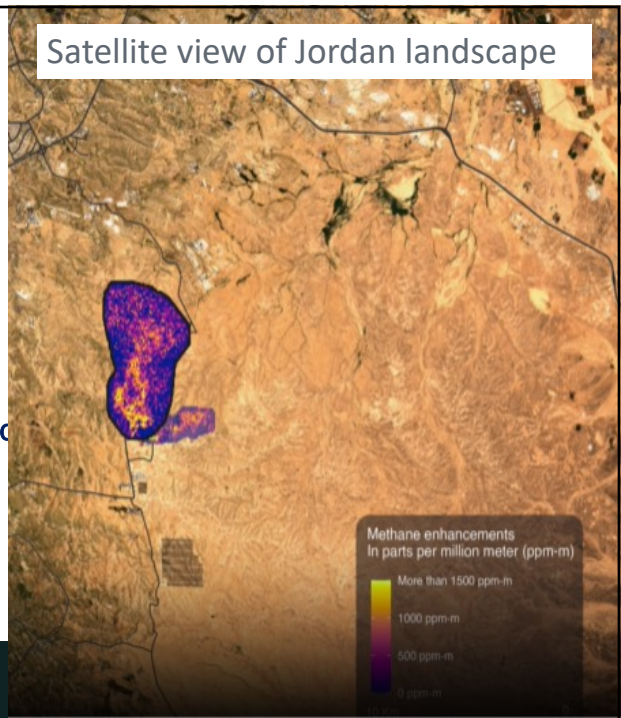
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## OPTIONS

1. Open path systems (FTIR or laser)
2. SF<sub>6</sub> tracer
3. GreenFeed
4. Polytunnel
5. O/C respiration chambers (gold standard)
6. Headbox
7. Laser
8. Portable Accumulation Chambers

Satellite view of Jordan landscape

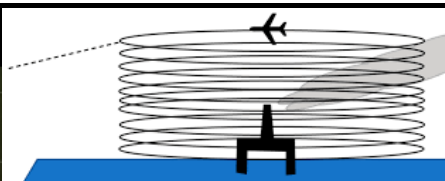


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# MethaneSAT™

## MethaneAIR

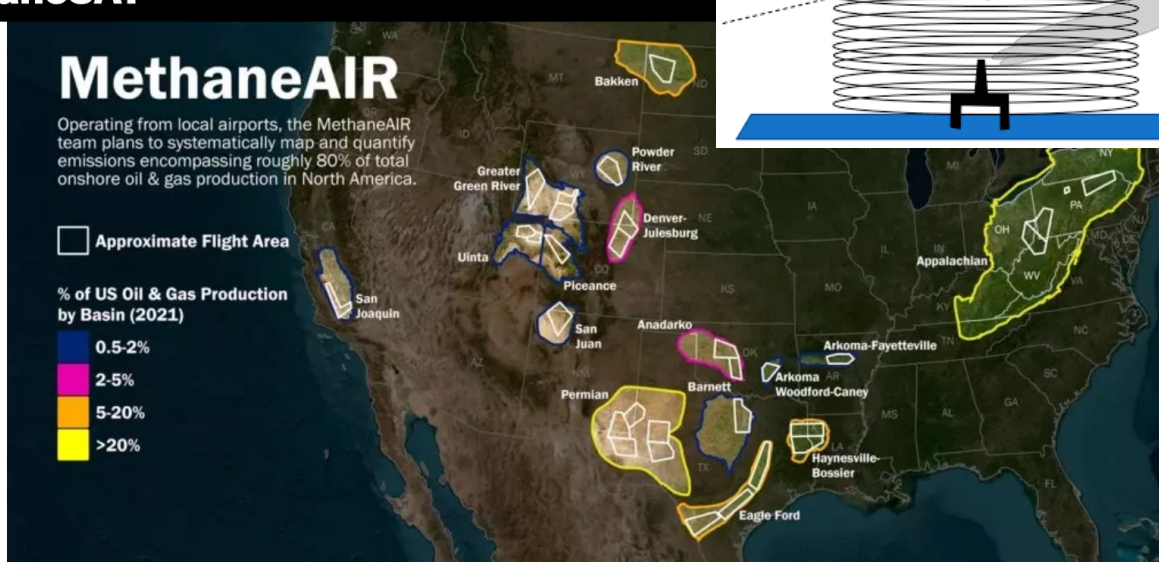
Operating from local airports, the MethaneAIR team plans to systematically map and quantify emissions encompassing roughly 80% of total onshore oil & gas production in North America.



Approximate Flight Area

% of US Oil & Gas Production by Basin (2021)

- 0.5-2%
- 2-5%
- 5-20%
- >20%



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## OPEN PATH SYSTEMS

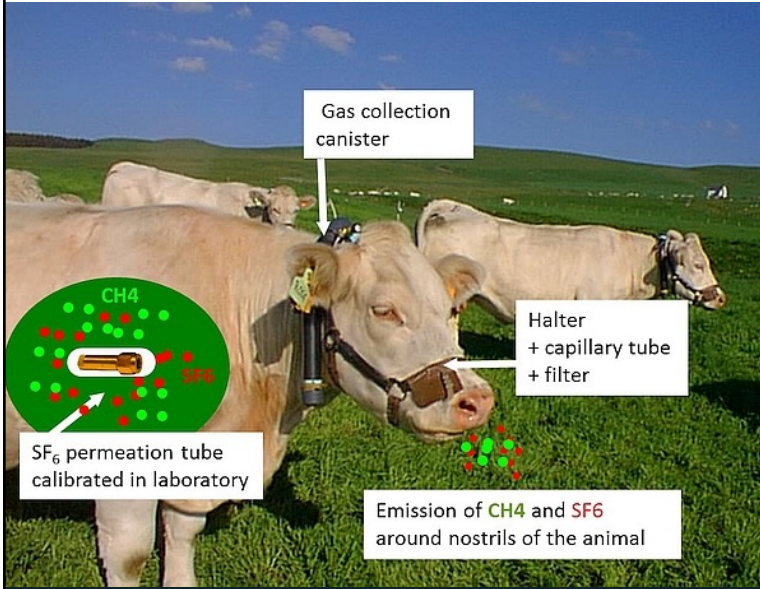
1. Shine a laser or a strong IR (FTIR) or laser beam along the upwind and downwind side of a herd of cattle.
2. Use a weather station to record 3D air movement
3. Use Backward Lagrangian stochastic model to work out how much CH<sub>4</sub> must have been produced to generate that difference in [CH<sub>4</sub>]




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## SF<sub>6</sub> TRACER (marker) gas system (CH<sub>4</sub>:SF<sub>6</sub> ratio)



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## CH<sub>4</sub>: CO<sub>2</sub> ratio



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<https://doi.org/10.3168/jds.2020-18559>

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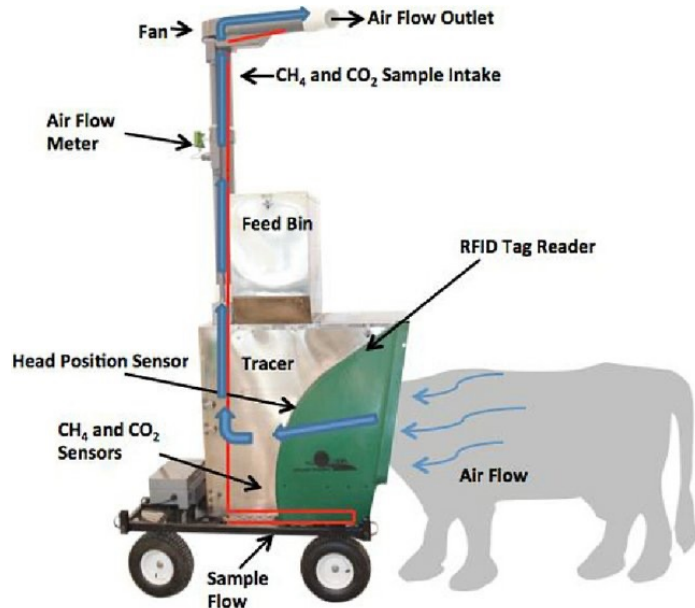
**Short communication: Variation in feed efficiency hampers use of carbon dioxide as a tracer gas in measuring methane emissions in on-farm conditions**

P. Huhtanen,<sup>1\*</sup> A. R. Bayat,<sup>2</sup> P. Lund,<sup>3</sup> A. L. F. Hellwing,<sup>3</sup> and M. R. Weisbjerg<sup>3</sup>

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## GREENFEED (C-Lock Inc)

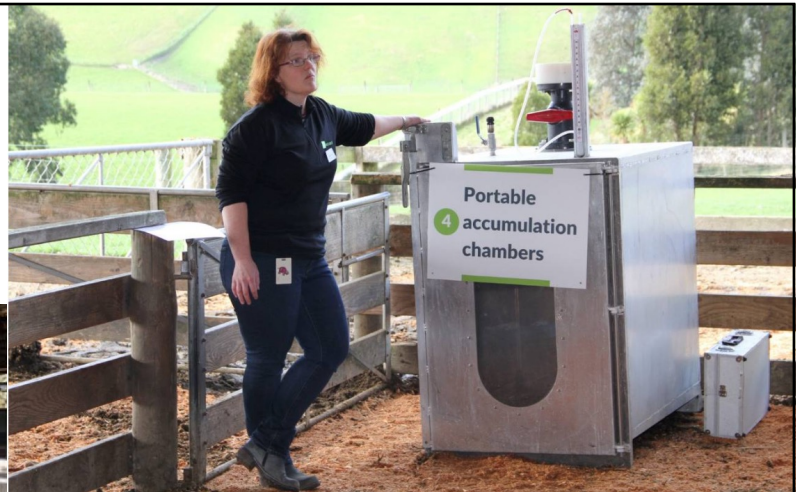
- Measures emissions over many 2-5 min periods to generate an average DMP
- Applies in grazing and in controlled feeding environments
- Requires a supplement be fed
- Increasingly accepted as valid measure of foregut emissions
- Needs internet connection for full functionality



We will come back to the details at the end

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## PORTABLE ACCUMULATION CHAMBERS



Measures emissions 1-2 time /d over 40min.  
 Use multiple PACS simultaneously.  
 Measure 72 sheep/d  
 Principally used as genetic selection tool

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## POLYTUNNELS

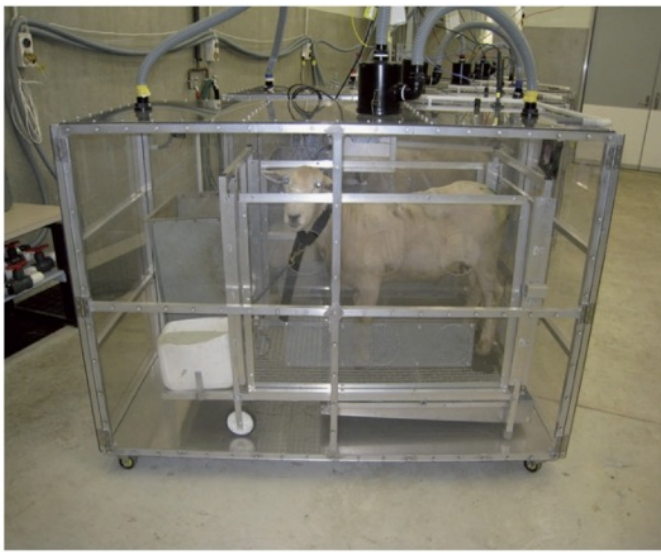


- Made for short term paddock measurement, like portable flow-through respiration chamber
- Now used in static mode with 1h confinement periods & averaging the emission rate

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## OPEN CIRCUIT RESPIRATION CHAMBERS

“Gold standard” ~ how do we define perfect?



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## HEADBOXES

Allow enteric measures without needing to put in air conditioning for the cow



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## LASER

A work in progress: Very cheap, very simple but how to convert to daily methane??

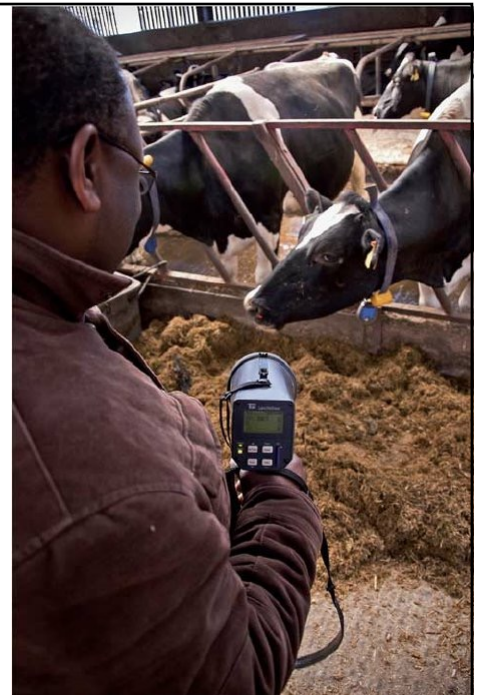
Open Access Review

### Measuring Livestock CH<sub>4</sub> Emissions with the Laser Methane Detector: A Review

by Diana Sorg 

German Environment Agency (Umweltbundesamt), Wörlitzer Platz 1, 06844 Dessau Rosslau, Germany

*Methane* 2022, 1(1), 38-57; <https://doi.org/10.3390/methane1010004>



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TODAY

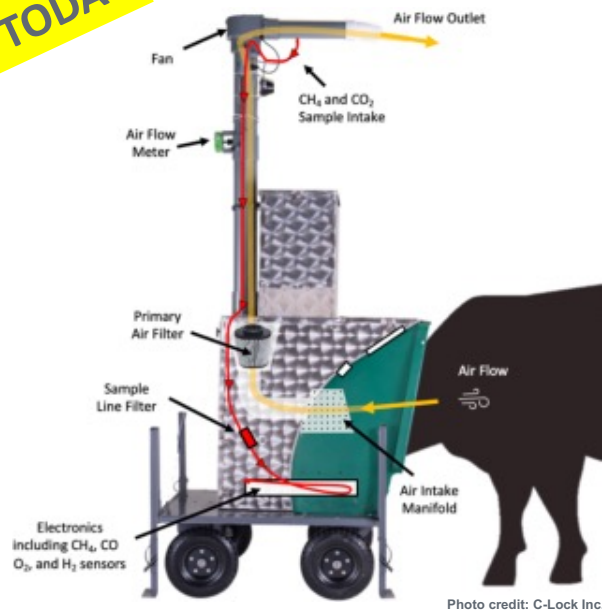


Photo credit: C-Lock Inc.

### Basic Greenfeed Components.

**1. Feeding Hood.**  
The feeding hood comprises the *air intake manifold*, a *feed dish* with a *feed drop shoot*, a *head proximity sensor* and an *EID reader*. A web Cam is located on upper lip of the Feeding Hood.

**2. Air Flow**  
A fan located on the top of the chimney structure draws air at the rate of approximately 40 litres per second through the *air intake manifold*. A *primary air filter* extracts particulate particles from the airflow. The rate of flow is then measured by the *air flow meter* and the air expelled from the chimney through the *air flow outlet*.

**3. Sample**  
A mixed *sample of air* is drawn by the *sample pump*, located in the electronics box, from a position midway between the fan and the airflow outlet. The sample passes down through a *sample line filter* and into the *gas sensors*.

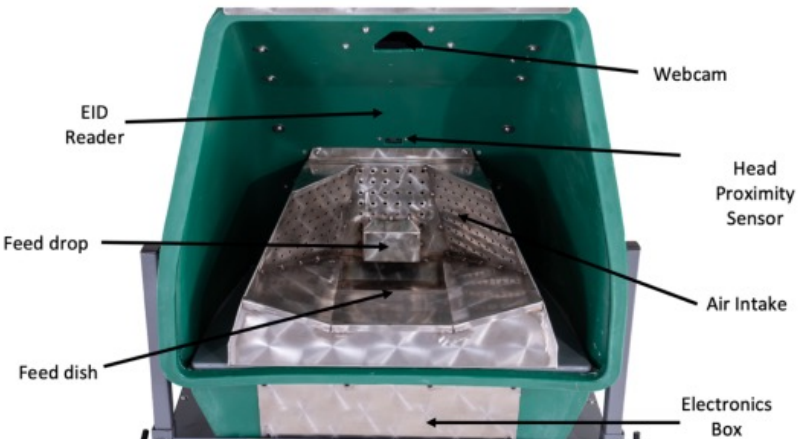
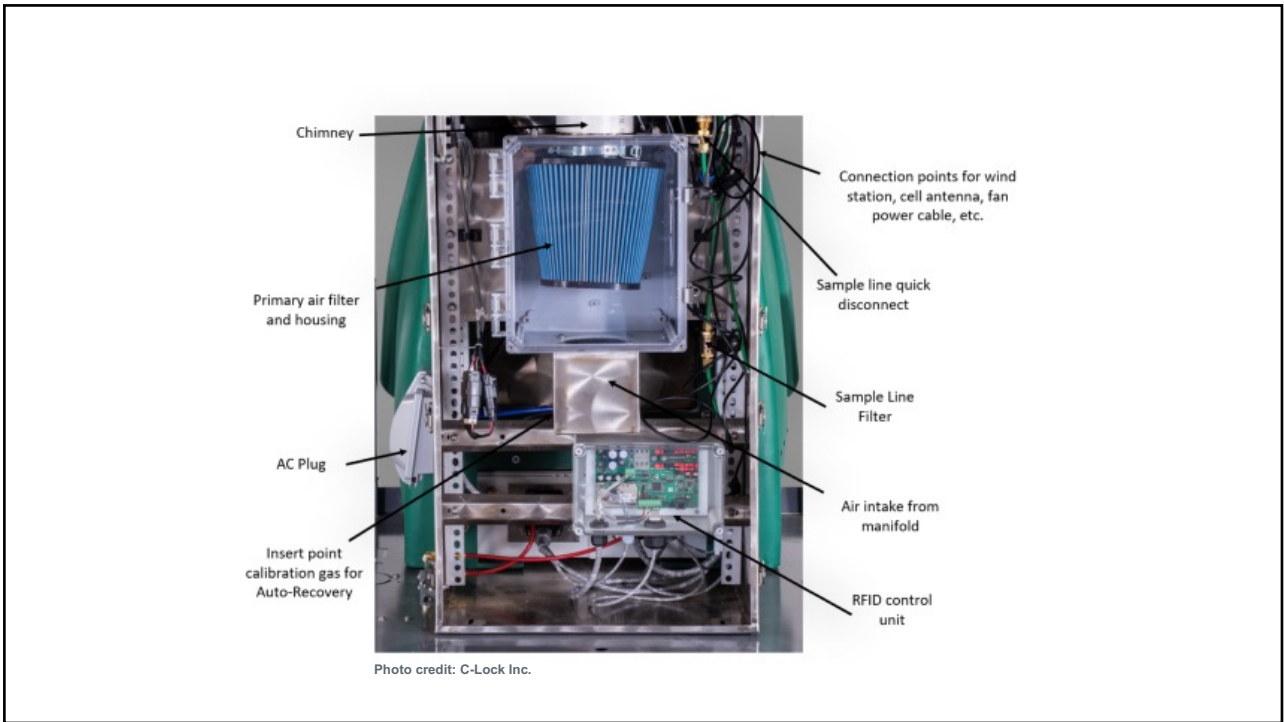
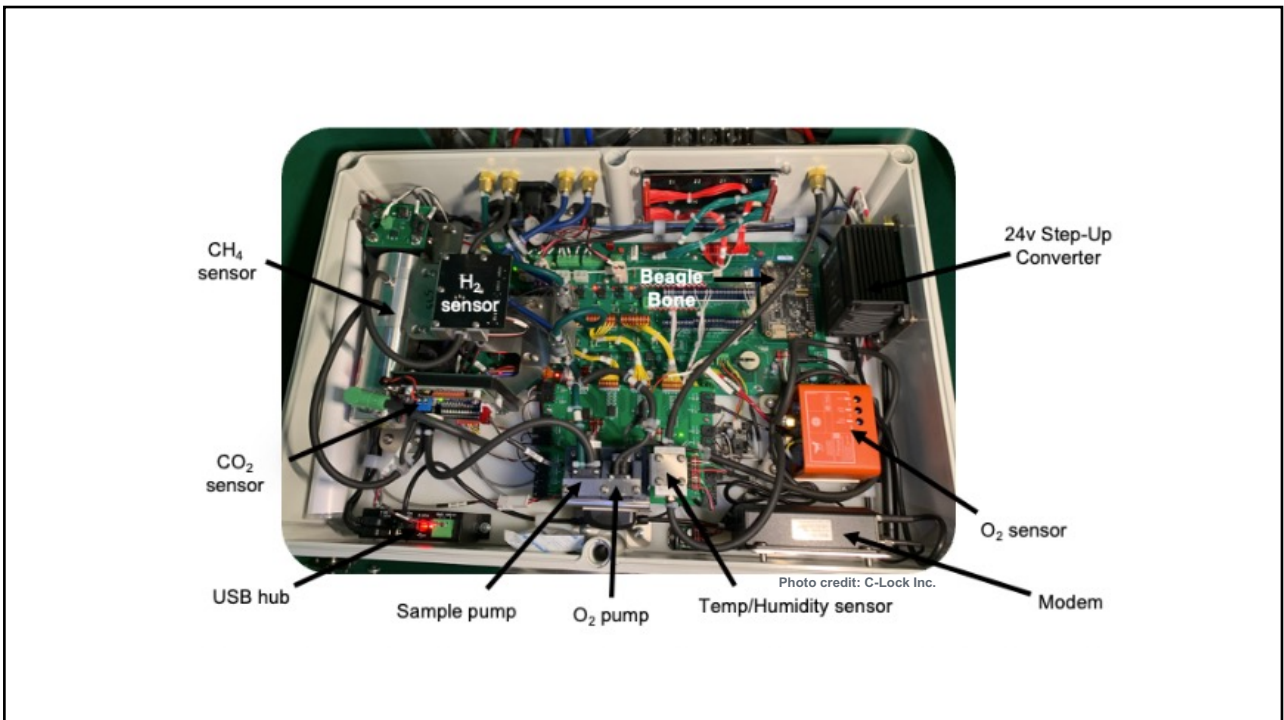


Photo credit: C-Lock Inc.



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**GO TO IT !!!**

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