

Methane from oil & gas: Serious but solvable

Ilissa Ocko, PhD

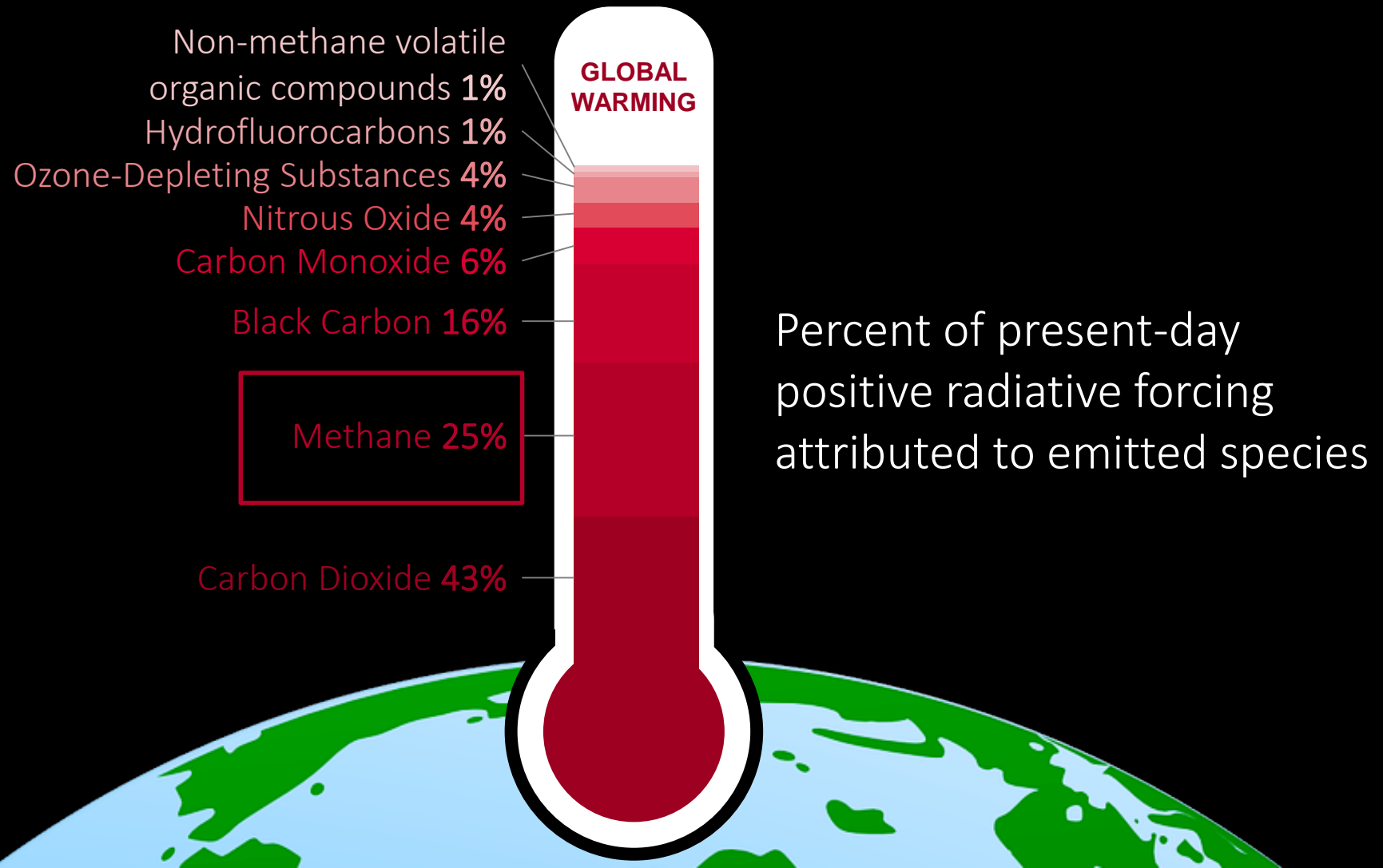
AEC 2018

Sustainable Gas Systems – Public Policies

March 27, 2018

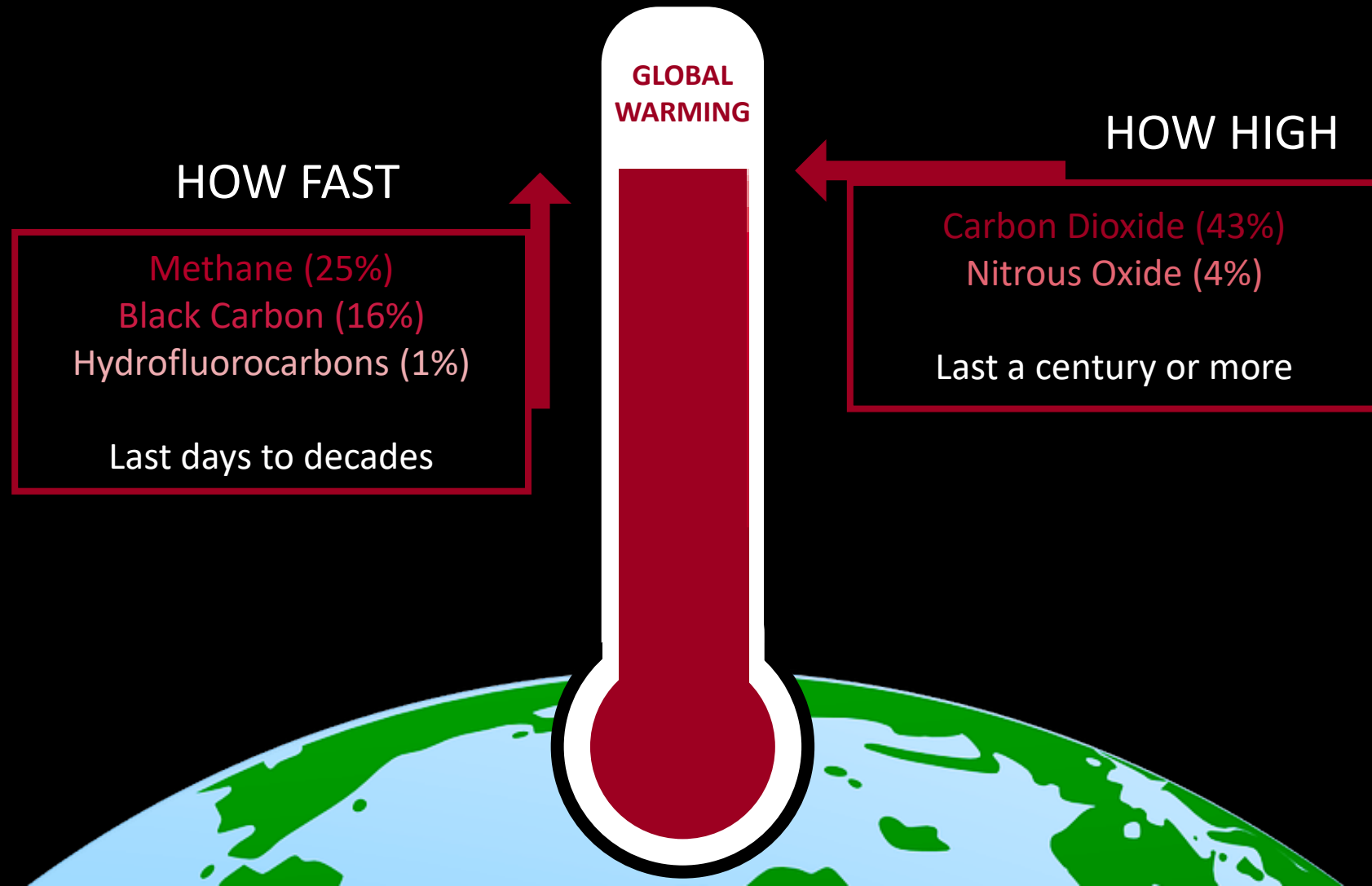


A **quarter** of today's warming is from methane emitted by human activities

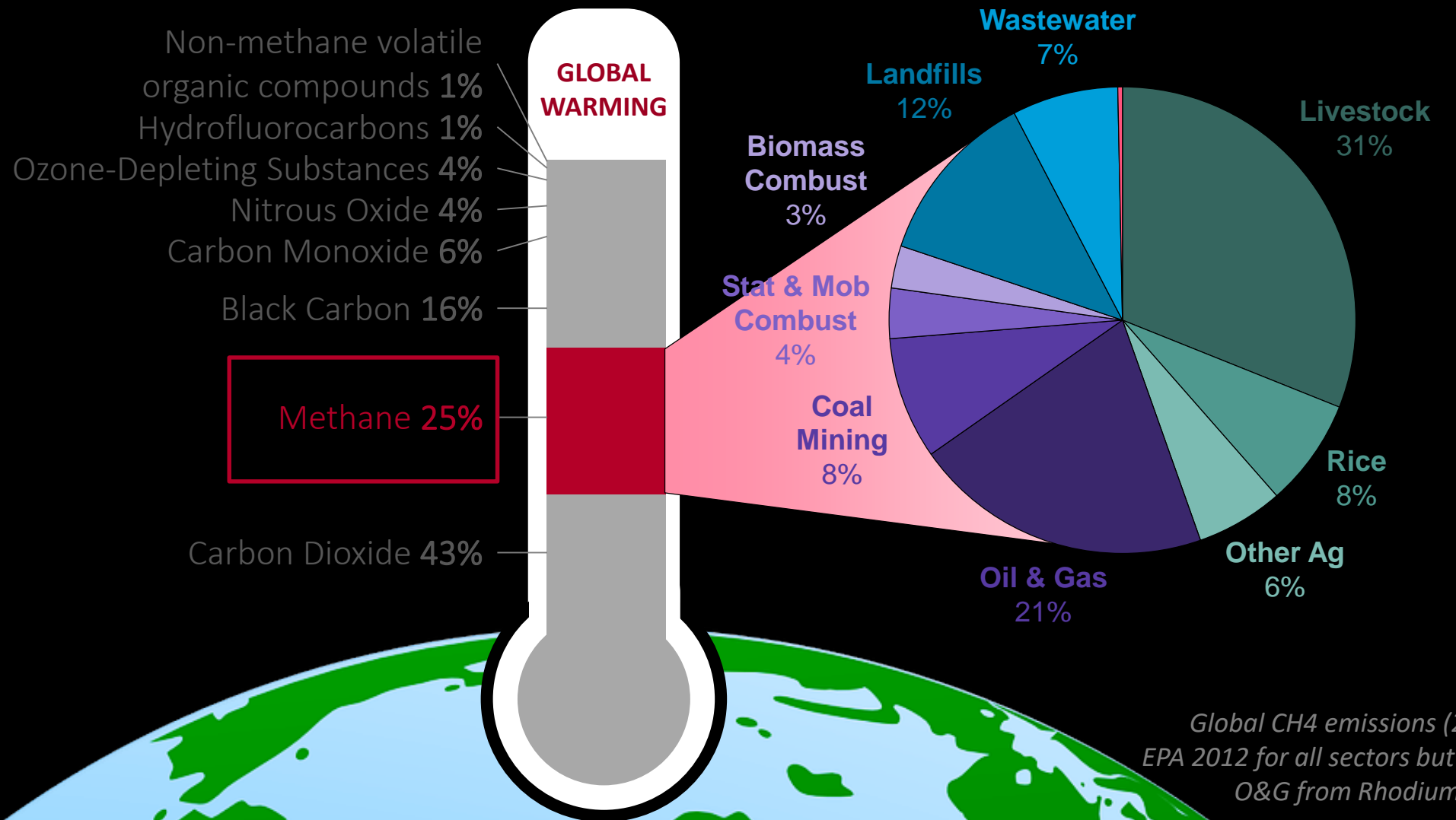


*Radiative forcing proxy
for today's warming,
IPCC AR5 WGI 2013*

Must reduce emissions of **both** short- **and** long-lived climate pollutants



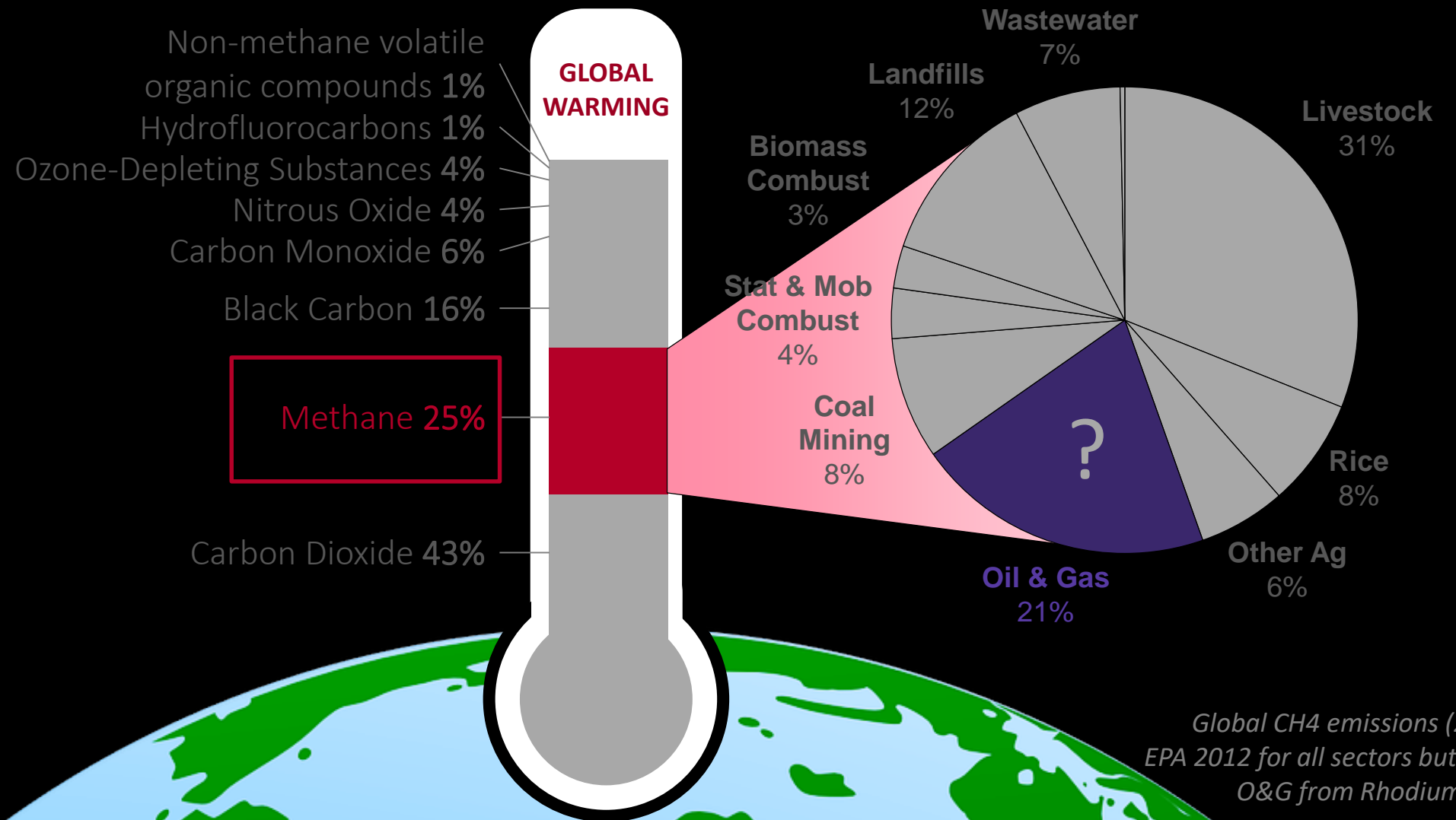
Methane is emitted from farming, fossil fuels, and waste



Radiative forcing proxy for today's warming, IPCC AR5 WGI 2013

Global CH₄ emissions (2010): EPA 2012 for all sectors but O&G, O&G from Rhodium 2015

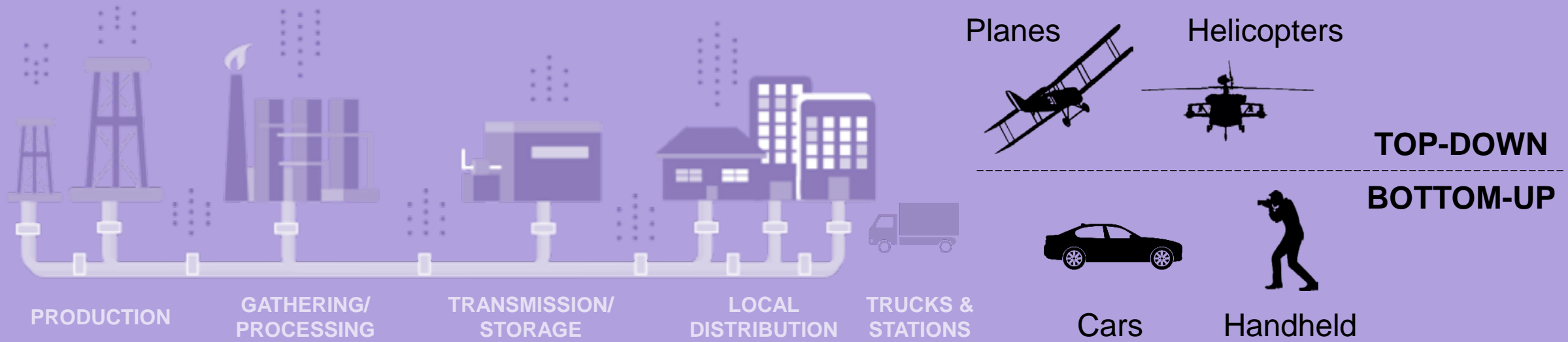
Methane from oil & gas sector was particularly uncertain 5-10 years ago



Radiative forcing proxy
for today's warming,
IPCC AR5 WGI 2013

Global CH4 emissions (2010):
EPA 2012 for all sectors but O&G,
O&G from Rhodium 2015

EDF launched 5-year, \$20 million effort to measure leaks from U.S. O&G supply chain



SCIENCE

Independent experts, led by academics, multiple methods, public data, publish in peer-review

+



COLLABORATION

150 researchers from 40 academic, industry, and research institutions

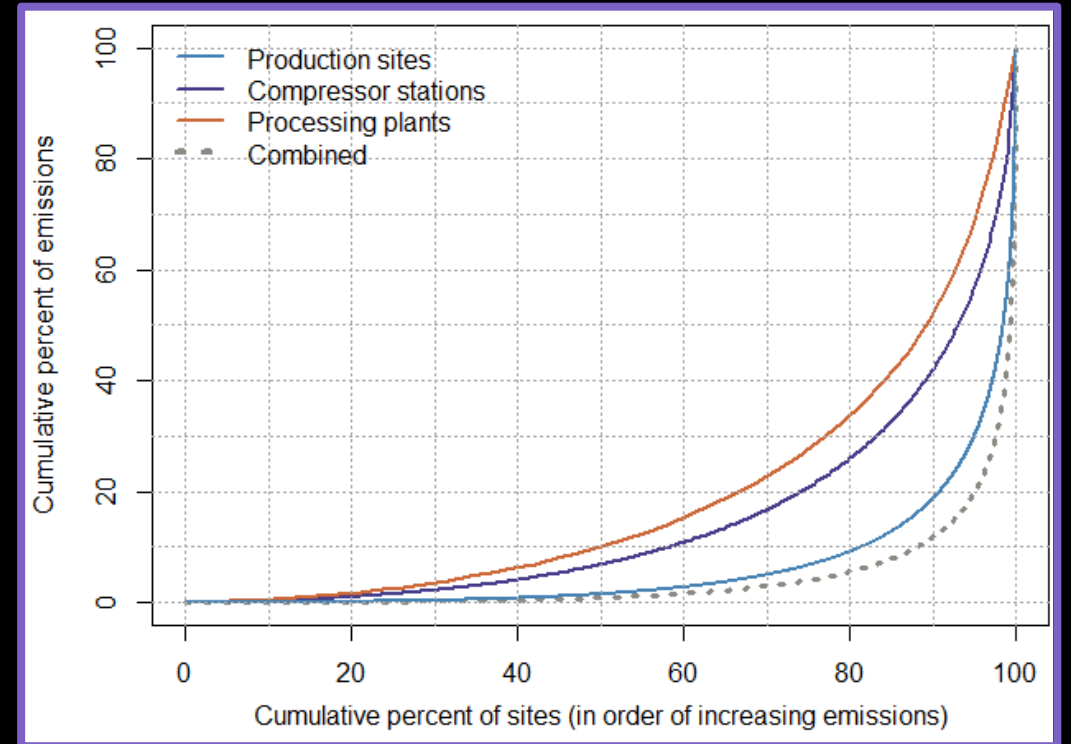
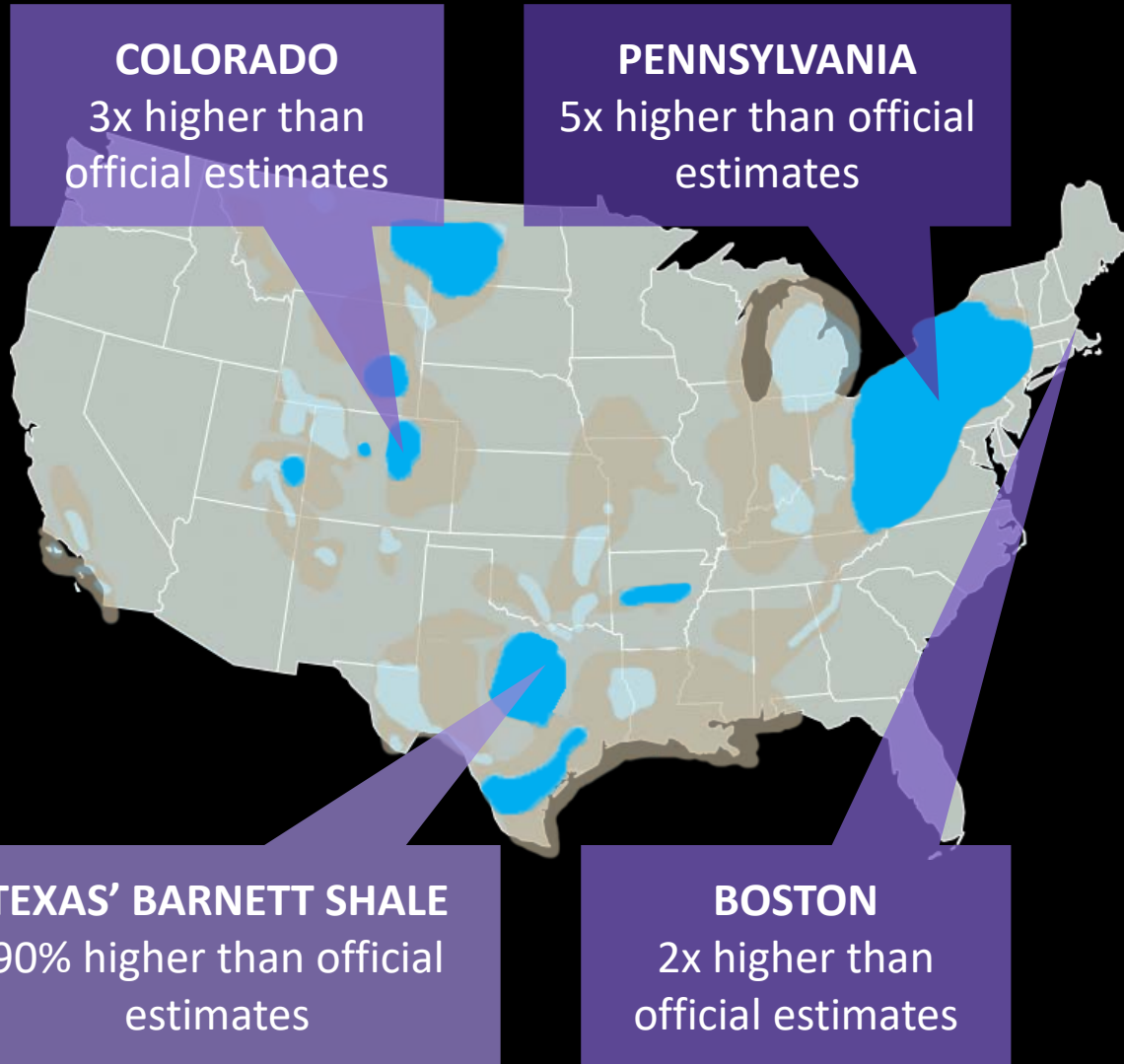
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RESULTS

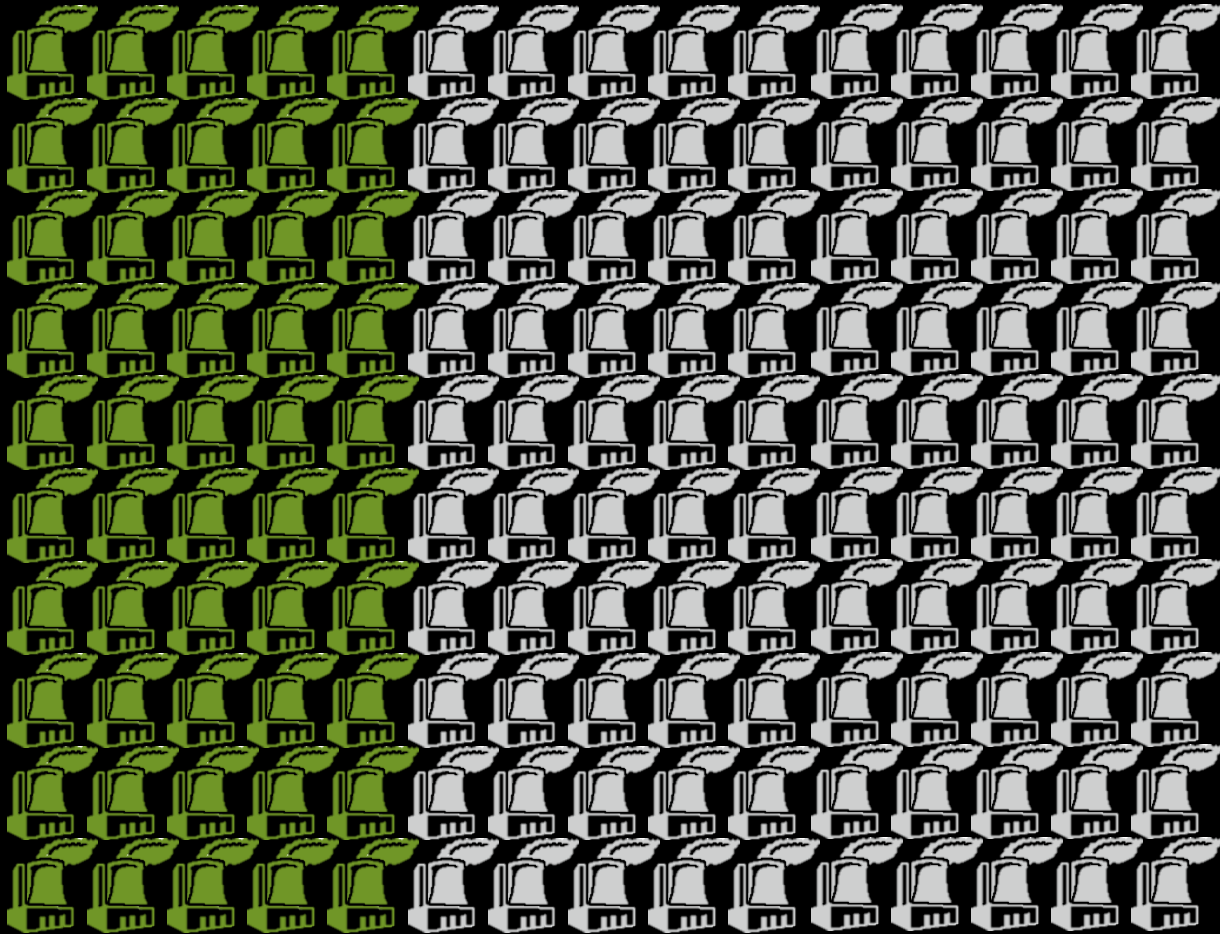
35 published papers in peer-reviewed journals with publicly available data

Measurements revealed **higher** methane emissions than reported, but small % of sites are responsible for majority of emissions



But problem is solvable!

Can reduce leaks by 45% globally at little to no cost, and 75% with available tech



TOP OPERATORS SIGN
TO REDUCE METHANE



O&G methane emissions 45% below 2012 levels:

Same warming benefit over following 20 years
as closing 1/3 of coal-fired power plant fleet!*

*Calculation via WEO 2017,
Rhodium 2015, IPCC AR5 2013



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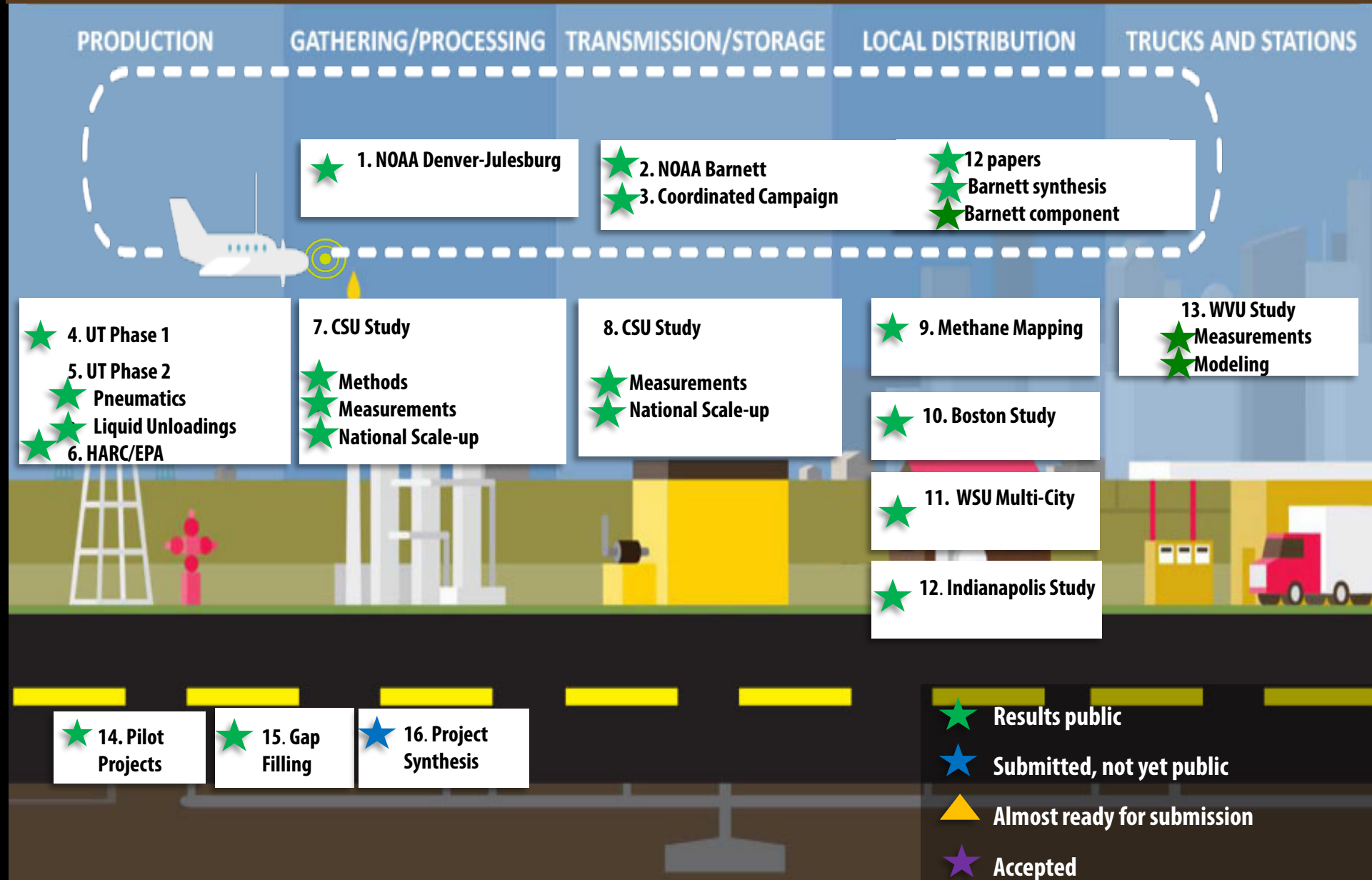
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EXTRA SLIDES

EDF STUDIES BY SUPPLY CHAIN SEGMENT: March 2018



Detecting Methane Leakage

Top-down methods



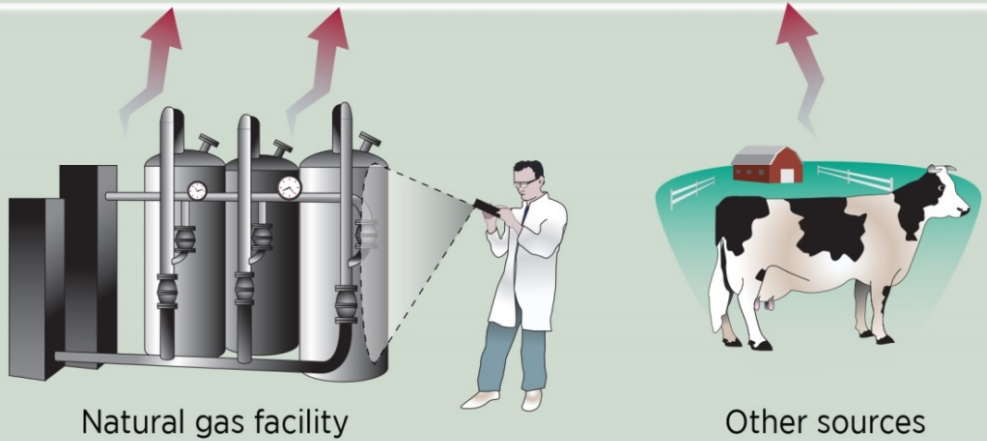
Advantages

- Detects total emissions
- Covers large areas

Challenges

- Attributing emissions to sources
- Accounting for meteorology

Bottom-up methods



Natural gas facility

Other sources

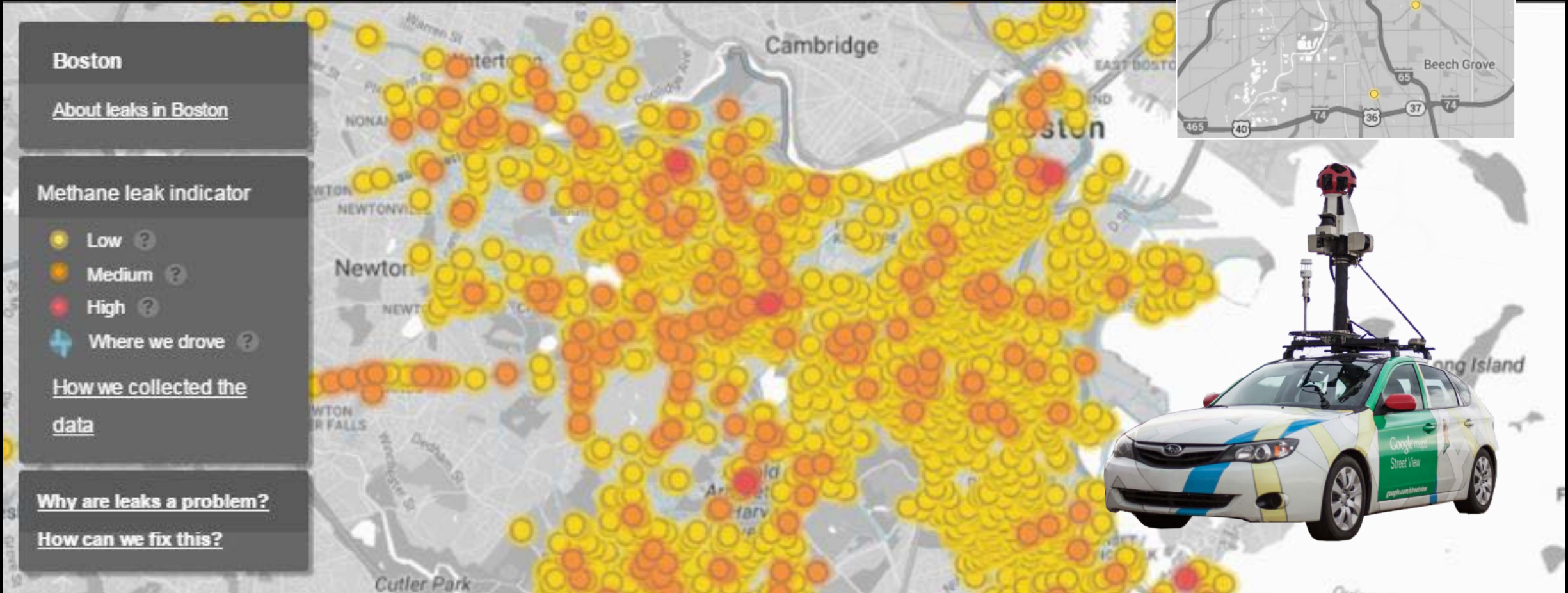
Advantages

- Knowledge of sources
- Precise leakage measurement

Challenges

- Cost of sampling limits sample sizes
- Sampling bias

Google Partnership



Lessons Learned



Drilling & Production

Liquids unloading and pneumatics are significant sources of emissions



Gathering & Processing

Gathering station emissions were 8 times larger than EPA's previous estimates



Transmission & Storage

Companies that participated in emissions reduction programs had 30% fewer emissions than those that didn't



Local Distribution

Older, cast-iron infrastructure has more emissions than newer systems with plastic pipes



Regional Research

In the Barnett Shale, emissions are 90% higher than EPA's previous estimates

Existing technologies to reduce emissions

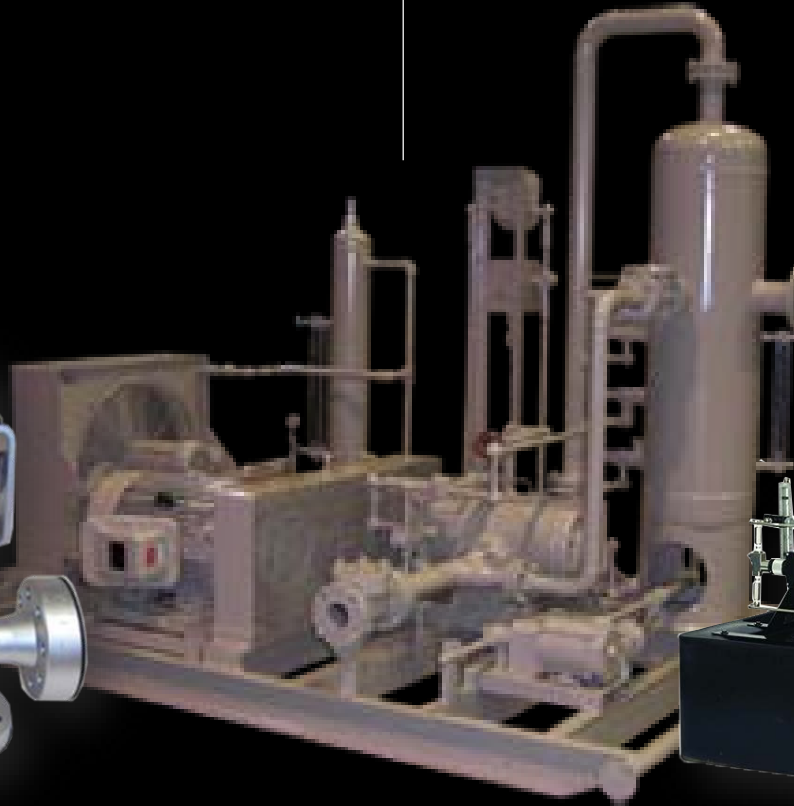
Replacing
Wet Seals
with Dry



Zero-bleed
Pneumatics



Vapor Recovery
Units



Solar Chemical
Injection
Pumps



Leak
Detection
and Repair



Publications

1. Future methane emissions from the heavy-duty natural gas transportation sector for stasis, high, medium, and low scenarios in 2035. <http://www.tandfonline.com/doi/abs/10.1080/10962247.2017.1368737>
2. Spatiotemporal Variability of Methane Emissions at Oil and Natural Gas Operations in the Eagle Ford Basin. <http://pubs.acs.org/doi/abs/10.1021/acs.est.7b00814>
3. Rapid, Vehicle-Based Identification of Location and Magnitude of Urban Natural Gas Pipeline Leaks. <http://pubs.acs.org/doi/abs/10.1021/acs.est.6b06095>
4. Super-emitters in Natural Gas Infrastructure are caused by abnormal process conditions <http://www.nature.com/articles/ncomms14012>
5. Pump-to-Wheels Methane Emissions from the Heavy-Duty Transportation Sector <http://pubs.acs.org/doi/abs/10.1021/acs.est.5b06059>
6. Direct and Indirect Measurements and Modeling of Methane Emissions in Indianapolis, Indiana <http://pubs.acs.org/doi/abs/10.1021/acs.est.6b01198>
7. Aerial Surveys of Elevated Hydrocarbon Emissions from Oil and Gas Production Sites <http://pubs.acs.org/doi/abs/10.1021/acs.est.6b00705>
8. Emissions of coalbed and natural gas methane from abandoned oil and gas wells in the United States <http://onlinelibrary.wiley.com/doi/10.1002/2015GL067623/full>
9. Possible Malfunction in Widely Used Methane Sampler Deserves Attention but Poses Limited Implications for Supply Chain Emission Estimates <https://www.elementscience.org/articles/10.12952/journal.elementa.000137/>
10. Reconciling divergent estimates of oil and gas methane emissions <http://www.pnas.org/content/112/51/15597.abstract>
11. Methane Emissions from United States Natural Gas Gathering and Processing <http://pubs.acs.org/doi/abs/10.1021/acs.est.5b02275>
12. Using Multi-Scale Measurements to Improve Methane Emission Estimates from Oil and Gas Operations in the Barnett Shale Region, Texas <http://pubs.acs.org/doi/abs/10.1021/acs.est.5b02305>
13. Methane Emissions from Leak and Loss Audits of Natural Gas Compressor Stations and Storage Facilities <http://pubs.acs.org/doi/abs/10.1021/es506163m>
14. Integrating Source Apportionment Tracers into a Bottom-up Inventory of Methane Emissions in the Barnett Shale Hydraulic Fracturing Region <http://pubs.acs.org/doi/abs/10.1021/acs.est.5b00057>
15. Airborne Ethane Observations in the Barnett Shale: Quantification of Ethane Flux and Attribution of Methane Emissions <http://pubs.acs.org/doi/abs/10.1021/acs.est.5b00219>
16. Toward a Functional Definition of Methane Super-Emitters: Application to Natural Gas Production Sites <http://pubs.acs.org/doi/abs/10.1021/acs.est.5b00133>
17. Direct Measurements Show Decreasing Methane Emissions from Natural Gas Local Distribution Systems in the United States <http://pubs.acs.org/doi/abs/10.1021/es505116p>
18. Aircraft-Based Estimate of Total Methane Emissions from the Barnett Shale Region <http://pubs.acs.org/doi/abs/10.1021/acs.est.5b00217>
19. Aircraft-Based Measurements of Point Source Methane Emissions in the Barnett Shale Basin <http://pubs.acs.org/doi/abs/10.1021/acs.est.5b00410>
20. Assessment of Methane Emissions from Oil and Gas Production Pads using Mobile Measurements <http://pubs.acs.org/doi/abs/10.1021/acs.est.5b00410>
21. Characterizing Fugitive Methane Emissions in the Barnett Shale Area Using a Mobile Laboratory <http://pubs.acs.org/doi/abs/10.1021/es5063055>
22. Constructing a Spatially Resolved Methane Emission Inventory for the Barnett Shale Region <http://pubs.acs.org/doi/abs/10.1021/es506359c>
23. Near-Field Characterization of Methane Emission Variability from a Compressor Station Using a Model Aircraft <http://pubs.acs.org/doi/abs/10.1021/acs.est.5b00705>
24. Methane Emissions from the Natural Gas Transmission and Storage System in the United States <http://www.atmos-meas-tech.net/8/2017/2015/amt-8-2017-2015.html>
25. Measurements of Methane Emissions from Natural Gas Gathering Facilities and Processing Plants: Measurement Results <http://pubs.acs.org/doi/abs/10.1021/es5052809>
26. Measuring Emissions from Oil and Natural Gas Well Pads Using the Mobile Flux Plane Technique <http://pubs.acs.org/doi/abs/10.1021/acs.est.5b00099>
27. Mobile Laboratory Observations of Methane Emissions in the Barnett Shale Region <http://pubs.acs.org/doi/abs/10.1021/es506352j>
28. Methane Emissions from Natural Gas Compressor Stations in the Transmission and Storage Sector: Measurements and Comparisons with the EPA Greenhouse Gas Reporting Program Protocol <http://pubs.acs.org/doi/abs/10.1021/es5060258>
29. Methane emissions from natural gas infrastructure and use in the urban region of Boston, Massachusetts <http://www.pnas.org/content/112/7/1941.abstract>
30. Methane Emissions from Process Equipment at Natural Gas Production Sites in the United States: Pneumatic Controllers <http://pubs.acs.org/doi/abs/10.1021/es5040156>
31. Methane Emissions from Process Equipment at Natural Gas Production Sites in the United States: Liquid Unloadings <http://pubs.acs.org/doi/abs/10.1021/es504016r>
32. Measurements of methane emissions from natural gas gathering facilities and processing plants: measurement methods <http://www.atmos-meas-tech.net/8/2017/2015/amt-8-2017-2015.html>
33. A new look at methane and nonmethane hydrocarbon emissions from oil and natural gas operations in the Colorado Denver-Julesburg Basin <http://onlinelibrary.wiley.com/doi/10.1002/2013JD021272/pdf>
34. Measurements of methane emissions at natural gas production sites in the United States <http://www.pnas.org/content/110/44/17768>