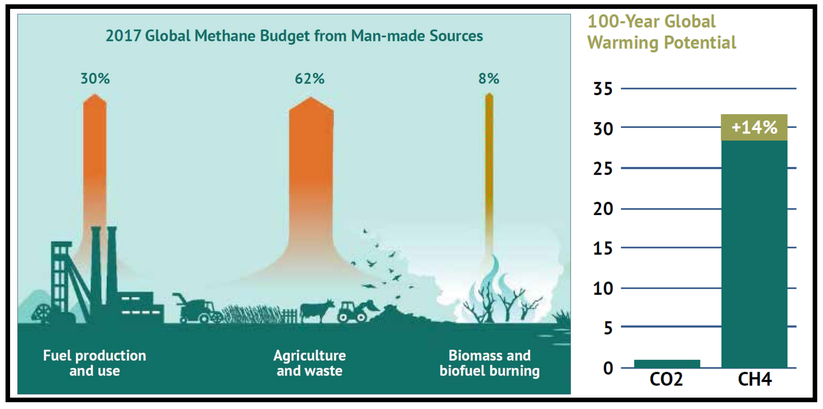
Monitoring Methane Emissions from Oil and Gas Operations

Opportunity for Impactful Action

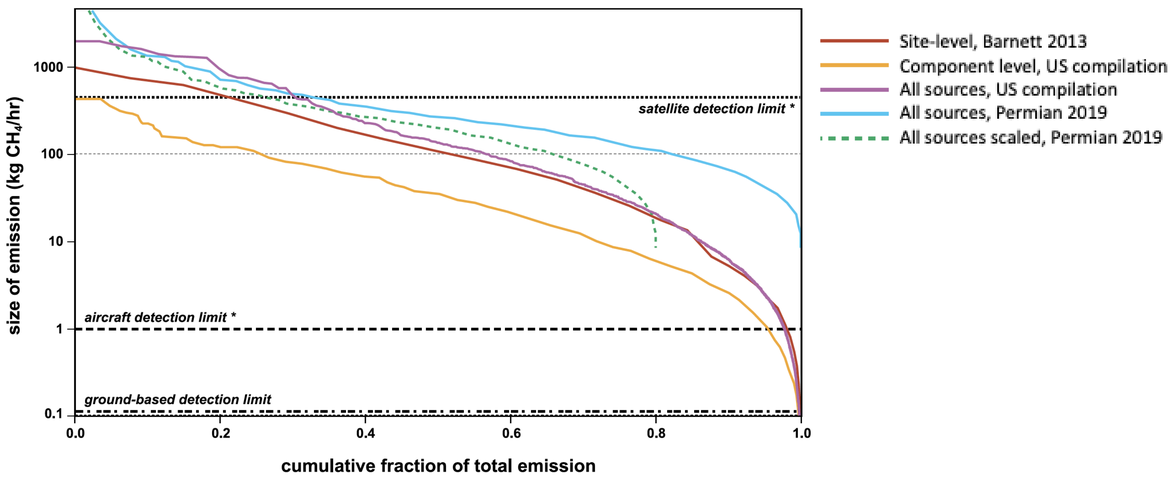
Methane is the second most abundant anthropogenic greenhouse gas with approximately 30% of global emissions coming from the oil and gas sector.



Its **strong global warming potential and relatively short atmospheric lifetime**, compared to carbon dioxide, make it a prime target for emissions reduction efforts to combat climate change.

Sources: (left) The Global Methane Budget 2000-2017, DOI:10.5194/essd-12-1561-2020, (right) M. Etminan et al., Geophysical Research Letters 43 (2016)

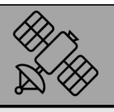
Distribution of Emissions – Size Matters



Magnitude of oilfield methane emissions plotted vs. the cumulative emission, i.e., the fractional contribution of all leaks of a given size or larger.

Methane emissions from oil and gas production are localized, intermittent, and dominated by a relatively small number of super-emitters: Targeting leaks greater than 30 kg/hr for repair would reduce emissions by ~70–90% while keeping the number of leaks at an actionable level for industry

Existing Sensing Capabilities and Needs

Key Attributes			
Autonomous	✓	✗	✓
Continuous	✓	✗	✗
Leak Quantification	Component-Scale	Component-Scale/Pad-Scale	Facility-Scale
Leak Localization	1 – 10 meters	1 – 50 meters	25 meters – 7 kilometers
Cost	$-$$	$$-$$$	$$$$

Key attributes of common sensing modalities (ground-based, airborne, and spaceborne)

Monitoring systems need to rapidly find and quantify large leaks, but source intermittency presents a significant challenge. **Continuous monitoring and low latency are required** which impacts sensor selection and integration at an oil patch.

Physics-Based Research Targets

Three target areas, well suited to the APS/Optica communities, that can address gaps in our current knowledge and practice in emissions monitoring:

- High Quantum Efficiency Photodetectors to Support Methane Lidar
- Measurement of Carbon Isotopes and Remote Sensing of Ethane for Source Attribution
- Improved High-Resolution Spectroscopic Databases to Support Methane Sensing

A Unified Approach is Needed for Effective Emissions Reduction

Policy recommendations to address challenges related to methane emissions detection, data and models, and regulation include developing:

- Strategies to achieve 24/7 continuous monitoring of methane
- Facilities for testing and intercalibration of methane measurements
- A repository of unified methane observations open to the international climate community
- Regulation structure for a high-impact and cost-effective approach to reducing methane emissions from oil and gas operations