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Recommendations for OMB

Presented by Kairos Aerospace

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Agenda - Discussion of leak detection matrix for advanced technology

1. Prevalence of 30 kg/hr emissions outside the Permian Basin
2. How sensitivity standards are impacted by wind speeds
3. GHG impact of >30 kg/hr leaks

A 30 kg/hr Standard is Protective and Equivalent

- EPA correctly relied on peer-reviewed science that included the Permian Basin to develop its matrix
- The Permian Basin produces nearly 50% of US oil production, so it is appropriate for this analysis
- The modeling used by EPA is representative of emissions outside the Permian as well

Kairos >30 kg/hr emission detections, Permian and non-Permian regions		
Basin	Number of >30 kg/hr detections	Frequency of 30 kg/hr detection per 100 sites
Haynesville	207	1.4
Eagle Ford	83	1.2
Permian	4405	1.1
Anadarko	782	0.9
San Juan	241	0.7
Barnett	151	0.6

Kairos coverage trends towards the Permian Region, but **emission rates remain consistent when normalized for coverage**

How does sensitivity change under different wind conditions?

90% probability of detection at a given windspeed	Frequency winds are at or below the given windspeed*
30 kg/hr at 20 mph (maximum safe operating conditions)	Avg winds 100% of the time
23 kg/hr at 15 mph	Avg winds >95% of the time
15 kg/hr at 10 mph	Avg winds 57% of the time
7.6 kg/hr at 5 mph	Avg winds 11% of the time
1.5 kg/hr at 1 mph	Avg winds <1% of the time

A 30 kg/hr standard for all wind conditions will have a 90% probability of detection at 15 kg/hr under more than half of typical wind conditions

**Windspeed values calculated for Permian Basin*

A 30 kg/hr Standard Will Yield Significant Emission Reductions

Stanford University analyzed basin-wide aerial measurements between 2016 and 2021¹

Over 50% of the total emissions volume for each basin was made up of leaks greater than 30 kg/hr

In some cases over 80% of the basin's total emissions volumes was made up of leaks greater than 30 kg/hr

Percent of Total Emissions Volume from Large Emissions by Basin (2016-2021)

Basin	Number of Surveys	Percent of Total Volume from Sources >30 kg/hr	Percent of Total Volume from Sources >50 kg/hr
Delaware	1	85%	81%
Barnett	1	83%	81%
Appalachian	1	80%	77%
Permian	7	77%	73%
San Joaquin	5	56%	54%

¹ Sherwin et al. ["Quantifying oil and natural gas system emissions using one million aerial site measurements"](#). 2023. Accepted, pending publication in *Nature*.

EPA Correctly Focused on Frequency of Surveys

- Sensitivity is an important lever in leak mitigation
- Survey frequency is a more important metric

Impact of constraining duration on a 30 kg/hr emission		
Leak detection program	Mean leak duration	Cumulative methane emissions
None	180 days	129.6 tonnes
4x/year	45 days	32.4 tonnes
6x/year	30 days	21.6 tonnes
12x/year	15 days	10.8 tonnes

A persistent 30 kg/hr leak captured in a quarterly survey will emit 3x the greenhouse gases than one captured in a monthly survey.

Summary

- 30 kg/hr emissions are widespread - both inside and outside of the Permian Basin
- A 30 kg/hr standard as currently written will generally yield higher sensitivities (e.g. 15 kg/hr) under typical conditions due to the impact of wind on sensitivity
- 30 kg/hr leaks represent a significant amount of GHG reduction potential, particularly when paired with a high frequency survey program

Questions?