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EPA OOOOb/c Alternative Monitoring Recommendations

Presented by

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Kairos EPA rule analysis

EPA's goal is cost-effective methane emission reductions, but:

- EPA overestimates the effectiveness of OGI
- EPA underestimates ability of alternative tech to find super-emitters

Good at Finding SMALL Leaks

Good at Finding LARGE Leaks

Implications:

1. The **net cost** to industry is higher than necessary to achieve target goals.
2. Finding more small leaks and less large leaks has important **emissions** and **safety implications**.

EPA should use modeling to establish equivalence

- Modeling provides a method to simulate many real-world conditions that impact LDAR programs

- Modeling captures technology performance AND work practice design

- Modeling provides transparent, repeatable tool to evaluate disparate technologies and establish costs/benefits

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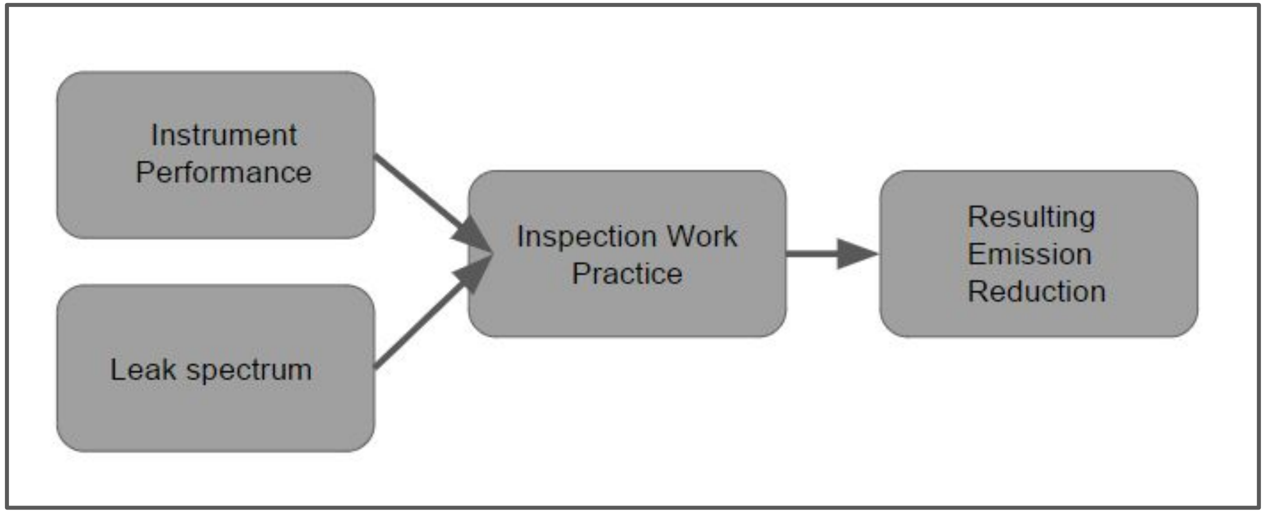
How LDAR-Sim works

1. LDAR Sim is our best method of predicting what will happen in the real world.

2. Requires accurate inputs:
    - Representative distribution of leak size and frequency
    - Accurate description of technology performance
    - Description of work practice effectiveness



But LDAR-Sim won't represent the real world if the underlying model isn't accurate.

Establishing leak spectrum

STUDY NAME	SITES MEASUREMENTS	LARGEST EMISSION
FORT WORTH AIR QUALITY STUDY	388	20 kgh
OMARA 2018	1,009*	287 kgh
KAIROS PERMIAN 2019 (Chen et al., in revision)	117,658	4,344 kgh
DUREN 2019	198,000	675 kgh
CUSWORTH 2021	72,000	4,689 kgh

**Sites with detections. Total sites surveyed unreported.*

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Must have:

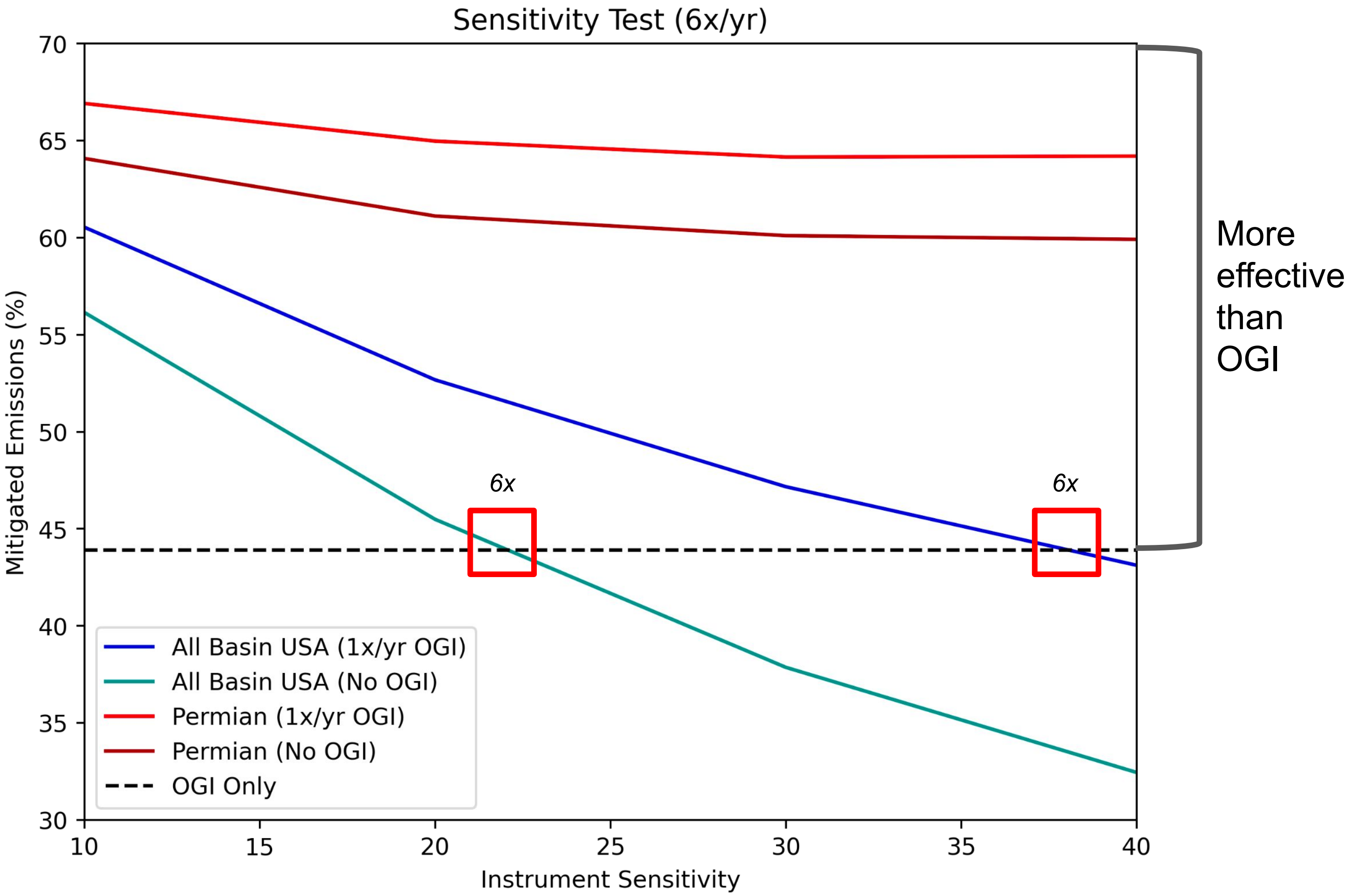
- Large sample size to capture super emitters
- Representative sites
- Capture full range of emission sizes (big and small)

Should have:

- Include diverse screening approaches (can see what OGI cannot)
- Survey all area infrastructure (midstream/pipelines are important)

LDAR-Sim modeling results - six surveys per year

- Models establish equivalence to OGI at different sensitivities and inspection frequencies
- Different leak distributions have different curves based on how many large leaks are generated
- The point where lines intersect with the dashed OGI line represent equivalence (red boxes)
- Points above the dashed line are more than equivalent with OGI



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LDAR-Sim modeling results - five surveys per year

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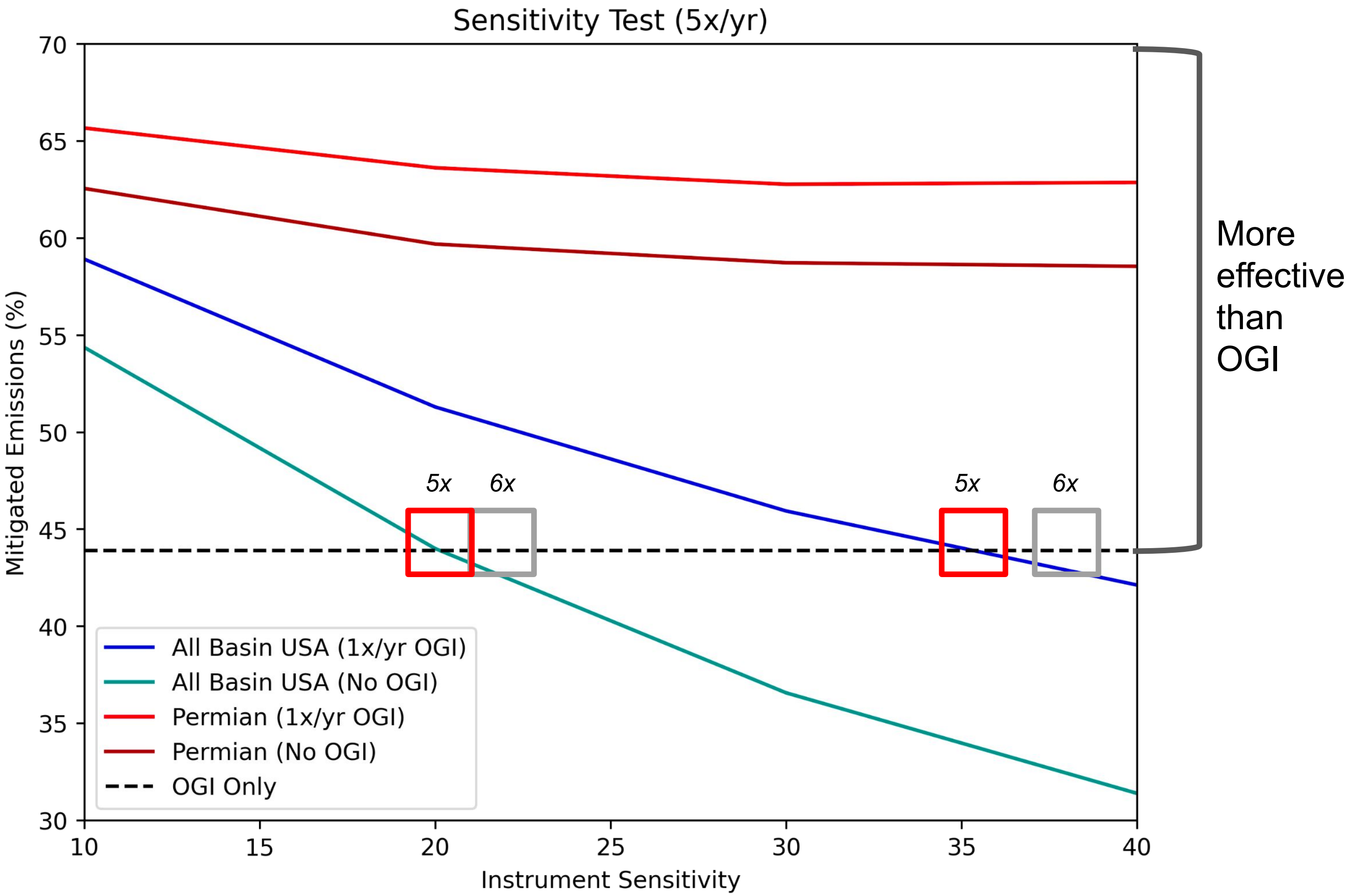

LDAR-Sim modeling results - four surveys per year

- Models establish equivalence to OGI at different sensitivities and inspection frequencies
- Different leak distributions have different curves based on how many large leaks are generated
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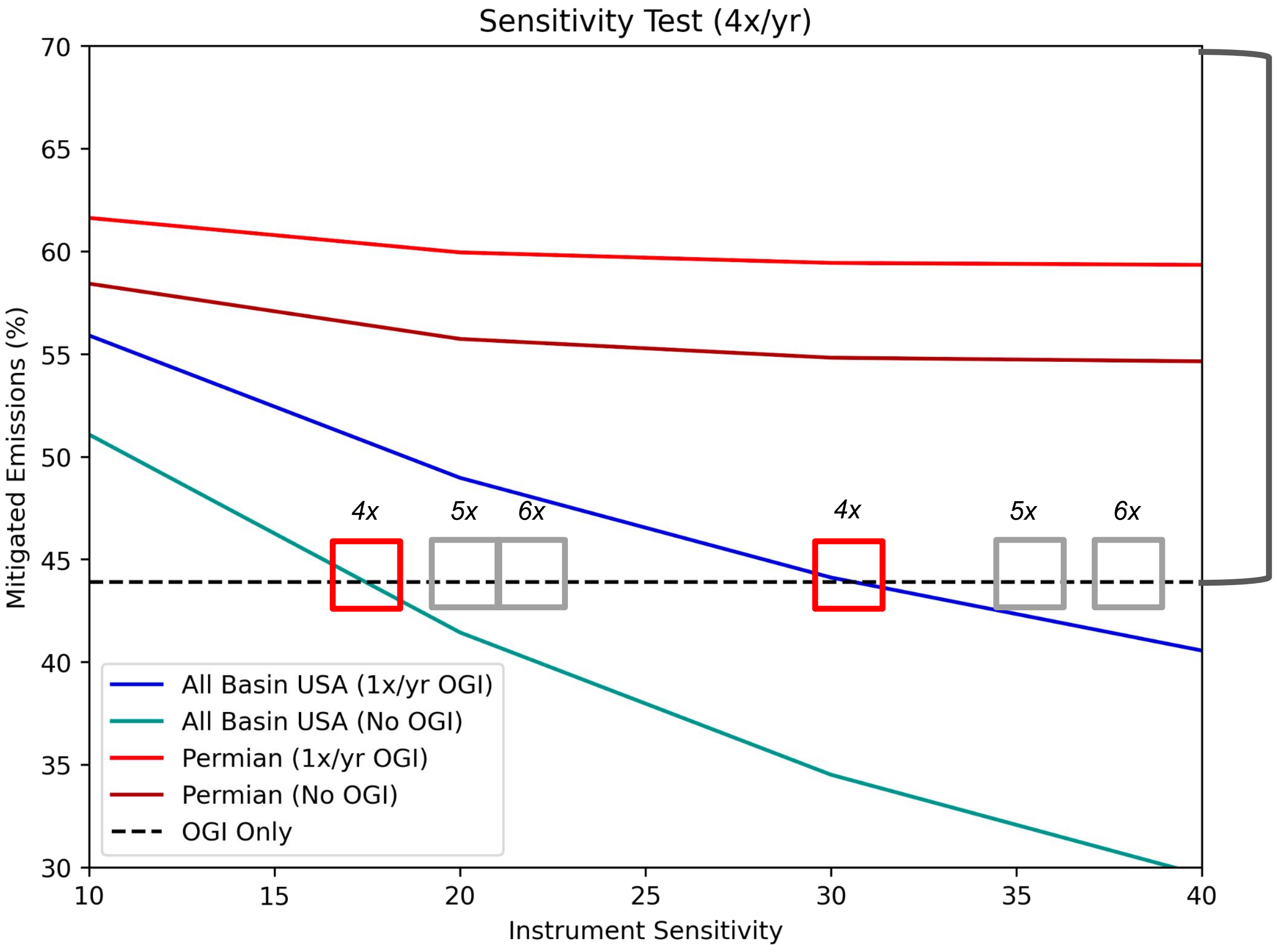

More effective than OGI

Kairos proposed LDAR matrix

Survey Strategy	Required Sensitivity to have same methane reduction as 4 OGI
4x aerial + 1 OGI	**30 kg/hr**
5x aerial + 1 OGI	**35 kg/hr**
6x aerial + 1 OGI	**40 kg/hr**

With annual OGI

Survey Strategy	Required Sensitivity to have same methane reduction as 4 OGI
4x aerial + 0 OGI	**15 kg/hr**
5x aerial + 0 OGI	**20 kg/hr**
6x aerial + 0 OGI	**25 kg/hr**

Without annual OGI

Kairos recommendations to EPA

- EPA's proposed 10 kg/hr detection limit at 6x/year with an annual OGI screening is far more stringent than quarterly OGI
- EPA is on the right track with seeking comment on the sensitivity vs. frequency matrix concept. It is part of a streamlined process for achieving EPA's goals of methane reductions.
- EPA must set appropriate standards for new technologies or it will create additional costs for industry
- Modeling based on real-world data is a highly effective tool to evaluate equivalence of different LDAR programs

Thank You

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