From:	Ryan Streams
To:	WasteRule, EMNRD, EMNRD
Subject:	[EXT] Kairos Aerospace Comments on EMNRD Draft Methane Rule
Date:	Wednesday, September 16, 2020 12:35:25 PM
Attachments:	Kairos Aerospace EMNRD Venting and Flaring Rule Comments 200916 signed.pdf

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Hello,

Please find attached comments on behalf of Kairos Aerospace. If you have any questions or concerns, please feel free to contact me.

Sincerely,
Ryan Streams

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Ryan Streams
Business Development Manager
Kairos Aerospace

Denver, CO
Direct: (435) 503-5392
ryan@kairosaerospace.com

September 16, 2020

New Mexico Energy, Minerals, and Natural Resources Department
Attn: Tiffany Polak
1190 St. Francis Dr.
Santa Fe, NM 87505

RE: 19.15.27 Rulemaking for Venting and Flaring of Natural Gas and; 19.15.28 Rulemaking for Natural Gas Gathering Systems

Dear Ms. Polak:

Kairos Aerospace appreciates the opportunity to comment on the draft rules for the venting and flaring of natural gas and operation of gas gathering systems by the New Mexico Energy Minerals and Natural Resources Department ("EMNRD"). As an alternative methane monitoring technology vendor, Kairos Aerospace is on the front lines of innovation. Since 2013, Kairos Aerospace has provided a range of aerial solutions to oil and gas industry clients and stakeholders to better understand emissions and operational efficiency. Using the latest aircraft-based methane spectrometry, thermal infrared, and optical imaging technologies, Kairos' proprietary data service identifies actionable opportunities for our customers to reduce emissions and improve field performance. Kairos currently operates full-time aerial surveys in Hobbs, New Mexico and Midland, Texas. To date, Kairos helped oil and gas operators reduce more than 7 billion cubic feet of methane emissions from oil and gas infrastructure in the United States and Canada.

Executive Summary

Kairos has been actively engaged in the State of New Mexico's deliberative process to regulate methane emission from the oil and gas sector. In our comments to the Methane Advisory Panel, submitted February 20, 2020, we identified the opportunities for cost-effective methane reductions that exist in southeast New Mexico based on peer-reviewed science and Kairos' measurements of tens of thousands of oil and gas facilities. Those comments are attached to this letter as Appendix A.

In our careful review of the proposed rules by EMNRD, we believe the approach taken which emphasizes proactive screening for emissions is an appropriate one. We appreciate EMNRD's efforts to establish standards that are both transparent and measurable, while maintaining flexibility for new technologies like what Kairos Aerospace can offer. We do have several suggestions which we believe will further strengthen the proposed rule and make it more flexible for industry to implement. First, we believe EMNRD should increase the incentives for industry to leverage ALARM technology. Second, we recommend EMNRD alter the timeframes associated with gathering and responding to ALARM data. Finally, we request clarification around the applicability of the gas gathering requirements.

ALARM Technology

We are encouraged by EMNRD's decision to allow for advanced leak monitoring technology to be used as a compliance tool with its proposed rule. As an alternative leak monitoring technology provider with several years of experience operating in the Permian Basin, we have gathered extensive data that clearly demonstrates the emission reduction potential from advanced technologies like ours.

By allowing advanced technology to be used in compliance with the EMNRD rule, the State will ensure meaningful emission reductions at a substantially lower compliance cost to industry than traditional ground-based technologies like optical gas imaging (OGI) can provide. Emission screening tools, like aerial monitoring technology, are able to scan large areas and rapidly identify large sources of emissions for prioritized repair. The scientific evidence and Kairos' own data strongly points to these largest sources of methane contributing the majority of methane emissions in the Permian Basin, so a strategy that prioritizes rapid identification of "super-emitters" will reduce emissions quickly and at a lower cost. For a full discussion of super emitters and Kairos' findings on methane emissions in the Permian Basin, please refer to Appendix A.

We believe, however, that the ALARM incentives provided should be strengthened in two ways. First, ALARM monitoring should provide operators with more than a 30% reduction in venting volume reporting. In order to claim credit for a 30% reduction in volume, operators must conduct twice annual screenings. However, Kairos data in the Permian indicates that with a single aerial survey, operators are reducing emissions by 40% or more. Therefore, the likely benefits of twice annual ALARM monitoring will be well in excess of a 30% reduction in venting volume. If the state offers greater incentives to operators, it will further encourage the use of efficient emission reduction technology.

Similarly, the additional 10% reduction gained from conducting quarterly ALARM surveys is too low. The emission reduction potential of four surveys per year is far greater, and we recommend EMNRD align its incentives with the significant emission benefits it stands to realize. We recommend a 40% reduction for semi-annual ALARM surveys and a 60% reduction for quarterly ALARM surveys. In reality, rapid identification of leaks on a quarterly basis will almost certainly eliminate substantially more than 60% of venting volumes. For further discussion of how more frequent aerial monitoring translates into emission reductions, please refer to Appendix B.

We also suggest modifying the requirements for operators to respond to an ALARM detection, given that oftentimes ALARM systems will be operated by third parties and that the process of moving from an aerial pass to ground follow-up can require several steps. Given the nature of leak screening surveys, it is generally not possible to pinpoint component-level leaks from aircraft; the focus is rather to get ground crews to visit the sites with suspected large emissions as soon as possible for verification and follow-up. Since emissions are sometimes intermittent, a detection by aircraft cannot and should not constitute ground truth verification of a leak. That can only be done at the ground level where it is possible to identify specific component failures and evaluate emissions as permitted process vents versus unplanned fugitive leaks.

With that in mind, we recommend that EMNRD define "initial discovery" as the ground verification of a reported ALARM detection. We also recommend that in order to allow crews sufficient time to react to ALARM data, ground crews be given one week from the date of a reported ALARM detection to conduct their initial evaluation. From that point, the 15 day repair clock can rightfully begin. This schedule will balance the State's desire to have rapid responses to suspected fugitive emissions with the reality of workflows in the field, which often involve personnel from multiple companies closely coordinating to respond to leak reports.

Finally, we wish to clarify several aspects of the ALARM monitoring program. First, we request that EMNRD clarify that the requirements for ALARM and "gathering system" inspections apply to both the network of pipelines and the associated surface facilities like compressor stations, booster facilities, gas processing facilities, etc.

Second, we request EMNRD provide clarification on the credit system. We understand that a credit can only be used once in a 13-month period. What is unclear is if this credit for an identified leak is for that specific facility, or for an operator. For example, if an operator detected one leak of 100 MCF/day, would the operator be allowed to claim credit for that leak once for that facility, or would that be the only leak for which it could claim credit? And how long would one assume a leak to be emitting in order to calculate a volume estimate?

Third, how would this requirement be applied to gathering lines? Since these may not have unique facility identifiers and are almost certainly connected to other pipelines, or may span many miles, it is unclear how midstream operators can claim credit for leaks identified using ALARM.

Finally, how would an operator claim credit for a leak reported to someone else? Would it be based on the volume reported to the third party or would it be through another mechanism?

Conclusion

We appreciate the opportunity to provide feedback to EMNRD on the draft rule. We agree with EMNRD's decision to include ALARM technologies as an efficient pathway to monitor and verify for fugitive emissions from the state's oil and gas infrastructure. We believe the targeted changes we identified in our comments will increase the utility of the ALARM provisions to operators while still providing the State with the robust methane reduction mechanisms it is seeking to implement.

At Kairos Aerospace, we are excited to use our innovative methane monitoring technology to work with industry and the Agencies to reduce methane emissions faster and at a lower cost than traditional monitoring technologies. We've identified and mitigated billions of cubic feet of emitted natural gas through aerial monitoring. We've also eliminated thousands of hours of vehicle trips and improved safety in the field for operations personnel. This has all been done on a voluntary basis and we believe that with industry able to use aerial monitoring as a regulatory compliance tool, the benefits will be even greater.

We look forward to being able to use our technology nationwide to help the oil and gas industry quickly and safely reduce methane emissions.

Sincerely,

Steve Deiker

Steve Deiker
CEO

Appendix A
Kairos Aerospace Comments to the Methane Advisory Panel

February 20, 2020

New Mexico Environment Department
New Mexico Energy, Minerals, and Natural Resources Department
Attn: Sandra Ely
1190 St. Francis Dr.
Santa Fe, NM 87505

RE: New Mexico Methane Advisory Panel draft technical report

Dear Director Ely:

Kairos Aerospace appreciates the opportunity to comment on the draft Methane Advisory Panel technical report ("the Report") produced by the stakeholder group convened by the New Mexico Environment Department and the New Mexico Energy Minerals and Natural Resources Department ("the Agencies"). As an alternative methane monitoring technology vendor, Kairos Aerospace is on the front lines of innovation. Since 2013, Kairos Aerospace has provided a range of aerial solutions to oil and gas industry clients and stakeholders to better understand emissions and operational efficiency. Using the latest aircraft-based methane spectrometry, thermal infrared, and optical imaging technologies, Kairos' proprietary data service identifies actionable opportunities for our customers to reduce emissions and improve field performance. To date, Kairos helped oil and gas operators reduce more than 4 billion cubic feet of methane emissions from oil and gas infrastructure in the United States and Canada.

Executive Summary

As MAP panelists detail in the Report, traditional ground-based leak detection and repair (LDAR) techniques can impose significant costs on oil and gas facility operators. However, panelists also correctly identify that fugitive emissions from oil and gas facilities can be significant and are worthy targets of emission reduction efforts. It's clear that what's needed is a low-cost leak detection technique that can reduce emissions without imposing significant additional operating costs.

Kairos' airborne monitoring system achieves greater emission reductions than optical gas imaging (OGI) by finding large leaks earlier and at a fraction of the cost. With a single aircraft, Kairos surveys up to 2,000 oil and gas facilities per day, compared to approximately 4-6 per day for a ground-based OGI operator. However, without sufficiently flexible regulations that foster the use of new technologies, many oil and gas companies will default to OGI and forego the environmental benefits of airborne monitoring.

We encourage the Agencies to adopt flexible regulations that address methane emissions and provide ample pathways for alternative technologies that can demonstrate effectiveness as emission reduction techniques. The Agencies must recognize the importance of super-emitters and the ability of new monitoring methods to find them. A small number of large leaks cause the majority of fugitive

emissions. This is often called a “fat-tail” or “super emitter” leak distribution. Finding and repairing a single super emitter accomplishes more, in terms of emission reductions and cost savings, than repairing a host of small leaks. While OGI and Method 21 are limited in their ability to find super-emitters due to their relatively long inspection times, the technologies being developed today find large releases quickly by inspecting multiple facilities across large geographic areas, more frequently, and at lower cost.

Rather than focusing on detection equivalence with traditional OGI and Method 21 technologies, we urge the agencies to evaluate methane mitigation strategies based on mitigation equivalence. Detection equivalence at an individual site is an outdated metric that sheds little light on whether new monitoring technologies achieve emission reductions that are equivalent to OGI. The Agencies should instead evaluate whether the overall emission reductions achieved across many facilities are equivalent to those of OGI.

Fugitive Emissions Are Significant and Worthy of Regulatory Oversight

The Report correctly identifies that fugitive emissions can contribute significant methane emissions, particularly from sites commonly referred to as super emitters. Based on Kairos’ extensive experience in surveying approximately 30,000 oil and gas production facilities in southeast New Mexico, our data support the conclusion that a small number of facilities represent the majority of total methane emissions.

In the course of surveying southeast New Mexico for methane emissions, Kairos identified 1,056 emission sources out of the 30,000+ active wells and 10,000+ miles of gathering lines in the region. The median emission size Kairos identified was 88 MCF per day, with a 90th percentile rate of 441 MCF per day. In other words, Kairos found approximately 100 sources of emissions across the entire that were emitting more than 441 MCF per day, which indicates a relative handful of sites are strongly skewing the total emissions for the basin.

Our survey results reflect the broader consensus in the scientific community, which is referenced in the Report: a small number of sites are responsible for significant emissions and those sites appear to have an element of randomness to them.

That points to two important conclusions. First, there are sites in New Mexico today that are contributing significant methane emissions. Second, those sites are relatively uncommon but identifying them quickly can lead to very rapid emission reductions. In other words, it would take many, many equipment retrofits to achieve the same level of emission reductions that would be achieved by strategically identifying and eliminating all 100 sources that are emitting greater than 441 MCF per day.

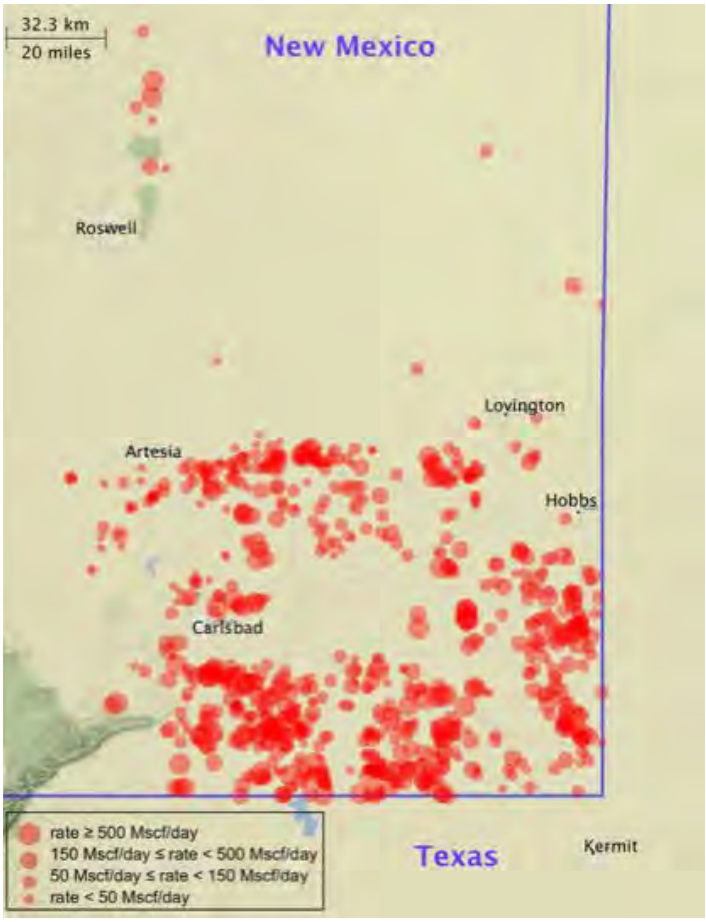

Fig. 1: Kairos 2019 survey results from the New Mexico Permian Basin

The Report also references several scientific studies that point to the outsized impact super-emitters play in total emissions.[1] Kairos has conducted similar comparisons to expected emissions based on

[1] Papers cited include: Rella, Chris W., et al, (2015), "Measuring Emissions from Oil and Natural Gas Well Pads Using the Mobile Flux Plane Technique," Environ. Sci. Technol., 2015, 49 (7), available at http://pubs.acs.org/doi/abs/10.1021/acs.est.5b00099, See, e.g., Allen, D.T., et al., "Measurements of methane emissions at natural gas production sites in the United States," Proc. Natl. Acad., 110 (44) pp. 17768–17773 ("Allen (2013)"), available at http://www.pnas.org/content/110/44/17768.full; ERG and Sage Environmental Consulting, LP, "City of Fort Worth Natural Gas Air Quality Study, Final Report" ("Fort Worth Study") (July 13, 2011), available at http://fortworthtexas.gov/gaswells/default.aspx?id=87074 (finding that the highest 20 percent of emitting sites account for 60–80 percent of total emissions from all sites; the lowest 50 percent of sites account for only 3–10 percent of total emissions); Zavala-Araiza, et al., (2015) "Toward a Functional Definition of Methane Super-Emitters: Application to Natural Gas Production Sites," Environ. Sci. Technol., 49, at 8167−8174 ("Zavala-Araiza (2015)"), available at http://pubs.acs.org/doi/pdfplus/10.1021/acs.est.5b00133 (finding that "functional super-emitter" sites represented approximately 15% of sites within each of several different "cohorts" based on production, but accounted for approximately 58 to 80% of emissions within each production cohort); Zavala-Araiza et al., (2015) "Reconciling divergent estimates of oil and gas methane emissions," Proceedings of the National Academy of Sciences, vol. 112, no. 51, 15597 at 15600 (finding that "at any one time, 2% of facilities in the Barnett region are responsible for 90% of emissions, and 10% are responsible for 90% of emissions.") ("Barnett Synthesis")

component-level emission measurements, and found that isolated large sources of emissions are likely responsible for the majority of methane being emitted in southeast New Mexico.

For example, Kairos conducted a comparison with the University of Texas (UT) and Environmental Defense Fund's (EDF) study of site-level emissions at 150 sites.[2] Kairos compared the measured number of leaks and emissions from those leaks in that study to the actual number of sites that Kairos found to be emitting in New Mexico, and the emission rates measured by Kairos. Their study examined 489 wells at 150 sites, identifying 769 sources of emissions. Scaled basin-wide in New Mexico, that would translate to over 47,000 leaks from New Mexico's 30,000 active wells. The study also calculated emission rates from its observed leaks.

Kairos evaluated its own survey data and determined that approximately 2% of leaks (based on UT-EDF study leak frequency) are responsible for 73.5% of basin-wide methane emissions (based on UT-EDF study emission measurements.) In other words, Kairos data both confirms the existence of the fat-tail distribution of methane as well as provides an operational tool to find and address these very same sites.

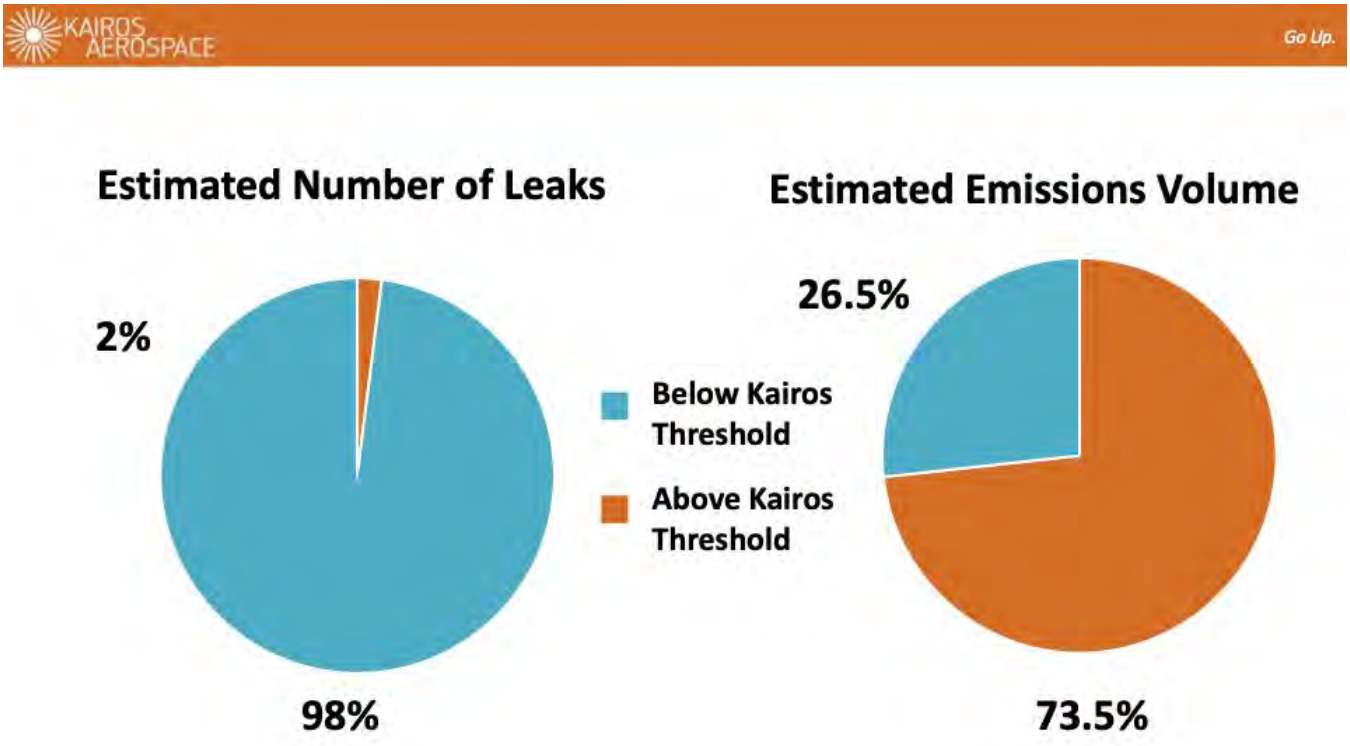

Fig. 2: Count of emissions detected by Kairos vs. estimated overall emission contribution from those detections

[2] Adam, David, et al. " Measurements of methane emissions at natural gas production sites in the United States." PNAS October 29, 2013 110 (44) 17768-17773 https://www.pnas.org/content/110/44/17768

Current Fugitive Emissions Monitoring Techniques Can Be Improved Upon

As further support for the need for a technology like Kairos' in the market, the authors of a 2016 paper [3] analyzed ~15,000 measurements from 18 prior studies and showed that "all available natural gas leakage datasets are statistically heavy-tailed, and that gas leaks are more extremely distributed than other natural and social phenomena. A unifying result is that **the largest 5% of leaks typically contribute over 50% of the total leakage volume**. (emphasis added)"[4] The study authors concluded that "performance targets for novel detection technologies can be informed by the emission distributions synthesized here…[which] could possibly allow more efficient solutions to the problem (i.e., avoid 'over-engineering' of detector technologies.)"[5] Rather than over-engineering an expensive, sensitive instrument, we have built a technologically innovative solution that prioritizes efficiency by identifying these super-emitters quickly.

As MAP panelists identified in the Report, traditional ground-based inspection techniques can be expensive and come with operating and capital expenses that need to be taken into account. While estimates vary, the cost of an OGI camera alone can be $85,000 to $120,000. Moreover, the time and expense involved with site inspections is a factor to consider. As one commenter noted, "Though pricing can fluctuate, a 2014 study determined that average cost of hiring an external service provider to conduct OGI LDAR surveys was estimated to be $2,300 for a compressor station, $5,000 for a gas plant, $1,200 for a multi-well battery, $600 for a single well battery, and $400 for a well site." Rapid aerial screening can cover more sites and therefore achieve economies of scale that may not be possible with reliance on more labor-intensive ground based techniques.

However, many existing methane regulation schemes are geared toward using these traditional ground-based techniques, despite their cost and other limitations. Many alternative methods are therefore compared to a ground-based OGI program, which is an understandable but ultimately flawed way of thinking. If an alternative monitoring standard focuses on an instrument being able to detect the exact same emissions in the same way as an OGI camera, then that analysis undervalues other very important considerations like speed and cost. For example, lower cost surveys can be conducted more frequently, and therefore may catch super-emitters faster, which the data show to be an important path to reducing emissions. Similarly, technologies that are able to rapidly inspect may shorten overall inspection times and deliver results faster. Sensitivity is not the only measure by which a technology should be evaluated. Traditional methods like OGI cameras also have technical weaknesses. For example, OGI camera quantification algorithms are in the early stages of development and are not yet reliable. Many emerging technologies, including LeakSurveyor, have more accurate quantification than current industry standard practices. Encouraging the use of new technologies will capture benefits beyond simply better resolution, faster surveying, and lower program costs.

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[3] Brandt, Adam, et al. "Methane Leaks from Natural Gas Systems Follow Extreme Distributions." *Environ. Sci. Technol.* Oct. 14, 2016. URL: http://pubs.acs.org/doi/pdf/ 10.1021/acs.est.6b04303.

[4] Id.

[5] Id.

The key difference in what we suggest the Agencies consider in future rulemakings is between **detection equivalence** and **mitigation equivalence**. Conducting more frequent surveys would identify any potential fat-tail emission sources faster than a ground-based method, even if the detection sensitivity is lower. Cheaper, faster monitoring will provide mitigation equivalence or superior performance by more frequent targeting of super-emitters.

New technologies like Kairos' aerial methane imaging can find super-emitters much more efficiently than OGI. We urge the Agencies to orient any leak detection programs they develop away from narrow inspections of individual facilities and toward broad inspections of many facilities. Any future rules should incorporate a mitigation equivalence determination rather than focusing on site-by-site detection equivalence. There is ample scientific evidence, as referenced above, showing the relative emission contribution of super-emitters. Developing a regulatory program that provides flexible pathways to efficiently identify and mitigate those sources will yield better outcomes for the Agencies, operators, and the environment.

The Technology to Improve Fugitive Emissions Monitoring Programs Exists Today

Our technology also fills technical needs in the marketplace. At the most basic level, we are filling a gap between handheld gas imaging devices (which are sensitive but time-consuming and costly to use) and aerial air-sampling devices (which are better suited to scientific research than leak detection), creating an entirely new category class of detection technology: aerial methane imaging. Our technology is designed to efficiently and cost-effectively target super-emitters, which have been increasingly shown to be responsible for most of the volume of fugitive methane emissions.

Kairos has demonstrated that new technology isn't simply a promise on the horizon; it is being implemented with success by operators today. In 2019, Kairos surveyed 40,000 oil and gas wells along with thousands of miles of pipelines. The results of our work with industry speak for themselves. Kairos customers eliminated 3.9 billion cubic feet of methane in 2019. This is not simply promising research that needs to be studied; Kairos and others have developed operational tools that already operate at scale. We urge the Agencies to provide a pathway for such technologies to be rigorously reviewed and implemented in the field as soon as possible.

With the proper framework in place, New Mexico can enact methane reduction strategies while minimizing the operational and financial impact to operators. We encourage the Agencies to think about these new tools as part of an overall strategy, not simply as a substitute of OGI or any other kind of emissions monitoring technology.

Conclusion

We appreciate the opportunity to provide feedback to the Agencies and we support many of the arguments laid out in the Report.

- Based on the available scientific research and Karios' own work, super emitters have an outsized impact on total methane emissions.
- We believe that new technologies like Kairos that focus on rapid screening can complement the slower, more detailed ground-based techniques to improve upon the current state of leak detection programs. This can be done by focusing on mitigation equivalence over detection equivalence in leak detection regulatory schemes.
- The technology to make the necessary changes we outlined exists today. Kairos and others have developed proven tools that are ready for field-wide deployment now.

At Kairos Aerospace, we are excited to use our innovative methane monitoring technology to work with industry and the Agencies to reduce methane emissions faster and at a lower cost than traditional monitoring technologies. We've identified and mitigated billions of cubic feet of emitted natural gas through aerial monitoring. We've also eliminated thousands of hours of vehicle trips and improved safety in the field for operations personnel. This has all been done on a voluntary basis and we believe that if industry were able to use aerial monitoring as a regulatory compliance tool, the benefits would be even greater. We look forward to being able to use our technology nationwide to help the oil and gas industry quickly and safely reduce methane emissions.

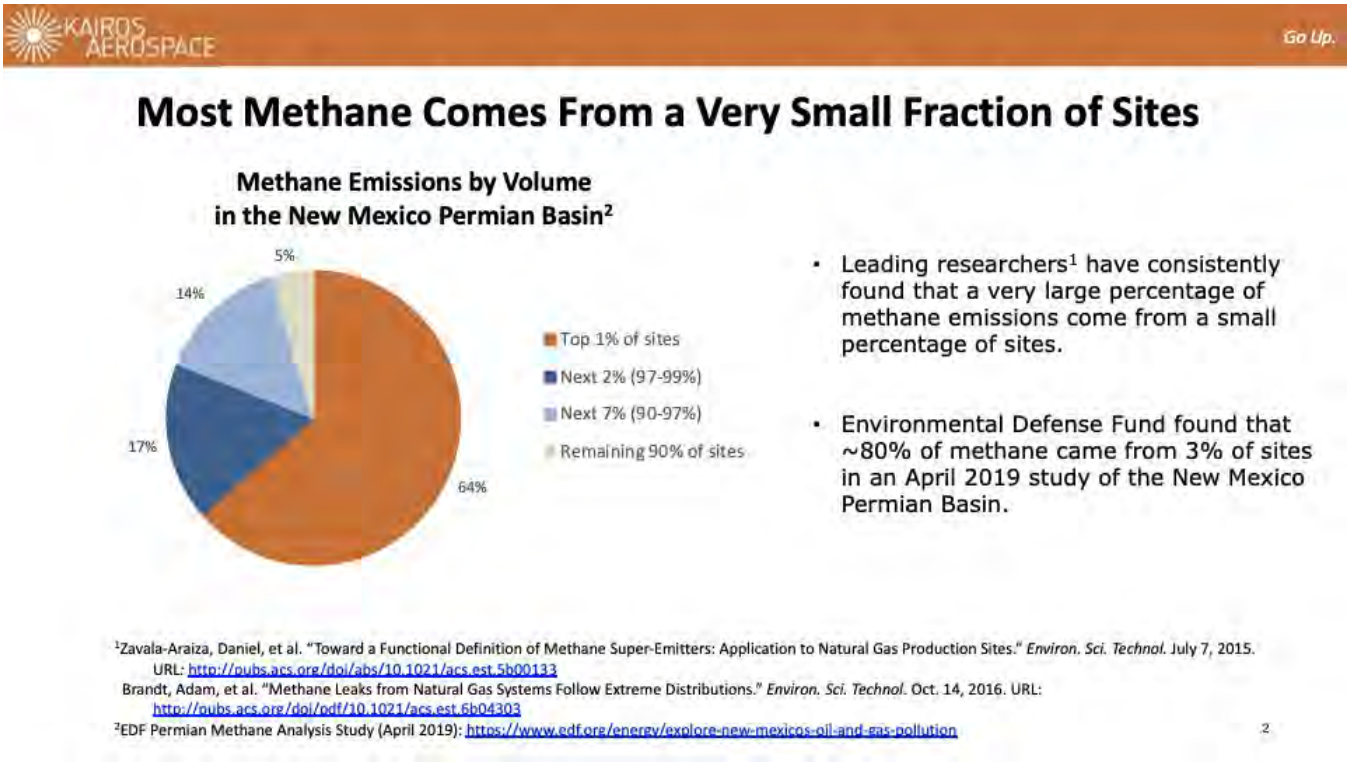
Sincerely,

Steve Deiker
CEO

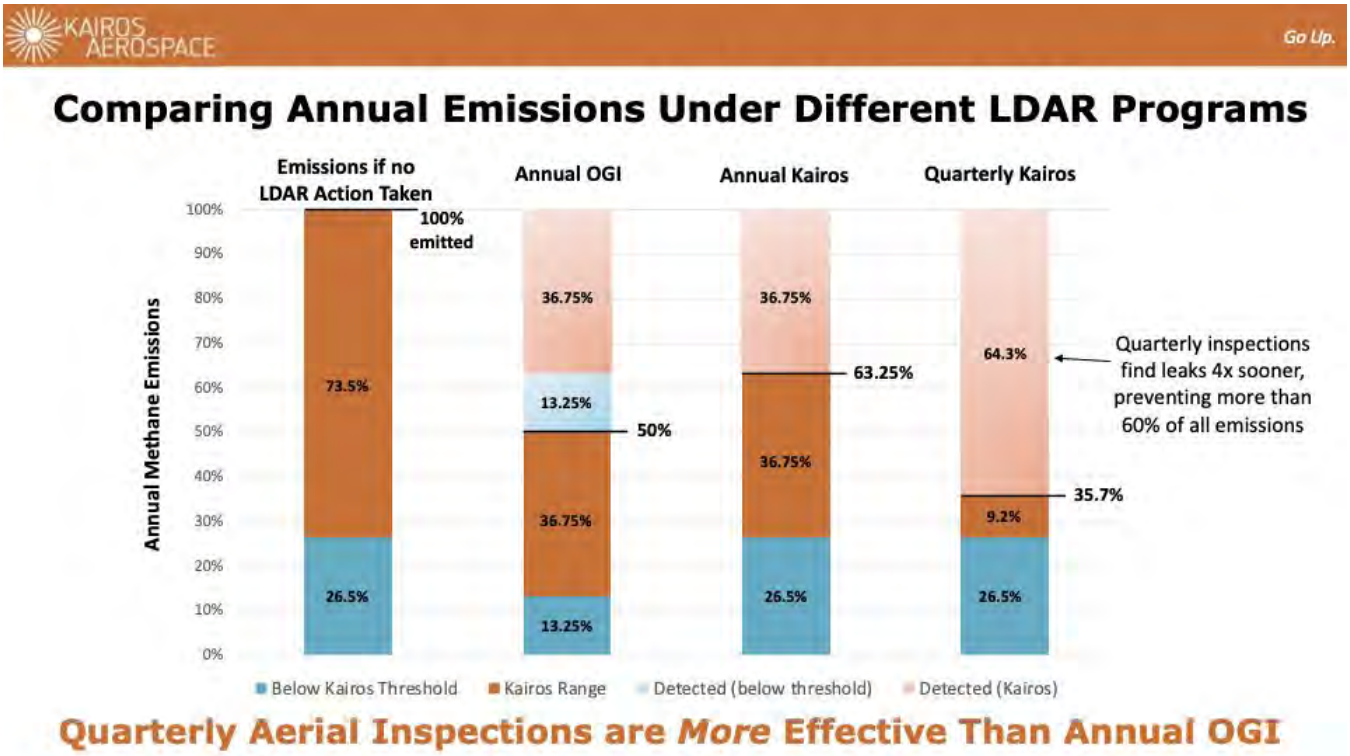
Appendix B
Emission Reduction Potential of Aerial Monitoring at Varying Frequencies

In order to assess the efficacy of aerial monitoring, Kairos has examined the scientific literature to estimate the distribution of leaks by volume. It is increasingly clear that the majority of methane emissions come from a relatively small number of sites, although the exact amounts are subject to some uncertainty.

Below is data published by the Environmental Defense Fund based on a number of site measurements in the Permian Basin:



Kairos Aerospace is able to rapidly identify emissions from the top ~3% of emitting sites, which means it could identify approximately 80% of basin methane emissions. Below, we describe how aerial monitoring capable of detecting just 73.5% of total methane could eliminate approximately two thirds of the Permian Basin's methane emissions.



We estimate that annual Kairos inspections can detect (and therefore potentially prevent) ¾ as much of the emissions as a traditional annual OGI inspection program for a small fraction of the cost, and quarterly Kairos inspections would be almost 30% *more* effective than an annual OGI LDAR program.

If we assume that annual OGI identifies emission sources after an average of six months, then it will reduce about half the total fugitive emissions. On the other hand, an aerial survey with Kairos will catch only the leaks at or above its detection limit every six months. This means that smaller leaks will go undetected and large leaks will be detected after an average of six months. Therefore annual aerial surveys would not be equivalent with annual OGI, although the program cost would be drastically lower.

If, however, we assume that aerial surveys conducted quarterly would identify leaks after an average of 1.5 months, then an annual survey would eliminate the majority of emissions above its detection limit, while still missing the emissions below the detection limit. This, however, would mean that a quarterly survey as a whole would eliminate more total emissions than an annual OGI camera LDAR program.