

Methane: Using New and More Data to Manage Rising Risk in a Carbon Constrained World

June 2016

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Methane accounts for 25% of the warming our planet is experiencing right now



Reducing global oil and gas methane emissions by 45% equivalent to shutting 1,000 coal-fired power plants



Global oil and gas methane emissions estimated at \$30 billion

Analysis highlights global methane reduction opportunity

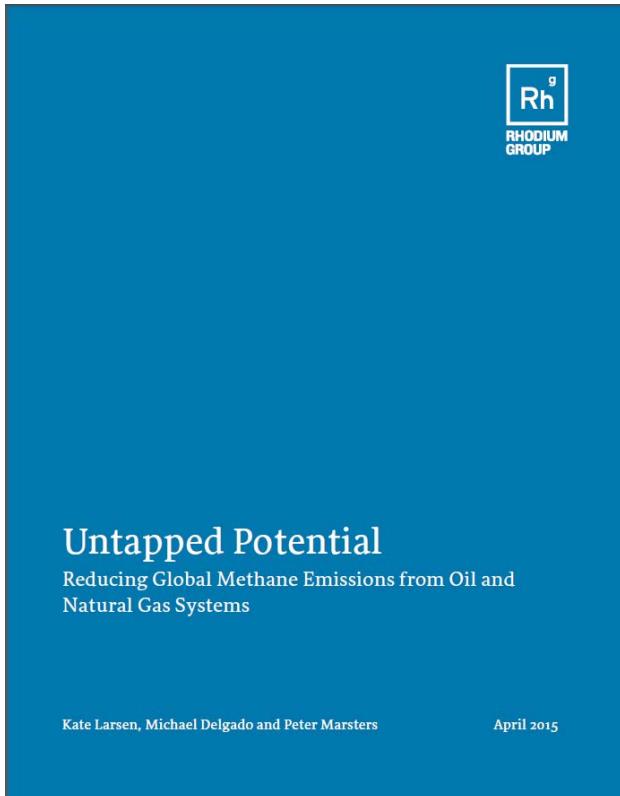
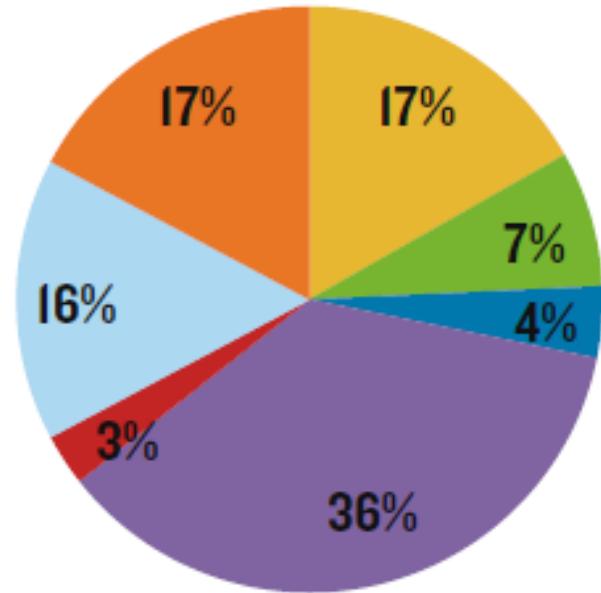


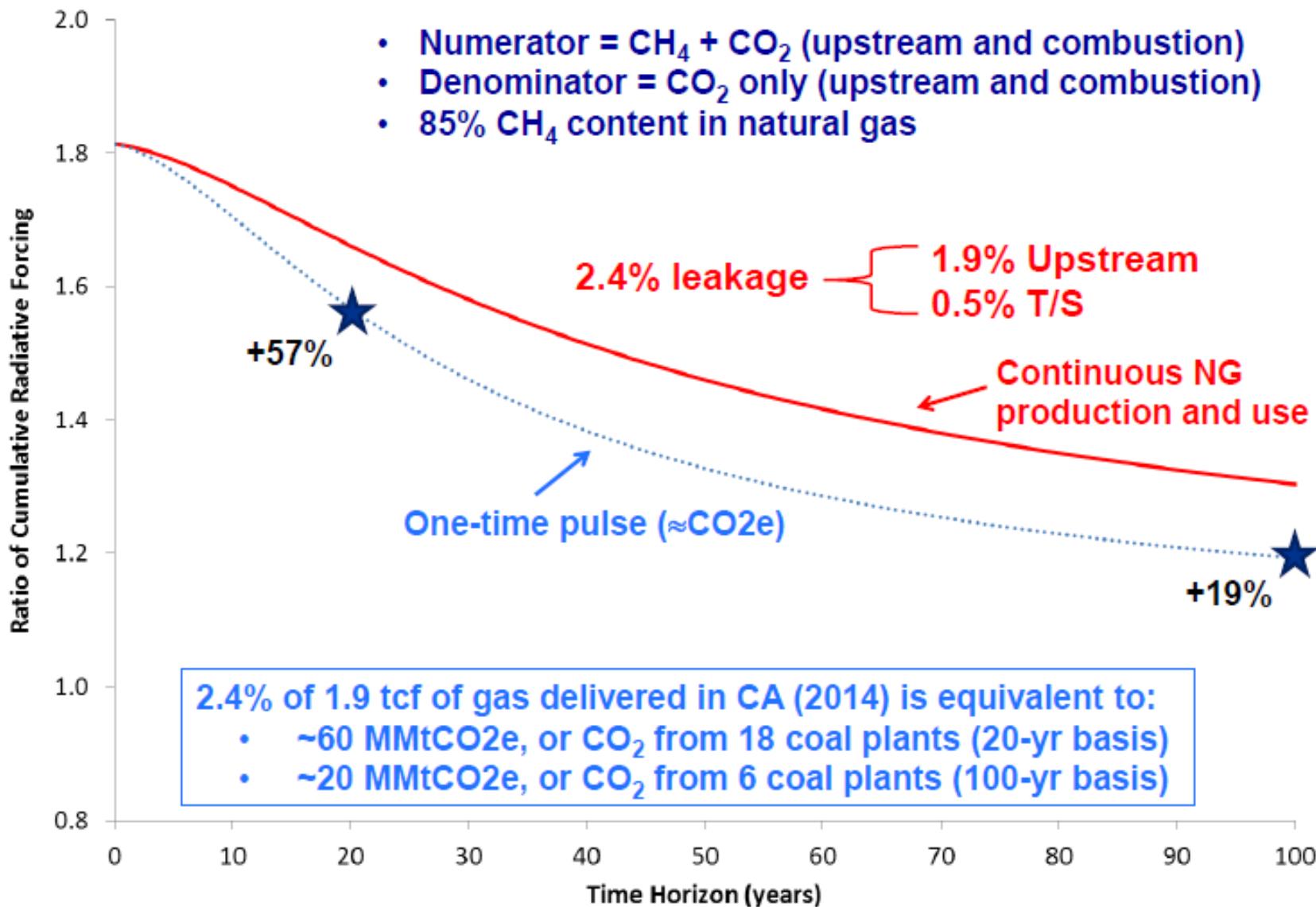
Figure 5: Current oil and gas methane emissions by region

- Africa
- Asia & Oceania
- Central & South America
- Eurasia
- Europe
- Middle East
- North America

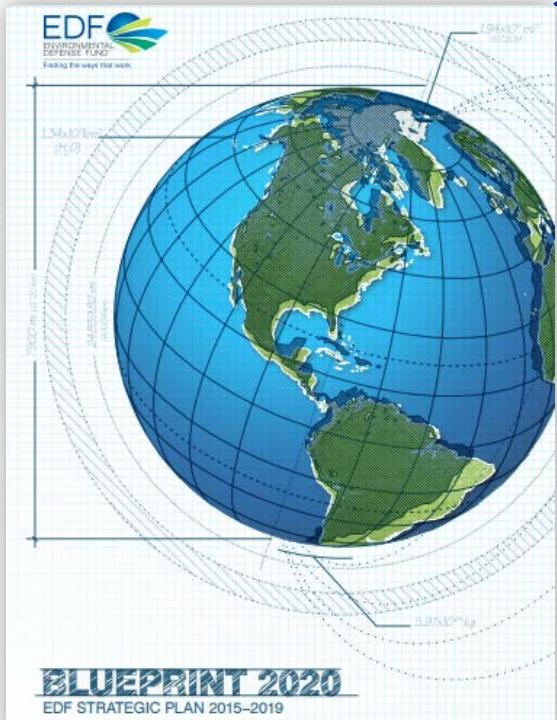


Source: UNFCCC, EIA, Rystad and RHG estimates. For region definitions, see the Appendix.

CH_4 impact on climate forcing of natural gas



EDF seeks to achieve 45% oil and gas methane reduction by 2025



Interim 2020 Goals

Description

Methane leakage rates quantified globally for oil and gas sector

Companies or countries representing 40% of global market committed to measuring, reporting and reducing methane emissions

Question: What does all the methane data mean?

For emitters?

For investors?

For the public?

For regulators?

Unchecked methane presents many risks

REPUTATIONAL

REGULATORY

FINANCIAL

ENVIRONMENTAL

LEGAL

LEAKAGE

RISK



Investors weighing in on the importance of reducing methane control

Joint statement on methane emissions by Institutional Investors Group on Climate Change (IIGCC), the Investor Network on Climate Risk (INCR) and the Investors Group on Climate Change (IGCC).

IIGCC, INCR and IGCC represent more than 220 institutional investors with \$20 trillion in assets that share a common concern about the potential for climate change to have major negative impacts on the global economy and the long-term financial performance of our investments. Our members support cost-effective efforts to mitigate climate change.

We are concerned about the volume of natural gas that is emitted to the atmosphere through venting or leaking, or “leak,” equivalent to nearly two gigatons CO₂ or greenhouse gas emissions per year. We are particularly concerned about methane, given its short-term potency as a greenhouse gas. High methane leakage rates undermine the climate change benefit of using natural gas as an energy source.

In 2012 we called¹ on natural gas producing companies and government regulators to consider how they can play a role in encouraging the more effective control of methane emissions. We subsequently engaged with companies on these issues and asked the CDP to incorporate questions on methane control into their survey.

Companies told us that when using the best new technologies, methane emissions from oil and gas production can be reduced to close to zero. This feedback is backed by new research evidence.² Research also indicates that methane emissions can be very high in gas producing regions where there is no regulation or enforcement.

This is evident as emissions patterns underscore the importance of adopting best practice methane emissions controls. We support efforts by the global oil and gas industry to encourage universal implementation of best practices, in order to maintain the chance of achieving a 2°C trajectory.³

We therefore encourage oil and gas companies to join the new CCAC Oil and Gas Methane Partnership. The Climate and Clean Air Coalition (CCAC) is an international effort backed by over 30 governments to bring together countries, companies, and others to work together to substantially and cost-effectively reduce methane, black carbon, and HFCs. The Oil and Gas Methane Partnership is a good example of bringing systematic and measurable reductions of methane emissions in a market-oriented, cost-effective manner. It will help aims to develop the technical, transparent, publicly reporting and national policies that will ensure progress is made on this issue.

We believe that participation in the CCAC Oil and Gas Methane Partnership will help companies to reduce their emissions, improve the efficiency of company operations and enhance the role and credibility of low carbon gas as a bridge to a low carbon future.

¹UNEP CCAC “Climate and Clean Air Coalition Working with Oil and Gas Companies to Reduce Methane and Black Carbon Emissions”
²<http://www.incr.org/investor-statements/2013-energy-research-report-on-methane-leaks/>
³<http://www.incr.org/investor-statements/2012-climate-change-and-investor-action-on-methane-leaks/>
⁴<http://www.incr.org/investor-statements/2012-reducing-the-energy-dilemma/>
⁵<http://www.incr.org/investor-statements/2013-energy-research-report-on-methane-leaks/>

IIGCC  **Investor Network on CLIMATE RISK**  **Investor Group on Climate Change** 

June 2012
\$20 Trillion
in assets
supporting
global action
on methane

October 2014

Administrator Gina McCarthy
U.S. Environmental Protection Agency
1200 Pennsylvania Ave NW
Washington, DC 20460

Ra. National Oil and Gas Methane Regulation

Dear Administrator McCarthy,

We are writing to you today to urge the EPA to move forward with a robust effort to regulate methane emissions from the oil and gas industry – upstream and midstream. As investors, we believe that the oil and gas industry can contribute significantly to climate stability and a serious effort to combat instability, accelerating the rate of warming in the near term and downstream infrastructure and economic harm that are bad for the country and bad for investors. To do this, the EPA must take actions across the burgeoning American oil and gas industry. It is a positive step the Administration has taken to further focus its climate legacy and to benefit the economy.

A comprehensive, timely national methane policy will: (1) minimize harmful methane and associated emissions; (2) build investor confidence that natural gas is appropriately regulated so that it can help the economy transition to a clean energy economy; and (3) have a positive impact on the oil and gas industry, creating working for the economy in America towards a more sustainable energy mix.

The undersigned investors encourage the EPA to initiate comprehensive rulemaking on methane emissions from existing and future oil and gas facilities, for the following reasons:

1. Methane emissions are a serious climate problem.
Methane is a highly potent greenhouse gas – at least 84 times more powerful than carbon dioxide over a 20-year time period. About 30 percent of the world’s greenhouse gas emissions come from human activity. About 30 percent of those greenhouse gas emissions will come from methane. Oil and gas is the largest industrial source of methane emissions in the US, and recent studies have concluded that methane emissions from US oil and gas wells are double what the industry’s own official estimates.¹ As the Administration noted in its March 2014 Strategy to Reduce Methane Emissions, “reduce measurement and estimate until consistent

¹ IIGCC, Climate Change 2013: The Physical Science Basis, Fifth Assessment Report, Chapter 2 Table 2.2.1
² Bravos, A. et al., “Methane Leaks from North American Gas Systems,” Science Magazine (February 2014)

1



Investor Network on
CLIMATE RISK
a project of Ceres

Investor Statement in Support of the White House’s January 14, 2015
Announcement on Methane Emissions Regulation

July 1, 2015

Investors representing \$1.1 trillion commended the White House’s proposal to reduce methane emissions from the oil and gas industry by at least 45 percent below 2012 levels by 2025.¹ This announcement demonstrates a commitment to combat climate change, protect economic growth, transition to a renewable energy economy, and provide more regulatory clarity for the industry.

The proposal is in line with the recommendations made by the International Energy Agency (IEA) in its “Golden Rule for a Golden Age of Gas,” which calls on public authorities . . . to consider imposing restrictions on venting and flaring and specific requirements for harvesting equipment to help minimize emissions.”²

In 2012, institutional investors representing over \$20 billion in assets spoke up in support of the “Golden Rule for a Golden Age of Gas” and called on governments to:

review their policies to ensure their regulations are effective in minimizing methane emissions across the oil and gas value chains. This can be achieved through inclusion of methane in state and federal environmental laws and regulations, requiring appropriate methane emissions control technologies along the oil and gas value chain, including green completions, plunger lifts, low-sheath pneumatics, vapor recovery units and flash tanks separators.

As widely diversified, long-term investors with holdings in the oil and gas industry, we have a vested interest in the industry’s long-term success. At the same time, we are invested in a renewable energy and energy efficiency-based sustainable energy economy. Therefore, consistent with our fiduciary duties, we are concerned that methane emissions pose a serious threat to climate stability, according the rate of warming in the near term and downstream infrastructure and economic harm will weaken not only the companies we invest in, but the nation as a whole.

As a result, we strongly support the President’s proposal, which will not only reduce methane emissions in a meaningful way, but will also improve investor confidence by clarifying the regulatory structure and expectations for the oil and gas industry.

¹<http://www.whitehouse.gov/the-press-office/2015/01/14/the-white-administrations-new-methane-emissions-control-action-plan>

²<http://www.iea.org/goldenrule/methane.html>

**October
2014
\$300 Billion
in assets
supporting
federal
methane
action**

**July 2015
\$1.5 Trillion in
assets
supporting
federal
methane
announcement**

Investor Statement in Support of the joint U.S. and Canadian March 10, 2016
Announcement on Limiting Methane Emissions from the Oil and Gas Industry

Investors representing \$1.6 trillion commended the joint U.S. and Canadian March 10th announcement that both countries will take steps to limit methane emissions from the oil and gas sector. Both countries have now pledged to reduce oil and gas methane pollution by 40 to 45 percent over the next decade, and put forth standards to achieve this goal. Curbing methane emissions from all sources in the oil and natural gas value-chain will reduce climate change, promote economic growth and provide regulatory clarity for industry and investors.

As widely diversified, long-term investors with holdings in the oil and gas industry, we share a vested interest in the industry’s long-term success. Natural gas plays a significant role in the North American energy mix, and has demonstrated the potential to reduce greenhouse gas emissions while supporting economic growth and lower energy prices. However, in order to realize these benefits, we are concerned that methane emissions pose a risk to our oil and gas investments.

Unchecked methane emissions create a reputational risk that jeopardizes the value-proposition for natural gas in a carbon-constrained world. It is in the industry’s (and investor’s) best interests to act decisively to reduce this risk. Further, prevention of wasted methane will keep more natural gas available for the North American economy. Investors will remain committed to a responsible way of doing business. The U.S. and Canadian focus on limiting emissions from oil and gas sources, which will not only help reduce environmental impact, but will also improve investor confidence by clarifying expectations for the oil and gas industry operating going forward.

We acknowledge that the industry is facing significant near-term financial pressure. However, limiting methane emissions is important given that our investment time horizons extend well beyond any single commodity price cycle. Methane represents a growing risk that does not fluctuate with commodity prices. The risk can be managed in a financially friendly, cost-effective manner. We urge companies to minimize methane emissions in a responsible manner and provide investors and the public with better methane reporting.

We applaud the recent US and Canada announcement and look forward to encouraging both countries and their respective operators to address methane risk in a comprehensive and timely fashion.

Investor Signatures:
Addenda Capital Inc.
Alberta Investment Management Corp.
Align Impact
Aguilar Associates

**May 2016
\$3.6 Trillion in
assets
supporting US -
Canada
methane
announcement**

Investors with \$3.6 trillion weigh in on financial risk as they support global methane action in May 2016

European Letter: Commending President Obama and Prime Minister Trudeau on pledge to reduce methane pollution from oil and gas industry by 40 – 45% over the next decade

Highlights:

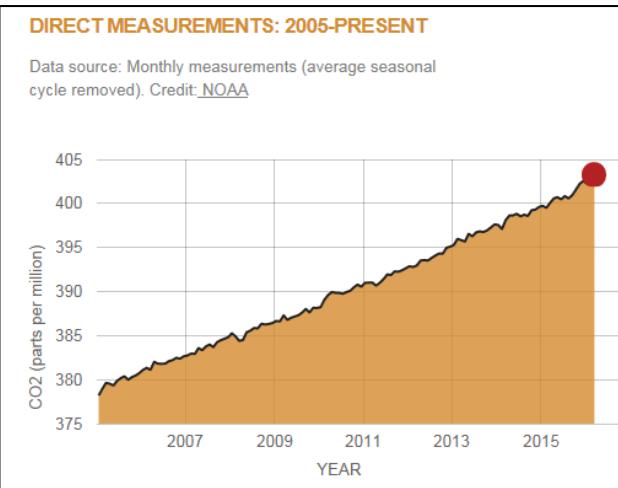
“Curbing methane emissions from all sources in the oil and natural gas value-chain will help limit climate change, promote economic growth and provide regulatory clarity for industry and investors.”

“As widely diversified, long-term investors with holdings in the oil and gas industry, we share a vested interest in the industry’s long-term success.”

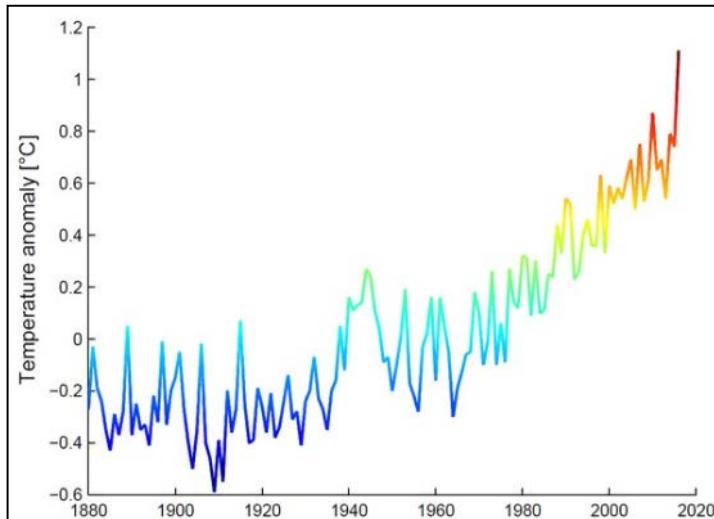
“We urge companies to minimize methane emissions in a transparent manner and provide investors and the public with better methane reporting.”



The climate damage risk is also compelling



Concerning 2016 temperature trends continue...

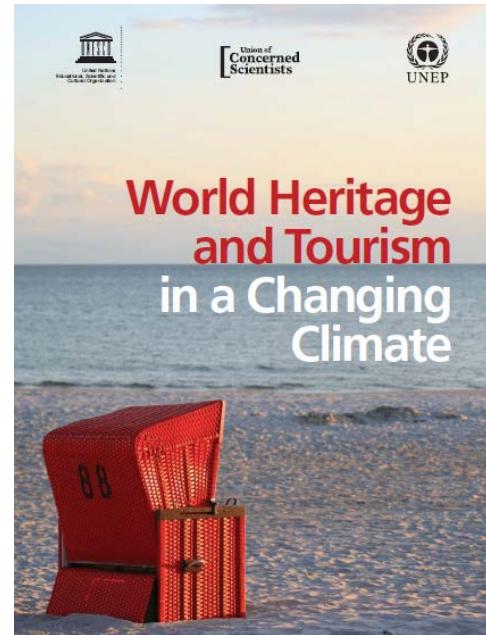


**March 2016 –
403 ppm CO₂**

Source: NOAA

Climate
Change
Threats
Mounting

Source UCS



Wildfires are **increasing** and wildfire season is getting **longer** in the Western U.S.



Average number
of large wildfires
per year
bigger than 1,000 acres



1980-1989
~140



1990-1999
~160



2000-2012
~250

Is there a legal risk for not pursuing lifecycle GHG reductions for imported natural gas?

- AB 32 requires the state board to minimize leakage of greenhouse gases to achieve climate pollution goals
- Under the law, the very definition of leakage is “a reduction in emissions of greenhouse gases within the state that is offset by an increase in emissions of greenhouse gases outside the state.”
- Over the last several decades, California has benefited from the use of natural gas for power generation and more recently, as a transportation fuel.
- Leakage of methane within the natural gas value chain can seriously undermine the climate benefit of using natural gas.

(8) Minimize leakage.

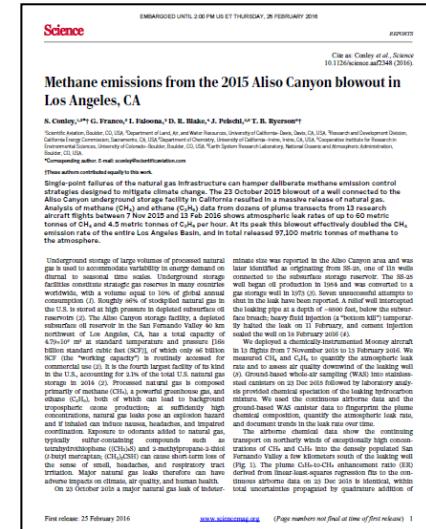
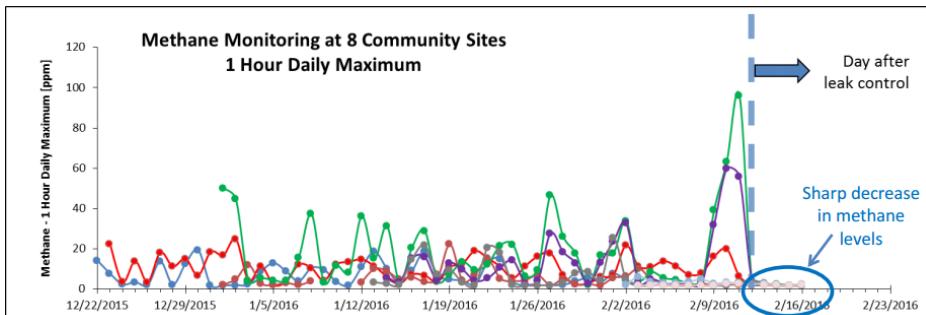


**New data tools and streams can play a
BIG part in finding solutions and
reducing risk**

- Event characterization**
- Mitigation prioritization**
- Regulatory design**
- Cost analysis**
- Community protection**
- Investor confidence**

Use of new data tools for event characterization

- Also canyon
 - Massive sampling during release
 - Testing of tech. after the leak
 - New models developed for extreme events
 - Increased community testing
 - Increased prevalence of super emitters in inventory



Use of new data tools for event characterization

CPUC Filing of SoCalGas – Feb 2016

- “not aware of any established methodology that could be used to determine the release of methane ... these types of events require specialized consideration and collaboration with various regulatory agencies to estimate the volume of emissions for potential inclusion in the greenhouse gas inventory for the State.”

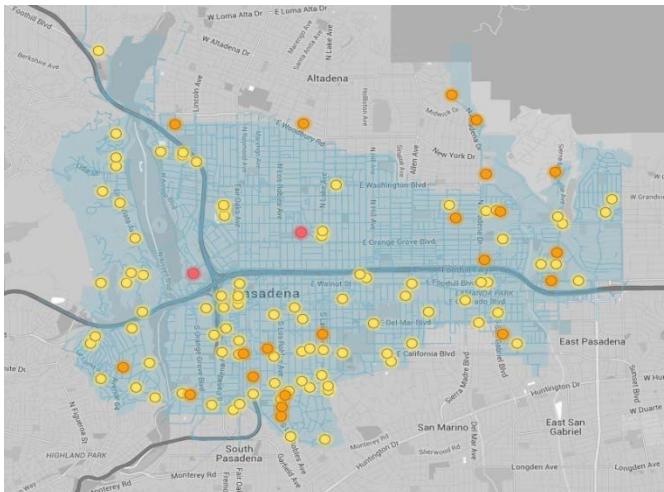
Statement of So Cal Gas – May 2016

- “Southern California Gas Co. (SoCalGas) today announced it has completed a thorough physical measurement of the gas inventory in its Aliso Canyon storage facility reservoir ... emissions align closely with preliminary estimates made by the California Air Resources Board (ARB), and estimates made by third-party scientists.

One science study featured methane mapping generated by detector equipped Google cars

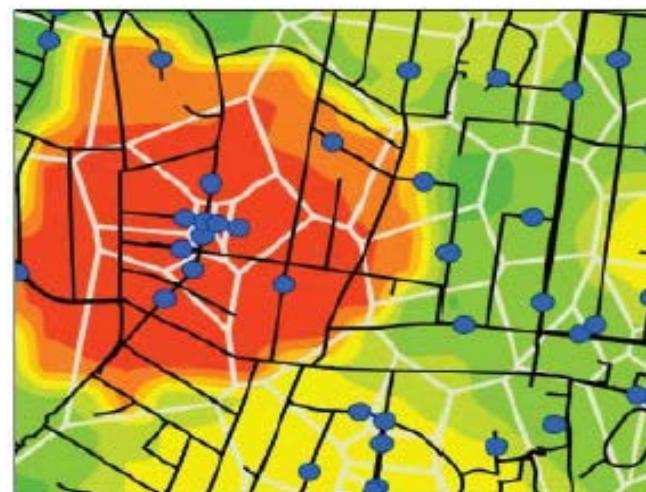


Using data to find individual leaks



Source: EDF

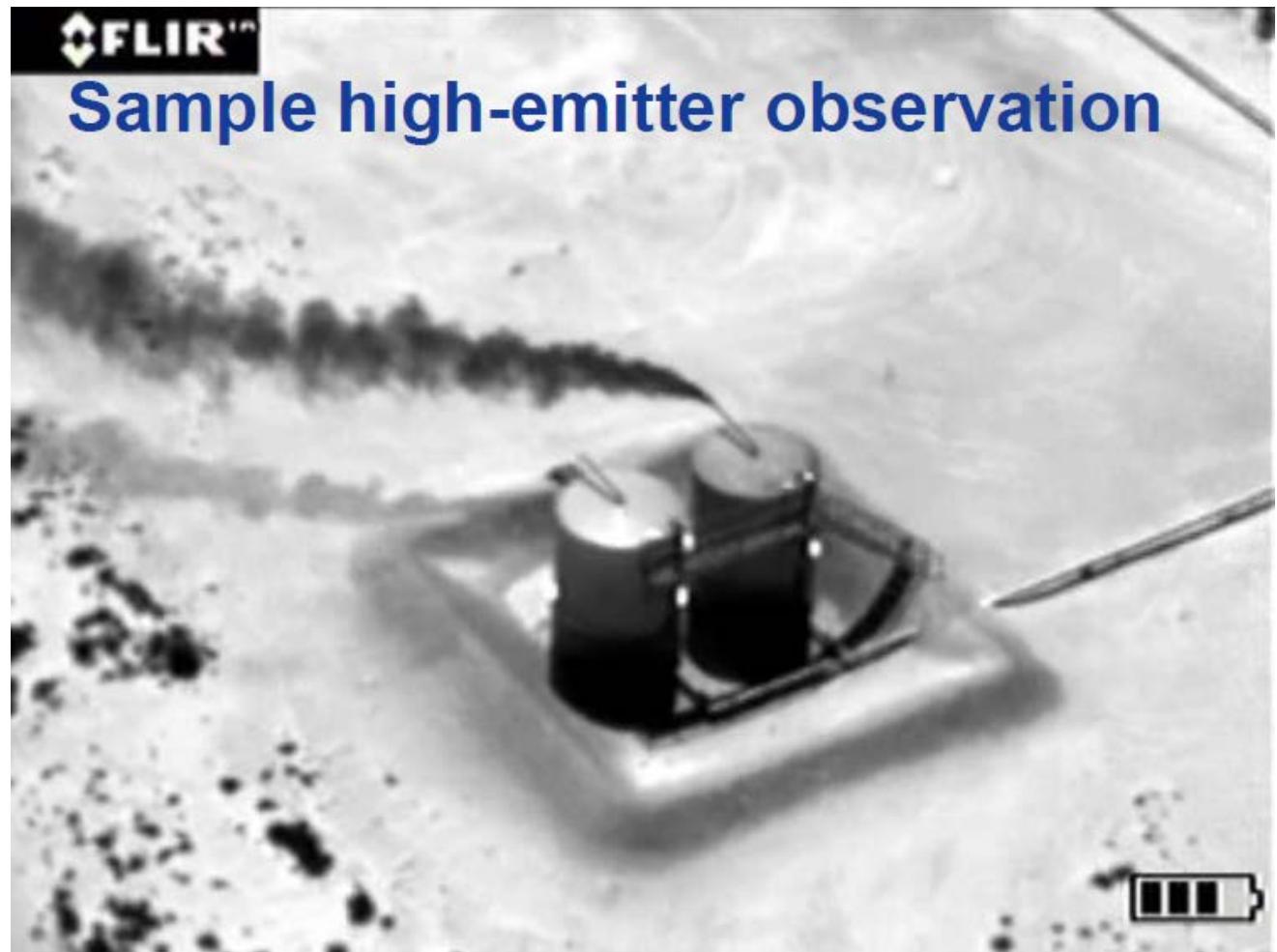
Using leak data for spatial analytics



Source: PWC

Recent helicopter study reinforced irreplaceable value of regular inspections

Frequent monitoring required to identify high-emitters



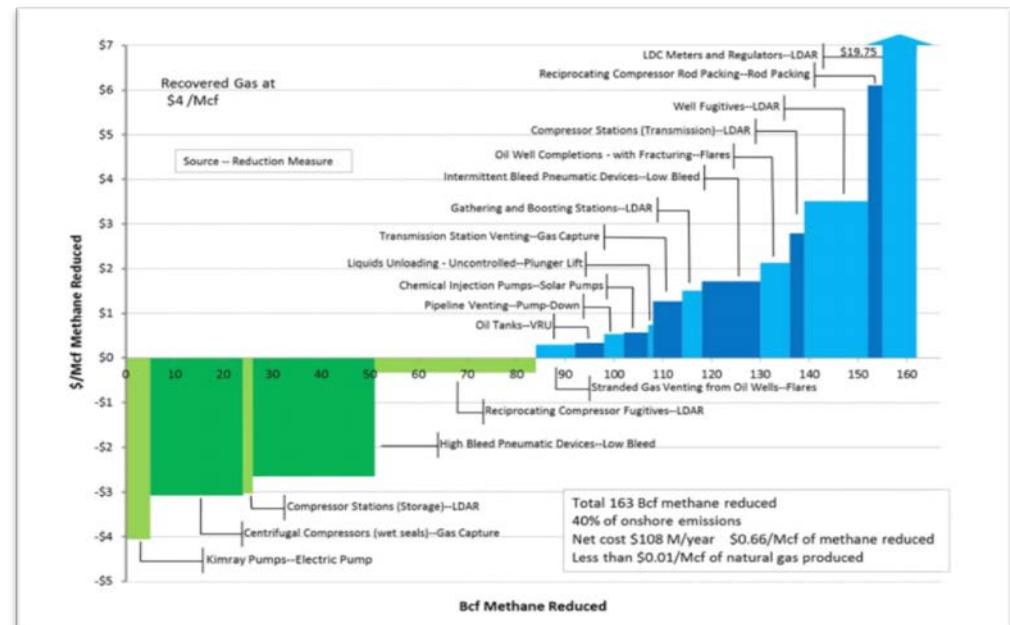
Lyon et al, *ES&T* (2016) <http://pubs.acs.org/doi/abs/10.1021/acs.est.6b00705>

2014 ICF study found that cost-effective methane mitigation solutions exist today

40% reduction in onshore methane emissions achievable for <\$0.01/Mcf of gas produced

40% reduction is achievable while saving the US economy \$100MM per year

Initial capital cost of measures estimated at \$2.2 Billion



Driving innovation for new technologies

Demand
Test and Use



Shell



Market Maker
Convene and
Catalyze



Supply
Innovate



Advise

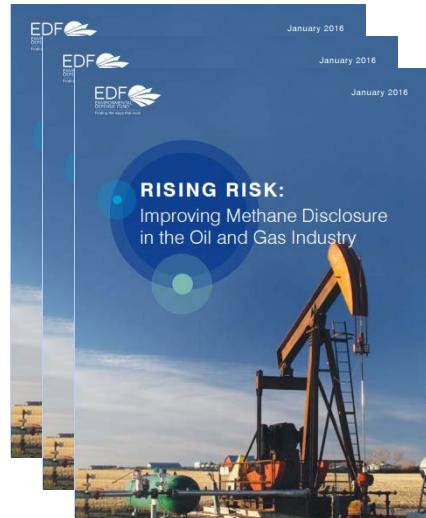


HARVARD
UNIVERSITY



...and more...

Recent EDF study found level of reporting on methane emissions limited

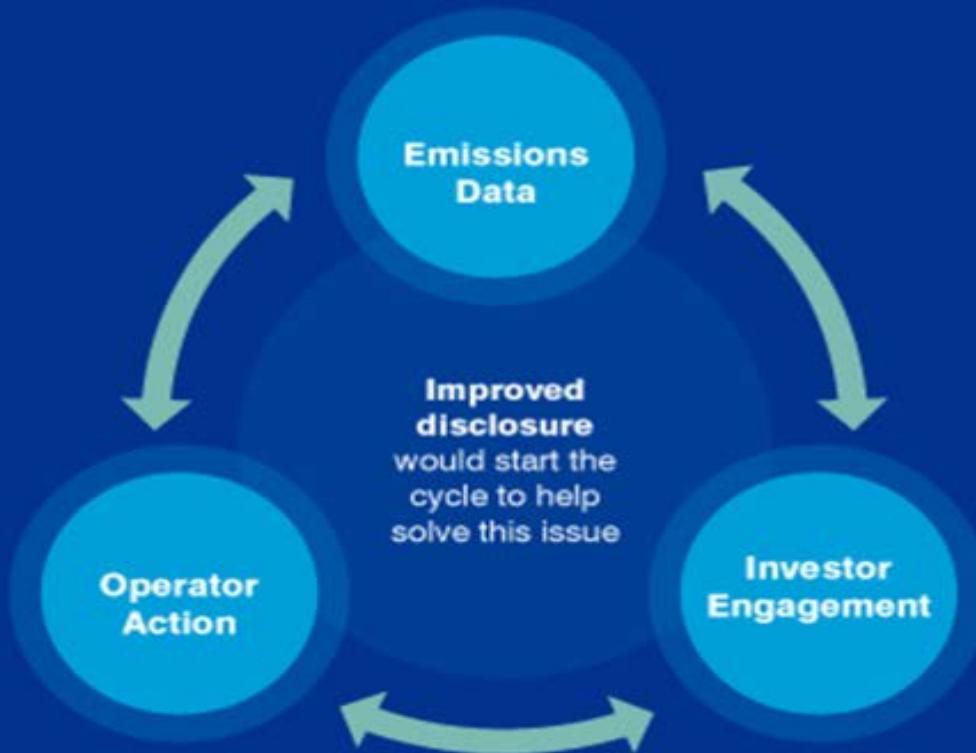


- 28% of companies surveyed report methane emissions in investor facing channels
- Zero companies provide quantitative reduction targets
- One company provided detailed information on its leak detection and repair (LDAR) program
- Information provided generally vague, qualitative and non-actionable

Results for Select European Producers

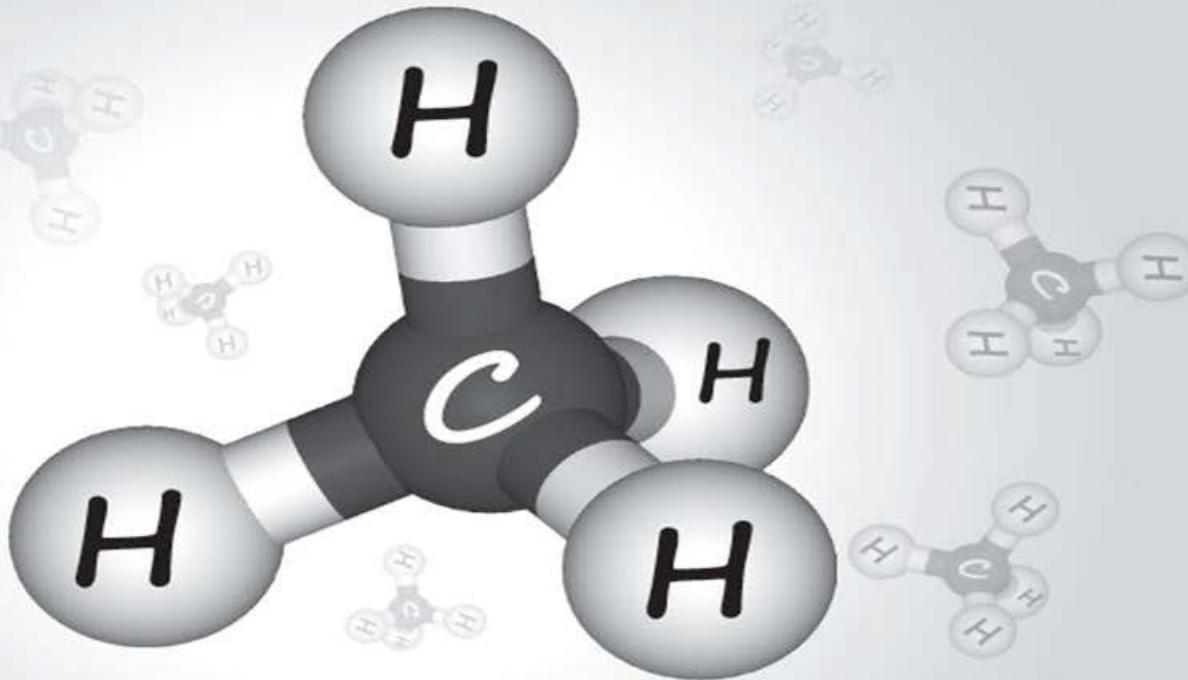
Company Name	Report methane emissions as rate	Report methane emissions as standalone figure	Quantitative emissions reduction target	Report position on methane policy	LDAR discussed
BP	X	✓	X	X	✓
Shell	X	✓	X	X	✓
Total S.A.	X	✓	X	X	✓

Leaving investors in the dark on the rising risks from methane emissions



Transparent companies make for better investments.

"We are particularly concerned about methane, given its short-term potency as a greenhouse gas. High methane leakage rates undermine the climate change benefit of using natural gas as an energy source."
IIGCC et al 2012



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