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Docket Number:	16-IEPR-02
Project Title:	Natural Gas
TN #:	211773
Document Title:	Presentation - Methane: Using New and More Data to Manage Rising Risk in a Carbon Constrained World
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Filer:	Raquel Kravitz
Organization:	Environmental Defense Fund
Submitter Role:	Public
Submission Date:	6/9/2016 1:00:59 PM
Docketed Date:	6/9/2016

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

June 2016

Timothy O'Connor

Director, California Oil and Gas



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



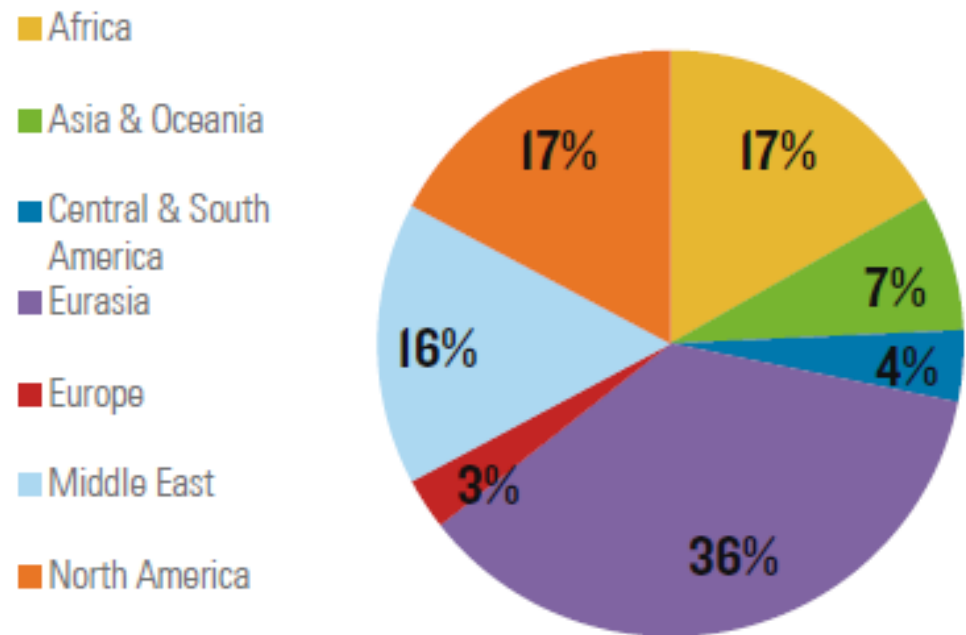
Untapped Potential

Reducing Global Methane Emissions from Oil and Natural Gas Systems

Kate Larsen, Michael Delgado and Peter Marsters

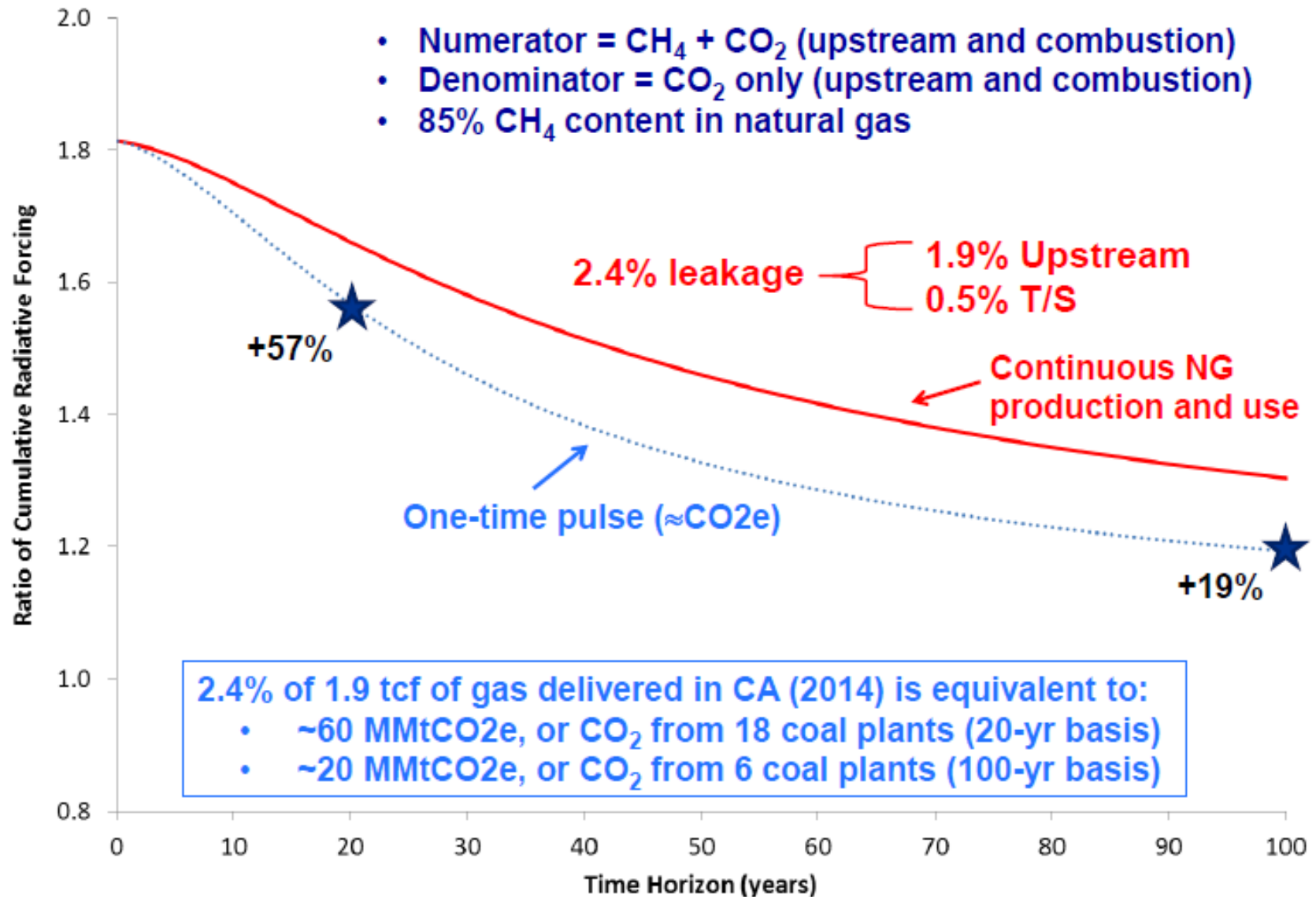
April 2015

Figure 5: Current oil and gas methane emissions by region



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

CH₄ 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



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

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

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

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



1

¹ <http://www.schibone.gov.hk/pcc/office/2015/15/1504/15040401.htm>

Addenda Capital Inc.
Alberta Investment Management Corp.
Align Impact
Aquinas Associates

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.”

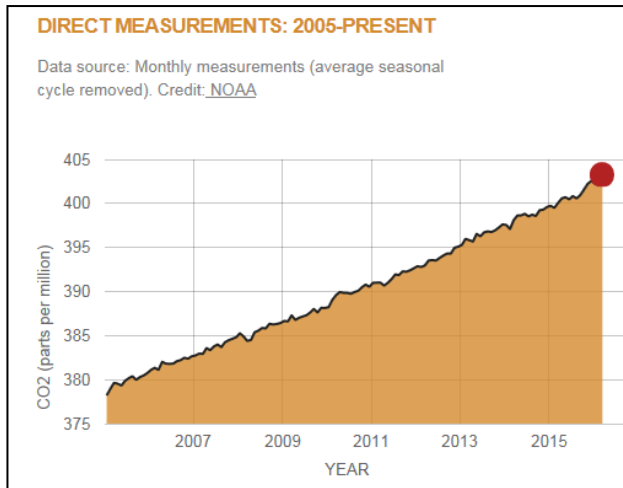
“We urge companies to minimize methane emissions in a transparent manner and provide investors and the public with better methane reporting.”

ROBECO



HERMES
INVESTMENT MANAGEMENT

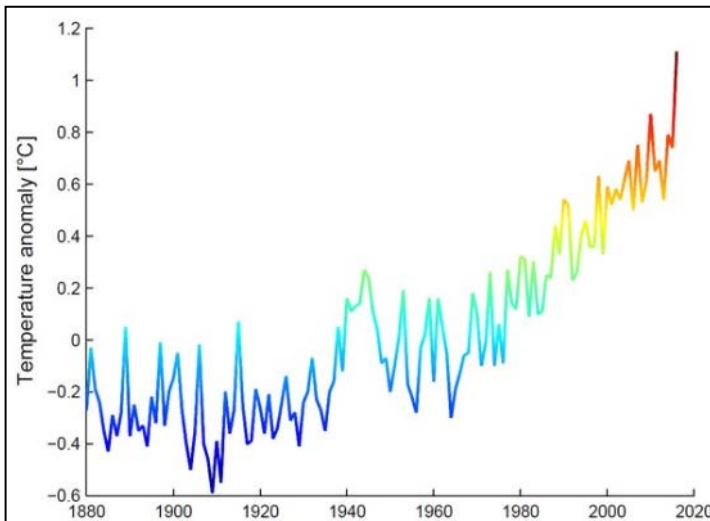
The climate damage risk is also compelling



March 2016 –
403 ppm CO₂

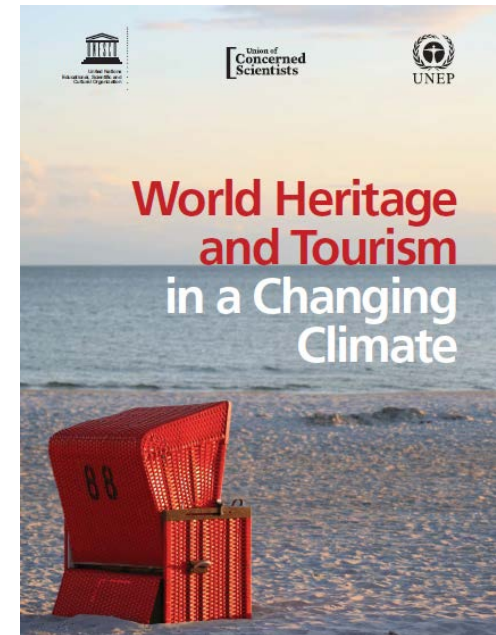
Source: NOAA

Concerning 2016 temperature trends continue...



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

(8) Minimize leakage.

- 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.



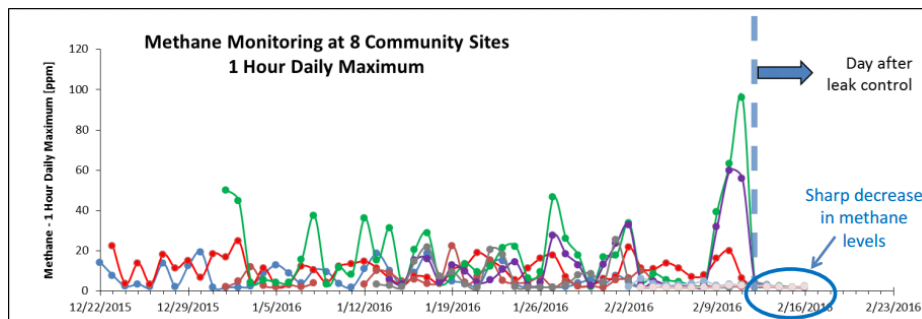
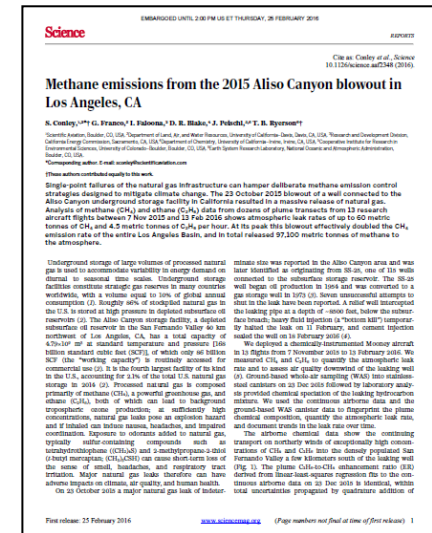
New data tools and streams can play a BIG part in finding solutions and reducing risk

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



Use of new data tools for event characterization

- Aliso 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.”

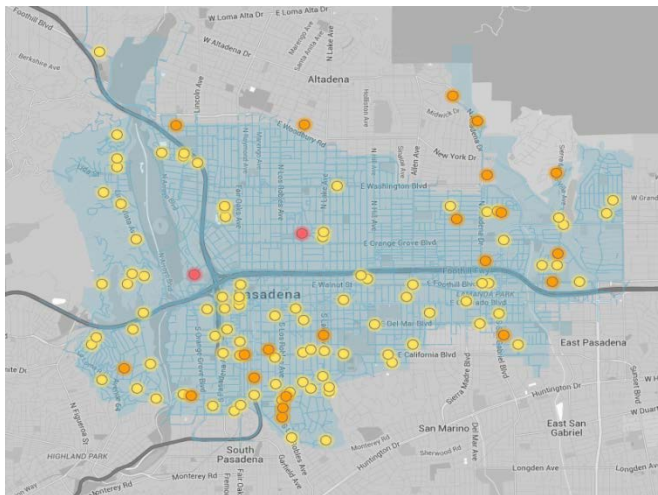
Statement of So Cal Gas – May 2016

- “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

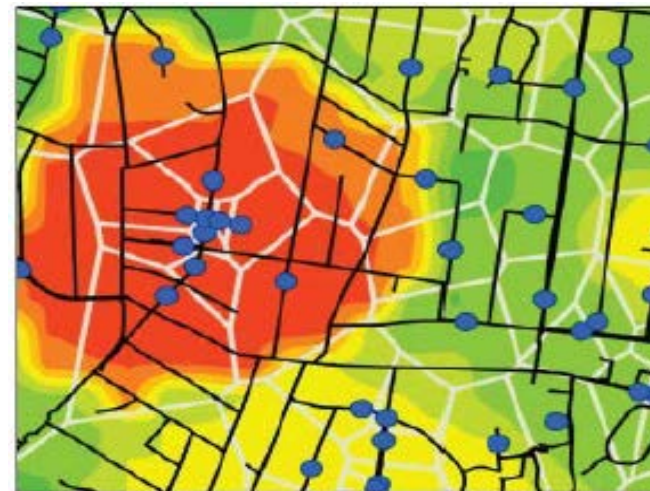


Using data to find individual leaks



Source: EDF

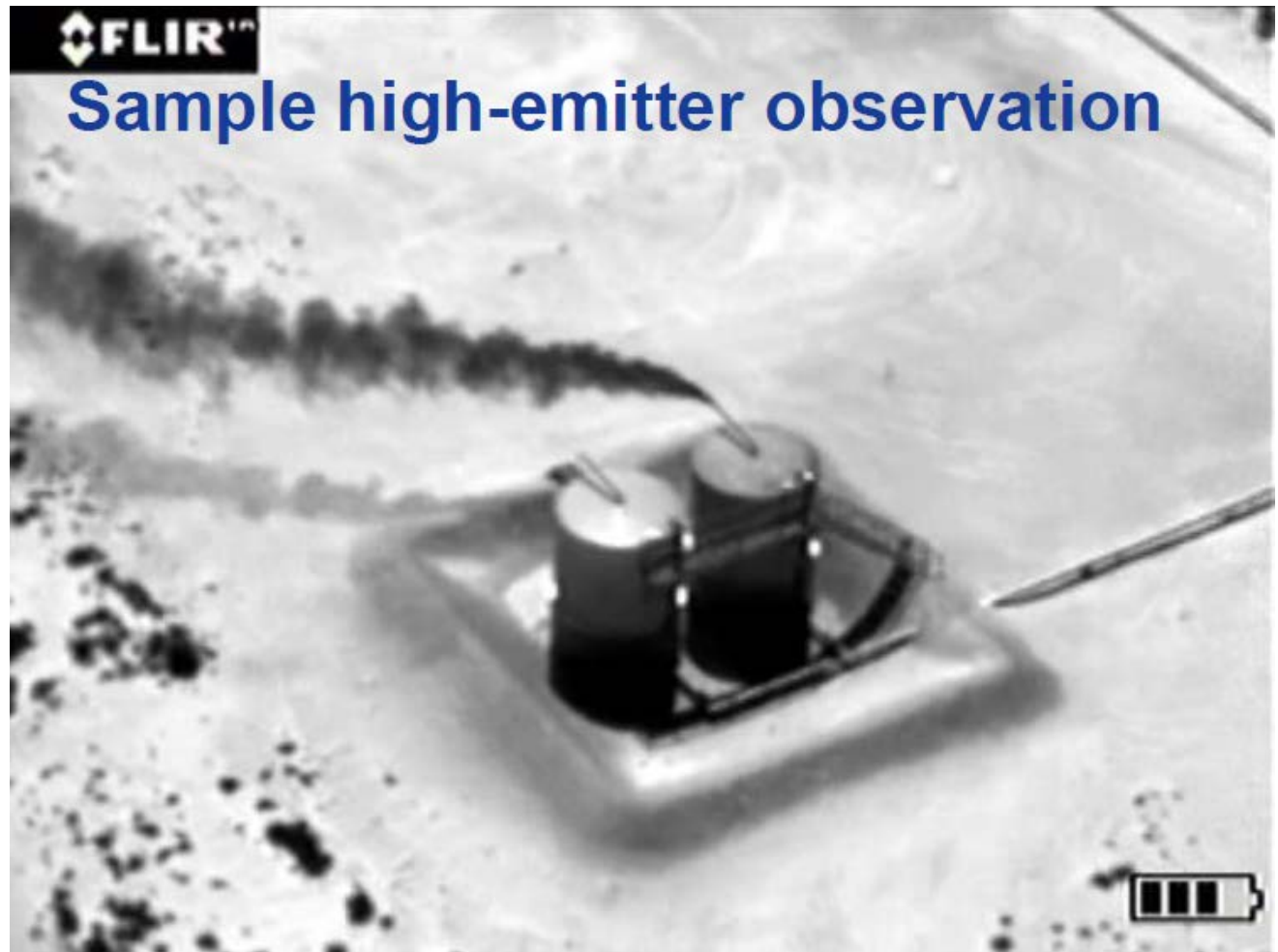
Using leak data for spatial analytics



Source: PWC

Recent helicopter study reinforced irreplaceable value of regular inspections

Frequent monitoring required to identify high-emitters



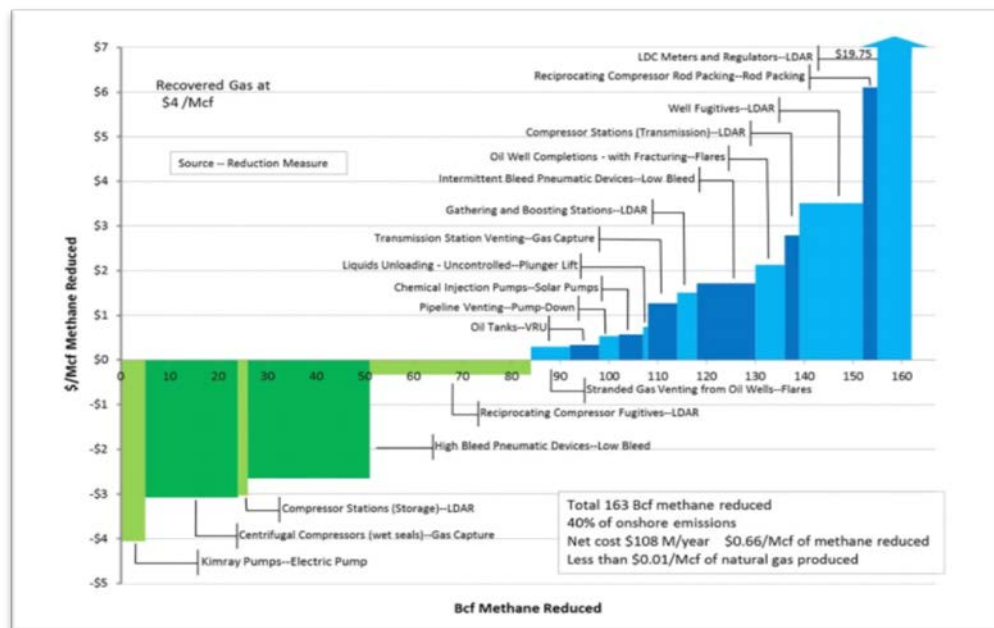
Lyon et al, *ES&T* (2016) <http://pubs.acs.org/doi/abs/10.1021/acs.est.6b00705>

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



Market Maker Convene and Catalyze



Supply Innovate



Advise



HARVARD
UNIVERSITY



...and more...

Recent EDF study found level of reporting on methane emissions limited

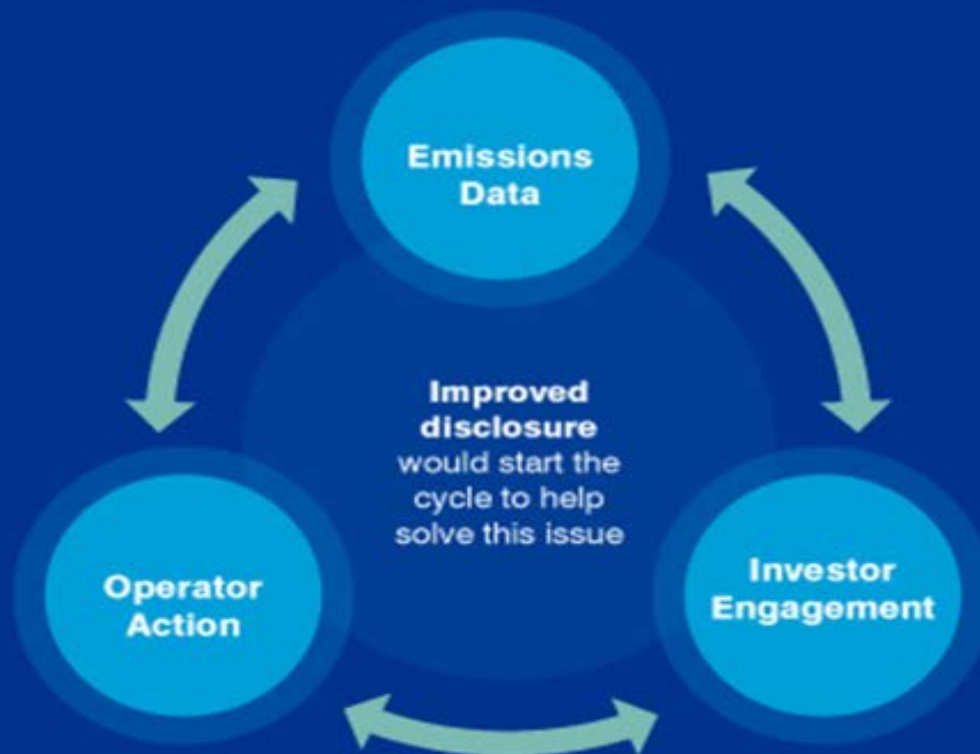


- 28% of companies surveyed report methane emissions in investor facing channels
- Zero companies provide quantitative reduction targets
- One company provided detailed information on its leak detection and repair (LDAR) program
- Information provided generally vague, qualitative and non-actionable

Results for Select European Producers

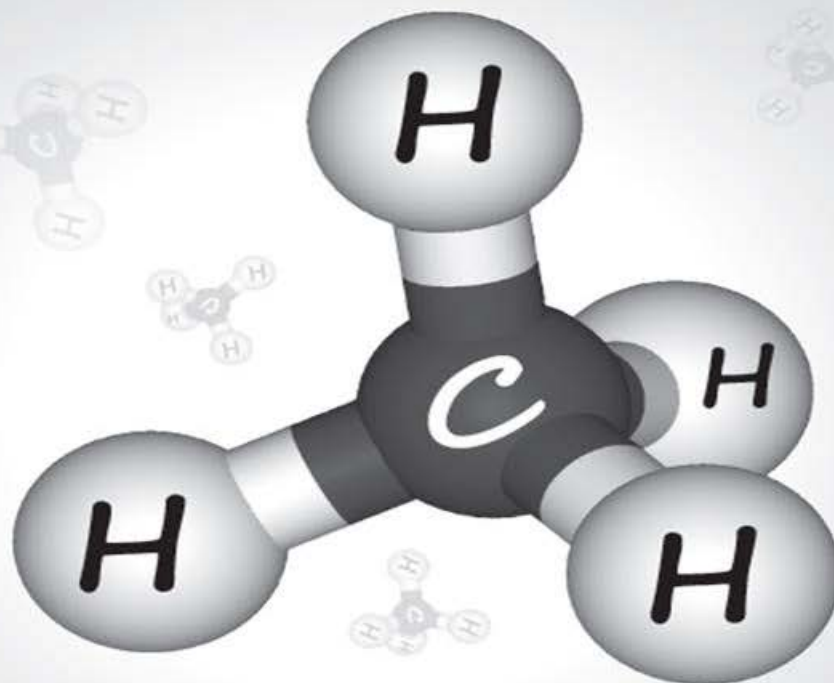
Company Name	Report methane emissions as rate	Report methane emissions as standalone figure	Quantitative emissions reduction target	Report position on methane policy	LDAR discussed
BP	X	✓	X	X	✓
Shell	X	✓	X	X	✓
Total S.A.	X	✓	X	X	✓

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



METHANE

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