

North America

Fossil Fuels | Natural Gas

California Leak Exposes Risks Of Increasing Reliance On Natural Gas

Regulatory Actions Likely To Enhance Methane Detection And Remediation Requirements

January 25, 2016

Policy Brief

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Key Takeaways:

- The California Department of Conservation (DOC) will issue emergency natural gas storage regulations in response to a persistent leak at the Aliso Canyon Natural Gas Storage Facility in Los Angeles County
- This incident exposes underground storage risks and regulatory disparity as utilities continue to increase natural gas-fired generation
- Innovative methane detection technology will allow the industry to improve operational efficiency and reduce methane emissions
- Curtailing emissions of methane, a prime component of natural gas, is critical to meet the nation's emissions-reduction targets

Entities Mentioned:

- California Air Resources Board
- California Department of Conservation
- Department of Energy
- Energy Information Administration
- Environmental Protection Agency
- Federal Energy Regulatory Commission

Related Research

[Obama Administration Seeks Safeguards For Energy Reforms](#)

[Regulators Reconsider Utility Hedging Policies Given Shifts In Natural Gas Flow](#)

Insight for Industry – Persistent Leak at California Natural Gas Storage Site Reveals Need for Stronger Regulatory Oversight Amid Increasing Reliance on Gas

On January 15, 2016, the California Department of Conservation (DOC) issued a notice of intent to propose emergency natural gas storage regulations in response to Governor Brown's emergency proclamation to address the ongoing natural gas leak at the Aliso Canyon Natural Gas Storage Facility in Los Angeles County. The leak, detected in October 2015, is attributed to the failure of a 40-year-old pipe more than a thousand feet underground, allowing pressurized gas to flow back to the surface and into the atmosphere. While the methane emissions rate has been slowing due to reducing pressure from gas withdrawals, at one point, the leak was estimated to account for 25 percent of all methane emissions in the state.

Underground gas storage facilities involve injection of large quantities of gas into underground reservoirs for withdrawal during peak load periods. Industry stores methane underground in depleted oil and gas fields, aquifers, or salt caverns for future use as it is more economic than storing gas in tanks on the surface. The Aliso Canyon storage facility is an oil field that was converted into a natural gas storage reservoir in the 1970s. Although natural gas storage is critical for the economy and grid resilience in the transition to a low-carbon future, the California incident illustrates the risks associated with aging natural gas infrastructure and underscores the need for rigorous oversight using effective technology.

Natural gas is composed primarily of methane (approximately 80 percent) - a potent greenhouse gas. While natural gas burns cleaner than other fossil fuels, fugitive emissions during the production, storage, and delivery have the potential to undo much of the greenhouse gas benefits. Given the scale of the California site leak, regulatory outcomes could not only impact natural gas practices, but also the electricity sector, as natural gas utilization is assumed to grow significantly over the next decade as utilities shift away from coal generation in response to the Clean Power Plan.

Current methane reduction measures from oil and gas operations primarily target above-ground pipeline infrastructure on storage sites, rather than subsurface malfunctions. Given methane's substantial environmental impact, regulatory requirements for real-time methane detection and controls to address below-ground leaks will become increasingly crucial for sustainability.

Prolonged Natural Gas Leak Prompts Emergency Declaration in California to Strengthen Regulatory Oversight

In proposing the emergency regulations, the California DOC's Division of Oil, Gas, and Geothermal Resources (DOGGR) emphasized the immediate need to implement performance standards to ensure proper risk mitigation and appropriate measures to prevent uncontrolled leaks, blowouts, and infrastructure-related accidents at underground gas storage facilities. Southern California Gas Company (SoCalGas) discovered the leak in one of the wells at its Aliso Canyon natural gas storage facility on October 23, 2015.

While natural gas burns cleaner than other fossil fuels, fugitive emissions during the production, storage, and delivery have the potential to undo much of the greenhouse gas benefits

Following unsuccessful attempts to plug the well, on December 4, 2015, the utility started drilling a relief well to intercept the leaking well at more than 8,000 feet underground and stop the leak – an activity expected to take three to four months. SoCalGas continues to withdraw natural gas from the storage facility to reduce the overall pressure in the storage facility, thereby reducing the amount of natural gas emitted from the impacted well. According to the California Air Resources Board (CARB), the amount of gas being released has declined from a November 2015 peak of 58,000 kilograms per hour to 23,400 kilograms per hour on January 8. At one point, CARB's preliminary report suggested that the leak would have added approximately 25 percent to the regular statewide methane emissions from October 23 to November 20, 2015. It also warned leaks could compromise the state's 2030 goal of reducing methane emissions by 40 percent from current levels.

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Governor Brown's emergency proclamation, issued on January 6, requires emergency regulations that impose safety and reliability standards for all underground gas storage facilities in California. The regulations would ensure that operators of existing underground gas storage facilities monitor leak indications in well casing and report anomalous detections, function-test safety valve systems, apply effective leak detection technology to inspect wellheads and surrounding area and equipment, develop risk management plans that verify mechanical integrity and corrosion assessment, and monitoring, and provide complete project data and risk assessment results. The proclamation seeks immediate implementation of these standards to ensure safe operations and prevent the recurrence of a similar incident.

The emergency proclamation builds on months of regulatory and oversight actions from seven California agencies – the Governor's Office of Emergency Services; DOGGR; Office of Environmental Health Hazard Assessment; California Public Utilities Commission; CARB; Division of Occupational Safety and Health; and the California Energy Commission – to oversee SoCalGas' actions to stop the leak, track methane emissions, and address other potential issues from the leak. The emergency order requires SoCalGas to maximize daily withdrawals of natural gas from the impacted facility for use or storage elsewhere, capture leaking gas and odorants while relief wells are in progress; and identify means to stop the leak if relief wells fail to seal the leaking well, or if the ongoing leak worsens.

The proposed regulations will be submitted to the Office of Administrative Law (OAL) on January 26, 2016, and subsequently, the OAL will allow five days to submit comments. While DOGGR has announced a plan to overhaul the Underground Injection Control (UIC) program which regulates underground gas storage facilities, the gas leak incident highlights the urgency for reforms. Currently, the California DOC regulates fourteen active gas storage facilities in twelve fields across the state.

Building on the emergency proclamation, on January 11, Sen. Fran Pavley (D-CA) announced a package of legislation which would require a moratorium on new injections in the facility until state agencies and independent experts

determine that it is safe to resume activity. Among other provisions, the legislation would require response costs to be funded by the company shareholders and not ratepayers, strengthen laws regulating gas storage facilities, and establish emissions reduction targets holding polluters accountable to meet those targets.

California Gas Leak Incident Exposes Growing Risks of Shifting Toward Natural Gas for Energy

The severity of the Aliso Canyon incident and the prolonged failure of efforts to control the leak illustrates the risks associated with underground gas storage facilities and the importance of proactive measures to identify and mitigate those risks. The incident also highlights the increasing risks of leaks and explosions from aging pipelines and storage facilities in the U.S., as natural gas continues to supplant coal as the dominant energy source. In April 2015, CPUC imposed a record penalty of \$1.6 billion on Pacific Gas and Electric Company shareholders to pay for the unsafe operation of its gas transmission system that caused a pipeline rupture in San Bruno, California in 2010, providing redress for the systemic causes and improvements to gas pipeline safety. Explosions have occurred due to gas leaks from underground caverns in Texas and Kansas in 1992 and 2001, respectively.

The incident highlights the increasing risks of leaks and explosions from aging pipelines and storage facilities in the U.S., as natural gas continues to supplant coal as the dominant energy source

Such incidents have prompted legislative efforts to mitigate leaks and emissions associated with natural gas storage (Table 1).

Table 1 – Natural Gas Storage Legislation Enacted in Recent Years

State	Legislation Enacted	Date	Description
California	SB 861	06-20- 2014	Requires an independent scientific study to evaluate hazards and risks of well stimulation treatments, including, hydraulic fracturing and acid well stimulation treatments
California	AB 1257	10- 11- 2013	Requires development of strategies for infrastructure expansion to maintain or enhance pipeline and system reliability, including increased natural gas storage, minimize system leakage and emissions, and mitigate investment risks
Utah	HB 25	03- 27- 2014	Allows exercising right of eminent domain on underground natural gas storage facilities

Source: EnerKnol

Several bills were introduced in 2015 and 2016 to strengthen regulatory oversight of natural gas operations including safety requirements during injection of gas into and recovery of gas from natural gas storage reservoirs (Table 2).

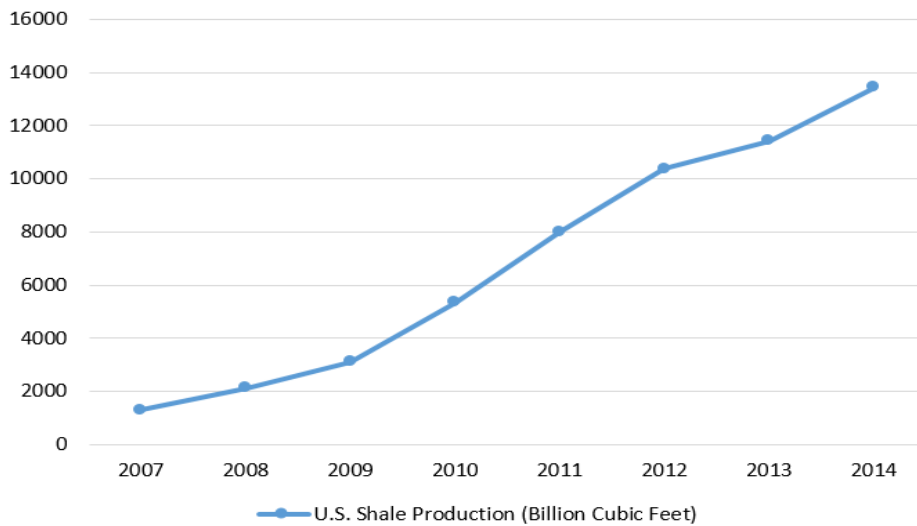
Table 2 – Legislative Proposals Addressing Natural Gas Operations in 2015 and 2016

State	Legislation Introduced	Date	Description
California	SB 887	01-21-2016	Would strengthen current laws governing regulation of gas storage facilities that affect people, homes, and businesses
	SB 886	01-21-2016	Would impose moratorium on any new injections of natural gas and use of vintage wells for production at the Aliso Canyon storage facility until state agencies and experts determine that the site does not pose a risk to public health or safety; would consider ways to minimize or eliminate use of the facility while maintaining energy reliability in the region
	SB 888	01-21-2016	Would designate a single point of accountability and responsibility in state government for disasters; require all GHG mitigation cost impacts of the gas leak to be paid for from utility profits and not ratepayers
Alaska	HB 247	01-19-2016	Pertains to refunds for gas storage facility tax credit and liquefied natural gas storage facility tax credit, and disclosure of oil and gas production tax credit information, among others
	SB 130	01-19-2016	
Maine	LD 881	03-12-2015	Would allow the state Public Utilities Commission to contract for liquefied natural gas storage and distribution
Oregon	HB 3569	06-30-2015	Would impose a moratorium until December 31, 2026, on the use of hydraulic fracturing for oil and gas exploration and production
Florida	SB 1468	02-26-2015	Would ensure necessary precautions to prevent spillage of oil or any other pollutant in all phases of the drilling, including high pressure well stimulations, or during the injection of gas into and recovery of gas from a natural gas storage reservoir
Louisiana	HB 814	04-22-2015	Would provide for carry forward rather than refund of the tax credit for ad valorem taxes paid for certain natural gas storage services or operating natural gas storage facilities
	HB 432	04-02-2015	
	HB 727	04-03-2015	Would reduce the amount of income and corporation franchise tax credits for taxes paid on natural gas held, used, or consumed in providing storage services or facilities
	SB 89	04-1-2015	Would remove the refundable tax credit for ad valorem property taxes paid on natural gas held, used, or consumed in providing natural gas storage services or facilities

Source: EnerKnol

The shale gas boom has intensified pressure on the aging system of underground storage, which plays a significant role in meeting winter demand. The expansion of horizontal drilling and hydraulic fracturing, which has facilitated shale development, has paved the way for abundant and low-cost natural gas, making the U.S. the world's largest natural gas producer (Figure 1).

Figure 1 - U.S. Shale Gas Production, 2007-2014 (billion cubic feet)

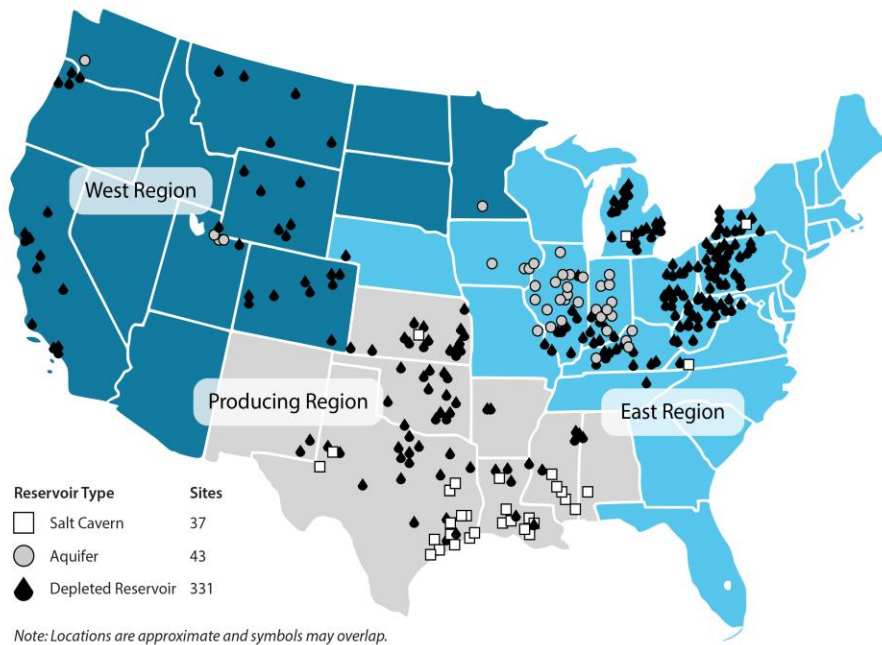


Source: EIA

The incident also exposes the possibility of inadequate oversight of approximately 400 underground natural gas storage facilities in the U.S., most of which are regulated by states (Figure 2).

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Figure 2 - Underground Gas Storage Facilities in the Contiguous U.S., 2010



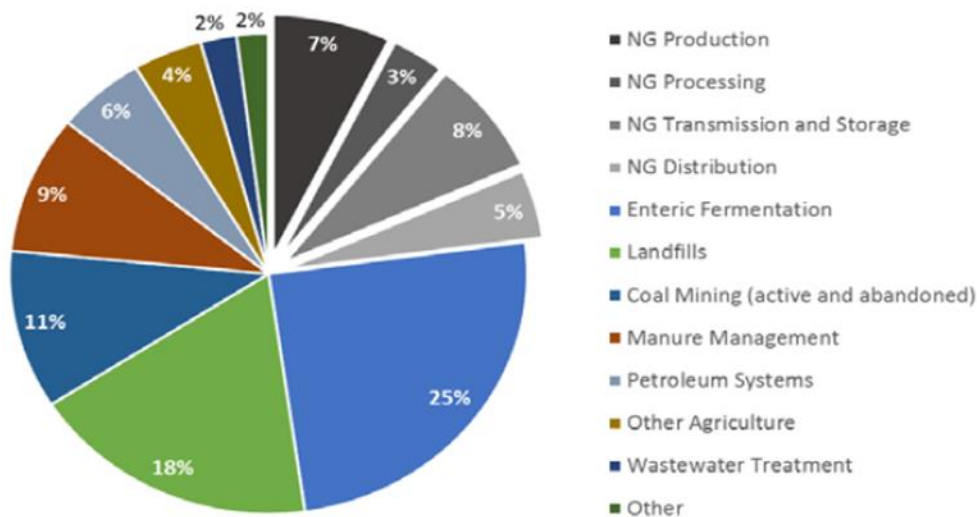
Source: EIA

In addition, the California example also raises concerns over fugitive emissions associated with the natural gas value chain even though natural gas power

plants offer definite air quality benefits in comparison to coal plants. Natural gas creates significantly less smog-forming nitrogen oxides, almost no sulfur dioxide and soot, and no mercury per unit of electricity generated. However, leaks and routine venting during the extraction, processing, and transportation of natural gas result in fugitive emissions, contributing to air pollution. Leaked methane is of more concern than flared methane as flaring converts the methane to carbon dioxide, which has a lower heat-trapping potential. In addition to unintentional leaks, a number of sources intentionally vent gas during well completions or when liquids are unloaded from wells. For example, pneumatic valves that operate on pressurized natural gas release small quantities of natural gas during regular operation. According to the Environmental Protection Agency (EPA), methane has 25 times the heat-trapping potential of carbon dioxide over a 100-year period. Methane emissions accounted for approximately 10 percent of U.S. greenhouse gas emissions in 2012. Natural gas sector emissions from all segments accounted for approximately 23 percent of total U.S. methane emissions (Figure 3).

Methane emissions accounted for approximately 10 percent of U.S. greenhouse gas emissions in 2012, with the natural gas sector representing approximately 23 percent of total U.S. methane emissions

Figure 3 - U.S. Methane Emissions, 2012



Source: DOE

About two percent of all natural gas is wasted through leaks, with these rates increasing at some sites. The environmental advantage of natural gas over oil and coal could be undermined if fugitive emissions and methane leaks are not properly addressed.

Federal Efforts to Regulate Oil and Gas Sector Methane Emissions Target New Sources

Federal regulatory frameworks for pollution controls currently address venting and leaking of natural gas from certain equipment and facilities. In August 2015, EPA proposed the first national standards for methane emissions from the oil and gas sector as part of the 2013 Climate Action Plan aiming to reduce methane emissions by 40-45 percent below 2012 levels by 2025. The standards target new and modified oil and gas wells, processing equipment, and storage facilities, while omitting existing wells. The proposed standards

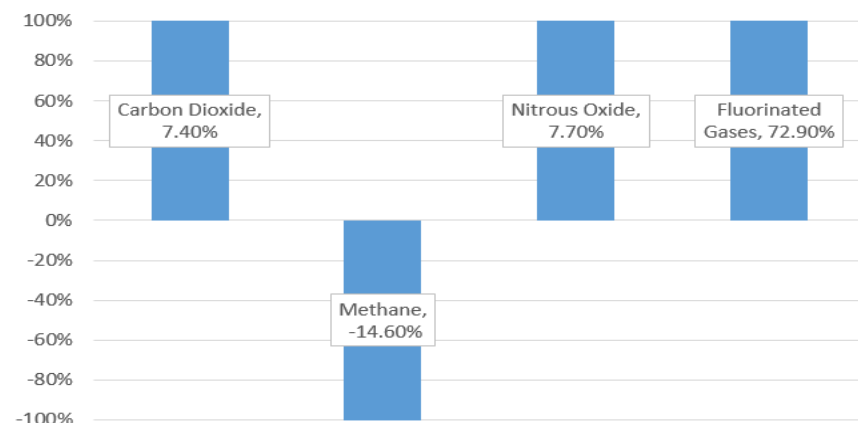
primarily target emissions of methane and volatile organic compounds (VOC) from new and modified sources to address leaks, capture gas from hydraulically fractured wells, and limit emissions from several equipment types used at compressor stations and storage facilities. However, environmentalists emphasized the need to expand the regulations to existing sources to meet the 2025 goal. The Environmental Defense Fund (EDF) has criticized the proposal for disregarding existing sources, which will account for an estimated 90 percent of methane emissions in 2018.

Historically, federal and state regulation to address methane emission reductions from the natural gas industry sector have occurred as a co-benefit of policies that target air pollution, such as smog, and safety improvements. The EPA’s New Source Performance Standards for the sector require oil and gas operators to limit VOC emissions from certain new and modified equipment and activities in the production, processing, storage, and transmission sectors. The standards specifically require storage tank operators in these sectors to control emissions by 95 percent using modern control technology such as flares or vapor recovery units.

The EPA’s greenhouse gas inventory shows that methane emissions from the natural gas system has decreased since 1990 (Figure 4). Majority of the emissions reductions in recent years have occurred in the production stage of the supply chain. An April 2015 report from the Department of Energy (DOE) points that methane emissions from the processing and transmission and storage segments increased by 13 percent from 2005 to 2012. Processed or pipeline-quality gas consists mostly of methane, meaning that emissions from downstream of processing – storage, transmission, and distribution sectors – contain more methane compared to VOCs. The report identifies existing frameworks as viable options to modify current regulations or adopt new regulations to reduce methane leakage. Importantly, the current regulatory framework does not directly address methane controls and does not cover methane emissions from older equipment, sources downstream of processing plants, and other select sources across all segments.

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Figure 4 - Percentage Change in U.S. GHG Emissions, 1990-2013



Source: EPA

Among other measures, the Obama Administration's Strategy to Reduce Methane Emissions commits the Bureau of Land Management (BLM) to propose updated standards to reduce venting and flaring from oil and gas production on public lands. The Federal Energy Regulatory Commission (FERC) has proposed a policy to enable a cost-recovery mechanism for investments in pipeline modernization, addressing "lost and unaccounted for gas" (LAUF) – difference between the gas that is metered into the system and metered out of the system. The policy would benefit pipeline companies' efforts to reduce LAUF gas. Under the traditional cost-of-service approach, the value of LAUF gas is typically passed through as a cost to ratepayers.

In July 2015, EPA proposed a voluntary framework for oil and natural gas producers to commit to methane-reduction and reporting targets. The EPA's proposed Methane Challenge Program builds on the 1993 Natural Gas STAR Program which provides a platform for companies making methane reduction commitments. The Program will complement regulatory actions, provide incentives and opportunities for voluntary methane emission reduction efforts, primarily from existing methane emission sources. While the Natural Gas STAR program requires partners to make a general commitment on a company-wide or regional level and report emissions reduction actions, the Methane Challenge Program will create a structure for companies to make specific ambitious commitments and annually submit data and information through the GHG Reporting Program to transparently track progress. According to EPA, ambitious commitments and transparency will facilitate information sharing regarding accomplishments and progress, encouraging broad industry adoption of best practices.

Several State Efforts Surpass Federal Requirements and Include Existing Sources and Directly Regulate Methane

Several states directly regulate, or have proposed to regulate, methane emissions, including requirements for new and existing sources. According to DOE, Colorado, Wyoming, Ohio, Pennsylvania, and California are in the forefront, with leak detection and repair requirements that limit emissions from well sites and gathering sector compressor stations (Table 3). In February 2014, Colorado became the first state to adopt a comprehensive set of requirements to directly control methane and VOCs from oil and gas production sources. These rules demonstrate the technical and economic feasibility of controlling methane emissions and provide a possible framework for adoption by other jurisdictions.

While Colorado and Pennsylvania directly regulate methane emissions, the other state programs directly regulate VOC emissions. The DOE notes that all five states require operators to use instrument-based detection methods that comply with EPA standard leak detection methods, such as infrared cameras or hydrocarbon analyzers. The rules require sound recordkeeping and reporting, and all programs require frequent inspection and timely repair of discovered leaks. Following suit, California has announced its intention to develop

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methane rules for oil and natural gas sources. Most other state regulations aim to reduce VOC emissions in the effort to lower ambient ozone levels.

Table 3 - State Leak Detection and Repair Requirements for Production Sources

State	Description
Colorado	<ul style="list-style-type: none"> • Frequency of instrument-based inspection depends on emissions potential • Applies to existing facilities • Statewide regulations
Wyoming	<ul style="list-style-type: none"> • Quarterly instrument-based inspections • Does not apply to existing facilities; proposal to cover well sites with at least 4 Tpy of fugitive VOCs. • Regulations limited to Upper Green River Basin Ozone nonattainment area
Ohio	<ul style="list-style-type: none"> • Quarterly instrument-based inspections; potential to reduce to semi-annual and then annual if less than 2% of components leaking after 5 consecutive inspections • Does not apply to existing facilities
Pennsylvania	<ul style="list-style-type: none"> • Annual inspections • Does not apply to existing facilities • Statewide regulations
California	<ul style="list-style-type: none"> • Quarterly inspections; potential to reduce to annual based on percentage of leaking components • Applies to existing facilities • County specific regulations • Exempts low-VOC components

Source: DOE

Enhanced Leak Detection Capabilities Critical to Address Leaks and Fugitive Methane Emissions

According to DOE, existing methane monitoring devices have limited ability to cost-effectively, consistently, and accurately locate and quantify leak rates. Operators may not easily identify leak locations without the use of high-cost monitoring equipment, hindering the adoption of efficient remedies to mitigate methane leaks. The Advanced Research Project Agency-Energy’s (ARPA-E) Methane Observation Networks with Innovative Technology to Obtain Reductions (MONITOR) program aims to address these inadequacies through new technologies that can estimate methane emission flow rates, provide continuous monitoring, localize the leak source, and improve the accuracy of methane detection.

Several oil and gas companies are currently engaged in voluntary efforts to implement innovative technologies, such as Forward-Looking Infrared (FLIR) technology to address fugitive emissions, vapor recovery towers, efficient compressors, and programs for leak detection and repair surveys. Companies

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participating in EDF's Methane Detectors Challenge are engaged in a competitive approach to develop cost-effective technologies for real-time methane detection to simplify leak-fixing. The EPA's Gas STAR partners have implemented more than 50 specific cost-effective technologies and practices across the oil and natural gas value chain. Through 2013, Gas STAR partner companies have reported voluntary methane emission reductions of over one trillion cubic feet (over 400 MMTCO_{2e}). The ONE Future Coalition, a group initiated by leading natural gas producer Southwestern Energy, aims to reduce methane emission from the entire natural gas value chain. Its members include natural gas distributor AGL Resources Inc., electricity and gas distributor National Grid, upstream operators Apache Corporation and Hess Corp, pipeline operator Kinder Morgan and mining giant BHP Billiton.

In addition to administrative costs for governments, new regulations would carry investment costs for industry alongside fuel savings and other co-benefits. For example, EPA estimates its proposed methane rule to cost \$320 to \$420 million in 2025 while providing total benefits of \$460 million to \$550 million. The proposal could reduce the benefits of growing the share of natural gas in electricity generation, which is a key compliance option under the EPA's Clean Power Plan.

Reducing Methane is Crucial for Meeting U.S. Emissions Targets

Curtailing methane emissions is critical for the U.S. to meet its emissions-reduction targets. Utilities and pipeline companies consider natural gas as an important fuel to replace coal and supplement renewable energy generation and meet environmental regulations in the near term. Investments in natural gas-fired generation have been spurred by easy access to low-cost shale gas. As utilities face the need to shift to carbon-free energy sources, natural gas is expected to serve as backup fuel providing grid flexibility in integrating renewable technologies.

Industry would be required to increase focus on methane detection technology to improve operational efficiency and reduce methane emissions. Expansion of existing voluntary initiatives would enable companies to access cost-effective technologies and incentives to reduce emissions. Regulation at federal and state levels and investment in new technologies will enable industry to efficiently and substantially reduce fugitive emissions and methane leaks.

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Disclosures Section

RESEARCH RISKS

Regulatory and Legislative agendas are subject to change.

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