The Methane Detectors Challenge

An Unexpected Partnership:
Accelerating technology innovation for continuous methane detection in the oil and gas sector
The Methane Detectors Challenge (MDC) is a groundbreaking partnership between Environmental Defense Fund (EDF), oil and gas companies, U.S.-based technology developers, and other experts that aims to catalyze the development and commercial marketability of continuous methane detection technologies.

Continuous detection technologies will enable oil and gas companies to detect and fix methane leaks in real time, in days instead of months. Timeliness is imperative since methane is roughly 80 times more powerful than carbon dioxide as a greenhouse gas in the first twenty years.¹

Launched in 2014, MDC successfully raised awareness about the role of technology innovation to solve the serious problem of undetected methane emissions along the oil and gas supply chain. By forming a unique collaboration among an environmental group, oil and gas companies and tech entrepreneurs, MDC led to the development of breakthrough technology and catalyzed oil and gas industry leaders to engage in deploying potential solutions to quickly find and fix methane leaks.

Introduction

Methane, the primary component of natural gas, is also a potent greenhouse gas. Many studies have shown that methane is emitted to the atmosphere at many stages of the oil and gas industry – sometimes on purpose, and sometimes by accident, (accidental emissions are technically known as “leaks” or “fugitives”). It is estimated that 9.8 million metric tons of methane were released by the U.S. oil and gas industry in 2014 alone.

Estimates of emissions of methane from the oil and gas industry vary widely; however lower bound estimates suggest that at least 1-2 percent of the product is lost to the atmosphere throughout the supply chain that includes exploration, production, transportation, processing and distribution. This is highly problematic for the climate, since methane is more than 80 times more powerful than carbon dioxide as a greenhouse gas over the first 20 years. It is estimated that 25 percent of current global warming is caused by methane emissions.

Methane emissions are also a business challenge because lost methane is wasted product.

Today’s approaches to detecting methane leaks are uneven across the oil and gas industry, in part because of the lack of federal regulation for leak detection and repair (LDAR) programs. Some companies conduct LDAR on a voluntary basis while others send trained personnel to a well pad on a fixed schedule.

However, methane leaks can occur at any time and in any location along the oil and gas supply chain. In fact, a small number of leaks account for a majority of methane emissions. These “super emitters” are leaks that need to be detected in minutes, not months. Therefore, continuous methane monitoring technology can be the solution.

Many oil and gas companies use infrared cameras that allow visual identification of leaks. However, these cameras cost approximately $100,000 each and it is not cost effective for them to be stationed continuously at every potential emissions source.

Today, there are more than one million oil and gas wells in operation in the U.S. If those wells were equipped with low-cost methane leakage sensing systems, this it would represent a substantial market opportunity. The Methane Detectors Challenge identified the most promising continuous detection technologies that can have significant benefit for the environment, partner oil and gas companies and local communities.

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Methane has more than 80 times the global warming impacts of carbon dioxide over a 20-year period.\textsuperscript{2}
Reducing methane emissions can be done affordably, with existing technology and with benefit to industry, including: recaptured product and improved operational efficiencies.

The Methane Detectors Challenge (MDC), a groundbreaking partnership between Environmental Defense Fund (EDF), oil and gas companies, U.S.-based technology developers, and other experts, aims to catalyze the development and commercial marketability of continuous detection technologies that will enable oil and gas companies to detect and fix methane leaks in days, not months.

Additionally, if we can catch and fix more leaks, more rapidly, we will increase saleable product while improving operational efficiency.

During a three-month period, the Methane Detectors Challenge accepted proposals from technology developers that were reviewed by EDF and oil and gas company partners. The most promising MDC technologies underwent rigorous, independent testing and received substantive technical performance feedback. The technologies that met required specifications advanced to pilot field trials at facilities run by MDC partners and other oil and gas companies.

Minimizing methane emissions is a common sense goal for both the oil and gas industry and environmental community. Today’s methane leak detection approaches are periodic, require site visits and do not catch all leaks when they start.

However, cost-effective, continuous leak detection technology is possible and can deliver important environmental and business benefits.

Globally, the oil and gas industry loses $30 billion each year in revenue through wasted unburned natural gas.4

In the U.S. alone, it is estimated that the oil and gas industry loses $2 billion each year in revenue through wasted unburned natural gas (an amount that could meet the heating and cooking needs of more than 7 million U.S. homes for a year5).


$2 billion in revenue is lost each year through wasted, unburned natural gas in the U.S.

This could have met the heating and cooking needs of over 7 million homes for a year.
EDF has consistently broken the expected mold for environmental NGOs. Over its 50-year history, EDF has applied science, economics and strategic partnerships to achieve results. EDF’s pragmatic approach reaches across political parties, the environmental community and the private sector. When EDF drives environmental solutions, it ensures that people and businesses thrive right alongside the planet.

Corporate partnerships have been a cornerstone of EDF’s approach since 1990, when it launched a game-changing collaboration with McDonald’s. In the following years, EDF partnered with other unlikely allies to kick-start market transformations in shipping with FedEx, private equity with KKR and retail with Walmart.

The oil and gas sector is the largest source of methane emissions globally and in the United States. By working with key leaders in the sector, EDF believed there was an opportunity to have a substantial impact on reducing methane emissions.

In 2012, EDF partnered with 100 universities, research institutions and oil and gas companies to conduct a series of research projects that sought to quantify the scope of the methane leak problem.

The research was designed to find out how much and from where methane was escaping across the entire oil and gas supply chain. Overall, it was found that methane emissions exceeded industry estimates. Of the 16 studies in this research project, data from 14 were published in 28 peer-reviewed papers.6

The Methane Detectors Challenge emerged from this earlier research as one solution to the problem: how to reduce methane emissions by detecting and fixing leaks fast. EDF and the oil and gas partners began to focus on catalyzing the development of continuous detection technologies. The earlier research allowed Methane Detector Challenge partners to understand the technical challenges of distributed continuous monitoring which resulted in more market-ready solutions. These relationships provided an opportunity to bring innovative technologies from the lab to real-world application.

6 For the most recent list of peer-reviewed papers, go to: <https://www.edf.org/sites/default/files/methane_studies_fact_sheet.pdf>.
In March 2014, the Methane Detectors Challenge called for proposals for methane sensor technologies that measure methane down to a detection level of 2 ppm, targeting a hardware cost of $5,000 for pilot phase deployment and $1,000 hardware when produced at scale. These specifications were jointly designed by scientists, environmental groups and oil and gas companies so that solutions could be deployed rapidly while providing significant environmental and business benefit. This call attracted 20 proposals from companies and university research teams in the United States, South Africa, Singapore, Sweden and China. The proposals utilized diverse technologies ranging from infrared lasers to circuit boards filled with off-the-shelf sensors.

In August 2014, five technologies were chosen by EDF and partners for rigorous testing at Southwest Research Institute (SwRI), one of the nation’s largest independent applied research organizations headquartered in San Antonio, Texas. Innovations selected to move forward included:

- an integrated system for low-level methane leak detection adapted from a handheld sensor currently used in vehicles to detect high alcohol levels in drivers, developed by RAE Systems, a subsidiary of Fortune 100 company Honeywell, in collaboration with SenseAir, a Swedish sensor designer;
- a sensor network on a single circuit board, using low-cost, commercially available sensors, designed by a research team from the University of Colorado Boulder;
- an electrochemical sensor solution with a target cost of $30, developed by researchers from Oakland University and Michigan State University;
- an infrared laser-based methane detection system designed by Acutect Inc., a San Francisco startup building on laser technology currently used to sense natural gas in the Chinese energy industry; and
- a low-cost, methane-specific laser-based system that does not require direct contact for detection, developed by Quanta3, a technology startup company founded by a Boulder, Colorado-based research engineer.

From September 2014 to August 2015, the selected technologies were further tested in the lab and field locations.

During September 2015, EDF and the partner oil and natural gas companies identified the top two performing technologies that met required specifications and qualified for consideration for pilot purchases and deployments.

The two companies selected for the Methane Detectors Challenge were: Quanta3 and Acutect Inc. These entrepreneurs are working with PG&E and Statoil to pilot the technologies at active operational sites.
EDF initiated this Methane Detectors Challenge to jumpstart the market in finding solutions that could cut emission detection time. Speed matters—we can slash detection time from months to minutes. We’re collaborating with leading oil and gas companies, researchers, and other experts because we all see the promise of unlocking emerging technology to cut waste and help the climate in a big way.

– BEN RATNER, DIRECTOR, EDF
EDF convened a workshop with industry stakeholders and experts to discuss the need for low-cost, continuous leakage detection systems and key requirements for these systems.

Global call for proposals for methane sensor technologies that operate autonomously, measure methane down to a detection level of 2 ppm and would have a hardware cost of $1,000 per site or less, if produced at scale.

Five technologies chosen for rigorous testing at Southwest Research Institute (SwRI), one of the nation’s largest independent applied research organizations.

Twenty proposals from technology entrepreneurs submitted to EDF, the participating oil and gas companies and other advisors and experts.

Technologies undergo testing with controlled releases of methane in indoor laboratory environment at SwRI.

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Technologies undergo testing with controlled releases of methane in indoor laboratory environment at SwRI.
Entrepreneurs continue technology development to prepare units for second phase of intensive testing.

SwRI conducts several months of technology testing with controlled releases of methane indoors and outdoors, utilizing methane emission events of varying sizes and distances from the methane detection systems.

Technologies developed by Acutect and Quanta3 piloted by Statoil, Southwestern Energy and other oil and gas partners.
For EDF and partner oil and gas companies, the Methane Detectors Challenge was a win-win value proposition: reducing methane gas emissions is good for the environment and good for the oil and gas industry. However, MDC faced several external challenges.

In 2015/2016, global oil and gas commodity prices dropped precipitously. At the nadir, oil prices had dropped from $100 per barrel to $29 per barrel and natural gas prices had declined from $6 per MMbtu to under $2 per MMbtu. MDC industry partners experienced significant financial difficulties as revenues declined. Many were forced to reduce staffing and slash funding for capital expenditures. It was at this time that the MDC timeline called for partner staff time and investment for testing new technologies. Despite adverse conditions, many MDC oil and gas partners maintained their commitments to the project.

Also, during the Methane Detectors Challenge, the Environmental Protection Agency (EPA) was planning new standards to reduce methane emissions from both new and existing sources in the oil and gas sector.

After SwRI testing of MDC technologies concluded, it was still unknown whether the EPA would grant compliance credit for development or utilization of new technologies and monitoring strategies. MDC industry partners, therefore, were considering investments in new technologies without a guarantee that these investments or the technologies themselves would meet their regulatory obligations. In May 2016, the EPA published the new regulations, including an innovation pathway through which new approaches yielding equivalent or better environmental results can be approved.

As a result, there is an opportunity for continuous methane detection monitors to be approved as regulatory compliance tools.

The Methane Detectors Challenge has provided entrepreneurs with an opportunity to test and market innovative technologies. As is the case with new product-based ventures in any sector, MDC finalist are challenged as they move from prototype to orders at scale that will drive down unit costs and create a sustainable revenue stream. MDC finalists are in the "Valley of Death", the period of time when startups must turn from prototyping to streamlining production and customer service. During this time, there are significant demands on cash flow and little revenue.
The solutions we are using to mitigate emissions are very cost-effective in nature meaning that the benefit is clearly outweighing the costs associated with doing this, but at the same time, from a business perspective, if you can reduce emissions, improve productivity by keeping the product in the pipeline and do it cost-effectively, it is a win-win-win situation.

– DESIKAN SUNDARARAN, SR. RESEARCHER, STATOIL
Conclusions

While the long-term impact of new methane detection technologies will only be clear in years to come, the immediate successes of the Methane Detectors Challenge are already known:

**Raised Awareness**
MDC has dramatically raised awareness about the key role that technology innovation plays in solving the challenge of continuously detecting methane emissions along the oil and gas supply chain. This raised awareness has led to a surge of entrepreneurial activity and an increased openness to new ideas, approaches and technologies by leading oil and gas companies.

**Unexpected Partnerships**
MDC has demonstrated that environmental groups and oil and gas companies can find common ground and work together on environmental issues in a win-win relationship. This solutions-oriented approach is a model for collaborative partnerships that EDF will pursue in the future.

**Breakthrough Technology**
While it is too early to declare success, a number of breakthrough continuous detection technologies have emerged from MDC. These technologies are being continually improved and are being purchased by Statoil and others.

Without MDC, technology innovators may never have turned their attention to continuous methane detection nor would their technologies have been rigorously evaluated against the needs of the oil and gas sector.

**Industry Leadership Catalyzed**
EDF was able to engage oil and gas sector leaders in both quantifying the scope of the methane leak problem through an earlier collaborative research project, and, then, through MDC, partnering to find potential solutions. Industry leaders such as Statoil and Southwestern Energy committed staff and resources to MDC, despite difficult external economic conditions, because they believed that innovative, low-cost technologies could substantially impact their ability to quickly detect methane emissions.

EDF assesses the success of our corporate engagement activities based on our impact. By working with leaders from the oil and gas industry, the largest source of methane emissions globally, EDF was able to proactively engage companies in both defining the problem and creating the solution.
In April 2016, Pacific Gas & Electric (PG&E) approached EDF about their efforts to drive reductions in methane gas emissions through the use of innovative technologies. After initial discussions, it was decided that PG&E would test a technology developed by Acutect, a San-Francisco startup that built on affordable laser technology. The Acutect technology was one of two technologies identified as most promising by the Methane Detectors Challenge.

In August 2016, PG&E placed an Acutect system at their training facility and lab located in Livermore, California. Based on PG&E’s feedback, Acutect improved the reliability of the data collection and telecommunication of their unit, which was then subjected to controlled tests in September 2016. During this time, the unit successfully detected methane leaks from 100 feet away. Based on the positive results observed during the controlled tests, PG&E proceeded with the next assessment phase. In November 2016, the Acutect unit was installed at the PG&E Los Medanos gas storage facility where it will be tested and monitored for three months.

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There is consensus that methane emissions are a challenge that oil and gas companies and innovators can meet. EDF brought together uncommon partners to tackle a complex problem. As with many new partnerships, this required patience, good will, problem solving and the ability to understand different perspectives. The reward: technical innovation that no one could have imagined four years ago.”

– AILEEN NOWLAN, MANAGER, EDF
LOOKING FORWARD

While the Methane Detectors Challenge is a unique undertaking, EDF plans to pursue more collaborative projects with the global oil and gas sector.

EDF aims to continue catalyzing innovation by working with innovators and industry stakeholders with the goal of reducing global oil and gas methane emission by 45% by 2025.

Inspired by the potential of open source innovation, EDF is also working with entrepreneurs and advisors to meet ambitious goals in health, agriculture and clean energy.

RELATED REPORTS:

Methane Detectors Challenge Phase 1 Testing Report, Southwest Research Institute, 2014.
⇒ EDF.org/MDCPhase1

Methane Detectors Challenge Phase 2 Final Report, Southwest Research Institute, 2015.
⇒ EDF.org/MDCPhase2
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