PREDICT WITH PRECISION: A QUICK WIN TO REDUCE EMISSIONS USING IOT
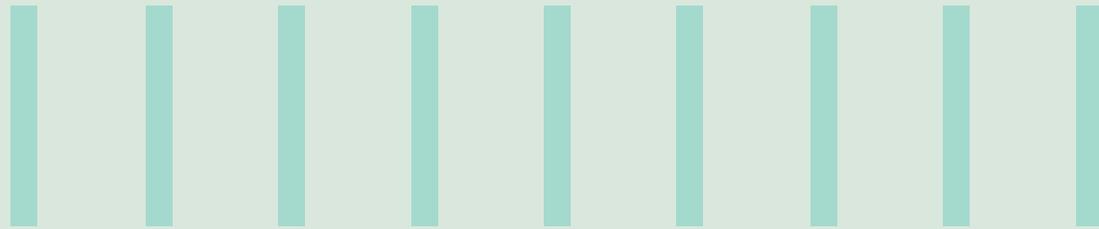
Abstract

The oil and gas industry is under pressure from regulators and global agencies to reduce greenhouse gas (GHG) and carbon emissions. Many players are considering different technologies and tools to achieve these sustainability goals. This paper explains how the Internet-of-Things (IoT) is a useful solution to minimize equipment downtime and reduce fugitive emissions. It also looks at the challenges of implementing IoT in the oil and gas value chain and provides a way forward.

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Introduction

The oil and gas industry is under immense pressure to reduce greenhouse gas (GHG) emissions. Their contribution is critical, considering this industry is responsible for approximately one-third of total GHG emissions worldwide (1). Thus, there is an increasing global focus on encouraging oil and gas companies to use green and renewable energy and meet net zero emissions. Further, the tightening of regulations on GHG emissions is forcing companies to rapidly transform their operations.
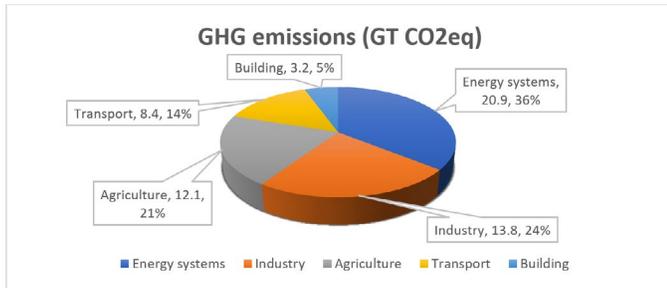

Figure 1: Industry-wise GHG emissions in 2023

Green Imperatives for the Oil and Gas Industry

In response to the increasing pressure and tightening regulatory requirements, companies have set ambitious targets to achieve net zero emissions by 2050. But fugitive emissions or venting is a major emission source and accounts for more than 50% of the total GHG emissions in the oil and gas value chain (2).

Figure 2: Types of emissions in the oil and gas value chain, by source and share

Since fugitive emissions or venting account for a majority of the emissions from the industry value chain, cutting down on these can be a quick win for the companies. Some leading oil and gas companies are already working their way towards these goals.

O&G companies		Scope 1	Scope 2	Scope 3	Emissions intensity	Targets (Scope 1 and 2 emissions)
Tier-1 OFS companies	HALLIBURTON	✓	✓	✓	✓	Unspecified reduction targets
	Baker Hughes	✓	✓	✓	✓	~ 50% by 2030, net zero by 2050
	Schlumberger	✓	✓	✓	✗	~ 30% by 2025
	Weatherford	✓	✓	✗	✗	Only 2020 targets visible
Explorations and production companies	bp	✓	✓	✓	✓	Net zero by 2050
	Chevron	✓	✓	✓	✓	Oil: 5-10% by 2023; Gas: 2-5% by 2023
	ExxonMobil	✓	✓	✗	✗	~ 10% in Canada by 2030. Few other visible targets
	Shell	✓	✓	✓	✓	Net zero by 2050
	TOTAL	✓	✓	✓	✓	Net zero by 2050
	ConocoPhillips	✓	✓	✓	✓	Net zero by 2045-2055
	eni	✓	✓	✓	✓	Net zero (upstream) by 2030, net zero (group) by 2040

Figure 3: 2050 emission reduction targets of major oil and gas companies

An IoT Solution

Leveraging the Internet of Things (IoT) for the oil and gas industry is a promising way to reduce emissions through the seamless collection and processing of data. The IoT market in the energy sector is expected to grow at a CAGR of nearly 9% from US $37.7 billion in 2020 to US $59 billion by 2025 (3).

For example, an IoT-based leak detection and predictive maintenance solution can help oil and gas operators reduce fugitive emissions and flaring. The sensors installed in equipment and pipelines can fetch real-time data and pass this to the cloud for detailed analysis and prediction.

As seen in Figure 4, operators can leverage such data to identify pre-failure conditions and perform preemptive maintenance, thereby avoiding unplanned downtimes, ensuring smooth operations, and enabling smarter utilization of assets.
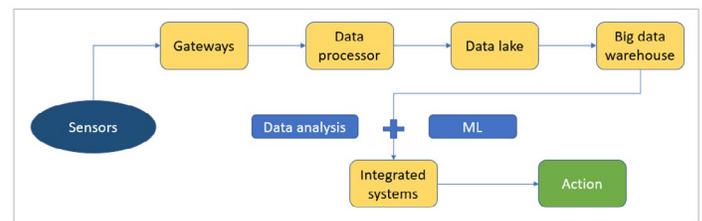

Figure 4: Schematic diagram for an IoT solution

Challenges of Implementing IoT for Predictive Maintenance

While IoT solutions can deliver operational efficiencies at speed, there are some fundamental challenges to its adoption, which is why IoT is not widely implemented in the oil and gas industry thus far. These challenges are listed below (4):

Cost - Intensive	• Significant investment needed in smart sensors, technology, and monitoring software • High costs involved in training staff to work with new technology
Compatibility with sensors	• Existing machines may not be compatible with smart sensors • Need to alter existing assets or install new ones
Integration with existing systems	• IoT network should be secure in order to send, process, and store all data • Integration of existing systems such as ERP with new IoT technology using APIs
Data privacy and security	• Compliance with strict confidentiality guidelines • Concerns about the security of IoT network and privacy of data
Reluctance to change	• Incumbent staff know that moving to predictive maintenance will mean that their skills and knowledge may become redundant

Implementation Strategy

Based on our experience, there are four key pillars to implementing IoT-based predictive maintenance. This approach can help oil and gas organizations address the above challenges and seamlessly adopt the technology.

Master data management	Robust analytics infrastructure	Stakeholder alignment	Right expertise
Recognize that the organization's database management and governance frameworks play a critical role in implementing an effective predictive maintenance strategy Ensure availability of high-quality and actionable data for accurate predicting and forecasting	Implement a robust analytics infrastructure, which can process and store large volumes of big data Focus on setting up both hardware and software capabilities	Demonstrate the value of predictive maintenance and analytics-driven decision-making in order to get senior leadership support Align the organization strategy with the outcomes of predictive maintenance	Onboard specialists such as data scientists and analysts with relevant expertise Procure technologies to build analytics models that unlock maximum benefits from predictive maintenance

Conclusion

Typically, oil and gas companies face at least 27 days of unplanned downtime each year, which translates into average monetary losses of US $38 million (5). According to a McKinsey report, IoT-based predictive maintenance extends the life of equipment and reduces downtime by 20% (6).

As a solution, IoT implementations in the oil and gas sector are still nascent. Capturing the full potential of IoT applications will require innovation in technologies and business models. Companies will also need to invest in new capabilities and expertise by sourcing the best talent. With the right strategy, IoT-based predictive maintenance can enable oil and gas companies to predict potential issues with precision and reduce fugitive emissions. This, in turn, will deliver quick wins, accelerating the journey to achieving net zero carbon emissions. While there are certain challenges to adopting IoT in legacy industries such as oil and gas, when carried out systematically and incrementally, the companies will see sustainable business benefits in the long term.

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