

# HOW THE INTERNET OF THINGS IS POWERING THE OIL AND GAS INDUSTRY

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# HOW IOT IS POWERING THE OIL AND GAS INDUSTRY

## Oil & Gas + IoT = Success

The Internet of Things (IoT) is transforming the oil and gas industry at a rapid pace, with experts projecting that IoT solutions could eliminate unplanned well outages, boost crude output by 10 percent over a two-year period, and increase profits by nearly \$1 billion for large O&G companies.

In fact, IoT applications in this industry are predicted to increase GDP by as much as 0.8 percent, or \$816 billion, over the next decade. With so much potential, it makes sense why 62% of oil and gas executives are developing a digital strategy to transform their business.

In this white paper, we'll explain how IoT technologies have delivered value for **upstream, midstream, and downstream** O&G companies. While this value can be achieved in a variety of different ways, we'll examine the major IoT use cases for each of the main parts of the O&G value chain.

## The internet of things in the oil and gas value chain

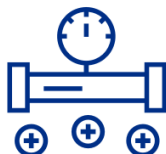


### Upstream

Upstream O&G companies search and drill for crude oil and natural gas resources.

#### Major IoT Use Cases

- **Preventative Maintenance.** Receive automatic alerts when systems need to be fixed.
- **Inventory Management.** Monitor small and large equipment across multiple sites with IoT-based sensors.
- **Big Data Analytics.** Improve operations by collecting performance data from industrial machines.



### Midstream

Midstream O&G companies transport oil and natural gas to markets.

#### Major IoT Use Cases

- **Remote Monitoring.** Collect remote data on pipeline pressure, temperature, and flow, etc.
- **Environmental Monitoring.** Monitor gas emissions and waste conditions to ensure compliance.
- **Remote Data Collection.** Collect real-time performance data from massive pipeline networks.



### Downstream

Downstream O&G companies refine oil and gas, as well as market and distribute it.

#### Major IoT Use Cases

- **Predictive Maintenance.** Use wireless sensors to counteract unplanned shutdowns.
- **Supply-Chain Management.** Collect data on consumer consumption to improve forecasting demands.
- **Compliance Reporting.** Remotely track fuel levels at gas stations to meet regulatory standards.

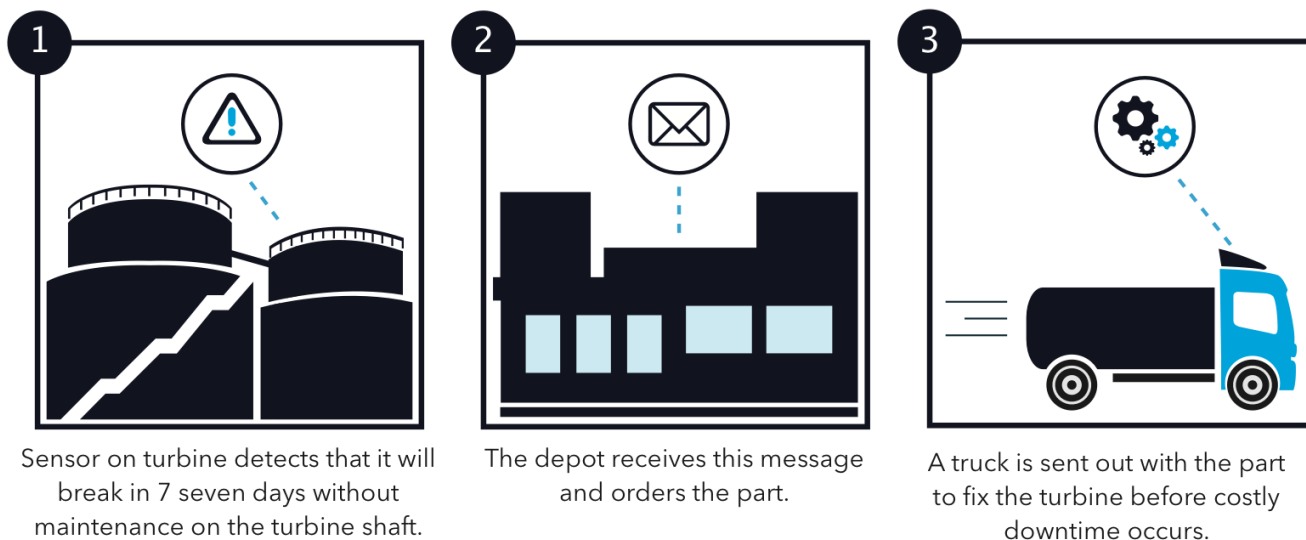
## 1. How IoT is powering upstream O&G companies

According to Deloitte, IoT applications could reduce the lift and production costs of oil and gas by more than \$500 million. For instance, IoT technologies could help upstream O&G companies increase rig uptime through sensor-based preventative maintenance, improve equipment monitoring across sites, and provide better seismic data about what lies underneath subsurface exploration sites. Here are some ways operators are using IoT-based preventative maintenance, equipment monitoring, and big data analytics to increase upstream operations and production:

### Preventative maintenance for remote machinery and equipment

A typical large O&G company may find itself monitoring more than 50,000 wells and multiple pieces of equipment (small and large) per well. The costs of equipment malfunction tend to cascade. A single malfunctioning machine can slow production, and result in regulatory non-compliance.

*Preventative maintenance on a gas turbine*



Thankfully, IoT technologies are helping businesses protect valuable in-field assets. By returning to the use case of oil and gas extraction, we can see how IoT technologies stand to revolutionize equipment maintenance. Extraction sites are filled with highly complex and expensive equipment. Traditionally, that equipment was safeguarded solely by infrequent and imperfect in-field inspections. Due to their scale and complexity, even minor technological malfunctions can result in reduced efficiencies and significant financial losses.

Now, an inexpensive IoT device can be deployed to remotely monitor equipment, track maintenance schedules, and prevent malfunction. If a piece of equipment begins to malfunction or underperform, the IoT device will instantly issue an automated alert. Doing so will limit losses caused by inefficiency, and help prevent full-scale failures and equipment damage. In this way, IoT devices help transform equipment maintenance from a responsive process into a proactive one.

## **Inventory management across large sites**

IoT technologies have been proven to help track, service, and maintain wells and equipment across sites as well. By attaching IoT-based asset trackers and other sensors, producers can track their equipment and machine fleets in real-time. Moreover, additional sensors can gather data, such as the temperature and liquid levels of moving goods, and send that to a consolidated asset tracking interface. Not only can IoT technologies help providers locate important field assets, but they can also help keep employees safe. With oil and gas workers seven times more likely to be injured on the job, monitoring equipment and alerting operators the minute a piece of machinery needs to be replaced ensures that employees are working in a safer environment.

## **Reduce well downtime through big data analytics**

According to Microsoft, a single pump failure can cost \$100,000 to \$300,000 a day in lost production. From progressive cavity pumps to blow-off valves, virtually every major piece of machinery requires regular maintenance by trained staff. Oil producers typically use different types of sensors to monitor key components and equipment. However, most companies still retrieve this data manually through service technicians who have to spend the majority of their time collecting data instead of analyzing it. By adding wireless connectivity to these sensors, producers can direct their analysts towards leveraging big data to improve the efficiency and lifetime of their production assets.

Introducing connectivity into wells helps operators improve production and efficiency. When an oil well gets blocked by fluids, producers artificially lift the fluids using a plunger in order to resume production. The decision of when and how to deploy this plunger is traditionally taken by a human operator. The operator assesses several critical data points, such as time, pressure, production volume, and temperature, and develops a dynamic production schedule for each individual well. Connecting these sensors to a cloud-based AI solution can enable a better understanding of how respective data points correlate and change over time. This leads to more efficient plunger lift control, a higher degree of automation, and increased well productivity.

## 2. How IoT is powering midstream O&G companies

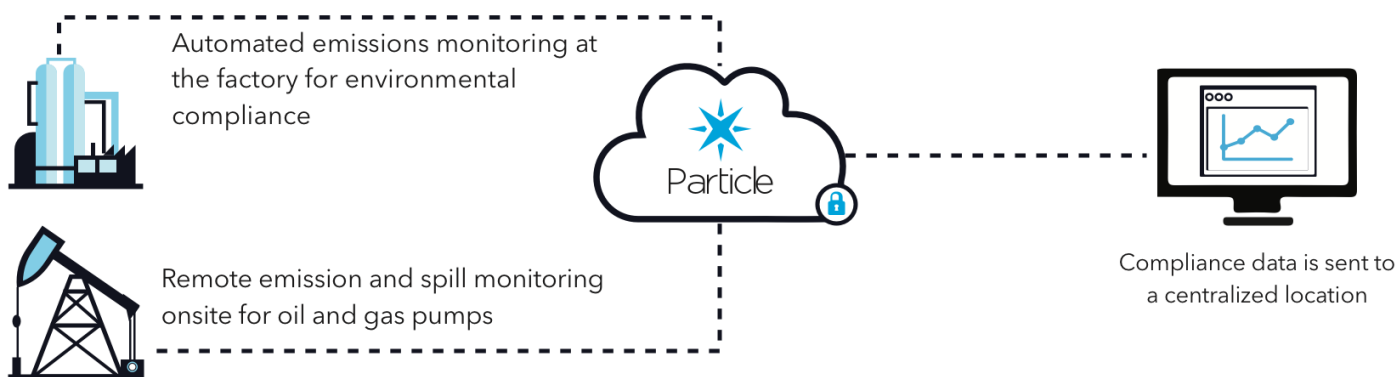
The ability to effectively monitor and control pipeline infrastructure is critical to midstream pipeline operations. Pipelines are prone to damage and leaks because fuel is typically transported under high-pressure conditions. According to PennEnergy, pipeline operators lose approximately \$10 billion per year due to pipeline leaks and fuel theft. This has led many operators to examine IoT monitoring solutions that can help them adequately maintain their pipeline infrastructure. Here are some ways oil and gas operators are using IoT technology to build smarter pipeline systems.

### Remotely monitoring oil fields instead of site visits

Leading multinational operators are saving millions by using IoT sensors to monitor pipelines in remote locations. With sensors, they are able to collect field data on pipeline pressure, temperature, and flow. This has helped them build a support platform to optimize their productivity and increase the safety of their oilfield operations. These sensors have also enhanced pipeline maintenance operations by enabling operators to detect pipeline malfunctions early on, preventing major problems before they occur. In other words, IoT-based remote monitoring not only limit losses caused by inefficiency, but also helps prevent full-scale failures and equipment damage.

### Environmental monitoring and regulatory compliance

Another key benefit of using IoT-connected sensors is that it allows pipeline operators to adequately monitor environmental conditions and ensure compliance with regulations on emissions and waste, among other areas. In the past, a field agent would need to physically inspect an extraction or processing site to ensure regulatory compliance. Now, an IoT device can be deployed in the field to remotely monitor essential compliance metrics, such as oil leaks and gas emissions.



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Not only does this functionality reduce the costs associated with field monitoring, it is also much more responsive. Whereas a field agent may only be able to visit a given site once a quarter, an IoT device can provide constant, up-to-the-minute data in real time. This responsiveness helps limit the extent of penalties when non-compliance does occur. In the case of leaks and emissions, regulatory penalties are often proportional to the amount of materials released. IoT devices could therefore limit a company's exposure to penalties by allowing them to respond to leaks proactively.



*An estimated 10 terabytes of data is generated out of every 150,000 miles of pipeline*

## Remote data collection on pipeline networks

Pipeline development typically happens over large distances in areas where population density is very low. Because of this, communications infrastructure has had to evolve in previous years in order to securely connect oilfield operational technologies (OT) with the information technology (IT) resources to control and optimize them.

As low-power wide-area cellular networks progress towards commercial maturity, device manufacturers and software providers are coming up with new solutions to unlock efficiency gains. In the context of the oil & gas industry, the aim of these solutions is a seamless integration between OT and IT. For example, monitoring infrastructure can integrate tighter feedback loops, thus enabling process control and optimization as well as asset management to occur semi-autonomously.

According to GE, operators invest around \$40 billion every year to maintain, modernize, and expand gas pipeline networks. That's because many U.S. gas pipeline networks have been in service for at least two decades, which means they often need to be improved to move fuel to market quickly and safely. IoT technologies give operators an opportunity to monitor and collect real-time performance data from these massive pipelines.

One major midstream operator equipped their 15,000-mile gas pipeline network with IoT sensors to track where repairs are needed and receive detailed analytics of the pipeline's performance. With an estimated 10 terabytes of data generated out of every 150,000 miles of pipeline, it is clear that pipeline operators are gaining unprecedented insights from IoT sensors.

## 3. How IoT is Powering Downstream O&G Companies

Downstream oil and gas companies, including petroleum delivery operators, gas retailers, and others, face significant business challenges because they sell highly commodified products. The price of oil and gas fluctuates constantly, forcing companies in this space to focus on financial stability and long-term strategic planning rather than on investing in R&D technology and processes. Despite these challenges, IoT technologies have been proven to improve operational efficiency and reduce costs by connecting internal infrastructure.

### Optimizing refinery shutdowns with IoT-based predictive maintenance

According to Hydrocarbon Publishing, there were more than 2,200 unscheduled refinery shutdowns in the United States alone between 2009 and 2013. These unplanned shutdowns cost global process industries 5 percent of their total production (equivalent of \$20 billion per year). Ineffective maintenance practices also result in unscheduled downtime that costs global refiners an additional \$60 billion per year, on average, in operating costs.

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#### Quick Highlights

- Minimized downtimes
- Improved efficiency
- Immense savings
- Responsive maintenance
- Planned downtimes

With the assistance of IoT sensors and technology, global process industries can save millions and conduct maintenance procedures only when needed. A simple IoT device can now monitor essential performance metrics in real-time and send alerts the moment something starts to go wrong. This means that operators can address malfunctions and breakage before they become larger issues and plan downtimes more efficiently.

Moreover, when downtimes do occur, these sensors and monitors can help identify the source and location of the issue, thereby minimizing time lost during maintenance inspections. While that type of functionality might sound relatively minor, when applied at scale, it can result in immense savings and increased efficiencies.

Leading oil and gas refineries have taken advantage of wireless IoT sensors to counteract refinery shutdown problems. Specifically, these sensors measure temperature and flow rates to better locate heat exchanger fouling (the accumulation of unwanted material). By implementing these sensors, they are able to minimize downtime, resulting in estimated annual savings of \$55,000 per exchanger.

## Enabling distributors with real-time supply chain data

In 2017, nearly 6 million Americans still use home heating oil (HHO) to heat their homes. This oil is typically stored in giant oil tanks and is periodically refilled by licensed oil distributing companies. For consumers, this process of monitoring oil levels, ordering, and refilling is not only inefficient but also cumbersome. However, TankClarity has created a smart sensor that notifies homeowners and delivery companies when fuel levels are low, which saves both parties time and money.



7  
Months

Tankclarity shipped their IoT solution to market in just 7 months with Particle

2  
Minute Install

TankClarity reduced their device installation time to 2 minutes with Particle.

700  
Units

TankClarity deployed 700 IoT devices and intends to deploy more with Particle.

With Particle's Device Cloud, TankClarity can provide this data to oil distributors, which has become a primary revenue driver for them. Distributors are also using this information to help predict consumer consumption in future weeks, months, and years. Real-time data has helped TankClarity improve their relationship with oil distributors and create an ecosystem that is valuable to customers and suppliers.

## Reducing the compliance overhead

Each year, American manufacturers spend an estimated \$192 billion to comply with workplace safety regulations. That's because almost every industry, in some capacity, requires a field agent to physically inspect equipment to ensure compliance. However, one of the easiest ways to create value through IoT is to replace those inspections with Internet-connected sensors.

Take Canary Compliance, which uses IoT hardware to monitor fuel volumes in storage tanks underneath gas stations. Their remote monitoring system allows enterprises to provide real-time inventory feeds to haulers and up-to-the-minute inventory reports on demand. While keeping track of fuel levels seems like an easy task, uncontrollable elements like storage leaks and extreme weather conditions make it difficult for gas station owners to keep perfect records. IoT systems that constantly keep track of fuel add another failsafe for business owners and, in turn, can save them a lot of money.

## 4. How to start your IoT deployment with Particle

The oil and gas industry is incredibly large and complex, which means there is no one-size-fits-all IoT solution. However, Particle provides all the tools you need to develop a customized IoT solution that works for your specific business problem.

Particle provides your business with the **hardware, software, and network infrastructure** it needs to overcome the innumerable challenges of IoT.

### Particle offerings

Particle provides everything you need to power your IoT product, from device to cloud:



#### IoT Hardware (Wi-Fi, Cellular, Mesh)

Connectivity hardware that is designed for building IoT products and devices



#### Developer Tools

Software development tools for every layer of your IoT stack



#### Device management

A web interface for managing and provisioning remote IoT devices



#### Device OS

An operating system that handles the complexity of IoT infrastructure



#### Device Cloud

A reliable gateway between your IoT devices and the Internet



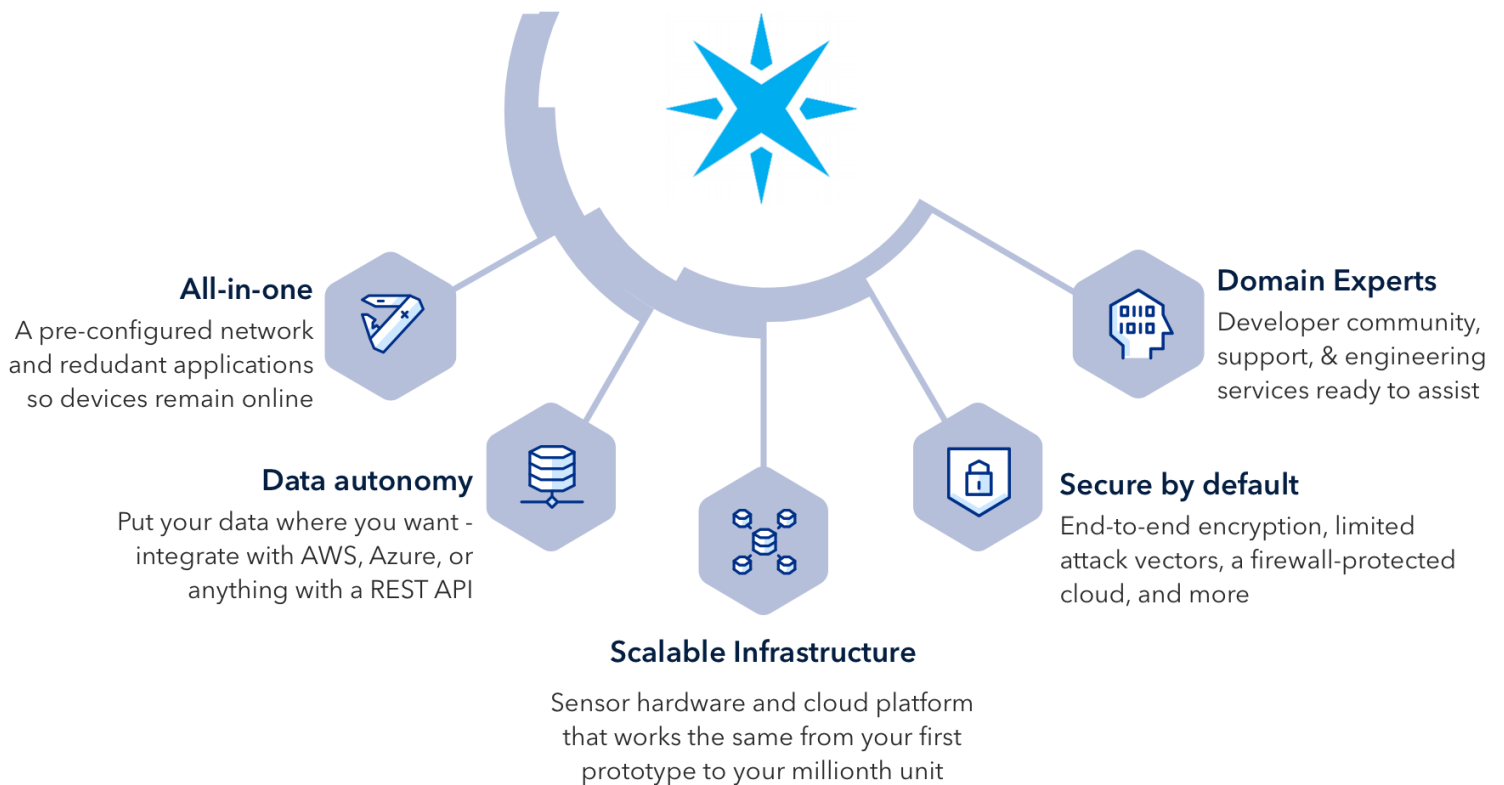
#### Cellular IoT SIMs

Low-cost SIM cards designed for low-bandwidth IoT devices

### Benefits of using Particle

Developing your own connected device has a few key benefits. First, you can easily customize and tailor a solution to meet your organization's specific needs. You will not be tied to a rigid system that cannot adapt to your fleet's evolution and shifting requirements. Second, you can scale new revenue channels by having open access to any business or performance data you need, and integrate these data streams into your existing analytics platforms. With this data, you can take action in the physical world using predictive analysis on both real-time and historical data, which, in turn, trigger actions on devices or through other web services

## Particle differentiators



## How to start your IoT journey

Starting your own IoT project may seem challenging or near impossible (as a matter of fact, nearly three-fourths of self-initiated IoT projects are considered a failure, while a third of all projects were not seen as a success). The two biggest contributors to the failure rate are: lack of internal IoT expertise and platform (hardware/software) reliability. With Particle, you have full access to IoT experts, a large community of IoT enthusiasts, support services, and professional engineering services (Particle Studios) to help you get your IoT projects off the ground. Additionally, you will be building on top of an enterprise-grade, production-tested IoT platform used across the industry.

### Check out the Particle store



Start your IoT journey by checking out our industrial hardware on the [Particle Store](#).

### Contact our experts



Contact our team of experts at [Particle.io/sales](https://particle.io/sales) to discuss solutions development.

## Consult Particle's IoT experts



### **Tamer Aboul Hossn** | Business Development at Particle

With a degree in Chemical Engineering and experience in consulting and oil & gas, Tamer specializes in helping clients in the energy, transportation, and logistics industries implement IoT solutions that improve their operational efficiency and unlock opportunities for growth.

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### **Benedict Von Merrey** | Business Development at Particle

An International Energy major with a background in strategy consulting, Benedict has experience in developing proprietary IoT solutions for large enterprises from prototype to deployment at scale.

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### **Jeffrey Lee** | Technical Content Writer at Particle

Jeffrey Lee is a technical content writer at Particle where he writes and designs articles that explore the complexities of IoT. In his spare time, he writes original content for world-renown tech publications and is currently finishing his MSc in Technical and Professional Communication.