

Why emissions management will define the energy industry's next decade

Proactively helping the world achieve its commitments
to address the impacts of climate change



Executive summary

Recent events have accelerated the global goal of achieving carbon neutrality to minimize climate change impacts. Key to this goal is managing and mitigating greenhouse gas (GHG) emissions. Corporate initiatives for emissions management, now driven by global regulations and policies, corporate responsibility, and customer demand, hold the key to a stronger future for businesses, individuals, and the environment.

Intensifying pressure around emissions management is catalyzing change and is focused heavily on the energy sector. Country and corporate commitments in support of the Paris Agreement, a global climate change initiative, are being bolstered by legal actions, regulatory drivers, shareholder activism, and consumer demands. Energy companies are beginning to embrace emissions management. That journey, however, is fraught with complexities and novel challenges that require new skills and competencies.

Read on to learn more about the emerging forces around climate change that impact energy companies—today and for the future—and the ever-evolving emissions management journey ahead. Understanding how to navigate that journey is vital for future viability. While challenges exist throughout the emissions management journey, leading energy companies are forging collaborative partnerships to co-navigate, co-create, and accelerate an effective and transformational path forward with the collective goal of reducing the impacts of climate change.

With its rich history in the energy sector, Baker Hughes is passionate about **Taking Energy Forward**. Baker Hughes is catalyzing change by leveraging its' industry experience, innovative technology, and long-standing subject matter expertise. Please join us in learning more about the increasingly crucial emissions management journey as the energy industry's defining moment for the decade ahead.

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The urgent call for climate change initiatives

The focus on lowering emissions is escalating rapidly. No industry is exempt, although the energy sector is facing mounting and focused societal pressure to meet necessary global climate goals. Regulatory mandates and legal claims that demand compliance via operational and financial penalties further underscore the elevated significance and urgency of emissions management.

The world is embracing carbon abatement, to build a stronger future for all. Emissions management plays a key role in global emissions reduction. Energy companies and policy makers worldwide are stepping up to the challenge.

Global climate goals

The Paris Agreement, a landmark international accord, represents a global leadership view that emissions need to be reduced to limit the impacts of global warming. In 2015, the Paris Agreement was adopted by nations around the world.

Measurable milestones of the Paris Agreement include:

- Limiting this century's global temperature increase to **2 degrees Celsius** above pre-industrial levels
- Limiting the century's total global temperature increase to **1.5 degrees**

Globally, 191 entities (190 countries plus the European Union) responsible for 97 percent of the world's climate pollution, are committed to the Paris Agreement. Country commitments via the international treaty are to reduce their emissions by 25 to 37% by 2030 and work to increase those reductions over time.

Most recently, COP26 (Conference of Parties) tightened the Paris Agreement targets with country pledges to accelerate climate change initiatives and limit temperature rises to 1.5 degrees by 2030. COP26 also bolstered public and private financial commitments to help drive faster progress in climate change around the world.



For energy companies, emissions management is a corporate imperative

Growing pressure to combat climate change

Methane initiatives

Specific regulatory requirements are emerging, such as renewable energy and methane-specific regulations.

Regulatory requirements

Recent regulatory requirements aim to accelerate the energy transition. These tougher standards are impacting companies and industries globally and mandating compliance. The European Commission, for example, is enacting laws that will ensure climate goals are met, such as increasing renewable energy sources and limiting automobile emissions. Together, the Environmental Protection Agency (Clean Air Act) and the European Commission (European Climate Law) are influencing other country requirements and creating stricter environmental standards around the world.

Methane-specific regulations, such as a recent EPA (Environmental Protection Agency) proposal, are focused on significantly reducing methane emissions from the oil and gas sector. A recent EPA ruling includes an aggressive methane reduction across a broad range of methane-producing sources.

Social license to operate

Emissions management has recently become a must-have competency to sustain ongoing operations. Beyond financial penalties, corporations also risk the loss of social license to operate from being out of step with industrial decarbonization emissions management.

For energy companies, these collective forces make emissions management a corporate imperative.



Greenhouse gas emissions by type and industry

Global emissions data indicates that energy companies are key to reducing greenhouse gas emissions. Let's look at the composition of climate-changing emissions, and the primary sources of those emissions.

Estimates indicate the primary gas emissions that impact climate change globally are comprised of: 76% carbon dioxide (CO₂), 16% methane (CH₄), and 6% nitrous oxide (N₂O). The rest are fluorinated gases. These gases are collectively described as greenhouse gases (GHG).

These three gases have different levels of impact on the environment. GHG emissions warm the earth by absorbing energy and insulating the earth. The two key factors that describe their impact are:

1. Radiative efficiency or ability to absorb energy
2. Lifetime or how long the gas stays in the atmosphere

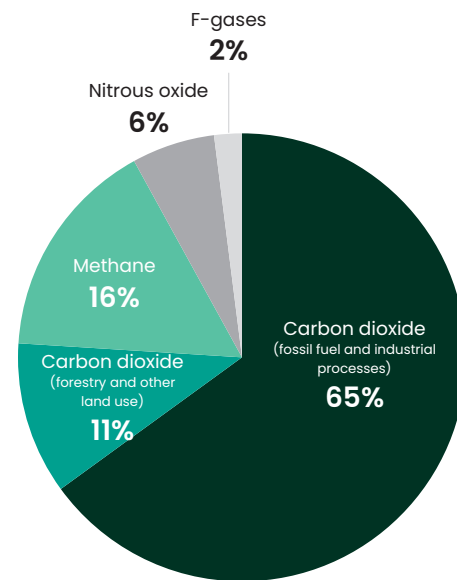
Relative to CO₂, the potency of GHG's can be described as:

| Gas | Radiative efficiency | Lifetime |
|------------------|-------------------------|---------------------------------|
| CO ₂ | 1 (baseline) | Hundreds to thousands of years |
| CH ₄ | 84X of CO ₂ | 10 years and precursor to ozone |
| N ₂ O | 300X of CO ₂ | 100+ years |

While CO₂ is the most abundant greenhouse gas, CH₄ and N₂O have a far greater impact on global warming. To stem global warming, emissions management is addressing their reduction with deliberate strategies and approaches.

* in CO₂ equivalent. <https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data>

Global greenhouse gas emissions by gas*

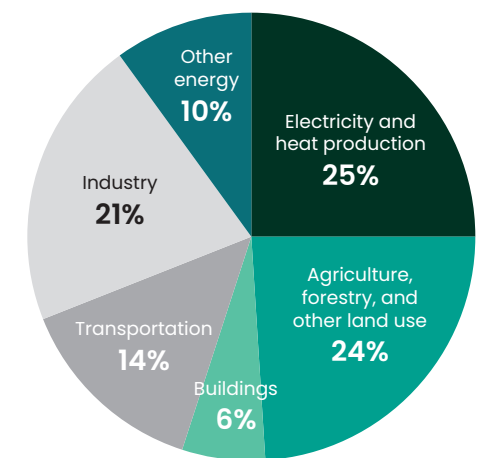


Where are greenhouse gas emissions coming from?

Globally, greenhouse gas emissions are produced by a handful of industries. The energy sector is responsible for a significant percentage of greenhouse gas emissions as shown on the graph at the right.

Climate focus on the energy sector is based on the fact that it generates a large percentage of greenhouse gas emissions. These emissions encompass CO₂, CH₄, and N₂O. Based on these estimates, emerging solutions in emissions management are needed to help energy companies operate in a climate-constrained world.

Global greenhouse gas emissions by sector*



The emissions management journey

To limit global warming, energy companies must take two simultaneous and interdependent paths forward:

1. Reduce and manage emissions in traditional operations
2. Decarbonize the industry with technologies to significantly reduce emissions and move to renewable energy sources

Technology, including software-based solutions, are vital to enabling a successful emissions management journey.

Emissions management is a multi-phase journey, although it must rapidly produce improvements and measurable outcomes in order to meet global climate goals. For energy companies, there are three key phases to emissions management, each with distinct challenges and solutions.



Emissions monitoring, detection, and quantification

Challenges

To start an effective emissions management journey, an understanding of actual emissions is required. Reliable data from emissions—measured or estimated using factual data—enables smarter decisions and facilitates a successful emissions management approach. Thus, an essential first step on the journey to reduce emissions is to quantify emissions data so that regulatory and corporate goals can be achieved. This is done via ongoing monitoring technologies and advanced software that provide emissions tracking capabilities.

Actions

- Define emissions measurement and reporting requirements based on your organization's objectives
- Deploy a measurement technology program to meet these requirements
- Enable digital tools to gain actionable intelligence and meaningful reports from measurements

Solutions

Methane monitoring technology such as LUMEN Sky (drone-based leak identification), LUMEN Terrain (continuous monitoring) supported by advanced analytics and expert advisory services from Baker Hughes.

Abatement

Challenges

As insights are gathered around key emission sources, targeted upgrades can be evaluated to reduce both emissions and operational cost. The oil and gas sector is strongly positioned to find synergies between emission reductions and operational savings at the same time. According to the International Energy Agency over 50% of methane emissions in oil and gas can be reduced without adding operational cost. The success of reducing emissions in an economically feasible manner is highly dependent on the application, region and technology. These factors need to be taken into account and knowledge about the oil and gas domain is key here. There is no silver bullet.

Actions

- Implement flare control and reduction technologies
- Retrofit existing systems to reduce energy consumption
- Measure immediate impacts using advanced digital tools

Solutions

Energy conservation/optimization solutions and flare reduction solutions such as Panametrics flare.IQ, Becker and Masoneilan Valves, and Reciprocal compressors and turboexpanders. Solutions help enable smarter emissions management practices and technology.

Decarbonization solutions

Challenges

Reducing emissions in a sustainable manner means planning for GHG outcomes in a multi-year plan. Planning for new technologies, deciding on where to upgrade across a fleet of assets is required for capital efficiency. Emission management strategies need to include scenarios for a changing regulatory landscape. Similarly, emissions trading systems are creating new incentives to lower emission abatement costs and drive innovation. Although many technologies are readily available today, a string of new technologies is expected and will drive synergies and disruptions. Partnering with technology providers and developers will be key to successfully navigate the energy transition.

Actions

- Continuously gather intel around new regulatory requirements
- Develop future technology and operational strategies to build on latest innovations to lower emissions

Solutions

Sustainable decarbonization solutions such as CCUS (carbon capture, utilization, and storage), hydrogen power, clean integrated power systems, and geothermal.

Important, expansive goals, such as constraining climate change, are often the hardest goals to achieve. Collective efforts via a connected ecosystem of collaborators and partners are required to leverage subject matter experts with deep industrial experience and industry know-how. Leading energy companies are adopting a pragmatic, actionable roadmap together with collaborative partners to navigate the dynamic landscape of emissions management.

What's next?

For energy companies and emissions management, the time to act is now. Limiting the impacts of climate change is the right thing to do. And, avoiding unplanned downtime, regulatory actions, and increased costs from carbon tax and/or penalties are essential to business survival. Emissions management, without question, represents a defining moment for the energy industry for the foreseeable future.

Baker Hughes is passionate about catalyzing change and committed to taking the energy industry forward. With its rich history and deep expertise in the energy sector, Baker Hughes is partnering with customers to help mitigate risks and realize opportunities from the energy transition. By developing a clear roadmap, together with comprehensive emissions management solutions, Baker Hughes stands ready to help companies navigate and solve the complicated and evolving areas of emissions management and create a stronger climate and better future for us all.

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