


# Balancing Risks and Opportunities in the Energy Transition



In a [recent report](#), the International Energy Agency (IEA) outlined the world's collective progress toward net zero. The agency cited numerous positive developments: Overall energy efficiency doubled year-over-year, electric vehicle manufacturing capacity has scaled up to meet increased demand and 7.9 GW of nuclear power was brought online in 2022, representing a 40% increase over the previous year. But there's still significant work to do in order to achieve [IEA's Net Zero Emissions by 2050 Scenario](#). Our industry will play a critical role in this next phase of progress.

To achieve net zero and meet the expected growth in energy demand, the energy and process industries must achieve a two-prong, mission-critical goal: transition to cleaner energy sources while maintaining energy security. This ambitious undertaking isn't just critical for the planet's future; it's also a key opportunity to fuel our industry's future growth. With enhanced energy efficiency, greenhouse gas (GHG) emissions management and decarbonization come greater energy security. At the same time, low-emissions hydrogen and carbon capture, utilization and storage (CCUS) are ushering in a wave of innovation across mission-critical operations. In the new energy economy, organizations that embrace this challenge will have a considerable competitive advantage, not just in terms of sustainability but cost and overall efficiency.



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## Enhancing Energy Efficiency

There's a reason why energy efficiency is nicknamed "[the first fuel](#)." In an era of rising costs and demand, efficiency is one of the most cost-effective vehicles for achieving a low-carbon future. In the IEA's [scenario for net zero](#), energy efficiency is the single-most important measure for mitigating energy demand. Beyond its pivotal role in decarbonization and energy security, increased efficiency also can deliver clear operational benefits. Among our customers, it acts as a key bridge between sustainability and operational excellence.



### Key Opportunities

The benefits of energy efficiency are clearly documented. Most leading solutions have attractive ROI, stemming from the cost-savings and overall performance boost that energy efficiency can provide. Case in point: By reducing water consumption, [this customer](#) not only reduced its water costs but also doubled its mean time between repairs (MTBR). Other operators have incorporated energy efficiency into their [asset management programs](#), yielding clear performance benefits.

Investment in energy efficiency increased by 16% in 2022, and policies supporting this goal have strengthened in the past year. But despite this upward trajectory, the IEA estimates that progress must double to achieve net zero goals — a challenge in any economy, but particularly amid current uncertainty. Slowed economic growth and interest rate hikes have put a damper on 2023 investments; they've also increased retrofit costs. To accelerate progress in energy efficiency, it will require a significant uptick in investment and an emphasis on practical solutions that deliver ROI.

16%

Increase in investment in energy efficiency in 2022

### How John Crane Can Help

At John Crane, efficiency and reliability are in our DNA. Since inventing the first mechanical seal nearly a century ago, we have continued to pioneer technologies that help customers extend equipment lifespans as they use less energy.

- By replacing a conventional mechanical seal with our innovative [Upstream Pumping seal face technology](#), operations can extend seal life, increase the pump's mean time between repair (MTBR), and significantly reduce energy usage and water consumption. This technology removes the need for a high-pressure water line and nearly eliminates cooling water requirements.
- In most difficult abrasive pump services with high solid contents, customers trust [John Crane's Diamond® seal face technology](#) to help lower heat generation, reduce power consumption, increase reliability and lower lifecycle costs. Its low heat generation also reduces CO<sub>2</sub> emissions.
- John Crane's retrofit solutions [improve the efficiency of existing systems](#), equipping them to meet the latest environmental and performance standards without the need for a complete replacement. Over the last 10 years, our wet-to-dry gas seal retrofits have helped customers reduce approximately 278,000 tonnes of CO<sub>2</sub> equivalent emissions per year while optimizing energy consumption and enhancing compressor reliability.
- Customers leverage John Crane's [Safeunit™ control and monitoring system](#) to decrease seal water usage by 80%. This system maximizes efficiency through easy adjustments to seal water flow and pressure.

As energy and process pioneers race toward net zero, we're committed to investing in solutions that shape the future of our industry. That includes water conservation technologies that enhance reliability and reduce energy waste through simple, streamlined designs.

## Reducing Methane Emissions in Oil and Gas

According to IEA estimates, methane emissions have been responsible for [roughly one-third](#) of the rise in global temperatures since the Industrial Revolution — the world's first energy transition. Although methane has a shorter atmospheric lifetime than CO<sub>2</sub>, it is 28 to 34 times more potent than CO<sub>2</sub> at trapping heat in the atmosphere over 20 years. The oil and gas sector produces 40% of the world's methane emissions, making it a key target for urgent, measurable progress.

### Key Opportunities and Risks

Methane leaks account for 3% to 4% of total gas production each year, with potential revenue losses of up to \$30 billion for the oil and gas industry. Simply put, methane leaks are bad for the environment and bad for business. The climate impact of methane and the urgency of net zero goals have accelerated abatement technologies, which have become increasingly cost-effective with time. Because methane has an outsized influence on the world's GHG emissions progress, abatement solutions also have the potential to deliver quick, quantifiable sustainability improvements.

Fugitive emissions — defined as unintentional emissions caused by leaks or defective seals — add another layer of complexity to the methane issue. Some estimates peg fugitive emissions at [20% of all global methane emissions](#), or 5% of global GHG emissions. Fugitive emissions are especially common in natural gas production, transport and liquefaction operations; that makes methane abatement critical not only to reducing GHG emissions but to accelerating decarbonization and LNG as a bridge fuel.

### How John Crane Can Help

John Crane has been a leader in methane abatement for decades. Our sealing solutions are proven to reduce significant amounts of leakage in natural gas transport and compression, and LNG. Every day, these market-ready solutions are enabling operations such as CCUS and LNG — reducing GHG emissions and accelerating the use of key bridge fuels.

Our broad portfolio of solutions also includes dry gas seals that nearly eliminate emissions, seal gas recovery systems that redirect compressor gas leakage from flares to productive processes, and wet-to-dry gas retrofits that mitigate methane leaks. We're committed to investing in new technologies that help our customers achieve their emissions reduction targets.

\$30B

Potential revenue losses  
from methane leaks



# Strengthening the Hydrogen Value Chain

Hydrogen has emerged as a key lever in decarbonization. Hydrogen production is hardly new — the oil and gas industry has been producing hydrogen at scale for more than four decades — but “clean,” low-emissions production methods have yet to enjoy widespread adoption and anticipated volumes of hydrogen to be produced and transported across long distances are unprecedented. In 2022, [less than 1% of global hydrogen](#) was produced using low-emissions methods. To achieve IEA’s net zero scenario, 50% of total hydrogen production must be clean by 2030, with 50 Mt of hydrogen produced through electrolysis and 30 Mt produced alongside CCUS solutions.

Around the globe, hydrogen investments are expected to [eclipse \\$300 billion](#) over the next eight-to-nine years. However, this pales in comparison to oil and gas investment, which pulls in more than \$600 billion per year by some estimates.

## Key Opportunities and Risks

Low-emissions hydrogen is critical to achieving ambitious net zero goals. However, the unique dynamics of producing low-emissions hydrogen have posed key barriers to scalable deployment. Some challenges are technical in nature, such as navigating the demands of high-speed compressors, transient operations and volatile cryogenic temperatures. Producing hydrogen through water electrolysis requires less water consumption than fossil fuel production and refining. Still, the electrolysis process requires a vast amount of water, which is both costly and unsustainable in an [already water-scarce world](#).

Using today’s processes, hydrogen costs roughly \$1 per kilogram; through water electrolysis, the cost can increase threefold or more. Simply put, producing low-emissions hydrogen is significantly more expensive than producing gasoline — a reality that further exacerbates the need for technologies that lower costs and accelerate scalability.

Other considerations include the safe distribution of the highly volatile and flammable hydrogen gas, minimizing contamination to achieve the high purity requirements for some applications and ensuring critical pumps and compressors are equipped to reliably support the electrolysis process.

With these challenges, low-carbon hydrogen also offers key opportunities for innovation. Infrastructure for hydrogen transport will be key to building out the new hydrogen ecosystem. Market-ready sealing, filtration, power transmission and digital solutions have the potential to deliver reliability across the hydrogen value chain, giving customers the confidence in embracing this world-changing decarbonization strategy. Policy and investment will also play a pivotal role in building out the hydrogen ecosystem of the future.

## How John Crane Can Help

With more than 40 years of experience in hydrogen sealing and filtration, John Crane is a leader in market-ready decarbonization technologies. We believe it is essential to deploy all sources of low-carbon hydrogen, including hydrogen produced through renewable- or nuclear-powered electrolysis and traditional natural gas reforming technologies retrofitted with [carbon capture solutions](#).

Every day, our technologies enable green hydrogen operations around the world, delivering reliability across every link in the value chain.

- **Production:** Specialized pump and compressor sealing solutions and filters for electrolysis systems; traditional SRM or ATR with carbon capture systems; and concentrated solar sealing solutions
- **Transport:** Hydrogen pipeline compression seals; turboexpander seals and low-temperature filters for liquefaction efficiency; cryogenic storage and boil-off gas recovery solutions; and fuel supply system components proven to stand up to the demands of hydrogen transport
- **Alternative carrier transport:** Compressor and pump sealing and power transmission solutions for ammonia, methanol or LOHC conversion; and specialized filtration equipment to support marine transport and fueling
- **End use applications:** Tailored solutions for a variety of industries, including refining and chemical processing, green steel, fertilizer production and synthetic fuels

Since producing the first gas seal suited for hydrogen compression in 1979, John Crane has supplied thousands of dry gas seals to hydrogen applications. More than 5,000 seals, filters, couplings and systems are in use today, enabling some of the world’s most innovative conventional and clean hydrogen facilities. We’re committed to accelerating the new hydrogen ecosystem through market-ready solutions and investments across the hydrogen value chain that make this decarbonization technology affordable and scalable for hard-to-abate operations around the globe.

> 1%

of global hydrogen was  
produced using  
low-emissions methods



## Accelerating CCUS Initiatives

Pragmatically, many existing assets will still operate for years or decades to come — and it is critical to reduce emissions in the quickest way possible. CCUS initiatives are one technology required at scale to decarbonize existing assets.

In IEA's [Net Zero by 2050 framework](#), the agency predicts that by 2045, "hundreds of industrial plants will be using carbon capture or hydrogen." In its Sustainable Development Scenario, [more than half of CO<sub>2</sub>](#) captured by 2030 will be from retrofitted assets, with CCUS contributing approximately 9% of total CO<sub>2</sub> reduction.

CCUS technology has matured significantly over the last decade, with carbon capture facilities around the world producing measurable progress. However, CCUS initiatives have been slow to gain momentum and [lag 30% behind IEA benchmarks](#) for achieving net zero — despite more than 500 projects in various stages of development worldwide.

### Key Opportunities and Risks

Like hydrogen production, CCUS initiatives are complex undertakings that require specialized technology and expertise. Pumps and systems play a pivotal role in a CCUS operation's success. These solutions must overcome the significant pumping and compression challenges posed by CO<sub>2</sub>; that includes supercritical CO<sub>2</sub>, which is particularly challenging due to multi-phase operation.

Beyond these specialized technical requirements, CCUS systems are also expensive and complex. Although the oil and gas industry has experience with sequestering and transporting CO<sub>2</sub>, rapid technological advancements are essential to scaling these existing systems and rules. As CCUS infrastructure continues to evolve, modular, fit-for-purpose systems could contribute to faster deployment and wider adoption. There is also potential for systems with [capture rates as high as 99%](#), which would offer significant sustainability improvements over current solutions that deliver a maximum 90% capture rate.



80%  
of the world's CO<sub>2</sub>  
injected underground  
utilizes John Crane  
dry gas seals.

### How John Crane Can Help

John Crane is working alongside oil and gas leaders and OEM partners to accelerate the deployment of CCUS initiatives. Approximately 80% of the world's CO<sub>2</sub> injected underground utilizes John Crane dry gas seals.

With more than 1,000 references in CO<sub>2</sub> sealing and related applications including supercritical fluid conditions across LNG, pipeline transport and capture, John Crane is helping CCUS leaders make tangible decarbonization progress today. Our dry gas seals, high-performance couplings and seal gas systems are accelerating CCUS scalability. Our pump sealing solutions enable safe transport and our filtration solutions ensure the right medium quality for each end use.

To accelerate CCUS progress, we're investing heavily in new CO<sub>2</sub> sealing and filtration technologies. This includes next-generation sealing for supercritical CO<sub>2</sub>, special reactor vessel seals for modular systems and best-in-class filtration solutions for CO<sub>2</sub> and amine fluid streams. As CCUS systems become more complex — and more critical — John Crane is continuing to lead the way.



# Building a Sustainable Future Today

As we enter the world's third energy transition, it's helpful to apply lessons learned from the ones that came before. The Industrial Revolution and the rise of oil and gas taught us that delivering a new ecosystem creates both opportunities and challenges. To navigate them, it takes innovative solutions, technology leadership and an unwavering commitment to our industry's shared future. This has been at the heart of John Crane's legacy for more than a century, and we're drawing from this same pioneering spirit to shape its next 100 years.

Although net zero goals are ambitious, operators around the globe are achieving tangible progress in decarbonization and energy transition initiatives. We're proud to deliver market-ready solutions that accelerate our industry's net zero future, from energy efficiency and GHG emissions management to hydrogen and CCUS applications that support scalable decarbonization.

Shape your new energy reality with John Crane.

[johncrane.com](http://johncrane.com)

