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DEMYSTIFYING THE EVOLVING GAS INDUSTRY:

The Drive Towards Affordability, Sustainability, and Security

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The energy transition is upon us. The convergence of environmental/climate concerns, the availability of new technologies, and a regulatory/legislative environment that is moving the needle in the direction of sustainability are all contributing to this new era where transitioning to more renewable energy and a more sustainable posture towards business and industrial operations are becoming core to how businesses operate. Among the broader population, climate concerns are part of the regular news cycle these days. The Pew Research Center reports that a majority of Americans favor a broad range of actions to combat climate change.

Examples of how this transition is happening are abound. Over the last decade, wind energy costs have fallen 44% and solar photovoltaics have fallen 78% according to Wood Mackenzie. Additionally, analysts at Wood Mackenzie estimate that by 2026, global renewable-electricity capacity will rise more than 85% from 2020 levels. Similarly, global battery storage costs have fallen 75% over the past decade.

On the regulatory and legislative front, consider California's Senate Bill 1020, which drives the state towards achieving 90% renewable energy and zero-carbon electricity by the end of 2035, 95% by the end of 2040, and 100% by 2045; and the recent U.S. Inflation Reduction Act that includes over $360 billion in energy funding, much of it for renewable energy, energy storage, electric vehicle (EV), and various fossil fuel incentives and investments.

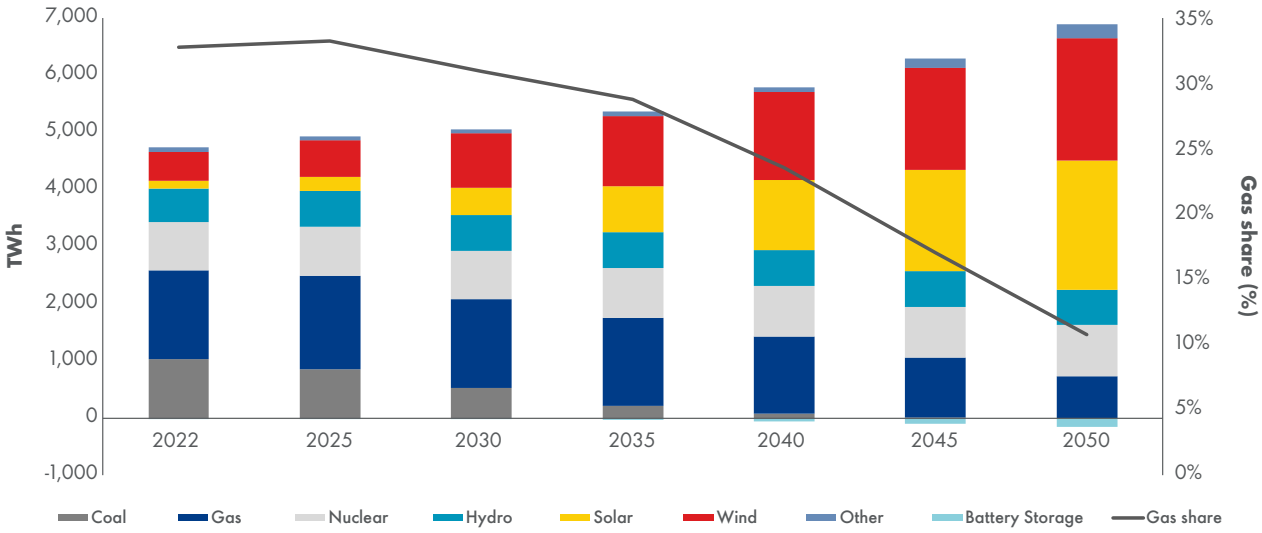
Given the progress made in the energy transition in recent years, along with the goals in the years ahead as noted above, it is reasonable to ponder how gas fits into this transition. To this end, note Figure 1, which shows how the transition looks from a macro level in the power generation sector. This clearly demonstrates that gas is a key component in achieving energy transition goals.

$360 BILLION
for energy investment

85%
increase in global renewable-electricity capacity from 2020 to 2026

75%
decrease in global battery storage costs over the past decade

Figure 1.
North America power generation by type



Source: Wood Mackenzie

A SUCCESSFUL ENERGY TRANSITION INCLUDES GAS

So, while there is agreement in keeping the momentum going on the energy transition, this does beg the question, "what is the role of gas within the transition?". The bottom line is gaseous fuel is an important part of the energy transition. As this brief will demonstrate, gas is not just a transition fuel; gas is a fuel in transition.

Starting with the transition away from coal-based power generation, gas, along with the growth in renewables, has been a key component in the decreasing use and dependence on coal that has led to significant reductions in CO2 emissions in the U.S. in recent years. The U.S. Environmental Protection Agency (EPA) reports that emissions of carbon dioxide decreased by 8% from 1990 to 2020, due to the decreased reliance on coal generation facilitated by the growth of renewables and the increased use of gas. A complete phase out of coal generation by the 2040 in the US is expected by Wood Mackenzie.

Another consideration for the role of gas in the energy transition is that not everything can be electrified. Many industrial processes require higher heating temperatures that renewable energy cannot deliver, requiring gaseous fuels.

Also of note is that commercial and industrial entities are looking to differentiate themselves in competitive markets. One way of doing this is to demonstrate that they can operate at a lower carbon intensity. This is becoming not only a competitive advantage but is also a necessity in cases where manufacturers and other business and government entities are requiring lower carbon footprints across their entire supply chain. Utilizing gas in these instances can help organizations meet their carbon objectives.

FOR ENERGY SOLUTIONS, GAS IS NOT "ONE SIZE FITS ALL"

As gas is part of the energy transition, what does this look like from a closer perspective? There are different gas formulations that meet a variety of business and compliance needs and requirements.

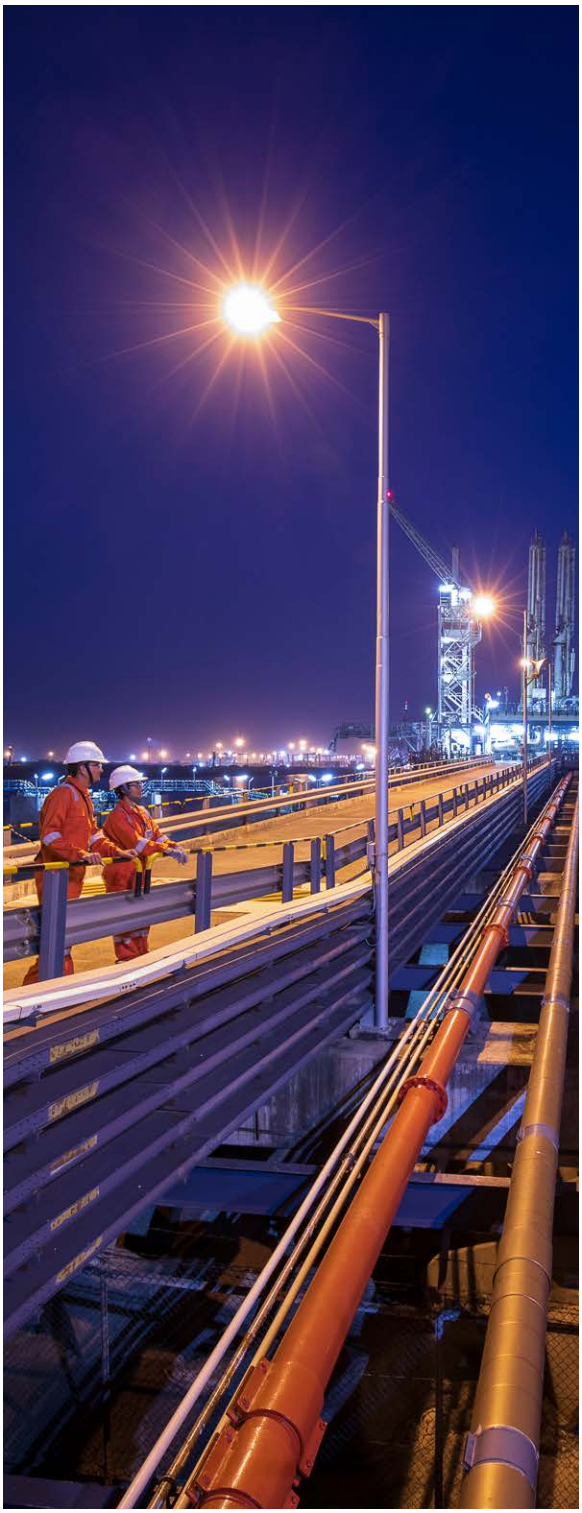
Conventional Gas

Conventional Natural Gas is gas that can be extracted from the earth either through naturally occurring pressure or pumping mechanisms. Alternatively, there are unconventional gas sources, such as shale gas or coal bed methane which require newer innovations to unlock their potential. While conventional gas typically has a higher carbon intensity than the other types of gas noted below, conventional gas-with-offsets (conventional natural gas bought with nature-based carbon offsets) is a tool to that can be an important part of an organization moving towards net zero.

LNG

Liquefied natural gas (LNG) is natural gas that has been converted to a liquid form to enable easier and safer transportation. In creating LNG, natural gas is cooled to approximately -260 F, the result being a clear, colorless, and non-toxic liquid that can be transported from areas where natural gas is plentiful to areas where demand outstrips what is available locally. Another benefit of LNG is that in its liquid state, it takes up 1/600th of the space that would be required for the same volume in its gaseous state, making it much easier to ship and store when pipeline transport is not feasible.

LNG exports are projected to grow over the next decade. According to Wood Mackenzie, North American LNG reaches 31 bcfd by 2033, up from 12.4 bcfd in 2023, led by the strong global appetite for energy security and transition. The vast low-cost North American gas supply base primarily supports LNG exports as North American producers seek new markets to grow into.



RNG

Renewable natural gas (RNG) is a pipeline-quality gas that is fully interchangeable with conventional natural gas and can be used in common applications like natural gas vehicles. RNG is essentially biogas (the gaseous product derived from the decomposition of organic matter) that has been upgraded to higher energy content and purity standards. RNG, or biogas, is typically extracted from landfills, livestock operations and wastewater treatment plants.

Among the benefits of RNG are that, like conventional natural gas, it can be used as a transportation fuel in the form of compressed natural gas (CNG) or liquefied natural gas (LNG); it can be used as part of a blended product with up to 10% RNG; it can create significant product differentiation (via using renewable energy sources for industrial/production processes); and RNG has a carbon intensity that is significantly lower as compared to conventional natural gas.

One additional benefit associated with RNG is that the grid, as it becomes increasingly decarbonized, will still need gas behind it as a complement to intermittent renewable energy sources, and to meet customer demand during peaking events. These examples demonstrate that using RNG is both pragmatic and underscores the need for a regulatory environment that encourages, or maybe even requires RNG, as part of the energy transition.

Relative to supply, RNG supplies are expected to grow from only 150 mmcfd in 2018 to more than 1.4 bcfd in 2033 according to Wood Mackenzie.

While this growth is very promising, note that this represents only approximately 1% of the overall gas market in North America. Recent RNG acquisitions in the RNG market provide momentum for additional transactions and capital flows to increase its growth trajectory. These increases in RNG supply, along with regulatory and legislative support of RNG production, have the potential to lower RNG process over time.

Despite not requiring extensive new pipeline infrastructure, upgrading biogas to RNG requires significant investments. Federal and State mandates and/or incentives such as Low Carbon Fuel Standard (LCFS), are helping make RNG more competitive with lower cost natural gas production. Technology improvements, project standardization, and economies of scale provide productivity gains that will lower RNG costs in the future.

RSG

A third gas category of note is Responsibly Sourced Gas, or RSG. Generally referred to as "certified gas," RSG is natural gas produced at facilities that have undergone an assessment by a third-party certifier that meets a number of sustainability goals. In general, to receive the RSG distinction, companies must demonstrate they are:

- Below a certain threshold for methane emissions intensity and using best practices for mitigating it.
- Minimizing community and environmental impacts.
- Responsibly managing water, waste and more.

While there is no single, "go-to" certification body in the gas industry, there are several bodies that are working towards creating a more formal RSG certification (MiQ and Project Canary are two leaders here, among others).

The use of RSG can be an important part of an organization's energy transition strategy, particularly as commercial and industrial users are looking to make tangible reductions in their carbon footprints. With its lower carbon intensity, RSG is an important tool in moving the carbon footprint in the right direction.

Also, as noted above, cleaner energy is becoming an imperative across entire supply chains, not just at a single entity. As the availability of RSG grows, commercial and industrial businesses and organizations will be able to include this in their energy portfolio to demonstrate that they are moving deeper into the energy transition and generating fewer emissions as part of their clean energy strategy.

The cost of RSG will vary by operator and producing region. Although the actual cost of implementation at the field sites will be an added cost of doing business, the cost afterwards of getting certification is minimal. As the supply and availability of RSG continues to grow and scale, marginal increased RSG costs will still be minimal compared to the total cost of production.

Major North American gas producers are continuing to move forward to attain 100% of volumes certified as RSG.

Wood Mackenzie expect certified gas to reach more than 23 bcfd by the end of this year in North America, approximately 20% of total expected gas production.

MOVING TOWARDS SOLUTIONS IN THE ENERGY TRANSITION AT SCALE

Given that gas is an abundantly available fuel that has helped the US reduce its carbon footprint, what are some of the ways that gas will be a part of the energy transition? Below are some examples of what this looks like.

Consider low-carbon steel or other low-carbon manufacturing. Manufacturers can offer differentiated products based on the fuel feedstock that they purchase to produce the products they manufacture. Increasingly, consumers of their products want to buy from producers that are actively engaged in sustainable production.

Correspondingly, companies, organizations, or even entire markets or industries are adopting sustainability goals that can be relatively high level (e.g., demonstrating cleaner energy, and manufacturing and supply chain processes) or very specific (e.g., specific fuel standards). The use of gas in its various forms will be a key part of meeting these standards.

Continuing to look at this through the colors of hydrogen, "black or brown hydrogen" – hydrogen produced from coal– is the least attractive. "Blue hydrogen" is produced from natural gas and supported by carbon capture and storage. With this process, the CO2 generated during the manufacturing process is captured and stored permanently underground, creating a lower-carbon hydrogen resource.

Next on the color spectrum is "turquoise hydrogen" – hydrogen produced using RNG, also supported by carbon capture (this is capturing the carbon dioxide produced by power generation or industrial activity; transporting it; and then storing it deep underground). Both blue and turquoise hydrogen have the added benefit of providing significant tax incentives via the Inflation Reduction Act that are significantly higher than previous incentives.

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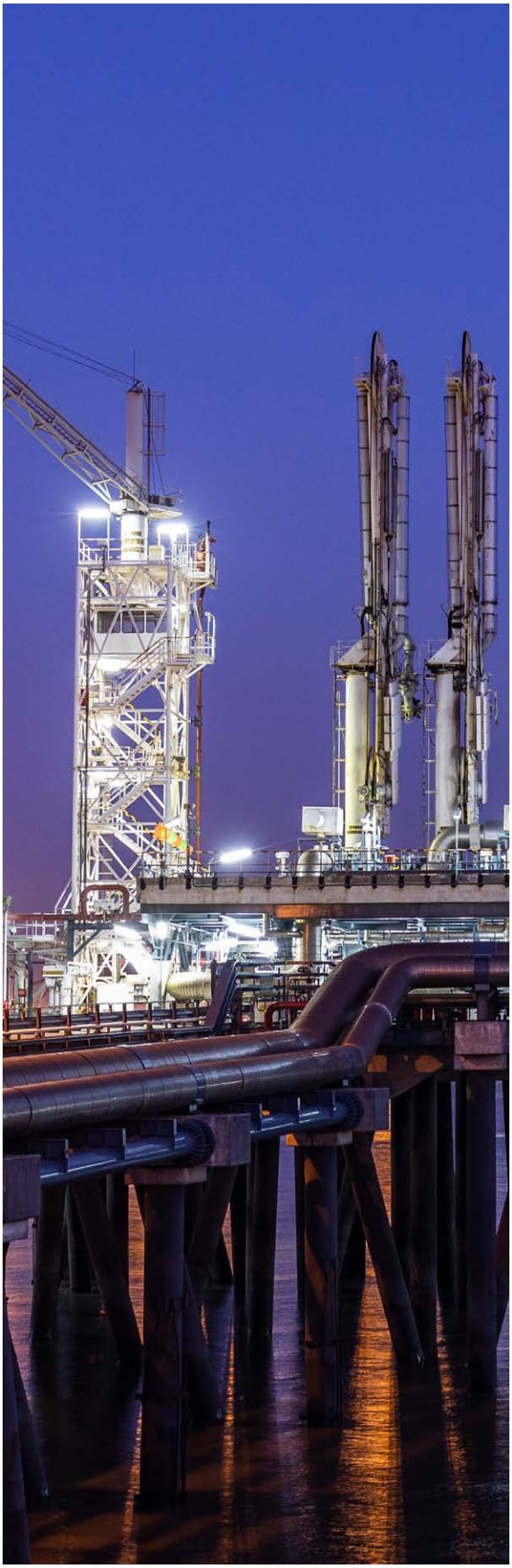
For organizations looking to lower their overall carbon footprint for several different business reasons like product differentiation or meeting sustainability goals, the quest for a lower carbon footprint can start at the energy production site where methane intensity rates can vary greatly based on production practices. For example, methane leakage at a production site can exceed 2%, but for the highest RSG certification, leakage rates can be as low as 0.2%. Additionally, non-associated gas production has much better methane intensity rates than oil production which has enabled the Haynesville and Northeast gas to achieve RSG certification more readily.

Energy security is another important consideration, and recent events have demonstrated that without domestic gas production the economy, and indeed the very well-being of citizens, can be put at risk in very short order. Indeed, inadequate energy resources to meet the needs of customers across the industrial, commercial, and residential spectrum puts societies in peril due to global uncertainties. The right mix of domestic resources minimizes, or even prevents, much of the energy uncertainty that has been experienced in recent years.

GETTING IT RIGHT

The energy transition holds great promise for commercial and industrial entities with large energy requirements, energy consumers living their day-to-day lives, and countries looking to maintain or improve quality of life while pursuing sustainability and focusing on security. This promise, of course, is not without its challenges and the transition will not happen overnight.

The key to successfully navigating this transition is to use the right fuels at the right time in the right place for the right purpose. Gas, whether as a stand-alone energy source or in combination with renewables, is going to continue as an important element in delivering more and cleaner energy around the world.



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