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# ENERGY CAPITAL

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JUL-AUG **2021**, ISSUE **04**

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- Leveraging Nat Gas Storage Expertise in Deep CO2 Injection
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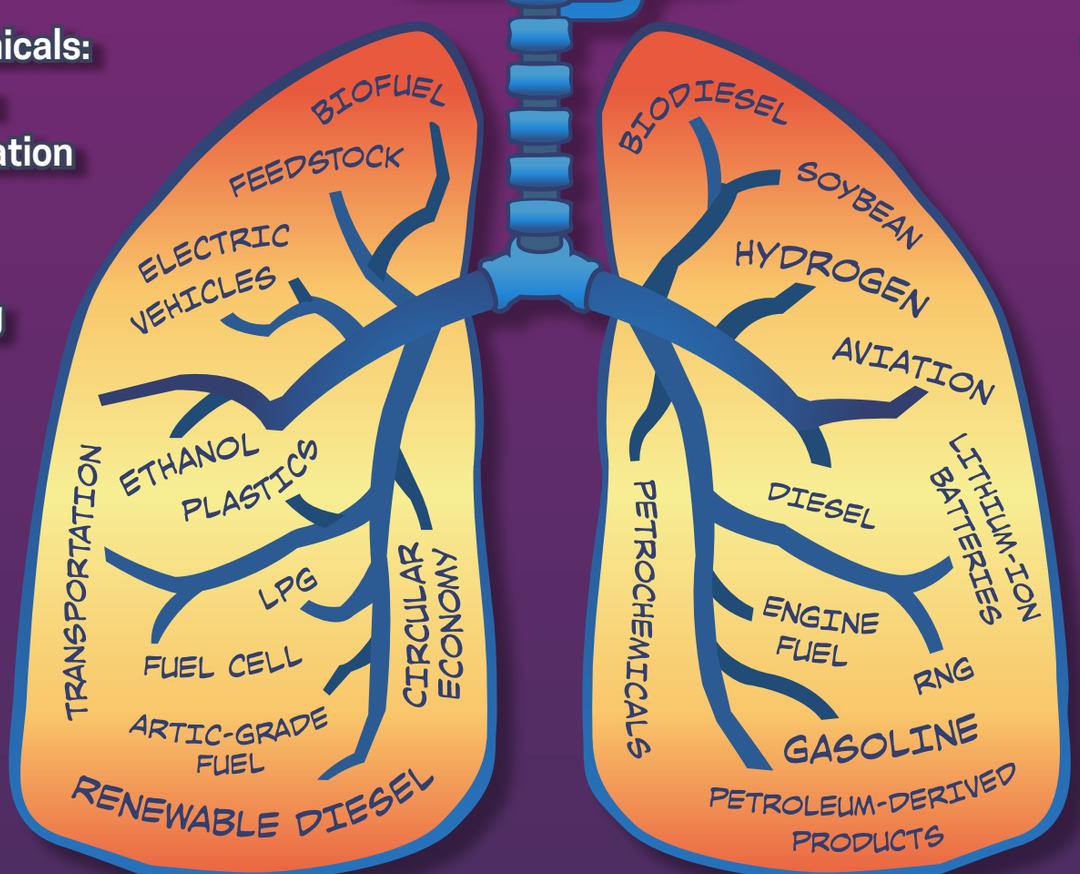


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# New Downstream
## A breath for the industry

***Dear Reader***

Welcome to the July-August edition of ENERGY CAPITAL THE MAGAZINE. Once again, we are excited to have you as a reader, and we hope that the contents you'll find inside this issue will be of your interest. As always, we look forward to keeping you aware of new trends, developments, projects, and assets across all energy sectors.

As you might know, the energy industry is rapidly changing, and downstream activities are not being left behind. So in this edition, with a particular focus on this sector, we included articles and insights addressing the transformation it is currently undergoing. What we've found is that a new downstream is evolving, and what is coming, particularly in North America, is a breath for the industry.

## THE FUTURE OF DOWNSTREAM

As the energy sector continues transitioning into a cleaner one, each one of its industries is embracing change. In this sense, downstream operations -which include all the processes involved in converting oil and gas into the finished product-, are likewise undergoing a significant transformation in order to remain competitive and address sustainability.

Notably, in North America, the scene is exciting. Transformations, including transitioning traditional refineries into biofuel hubs; developing new fueling solutions such as fuel-cell hydrogen, renewable natural gas, and renewable fuels; or advancing petrochemical processes to comply with the economy circularity, are underway and rapidly evolving into more advanced technologies.

What will come in the years ahead is undoubtedly exciting. However, it also poses an important question: is the traditional downstream coming to an end? What we've seen is that the industry will continue transforming itself but leveraging the years of expertise that precedes it.

By integrating new solutions such as Big Data, analytics, and machine learning, downstream actors will sustainably grow, reduce their environmental footprint, and prepare for the energy needs of the future.

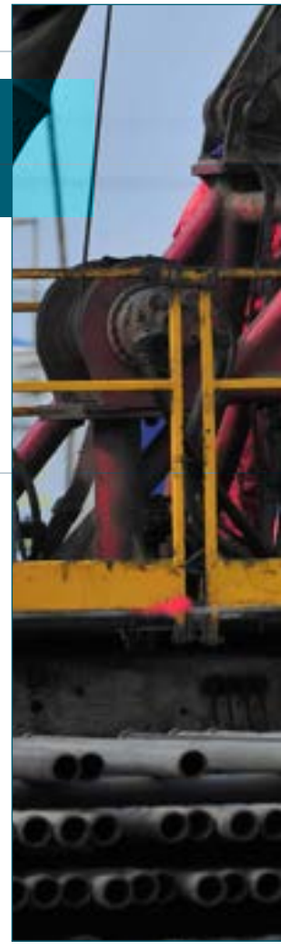
Not only is downstream successfully embracing the change while leveraging past experiences. As you'll find inside this issue, several other efforts in power, upstream, downstream, and infrastructure reflect a major commitment towards the transitioning economy.

Solar expertise used to create invisible solar panels that can be installed in any glass surface; natural gas storage knowledge applied in CO2 emissions' underground injection; or international shipping principles to reduce carbon emissions used as a benchmark to decarbonize the hard-to-abate steel sector are just some of the few examples that we included inside this issue.

Welcome once again to the July-August edition of Energy Capital! We hope that you enjoy this issue, and we look forward to continuing to provide you with attractive, helpful, and exciting information on what's going on in the energy industry.

**The Energy Capital Team**

# Big Data and Analytics: An Opportunity under Development in Downstream



In an increasingly digitized world, the global oil and gas industry has had to explore turbulent waters to reinforce investments and not be relegated. In this sense, various companies in the sector have begun to consider advances in digital technology to take advantage of their benefits.

*By* ***Rubi Alvarado*** in
*General Director,*
*Energy Capital*

In particular, the applications of several technology solutions have proven to be highly beneficial in oil refining activities, as well as in distribution and retail. This is particularly relevant since today, even with the growing electrification of transport, downstream remains one of the energy sectors with the highest demand globally.

Faced with the reconfigurations of global demand —influenced by factors such as the importance of energy efficiency and the energy transition—, refineries will have to increase their investments in big data and analytics; mainly, to reduce its carbon emissions even more and transcend its processes to more resilient and profitable forms of energy.

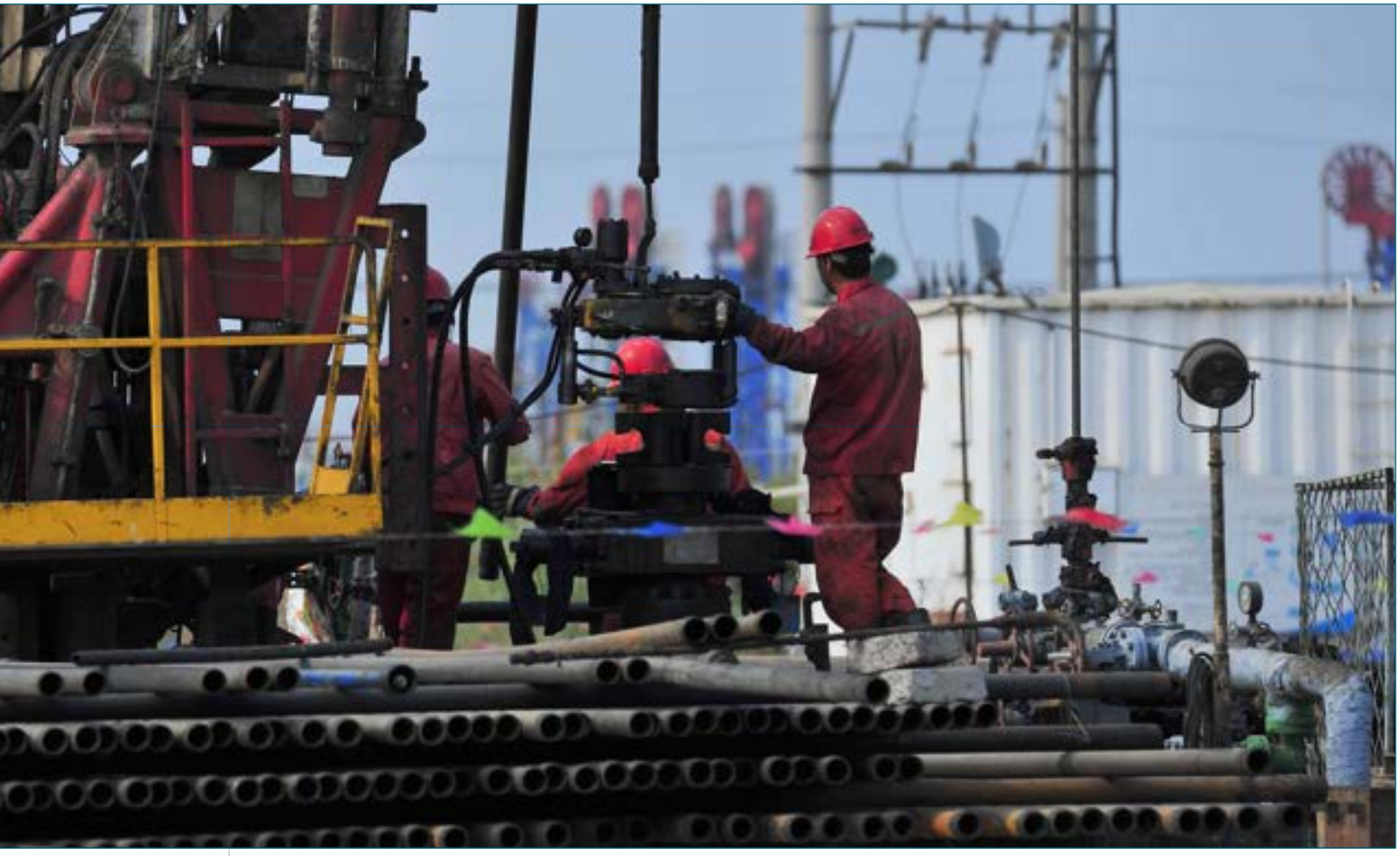
In this regard, Big Data can help oil and gas companies in the downstream sector manage and process large datasets and improve their production processes. As various industry experts acknowledge and underscore, "data is currently the oil of the new economy."

Worth noting, Big Data and analytics have a long history in refining. For instance, the analytic equation was introduced in some refineries in the late 1980s for property prediction in rotating equipment and detect poor performance.

More recent advances in big data technologies include data logging, storage, and processing. Accordingly, some of these solutions can be applied in the refinery sector, including estimating energy efficiency and its use to correctly assess downtime maintenance.

Likewise, big data can be used in repair costs through various models and analysis methods. On the distribution industry side, too, it is used in maintenance and to predict process and equipment failures.

As a complement to big data, the analytics part is also being introduced in the downstream sector with enthusiasm, particularly with the aim to investigate and understand the inner meaning of the large datasets an asset produces. Some of the processes throughout analytics work include machine learning and data



mining; these can later be used along the downstream's manufacturing process and help improve the sector's laboratory information systems.

On the refining side, some companies have introduced asset management systems relying on data providers. Similarly, reliability managing systems are also being introduced in some refineries. However, in practice, these information sources are mostly separated, only connected at some level.

In this sense, various providers are integrating elements of these sources into only one database (megadata structure) reference architecture. To illustrate, that type of data system is popular now in the refinery sectors with suppliers including Honeywell and Siemens.

Also, some parts of the industry that are adopting these more modern platforms are supply, trading, competitive analysis, and supplying. Some examples of Big Data solutions in Pricing, Supply, and Price Optimization (sale and retail) are those provided by IBM, Oracle, SAS, Teradata, EMC, and others, who are leveraging opportunities in the technology space.

Finally, and it should be noted, this technology adoption is still under development. In fact, it was not until more recently that several oil and gas companies in the United States realized the applications that big data had in the industry. However, as early as 2018, a survey by General Electric and Accenture found that 81% of executives considered big data among their future investment priorities.

As can be seen, the trend of Big Data and analytics is still on its way; And most likely, companies in the downstream sector will continue that line. In brief, digitization has proven to be beneficial by providing additional information resources, which maximize the industry's growth and generate value in the long term.

# Why does clean energy in the oil and gas sector matter?

*By* ***Aldo Santillan*** in
*Managing Director & Editor in Chief, Energy Capital Magazine*

It is not surprising that the transition to cleaner energy alternatives has already come to influence the oil and gas sector. But, moreover, what is most evident in the North American case is that it has not only had an influence; it is also defining the agenda as never before.

Until just a few months ago, the large North American companies in the sector, including ***Chevron***, ***ExxonMobil***, and ***ConocoPhillips***, were reluctant to make

more substantial commitments related to emissions reduction. Likewise, within these oil majors' development plans, few or no strategies were included for their infrastructures' transition into cleaner ways of generating energy.

In contrast, their European counterparts had already made giant strides on the subject in the past. Companies such as ***bp***, ***Shell***, ***Eni***, ***Repsol***, and the recently renamed ***TotalEnergies***, refocused their strategies in recent years, prioritizing strengthening their renewable energy developments.

Likewise, most of these companies sought, for instance, to extend profit returns on their existing assets. As a result, they also limited their investments in future oil exploration and production (E&P) activities.

While it took longer for U.S. oil companies to conclude that clean energy is also their business, change is already happening. Accordingly, the U.S. energy industry is moving more aggressively than ever before to reduce its carbon footprint.

What led companies in the region to come to this understanding? In part, this trend is being spurred by vast policy pressure from a new administration and also by the increasing relevance of ESG standards in capital raising.

Therefore, the focus now is more on how the sector will get there than whether it is the right decision. As Dan Yergin, IHS Markit vice chairman, ***said in early March:*** "The oil and gas industry is calibrating itself into what has become the new benchmark — net zero carbon by 2050." Indeed, "there's a lot of variation in strategies. But the big cross-cutting themes are hydrogen, carbon capture, innovation," Yergin noted.

Similarly, Baker Hughes Chairman and CEO Lorenzo Simonelli ***recently said*** that oil and gas companies could start their energy transition journey by leveraging efficiency to reduce the carbon footprint from hydrocarbons today.

Also, they could benefit from the use of existing technologies which can already limit methane emissions. Lastly, the industry must divert its operations into the increasingly varied energy mix, the CEO added. There, the potential of other energy sources like hydrogen and fuel cells is emerging.

However, we can't neglect that some hydrocarbons will still be crucial in this energy transition process, particularly since a lot of energy is still required by the world population. In that sense, and as experts like Simonelli note, it all comes down to be socially responsible.

Companies in the industry are more motivated than ever to come with net-zero commitments; mainly, ones that are reachable and that make financial sense to them. Thus, oil and gas players can ease this energy transition path by implementing ways and strategies to lower their own carbon footprint within their manufacturing processes. Finally, they can also develop digital remote operations to decrease the footprint of their operations. The technology will continue evolving, and companies in the sector must take leverage of those now.

# **Transforming downstream** for a cleaner energy future

# A breath for the industry

*By* ***Energy Capital***
*www.energycapitalmedia.com*

The present decade is a crucial one for the energy sector. As the climate crisis becomes increasingly relevant for production methods, and the processes from which energy is harvested and utilized mutate, transforming downstream has become a key element in the overall energy transition agenda.

Particularly in the United States, despite, or maybe even because of the disruptions experienced during the winter storm Uri or the Colonial Pipeline cyberattack, gasoline demand is up.

According to the Energy Information Administration, 2021's fuel consumption rate will increase to almost 9.0 million barrels a day; 1,2 million more when compared to last year's same period. Accordingly, U.S. crude oil production is forecasted to reach 11.3 million b/d in the fourth quarter of 2021; and then rise to an average of 11.8 million b/d in 2022.

However, gasoline burning, specifically in the transportation sector, is one of the most pollutant activities among the overall pollution share. Indeed, this process accounts for about 28% of total U.S. greenhouse gas emissions, making it the most significant contributor to the country's GHG emissions.

Consequently, diversifying the downstream sector, and going from 100% fossil-fuel-based gasoline to multiple feedstock-based fuels, is vital. In fact, the Biden-Harris administration has made this a cornerstone of its agenda. It has pledged to spend over $2 trillion to accelerate the adoption of greener transportation solutions by 2024.

## The many faces of the new downstream

The new downstream has, in fact, many faces; this diversified sector includes solutions like blending biofuels and ethanol-based into petroleum-based fuels to be used with conventional motors.

Similarly, new natural gas-fired vehicles, electric vehicles, and fuel cell vehicles are powered by

hydrogen or biofuels produced with biomass. To support those solutions, public and private investment are needed, mainly for infrastructure development. Also, to create new standards and public policies that incentivize the market and push it into new clean and reliable scenarios.

## An overview: a multifaced sector

### *Ethanol*

One of the first efforts in the U.S. for greener fuel adoption was the Renewable Fuel Standard, a program created by Congress to tackle emissions and introduce and incentivize renewable fuel use.

It was created under the Energy Policy Act of 2005 and expanded under the Energy Independence and Security Act of 2007. As such, it mandates that refiners must blend specific amounts of biofuels into their conventional fuels mix.

Such measure would uplift the demand for ethanol, a volatile liquid produced from corn, which is the main ingredient for a specific type of biofuel. A strong ethanol demand would strengthen the agriculture sector and create a stronger supply chain.

Nevertheless, the ethanol industry in the U.S. has struggled with both the effects of the pandemic and the resistance from refiners, who argue blending ethanol-based fuels into their mix hurts their financials.

A rush of waivers for refiners under the Trump administration meant a massive blow for ethanol producers, and during the pandemic, they faced almost the destruction of demand. According to the EIA, ethanol output in April averaged 951,000 barrels per day, just 6,6% below the 2017-2019 period; indeed, a post-pandemic-best.

### *Hydrogen*

Green hydrogen production has been another solution for the downstream sector, specifically for the long-haul transportation industry. As batteries for long-haul electric trucks would be considerably heavy, making large-scale fleets economically and logistically inviable, hydrogen fuel cell trucks are becoming the next generation solution for the decarbonization of heavy-duty trucks.

For that matter, Nikola Motor company recently partnered with TravelCenters of America (TA-Petro) to develop and deploy hydrogen fueling stations for heavy-duty trucks. The installments would be done in two existing TA-Petro sites in California; the ultimate goal is to deploy a nationwide, full-scale charging network.

Similarly, oil giant Chevron announced in April that it teamed up with Toyota to explore the use of hydrogen in the transportation sector. Through a Memorandum of Understanding, both companies agreed on pushing for policies that support hydrogen infrastructure, particularly for hydrogen-powered transportation and storage.

Such hydrogen developments would help Chevron lower its greenhouse gas intensity for oil and gas by 35% versus the 2016 threshold.

In Canada, where hydrogen is also advancing strongly, Suncor Energy and ATCO announced in May a partnership to develop a world-class hydrogen project in Alberta; in fact, the most extensive of


the country and worldwide.

In this sense, both companies intend to produce more than 300,000 tons of clean hydrogen per year, to be used, 65% of it for Suncor's refining processes in its Edmonton refinery and 20% for the Alberta natural gas grid. Moreover, 90% of the emissions related to the production of the hydrogen itself would be captured.

This project would lower Alberta's GHG emissions by over 2 million tons a year. In addition, in late May, Suncor announced its goal to reduce its GHG emissions by ten megatons by 2030. Switching to biofuels and the hydrogen production effort in Alberta would play a vital role in reaching that goal.

***Renewable Natural Gas***

Renewable Natural Gas (RNG) has been attracting attention given its potential to dramatically lower emissions from fuel burning. Mainly produced from the capturing of methane from decomposing biomass or organic waste from dairies, landfills, and wastewater treatment plants, it can decrease at least 70% of the harmful GHG gas emissions related to burning it.

Furthermore, depending on the RNG source, it can reduce even 300% of these gases, making it a negative carbon fuel solution. Consequently, Clean Energy Fuels, the leader in clean fuels in the U.S., announced in early May it secured contracts for its RNG supply aimed at transportation fleets.

Specifically, the company secured a contract with Pac Anchor, a port drayage company that serves Long Beach and Los Angeles ports, for the supply of 2,5 million gallons of RNG. Such output will serve as fuel through the company's charging network for trucks.

The company also expanded RNG accords in Canada, where it secured a contract for the supply of 13 million gallons of RNG over the duration of the contract. Such output will serve BC Transit stations and Central Frazier Valley Center, where 60 buses will be powered with the RNG.

This fuel has become one key element of the new downstream; this is not surprising if we consider its carbon lowering potential. According to Trucking.info, measured in grams of CO2 equivalent per megajoule, diesel and gasoline have a 100 measure; in contrast, RNG from landfill sources has 50, and biogas from dairy manure -250.

***Green jet fuel***

EIA's data show that the U.S uses around 45 million gallons of jet fuel every day; such amount is equivalent to the 6% of total petroleum use. In terms of emissions, the Air Transport Action Group, a coalition of aviation experts focused on sustainability issues, says that air travel emits around 2% of the total GHG emissions globally.

Consequently, lowering the footprint of jet fuel is a critical component of the strategy that the global energy industry is embracing to tackle climate change. This is particularly the case for the U.S., as it recently drew a new bill to subsidize greener forms of jet fuel substantially.

Produced from sustainable feedstocks like animal grease or plant oils and later combined with traditional fossil fuel, the green jet fuel can reduce the emissions of airplanes by almost 85%.

One of the companies pushing its use is Honeywell. The Honeywell Green Jet Fuel offers substantial cuts in emissions and higher energy density in flight, allowing aircraft to fly farther on less fuel.

The bill drawn by the U.S. government includes a tax incentive of $2,00 for every gallon of sustainable fuel produced. Such an amount would make the tax credit one of the most extensive subsidies for clean fuel in the country.

The bill is expected to pass shortly; it already has support from environmental groups, federal agencies like the Environmental Defense Fund, and companies like United Airlines and Airlines for America.

## Making business; where are the opportunities?

In conclusion, the downstream sector is well on its way to diversification; from EVs to biofuels to RNG and hydrogen, new solutions are arising to lower the sector's environmental footprint.

Companies in the U.S. and Canada are increasingly betting on these new solutions, thus creating a demand and supply platform that is expected to tackle one of the most pollutant sectors of all. The transportation one, whether it is from air, land or water.

But a final question remains unanswered, where are the opportunities? There's one answer: Innovation. With increased competition for cleaner alternatives, a traditional fossil-fuel-based downstream is on the way out.

With greater rates of efficiency, lower carbon footprint, and cheaper feedstocks, advanced biofuels are already eating up the market. According to the EIA, on its latest data available, the U.S. petroleum refining capacity hit a low record of 18,4 million barrels a day (Sept 2020), mainly due to the push of renewable fuels and lower carbon petroleum subproducts.

Particularly renewable diesel has been emerging as a top choice for low carbon intensity fuels. For instance, since December 2020, major refiners like Marathon, Shell, and HollyFrontier transitioned their hydrocarbon-based refineries into renewable fuel production stations.

Moreover, the Department of Energy announced in May 2021 a $35 million grant for research projects that optimize the synthesis of renewable fuels and biorefining to benefit the energy, transportation, and agriculture sectors.

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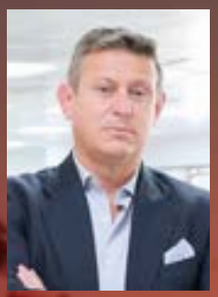
# Digitalization in the Energy Sector: the value of a suitable technology partner



By ***Manuel Losada,***
*Chief Operating Officer, Isotrol*

Video Interview

Two recent press releases highlight the current situation in the energy sector in North America on its way to decarbonization:

Last Wednesday, 31st March 2021, U.S. President Joe Biden unveiled a $2 trillion infrastructure plan in Pittsburgh, an eight-year initiative that includes hundreds of millions of dollars to boost renewable energy, marking a milestone to date in administrative terms to achieve clean energy targets by 2050.

Elsewhere, a group of Canadian natural gas producers, including Tourmaline Oil, ARC Resources, and Birchcliff Energy, announced

**WITHIN THIS EXCITING ROUTE TOWARDS ENERGY TRANSITION, UNDERTAKEN BY ORGANISMS AND INSTITUTIONS WORLDWIDE, DIGITALIZATION HAS BECOME A KEY FACTOR, WHICH IS DECISIVE FOR ACCELERATING THE COMPETITIVENESS.**

**TO BECOME SUCCESSFUL WITH THIS NEW ENERGY MODEL, COMPANIES WILL HAVE TO ANTICIPATE CHANGES, REDEFINE THEIR STRATEGIES, AND MAKE DECISIONS REGARDING MODERNIZATION THAT FACILITATE THEIR BUSINESSES' DIGITAL TRANSFORMATION AND SUSTAINABILITY.**

they will be joining with other energy companies to establish a new capital fund that will invest in clean technology start-ups.

Both milestones underline an essential idea: as people continue to demand more and more energy, governments and companies continue to increase their commitments to investing in renewable energy. This reality includes the Oil & Gas industry, making it clear that it will play a leading role in the supply of low-carbon energy.

Within this exciting route towards energy transition, undertaken by organisms and institutions worldwide, digitalization has become a key factor, which is decisive for accelerating the competitiveness among renewable (energies??). For this reason, companies in the energy industry are investing in digital technology as part of their strategies.

However, the digitalization of the energy sector is not without its complexities: all agents will have to overcome challenges during this process. To become successful

**AMONG THESE DECISIONS, WE HAVE FOUND THAT A SUITABLE TECHNOLOGY PARTNER IS CRUCIAL. AS A TRAVEL PARTNER, THIS PARTNER WOULD UNDERSTAND THE NEEDS AND COMPLEXITIES OF THE ENERGY SYSTEM**

with this new energy model, companies will have to anticipate changes, redefine their strategies, and make decisions regarding modernization that facilitate their businesses' digital transformation and sustainability.

Among these decisions, we have found that a suitable technology partner is crucial. As a travel partner, this partner would understand the needs and complexities of the energy system and, at the same time, would propose technological innovations for modernization to improve competitiveness and maximize the results.

This need opens up an exciting business opportunity and brings great value to Isotrol. Although it hasn't been until nowadays that digitizing energy is being so hotly discussed, digital technology designed to manage electricity and gas has been used since the 1970s. For decades, the automatization of processes has been used within the industry, maximizing quality and minimizing energy use and transport, whose security, reliability, and efficiency have been massively enhanced when it comes to monitoring routes and optimizing them via software.

Since we started in 1984, Isotrol's activity has been linked with innovative projects in the energy sector, applying technology to control energy installations. As a result of this journey/experience, besides helping to increase the efficiency and profitability of renewable energy power plants, we can offer technology solutions for their integration within the network and allow large companies to optimize their commercial energy operations. This ability provides us with a singular company profile. It puts us in a privileged position to contribute to the energy sector's digital transformation as an expert technology partner.

Specifically in the United States, this position has been strengthened by signing a recent agreement with Berkana Resources Corporation, leader in Operational Technology (OT) infrastructures for the energy market. Counting on its wealth of experience and prestige in the Oil & Gas sector has allowed us to present an even more competitive, higher quality offer that will enable the solution to the needs of an ever-expanding variety of clients in the US towards renewable energy.

# Expanding Our Renewable Energy Infrastructure

There is growing demand to expand our global renewable energy portfolio. The needs are obvious, limiting our reliance on fossil fuels and reducing greenhouse gas emissions. However, the most widely deployed renewable energy technologies, wind and solar, both require tradeoffs – they require a lot of land and they have significant aesthetic drawbacks.

Video Interview

*By **Veeral Hardev***
*Vice President of Strategy, Ubiquitous Energy*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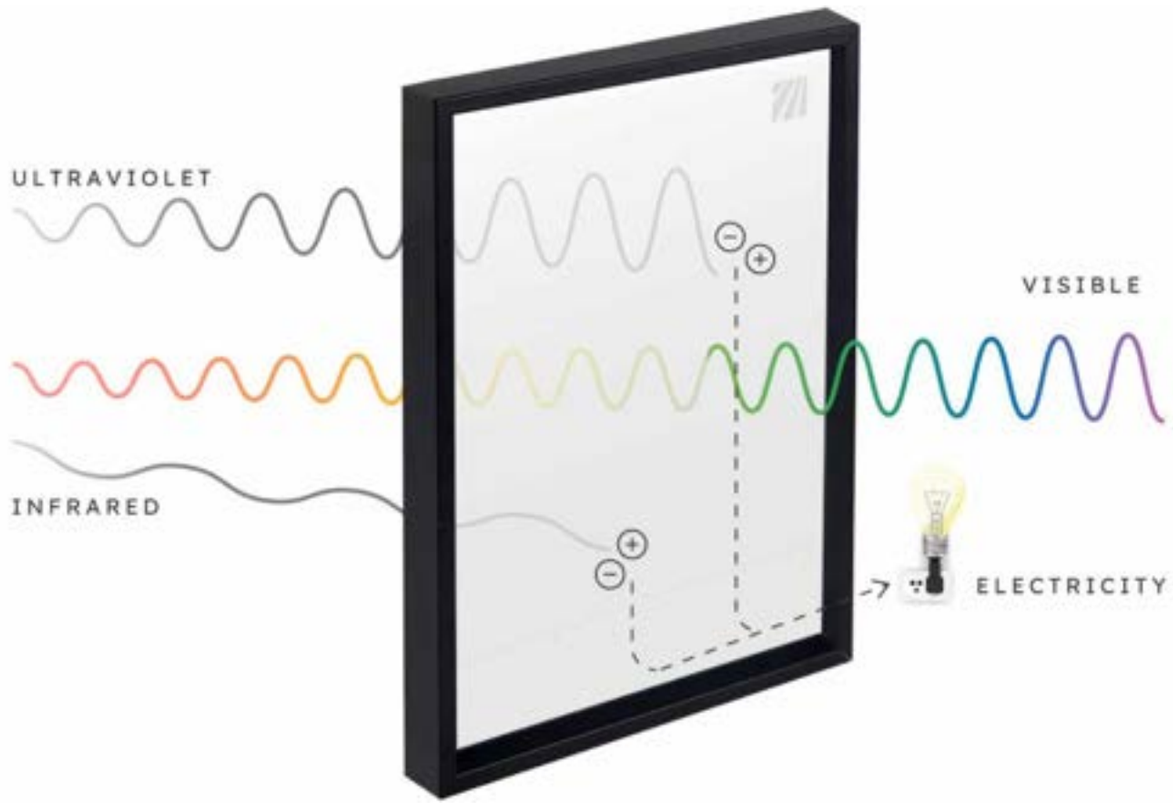
What if there was a way to deploy a significant amount of clean, renewable energy without the need for additional space and infrastructure? A potential solution is transparent solar.

What is transparent solar? Transparent solar works in a similar way as does conventional opaque solar. Sunlight is absorbed and converted into useful electricity. However, with transparent solar only the invisible portion of sunlight (ultraviolet and infrared) is converted into electricity and the visible light that we can see passes right through.

This technology can therefore be deployed onto almost any surface that sees sunlight without impacting its appearance, turning the infrastructure all around us into "invisible" solar panels. A few applications include turning the window glass in commercial buildings

**THE POTENTIAL SCALE TRANSPARENT SOLAR CAN HAVE ON OUR ENERGY INFRASTRUCTURE AND BUILT ENVIRONMENT CAN BE PUT INTO PERSPECTIVE BY LOOKING AT THE SCALE OF THE ARCHITECTURAL GLASS INDUSTRY.**



into vertical solar farms, complementing or expanding the amount of renewable energy that can be produced in residential and multi-family homes, and even helping to increase battery life when deployed onto the glass of electric and hybrid vehicles.

The potential scale transparent solar can have on our energy infrastructure and built environment can be put into perspective by looking at the scale of the architectural glass industry.

According to the glass industry organization, Glass Performance Days, approximately 26 billion square feet of coated architectural glass (think windows and glass facades) is produced and installed annually. If this glass were coated with transparent solar during the glass manufacturing process, that would result in ~600,000 acres of transparent solar per year, or additional production capacity roughly equivalent to the surface area of conventional solar panels installed in 2020 (~127 GW according to the International Renewable Energy Agency). That would mean doubling the area of solar installed each year by simply piggybacking off the glass that is already being manufactured and installed in buildings.

**WHAT IF THERE WAS A WAY TO DEPLOY A SIGNIFICANT AMOUNT OF CLEAN, RENEWABLE ENERGY WITHOUT THE NEED FOR ADDITIONAL SPACE AND INFRASTRUCTURE? A POTENTIAL SOLUTION IS TRANSPARENT SOLAR.**

**NOT ONLY COULD TRANSPARENT SOLAR HAVE A SIGNIFICANT IMPACT IN INCREASING THE GLOBAL SOLAR CAPACITY, BUT IT CAN ALSO BE DONE IN A WAY THAT IS SEAMLESS, CONVENIENT, AND EFFICIENT.**

Not only could transparent solar have a significant impact in increasing the global solar capacity, but it can also be done in a way that is seamless, convenient, and efficient. It can be deployed on site where the energy is needed and consumed in buildings. According to the US Department of Energy, buildings consume 40% of our electricity and account for just as much of our global greenhouse gas emissions.

By deploying transparent solar directly onto the vertical surfaces of buildings we can offset a significant portion of a building's energy consumption, reducing greenhouse gas emissions in the process and using real estate that would otherwise be passive and unavailable for energy generation.

So, when will transparent solar be ready and available? Companies such as Ubiquitous Energy are leading the charge in the development and commercialization of transparent solar. There are some solar glass products already on the market, but the available products all have some type of tradeoff that is limiting their adoption. Truly transparent solar is the key to broad industry adoption; already deployed in pilot scale installations, it is expected to be commercially available in 2023.

# Bringing advanced nuclear to the energy state

By **Doug Robison**
*Founder, president, and executive chair of ExL Petroleum*

Video Interview

In the last two decades, hydraulic fracturing has revolutionized the oil and gas industry, not just in Texas but domestically and internationally. That technological change brought energy independence to the U.S. New ways of doing things changed everything.

Today, advanced nuclear technology is shattering paradigms in a similar way, and Texas energy stands to benefit from another revolution.

In 2004 I co-chaired the Energy Supply Committee for the Texas Energy Planning Council and spent a year holding hearings around the state on how to maximize energy production. One of our findings was that hydrocarbons would be the mainstay of energy for the foreseeable future. The renewables – wind and solar – could not carry that load alone; the only technology that existed to replace hydrocarbons was nuclear.

That was 2004, and the potential and importance of this technology has only increased since then. The energy of the future will be nuclear. It will be renewable and reliable; it will be low or zero-emission, and it will be deployable where it's needed.


*Credit: Jeremy Enlow*


Face Shield
NEXT

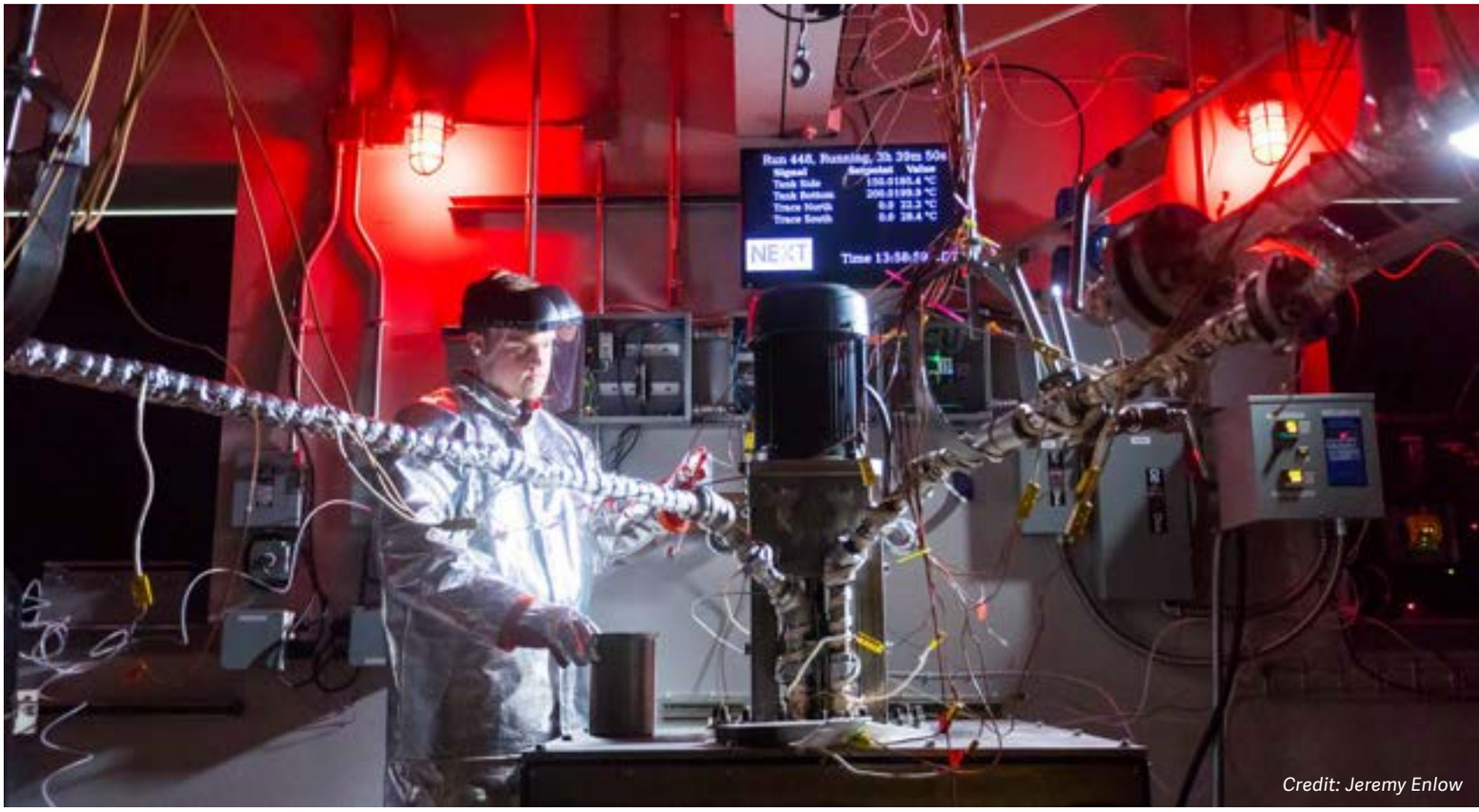
**ALREADY, NUCLEAR POWER IS THE SAFEST AND CLEANEST METHOD TO GENERATE ELECTRICITY ON A COMMERCIAL SCALE. ITS SAFETY RECORD IS FAR SUPERIOR TO OTHER ELECTRICITY-PRODUCING METHODS, AND ADVANCED REACTORS – USING MOLTEN SALT AS THE COOLANT – ARE EVEN SAFER.**

Already, nuclear power is the safest and cleanest method to generate electricity on a commercial scale. Its safety record is far superior to other electricity-producing methods, and advanced reactors – using molten salt as the coolant – are even safer.

Advanced nuclear power produces zero-carbon dioxide emissions and minimal waste. A molten salt reactor, for example, will only make a few percent of the total waste that current reactors produce, and that waste will be relatively short-lived.

The use of advanced molten salt nuclear reactors also significantly reduces the cost of power plants, providing electricity at a lower actual cost than any current energy source, including coal, natural gas, solar, or wind.

Electricity output can be quickly adjusted to match demand, helping stabilize the grid in areas with a high volume of intermittent renewables. And advanced reactors will come in a wide range of sizes, allowing owners to tailor electricity generation to demand.



Credit: Jeremy Enlow


Credit: Jeremy Enlow

Beyond the advantages to Texas energy production, advanced molten salt reactors have the potential for lifesaving benefits through the desalination of water and medical isotopes. Molten salt reactors operate at high temperatures and are an efficient heat source for the desalination of water. Given that one in three people worldwide suffers from a shortage of freshwater, this addresses a fundamental global need.

Molten salt reactors also naturally produce isotopes needed for treating cancer but are not found in nature. Molybdenum-99 (Mo-99) and bismuth-213 (Bi-213) are two radiopharmaceuticals showing great promise for diagnosing and treating cancer. Mo-99 allows doctors to make diagnoses quickly without the need for an invasive procedure.

Bi-213 provides a new treatment option that could spare patients from the pain caused by chemotherapy. With the current unstable and limited worldwide supply of Mo-99, physicians are sometimes forced to choose which patient has a greater need for the procedures. People around the world are searching for a reliable supply of Mo-99. Currently, there is no source for Bi-213.

Texas universities are already stepping up to explore the possibilities of advanced nuclear reactors, with funding from Natura Resources. Abilene Christian University, Georgia Institute of Technology, Texas A&M

Credit: Jeremy Enlow

University, and The University of Texas at Austin. Thus, they are at the forefront of researching the potential of a molten salt reactor.

ACU's NEXT Lab is leading the four-university NEXT Research Alliance. The consortium launched in 2019 to design, license, and commission the first university-based molten salt research reactor, hosted and owned by ACU.

In 2020, Natura Resources entered into a $30.5 million sponsored research agreement with the four consortium universities: $21.5 million to Abilene Christian and $9 million to the other three universities. Natura also has a project management agreement with ACU that provides for the design, licensing, and construction of the reactor.

To that end, ACU's NEXT Lab has secured its first patent and has a second patent in the provisional stage. Lab work on campus in Abilene continues with the construction of a second salt loop, the development of a salt purification system, the commissioning of the molten salt filter system, the second-generation chemical analysis system, and a series of public meetings with the Nuclear Regulatory Commission to prepare for submission of a reactor construction permit later this year.

Globally, we're seeing the energy industry as a whole moving from natural gas to nuclear. As Texans, we can be leading this next revolution or lagging behind. It's time we get serious about researching, funding, and supporting the next generation of nuclear energy.

*Doug Robison is a third-generation oilman, partner, co-founder, president, and executive chair of ExL Petroleum, a Permian-based oil and gas exploration, and production company. He previously served nine years as general counsel and chief negotiator for Henry Petroleum LP and worked more than 14 years for Exxon Company U.S.A. In 2004 he served on the Texas Energy Planning Council and co-chaired the Energy Supply Committee. He is the founder and sole member of Natura Resources. He also serves on the strategic committee for Abilene Christian University's Nuclear Energy eXperimental Testing Laboratory.*

# **Comparing Underground Natural Gas** Storage With Deep Saline Injection Of Carbon Dioxide

Find out why underground natural gas storage can serve as a useful analog when developing large-scale carbon capture and sequestration projects.

*By* ***Steve Hendrickson***
*shendrickson@ralphedavis.com*

*By* ***Harrison Perrin***
*hperrin@ralphedavis.com*

**Video Interview**

Public opinion regarding the effects of climate change has evolved steadily over the last decade; recent surveys typically indicate that most Americans believe more needs to be done to offset its effects. This change has altered the political landscape, and it now seems likely the federal government will maintain—and perhaps increase—the incentives for companies to reduce their greenhouse gas (GHG) emissions.

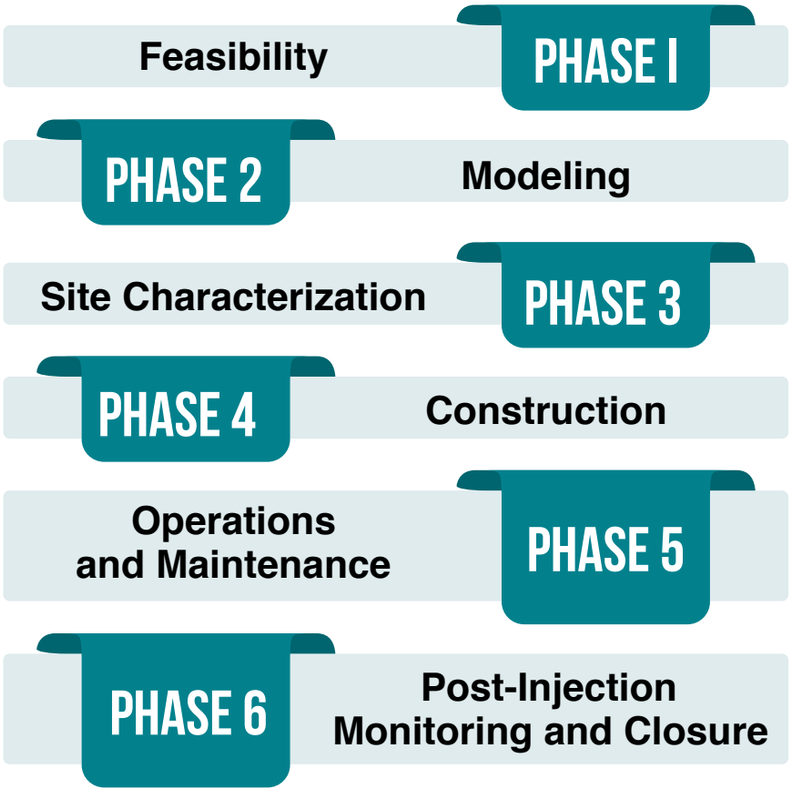
Because fossil fuels, particularly natural gas, are expected to continue to play a significant role in electricity generation, achieving GHG emissions reductions will require the large-scale deployment of carbon capture and sequestration (CCS) technologies.

Injection of carbon dioxide ($CO_2$) into deep saline aquifers is expected to be the most deployed technology for achieving carbon sequestration. Because carbon sequestration is only beginning to be implemented in large-scale projects, it makes sense to look to an already commercialized analog industry

on which companies seeking to develop carbon sequestration sites can leverage their experience. Underground natural gas storage is a useful analog to deep saline injection of $CO_2$, and the purpose of this paper is to briefly compare the two applications from a petroleum engineering perspective.

## Operational Objectives

There are three overall objectives for designing and operating a natural gas storage reservoir: (1) accessing the desired storage capacity, (2) preventing gas migration, and (3) developing and maintaining desired gas deliverability. These objectives align very well with the objectives of $CO_2$ storage: ensuring sufficient capacity, demonstrating, and monitoring containment, and ensuring sufficient injectivity to minimize the number of injection wells. The phases of project development and operation of the two project types reflect the similarity of their operations (Figure 1).




*(Figure 1. Carbon Storage Phases of Development)*

## Project Feasibility & Modeling

The feasibility and modeling phases ensure that the reservoir is suitable for capacity, containment and injectivity. The components of an ideal natural gas storage site include a porous and permeable formation overlain by an impermeable seal. Core analysis, wireline logging, seismic surveys, and comparison to analog reservoirs are used to determine the geologic parameters needed for ascertaining the suitability of the reservoir for storage. Because depleted oil and gas reservoirs represent 80% of active natural gas storage facilities in the U.S., these reservoirs have typically been penetrated by many wells and ample reservoir and petrophysical data is available.

Most underground $CO_2$ storage capacity in the U.S. is in saline formations, however. These reservoirs may have no prior wellbore penetrations and lack extensive reservoir data. In those cases, seismic and analog reservoir data can be used in the feasibility stage.

For underground gas storage, shallow reservoirs are typically preferred. This reduces the cost of drilling the wells and reduces the pressures required for injection. Carbon dioxide storage sites, however, require a minimum reservoir depth of 2,600 feet to keep reservoir pressures high enough to maintain the injected $CO_2$ as a supercritical fluid to maximize storage capacity.

During the feasibility and modelling phases, many of the engineering techniques used are very similar, although there are some differences. For example, natural gas and $CO_2$ have very different fluid properties, which must be considered through appropriate equations of state, and because an element of long-term deep saline storage is trapping the $CO_2$ in the reservoir at residual saturations, those projects require greater information of the relative permeability characteristics of the reservoir.

## Site Characterization

Following the feasibility and modeling phases, data is acquired to build additional models and reservoir simulations in the site characterization phase. Methods of data acquisition include seismic and well logging, core analysis, and injectivity tests. This data is submitted during the permitting process to demonstrate the suitability of the storage site to the appropriate regulatory agency.

Under the Safe Drinking Water Act of 1974, the U.S. Environmental Protection Agency (EPA) has authority to regulate the underground injection of fluids, but an amendment to the Act excludes natural gas storage facilities. The EPA's Underground Injection Control Program regulates the construction, operation, permitting, and closure of injection wells, with $CO_2$ injection wells for long-term store denoted as Class VI. Each $CO_2$ injection well requires its own permit, and five plans are required to acquire a Class VI permit:

**1.** Area of review and corrective action plan
**2.** Testing and monitoring plan
**3.** Injection well plugging plan
**4.** Post-injection site care
**5.** Site closure plan, and emergency and remedial response plan

The regulatory agency with jurisdiction over an underground gas storage site depends on whether the facility is designated as "interstate" or "intrastate". Interstate facilities are regulated by the Federal Energy Regulatory Commission (FERC) while intrastate facilities are regulated by state agencies. FERC regulators deferred to state agencies in 1997 following the Research and Special Programs Administration issuance of Advisory Bulletin ADB-97-04, which concluded that natural gas storage requirements would be tailored by a state's geology and hydrology.

As a result, natural gas storage regulations vary by state. The natural gas storage permitting process is like the $CO_2$ permitting process in its focus on protecting the environment and demonstrating that the storage zone is secure, but the process is lengthier for $CO_2$ storage projects.

## Construction

Construction begins following acquisition of the necessary permits. In addition to injection wells, infrastructure for natural gas storage sites includes monitoring wells, extraction equipment, pipelines, dehydration facilities, and compressors. Additional infrastructure for $CO_2$ storage sites include pipelines and monitoring wells. Carbon capture infrastructure is also constructed at the emission site during this step. The EPA's requirements for the construction of Class VI wells are detailed below and depicted in Figure 2.

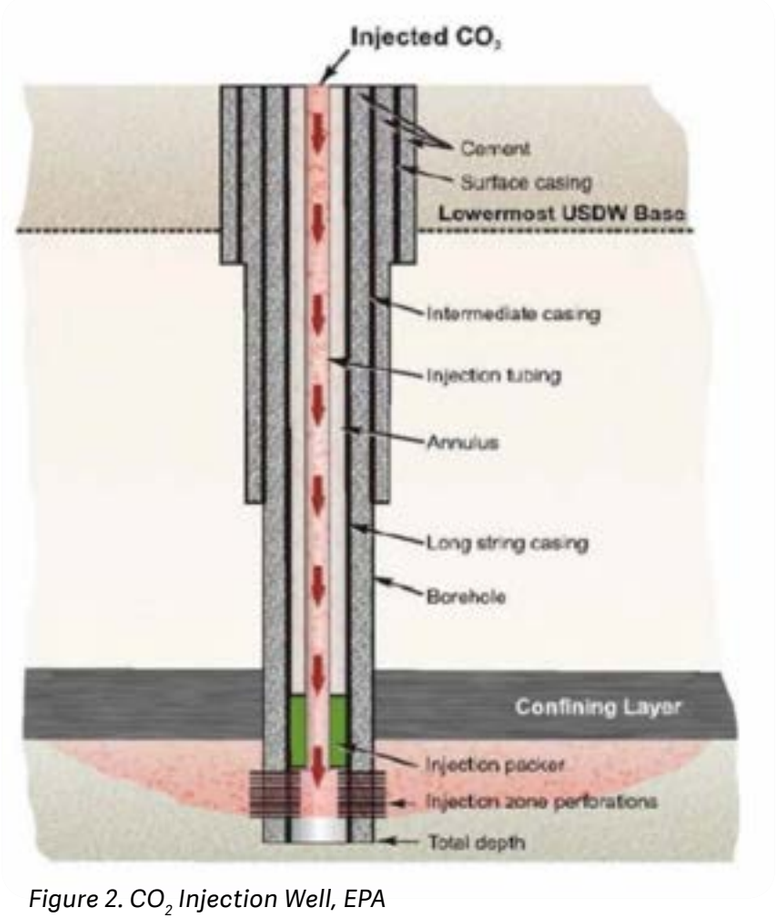



*Figure 2. $CO_2$ Injection Well, EPA*

**1)** Surface casing must extend through base of lowermost underground source of drinking water (USDW) and be cemented to the surface.
**2)** At least one long string of casing with centralizers from surface to injection zone and cemented back to the surface is required.
**3)** Tubing and packer with appropriate materials suitable for $CO_2$ service.
**4)** Annulus between tubing and long string casing must be filled with a non-corrosive fluid.
**5)** Continuous recording devices must be installed to monitor pressure, flowrate, volume/mass, and $CO_2$ stream temperature.
**6)** Alarms and shut-off systems may be required.

Additional seismic, well logging, and core samples must be acquired once a $CO_2$ injection well is completed. If the data correlates with the submitted plans, the EPA authorizes $CO_2$ injection. A Monitoring, Reporting and Verification (MRV) Plan must be submitted within 180 days of injection.

## Operations & Maintenance

The operations phase includes operational planning, site preparation, and monitoring. Well integrity testing and monitoring wells are utilized to ensure that the natural gas and $CO_2$ are not leaking from the storage reservoir. The EPA requires the following during $CO_2$ injection operations:

**1)** Continuous and periodic well integrity tests.
**2)** Analysis of $CO_2$ stream.
**3)** Continuous monitoring of pressure, flowrate, and volume.
**4)** Corrosion monitoring on a quarterly basis.
**5)** Monitoring of groundwater quality and geomechanical changes above the confining zone(s).
**6)** Monitoring of the $CO_2$ plume and the associated pressure changes.
**7)** Description of the Area of Review at a minimum of every five years during operation, including the projected movement of the $CO_2$ plume and formation fluids.

## Post Injection Monitoring & Closure

Site closure begins following the completion of injection. Activities include injection equipment removal, plugging of injection wells, and beginning site restoration work. As with the other elements of the carbon sequestration process, post-injection monitoring is specific to each $CO_2$ storage site. Monitoring wells are utilized along with reservoir models to track the pressure of the $CO_2$ plume.

The EPA dictates that post-injection monitoring must occur for 50 years unless an application for reduction is approved or non-endangerment is established, which occurs once the $CO_2$ plume pressure reaches a certain level. Once non-endangerment status is reached, monitoring wells are plugged, monitoring equipment is removed, and the surface is reclaimed.

## Conclusions

In addition to the notable difference of permanent versus temporary storage, certain reservoir characteristics and the regulatory agencies differ for natural gas and $CO_2$ storage. The exemption of natural gas storage sites from EPA regulation coupled with the experience of the natural gas industry results in a less rigorous regulatory process for natural gas storage compared to $CO_2$ storage. While these differences are important to note, underground gas storage remains an important and useful analog as $CO_2$ storage transitions from its current state to large-scale deployment.

## About the Authors:

Steve Hendrickson is the president of Ralph E. Davis Associates, an Opportune LLP company. With over 35 years of professional leadership experience in the energy industry, he has a proven track record of adding value through acquisitions, development, and operations. A licensed professional engineer in the state of Texas, he earned an M.S. in Finance from the University of Houston and a B.S. in Chemical Engineering from The University of Texas at Austin. Hendrickson recently served as a board member of the Society of Petroleum Evaluation Engineers (SPEE) and is a registered FINRA representative.

Harrison Perrin is a Petroleum Engineer with Ralph E Davis Associates, an Opportune LLP company. Prior to Opportune during her collegiate studies, Harrison was a Production Engineering Intern at Anadarko and a Finance Intern at White Deer Energy. During her final semester, Harrison completed a thesis on the topic of simulation parameter fitting of steady state foam flow during enhanced oil recovery. Harrison graduated from The University of Texas at Austin with a B.S. in Petroleum Engineering.

# Chemicals: Industry in Transformation

Where the 2010's marked a decade of growth for the US petrochemical industry, the 2020's are poised to be a decade of transformation. And, while there has historically been a strong linkage between energy and chemicals, market forces are likely to drive more independence in the energy-to-chemicals value chain.

*By **Victoria Meyer,***
*President, Progressio Global*

Video Interview

The North American petrochemical industry rode a wave of growth throughout the last decade, driven in large part by access to cheap feedstock via shale gas. Over $120 Billion was spent on hundreds of projects, from small expansions to massive petrochemical megaprojects .

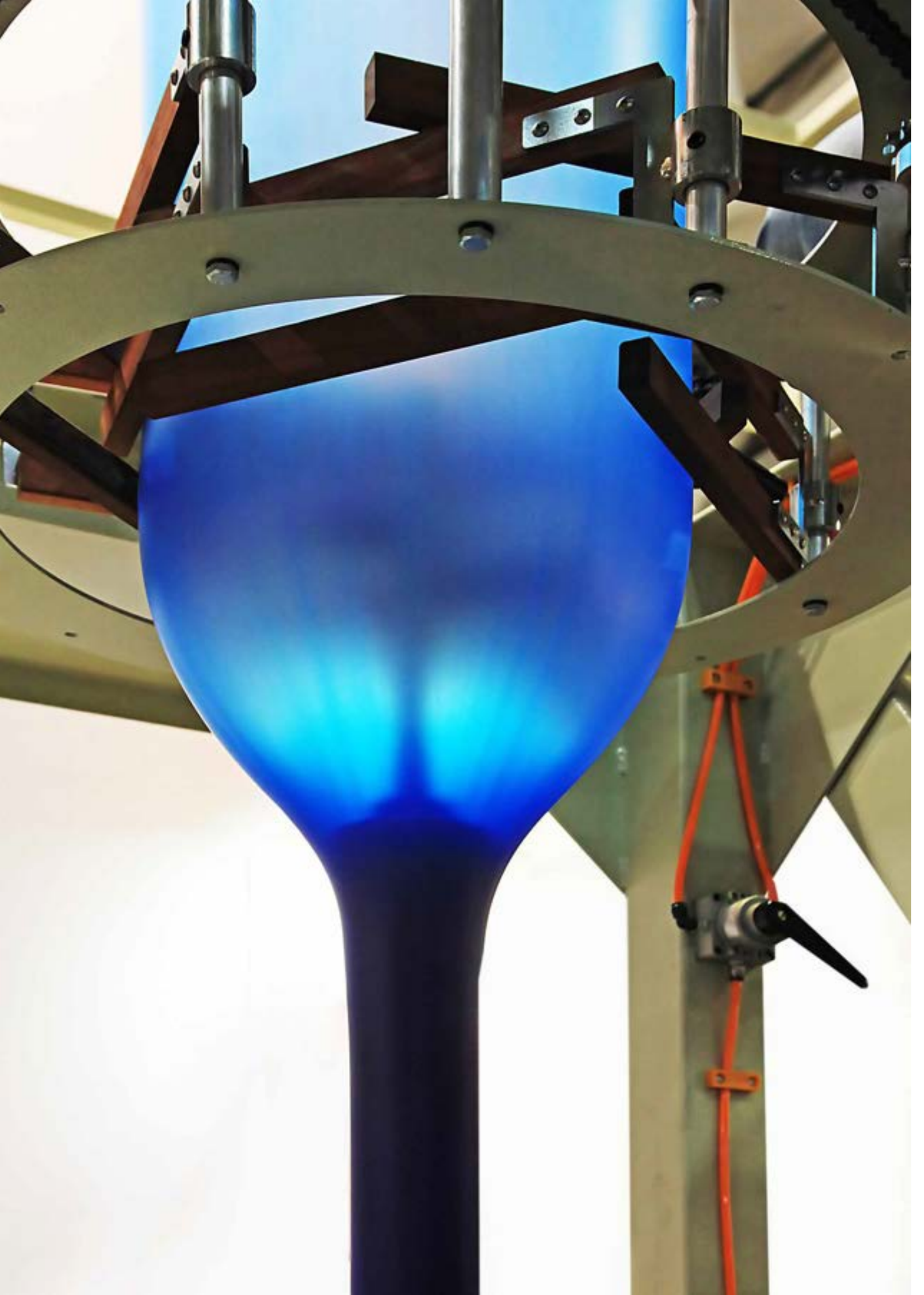
Investments were strong until the end of the decade, when chemical investing, particularly in megaprojects, slowed down as the first of the new plants started up. Then, the industry recognized an increased potential for future oversupply, and markets questioned whether a broad second wave of investment was viable. Enter COVID-19 in early 2020 and growth and investment slammed to a screeching halt, at least temporarily, while individuals, markets, and companies grappled with the impacts of the pandemic.

As we move forward in a post-pandemic world, the likelihood of strong investment in traditional chemical value chains is reduced. Trends are reshaping chemical industry strategies and focus, and ultimately a reduced interdependence of the energy-to-chemicals value chain is seen.

A number of disruptive forces are at work in the chemical industry driving this transformation: Increasing market volatility influenced by value chain dislocations, the acceleration of sustainability and circularity, and increasing focus on green solutions.

## INCREASING MARKET VOLATILITY, INFLUENCED BY VALUE CHAIN DISLOCATIONS

The interconnectedness of the energy-to-chemicals value chain has been both a strength and weakness to the chemical industry. This interconnectedness, where refinery off streams become chemical feedstocks, and, in turn, chemical cracker products become additional chemical products, has created a symbiotic relationship. Yet, as we saw in 2020, when one part of the value chain halts abruptly, while another sees increased demand, the value chain becomes stressed and dislocated and, alternate solutions will develop.



A good example of this occurred in the propylene value chain. Refinery grade propylene (RGP) is a key feedstock into propylene-derived chemical products, including polypropylene. With the abrupt cessation of air and road travel at the beginning of 2020, refineries slowed or idled and RGP production diminished to a trickle, leaving polypropylene producers scrambling for feedstock (and market prices escalating wildly) while the demand for polypropylene increased, driven in large part of healthcare, including personal protective equipment (PPE), facemasks, and other single-use medical products. There are already alternate sources of propylene feedstock, including cracker streams and on-purpose propylene production, typically via propane dehydrogenation (PDH). Chemical companies are continuing to pursue and develop alternatives to its reliance on refinery byproducts.

## ACCELERATION OF SUSTAINABILITY AND CIRCULARITY

While the pandemic stalled the implementation of plastic bag bans and (temporarily) silenced the outcries against single-use plastics, the chemical industry and major plastics producers know that it is only temporary. Chemical companies, big and small, are creating alliances to respond to the increasing pressures against plastics and innovating to create sustainable solutions to support what is a $430 billion industry accounting for 1 million jobs and one in which 60% of all ethylene, the backbone of the petrochemical industry, is turned into polyethylene.

Innovation is rampant across the chemical and plastics industry, as investors and operators, ranging from startups to private equity-backed firms to Fortune 50 companies, hustle to create solutions. The most promising is the focus on chemical recycling and pyrolysis as a means of transforming plastics waste back into a chemical feedstock. As those projects and technologies succeed and eventually increase in scale, it has the potential to further stretch the interdependence of the energy-to-chemicals value chain.

## THE "GREENING" OF THE INDUSTRY

Much like the refining industry is trying to re-invent push toward green and sustainable solutions, to combat the rise in electric vehicles (EV), the potential refinery demand reduction or dislocation, so, too does the chemical industry working to make that pivot.

Some of this is in response to the reduction in chemical feedstocks from refineries as overall demand for refined products decreases with changing transportation patterns and the rise in EV. There is also distinct focus on green and renewable chemistry as an alternative to fossil-fuel based products, with an impressive focus by leading companies on green hydrogen.

## HOW ARE SUCCESSFUL COMPANIES RESPONDING TO THESE TRENDS AND CHANGES?

**1.** Investing in independence, while leveraging existing interdependence

Leading chemical companies are investing in products and technologies that are single-product focused, with less dependence on prior refinery or cracker outputs. Good examples are recent investments in on-purpose hexene and continuing investments in PDH units as feedstocks for polypropylene and other propylene derivatives by a variety a players, creating relative independence in the value chain. At the same time, these same companies are heavily investing in supply chain technologies and resources, to more effectively understand the complexities and leverage the interdepencies across the shifting energy-to-chemicals value chain.

**2.** Increasing organizational agility by rapidly trialing new technologies to support sustainability, circularity, and growth goals

Every chemical executive I encounter is focused on increasing its agility and speed of innovation, implementing processes to support rapid trialing and commercialization of promising technologies. This is particularly critical in markets, such as plastics that have looming deadlines, imposed by end-use customers, NGOs, and governing bodies. Changing the innovation game is critical. Developing and trialing new technologies in a linear fashion, as was historically done, is simply too slow and costly. Rapid, agile innovation across a variety of solutions to find the "winners" is required to support the necessary industry transformation.

**3.** Partnering in industry solutions while competing fiercely with individual investments

Leaving nothing to chance, many companies are running parallel paths of investing in and searching for industry solutions, by participation in groups such as Alliance to End Plastics Waste, while also applying ample company resources and millions of dollars to finding their own solutions to challenges such as circularity and chemical recycling, carbon capture, and green hydrogen.

As the decade progresses, chemical companies and the energy-to-chemicals value chain will see rapid transformation to a more sustainable and competitive future, with shifting relationships and dependencies on upstream value chain partners.

1 Per American Chemistry Council, February 2021
2 Plastics Industry Association, 2020 Industry Size and Impact Report

# A Renewable Fuel Industry Driven by Climate Policy Signals

Covenant Energy was founded in 2019 with the mission to become a Canadian leader in the low-carbon fuel industry through the production of clean, renewable diesel and sustainable aviation fuel.

*By **Josh Gustafson***
*President and CEO, Covenant Energy*
*joshgustafson@covenantenergy.ca*

Video Interview


COVENANT
ENERGY

**WHEN IT COMES TO LOW CARBON FUELS LIKE RENEWABLE DIESEL, WE ARE ALMOST ENTIRELY RELIANT ON POLICY ENABLING INVESTMENTS**


The global energy economy is in the process of undergoing the largest shift since fossil fuels first became widely available. Canada is no exception to this transition, and neither is North America as a whole.

Recent efforts in Canada to lower transportation sector greenhouse gas emissions have generated excitement and anticipation from local companies like ours looking to be a part of a rapidly growing low-carbon and renewable fuels industry.

But let's face it – when it comes to low carbon fuels like renewable diesel, we are almost entirely reliant on policy enabling investments. The Canadian government has a price on carbon that will increase to $170/tonne in 2030; while the proposed Clean Fuel Regulations, currently published as a draft, is projected to see carbon credits trading at $215/tonne by the same year (note: currency is in Canadian dollars). High blends of renewable diesel are exempt from the carbon tax, and credits from the CFR can be stacked on top of this savings.

In other words, by 2030 a 100% renewable diesel blend would have a carbon policy advantage of approximately $2.50-$3.00/gallon (carbon price savings + credits from the CFR) compared to straight diesel fuel. This is key to ensuring that low carbon fuels become ubiquitous across Canada. It is also why Covenant Energy has undertaken important discussions with government, such as presenting to a House of Commons committee to convey to Members of Parliament from all political parties that policy is central to driving our project forward.

Coming from a fifth-generation canola farming family with over 13,000 acres of

**CANADA'S POLICY COMMITMENTS HAVE SHOWN THAT TO ACHIEVE A TRANSITION TO A LOW-CARBON FUTURE, GOVERNMENT MUST TAKE LEADERSHIP IN CREATING THE DESIRED ENVIRONMENT FOR GOOD QUALITY, LONG-TERM INVESTMENT.**

production, I have been able to see first-hand how the markets and supply chains have evolved and I believe that the time is now for Canada to lead in this industry.

In the United States, we see leading programs such as the California Low Carbon Fuel Standard that bring consistent investment in new projects and a flourishing renewable fuels economy. Supporting renewable fuel production in Canada is something that should be done and will bring benefits across both local and national economies as well as the environment. Canada also must ensure that our regulatory requirements align with our American neighbours so that a strong domestic market is created. If the domestic market is weak, there will be no reason to build new facilities in Canada, leading to loss of

job opportunities and economic growth, particularly when investors know that the market signals in the United States are clear. This would be a huge lost opportunity, particularly in light of the economic troubles that the COVID-19 pandemic has created.

Canada's renewed climate partnership with the United States that aims to accelerate ambitions was met with enthusiasm as it further serves to align North American interests, coordinate respective programs, and strengthen regional support.

The Canadian industry is also showing great interest in both arctic-grade renewable diesel and sustainable aviation fuel, as projects must meet the current and future needs of the transportation sector and for remote power generation. For instance, there are unique fuel requirements in Canada's northern and remote communities where temperatures can drop to -40 degrees Fahrenheit. Covenant Energy will be able to produce renewable diesel that meets these requirements.

The aviation sector is also in the midst of moving towards decarbonization and will be an important part of the renewable fuel economy very soon. As we have seen with pilot projects and procurement investments made by the United States government, Canada's government has followed suit and committed to developing low-emission marine and aviation fuels for its fleet. With this in mind, Covenant Energy's facility will have the capacity to produce both arctic-grade renewable diesel and sustainable aviation fuel.

Canada's policy commitments have shown that to achieve a transition to a low-carbon future, government must take leadership in creating the desired environment for good quality, long-term investment. Increased use of low-carbon fuels will be essential to meeting Canada's climate targets and this outlook is reflected in the demand for renewable diesel and biofuels. Equally, these policy measures will be essential to ensuring the success of projects like Covenant Energy's and a healthy renewable fuels economy.

**CANADA ALSO MUST ENSURE THAT OUR REGULATORY REQUIREMENTS ALIGN WITH OUR AMERICAN NEIGHBOURS SO THAT A STRONG DOMESTIC MARKET IS CREATED.**

# Forging a Collective Path toward Climate-Aligned Steel

You are surely aware of steel's footprint in modern civilization: it is found in everything from cars to skyscrapers, refrigerators to wind turbines. You are likely unaware however, that this metal has a tremendous carbon footprint as well.

*By* ***Lucy Kessler***
*Lead Steel, Center for Climate-Aligned Finance & Manager, Rocky Mountain Institute (RMI)*

Center for Climate Aligned Finance

Video Interview

The steel sector's carbon emissions account for about 8% of the world's total, equivalent to the annual emissions of India; meaning if the steel sector were a country, it would be the third largest emitter on the planet.

Not only that, but due to economic growth and projected demand, emissions from the sector are estimated to consume between 10% and 20% of the world's remaining 1.5°C carbon budget. The scale of the challenge is immense. But where are the solutions—and what role, if any, can capital providers play in the sector's decarbonization?

Let's examine the problem: why the steel sector is considered "hard to abate." There are three primary challenges to decarbonizing the steel sector. First, about 70% of global steel production relies on coal, used to remove oxygen from iron ore and turn it into steel. While other carbon-intensive industries, have viable alternatives, such as electric vehicles for the transportation sector, there are not yet sustainable cost-competitive alternatives in the steel sector. Since steel is a commodity with thin margins and fierce competition, investing in alternative technologies to reduce iron ore, by replacing coal with hydrogen, is cost-prohibitive for many producers.

Second, there is no established market for zero-carbon or "green" steel. This makes it impossible for customers to differentiate between products, which would otherwise indicate a demand signal for producers.

Lastly, steel plants are long-lived assets and transitioning to low-carbon technologies before

**THE STEEL SECTOR'S CARBON EMISSIONS ACCOUNT FOR ABOUT 8% OF THE WORLD'S TOTAL. MEANING IF THE STEEL SECTOR WERE A COUNTRY, IT WOULD BE THE THIRD-LARGEST EMITTER ON THE PLANET.**

the end of their useful lives could result in stranded assets. Many steel sector investors and lenders recognize how these issues are becoming a hotspot in their portfolios and pose risks from a valuation standpoint.

Capital providers are also in a difficult position. On one hand, global financial institutions have made their own net-zero commitments and are increasing efforts to align their portfolios with the goals of the Paris climate agreement. On the other, financial institutions face several barriers to achieving those net-zero commitments and are increasingly realizing the sizable challenges posed by hard-to-abate sectors, such as steel.

At the Center for Climate-Aligned Finance, we are supporting financial institutions to address these challenges by taking a "sectoral approach"—convening leaders from high-emitting, hard-to-abate sectors in the real economy.

This is what happened in the shipping sector through the Poseidon Principles, a

framework to assess and disclose whether banks' ship finance portfolios are in line with their climate targets. In practice, shipping companies disclose the carbon intensity of their vessels, and banks use that information to compare their actual carbon intensity to a benchmark that shows where the emissions should be to adhere to climate goals. Poseidon signatories also then work to bring their portfolios in line with climate targets.

The Poseidon Principles agreement, which was signed in 2019, now includes 26 leading banks, representing about $185 billion in shipping finance. Based on the success of this model, we are now working to replicate this real-world example of collective action catalyzed by a climate-aligned finance agreement for the steel sector.

**WHILE OTHER CARBON-INTENSIVE INDUSTRIES, HAVE VIABLE ALTERNATIVES, SUCH AS ELECTRIC VEHICLES FOR THE TRANSPORTATION SECTOR, THERE ARE NOT YET SUSTAINABLE COST-COMPETITIVE ALTERNATIVES IN THE STEEL SECTOR.**

This type of framework for the steel sector would represent a crucial step forward for the industry. First, banks arrange most global steel financing through corporate bonds and so a collective, voluntary commitment from banks lays out a proactive but realistic role for them. Secondly, a collective agreement creates a level playing field for financial institutions by helping overcome the fundamental challenge of "first-mover disadvantage"—a bank turning down a high-emitting client only for the client to go to the bank's competitor. Collective action helps to inform how banks can partner with their clients to support decarbonization.

To enable this collective action among steel financiers, the Center has gathered some of the largest steel sector lenders in a working group, led by ING and co-led by Societe Generale. This working group, together with some of the largest steel producers, will help develop an industry-backed pathway to net-zero emissions, identify a uniform metric to measure against that trajectory, decide upon a governance and reporting framework, and ensure access to transparent and comparable data for lenders.

The goal is to launch the finance agreement at COP26, alongside other multi-stakeholder commitments for the steel sector being coordinated by the Mission Possible Partnership.

Decarbonizing the steel sector will not be easy, but signs are promising. With leading banks developing a climate-aligned finance agreement for steel in the coming months, the momentum towards net zero for the steel sector is only getting stronger.

**Byrony Coan**
Director, Opportune LLP

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# Women In Energy: Considerations For The Next Generation

*It's well-known that women represent a minority of employees at all levels of American energy companies. While women are nearly half the workforce, they make up only 15% of the oil and gas industry—a number that drops further among higher-paying technical jobs. Even as companies have put forth an effort to hire more women, they're still challenged in retaining female employees. But women who demonstrate their expertise in their field are in high demand in the energy industry right now. Why? Because I've seen it firsthand.*

## EARLY BEGINNINGS

I grew up in an oil and gas family. My dad worked on offshore rigs and later became a leader in wellhead safety/blowout certification. After the 1980s, I was aware of the inherent cyclical nature of oil and gas. I chose to pursue a STEM major (mechanical engineering) to give myself as many options as possible. Beginning in college, I was conscious of the small percentage of women in my major.

I have, however, been relatively surprised that post-college—working for both an oil and gas software company and now an energy business advisory firm— leadership roles held by women (particularly middle to senior management) far exceed the percentage I would've guessed based on my college experience.

## CHANGING TIMES

When the COVID-19 pandemic struck the U.S., the world seemingly went virtual

**I CHOSE TO PURSUE A STEM MAJOR (MECHANICAL ENGINEERING) TO GIVE MYSELF AS MANY OPTIONS AS POSSIBLE. BEGINNING IN COLLEGE, I WAS CONSCIOUS OF THE SMALL PERCENTAGE OF WOMEN IN MY MAJOR.**

**Byrony Coan**
Director,
Opportune LLP

overnight. Our work life and home life became intertwined. Candidly, at the outset of the pandemic, things were a mess. Everyone had distractions—kids, dogs, deliveries, you name it. What I thought would frustrate people working remotely really became a bonding experience as everyone was in a similarly stressful situation.

I was fortunate to be staffed on a long-term software implementation project during the entire pandemic. Luckily, we kicked the project off in person and had already forged relationships with the client. When we went virtual, we all knew it would be a challenge, but we had a pretty strong foundation for the project team already developed. What I think the industry missed out on during the pandemic was the in-person

**BYRONY HAS OVER 20 YEARS OF EXPERIENCE IN PROJECT MANAGEMENT, OIL AND GAS SOFTWARE, PRODUCT MANAGEMENT, PROCESS CONSULTING, AND CHANGE MANAGEMENT.**

interaction and mentoring that comes along with industry events. The option to attend conferences remotely was a welcome option, but it didn't fully fill the void and value that in-person networking brings.

Because my children are teenagers and relatively self-sufficient, I counted myself lucky when I commiserated with my female colleagues. I witnessed that a lot of the daytime childcare, meals, and crisis school responsibilities naturally gravitated towards working moms. Conversely, I serve several clients whose wives gave birth during the pandemic and, because they were working from home, were able to be a little flexible with schedules and give their partner some time to rest and recuperate.

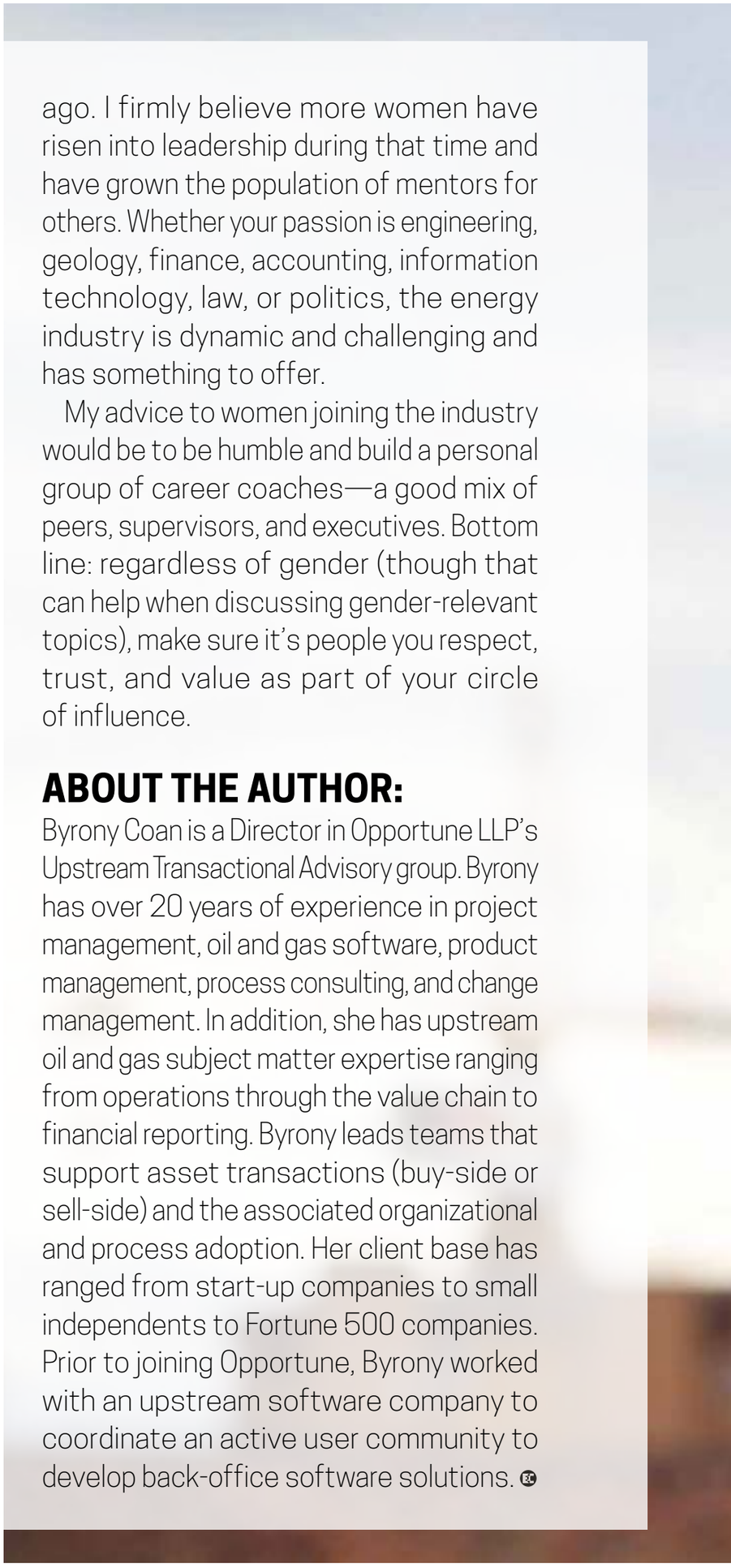
## BUILDING RELATIONSHIPS, NETWORKS ARE IMPORTANT

Beyond the historical networking events, there have been many networking opportunities, specifically within the women's community. Diversity and inclusion are hot topics with boards and investors since recent studies show that diverse management teams are more successful. Whether it's Kayo, Women's Energy Network (WEN), fishbowl communities, or others, there are far more opportunities for mentorship than there were when I first entered the industry 20 years ago. I firmly believe more women have risen into leadership during that time and have grown the population of mentors for others. Whether your passion is engineering, geology, finance, accounting, information technology, law, or politics, the energy industry is dynamic and challenging and has something to offer.

My advice to women joining the industry would be to be humble and build a personal group of career coaches—a good mix of peers, supervisors, and executives. Bottom line: regardless of gender (though that can help when discussing gender-relevant topics), make sure it's people you respect, trust, and value as part of your circle of influence.

## ABOUT THE AUTHOR:

Byrony Coan is a Director in Opportune LLP's Upstream Transactional Advisory group. Byrony has over 20 years of experience in project management, oil and gas software, product management, process consulting, and change management. In addition, she has upstream oil and gas subject matter expertise ranging from operations through the value chain to financial reporting. Byrony leads teams that support asset transactions (buy-side or sell-side) and the associated organizational and process adoption. Her client base has ranged from start-up companies to small independents to Fortune 500 companies. Prior to joining Opportune, Byrony worked with an upstream software company to coordinate an active user community to develop back-office software solutions.



# **Bringing Silicon Valley** to DSM Program Marketing - Taking Friction Out of the Customer Journey

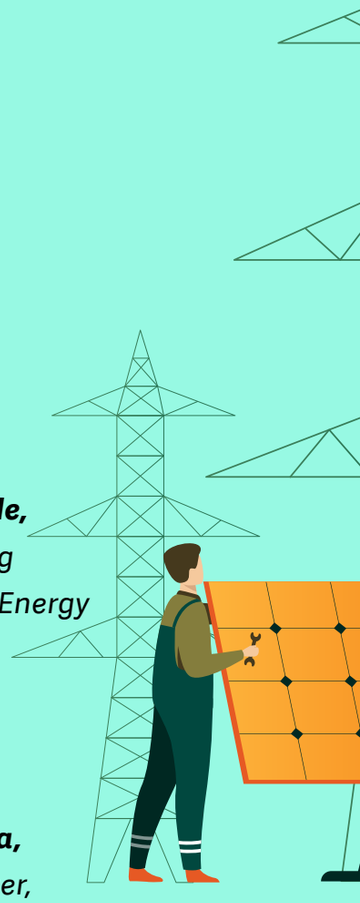
Silicon Valley is the birthplace of some of the largest and most profitable companies in the world. Continuous innovation and product development have become embedded in the culture of Silicon Valley – but what causes some products to succeed over others? Part of the success equation is the focus on building products that address tangible customer pain points while leveraging technology to create seamless experiences.

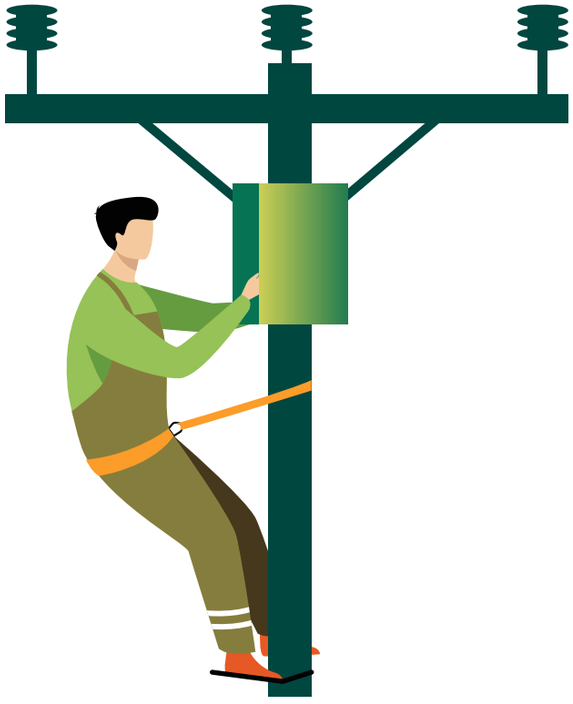
Many Silicon Valley-based companies generally find their path to profitability by utilizing "lean startup" best practices. This involves:

- Truly understanding a day in the life of your target customer, including their pain

*By **Jonathan Houle,** Product Marketing Manager, ecobee Energy*

*By **Alysha D'Souza,** Marketing Manager, ecobee Energy*





**CONTINUOUS INNOVATION AND PRODUCT DEVELOPMENT HAVE BECOME EMBEDDED IN THE CULTURE OF SILICON VALLEY – BUT WHAT CAUSES SOME PRODUCTS TO SUCCEED OVER OTHERS?**

points and purchase patterns. This is best achieved through discarding any preconceived assumptions and speaking with your customers directly through primary research.

▪ Developing a minimum viable product (MVP) early on in the process to solicit customer feedback before building large-scale solutions.

▪ Focusing on the features that bring the most value to customers and validating their desire to use them. The ultimate goal is to build features that are not just incrementally better than what customers have access to today but 10x better than current solutions that are on the market.

How does lean startup methodology apply to the energy industry and the success of demand-side management (DSM) programs? For starters, the

transition to a clean and flexible grid of the future requires active participation from utility customers.

As the nation strives to achieve 100% decarbonization and electrification, individual households will play an increasingly critical role in the process. Utilities are facing increasing pressure to integrate new renewable resources within their system while minimizing costs and maintaining high reliability.

**FOR STARTERS, THE TRANSITION TO A CLEAN AND FLEXIBLE GRID OF THE FUTURE REQUIRES ACTIVE PARTICIPATION FROM UTILITY CUSTOMERS.**

## AS THE NATION STRIVES TO ACHIEVE 100% DECARBONIZATION AND ELECTRIFICATION, INDIVIDUAL HOUSEHOLDS WILL PLAY AN INCREASINGLY CRITICAL ROLE IN THE PROCESS.


Distributed Energy Resources (DERs) have the potential to flip the "supply-demand" energy equation, allowing demand to match available supply. However, ensuring the success of these new energy resources will rely on customer adoption and, therefore, the industry's ability to focus our marketing efforts on the pain points and unique value propositions that resonate most with the end-user.

In order to appeal to a specific target audience, we must focus on the unique benefits offered to the customer and the problems that DSM programs can solve for them. For many utility programs, this could be achieved by quantifying expected bill savings, automating energy conservation for customers with no additional effort required, or highlighting how these programs can enhance comfort by personalizing the customer experience.

Automation technology is arguably essential to the success of these programs, as industry stakeholders must find innovative ways to reduce the friction involved in participating in DSM programs.

If customers are required to take additional steps or use frustrating and outdated methods of enrolling in energy programs, the likelihood of success will decrease significantly, and customers will not be incentivized to change their behavior. A great rule of thumb to reference here is to meet customers where they are – identifying what type of mobile devices they have, where they spend most of their time (which websites, mobile apps, online activities), and what types of online experiences do they love that we should mimic?

This is an ideal place to employ the "10x improvement" rule. In order to truly change consumer behavior, how can we reposition DSM programs in the minds of customers as a utility offering that improves their quality of life and satisfaction by 10x?

By increasing the number of smart home devices available in households across America, we have a more attainable opportunity to achieve "Load Flexibility" at scale and bring this new demand-supply balancing act to the forefront.

For example, smart thermostats can automate participation in energy programs by intelligently responding to pricing signals (Time-of-Use rates)

and event-based DR signals, helping customers effortlessly save on energy bills and reduce barriers involved in participating in DSM programs. Brattle has estimated that there could be ~200GW of flexible loads available by 2030, with smart thermostats consisting of ~40% of this potential. The National Potential for Load Flexibility.pdf

Ultimately, removing the friction involved in the customer journey requires a multi-pronged approach: using effective marketing tactics, automating participation through smart home technology, and taking a lean startup approach to building program enhancements. When used in unison, these tactics can help incorporate the best practices used in Silicon Valley to improve the success of DSM programs at scale.

To learn more about ecobee's flexible load management solutions, visit www.ecobee.com/utilities.

**María José Flores**
Legal and Compliance Manager, MODEC Mexico

# Following the Example on Compliance and Gender Perspective

*Regulatory challenges and managing risks are some of the everyday issues almost every energy company must face. Whether it is an oil company, a utility, a partner, or a contractor, current organizations must be prepared to meet requirements, manage all types of risk, maintain capital and operative security, and efficiently respond to legal incidents.*

In this sense, compliance in the Mexican energy sector is currently a crucial topic to consider. Mainly, seeing that the game rules for companies in the industry, particularly under the current administration, are constantly changing.

Not only is the compliance requirement one in which the Mexican industry should pay attention and learn more from offshore experiences and benchmarks; but it also is the diversity and inclusion one. According to 2020 numbers, women only represented 10% of the energy industries' workforce. Moreover, only 16% of this industry's top management positions were occupied by females, and 40% of junior energy positions in the country were filled by women.

In this regard, in interview with Energy Capital, María José Flores, Legal and Compliance Manager with MODEC Mexico, talked about the particularities of the Mexican energy sector compared to other countries more 'advanced' in terms of compliance and benchmarking.

Further, María José shared some key perspectives regarding the role of women in the energy sector. More personally, she addressed the challenges she needed to overcome as a female professional in the industry and the importance of integrating a comprehensive gender perspective within organizations.

## Compliance in the Mexican Energy Sector: Still a long way to go

María José is a highly experienced professional within the energy sector, mainly in the compliance

**MEXICO CAN STILL OVERCOME THESE ISSUES AND FOLLOW OTHER COUNTRIES' EXAMPLES IN THE SUBJECT. "I DO THINK THAT THESE COUNTRIES ARE IN A POSITION TO BE AN EXAMPLE TO FOLLOW. THEREFORE, WE COULD TAKE ADVANTAGE OF THEIR EXPERTISE AND MISTAKES," MARÍA JOSÉ SAID.**

area, where she found a particular interest as a lawyer. "Compliance is everywhere, in all the areas of the company. In a small or a big step, it is in all the processes and areas of a company. So, little by little, I started to get engaged with that."

Indeed, Mexico is still in an early stage in terms of compliance legislation. As María José notes, the country still has "a long way to go to be compared with other countries." Consequently, some of the most vulnerable topics with respect to compliance in the country are corruption and facilitation payments. To these issues, adds the little knowledge on the matter.

> **COMPLIANCE IS EVERYWHERE, IN ALL THE AREAS OF THE COMPANY. IN A SMALL OR A BIG STEP, IT IS IN ALL THE PROCESSES AND AREAS OF A COMPANY.**
>
> **María José Flores,**
> ***Legal and Compliance Manager, MODEC Mexico***

However, Mexico can still overcome these issues and follow other countries' examples in the subject. "I do think that these countries are in a position to be an example to follow. Therefore, we could take advantage of their expertise and mistakes," María José said.

## Gender perspective and breaching the gaps

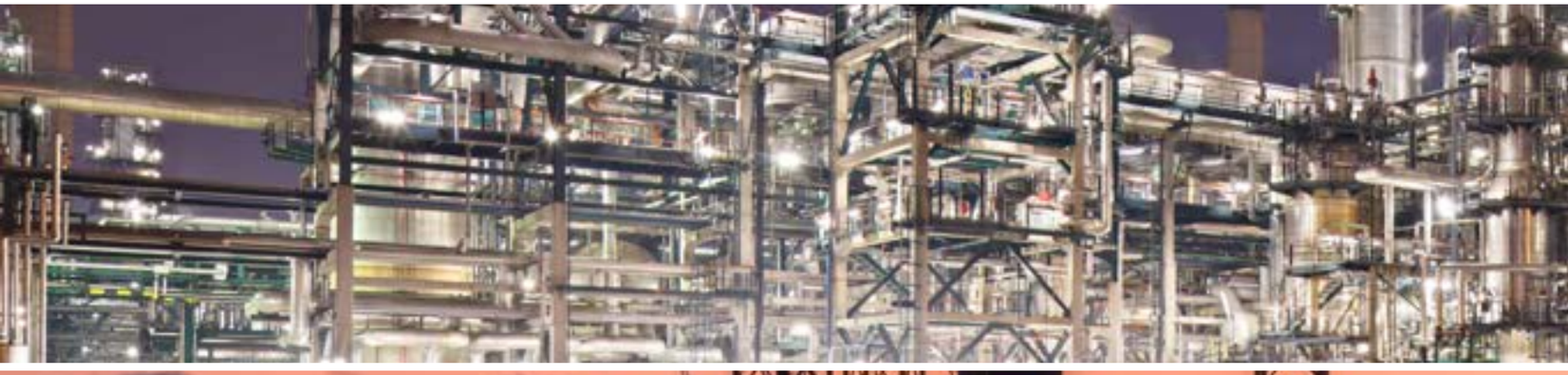
Regarding the challenges she had to overcome as a female professional in the sector, María José referred to the need to make her voice —and of other female colleagues— heard. "I believe we as women have a lot to say, and I found that there very few spaces where we can freely express ourselves. Many times, you

have to work twice as hard to show that you have an important voice and that we are in the right place, knowing what to do."

In this sense, the differences between foreign companies currently operating in Mexico and the national ones regarding gender perspective and related policies are considerably visible. As María José notes —who has experience working at both private and public organizations—, the differences are evident.

For instance, several foreign companies have taken the time to make awareness and open spaces for the participation and learning of women in the industry, María José noted. On the other hand, many Mexican companies still lack substantial female participation within their workforce, mainly in managerial positions; therefore, there's an opportunity area where national organizations could follow their foreign counterparts' example and start breaching an unfair gap.

Finally, María José shared a piece of advice with other young women interested in starting a career in the energy sector and aiming to reach a leadership position such as hers within the industry. Thus, she recommended staying curious and go after their professional and personal goals simultaneously.



# The Refinery Paradox

How could North America still be a refining leader if it's shutting down one in five refineries by 2025?

*By* ***Energy Capital***

## Refining is still in the game

In a world increasingly focused on reducing emissions, is the future of downstream and refineries consistent? Even though in 2020 carbon emissions from the use of fossil fuels and the industry fell by 7% compared to 2019 levels, this year's greenhouse gas emissions generated by the transportation sector alone are expected to return to pre-pandemic levels, accounting for approximately 29% of total industry emissions in the United States.

Moreover, although the COVID-19 pandemic has negatively affected the market —delaying many refinery projects across the globe, and leading to more than 1 million b/d of US and Canadian refining capacity shut in 2020 —, increasing demand for petroleum products in the coming years, is expected to drive further the sector's growth. This matches a global refining capacity expected to grow at a CAGR of more than 1.25% during 2021-2026.

Indeed, the Energy Information Administration expects global consumption of petroleum and liquid fuels to average 97.7 million b/d for all of 2021, which is a 5.4 million b/d increase from 2020. By 2022, EIA similarly forecasts global consumption of petroleum and liquid fuels to increase by 3.6 million b/d to an average of 101.3 million b/d.

Additionally, refining investment is still underway. According to the International Energy Agency (IEA), refining investments have surged since 2015, with the exemption of 2020's numbers. In this sense, spending on new refinery builds and upgrades amounted to USD 52 billion in 2019.

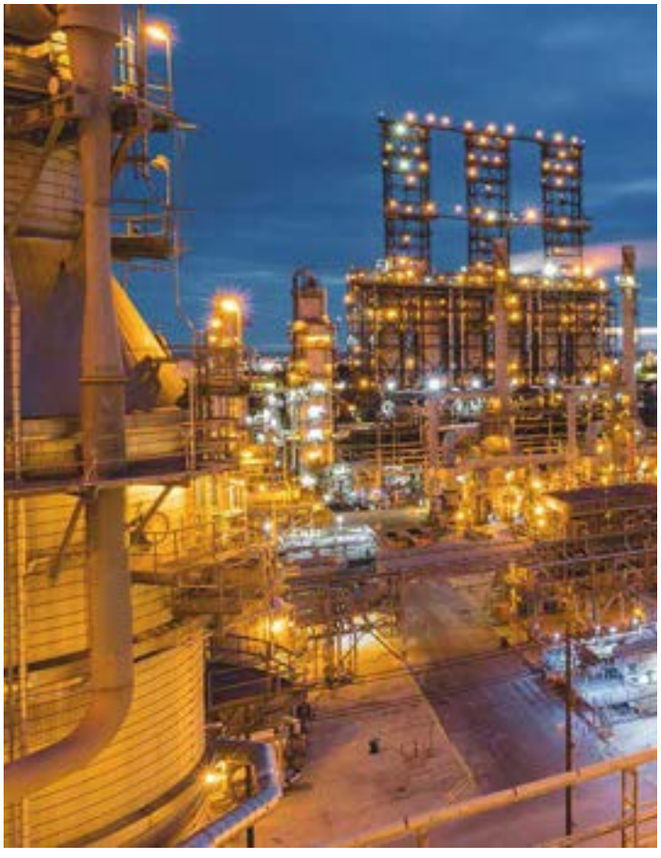
## The challenges

Even though some regions such as North America have advantages in terms of infrastructure and expertise, the refining market is finding several restraints. A lack of funds, delay in commissioning projects, and the increasing adoption of electric vehicles in developed nations are expected to significantly affect the market.

Accordingly, several energy agencies wonder what actions will leading downstream producers take to address this situation. The ways are many, including, for instance, closures, changes in the integration of value chains, and transitions towards new, more sustainable products, among other strategies.

This is particularly important considering that, in a forecasted scenario, one in five refineries will shut down over the next five years. Further, this picture is remarkably notorious for North America and Western Europe since, by 2030, one in three refineries will need to reassess its operating model. Indeed, calculations expect that about 1 million b/d of North American refining capacity will be shuttered shortly.

Worth noting, this is an interesting paradox because even though several refineries are shutting down



in North America, the total refining capacity in the US, for instance, continues to expand

In this regard, we can wonder how will the refineries of the future, particularly in North America, likely look? What current elements will let them overcome the challenges the market is posing to them? Will they remain as market leaders even in a highly competitive and changing environment?

## North American Refineries – the differentiators

When we look at the refining progress in North America, we can identify the high degree of difficulty involved in the industry. We see strong producers been resurgent through the energy revolution and, despite all the challenges, still striving to maintain their global leadership.

To keep this pace, technical excellence has been essential, along with the shale revolution's advantages and a boost coming from policy. It is worth noting that US refiners are among the most sophisticated globally, benefiting from operating in the world's largest oil-consuming nation.

As some experts note, North America, overall, can upgrade and produce lots of highly marketable gasoline and diesel fuel, with very few byproducts. Moreover, the region produces almost all types of gasoline, diesel, and jet fuel, to meet approximately 60% of demand globally.

Indeed, according to ENI World Oil Review 2020, North American —predominantly the US — refiners, on average, are significantly more complex than their counterparts in Europe and Asia. In addition, US refiners are highly adaptive to changing market circumstances.

Moreover, a boost from policy considerably contributed to North America's refining profitability. Simultaneously, between 2000 and 2019, US refining capacity and throughput increased substantially (+2.4 and +1.5 million b/d, respectively). Consequently, over that period, the US moved from being one of the largest net importers of refined products globally to being one of the largest net exporters.

Remarkably, North American refiners experienced a sharply different trend compared to refiners in other industrialized countries. For instance, capacity and throughput in the European Union each fell by 1.6 million b/d over the same period, and Japanese refiners suffered even more significant declines in percentage terms.

To these advantages adds the refining integration scheme. For instance, refiners on the west coast emphasized the right location (Alaska) and upgrades (California). For Gulf Coast refineries, producers well-understood conversion capability as a prerequisite of crude slate flexibility. On the east coast of North America, refiners favored downstream integration where there was proximity to crude and a large retail market. Lastly, Central

Canada and mid-America leveraged on an excellent combination of pipeline access to Western-Canadian crude and limited product competition. Prompted by growing exploration in Canada's oil sands, some refineries in the region also improved their processing capability toward heavier crudes.

## What's changing the scene?

Shrinking gasoline demand has significantly impacted refiners within the United States. Moreover, refineries on the North American east coast are vulnerable to declining demand for gasoline, the highly unfavorable WTI-Brent spread, and the competition from overcapacity in Europe and coming infrastructure additions in the Asia Pacific, Middle East and Africa.

Moreover, under a new US administration, refineries themselves are likely to face a more challenging policy environment, particularly as emissions of $CO_2$ meet stricter regulation. This trend will add to the significant shutdowns and sales the industry is seeing.

The Asia Pacific region is expected to witness the highest crude distillation unit (CDU) capacity additions globally by 2025, contributing about 48% of the total global CDU capacity additions. Similarly, the Middle East will be the second-highest contributor to the global CDU capacity additions and Africa the third. This can be better understood if we consider that oil consumption continues to rise in developing markets and fall (or remain static) in developed countries.

Similarly, the conventional wisdom of vertical integration as the ideal model for refiners is being challenged. When we talk about vertical integration,

we refer to a company's ability to capture value by making the most advantages across the entire value chain. In this regard, North America has seen a significant shift with respect to conventional vertical integration wisdom. Accordingly, several companies, including BP, Sunoco, ConocoPhillips, and Marathon, recently ran into separate upstream and downstream companies.

## Where are the opportunities now?

According to global energy agencies, the competitive refineries of the future in North America will be complex facilities with a solid bend for petrochemicals or repurposed activities, including biofuels or biodiesel production. Indeed, that's precisely what's already happening in the industry.

For instance, in March this year, North America's largest refiner Marathon Petroleum announced its plans to convert and repurpose its Martinez, California, refinery into a renewable fuels manufacturing facility; the move was approved by its Board of Directors. Similarly, Marathon has a 12,000 b/d renewable diesel (RD) plant in Dickinson, North Dakota, which began production in the first quarter of 2021. Lastly, the company completed in May the sale of its convenience store arm, Speedway, to 7-Eleven.

Marathon is not the only North American refiner adjusting its growth plans. Similarly, Valero Energy announced that it will spend 40% of its $2 billion 2021 capital spending on growth projects and half of that on renewable diesel growth. Indeed, the company shared that this was the only segment that posted positive earnings in the first quarter.

Accordingly, the company is working through Diamond Green Diesel, its joint venture with Darling Ingredients, Inc., to build the DGD III located at Valero's Port Arthur, Texas, refinery. This facility is expected to be online in the second half of 2023 and produce 470 million gal/year of renewable diesel. Other North American refiners addressing the energy transition and changing market conditions with similar strategies are Phillips 66, ExxonMobil, Chevron, among others.

In resume, there is only one certainty surrounding the evolving refining market in North America and globally: companies must be adaptative and deliver over-the-top solutions. Although the upscaling in global refining will mainly result in divestment and closure of lagging assets in the region, refiners are well fitted to repurpose or start building facilities to deliver more advanced fuels. As a result, North America can still be a refining leader, following its understanding that things must change to advance.