

2020-2021 | AN ONLINE ENERGY CONVERSATION

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FELLOWS

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2020 - 2021 | AN ONLINE BLOG FORUM COLLECTION

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**Selected from nine colleges across campus,** the Fellows work in collaboration with UH Energy and the Energy Advisory Board to shape the conversation on energy at UH and beyond. The Fellows serve a term of one full academic year and contribute to an online blog forum hosted by UH Energy and Forbes.

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# *WE ASKED HOUSTONIANS ABOUT HARVEY. THEY HAVEN'T FORGOTTEN THE HURRICANE'S LESSONS.*

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After Hurricane Harvey devastated the Houston area in 2017, waterlogged Houstonians responded with resounding support for flood mitigation projects and for the view that climate change is to blame for the flooding.

A lot has changed in the past three years as entire neighborhoods have seen new construction and the elevation of older homes, and yet a survey of Houston-area residents found attitudes on climate change and support for flood mitigation projects remain remarkably unchanged or have even increased slightly.

That's despite the fact that flooding, while certainly a continuing threat, has been far more localized in the years since Hurricane Harvey. People have not forgotten the trauma of those weeks in August and September 2017. And as a series of new tropical disturbances once again heads our way, the message couldn't be more timely.

The survey by the Hobby School of Public Affairs at the University of Houston was conducted earlier this summer, the third in a series tracking residents' attitudes and, more broadly, the region's recovery.

We found most of those forced from their homes by Hurricane Harvey have either repaired their homes or built new ones, although about 20 percent remain in temporary housing. Pause for a moment and take that in — that is 1 in 5 three years after Hurricane Harvey forced them from their homes. A strong majority of Houstonians point to global warming as the principal source of recent flooding, and most say climate change is man-made rather than naturally occurring.

Support for a wide range of policies designed to reduce the negative impact of flooding remains extraordinarily high, and some of the work has already begun, with bayous widened and bridges raised to expand the waterways' capacity and both new and older homes elevated 5 and even 10 feet above street level.

You need only to drive near Cypress Creek or through Meyerland and other flood-weary neighborhoods to see the efforts underway to both limit future flooding and, if it happens, allow residents to literally rise above it. Support for building additional retention basins is nearly universal, at 93 percent, with similar levels of support for widening the area's bayous, elevating homes and

banning construction in flood plains. Perhaps more surprising, three out of four residents in a region known as the oil and gas capital of the world support government funding for the development of wind, solar and thermal energy, as well as for government regulation of greenhouse gas emissions. Not, of course, that Hurricane Harvey turned all Houstonians into raging liberals.

Two-thirds of area residents said they are either very or somewhat worried about global warming, and 74 percent think the more extreme flooding caused by global warming represents a threat to the Houston area, up from 67 percent two years ago.

But there is still sizeable disagreement on the cause, with about 38 percent saying they believe global warming is caused mostly by natural changes in the environment, rather than by human activities, including the burning of fossil fuels.

And despite their support for flood mitigation projects, residents aren't necessarily enthusiastic about higher taxes to pay for those projects. We found even less support for higher sales taxes than higher property taxes. About 85 percent, however, said Texas Gov. Greg Abbott and state legislators should tap the state's Rainy Day Fund to address future flooding.

One factor that perhaps dampens support for a tax increase is a lack of public confidence in city and county leaders' ability to prevent the negative impact of future flooding, with only 17 percent of residents very confident that local leaders know how to prevent future flooding from having a negative impact on the region.

That rises to 52 percent for those who say they are at least "somewhat" confident in local leaders, still a tepid vote of confidence considering that some of the work approved by voters in a \$2.5 billion bond election in 2018 is underway — a visible sign of action.

So what is the message to local leaders? It's mixed, but the average Houston area resident believes climate change is real,

caused by human activity and responsible at least in part for the city's severe flooding. And, they support policies to prevent the adverse effects of future flooding — from restricting development to public subsidies for renewable energy.

The other message? People are reluctant to pay more in taxes to support the changes, in part because they are not entirely confident that local elected officials will use those tax funds to notably reduce the risks of future flooding.

We still have work to do.

Published September 24, 2020 on Forbes.com

# *NAVALNY POISONING JUST A BUMP IN THE ROAD FOR NORD STREAM 2*

**PAUL GREGORY**

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Trying to figure whether Nord Stream 2 (hereafter NS2) – the undersea gas pipeline from Russia to Germany – is akin to solving five complicated jigsaw puzzles at once. Competing interests, changing legal foundations, and momentum all make it difficult to either start or stop. One thing is certain: Russia is playing a long game from which it will not retreat until NS2 becomes operational.

At 95% complete and 11 billion Euros out of pocket, the NS2 consortium, comprised of Russia's state-owned natural gas monopoly (Gazprom) and German, Austrian, and Dutch utility giants, seemed poised to enter into service by early 2021. The Trump administration had already played its sanction card to the limit, and there were just a few regulatory issues to be ironed out.

That was before the “attempted murder” (to use Angela Merkel's characterization) of Russian opposition leader Aleksei Navalny on August 20 over East Siberian skies. The Navalny case, piled on top of Russian hacking of the German Bundestag and a blatant political assassination on the streets of Berlin, raised German voices in favor of stopping NS2.

European leaders understood that the rising count of murders of Russian political opposition figures had to be approved (or not objected to) by President Vladimir Putin himself. In Navalny's case, the physical evidence was clear: German medical experts concluded Navalny had been poisoned with a banned nerve agent used in past assassinations of Russian opposition figures.

The German finding was confirmed by French and Swedish labs. The Navalny poisoning, therefore, raised the question: Do Germany and the rest of Europe really want to be energy dependent on a rogue regime that routinely engages in state murder?

The EU and NATO reacted with outrage as the facts of the Navalny poisoning became clear. The Navalny case elicited demands for a “transparent” investigation, but all parties realized that no investigation would be allowed to reach into the highest levels of the Kremlin itself. Anger intensified when the Kremlin claimed the attempted murder was a false flag operation to embarrass Russia, that Navalny poisoned himself (as Putin suggested to France's Emmanuel Macron), or that Germany's renowned Charite Hospital had misdiagnosed what was a case of food poisoning.

With each preposterous Russian claim, voices were raised that the Kremlin should pay a real price, which brings us to Germany and Nord Stream 2:

In 2010, Germany passed the Energiewende (Energy transformation), which called for 90% CO<sub>2</sub> reduction and 60% renewable energy by 2050. These benchmarks were to be achieved by phasing out nuclear and coal and switching to wind and solar.

As Germany sought to implement its energy transformation, electricity prices soared. To keep German industry competitive the price increases were borne primarily by households.

Moreover, the brown-coal industry – a major employer in the depressed Eastern states—had to be phased out, thus shifting votes to Germany’s extreme right and left parties.

Gazprom’s NS2’s projected second Baltic Sea pipeline running directly from Northern Russia to a coastal hub in Germany (which happened to fall in Angela Merkel’s electoral district) was seen as a way to tide Germany over with cheap natural gas as it advanced through its energy transformation. Moreover, NS2 would make Germany the hub of European natural gas by replacing gas transmission through Ukraine.

NS2 has powerful supporters in Germany, Austria, and the Netherlands. Giant utilities from these countries that paid half of NS2’s costs joined Merkel’s coalition partner (the SPD) and far right and left parties as firm supporters of NS2. Opposition came from within Merkel’s own party, notably from two potential candidates to replace Merkel, Friedrich Merz and Norbert Roentchen, and from the Greens, who oppose all forms of carbon energy.

The most vocal opposition to the completion of NS2 came from within the European Union, particularly Scandinavia, the Baltic States, and Eastern Europe, in particular Poland. These opponents feared domination of Europe by Russian gas and the loss of existing pipelines through Ukraine.

Contrary to its posturing as the guarantor of European unity, Germany has supported a key infrastructure project (NS2) opposed by most of its EU partners. When Europe amended its Gas Directive in April 2019 to apply to third countries (like Russia), it appeared that Nord Stream 2 was out of luck. The amended Gas Directive enforced rules of competition, such as the decoupling of transmission and distribution. This requirement would have meant that the state monopoly, Gazprom, would have to divest itself of distribution. There were other onerous requirements such as reserving space for other suppliers and allowing backflow sales that, if implemented, would threaten the economic viability of NS2.

It was Germany that saved NS2 in a last-minute compromise promoted by France that allowed Germany to “monitor” the Gas

Directive rules in a sort of fox-guarding-the-henhouse ploy. On the eve of the murder attempt on Navalny, NS2 lacked some 165 km until landfall. Permitting problems by Denmark seemed resolved, and Russia had brought in its own pipe-laying ship to replace the Swiss vessel frightened off by U.S. sanctions. It seemed that Russian patience had paid off. NS2 would at last be operational by early 2021. Ukraine’s pipelines would fall apart due to low transmission rates, and Russia would solidify its position as the dominant supplier of natural gas to Europe. Scandinavia and Eastern Europe would become even more dependent on Russia.

Enter Navalny and the growing realization that the only meaningful punishment for Putin would be the cancellation or significant delay of NS2.

Merkel’s first reaction was that NS2 is a commercial project that should not be decided by politics. As she came to understand the depth of the European reaction (and entered her final year as chancellor), she punted by proposing to let the European Union decide the fate of NS2.

Punting to the EU had two advantages for Merkel: First, German politics are hopelessly splintered. Two possible Merkel successors have proposed that NS2 be cancelled or delayed. Business interests argue that Russia is a reliable partner, and, after all, Germany does not have particularly clean hands when it comes to international energy dealings. Merkel’s coalition partner, the SPD, has no such qualms. Its upcoming chancellor candidate, Olaf Scholz, stands firmly behind NS2, which he characterizes as a purely commercial project. Former Chancellor Gerhard Schroeder heads the NS2 board, and his SPD opts for good relations with Russia, no matter how bad its behavior. How is Europe likely to deal with the NS2 hot potato?

With its complicated organizational structure and requirement that major issues, such as sanctions, be decided unanimously, the EU is unlikely to come up with any conclusive decision with respect to NS2, but one thing is sure: The wheels of decision making grind slowly in the EU; so we can count on a long period for the EU to decide that it cannot decide.

infrastructure investments in the former Soviet bloc, raises the thorny issue of money. According to the Charter, private investment projects must be compensated if terminated or otherwise harmed by state action. Under the Charter, someone would have to compensate the European utilities and Gazprom for their billion-euro losses.

The smart money would be on NS2's eventual completion and Russia's continued domination of the European gas market. Navalny has survived, NS2's defenders and lobbyists are in full swing. The Trump administration may have run out of sanctions options. The European Union has bigger problems to deal with. With the feeble demand for gas associated with COVID-19, Germany and Europe can take their time as Russia pulls out all stops in its defense of NS2.

NS2 will be completed. The only question is the duration of the delay.



Published October 23, 2020 on TheHill.com

# *FOR ENERGY TRANSITION, THE KEY WORD IS SUSTAINABILITY, NOT POLITICS*

**CHARLES MCCONNELL**

Executive Director, CCME

Two words — sustainable and transition — are frequently used when we talk about energy these days and unfortunately, the definitions are at best inconsistent and at worst, misleading. That makes agreeing on not just what we need to do, but how, especially difficult.

Nevertheless, doing nothing is not an option. The transition to a sustainable energy system, commonly known as the energy transition, is the most challenging task the energy industry — and society as a whole — has ever faced. Today's politically charged times make it more so.

We must stop with the extreme perspectives, the name-calling and self-serving points of view. Politics have no place in this debate.

Smart policy, however, will be crucial. We need to start with agreement on a key point, already recognized by many in the energy sphere: All forms of energy must be in the discussion. It's not about loving or hating a specific fuel, whether that's hydrocarbons or wind and solar. It's about reducing and eliminating emissions. Keeping our eye on the ball is the first order of any thoughtful strategy.

A few suggested pathways are gaining momentum: Decarbonizing the hydrogen production process to produce a carbon-free transportation and heating fuel is a requirement. Tailpipe emissions are the number one contributor to carbon emissions; hydrogen is critical to reducing these emissions.

Currently hydrogen is produced in an energy-intensive and carbon-emitting process; we can capture those emissions and make it cleaner. As the energy transition matures, we will be able to use carbon-free power to produce "green" hydrogen. Until then, we must deal with the emissions. We are adding renewable capacity to the electricity grid at record pace, hastened by both technology advancements and the use of subsidies to support the market in terms of rates, supply structure and tax dollars to investors in wind and solar. The goal is not 100 percent "renewables" — it is 100 percent "carbon-free." This is not semantics. Reliability, cost and baseload 24/7 power is non-negotiable. Driving electric cars will impact emissions only if the electricity is carbon free.

So what will it take? Carbon Capture Utilization and Storage (CCUS) is the answer. Neither carbon-free hydrogen nor a carbon-free grid can happen without CCUS, the backbone of the sustainable energy future. CCUS is a suite of technologies used to capture carbon before it reaches the atmosphere and to safely and permanently store or use the carbon to create a value-added project. It has been demonstrated as commercially reliable. Its necessity isn't just my opinion, but that of the International Energy Agency and the U.S. Energy Information Administration.

In addition to its role in expanding hydrogen as an energy source and for the decarbonized electricity grid of the future, CCUS can lower emissions from existing oil and gas operations, petrochemical and electric power industries. It is a pragmatic

recognition that hydrocarbons will be part of the global energy mix for years to come. Politically, CCUS has gained bipartisan support in the form of federal tax credits under Section 45Q of the tax code, and the marketplace is poised for further commercialization and investment.

Acceleration of federal support of technology development and commercialization will allow us to take full advantage of the potential CCUS offers, just like the investment and market structure support we have for renewables today. We need to see CCUS for what it offers, and not as competition for renewables or any other “preferred choice” on the environmental agenda. This is not a zero sum game — we need to accelerate work to reduce emissions. We need all options on the table.





Published November 11, 2020 on TheHill.com

# ***NUCLEAR WASTE - TEXAS MAY NOT BE THE SOLUTION***

**RAMANAN KRISHNAMOORTI**

Chief Energy Officer, UH Energy

Sixty-two years after its first commercial nuclear plant began operations, the U.S. is still grappling with what to do about nuclear waste.

As high-level nuclear waste continues to pile up in 80 sites across the country, the future of low-carbon nuclear energy and the path to net-zero hinge on finding a technologically, politically, socially and environmentally acceptable solution. With storage at reactor sites running low and many of these sites at risk from climate change-related sea level rise, the imperative to address nuclear waste is urgent. The latest bid has put Texas in the crosshairs.

Unfortunately, the ideal course of action is not straightforward and may not lie in Texas. The Nuclear Regulatory Commission's (NRC) recent recommendation to license an interim storage facility in Andrews, Texas, has evoked misguided discussions around safety and public health concerns. At the same time, critical issues such as seismic activity and the impacts of climate change have been overlooked by the NRC and Interim Storage Partners (ISP), the private company operating the site.

Any decisions must be backed by science, broad bipartisanship and public support, and be geared toward a permanent solution. We will need a geologic storage system to safely contain the waste for hundreds of thousands of years; however, anti-nuclear sentiment has blocked efforts to complete a repository under Yucca Mountain.

With no plans for a new permanent repository and growing liabilities from the current piecemeal storage, the NRC has

approved ISP's plans to accommodate 40,000 tons of waste from 36 decommissioned nuclear sites, potentially saving the government billions of dollars. However, environmental groups, oil and gas companies, agricultural unions and many Texas policymakers want to delay the project, citing public safety concerns, impact on the oil and gas industry and restricted public participation in the decision amidst the pandemic.

Texas Gov. Greg Abbott (R) weighed in through recent letters to President Trump and to the NRC. In these letters, Abbott undermines the well-established safety of nuclear waste casks used for transportation and storage and says hosting nuclear waste near the Permian Basin would make it a "uniquely provocative target" for terrorists. On the contrary, the casks are robustly designed and highly resistant to impact. If a leak were to occur, the airborne effects would be limited to a square mile of the storage facility.

In fact, our recent study (currently under peer review) demonstrates that the annual probabilistic risk cost associated with a release of radioactive material from an act of terrorism is a mere \$5,000. Abbott also claims nuclear waste transportation poses threats to public health and the Texas economy, despite the fact that a cask has never failed in over 40 years of high-level waste shipments.

Indeed, our study demonstrates the probabilistic risk cost associated with a release of radioactive material from a train or truck accident is a matter of pennies, as accidents are rare and significant damage to the cask is even less likely. Abbott is right, however, to express concern about the company's application.

ISP assumes a permanent repository will be operational within the next 60 years. Despite the \$43 billion Nuclear Waste Fund, many fear an interim facility will consume funding intended for a permanent solution while weakening any sense of urgency.

Additionally, the sharp increase in seismic activity in West Texas since 2009 isn't mentioned in the license application. Although most earthquakes have been below a 4.0 magnitude, the growing frequency indicates a significant earthquake is possible. Strong correlations between seismic activity and increased oil and gas drilling, fluid injection and the draining of the Ogallala Aquifer cast doubts on the project's safety. Unfortunately, neither waiting for a permanent repository nor the interim storage facility in West Texas are ideal. There is, however, a third option.

Deep boreholes drilled miles underground at isolated sites nationwide may be a better solution. Each would contain relatively low volumes of waste stored in damage-resistant casks to mitigate public fear of a catastrophic nuclear release, and these boreholes can be flexibly located to avoid regions with high seismic activity, economic import or climate concerns. Unfortunately, there is limited research into the safety of borehole disposal. Regardless, it is clear we need to act soon, knowing we can safely handle, transport and store the waste. The permanent and safe storage solution will only be achieved through broad bipartisan and public support.



Published December 1, 2020 on Forbes.com

# OIL PRODUCERS AND VALUE VS. GROWTH: WHAT IT MEANS IN THE OIL FIELDS

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Director, Institute for Regional Forecasting

Today COVID-19 is the center of attention for American oil as prices hover in the mid-\$40s and a vaccine for the virus remains on the horizon. But the U.S. fracking industry has been under continuous financial pressure since the oil bust of 2014 when OPEC and the Saudis withdrew as swing producers in world markets and allowed oil prices to collapse. A moderate oil price recovery in 2017-18 brought a partial return of activity in the oil fields, but it was quickly followed by an industrywide credit crunch in 2019, and the rig count and oil-related employment were in decline again well before the problems brought by COVID-19.

The most compelling issue for fracking is always the price of oil. It is a high-cost source of oil requiring prices over \$60-\$65 for real profitability, with \$55 oil hurting many companies and \$2 natural gas lethal for others. And it is today's price that matters most. Unlike conventional drilling, the typical fracked well delivers 40 percent of its production (and half its present value) in the first year.

Changes in oil prices come and go, but as current events unfold in the oil fields it is the ongoing credit crunch in fracking that will change industry behavior and leave a lasting scar on the industry. Fracking was born in an era of cheap money from the central bank, and too many producers used low interest rates and a rising stock market to try for a quick killing instead of building a viable business.

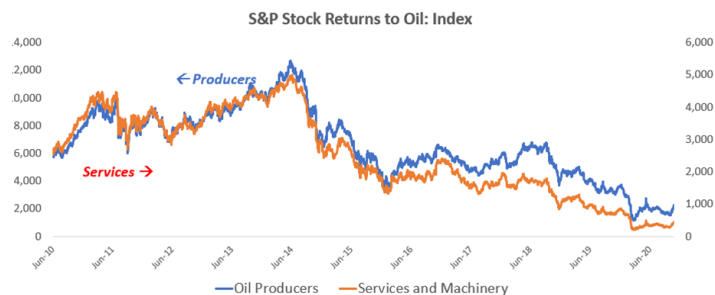
This past behavior is forcing changes in the industry's credit model that will divert large amounts of capital away from reserve replacement and new production, leaving a smaller and

chastened fracking industry in its wake. The question addressed here is how financial change translates into oilfield activity and how much smaller the industry will be.

## Growth vs. Value

By 2019, producers were struggling to deliver steady income and growth, and their failure to impress saw stock markets turn their back on the industry. (Figure 1) Energy stock prices never recovered from the 2015-16 downturn, began to decline again in 2018-19, and have continued the trend downward apart from a quick return from COVID collapse last summer and a small bounce from recent vaccine news.

**Figure 1: Lower Oil Prices and Poor Performance Pressures Fracking Profits, Leads to Lower Stock Prices and a Credit Squeeze**

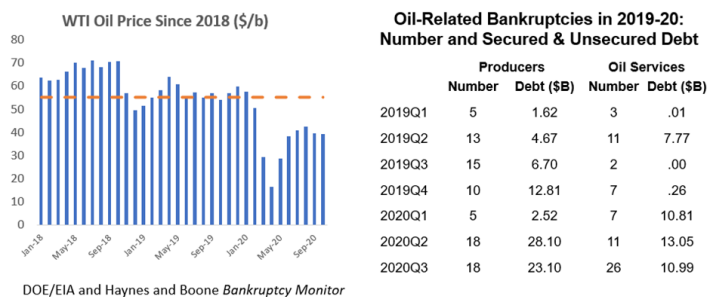


S&P Dow Jones to November 26, 2020

A wave of bankruptcies, delistings, and forbearance hit the industry hard in 2019, initially focused on the weakest companies. Figure 2 shows that as oil prices settled into a steady

\$55 per barrel in 2019 and early 2020, it resulted in mounting bankruptcies for both oil producers and service companies. By early 2020, it looked as if the core of the fracking industry – companies with solid operations and better balance sheets – had worked its way through the bankruptcy problem. Then came the COVID-19 pandemic and the Saudi-Russian oil war, resulting in a complete rout of oil markets in May. The number and scope of recent bankruptcies now rivals the serious setback of 2015-16.

**Figure 2: Moderate Oil Prices and a Squeeze on Credit Generate Bankruptcies in 2019-20**



Pressure from Wall Street increasingly has forced producers to sell themselves as a low P/E, dividend-producing value stock. In the past, they marketed themselves as rapidly-growing growth stocks that reinvested all profits. Apart from the big integrated companies, there was little thought of paying dividends in the upstream oil industry, and investors were expected to make their money on rapidly mounting equity gains.

Fracking producers now approach Wall Street with hat in hand, promising a new value model. What does the value-stock model mean? Borrowing some conservative numbers from a recent analysis by Richard and John Spears at Spears Associates (“Thinking About Free Cash Flow”), a \$60 oil price immediately will see about 10% to 15% taken off the top as a simple adjustment for oil-price and project risk, 20% goes to royalties and taxes, and another \$15 is needed to cover production costs. What is left of the initial \$60 would be free cash flow of \$26 under the growth model, which is the amount available for capital spending or to replace reserves and expand production. However, the new value model requires another haircut of

30% of these cash flows to pay down debt or pay dividends to stockholders. At \$60 the capital allocated to drilling falls from \$26 to about \$18. The first three columns of Figure 3 show oil prices from \$30 to \$100 per barrel and the cash flows under both models. The percentage haircuts for risk and royalties bite hardest at high oil prices and the fixed \$15 in production costs hurts more at low oil prices. Cash flows turn negative near \$20 per barrel.

**Figure 3: Cashflows Under Growth and Value Models**

Headline Oil Price \$/bbl	Growth Model	Value Model	Cash Flow Equivalent Price:
	Cash Flows \$/bbl	Cash Flows \$/bbl	Value versus Growth \$/bbl
100	52.50	36.75	76.7
90	45.75	32.03	69.7
80	39.00	27.30	62.7
70	32.25	22.58	55.7
65	28.88	20.21	52.2
60	25.50	17.85	48.7
55	22.13	15.49	45.2
50	18.75	13.13	41.7
40	12.00	8.40	34.7
30	5.25	3.68	27.7

### Less Oil-Field Activity

The growth model has dominated fracking for years, and the new value model will provide fewer funds to invest in the oil fields. What are the ground-level implications? The Baker Hughes rig count is still a useful and widely-watched measure of oilfield activity, and we ask here how the loss of cashflow translates into fewer rigs at work?

I have a simple statistical model that can do a respectable job of estimating the rig count from oil and natural gas prices. This model can answer our rig count question but only after a couple of small tricks as we go from oil price (P) to cash flow (C1,C2) to rig count (R1,R2).

$$\begin{aligned} \text{Growth: } P &> C_1 > R_1 \\ \text{Value: } P &> C_2 > R_2 \end{aligned}$$

The first problem is that the statistical model just skips over cash flows and goes directly from price to rigs, an issue since the change in cash flows sits at the heart of the problem. But if we know the financial model, Spears Associates offer a simple linear

transformation from oil price to cash flow, and to know one is to know the other.

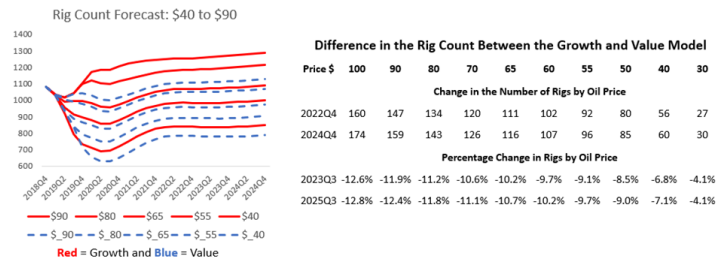
Second, the regression model is based on a growth-model history, so using a \$60 price to forecast gives us a \$60 growth-model outcome. What we now need for future rig counts is a value-model outcome somehow taken from the growth history. This requires value-model cash flows and the hypothetical oil price that would have generated them under the growth model. In the first row of Figure 3, for example, \$100 oil corresponds to cash flows of \$52.50 or \$36.75 depending on the financial model. The value-model cash flow – if it had materialized in the growth model – would have been generated by an oil price of \$76.70. Just interpolate between \$70 and \$80 in the first column. Putting this cash-flow equivalent price in the regression equation now yields the number of rigs at work at \$100 oil and under the value model. Column four of Figure 3 shows the value cashflow-equivalent prices that correspond to each headline oil price. The forecast of the rig count uses an error-correction model based on data from 1990Q1 to 2018Q4, with real oil and natural gas prices as independent variables. Oil prices dominate the results relative to gas. Also included are shift variables for the fracking boom of 2004-2018, the fracking bust of 2014-15, and the post-bust recovery 2015-18. After accounting for oil prices, the bust and recovery periods still show 10% to 15% fewer rigs at work after 2014, marking the end of the fracking bubble in oil markets. The number of rigs at work adjusts to changes in oil and gas prices over the following four quarters.

Our analysis is a hypothetical example. It simply ignores the ongoing credit crunch and current COVID recession and assumes a switch from growth to value that begins in early 2019. Beginning from an oil price of \$57 per barrel in 2018Q4, we forecast the effects on the rig count of oil prices that could rise as high as \$100 per barrel or fall as low as \$30. Natural gas prices are held flat at \$3 per thousand cubic feet.

Figure 4 shows the rig count’s response under growth and value models. The solid red lines are the number of rigs that would be at work in the growth model for oil prices from \$40 to \$90, while the broken blue lines are the equivalent post-2018 outcomes under the value model. Drilling activity under the value model

shifts down sharply at every oil price.

**Figure 4: Value Model Pulls Rig Count Down by 9%-13% for Headline Oil Prices Over \$50/bbl**



Calculations of the Institute for Regional Forecasting, University of Houston

The right side of Figure 4 spells out details of the number of rigs lost to the value model by oil price, e.g., 102 rigs at \$60 in 2022Q4. Differences between growth and value narrow sharply as cash flows shrink quickly below \$50 per barrel. Above \$50 the losses to the value model range from 80 to 160 rigs and reduce oilfield activity by 9% to 13%. Once the rig count completes its adjustment to higher prices, the differences between financial models remain but are stable over time.

**What It Means**

These estimates are an illustrative example of a quick swing by an entire industry from value to growth. Based on the financial straits of today’s fracking industry there is no question that such a swing is underway. It will not be a complete swing, as the large integrated companies have long paid dividends, and some independent companies may have a strong enough reputation and balance sheet to resist the change to value. But even if everyone doesn’t join in, it brings bad news for the industry: as oil prices slowly climb back from \$40 to \$50 to \$60, it implies that the coming recovery in the oil fields will be slower than the past at every step, with drilling expectations perhaps reduced by as much as 10% to 15%.

There is some good news as well. The often-predicted death of the fracking industry has been greatly exaggerated. Oil prices will recover and gravitate back to a long-run marginal cost near \$60

per barrel. If we previously expected to see 1,028 working rigs at \$60 oil, we still will see 926 in this recovery. And while the value model looks like it will be with us for some time to come, nothing is forever. Just take oil prices that are typically balanced on a knife edge, mix with faddish and fickle financial markets, and you have an enduring recipe for unexpectedly unraveling the most carefully laid financial plans.



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# CARBON MANAGEMENT IN 2021

EMILY PICKRELL

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If 2020 marked the year that the U.S. formally left the Paris Agreement, 2021 could well be the year it starts to get serious about climate action.

The time is ripe: an international pandemic has raised awareness about our interdependency, while incoming President Joe Biden has called climate change action a top priority. And it looks like he means business, putting together one of the most overtly pro-climate teams ever to grace federal halls of power.

Even oil major powerhouses like BP and Royal Dutch Shell say they are in, at least on paper, announcing plans in the last year to become carbon neutral by 2050.

The public also appears to be ready for a serious approach towards carbon management and climate change challenges, according to recent polling.

Americans now largely recognize that the climate is being impacted by human activity, several surveys show. The most recent survey was conducted by the University of Houston Hobby School of Public Affairs and UH Energy in October 2020. About four out of five respondents agreed that climate change is happening, and about three out of five felt that change is the result of human actions.

Another survey, sponsored by Yale Climate Change Communication and George Mason University's Center for Climate Communication, found that seven out of 10 Americans believe climate change is happening, and two-thirds of the population is worried about it. Even competing fears about the

Covid-19 pandemic have not managed to lessen anxiety amongst Americans, dispelling any such argument of the environment being a "luxury" concern, according to another recent survey, this one by Stanford University researchers.

The UH survey found that concerns about climate change hold true even in Texas, the nation's leading energy producing state, where people traditionally have been less likely to believe in climate change and, especially, to believe it is the result of the use of fossil fuels.

It is perhaps especially significant, considering expected actions by both government and corporate leaders, that the public says it is ready to pull out its pocketbook for the investments that will be required. They are willing to pay higher prices for electricity generated by a 100% renewable grid, as long as they perceive the prices to be affordable. "Affordable," of course, isn't the same thing as "whatever it takes," but it does suggest that the public understands climate action won't be free and is at least somewhat willing to shoulder a share of that cost.

There are limits to what researchers found the public supports. While there was strong support for paying for renewable energy, there was less enthusiasm about making fossil fuel production and generation more eco-friendly.

Currently, natural gas producers in the Permian Basin and elsewhere get rid of excess natural gas through flaring, because there aren't pipelines or other infrastructure that would allow that gas to be put to productive use, especially at current natural gas prices. Flaring is estimated to put about 400 million tons of

additional CO<sub>2</sub> into the environment each year— enough to fuel all of Latin America. Similarly, venting – that is, leaks of methane gas in various stages of oil and gas production – is responsible for as much as 7 million tons of methane emitted into the atmosphere.

The technology already exists to reduce flaring and venting. Yet survey respondents were more enthusiastic about paying more for renewable energy than for gas-based electricity produced without flaring or venting.

At the same time, respondents did not unilaterally reject the use of natural gas, suggesting there will be a place for a carbon-neutral, fuel-agnostic transition.

Ramanan Krishnamoorti, a chemical engineer and chief energy officer at UH, served as a principal investigator for the study. He notes that renewables are cost competitive “in this artificial environment where they don’t have to pay for the extension of the grid. When you factor in all costs, then the universal drive to renewables starts to slow down, and natural gas starts to get a lot more competitive.”

People have the same pragmatic attitude toward pipelines, which have also been a target of media attention and legal battles. A majority of survey respondents were either neutral or supportive of new natural gas pipeline infrastructure. Such attitudes could reflect the public’s tendency to weigh the options. And it’s also possible that much of the public simply isn’t aware of the magnitude of venting and flaring that is associated with natural gas production.

And then there is the question of timing.

A majority of Americans still mistakenly view climate change threats as far off in the future, even after spectacular weather events such as 2017’s Hurricane Harvey and the terrible forest fires in California in 2020. Only 16% say they expect climate change will harm them personally, even though five of the warmest years in the last century have occurred since 2015.

Aparajita Datta, a graduate assistant who worked on the UH

report, suggests that this sense of remove, in turn, impacts people’s assessment of how quickly action needs to occur. And fewer than half of respondents appeared to understand the various policy instruments that are common elsewhere in the world as a means of carbon management, including emissions trading systems and carbon pricing.

“The public could really benefit from education on their options,” Datta said.

They also had a mixed record on recognizing where responsibility for the current carbon emissions problem lies. Perhaps understandably, UH researchers found that people who know more about the energy industry are more likely to understand the role it plays in climate change. Those who said they aren’t familiar with the industry were less likely to assign blame, an attitude they extended to other sectors linked to climate change, including transportation and agriculture. They were also less likely to acknowledge their own role.

In short, the more the public understands the range of available solutions, the more willing they are to take action, even at a price. Survey respondents repeatedly said they will balance costs as they can, and are also interested in the benefits of making existing technologies, such as pipelines, more efficient and cleaner.

Now it is up to leadership – both in the Biden administration and industry – to show they are serious about their talk of seizing the moment. The public is ready to show support and is not bogged down in squabbling over the superiority of one given solution, as long as the results are real and significant.



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# ***OIL AND GAS INDUSTRY MUST GET SERIOUS ABOUT CLIMATE CHANGE TO COMPETE FOR MILLENNIAL AND GEN Z WORKFORCE***

**EMILY PICKRELL**

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Younger Americans are the most adamant about their belief that climate change is real.

More than 87% of those between 30 and 45 acknowledge that climate change is happening, according to a recent survey conducted by the University of Houston, almost 10 points higher than for people who are 45 and older.

Yet while the younger generations are eager to see climate change and carbon management addressed, they are more reluctant to accept jobs where their talent and enthusiasm is most needed to address it – in the oil and gas sector.

“Everyone teaching in the engineering programs is struggling with this issue,” said Harry Jones, a Dallas-based attorney with Littler, an international human resources consulting firm. Jones has several clients in the energy field who deal with these recruitment issues.

“These kids have to commit to something for 30 or 40 years,” Jones said. “Why should they lock themselves into a profession that is less and less relevant?”

To compensate, even a competitive institution like Stanford University, which has a top-rated petroleum engineering

department, rebranded the division that houses it in 2015 to the School of Earth, Energy and Environmental Sciences. The move, it explains, will “better reflect the breadth of its research and teaching, which focus on understanding the changing Earth and helping address resource and environmental challenges facing the world”.

Many energy companies are also finding that eye-popping financial offers and the challenge of interesting work are no longer enough. They are making great efforts to talk about incorporating climate change reduction plans into their work as a way of drawing top-drawer talent.

“What you find is that HR response from oil and gas is starting to incorporate those practices,” said Pablo Pinto, director of the Center for Public Policy at the University of Houston’s Hobby School of Public Affairs. “Large companies are bringing into their management experts officers who are responsible for developing ways to address climate change.”

BP’s recruitment page, for example, highlights the experience of an employee named Daniel, who talks about his concerns about climate change being one of the reasons he decided to work for BP.

“I believe that climate change and the impact it is having on the world is challenging companies to rethink their purpose and how they can be a part of solving the problem,” Daniel said in testimony for the website. “That’s where I believe I can make a difference at BP.”

Still, these companies have their recruiting work cut out for them.

Math and science students worldwide are favoring technology, biotech and medicine rather than a career in oil and gas, according to a 2019 survey by Abu Dhabi National Oil Company. The respondents also identified the tech sector as being the most impacted by new technologies – and gave the oil and gas sector the lowest relative rating on this account.

Meanwhile, 85% of students in a 2018 UH-Environmental Defense Fund survey said it is important for them to work for a company in the oil and gas industry with policies aimed at addressing climate change.

In another survey by PricewaterhouseCoopers, two-thirds of respondents said they would intentionally avoid an employer with a negative image of environmentalism.

In the UH-EDF survey, students said they were even willing to negotiate on salary if they believed that the job would have a beneficial environmental impact. And these results were consistent, whether the students were studying petroleum engineering or English literature.

It’s a hard message for oil and gas companies to ignore at a time when nearly three-fourths of the public holds the energy industry responsible for climate change, according to the UH survey. And this number grows higher – a startling 92% – amongst those who expressed more knowledge about the industry.

The potential lack of young people entering the oil and gas industry comes largely from their disappointment at the slow speed at which the companies are adopting carbon management practices.

The younger generation is not seeing changes happening on the energy side – they are not seeing a fast-enough progress,”

said Ramanan Krishnamoorti, chief energy officer for the University of Houston and one of the principal researchers for the survey, in a recent webinar. “The industry needs to find ways to accelerate that progress and not just talk about it as research and development, but truly commercial deployment of carbon management.”

Big players like Royal Dutch Shell and BP have responded by announcing plans to be carbon neutral by 2050. Other big players are branching out into innovative technologies: for example, Chevron has dabbled in making biofuel out of algae, and is one of several oil companies that have invested in a Canadian company working on technologies to pull carbon directly from the air. ExxonMobil flirted with a carbon capture project before shelving it in late 2020; it also is working with a direct air capture company, Global Thermostat.

Despite those moves, employees and future workers still are questioning whether it is enough, given that the companies represent a multi-billion dollar industry with more collective resources than many nations.

At the same time, the new workforce’s interest in seeing these companies adopt meaningful climate change strategies comes at a time when the industry is already facing a shortage of experienced workers. Middle-level managers hired in the 1980s following the last big oil decline are now beginning to retire. This shortage may actually give the incoming generation more bargaining power to push for the kinds of positions they say they want.

The interest of millennials and members of Gen Z in a workplace attuned to climate change also matches what the current oil and gas workplace believes is best for business. In a 2020 oil and gas workforce survey by EY, 40% of those surveyed felt that their company’s response to climate change could have the biggest positive impact on its growth.

This, in turn, could be the best possible recruiting pitch – that these future employees will have the unique opportunity to do transformative work in the energy industry, and that these companies are firmly committed to acting as soon as possible.

And that this could just end up saving the planet at the same time.

“My clients are doing the same things – recruiting from schools like Stanford where those students have been taught, and they are telling them part of your job will be figuring out how we can do this different,” Jones said. “What you have to do is talk about how you are ahead of the game and how they could be an exciting and creative part of the solution.”



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# *WE CAN CAPTURE CARBON, BUT WHAT THEN? TURNING A PROFIT WILL BE KEY*

**ELIZABETH GEORGE**

Energy Scholar, UH Energy

The new Biden administration has been in office a little more than a week, and carbon capture is already being identified as one of the leaders in the war against climate change.

It's not new: the technology has been commercially available since the 1970's and is currently used to help industrial plants reduce the amount of carbon and other greenhouse gases they spew into the air, mostly through powerful scrubbers at the site. A more futuristic plan, direct air capture, proposes to filter already-emitted carbon out of the atmosphere.

Growing concern about the damage from warmer temperatures – 80% of Americans now say they believe in climate change – has made carbon capture relevant as never before.

It is considered so important that it passed bipartisan scrutiny, featuring prominently in the Energy Act of 2020, included in the latest round of pandemic spending at the end of December and signed into law by former president Donald Trump, despite his long-time vocal skepticism.

And the Biden administration is already talking even bigger, with plans to invest \$2.3 trillion in fighting climate change, with carbon capture one of the main tools listed in his campaign strategy.

A more practical challenge is that carbon emissions are still predominantly seen as an expense for companies. One of the hurdles for the blossoming of carbon capture technology will

be coming up with creative ways to convert it into a valuable product.

“How do I incentivize the growth of a carbon utilization scheme so that market forces can take over?” said Ramanan Krishnamoorti, a chemical engineer and chief energy officer at the University of Houston. “That is what will push the innovation and really drive costs down.”

It's an issue that the 2020 legislation tries to tackle, calling for immediately increasing funding for carbon capture, utilization and storage to more than \$1 billion, up from the current \$200 million budget. Plans include six new carbon capture technology projects by the end of 2025.

The legislation is designed to push innovation in carbon capture. That's a goal big players like ExxonMobil are also looking into. In 2019, the oil-and-gas titan signed a joint development agreement with Global Thermostat to “advance breakthrough technology that can capture and concentrate carbon dioxide emissions from industrial sources, including power plants, and the atmosphere.”

Yet turning carbon dioxide into money-making products is still limited. The biggest demand for captured carbon dioxide is in enhanced oil recovery, a complex and expensive process that injects carbon dioxide to shake loose oil that otherwise couldn't be produced.

The independent oil producer Occidental is betting big, with

a proposed direct air capture plant that illustrates how technology can be commercialized when the financial benefits are clear. Occidental has said it will begin construction by 2022 and is currently working to secure funding. The plant will use new technology to essentially grab existing carbon dioxide out of the air, later using it for enhanced oil recovery in the Permian Basin in West Texas.

“We’re very committed to (direct air capture) and excited about it because this for us is a win-win-win,” said CEO Vicki Hollub at Anadarko’s third quarter 2010 earnings call. Hollub then listed these benefits: lowering its cost of enhanced oil recovery, selling its technology to others and at the same time, “helping the world by reducing CO<sub>2</sub> out of the atmosphere”.

While Occidental is promoting the advantages, a look at the math indicates steep economic challenges ahead. Direct capture of carbon dioxide costs a startling \$600 per ton of CO<sub>2</sub>, according to the Center for Carbon Management and Energy Sustainability at the University of Houston. Occidental’s plans rely heavily on a federal tax credit designed to stimulate investment in carbon capture.

The benefits for Occidental also rely on already-existing geographical conditions. Occidental has a lot of oil reserves in West Texas that require the use of enhanced oil recovery techniques using carbon dioxide.

The current high production costs are expected to fall with continued advancements in the technology, as happened with solar and wind generation, said Steve Capanna, the director of U.S. Climate Policy and Analysis at the Environmental Defense Fund. The EDF views investment in direct air capture as a starting point for developing the kinds of technology the U.S. will need by the 2040’s to meet climate targets.

But if engineers can make cutting-edge technologies like direct air capture generate a return for shareholders on their own - without government incentives and without niche demands like those of Occidental – the financial benefits will push the technologies forward on their own.

Researchers at the University of Toronto are exploring ways to use carbon dioxide to create plastics. Stanford University, working with the Department of Energy’s SLAC National Accelerator Laboratory, is searching for ways to create zero-emissions fuels from CO<sub>2</sub>.

If they are successful in finding high value uses, it will be a first step in bringing that \$600 per ton price tag down for companies. Add to that improvements in capture technology, and a reduction in the need for storage, and the costs fall further. Suddenly, even futuristic proposals like direct air capture – that currently rely on government subsidies - could start to have market allure.

“If we can start to find the utilization of carbon dioxide and the marketplace for it and make that a true driver, then we give it enough of a runway for it to make economic sense,” Krishnamoorti said. “As we start to find ways to integrate it with renewables, perhaps capture costs can be further reduced.”

It sounds ambitious, but look at what happened with investment in solar power.

The result has been a tumble from \$370 per megawatt-hour in 2009 to less than \$50 per megawatt-hour in 2020. Billionaire investor Warren Buffett is building a plant that promises to cut that in half: his \$1 billion, 690-megawatt solar plant in Los Angeles, now under construction, promises power at \$20 per megawatt — plus \$13 for storage.

It’s a good reminder that when the market runs with ideas that government has encouraged, the results can be transformative indeed.

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# ***FOR TEXANS RENEWABLES ARE THE FUTURE, AND COAL AND FRACKING THE PAST***

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Texas is far and away the largest U.S. producer of oil and natural gas, owner of the country's richest oil and gas play (the Permian) and the home of the energy capital of the world (Houston). Yet, far from being bullish on fossil fuels, Texans view renewables as the most promising sources of energy for the United States as they look ahead, and conversely believe the country should be shifting its reliance away from fossil fuels, especially oil and natural gas produced by fracking.

The Hobby School of Public Affairs at the University of Houston conducted a representative survey of 1,329 Texans 18 and older between January 12 and January 20. In the survey the respondents were asked if they favored expanding, reducing or maintaining at the present level 10 different sources of energy in the United States: coal mining, ethanol and other types of biomass, geothermal power plants, hydroelectric dams, hydraulic fracturing (fracking) for oil and natural gas production, nuclear power plants, offshore conventional oil and natural gas, onshore conventional oil and natural gas, solar power plants, and wind turbine farms.

An absolute majority of Texans favor expanding four energy sources, all renewables, as the country looks toward the future. The most popular targets for expansion are solar power plants

(69% want to expand them as a source of U.S. energy) followed by wind turbine farms (63%), geothermal power plants (58%), and hydroelectric dams (56%).

The expansion of U.S. reliance on solar power plants is favored by an overwhelming majority of Texans who identify as Democrats (83%), but also by three-quarters of Independents (77%), and even 50% of Republicans. In a similar vein the expansion of U.S. reliance wind turbine farms is favored by 82% of Democrats, 64% of Independents, and by two-fifths (44%) of Republicans.

In contrast, a plurality of Texans believes the U.S. should be reducing its reliance on coal mining (50% want to reduce U.S. reliance on it as an energy source) and reducing its reliance on fracking for oil and natural gas (42%). Conversely, only 19% and 27% of Texans believe the country should be expanding its reliance on coal mining and fracking for oil and natural gas respectively.

More than three-fifths (64%) of Democrats want to reduce U.S. reliance on the use of fracking to produce oil and natural gas compared to only 9% who want to expand fracking. In contrast, almost half (47%) of Republicans want to expand the use of fracking, compared to less than a fifth (17%) who want to reduce

the country's reliance on fracking. Independents are relatively equidistant between these two extremes with 28% favoring an expansion and 42% a reduction of fracking.

Other energy sources such as onshore and offshore conventional oil and natural gas and nuclear power plants have a roughly equal three-way split among those Texans who want to expand, reduce, and maintain the country's energy matrix's reliance on them.

Responses from the survey reflect a convergence of public opinion in Texas with the rest of the nation on issues of sustainable energy, carbon management and support for policies aimed at mitigating the impact of anthropogenic greenhouse gas emissions on climate change.

A December 2020 report by the Hobby School of Public Affairs and UH Energy, shows that Texans, just like respondents around the nation, believe that the government should promote, incentivize and subsidize carbon management technologies and that oil and gas companies should embrace those technologies. Texans are getting ready for a greener economy and express a willingness to pay for cleaner energy sources.

They are concerned about climate change but realize that the transition to a sustainable future will not happen overnight. It will require a joint effort by government, consumers and producers of energy (including oil and gas) to identify sound policy changes and environmental stewardship practices.



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# ***POLICIES COME AND POLICIES GO, BUT THE MARKET IS IN THE DRIVER'S SEAT***

**EMILY PICKRELL**

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Dramatic changes in energy policy have become signature moves for an incoming administration.

Former President Donald Trump began his term by issuing presidential approval of the Keystone XL pipeline, a contentious project that had not received go-ahead approval under Obama. Under Biden, Keystone XL is back off the list.

Trump also made much fanfare of his support of coal, loosening up coal emissions standards in 2019 that had been established in the Obama administration. The U.S. Court of Appeals for the D.C. Circuit struck down the Trump rule on his last day in office, and Biden is expected to enact an even stricter rule.

This same back-and-forth is also true of fuel efficiency: In 2020, Trump moved to weaken the fuel efficiency standards established by Obama, lowering the annual required efficiency increase for car manufacturers from 5% to 1.5%. Biden has already told his agencies to review the Trump decision.

Yet while these politically-motivated moves appear to be driving our energy policy, lurching first one way, then another, energy researchers say the reality is that markets and emerging technologies are both pushing towards a carbon-free future, regardless of U.S. domestic energy policy.

“That whiplash of trying to switch back and forth on these policies – it generates a lot of fanfare, but in the meantime, the market moves on to where the opportunities are,” said Ramanan Krishnamoorti, a chemical engineer and chief energy officer at

the University of Houston.

Take coal, for example. The continued decline of the coal industry, despite former President Trump’s efforts to help out by loosening environmental regulations, well illustrates the limitations of government intervention. The sector lost 12,000 jobs and 10% market share during the Trump administration, a result of fierce competition from cheap natural gas prices and from solar and wind power’s emerging viability as an inexpensive, clean alternative.

“A trajectory set in that had to do with the marketplace and not regulations,” Krishnamoorti said. “The market said coal is no longer competitive.”

Biden’s decision to officially revoke the presidential permit for the Keystone XL pipeline has likewise been praised by environmentalists as moving the country closer to a fossil free future.

“This is a massive movement victory of a 10+ year fight thanks to millions of people demanding an end to fossil fuels, and a signal that Biden is following through on his promises to protect people and planet,” environmental group Common Dreams wrote in a January 20, 2021 reaction to Biden’s decision.

Yet how influential is such a big ticket political moves in helping the U.S. become less of a carbon emitter? Not so much, according to Ed Hirs, an energy economist at the University of Houston.



“Unless you cut off the supplies all the way around the world, you are not going to cut U.S. consumption of oil,” Hirs said, noting that the Canadian crude will instead be transported by rail, which has more environmental hazards. “What we don’t buy from Canada, we will just import from Mexico, from Venezuela, from Saudi Arabia, rather than from our friend and ally, Canada.”

It’s a good example of a policy being credited for something – in this case, reducing reliance on fossil fuels – when it does no such thing.

Fuel efficiency standards have also undergone this same tug-of-war in the last five years. Under President Obama, new fuel standards were established that mandated a five percent annual increase in efficiency. In 2020, Trump’s Environmental Protection Agency rolled back the standard, replacing it with a 1.5 percent increase.

And while Biden’s new administration has not officially announced yet another change to this policy, it has made it clear that fuel efficiency – and a transition to electric cars – will be one of its highest priorities.

Incoming Transportation Secretary Pete Buttigieg talked about the importance of the market in driving this fuel-efficient behavior in his recent confirmation hearing, acknowledging that the transportation sector is the biggest contributor of US sectors to greenhouse gases.

“American companies, American workers, should be leading the way, and producing, for example, electric vehicles and the most efficient vehicles on the road, and we need to do everything we can to support that, as part of a partnership with other agencies in the administration,” Buttigieg said.

The market has been quick to indicate that it is ready to fill this gap.

General Motors has already announced that it plans to sell only zero-emission cars and trucks by 2035. It’s the kind of news that could never come in response to Biden – rather, it is

the end product of an industry that has spent the last five years working on where it sees the future, which is electric.

“Everyone in industry understood that this was a brief interlude, that the Trump administration was trying to give consumers a break in the march to a low-carbon future,” Hirs said. “The industry soldiered on, developing carbon capture and electric vehicle technologies. It is not that they faced headwinds in the Trump administration, it is now that they have some tailwinds.”

It’s a good reminder that while policy can encourage change, politicians can and will come and go. More important is the way the energy transition itself is already building its own momentum, and it’s markets and innovation that will be the deciding factor on how that transition occurs.

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# *AS RECYCLABLES PILE UP, A NEW APPROACH MAY HELP CUT THE HEAP DOWN TO SIZE*

**BILL MONTGOMERY**

Energy Scholar, UH Energy

Less than a tenth of the vast amount of plastic produced in the U.S. each year is recycled. Two-thirds of glass containers Americans use go in the trash.

Recycling is rising for wastepaper, but still a third of it never is made into new products. It's easy to blame consumers for throwing all sorts of the wrong things in recycling bins, but environmentalists are now calling for a different solution – pressuring manufacturers to help dispose of the materials they use to package their products.

These proposals push responsibility onto manufacturers as a way to raise recycling rates and reduce waste streams. This approach has been used in Europe for several decades. It even has a high-tech, syllable-intensive moniker, extended producer responsibility, or EPR. It is, at first glance, a seemingly tough sell for manufacturers in the U.S., but some trade groups for companies that make consumer goods are getting on board.

The idea is that manufacturers pay cities to handle the waste their products create. That creates a whole new set of incentives. And the idea is gaining momentum in a fifth of the legislatures around the country. In New York, for example, a New York State Senate committee just passed an extended producer responsibility measure. In Hawaii, a bill on the subject is getting a hearing this week in the Hawaii State House of Representatives.

Bridget Anderson, deputy commissioner for recycling and sustainability at the New York City Department of Sanitation, told The New York Times recently that EPR will turn the current

equation on its head by being proactive. The new system will reward companies that cut their packaging by decreasing the fees they would have to pay to handle packaging that consumers toss. As far as the current approach, she said: “We’re reactive.”

A study last year found that the new approach had negligible effects on product prices where it's used in Canada. Researchers compared costs in cities with EPR policies and those without, looking at prices for Fancy Feast cat food, M&M's, Honey Bunches of Oats cereal and other items. As the momentum grows for these new measures, industry groups see that it will be wise to have a say.

“It's only been in the last year where the producers of the packaging and the waste management industry have come to the table and been willing to engage in the discussions. And they've been fruitful,” Scott Cassel, CEO and founder of the Product Stewardship Institute in Boston, said during a recent online session by the institute and Keep Massachusetts Beautiful. One such industry group, Ameripen, told the Resource Recycling website: “I would not say wholeheartedly we're in support of extended producer responsibility, but our policy does say we will support these proposals, particularly at the state level, if they meet certain requirements. That is a distinct shift from where Ameripen was even a year ago.”

In the view of Ramanan Krishnamoorti, a chemical engineer and chief energy officer at the University of Houston, Europe's use of extended producer responsibility has helped. But as far as looking to increase the United States' recycling of plastics, he said there are still severe limitations. “Plastics recycling through single

stream recycling is a dream," he said.

Industry takes the approach that it's better to reduce the amount of plastic used than recycle and reuse. Furthermore, mixed and flexible plastics are not recyclable and go to landfills or are incinerated.

In the United States, Krishnamoorti said, "it is uneconomical to do any better" because of the economics of cleaning, sorting and processing.

"Mechanical recycling from current mixed waste streams for anything other than rigid PET and rigid HDPE does not work, and many suggestions of magic dust and silver bullets have failed for 40 years. Further, the path of chemical recycling is a nonstarter for current mixed waste streams," he said.

As Cassel told UH Energy, "You can recycle almost anything if you want to put the money into it." But nobody hopes to spend astronomical sums on disposing of waste, so that's where extended producer responsibility comes in. It gives incentives to switch from packaging that can't be recycled and thus carry a financial penalty.

"It's possible that #3-#7 may find fewer users because the costs may be too high," he said, referring to the numerical labels inside the recycling symbol.

Cassel also said that when the new approach is in place, some companies may switch from plastic packaging to something else. Or companies could choose to use the plastics or other materials that are worth more in the recycling market. The U.S. Environmental Protection Agency set a goal at year's end of the U.S. increasing its recycling rate from the current 32 percent to 50 percent. The agency called on businesses, communities and individuals to help improve the recycling system, create more jobs and conserve natural resources.

Some marketplace developments may help. The website Waste Dive reported that at the Solid Waste Association of North America's virtual conference in late January, panelists saw some recyclable commodities rebounding. One cited stabilizing prices

for corrugated cardboard and mixed paper, while another noted

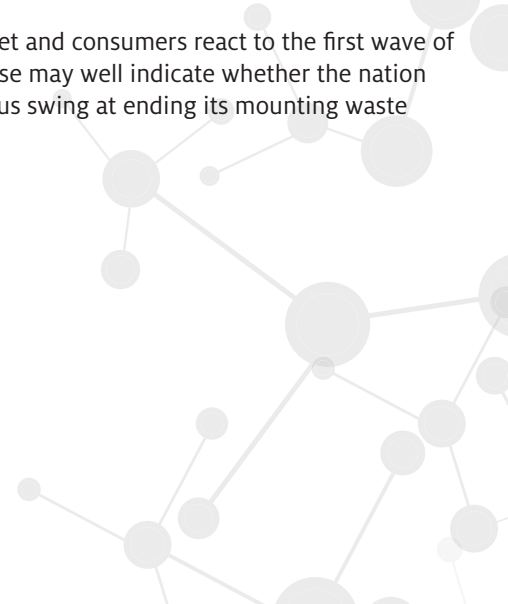
that prices for recovered natural high-density polyethylene, or HDPE, had risen above aluminum. Another factor that may drive EPR ahead is that cities across the country, already slammed by pandemic-related expenses, are struggling with recycling amid sharply rising costs.

One big reason for those rising costs is that the beginning of 2018, China barred two dozen categories of waste as it changed pollution strategies amid public health concerns. That created turmoil in the U.S. recycling industry by freezing out massive amounts of garbage-contaminated recyclables from the U.S.

As China's policy change in 2018 reverberates, it's clear that the current recycling system needs major repairs.

"In the long term, the problem has to be solved at the source. North America and Western Europe must take clear and conscious efforts to reduce waste," Lawrence Loh, an associate professor at the National University of Singapore, told CNBC in 2018 as the U.S. was feeling the effects of China's ban. "Rather than looking for the next place to dump waste, advanced countries should bear the responsibility of cutting down on waste generation through sustainable practices."

How will the U.S. market and consumers react to the first wave of EPR rules? That response may well indicate whether the nation is ready to take a serious swing at ending its mounting waste problem.



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# *WITH A DECARBONIZED FUTURE BEARING DOWN, REFINERIES LOOK AT THE NITTY-GRITTY OF THE TRANSITION*

**EMILY PICKRELL**

Energy Scholar, UH Energy

As the Biden administration makes good on its promises to heat up the conversation on climate change, owners of refineries and chemical plants are zeroing in on ways to cut their use of carbon-emitting fuels.

Refineries and other industrial plants are widely recognized as significant contributors to carbon emissions: industrial processes accounted for 27% of all carbon emissions in 2019, according to data from the U.S. Environmental Protection Agency.

The challenge is that industrial processes require massive amounts of energy for the transformative processes that make gasoline or cement. Many of these processes require really high temperatures – sometimes 1000 degrees or more; and heating is responsible for more than half of carbon emissions. The remaining emissions mostly come from the electricity required to run motors and other equipment, and from carbon dioxide produced as a byproduct in some of the processes.

There are several reasons oil refining and chemical companies in the US are thinking hard about their carbon footprint. The first is the growing acknowledgement by the vast majority of the public that climate change exists and is a result of human behavior.

An added incentive is the very real possibility that carbon pricing might be adopted by the Biden administration, given worldwide trends. And then there is the growing investor and

shareholder interest in how companies are making the transition.

“Independent refiners are absolutely feeling the same pressure and the same premise of the energy transition as majors like BP and Shell,” said Pavel Molchanov, an energy analyst at Raymond James. “The independent refiners are also subject to shareholder pressure to decarbonize.”

So, what are the options for refineries hoping to lessen their carbon contribution, other than abandoning the sector? There’s a number of them, according to Alan Rossiter, the executive director, external relations and educational program development for UH Energy at the University of Houston. Rossiter spent much of his career as a chemical engineer advising refineries and chemical plants on how to become more energy efficient.

Energy efficiency is a great place to start decarbonization, as it not only reduces greenhouse gas emissions, but also brings in cost savings from reduced energy consumption, Rossiter explained. And there is a range of improvements plants can make – for example, operational improvements, better maintenance, and facility improvements. The first two options are relatively cheap for plants, but facility improvements typically require additions and upgrades, or even completely new plants, which can be

extremely costly.

“The most common applications of energy efficiency in a refinery or a chemical plant are around recovering and reusing heat,” Rossiter explained. “This means recovering heat that would otherwise be wasted.”

As a result, improvements like upgrading an inefficient boiler system can reduce the need to burn fuel. Yet while these improvements are significant, a typical boiler upgrade, for example, only reduces energy demand by two to three percent. More can be achieved by major process revamps, but even these have limitations.

“There is just so far you can go with energy efficiency,” Rossiter said. “These plants make chemical transformations and separations that require a certain minimum amount of energy, and well before you get to these limits, you find that the equipment gets very expensive and you run into practical problems.”

Using electricity to replace natural gas or coal-fired heating is another option for plants. However, the electricity must come from low-carbon or carbon-free sources, or electrification would simply move the plants’ emissions to power generation facilities.

“Electrification can reduce your steam demand, therefore reducing the cost of environmental upgrades,” said James Turner, an executive director of process technology for engineering company Fluor, in a recent webinar. “Burning less fuel already means that you’ll make less CO<sub>2</sub>, which is a strategic driver for many companies.”

One of the biggest hurdles in using electricity to replace fossil fuels in industry will be the delivery of power to the industries that need it. A multibillion-dollar investment in power transmission and distribution lines will be needed, along with huge batteries.

Furthermore, “Inside the plant you’ll need a whole lot of investment for new equipment to electrify processes that currently use natural gas or other fossil fuels for heating,” Rossiter said.

In theory, about 70% of the services that currently burn fuel in these plants could use electricity to replace it. But for the oil refiners, the biggest challenge will be the costs of revamping the equipment.

Using hydrogen as fuel is another interesting option for refineries under investigation.

“It is a virtually unlimited store of energy, and it is available everywhere. It is contained in water,” Rossiter said. “However, it takes much more energy to convert it into a fuel than you get when you burn it. This is a major challenge.”

The use of hydrogen in cars is already popular in California, which now has more than 40 hydrogen fueling stations. And hydrogen is also being used as a fuel in refineries and chemical plants – but only in small amounts, mixed with natural gas. The leap to using pure hydrogen as a fuel is still under development, with companies like Shell and Dow Chemical studying the challenges involved in a transition from natural gas to hydrogen.

“If you want to burn it, you can, but you might have to do a lot of redesign on the furnace,” Rossiter said. “Hydrogen is very corrosive, and damage can occur to conventional materials if you expose them to hydrogen in high concentrations.”

Biofuels are yet another option. And while used cooking oil and algae tend to capture the public’s imagination when discussing biofuels, synthetic natural gas is actually a better option for decarbonizing refineries and chemical plants, as it can directly replace natural gas. This is a big advantage, as plants can use their existing equipment pretty much as is, greatly lowering the investment bar.

Yet biofuels face production challenges, as they take precious water and land resources as well as additional energy to produce. All of the options involve a balancing act. It’s all part of the transition, while keeping an eye on containing the costs to ensure that the business itself remains competitive.

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# DEBATE OVER RENEWABLES JUST A SIDESHOW AMID EPIC TEXAS POWER FAILURE

EMILY PICKRELL

Energy Scholar, UH Energy

Just like there are no atheists in foxholes, it is doubtful that many Texans pride themselves on anti-federalism in a house that's lost heat and electricity when it's 4 degrees outside.

Rick Perry, former U.S. energy secretary and ex-governor of Texas, prides himself on exactly that.

He didn't miss a chance to raise the specter of the kind of federal regulation that would have required generation plants to be winterized for conditions like those seen in Texas this week. Lack of winterization, which is required by the U.S. Federal Electricity Regulatory Commission, has been one of the major contributing factors to the inability of generation plants to run.

"Texans would be without electricity for longer than three days to keep the federal government out of their business," Perry told Houston Minority Leader Kevin McCarthy's Republican Leader blog Wednesday. The blog said he was speaking "partly rhetorically."

Perry blamed Texas' woes on insufficient baseload power, particularly from sources with on-site fuel storage such as nuclear reactors.

"We are at the same amount of power needed in the state today than we were in August of 2020, which was the highest megawatt usage in Texas history," he told the blog. "If wind and solar is where we're headed, the last 48 hours ought to give everybody a real pause and go wait a minute. We need to have a baseload."

He added that the only path to a baseload in the U.S. is with

natural gas, coal and nuclear.

Yet these sources already provide the lion's share of Texan power: Gas-fired power plants currently provide 65.7% of the power supply in Texas, coal-fired plants make up 15.9%, and nuclear generation supplies 6%. Wind contributes 9% of the power mix, according to ERCOT's winter fuels data.

Pointing fingers at different generation fuels avoids a much-needed discussion about how a lack of regulatory oversight in Texas has weakened its ability to reliably deliver power, according to Ramanan Krishnamoorti, chief energy officer at the University of Houston.

"The discussion is not about wind or natural gas or coal or nuclear – they all failed," Krishnamoorti said. "It is an absence of planning and the political will to deliver. In 2011, all the generating CEOs promised in letters to winterize (irrespective of source) – not one company demonstrated the winterization."

In retrospect, the 2011 freezing temperatures in Texas seem like a warm-up for what happened in much of the state this last week. Power outages on Feb. 2, 2011, lasted as long as eight hours in parts of Texas.

Later that year, the Texas Senate held hearings to identify how these outages could be avoided in the future. The need for plants to winterize was discussed, yet the Texas Public Utility Commission, which oversees generation, told the Senate at that time that passing legislation to require plants to weatherize was not necessary.

Instead, the Texas grid operator, ERCOT, prepared a list of recommended steps for generators to take to prepare for extreme weather conditions.

ERCOT can only impose regulations that the Texas Legislature will pass, Krishnamoorti said. Regulatory oversight in the energy sector for flaring, chemical storage and winterization have been seen as too much interference, and thus have not been legislated.

Instead, this lax regulatory approach has contributed to the failure of several natural gas generators to perform, as water froze inside wells, pipes and valves.

Another contributor to this week's power failure is the market's structure. Under Texas' market-based approach, power is dispatched on the basis of lowest incremental cost. Providing reliability in the system is done by incentivizing generators to build plants that might not get used as much but are available in peak conditions.

In Texas, this is done by allowing prices to climb as high as \$9,000 per kilowatt-hour during highest demand times. These incentives have encouraged generation to rise to 15 percent of reserve capacity in 2021, up from 8.6 percent in 2019's peak summer conditions. It is forecast to increase to 27 percent by the summer of 2022.

Yet the strain is instead showing in the upkeep of plants. The current system still doesn't provide power generators with the returns needed to invest in maintaining and upgrading plants, according to Ed Hirs, an energy fellow in the Department of Economics at the University of Houston.

"For more than a decade, generators have not been able to charge what it really costs them to produce electricity," Hirs said.

And reliability of power is where the lack of investment in the grid really shows.

"There is a cost for reliability, and that is something that must

be factored in," Krishnamoorti said, noting that wind is now typically being advertised as wind plus battery storage, where storage is the reliability cost.

"That works fine for typical times of summer challenges, when storage is required for less than 12 hours and the amount needed is a few hundred megawatt-hours," Krishnamoorti said. "It does not work when a much larger amount is needed for over 72 hours."

A new business model for intermittent power sources should address this, where the reliability cost for wind is either a natural gas plant or hydrogen storage and fuel cells for electricity generation.

The reliability cost for a natural gas plant would include winterization.

"Rolling blackouts and blackouts occur whenever a local region loses power generation," Krishnamoorti said. "Winterization issues would have been addressed, and the scale of the problems would have been substantially smaller."

And reliability in the system would also protect customers against the kinds of bills that power outages can rack up.

The Insurance Council of Texas has already estimated that the cost of this storm could exceed that of Hurricane Harvey, which ran up a tab of \$20 billion.

The costs will be reflected in insurance claims, but the peak power prices of \$9,000 that the Texas Legislature has permitted will also be reflected in customers' bills. One Houston customer of electricity retailer Griddy which lets customer bills float with market costs, has already calculated that his power bill for last week is more than \$4,000, even though he and his wife unplugged most appliances and just ran essentials.

They are scrambling to line up an alternative retailer but have been told it will take several days.

The defenders of the current market system - like Rick Perry,

former governor of Texas for 15 years - were the same ones who presided over the massive change in the Texas electricity market to turn it into one that can produce \$4,000 monthly bills for consumers. These changes were always about retaining home state control, and it has never been fully addressed that (usually) cheap comes at the expense of reliability.

Texas' decision makers must address the short falls in the electrical market and develop a strategy that serves the state's nearly 30 million residents. Trying to divert attention to out-of-state directors of ERCOT or make it a competition between renewables and fossil energy will not solve it.





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# ***TEXAS' ADDICTION TO FLARING COULD INFLICT UNEXPECTED ECONOMIC AND ENVIRONMENTAL COSTS***

**EMILY PICKRELL**

Energy Scholar, UH Energy

The meltdown of the Texas grid last week illustrated that a lack of regulation can look economically savvy – until it doesn't. Texas has been a noisy exception to the standard policy of other states to require weatherization of its natural gas generators. The Lone Star State's failure to do so was a contributor to the \$80 billion bill – per Bloomberg News - for last week's storm.

Yet Texas has also failed to use regulatory tools to handle another environmental issue that could have a big economic implications for the entire planet: flaring and venting off natural gas in the Permian Basin.

Flaring is a well-head technique used to dispose of excess natural gas that is produced along with oil at a well head. Shale plays like the Permian produce a lot of what is called associated gas along with the much more valuable oil. A trillion cubic feet of natural gas in the Permian Basin of West Texas has been flared since 2013, according to the U.S. Energy Information Administration.

The big problem is the amount of methane in associated gas, which is a disaster in terms of its climate change impact. Methane traps at least 80 times more heat than carbon dioxide. It is responsible for 25 percent of today's warming from human activities, according to the Environmental Defense Fund. Producers flare – or burn it – as a way to turn the methane into carbon dioxide. Yet some gas is also vented, meaning that it is released directly into the atmosphere in its

much more potent form as methane.

The value of the flared and vented gas, despite its relatively low cost, is staggering: the gas released in the third quarter of 2019 alone had a value of more than \$500 million.

While other oil-producing states – think New Mexico, Colorado, North Dakota – have established strict flaring standards, Texas regulators continue to allow the industry to mostly control the conversation.

"The missing link is regulation – no one is forcing these companies to do it, so everyone dips to the lowest common denominator," said Ramanan Krishnamoorti, the head of UH Energy. "In the absence of regulation there is an economic disincentive to do anything, and the simplest thing to do is to burn it."

Initially, one of the limitations in selling the associated gas was that the pipeline infrastructure was missing to take this gas to where it could be sold. Indeed, development of the Permian has been nothing short of transformative, outpacing its supporting infrastructure: The Permian Basin increased its oil production from 1 million barrels a day in 2010 to nearly 5 million barrels a day in January 2020.

"The thing to remember about the flaring in the Permian Basin is that it has enabled the oil production, and that has been a game changer for the country," said Christine Ehlig-Economides, a

professor of petroleum engineering at the University of Houston. “It would have been very expensive, if you had to put in the (natural gas pipeline) infrastructure from the get-go to make these wells. Had that been the case, you probably wouldn’t make the wells.”

Yet the spike in oil production has been accompanied by a growing rate of gas flared, known as “flaring intensity.” It is measured by the ratio of flared gas volumes to gross gas produced and grew from 2.7% in January 2017 to 3.8% by the end of 2019, according to a report prepared by Rystad Energy for the Environmental Defense Fund. It’s a number that some believe is much higher because of inadequate techniques for gathering the data.

The Railroad Commission of Texas is responsible for overseeing flaring, and any operator in the Permian Basin that wants to flare gas must receive its authorization.

It has not been hard to get.

The Texas Railroad Commission has an uninterrupted record of approving every request for flaring from Permian Basin. Currently, more than 300 million cubic feet of natural gas is flared each day, with at least half of this coming from routine flaring. This number is expected to climb back to close to 400 million cubic feet per day by the end of this year, according to the Rystad Energy report. It is lower than the 500 million cubic feet per day records hit in early 2019, an improvement that is largely attributed to larger operators taking over.

Texas regulators have repeatedly shown that they prefer recommendations over mandates, and in the end, expect the market to solve its own problems.

“I truly believe much of our state’s flaring will be eliminated as we expand our pipeline capacity and export infrastructure for LNG,” said Railroad Commission Chairman Wayne Christian, in a discussion over whether to support a permit for routine flaring of 100 percent of a company’s gas product, even though the necessary pipes were in place to move the majority of this gas to market.

“But in the meantime, I would love to hear suggestions from industry and the public on creative ways we can curb this practice and encourage using this gas for its intended purpose, powering Texas,” Christian said as the permit was approved.

Flaring opponents are pressuring Texas regulators to take steps to eliminate routine flaring within five years. They argue that without these kinds of bright lines, some companies will just continue to kick the can further down the road as long as possible.

Indeed, many companies are looking to reduce routine flaring. Large oil and gas companies such as Chevron, EOG Resources and Occidental have reduced their flaring rates to less than 1 percent, far below the 3.7% average Permian basin flaring rates, according to a report on how to tackle flaring in the Permian Basin. The report was prepared by GaffneyCline, a global oil and gas consultancy group.

There are technological proposals floating around to help reduce the amount of flaring: one involves going after the “zero-cost” flaring solutions, which Rystad Energy estimates could reduce emissions by nearly 100 million cubic feet per day. Another proposal involves mandating gas capture targets, which could be achieved through existing gas capture technology. For unexpected flaring or venting, robots and drone technology can and is being used to detect leaks.

Setting a gas capture requirement of 98% by 2025 would largely eliminate routine flaring and cut event-driven flaring by about a quarter, according to the report.

Yet companies like Chevron say the best solution for flaring is to not do it.

It has avoided routine flaring by planning in advance for how it will get that gas to market and making sure its supply chain to do so is reliable.

“Chevron says that it is a waste of an economic resource and believe they have the responsibility, as a prudent operator, to mitigate the risk that flaring poses,” said Jennifer Stewart, the

author of the GaffneyCline report and a vice president at Avitas, a subsidiary of Baker Hughes. “You mitigate risk by being committed to environmental stewardship, and by doing so, you are going to secure your license to operate and your investment base. They want to be held by investors that are in it for the long term.”

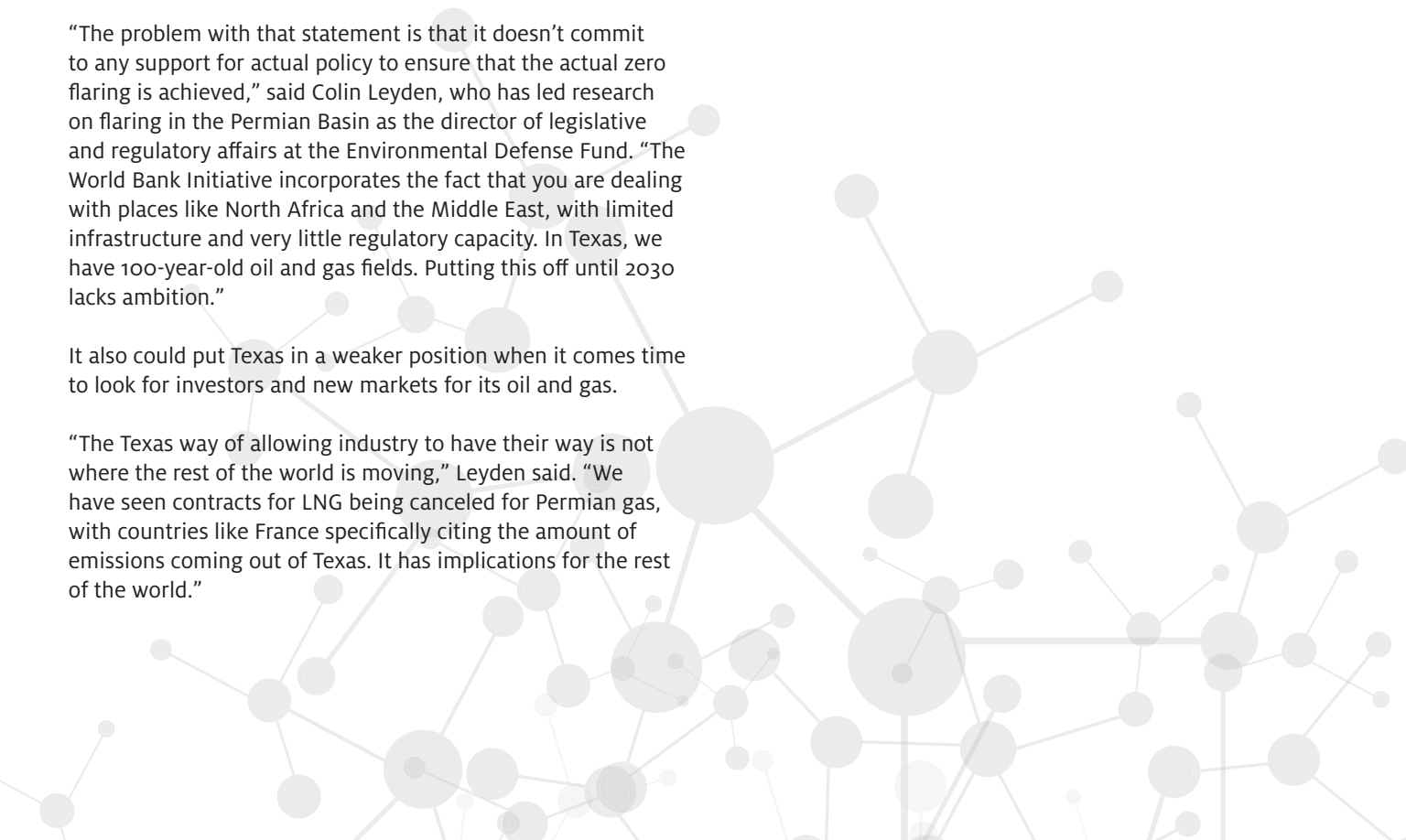
Occidental has become the first U.S. producer to publicly support a World Bank initiative for Zero Routine Flaring by 2030. This 2030 deadline for phasing out routine flaring is backed by an oil and gas industry group, the Texas Methane and Flaring Coalition.

Others are saying that 2025 is more reasonable, considering the magnitude methane’s role in speeding up climate change.

“The problem with that statement is that it doesn’t commit to any support for actual policy to ensure that the actual zero flaring is achieved,” said Colin Leyden, who has led research on flaring in the Permian Basin as the director of legislative and regulatory affairs at the Environmental Defense Fund. “The World Bank Initiative incorporates the fact that you are dealing with places like North Africa and the Middle East, with limited infrastructure and very little regulatory capacity. In Texas, we have 100-year-old oil and gas fields. Putting this off until 2030 lacks ambition.”

It also could put Texas in a weaker position when it comes time to look for investors and new markets for its oil and gas.

“The Texas way of allowing industry to have their way is not where the rest of the world is moving,” Leyden said. “We have seen contracts for LNG being canceled for Permian gas, with countries like France specifically citing the amount of emissions coming out of Texas. It has implications for the rest of the world.”



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# DO TEXAS' 13,000 WIND TURBINES NEED TO BE WINTERIZED?

**BILL MONTGOMERY**

Energy Scholar, UH Energy

Wind turbines spin in Antarctica, in Quebec and in Norway, even through severe winters. The story is the same in Iowa, North Dakota and even Arctic Russia.

But ice collected on a number of turbines in Texas' February freezing spell, causing them to shut down to avoid damage or destruction from load imbalances and vibrations and to keep them from slinging chunks of ice across the landscape. The shutdowns raise questions about the state's more than 13,000 turbines. Is winterization the best way forward for them? What exactly does winterization mean? How do the economics work to handle difficult-to-predict blasts of cold weather in Texas?

Hadi Ghasemi, a mechanical engineering professor at the University of Houston and chief technology officer for Houston-based Elemental Coatings, said the way to look at preparing wind turbines for extreme cold is this:

"Basically it's insurance on your assets. So you pay a small amount on these technologies – it's not that much – but you make sure that when you need them, they're completely functional."

Turbine blades can be prepared for severe cold through active systems, which heat the blades, or via a passive approach, such as coatings. Wind farm operators can buy cold weather packages that protect components such as the gearbox and motors as well through heaters in a wind turbine's nacelle. The Canadian government says with these measures, turbines can operate in temperatures down to minus 22 Fahrenheit.

With no financial incentives for operators to winterize turbines or penalties for not doing so, Texas turbines were left at the mercy of the elements. Many ground to a halt.

Iowa State University aerospace engineering professor Hui Hu, who has extensively researched wind turbine icing issues, told UH Energy that Texas' choices on winterizing turbines were not clear-cut. He said he could not remember a time in the last two decades when Texas' wind generation was dealt such a blow. In thinking about winterizing wind turbines, he compared the situation to buying a car. If you will only use heated seats once in the lifetime of the car, would you spend the money to buy them? Hu added that Texas' wind turbines faced a big problem during the recent freezing weather in that moisture collected on turbine blades and created ice. Moisture is the key. Most Iowa turbines normally don't have a big problem with ice buildup because of lower winter humidity there.

When ice forms on turbines, it can reduce power production up to 50% of normal, he said. Hu said the price per turbine to handle winter conditions is 5% to 10% more than one without, or up to \$400,000 more on a 2.5 megawatt utility-scale wind turbine, depending on the system chosen.

Lasse Hietikko, business development manager of Wicetec, a Helsinki, Finland-based company that installs carbon fiber-based heaters on surfaces of wind turbine blades that operate automatically, told UH Energy it likely would not be wise to put anti-icing systems on all turbines in Texas. "The oldest and the smallest should be left out as it would probably make no sense," Hietikko said. "However, with the energy price of \$9,000 per

megawatt-hour that was happening in Texas, the payback time would be just a few days on bigger turbines. If severe icing occurs, for example, three times in a turbine's lifetime, there could be a business case.

"But if we look at the issue from the energy supply point of view, it becomes more and more critical to avoid all wind power disappearing at the same time from the grid." In other words, if a lot of wind power dropped off the grid in just a few minutes, there's not enough time for thermal plants to jump in and fill the gap, so the case may be stronger for anti-icing systems on many turbines.

On the Wicetec system, the anti-icing blade heating system's power consumption is about 0.2% of the turbine's long-term output on a wind farm where icing occurs regularly, Hietikko said. Wind energy players such as Siemens, Gamesa, Enercon, Nordex and Vestas also develop technology to counter winter weather.

Houston's Elemental Coatings is working on the passive side of turbine winterization. It makes materials that prevent the buildup of ice and scale, which forms from minerals in water, on a range of surfaces. The company, which was started in 2018, is based on technology developed by Ghasemi and licensed through the University of Houston. The company has not used its products yet on wind turbines but has been testing its products in that field.

Elemental Coatings CEO Brian Huskinson said he expects to be ready to coat wind turbines in the winter of 2022. He said it's telling that companies have not invested in winterizing their wind turbines in Texas. "There's no question that the math is iffy because if it was clear, then it would be done from a purely economic point of view. Otherwise we would have to believe that many dozens of independent operators are making incorrect, uneconomic decisions, which I find hard to believe," Huskinson said.

But that was before the epic power failure last month, with overall costs measured in lives and billions in damages. Total damage estimates have run to \$90 billion or more.

"If you include those sort of effects, the math pretty overwhelmingly would favor winterization," Huskinson said. "In Texas I think we're in a nice situation where probably a lot of the active heating doesn't make a ton of economic sense. We have a cheaper solution that still provides a good solution around ice," he said.

Huskinson acknowledged that keeping wind turbines running during the crisis would not have been enough. But it would have helped.

"If wind had stayed where it was before the drop-off, it still wouldn't have prevented the blackout situation because we were many tens of gigawatts short on the supply side," Huskinson said.

"Our experience in talking to owners and operators is they know the economics of their turbines," said Allen Hall, CEO of Weather Guard Lightning Tech in Williamstown, Mass.

And knowing the economics will be crucial as Texas lawmakers and regulators decide how to proceed with increasing the grid's resilience. Deciding who will pay, and which power sources will get the most money, will be big decisions. Keeping the turbines spinning even in a bitter cold winter storm would contribute to the grid's resilience.



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# GETTING THE GAS YOU NEED WAS A KEY PROBLEM FOR TEXAS IN STORM

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Energy Scholar, UH Energy

Customers who rely on the ERCOT grid one freezing week in February have captured media attention around the world. Debates have sprung up over politics, environmental issues and grid reliability.

Yet another system's failure contributed greatly to the problem – getting the Texan natural gas to the generation facilities, including that from its Permian Basin shale play. And it failed when residential use of natural gas worked swimmingly, unfettered across the state. At the moment that the Texas grid came close to failing, Texas had at least 300 billion cubic feet (BCF) of natural gas stored.

The failure of the system to make this natural gas accessible to the generation facilities was a key factor in the collapse of the system on Feb. 15.

“We don't need more natural gas storage,” said Ramanan Krishnamoorti, a petroleum engineering professor at the University of Houston, in response to public discussions of whether Texas needs to expand its natural gas storage as a safeguard. “We need to have natural gas storage that is actually pumpable.”

It has been well reported how natural gas production dropped dramatically the week of Feb. 15. Conditions in the storm – including the freezing of some wellheads and natural gas processing outages – resulted in a 30% production decrease from 24 BCF per day to less than 17 BCF in the Texas region, according to Argus Media. It averaged at 13.8 BCF per day that week, falling as low as 11 BCF at one point, according to the U.S.

Energy Information Administration.

A big reason for this is the growing role of the Permian Basin in providing the type of natural gas Texas is using. Permian natural gas is known as “associated gas”, because it is a by-product of the much more lucrative shale oil being produced.

And while this gas is interchangeable with deliverable gas as a fuel stock, its production process is different, according to Christine Ehlig-Economides, a petroleum engineering professor at the University of Houston.

Deliverable natural gas comes from a pressurized gas reservoir, meaning that it can flow on its own, and does not have to be compressed, which requires electricity.

Associated gas, on the other hand, “comes to the surface at a low pressure, and now you need to compress it to gas plants, where you take out more valuable components, like propane and butane and ethane,” Ehlig-Economides said. “It comes because we are pumping oil out and that requires electricity. So with no power or winterization of the pumping process, you are not getting this gas out.”

The failure of these shale producers to move the associated gas made the gas storage facilities a natural backstop.

Under normal conditions, the Texas electricity grid relies less on storage capacity as an available backup than other states that are heavy users of natural gas, such as California, because it is normally much easier to extract the gas directly.

Nevertheless, gas suppliers had an advance warning from the Texas Railroad Commission, or TRRC, which issued an emergency order on Feb. 12, giving priority to natural gas generators in Texas for residential power.

However, the pipeline companies that largely control the storage sites began withdrawing a relatively much smaller amount of gas from storage than the combined drop in production and spike in demand, according to data from the U.S. Energy Information Administration, or EIA. Based on data available from the EIA and TRRC, Texas storage was pumping out about 5 billion cubic feet per day on average in the weeks prior to the snow. The week of the storm they were pumping out an average of 9 billion cubic feet per day.

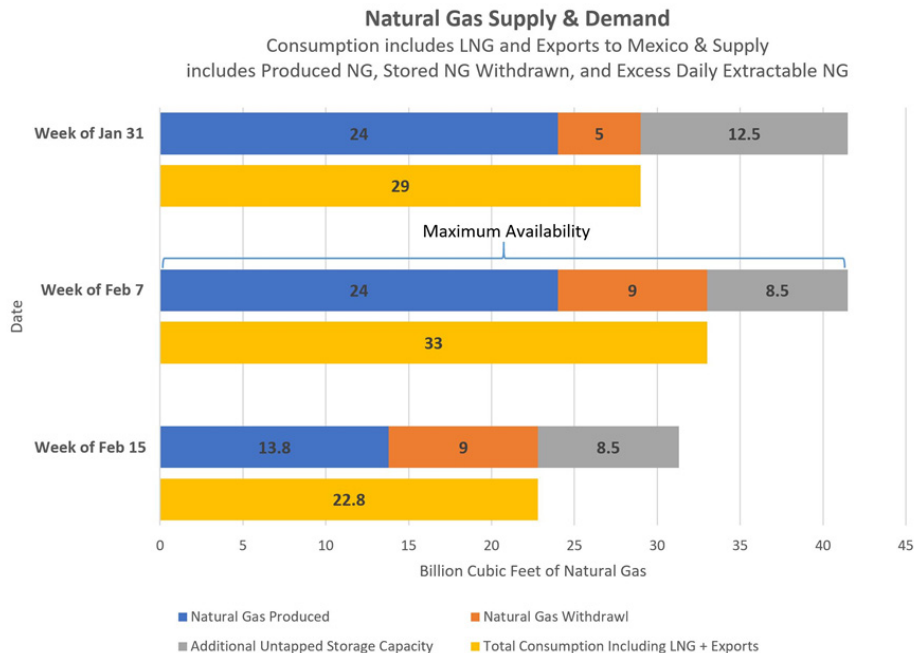
That is far short of the maximum 17.5 BCF per day that is available from storage facilities according to the data from TRRC on their public website.

During this period, the low temperatures, and continued

operations of export of natural gas to Mexico and LNG at least during the initial periods of the freeze, kept demand for natural gas at high levels. Natural gas experts say that the shortfall in the amount of natural gas that came out of storage was a result of limitations in the system.

Texas had sufficient natural gas in storage to cover the shortfall at the beginning of the week of Feb. 15, according to data from the TRRC. Yet there are further limitations in what the system can extract beyond what is reported to the TRRC, said Ben Chu, a natural gas analyst at Wood MacKenzie.

“The three facilities were drawing the maximum they could as early as the 10th of February,” Chu said, referring to storage sites that Wood MacKenzie tracks as indicators of sector behavior. The maximum extraction rate is estimated to be 17.5 BCF per day by the TRRC, but the real rate depends on the level of pressure in the reservoirs, which tends to fall off as it depletes.



For example, one of the largest natural gas storage facilities, Tres Palacios Storage in Matagorda, is reported by the TRRC as having 2.5 BCF per day of withdrawable gas. Wood Mackenzie says the real amount that can be withdrawn is much lower.

“That data is questionable or debatable,” said Eric Fell, director of North America natural gas at Wood Mackenzie. “Tres Palacios is a big facility – it is hypothetical that it could be that big. What we see in the daily (statistics) is that it has never done more than 800 or 900 million.”

Tres Palacios also went into “force majeure” on Feb. 15, meaning that it had serious performance issues that reduced the amount of natural gas that could be delivered.

The failure of Texas’ biggest salt cavern storage facility at the worst possible time has wrongly been written off as inevitable, Krishnamoorti said.

“The conditions should have been relatively good for Tres Palacios,” Krishnamoorti said. “It’s in one of the warmer parts of the state. And there is a much higher level of being able to pump that gas out in these salt caverns – the heavier hydrocarbons are likely to have settled in the reservoirs, it is naturally pressurized. We ought to have been pumping out more.” Who got priority for the natural gas that was extracted also made a difference.

Delivery of stored natural gas is also prioritized to those with firm supply contracts, which peaker natural gas generators are not required to hold. This means in effect that peaker plants – the ones the Texas grid was relying on on Feb. 15 - could be last in line behind other natural gas clients. Yet even who got priority is difficult to know, as Texas pipeline companies are not required to publicly disclose this contractual information, unlike pipeline operators under federal jurisdiction.

Many public utilities in other states have natural gas storage facilities specifically dedicated to providing fuel, even in adverse conditions, said John Hilfiker, a senior energy analyst at S&P Global Platts. It is not something that the market system in Texas would necessarily encourage, which instead depends on a thin percentage of excess capacity (known as a reserve margin)

to protect its system against a power collapse. And, as it turns out, this excess capacity relies on the natural gas being readily available as it is produced.

“There is a problem when you rely on production for a majority of your supply and then have one of these freeze off events,” Hilfiker said. “You are at the whim of a producer being able to maintain output.”

The shortages resulted in soaring prices for natural gas: \$206 per million British thermal units at the Waha Hub, which is located in the West Texas basin and best represents the price for Permian gas. The previous week, natural gas at the Waha Hub had had an average spot price of \$4.54. Prices for natural gas at the Houston Ship Channel were higher than Waha, reaching as much as \$400 per million BTU, in spite of being closer to the storage facilities.

This situation certainly has generated no shortage of unhappy customers, as well as an estimated more than \$85 billion cost for the state.

The awkward question remains – how much of this was foreseeable for natural gas producers, who own the mineral rights at storage facilities? Could they have more aggressively pumped gas the entire week prior to Feb. 15? Was any behavior influenced by the skyrocketing natural gas prices over that time? How does the market guide behavior under such conditions, when regulations do not govern it?

In 2016, the U.S. Department of Energy issued a report on how to decrease the potential impact of future prolonged disruptions of natural gas infrastructure.

In its report, it discussed the importance of ensuring that a failure to access the needed natural gas does not lead a collapse of the electricity grid.

It’s advice Texas legislators should take to heart, to make sure we are not having the same conversation again a few storms down the road.



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# ***CHALLENGES AND TRENDS FOR THE OIL AND GAS INDUSTRY***

**BILL MALONEY**

Director, Trident Energy & UH Energy Advisory Board

There are three primary challenges facing the oil and gas industry exist today. The first is to produce more energy at lower cost with less emissions. The global population is increasing, and energy demand post COVID-19 will not only recover, but also increase. At the same time, the world is demanding cleaner energy so oil and gas companies must supply this energy with less emissions. This is a tough task, but many groups are rising to the occasion. Just look at the work being done by industry, universities and governments to lower emissions, and you will see that a very large effort is being made to produce cleaner energy. It will take time, but the trajectory is clear to get to net zero emissions by 2050 or sooner. Oil and gas companies need to continue their good work at lowering costs. Investors are demanding better returns on their investment in oil and gas companies. While companies cannot control the price of their product, they can control the amount of money they spend annually. The trend since 2015 is one of remarkable achievement in lowering the cost base of the entire industry.

The second challenge is for the oil and gas industry to collectively invest approximately \$500 billion each year just to keep up with demand. What makes this particularly difficult is the strong headwind of rising capital costs. Since 2015 the oil and gas industry has underinvested, especially in the upstream portion of the business. Once the global spare capacity is depleted there will be a need to reinvest in not only maintaining, but actually growing oil and gas production to satisfy the needs of customers around the world. This challenge will be difficult to achieve and if it is not handled effectively to develop or re-develop supply to stay in-step with demand, we will see a period of higher oil and gas prices.

The third challenge is for oil and gas companies to demonstrate differential and durable cash flows. There's been a large number of investors fleeing the oil and gas sector. In the past, many oil and gas companies outspent their cash flows in the name of growth. That is no longer the case for the vast majority of companies. Still, investor confidence has not yet returned. Energy companies need to show that they have capital discipline and will consistently return money to their shareholders. This trend has already begun but the COVID-19 pandemic and its effect on lowering demand has delayed the positive impact of all the good work oil and gas companies have done and are doing to keep costs down and spend within their means while rewarding shareholders with consistent and predictable returns. As the world recovers from the pandemic, evidence of the industry's good work will be obvious from the returns they report.

So what trends we will see for the next 12 to 24 months? These are very clear. Oil and gas companies will continue to lower costs, lower carbon emissions and lower risk. Lowering cost requires the relentless pursuit of improving efficiencies in every aspect of the value chain. Lowering carbon emissions mandates best in class operational practices as well as continued technology development and deployment. Oil and gas companies can lower technical risk with better reservoir models, better visualization and more. These three trends will likely continue well beyond the next two years. They have become requirements for businesses to thrive and survive in today's energy market. Lastly, besides all the hard skills that are needed to meet the challenges outlined here, oil and gas companies will need to continually develop the softer skills of communication, collaboration and innovation. In some ways, the continued development and successful utilization

of soft skills is the hardest part of all, yet they are absolutely required for success.

The world will be using oil and gas for decades to come. The customer of today and tomorrow will demand not only access to energy, but that it is clean, affordable and reliable. The oil and gas industry can meet these challenges and must to do that in partnership with customers, governments and universities. Reaching net zero emissions by 2050 is possible, but we all need to do our part.



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# TEXAS' CRISIS AMID WINTER STORM SHAPES MEXICAN ENERGY POLICY

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When Gov. Greg Abbott cut off natural gas that usually flows from Texas to Mexico on Feb. 17, the hoped-for result was meeting Texas' skyrocketing demand and dwindling ability to supply it during the worst winter storm in decades.

"I hereby mandate that all sourced natural gas be made available for sale to local power generation opportunities before leaving the state of Texas, effective through Feb. 21, 2021," Abbott wrote in a letter to the Texas Railroad Commission, the state's energy regulator.

The order had both immediate and longer-term consequences for Mexico, highlighting the country's dependence on Texas natural gas.

Close to 5 million people in northern Mexico suffered outages and blackouts in the following days. Mexico relies on U.S. imports for about 65 percent of its 7.6 billion cubic feet a day of natural gas consumption. That number is expected to grow 20 percent to 9.1 billion cubic feet a day by 2025.

Free market champion Mary Anastasia O'Grady argued in the Wall Street Journal that the size of Mexico's market alone and its current consumption of natural gas should have given it more consideration, even at the expense of Texas' own power-starved residents.

O'Grady further noted that the politics of the cutoff have played well to a vision that populist Mexican President Andres Manuel Lopez Obrador has long been promoting: a Mexican return to energy self-sufficiency.

Or more aptly, increased reliance on and dominance by its state-owned oil and gas company, Petroleos Mexicanos, or Pemex.

To put these maneuvers into context, it is necessary to go back to decisions made by the previous investment-friendly and establishment-oriented Pena Nieto administration. In 2014, Mexico passed a slew of legislation to open its energy sector to competition as it tried to clip the wings of Pemex, which has a huge labor force, some of the country's most powerful unions, and historically close ties with the country's ruling elite.

Since his election at the end of 2018, Lopez Obrador has been working to reassert Pemex's dominance. To this end, he has argued that hydrocarbon-fired power from state-owned utility CFE should be providing the country's electricity. It will mean effectively leaving the renewable energy companies - many of them private and international players - at the back of the power-selling line after having invested millions of dollars.

And while two-thirds of Mexico's natural gas has been flowing from Texas, the storm and Abbott's decision have given Lopez Obrador an even stronger platform for attacking the country's fledging renewable energy industry -- especially that funded privately and, worse yet, by foreign entities.

"Gov. Abbott's decision provided a very good argument for AMLO's energy policy," said Rosanety Barrios, a former senior Energy Ministry official who was one of the chief architects of the previous energy legislation. "His objective of energy sovereignty has a new argument against natural gas dependence." In the three weeks since the storm, Mexico's Congress has passed

legislation that favors state-owned natural gas, fuel oil and diesel generation, requiring its grid to use this power first, regardless of cost. The rule, which undermines the 2013 legislation and is already being challenged in court, makes it much more difficult for renewable generation or for private plants to survive as part of Mexico's grid.

And while Lopez Obrador has been pushing in this direction with many earlier decisions, he was able to effectively campaign for the new law using the Texas cutoff as part of the justification.

Yet aside from what the return of a more powerful oil and gas monopoly means for Mexico politically, the president's decision not to diversify the country's power supply is shortsighted. Worse yet, his solution does little to address one of Mexico's biggest problems: Where is it going to get its natural gas in times of trouble in Texas?

For while Lopez Obrador ran on oil independence from the U.S., his administration has not pursued options for self-sufficiency in terms of natural gas, even though the nation is blessed with ample resources.

One of its most obvious potential resources would be to use the natural gas productively that Pemex currently flares, according to George Baker, editor of Mexico Energy Intelligence.

"Better investment in gas management would have provided gas to customers instead of being flared," Baker said.

Pemex flares more than 500 million cubic feet of gas daily, up from 305 million in 2019. These numbers are expected to grow as the company pushes for more oil production while leaving significant gas processing and gathering issues unaddressed. The flaring represents almost 10% of the 6 billion cubic feet of gas Mexico imports from Texas daily.

Natural gas storage – specifically, building some – has likewise been woefully neglected in Mexico.

"Despite its having been made open to private investment since 1995, there has been 25 years without any investment in gas

storage," Baker said. "It has left the country's electricity and industrial base vulnerable in case of an extreme incident such as the winter storm."

Lopez Obrador has also rejected the development of hydraulic fracturing in Mexico, even though the nation has rich gas potential in the northern Burgos and Sabinas basins. The Burgos basin holds the largest undeveloped shale resources in the country and was identified by the U.S. Energy Information Administration for its capacity to reduce Mexico's reliance on natural gas imports in the long term.

Part of the problem is that Mexico's current administration has no overarching natural gas policy, even as the country becomes increasingly dependent on it for both industrial production and electricity, according to Jose Maria Lujambio, an energy lawyer and former senior regulator (2009-2012).

As a result, investments not made by the private sector, such as natural gas storage, have not been taken up by its state-owned company, Pemex, despite the obvious energy security concerns. Some of Pemex's reluctance is understandable, given its \$110 billion and growing debt, which has made even critical investments challenging.

Even so, driving business back toward the country's state-owned natural gas power plants will do little to curb its growing dependence on Texas natural gas.

And discouraging private investors from developing its rich solar and wind resources will only make this dependency the more painful, should push come again to shove.

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# ***THE TEXAS GRID LOSES - TO ARIZONA, NEW YORK, MISSISSIPPI, ALABAMA, GEORGIA***

**ED HIRS**

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In 1998, about the time that Texas began to change the way it regulated electric utilities, NASA launched the Mars Climate Orbiter. It crashed on Mars due to a simple error, failing to convert English measures to and from the metric system. At any point in the design or even during the monthslong transit, the error could have been corrected. It was not. Last month, NASA's Perseverance rover landed on Mars. NASA learned from its mistakes.

But the same week Perseverance touched down on Mars, the Texas electricity grid tragically repeated its same mistake from exactly 10 years earlier, only this time on a much larger scale. The damage from the grid failure continues — deaths and funerals, bankruptcies, lawsuits, and more. The fired CEO of the Electric Reliability Council of Texas, the organization that manages a large part of Texas' independent energy infrastructure, testified that the grid was minutes away from a complete failure that would have required months to restart. The Northeast recovered from the 2003 complete blackout in no more than four days. Southern California recovered from its 2011 complete blackout in hours. Months? This vulnerability makes Texas a national security risk in addition to being the laughingstock of the nation. Worse, the economic development agencies of Arizona and New York are harvesting soundbites from the Texas Legislature's grid-failure hearings to win Samsung's competition for their new \$17 billion chip manufacturing plant. Mississippi, Alabama and Georgia will gather clips from the hearings too, to make Texas' electrical infrastructure look too unreliable. Can Samsung, or really any

corporation, afford to risk their businesses and employees' lives by moving to Texas? In addition to the immediate losses of tens of billions of dollars, Texans were hammered in a Wall Street Journal analysis showing that they paid \$28 billion more than consumers in regulated electricity markets. This is not news. Journalist L.M. Sixel of the Houston Chronicle has detailed the electricity cost disadvantages for Texans in several stories over the years.

Smart economists who supported the creation of ERCOT predicted that the Texas grid would flourish with no incentives to maintain or encourage investment in generation assets. One architect of ERCOT, a Harvard professor, stated that the market worked just as designed during the week of Feb. 14. If the market was designed to bilk consumers out of \$50 billion at prices 300 times the average, providing only 60% of the service, to cause dozens of deaths, to rack up tens of billions of dollars in economic losses and damages, and to line the pockets of some energy traders with billions of dollars at the expense of consumers, then his mission was accomplished. Funny that — to pay more and more for less and less is exactly what old-fashioned regulation of electric utilities avoided.

Midcourse corrections for the ERCOT market have always been possible. Free-market dogmatists scream "laissez-faire" but fail to recognize that the ERCOT market is very much regulated and constrained. "Laissez-faire" in this case can be translated as, "We are lazy." The pending bills in the current session of the Legislature do not address the structural problem of under

investment. These bills, if passed into law, will be temporary fixes and not address the profound weaknesses of the Texas electricity infrastructure. Repairing the Texas grid requires top-down changes from the governance to the wires and generators. An expedient solution is to add carrots-and-sticks in a capacity market by which generators would be compensated to keep their equipment ready. We could also return to a vertically integrated and fully regulated market focused on reliability. The electric utilities would earn a return on investment that would not be that much different from what we have now. Texas' fully regulated transmission companies and local utilities — as much as 70% of a consumer's bill — are guaranteed profitability by Texas law while ERCOT's guaranteed fees are raked off the top. California Gov. Gavin Newsom will now have to defend his stewardship following his state's grid failures in August. He faces a recall election similar to that of Gov. Gray Davis 20 years earlier. Arnold Schwarzenegger won that vote, sending Davis packing. Clearly, California has work to do to improve its grid, but the state knows how to hold its officeholders accountable. In Texas, there is currently no provision to recall the governor or state legislators. What can we do?

Here's a modest proposal. In January, Tom Herman was bought out of his remaining contract as University of Texas head football coach for \$15.4 million. Isn't failure of the electricity grid worse than failure on the gridiron? Perhaps Texans could buy out the terms of the governor, the lieutenant governor, the legislators, and the members of the Public Utility Commission for a comparable sum. We could then ask NASA to step in and fix the grid. We at least know they have the right stuff.



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# ***WE ARE FOCUSING ON THE WRONG ‘GREEN JOBS’***

**CHARLES MCCONNELL**

CCME, Executive Director

Facts and myths abound about the shiny new job of the future — the “green job.” Yes, these new green jobs will transform the job market, drive innovation, eliminate harmful emissions and change the world. But if we allow the myths surrounding green jobs to blind us, we will miss our chance to both eliminate harmful greenhouse gas emissions and to continue providing high-paying, transformative jobs. To reduce greenhouse gas emissions, we must focus on making all sources of energy cleaner, and stop pretending that fossil fuels’ role in supplying the world’s energy needs is going away anytime soon. That’s the fundamental error behind the two-fold myths clouding our understanding of the “green job” and until we see that clearly, our efforts to save the planet will be misguided.

One part of the myth would have us believe that all we need is renewable electricity and we can keep all fossil fuels in the ground. And two, that the renewable wind, solar and battery jobs are high-paying substitutes for those “dirty” hydrocarbon jobs. These are not only myths, but a destructive way to view the most effective path to transition and eliminate GHG emissions. In the popular lexicon, green jobs are generally viewed exclusively as jobs to do with wind turbines, solar panels and batteries. That limited definition is based on a narrative that renewables must be the only solution for the new green future. That’s a myth. It is overly simplistic and a dumbed-down premise that is false and misleading.

We are in a transition to transform our energy system that is today over 80 percent reliant on fossil fuels and our aspiration is to achieve net zero emissions by 2050. This cannot be solved by the elimination of fossil fuel energy by 2050. Rather, we

must eliminate emissions from all energy sources in that time frame. The world’s demand for energy is growing rapidly and we require more energy and advanced technologies — not fewer choices. Bill Gates has recognized that eliminating fossil fuels is an impractical aspiration and only through technology can we achieve net zero. It’s the emissions — not the fuels. The answer to the first myth is very simple: carbon management to eliminate the emissions is the best pathway for success. The entire energy industry must be transformed to reduce emissions impacts, especially the hydrocarbon industries, but not by eliminating jobs in the industry — rather, by re-imagining them.

The hydrocarbon industry generates large amounts of emissions, no doubt. It also produces, reliably and affordably, the fuels for transportation, the plastics and chemicals that have made everyday goods, food and medical packaging so advanced and safe. This industry must generate the new energy of the future such as hydrogen, and other fuels. We cannot focus simply on renewable electricity as we have a myriad of energy challenges that will require solutions beyond electrification to achieve this energy transition. De-carbonization of these industries will not only be the jobs of the transformed industry, but also help us the most to reduce emissions and advance our global leadership. These are the real green jobs!

What about the second myth? It suggests wind, solar and battery jobs are high-paying substitutes for the elimination of those “dirty” hydrocarbon jobs. In fact, they pay far less for both engineering and manufacturing jobs. The skill level and necessary education for the hydrocarbon process industries, especially a decarbonized hydrocarbon industry, is greater as well.

We must recognize that efficiency improvements in process technologies, carbon capture utilization and storage, decarbonized hydrogen, and carbon-free baseload electricity are all critical technologies and jobs in the energy transition. The drive for emissions reductions by the hydrocarbon industries to achieve net zero will require these highly technical jobs, skilled workers, and high-paying opportunities for incoming new hires. It will also require raising the skills of the existing workforce. The assembly and manufacturing of renewable hardware is not anywhere close to being the “high-paying substitutes” as is claimed. Not so very long ago, the U.S. was the world’s leading manufacturer of solar panels and is now a distant laggard to Asian countries.

So, let’s embrace the future. Let’s go green and lead the world. Let’s not get caught up in some political patter about eliminating the jobs in hydrocarbons that are and will be high tech, high paying, and high impact for the energy transition. Since when must we eliminate to grow? Keep your eye on the real ball of emissions reduction — transform the energy system — and do it with real global technology and business leadership.





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# ***PANDEMIC YEAR HAS NOT ACCELERATED THE DEATH OF BIG OIL***

**EMILY PICKRELL**

Energy Scholar, UH Energy

In some circles, the question is increasingly being raised whether, among the many victims of the COVID-19 virus, may be the large, multinational oil and gas companies.

Indeed, the 2020 reductions in travel and work hit energy companies hard. At the same time, a growing awareness of the potential devastation from climate change – think fires in California, freak storms in Texas - has focused attention on the importance of reducing our reliance on fossil fuels.

Both have meant a sour 2020 bottom line for Big Oil.

ExxonMobil, for example, once one of the most powerful companies in the world, reported a staggering loss of \$22 billion in 2020. BP, Shell and Chevron were not far behind, with \$20 billion, \$22 billion and \$5 billion in losses to show for the year.

These returns, combined with a growing U.S. acknowledgement of climate change and the need to address it, has led some energy pundits to question Big Oil's future.

“The world’s largest oil companies are emerging diminished and humbled by the pandemic-fueled oil bust,” wrote Paul Takahashi in a Feb. 26, 2021 article for the Houston Chronicle. “They face an uncertain future, under pressure from governments looking to curb greenhouse gases, investors seeking better returns and others simultaneously wanting both.”

Additional forces, such as a growing market for electric cars,

could further cut into Big Oil's revenues, reducing global oil demand by 25% according to a Columbia University 2019 study on electric vehicle trends. Meanwhile, some pundits have offered up President Joe Biden's push to rejoin the Paris Agreement as bad news for Big Oil, never mind the recent one-year moratorium on new oil and gas leases on federal land.

Certainly, the companies themselves have shown a marked decline of interest in holding the same oil reserves they once did, even though it is their main commodity. ConocoPhillips, for example, averaged between a 15 and 20-year supply of reserves up until about 2015. Now it has enough reserves for about 10 years. Shell has been even more aggressive in its depletion of reserves, holding about seven years of production at the end of 2020.

“The erosion of petroleum reserves is a sign that even Big Oil is capitulating to the decline of its key product,” wrote David Fickling, a commodities writer for Bloomberg. “If you still think crude will see bright prospects in the 2030's, you should be exploring and developing the oilfields to supply it.”

Many energy writers have taken a dim view as well, one writing last spring about how the astonishing price crash – down to an unbelievable and certainly unsustainable \$20 per barrel – could be a preview of the collapse of the industry.

Fast forward one year later and that prediction no longer looks so prescient.

“It is entirely wishful thinking that fossil energy is going away

and that Big Oil is going to lose its place,” said Ramanan Krishnamoorti, chief energy officer for the University of Houston. “Big Oil, with or without industry mergers, is likely to dominate the U.S. energy landscape, with oil prices likely to exceed \$100 in three years and gas prices likely to increase above \$4 in less than a year.”

It’s a calculation that is based partly on the slow-pace of global transition to electrical vehicles: They make up about one percent of the U.S. light vehicle fleet, despite Tesla’s relentless ability to appear in the news. And while brand name companies like GM have announced plans to phase out gasoline vehicles in the coming decades, it will require significant development of the electricity grid to do so.

Not impossible, yet the recent near-collapse of the Texas grid has made it vividly clear the kinds of problems increased reliance on shared infrastructure could create.

Even if we are bullish on the global appetite for going from weaning itself off gas guzzling transportation, there is still the uncomfortable fact that cars only account for about 25% of oil consumption. The other 75% - including truck and airline transportation, petrochemicals and other industrial use - may well prove harder to replace.

And while oil exploration has gone down in recent years as prices have made it less profitable, this trend has already encouraged price increases – all of which will benefit the large oil companies. Indeed, as of March 15, West Texas Intermediate crude traded just below \$60, more than double its \$25 per-barrel price this time last year.

Yet as prices start to recover, energy analysts like Pavel Molchanov point to a weak expected future price for oil, and say it is a reflection of the oil companies’ lack of investment in future reserves. Molchanov takes it to mean that while oil prices might eventually recover, he is not yet willing to gamble on the timetable.

“It will be at least another year before the industry can get out of its current austerity mode,” said Molchanov, an equity research

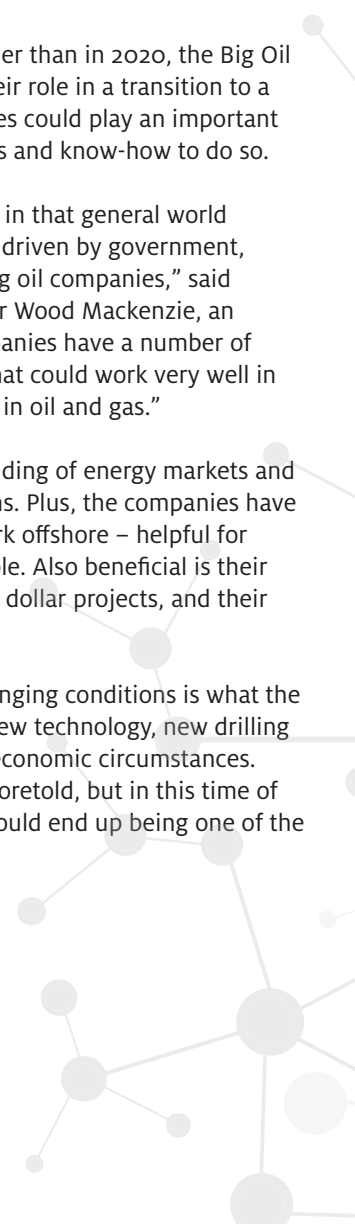
analyst with Raymond James. “Even a year from now, it is not remotely realistic for capital spending to get back to the levels of pre-pandemic spending. It may get closer to those levels but there is still so much fear, so much stress, so much uncertainty and the Big Oil companies exemplify this. They have to think about dividends and protecting the balance sheet.”

Finally, even as oil prices look healthier than in 2020, the Big Oil companies are trying to carve out their role in a transition to a decarbonized future. These companies could play an important role, because they have the resources and know-how to do so.

“In those policy-created markets and in that general world of progress towards decarbonization driven by government, you could absolutely see a role for big oil companies,” said Ed Crooks, a senior energy analyst for Wood Mackenzie, an energy consulting firm. “Big oil companies have a number of transferrable skills and capabilities that could work very well in renewable energy as they have done in oil and gas.”

These skills include a keen understanding of energy markets and managing good government relations. Plus, the companies have the equipment and know-how to work offshore – helpful for the push to offshore wind, for example. Also beneficial is their experience in managing multi-billion dollar projects, and their access to capital.

It will be a balancing game – but changing conditions is what the energy industry does best, seeking new technology, new drilling environments, changing worldwide economic circumstances. The death of Big Oil has often been foretold, but in this time of adaptation to climate change, they could end up being one of the transition’s biggest allies.



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# ***UNIVERSITY OF HOUSTON HOBBY SCHOOL SURVEY SHOWS BERKSHIRE HATHAWAY'S \$8 BILLION TEXAS POWER PLAN IS UNPOPULAR WITH TEXANS***

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Winter Storm Uri began to hit parts of Texas on Feb. 13, 2021 and - at its peak- left close to 4.5 million homes and businesses without power. The preliminary number of deaths attributed to the storm totals 111 and the storm's economic toll is estimated to be as high as \$295 billion. Over the course of the week of Feb. 14-20, more than two-thirds of Texans lost electrical power, for an average of 42 hours, and primarily due to the power outages, half lost running water for an average of 52 hours, with even more Texans with water lacking access to potable water for almost two days on average.

A little over a month later, on March 25, Warren Buffett's Berkshire Hathaway announced a proposal being pitched to Texas lawmakers under which it would build \$8 billion worth of power plants to substantially boost the state's electrical generation reserve capacity and, in doing so, help prevent the type of preventable disaster that afflicted the Lone Star State the week of Feb. 14. A mandatory monthly fee paid by Texas consumers as part of their electricity bill would be the principal

method of funding the Berkshire Hathaway project.

The Texas Electrical grid is located entirely within the boundaries of Texas; hence, it is not subject to the regulation of the Federal Electric Regulatory Commission. Two Texas counties are part of the Western Interconnection electrical grid while 29 are part of the Eastern Interconnection grid. The lack of federal oversight allowed Texas policymakers to design an electrical system based on market-based incentives that would promote innovation, competition, and lower prices for consumers. The system seems to have delivered positive outcomes along these dimensions, yet recurring extreme weather events, such as Winter Storm Uri, have exposed a flaw: the system is not resilient to sudden spikes in demand and drops in supply of electric power effected by the fall in temperature, resulting in massive blackouts, and human and material losses.

The central problem facing Texas is identifying solutions that would make the system more resilient. Yet building a resilient

electrical system has the typical properties of a public good, which is likely to be undersupplied by the market. A proposal such as Berkshire Hathaway's with its reliance on building excess reserve capacity requires government action. The catch for Texas policymakers is that despite the broad acknowledgement of the costs of the blackouts and the demand for policy remedies to mitigate the impact of severe weather events, a majority of Texans do not seem to be willing to pay an additional fee to the generators for the required investment in a more resilient electrical infrastructure. Perhaps these Texans do not believe they are the ones, after being left shivering in their homes, to pay an additional price for an investment that generators can make to assure a more resilient electrical infrastructure.

Between March 9-19, the Hobby School of Public Affairs at the University of Houston conducted a survey of 1,500 adults living in the 213 Texas counties (containing 92% of the state's 29 million population) served by the Texas Electrical grid, which is managed by the Electrical Reliability Council of Texas (ERCOT).

The survey respondents were asked about the extent to which they would support a proposal to allow electricity generators to charge consumers an additional fee to support the maintenance of a more substantial minimum electricity reserve in order to protect the state of Texas from the effects of severe weather affecting its energy supply and delivery. More than half (54%) of those surveyed oppose allowing generators to charge this fee, with 36% strongly opposed and 18% somewhat opposed. Conversely, fewer than one in four (24%) support this fee proposal, 8% strongly and 16% somewhat. The remaining 22% neither support nor oppose the fee proposal to bolster the state's reserve generation capacity.

This opposition is very bipartisan, with 57% of Republicans, 50% of Democrats, and 58% of Independents all opposing the proposal to allow a company like Berkshire Hathaway charge consumers a fee to support the creation of a larger reserve electrical generation capacity in Texas.

These same Texans were also asked how much more they would be willing to pay on their monthly electricity bill to protect the Texas electrical grid from the effects of severe winter weather by

increasing reserve generation capacity and insuring power plants were fully winterized. Half (51%) indicated that they would not be willing to pay any more at all on their monthly bill to achieve these goals. The next most common option selected was \$5 more which one quarter (25%) of Texans said they would be willing to pay each month, followed by 14% who indicated they would be willing to pay \$10 more monthly, with the remaining 10% spread among those who would be willing to pay \$20 more (6%), \$30 more (3%), \$40 more (0%), and \$50 more (1%).

Obviously, far more goes into the decision calculus of state lawmakers when considering a proposal of this magnitude. Other than public opinion. And lawmakers also face public demands to resolve problems with the electrical grid that Winter Storm Uri made apparent. That said, the Texas public surveyed in this poll indicated quite clearly that it opposes policies that would require consumers to largely shoulder the burden for boosting reserve electrical generation capacity with the goal of preventing another winter power outage of the magnitude experienced by Texans during Valentine's Day week of 2021.



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# ***TEXANS WANT WINTERIZATION OF UTILITIES, STUDY FINDS. ELECTED OFFICIALS MUST ACT TO PREVENT ANOTHER DISASTER***

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Texas prides itself as the world's ninth largest economy with close to 50 Fortune 500 companies. It is the home to multiple internationally-renowned universities, three major airline hubs and cutting-edge endeavors, ranging from Tesla's Gigafactory in Austin to NASA's Johnson Space Center in Houston to the SpaceX spaceport outside of Brownsville. And yet, this wealthy, modern state was brought to its knees on Valentine's Day. Between Feb. 14 and Feb. 20, Texans experienced an unprecedented failure of their electrical grid and ancillary infrastructure amid statewide freezing temperatures. Unfortunately, however, between the refusal of the Electrical Reliability Council of Texas (ERCOT) to release documents related to the debacle and the limited incentives for utility companies to be forthcoming, lawmakers, the media and the general public have been left in the dark in terms of understanding the full scope of the adverse effects of the Winter Storm of 2021.

A recent survey by the Hobby School of Public Affairs at the University of Houston brings to light the direct negative impact the winter storm and ensuing power outage had on the lives of more than 26 million Texans and gauges support for potential

policy changes. According to the survey, between Feb. 14 and Feb. 20, the most visible manifestation of the storm's negative impact was the loss of electrical power. More than two out of three Texans (69 percent) lost power at some point, with the average person going without power during this time frame for a total of 42 hours. The situation was even more dire for Harris County residents, with 91 percent losing power for an average of 49 hours. Although much attention has been paid to the storm's impact on electricity, water challenges were also prevalent. One-half of Texans report they were without running water at some point during this same period, with the average water outage lasting 52 hours. And in Harris County, almost two-thirds were without running water for an average of 56 hours.

Texans also suffered a wide range of other disruptions, ranging from the merely annoying to life threatening. Three out of four Texans experienced difficulty obtaining food or groceries, more than two-thirds lost internet service, slightly less than half had food spoil, a third suffered water damage to their home, and almost a fifth had a member of their immediate family member suffer an injury or illness as a direct result of the storm. And, among those who suffered damage to their home, less than a fifth

believe it is very likely that insurance will cover the full amount of the damages.

And, while there were some media reports of Texans leaving to ride out the storm in more comfortable surroundings, our survey indicates fewer than one in 200 Texans left the state. Most remained at home without power, where one-quarter used a gas cooktop or oven to heat their home while more than 1 in 10 used an outdoor grill, smoker or propane heater indoors to keep warm, actions that in several Texas homes resulted in carbon monoxide poisoning fatalities. What do Texans want to see their elected officials in Austin do to make sure a similar preventable disaster does not occur in the future? The most popular policy proposals are those that would require electrical generation companies (78 percent support) and natural gas pipeline companies (78 percent) to fully weatherize their infrastructure and for electrical generation companies to also maintain a minimum reserve capacity (78 percent) in order to be able to adequately respond to plants unexpectedly going offline. More than three out of four Texans support all three proposals, including four-fifths of Democrats and three-fourths of Republicans. However, fewer than one out of four support allowing companies to charge consumers an additional fee to cover the cost of increasing reserve capacity, such as was recently proposed to the Texas Legislature by Warren Buffett's Berkshire Hathaway.

Other proposals enjoy the support of more than three in five Texans. These include requiring the Public Utility Commission to engage in more rigorous oversight of power generation companies (77 percent), increasing the daily utility penalty cap from \$25,000 to \$100,000 (71 percent), upgrading building codes to make new construction more climate resistant (68 percent), adopting a solar bill of rights (64 percent), and providing state subsidies for the weatherization of low income households (61 percent). More than two-thirds of Texans believe that due to climate change Texas is today more likely to be adversely affected by severe weather than was the case 30 years ago. With the lurking threat of another harsh winter storm, it is imperative that our elected officials in Austin do everything within their power during the current legislative session to ensure the great state of Texas is not again left freezing in the dark.



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# WHEN YOU THINK ABOUT GREEN JOBS, BROADEN YOUR HORIZONS

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The binary conversation of green jobs and oil and gas jobs misses the bigger picture of what the energy transition is going to require. A relentless focus on decarbonization and a de-emphasis on the fuel source is going to define the energy transition.

The real challenge for the energy workforce will be figuring out creative ways to decarbonize the fuel and thus lower emissions.

It's an approach that will fast-track the U.S. into creating high-paying, technological jobs that will help to save us from the ravages of climate change, according to Charles McConnell, Executive Director of the Center for Carbon Management in Energy at the University of Houston and a former assistant secretary of energy in the Obama administration.

"We need to think about transformative science and jobs that are not wind and solar, but reimagining the oil and gas industry so that it is environmentally responsible," said McConnell. An example of one of these efforts is the BP-led Teesside project that will capture carbon from chemical plants in northeast England and sequester it in a reservoir under the North Sea. The New York Times quoted senior BP geologist Louise Duffy as saying that even as the company cuts jobs as it leaves the fossil fuel realm, "it is good to have new areas for geologists to move into."

When it comes to where the green jobs are, many think of wind farms, solar installations and battery storage. That's far from the complete picture, given that 85% of our energy still comes from oil and gas. The challenge is not to stop using these resources, but to change the way they are used.

"Our goal is to decarbonize and achieve net zero on emissions," McConnell said. "The world's demand for energy is growing, and we require more energy and advanced technologies, not fewer choices. The choice is to reduce emissions – not to eliminate energy options."

Part and parcel of making this leap will be having the workforce to do so. And attracting the kind of talent to push it forward will require thinking far beyond solar panel assembly work that McConnell describes as "low-paying and crap jobs."

Indeed, jobs traditionally thought of as green are not exactly paths to riches compared with many energy jobs.

The Wall Street Journal reported that pay for a Phillips 66 median worker, for example, was \$196,407 in 2018.

Compare that to the \$53,000 annual salary of a wind turbine service technician, the fastest-growing job category in the U.S., according to the U.S. Bureau of Labor Statistics. The annual salary of a solar installer, third on the fastest-growing list, is even worse,

with a median salary of about \$45,000. It follows that many in the oil and gas industry would not be excited about making such a transition.

“Someone working in a refinery leaving to go install solar panels, they’re probably going to take a 75 percent cut in pay,” Rick Levy, president of the Texas AFL-CIO, told the Houston Chronicle. “A transition sounds like a fancy name for a funeral.”

The good news is that effective carbon management to eliminate emissions will be a necessary route to address climate change concerns, and the field will need the kind of talent currently filling the industry’s ranks in places like Phillips 66.

As part of that green transformation, workers will likely need to bring or build the same kind of digital technology skills that has made oil and gas jobs lucrative for employees. Indeed, these skills – machine learning and predictive analytics – have become key in success in the oil and gas field, according to an EY workforce survey. Data analytics are already being widely used, for example, in place of humans, to find when something is going to break. The workers that can apply these tools are that much more valuable.

“Our energy companies in particular are saying data analytics is being integrated into every area of the business, so students’ ability to manage data is critical,” said Jamie Belinne, assistant dean for career services at the C.T. Bauer College of Business at UH’s Rockwell Career Center.

There is a wide range of these data analytics and visualization tools that companies say are in demand: Python, R, Tableau and Power BI, are all becoming increasingly important.

And the good news for students already in the oil and gas field is that these skills are equally transferrable to the energy transition, in areas like carbon management – and have the pay to match.

“Efficiency improvements in process technologies, carbon capture utilization and storage, decarbonized hydrogen, and carbon-free baseload electricity are all critical technologies and jobs in the energy transition,” wrote McConnell in a March 21, 2021 op-ed

in the Houston Chronicle. “The drive for emissions reductions by the hydrocarbon industries to achieve net zero will require these highly technical jobs, skilled workers, and high-paying opportunities for incoming new hires.”

Students who traditionally have gone into oil and gas jobs are increasingly interested in careers that contribute to a greener future, according to a 2018 survey by the University of Houston and the Environmental Defense Fund.

At the same time, the transformation to a low carbon future is moving forward, with the Biden administration embracing the Paris Agreement. The hydrocarbon industry appears ready and willing to offer highly technical jobs and high-paying opportunities for new hires as well as those in the existing workforce who are redeployed.

For policy makers driving the rhetoric, it is high time to get real about what these green jobs will require – and the level of compensation it will drive.



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# ***BANNING NATURAL GAS IN HOMES WILL INCREASE THE CONSUMPTION OF NATURAL GAS***

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Since 2019, several dozen U.S. cities — beginning with Berkeley, Calif., and expanding to other liberal strongholds — have prohibited natural gas hookups in new residential (and some commercial) construction. Instead, these cities are mandating the use of electricity for heating.

This shift is part of a larger push to phase out fossil fuels in the residential energy consumption sector. Since 2000, the residential energy consumption sector has also seen the smallest drop in its carbon emissions, especially compared to the sharp lowering of emissions in the electricity generation sector.

While proposing the elimination of natural gas may seem environmentally sound, it will likely lead to an increase in carbon emissions in most jurisdictions and — counterintuitively — it will increase in natural gas consumption.

Heating homes with natural gas is straightforward and efficient. The gas is piped into the house and then burned in a furnace with efficiency exceeding 90 percent in modern models. This means that 90 percent of the energy contained in the natural gas ends as useful heat for the home's residents. However, that use — as all fossil fuels — produces carbon dioxide emissions.

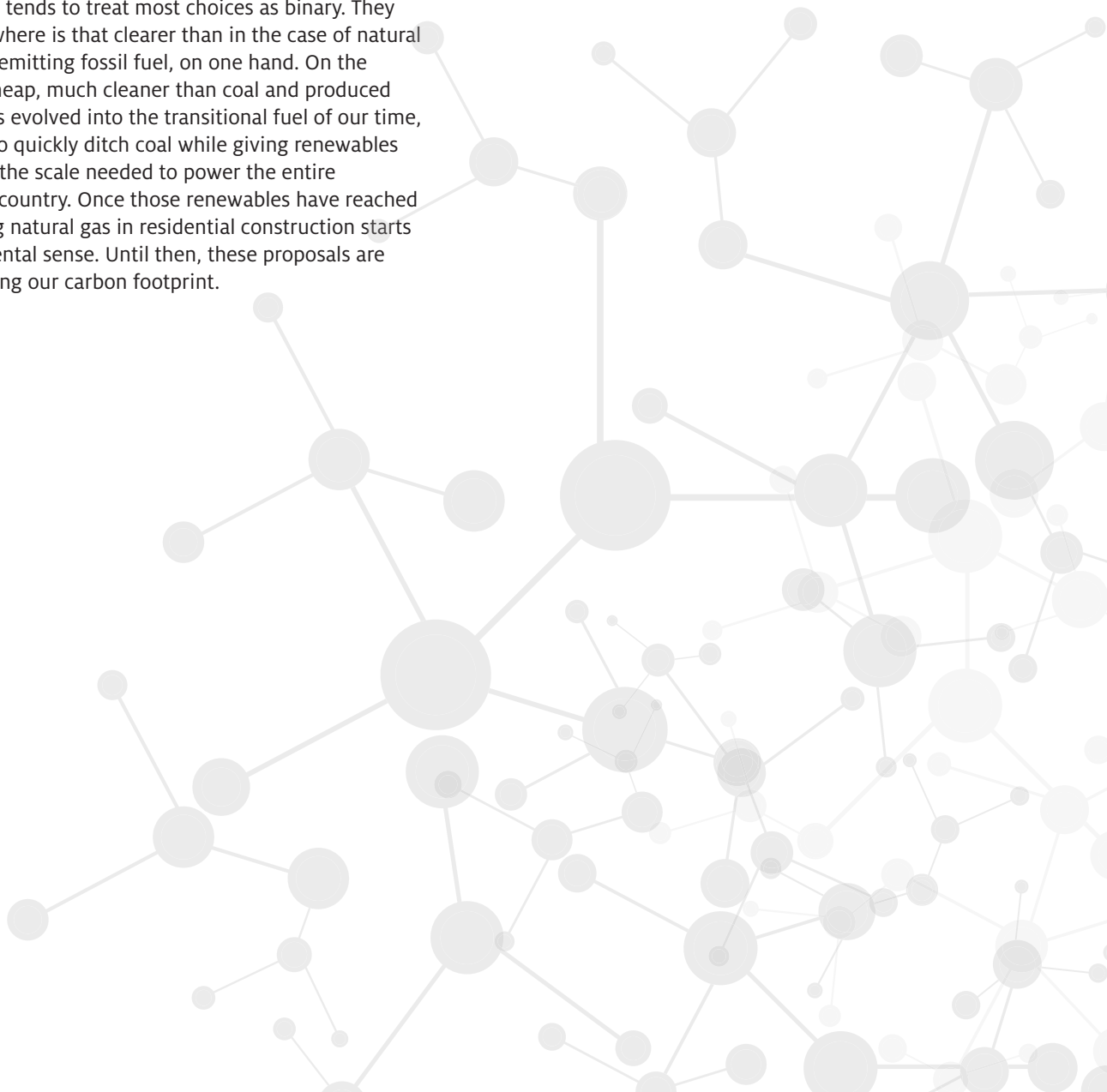
An electric heater can be just as efficient and produces no emissions. But what about the electricity used to run it? When natural gas is being burned in a power plant, only about 45 percent of the energy contained in it will be converted into electricity. As that electricity is transported and distributed,

additional 6 to 10 percent is lost; and the amount of electrical energy delivered to a house is typically just one-third of the energy contained in the natural gas fuel. Consequently, the overall efficiency of a gas heater is almost three times as high than that of its all-electric counterpart.

Of course, electricity can be produced from sources other than natural gas, including emission-free wind, solar, hydro or nuclear power. But the U.S. is not doing that at scale today. As the price of natural gas plummeted during the fracking revolution, it became a dominant player in U.S. electricity production. According to the New York Times, it provides 38 percent of all electricity in the U.S., 39 percent in California, 53 percent in Texas and almost 90 percent in Delaware. In fact, the overall lowering of carbon dioxide emissions in the electricity generation sector has less to do with renewables and more with the switch from coal to natural gas: per unit of energy, natural gas emits just half the carbon dioxide from coal. The reason why residential carbon emissions have not dropped much is twofold. First, the sizes and amenities of the newly built houses are continuously increasing. Second, while natural gas could displace coal in electricity generation, it could not in residential heating — since it was already established in that sector decades ago.

With the current state of electricity generation, increasing electricity consumption means increasing natural gas consumption, which is ill-advised when using electricity for heating. Making electricity is hard and using it for heating is a waste akin to carving a beautiful wooden sculpture and then burning it to boil water for soup.

A broader lesson behind these policies is that politicization of energy leads to bad decisions — both on the political left and right. Energy issues are always complex and the two-party U.S. political landscape tends to treat most choices as binary. They are not — and nowhere is that clearer than in the case of natural gas. It is a carbon-emitting fossil fuel, on one hand. On the other hand, it is cheap, much cleaner than coal and produced domestically. It has evolved into the transitional fuel of our time, allowing the U.S. to quickly ditch coal while giving renewables time to expand to the scale needed to power the entire electricity-hungry country. Once those renewables have reached that scale, banning natural gas in residential construction starts making environmental sense. Until then, these proposals are ultimately increasing our carbon footprint.



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# ***CAN ROBOTS TRANSFORM OFFSHORE ENERGY? STANDARDIZATION, REGULATIONS AND WORKFORCE ARE THE KEYS***

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When the BP Deepwater Horizon drilling rig exploded and caught fire on the Gulf of Mexico in 2010, killing 11 workers, it vividly illustrated the dangers of offshore work.

Since that time, breakthroughs in sensor technologies, data analytics and computer processing capabilities have ushered in a new era for robotics in car manufacturing, aviation and other sectors.

A similar adoption of robotics and automation in the energy sector is compelling to make energy infrastructure—including offshore energy—safer. As our colleague Aaron Becker, an expert in robotics, noted at a recent UH Energy symposium, if robots had been deployed on the BP Deepwater Horizon platform instead of humans, 11 lives would have been saved.

Offshore platforms are notoriously hazardous locations, dense with heavy equipment and handling large quantities of highly inflammable liquids and gases. A decade after the Deepwater Horizon incident, a few pilot projects now use automation to run platforms in the North Sea and off the coast of Australia.

Yet, for all the litigation and fanfare following the BP Deepwater Horizon accident, no such effort is underway in the U.S. Gulf of Mexico.

Why haven't robot-driven, automated and unmanned installations become the norm?

Three issues stymie the push forward: Standardization of equipment and designed infrastructure; uniform and adaptive regulations that keep up with the latest advances in technology; and a workforce that is robot-ready and can integrate automation into the workflow seamlessly.

Standardizing offshore energy infrastructure and technology would prime rigs for robots and automation. It would mean fully separating humans from the kind of work that resulted in scenarios like the 1988 Piper Alpha explosion that killed 167 workers, or the 1980 Alexander L Kielland explosion in the North Sea that killed 123 people. It could also help contain the spiraling costs of offshore oil and gas exploration.

However, the standardization of installations and technology has been hard to achieve in the offshore energy world. Typical offshore exploration and production projects are complex and gigantic, meaning no single company undertakes one alone. Projects often include various operators, service providers and drilling companies. The original equipment manufacturers who provide equipment to these companies also play a role.

This lack of standardization, in turn, makes automation incredibly challenging. Initial steps toward standardization will mean overhauling procurement systems, first in equipment, then in modules and projects.

In some regions, including the U.S., the biggest roadblock for

robots on offshore platforms is the regulatory climate. This is true especially in the U.S. Gulf of Mexico. While oil and gas regulations vary by geographic region, regulations in the U.S follow a prescriptive methodology, with strict enforcement of Safety and Environmental Management Systems.

Criticism of the U.S. system following the BP Deepwater Horizon accident resulted in more careful enforcement of rules, but failed to produce a forward-thinking regulatory approach that uses technology advancements to increase safety on a broader basis. It is a much more limited approach. By contrast, the off-shore European industry follows regulations that apply performance-based – i.e., results-based – standards.

Furthermore, lack of international regulatory harmonization for deepwater platforms means that European success with automating their offshore platforms fails to push the U.S. system forward. Currently, U.S. regulations do not permit full automation, while European regulations do. The lack of consistency makes it difficult for the same company to standardize its offshore platform operations globally.

On a company level, increasing automation on platforms would require a mindset overhaul. The industry has justified its resistance on safety concerns, such as equipment malfunction or cyber-attacks.

For offshore platforms, companies rightly place a high priority on securing the physical safety of operation, mindful of the tremendous importance of ensuring environmental safety. Companies are mindful that a potential malfunction on an unmanned platform might increase the time in a maintenance response.

Practical challenges include making sure that monitoring equipment is fully secure and reliable in the harsh conditions that platforms sometimes confront, be it freezing temperatures or hurricanes. Sensors installed on rigs to capture data must be secure and accurate, or the viability of the platform diminishes.

Another concern for the energy industry and its workforce is the extent to which robots could eliminate jobs, given recent

job losses in manufacturing due to automation. As many as 375 million people around the world will be forced to change jobs by 2030 as their positions instead become automated, according to a recent McKinsey report.

Yet labor and computing experts argue that this could provide new opportunities in the workforce, given the very different skill sets of robots and humans: the first, for repetitive and computational tasks, the second for judgment and perception.

“AI-based machines are fast, more accurate, and consistently rational, but they aren’t intuitive, emotional or culturally sensitive,” wrote David De Cremer and Garry Kasparov in the Harvard Business Review. “And, it’s exactly these abilities that humans possess and which makes us effective.”

In the energy sector, teams and infrastructure could be built of humans and robots working together to capitalize on the advantages of both. Equinor, for example, is planning to use their unmanned platforms to make additional discoveries near existing fields, thus extending the field life of these plays and making them more profitable.

It could also avert accidents, saving lives.

Indeed, the sad example of the Deepwater Horizon, where those onsite at the platform misguidedly relied on their assessment of the situation rather than the collected data indicating abnormal pressures on the drill pipe, shows that having all hands on deck does not necessarily avert disaster.

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# ***FAVORING EVS IN THE ENERGY TRANSITION OVERLOOKS OPTIONS***

**EMILY PICKRELL**

Energy Scholar, UH Energy

When a self-driving Tesla car crashed last weekend in Texas it made national news, with reports of two deaths and a battery fire that lasted more than four hours, despite repeated efforts to extinguish it.

It's a dark moment for the electric vehicle – or EV— movement, raising questions about its role as the heir apparent to the internal combustion engine.

Only a couple of days later, Toyota announced plans to expand its fleet of EVs with 15 additional models by 2025. Toyota's decision did not receive the attention of the unfortunate Tesla accident. Yet it is a significant indicator of how EV technology is embraced increasingly by latecomers like Toyota that invested heavily in hydrogen fuel.

"They were the big hydrogen holdouts for the last several years," said Ramanan Krishnamoorti, chief energy officer for the University of Houston. "It raises the question - what is the future of EVs? Are EVs going to dominate the market, as many people say, or are there other technologies?"

In the U.S., the Biden administration firmly favors EVs, announcing a \$2 trillion infrastructure plan with \$174 billion earmarked to push forward the electric vehicles market. This plan includes half a million new EV charging stations across the country. It also provides funds to convert existing plants to build electric vehicles and gives grants and tax incentives to encourage customers and establish a domestic supply chain for EV production.

The current federal focus on carbon emissions reduction is admirable.

The decision overlooks whether EVs prove better at removing carbon from the atmosphere than other technologies under development. Other options include hydrogen fuel generation, liquid natural gas and even potential improvements in internal combustion technology or hybrid vehicles.

Given the limits of EVs, the decision to increase their production appears rushed. One misnomer, and the most popular argument for EVs, is their potential to shift the country away from fossil fuel reliance.

The U.S. relies on fossil fuels for electricity production. Currently, about 80% of U.S. electricity comes from fossil fuels, while only about 4% comes from wind and solar energy. Although the latter percentage is growing, the US remains decades away from renewables generating most electricity. Until then, an electric-powered vehicle remains largely fueled by coal or natural gas, reducing its climate benefits.

Another significant obstacle for EVs is their reliance on the electric grid, which is desperately need of investment, as recent problems in Texas and California have illustrated. The batteries also require scarce and precious minerals, such as lithium, cobalt and vanadium, many of which must be imported.

A follow-up question concerns the need for infrastructure and the limitations for EVs prior to reaching critical mass. For example, EVolve Houston, a Houston-based EV advocacy group, says that while they are hoping EVs comprise 30% of new car sales

by 2030, their plans rely on “strategic deployment of charging infrastructure, similar to how the City of Houston is planning its public and private charging initiatives.”

Selecting any one technology at this point also overlooks the potential of other climate change-friendly options, including hydrogen power.

Recent EV enthusiasm stems from marketing savvy on the part of Tesla, according to former assistant Energy Secretary Charles McConnell.

“There is no one like Elon Musk for hydrogen, LNGs or anything else,” said McConnell, who served in the Obama administration and is currently the Executive Director of the Center for Carbon Management and Energy Sustainability at the University of Houston. “Many people have been inundated with this marketing message to the point where they believe that electric vehicles are the only option available, because that is what they are hearing.”

The impact, McConnell said, results in EVs as the preferred technology, prematurely cutting off development of other technologies – including advancements on internal combustion engines – rather than allowing EV technology to demonstrate its superiority via reductions of carbon emissions into the atmosphere.

“If you make the announcement that everything will not be an internal combustion engine vehicle – what do you end up with?” McConnell asked. “Zero innovation and zero investment in technology to improve internal combustion engines between now and whenever they eventually become extinct.”

This same further technology advancement could prove incredibly important to the environment.

Not every state is following the lead of the U.S. federal government. Concerns about a premature reliance on EVs has led states like California -- which vowed to end the sale of new gasoline powered cars by 2035 -- to continue exploring hydrogen power as an option.

Hydrogen fuel cells create electricity in cars by producing a chemical reaction between stored hydrogen and oxygen from the air. Electricity is generated from this reaction and only water vapor is emitted from the tailpipe. Hydrogen cars tanks can be fueled up in minutes, another advantage over EVs. And current models can run for 300 miles on a tank.

Currently, the development of storage tanks for hydrogen and the necessary infrastructure are the biggest hurdles. Another downside is that among possible renewable sources of hydrogen, most currently comes from traditional natural gas extraction.

But these challenges – as those EVs face - are not insurmountable.

History shows that in the evolution of transportation, some of the best ideas were not immediately adopted. Electric cars have been around since the late 1800’s. The first commercial EV was built by General Motors in the mid-1990’s, according to Popular Mechanics, nearly two decades before Tesla’s vehicles became commercially viable.

The current rate of new developments in both hydrogen energy and in EV fueling suggests that in two decades, profound technology breakthroughs could remove current road blocks.

It’s still very early in the game: Currently, only about 6% of cars registered in California are electric powered. Worldwide, this number is even lower, roughly 3%.

The U.S. is not alone in grappling with these issues as it tries to jump start its energy transition. In Europe, strict emissions reduction rules also fueled the push toward EVs. Challenges meeting new standards solely through improvements to combustion engines led to an increase in EV car purchases. Recent history demonstrates a need to strike a balance between creating a comprehensive pathway forward in the energy transition while supporting a diversified slate of innovations.

Northern European countries like Germany are trying to do so by building up hydrogen infrastructure, especially for trucks, given hydrogen’s tremendous fueling benefits over EVs.

Meanwhile, Japanese car manufacturers are leading the pack in developing hydrogen-fuel technology. The 2021 Toyota Mirai and the 2021 Honda Clarity – as well as South Korea’s 2021 Hyundai Nexo—run on hydrogen fuel cells.

Yet the implications of what the U.S. decides manifest huge international consequences.

China, one of the world’s biggest markets — with its focus on the future U.S. market — is aggressively leading the charge toward building necessary infrastructure for electric vehicles in anticipation of future sales worldwide. It accounted for more than half the charging stations installed in 2018.

But this push from China does not mean that internal combustion engine cars will be out of the mix any time soon.

Bloomberg New Energy Finance forecasts that by 2040 nearly three out of five new passenger vehicle sales will be for electric vehicles globally, but comprise less than 33% of all the cars on the road.

That means roughly two-thirds of all cars on the road in 20 years could still utilize 2020 internal combustion technology rather than benefit from improvements to emissions that come from research.

It’s a mistake to predict which technology will be superior two decades down the road. This precious time would be better spent focusing on how to make each technology as climate friendly as possible, and let the dice roll as they may.



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# ***ELECTRIC COOPERATIVES, THE LONE SHINING UTILITY STAR OF THE TEXAS 2021 WINTER STORM***

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Winter Storm Uri began to hit parts of Texas on February 13, 2021 and its onslaught left close to 4.5 million Texas homes and businesses without power at its peak. By some accounts, the preliminary number of deaths attributed to the storm is nearly 200, and the economic toll for the Lone Star State is estimated to be as high as \$295 billion.

The more than two-thirds of Texans who lost power during this devastating storm were notably more negative than positive in their evaluation of the performance of their local electric utility, with one exception. That exception are the members of the more than 60 electric cooperatives operating within the Texas Interconnection electrical grid, which, in sharp contrast to the customers of the commercial utilities that provide power to the majority of Texans, gave their local utility a positive evaluation related to its performance during the storm.

In order to study Winter Storm Uri's impact on Texas, the Hobby School of Public Affairs at the University of Houston conducted an online survey during the first half of March of residents 18 and older who live in the 213 counties (91.5% of the state population)

served by the Texas Electrical Grid, which is managed by the Electric Reliability Council of Texas (ERCOT).

Three-quarters of the survey population (75%) live in areas with a deregulated utility market, where a specified transmission and delivery utility by region is responsible for delivering the electricity (purchased from one of a myriad of private companies by the consumer) to homes and businesses. The four main utility providers are Oncor, CenterPoint, American Electric Power (AEP) North, and American Electric Power (AEP) Central.

The other 25% of the survey population live in areas with regulated markets, where a single company is responsible for both delivering the electricity to homes and businesses and serves as the only source from which electricity is purchased. Municipal-owned and operated utilities (e.g., Austin Energy, Bryan Texas Utilities, Burnet Electric Department, Denton Municipal Electric, New Braunfels Utilities, San Antonio's CPS Energy) serve 73% of the regulated market. Electric cooperatives (e.g., Bluebonnet Electric Cooperative, Central Texas Electric Cooperative, Guadalupe Valley Cooperative, Lamb County Electric



Cooperative, Pedernales Electricity Cooperative, Wood County Electric Cooperative) serve one-fifth of this market (21%), with private companies accounting for 6% of the regulated market.

The overall distribution of the survey population by electric utility providers is: Oncor (38%), CenterPoint (21%), municipal-owned utilities (18%), AEP Central & AEP North combined (12%), electric cooperatives (6%), other providers in the deregulated market (4%) and other providers in the regulated market (1%).

There were no noteworthy differences among the 31% of Texans who did not lose power during the winter storm in regard to their evaluations of their local electricity provider or their belief that the power cuts in their locale were carried out in an equitable manner.

However, among the 69% of Texans who lost power, those served by electric cooperatives in the regulated market and those served by private electric utilities in the deregulated market differed notably regarding their evaluation of the performance of their local electric utility, both in regard to their management of the rolling blackouts and to their overall performance during the winter storm. Those Texans who lost power and are served by electric cooperatives in a regulated market had a significantly more positive evaluation of the performance of their local electric utility than did those Texans who lost power and are served by a private company in a deregulated electricity market.

For example, only 24% of Texans served by electric cooperatives had a negative evaluation of their local electric utility's overall performance during the winter storm, compared to 55%, 56% and 61% of those served by AEP, Oncor and CenterPoint respectively. A slightly smaller proportion of Texans served by electric cooperatives (22%) had a negative evaluation of their local electric utility's performance managing the rolling blackouts during the winter storm, compared to 58%, 61% and 71% of Texans served by Oncor, AEP and CenterPoint, respectively.

Texans served by electric cooperatives in regulated markets were more likely to agree that the power cuts in their local area were carried out in an equitable manner compared to Texans served by commercial electricity utilities in deregulated markets. More than

half (52%) of those served by an electric cooperative agreed that power cuts during the winter storm in their area were carried out in an equitable manner, compared to only 26%, 23% and 23% of those served by Oncor, AEP and CenterPoint respectively

The survey data did not allow us to provide a conclusive explanation as to why the performance during the winter storm by electric cooperatives (and to a much lesser extent municipal utilities) in the regulated markets was viewed more favorably by their customers than was the performance of the private companies in the deregulated markets viewed by their customers. Yet here are three, far from exhaustive, possible explanations.

First, electric cooperatives might have performed better (based on objective empirical metrics) during the winter storm, perhaps because they are more committed to their customers, who are effectively their bosses. .

Second, members of electric cooperatives may believe their electric utility prioritizes their interests more than do customers of commercial electric utilities and therefore, even if equal empirical performance were the case, are more likely to rate their electric utility in a positive manner than are customers of commercial utilities.

Third, regulated electric utilities where a single entity is responsible for the commercialization, transmission and distribution of electricity might be better able to respond to the type of challenges presented by the February 2021 winter storm than are deregulated electric utilities where one entity is responsible for commercialization and another is responsible for transmission and distribution.

Other explanations for these findings may exist, which in addition to the three posited above, await future empirical verification via new and more comprehensive studies designed specifically to study electric cooperatives, large commercial utilities, and the incentives that these entities face under the regulatory system governing production, commercialization and distribution of electricity.

Still, opinion about electricity providers during Winter Storm Uri

is clear: Texans served by regulated electricity markets, especially by electric cooperatives, were much more satisfied with their providers' performance than were those in deregulated markets. Throughout its history, Texas has staunchly supported the free market. Could Winter Storm Uri change this propensity, or will attempts to regulate electricity lessen as the memories of the storm's havoc fades? With a hotter summer predicted to be on the horizon in 2021, we may soon get an answer.



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# ***DON'T BLAME THE NERDS: EXPLAINING THE COLONIAL PIPELINE HACK AND WHAT TO DO NEXT***

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Colonial Pipeline's web site – 1:21pm CDT, May 11, 2021

When I was seven years old, I watched my parents struggle to keep two cars gassed up through even-odd plate rationing and long lines at the pump. Since 1979, mighty have been the changes in the U.S. economy, in many ways for the better. With regard to resiliency, however, we have driven into a ditch. While many details remain unknown, the hacking of Colonial Pipeline, likely by a Russian cybercrime gang which calls itself DarkSide, indicates the poor state of cybersecurity in much of the critical infrastructure in the U.S. Like many other companies, from retailer Target to IT firm Solarwinds, Colonial's management was asleep at the wheel on cybersecurity. The company did what companies do, optimize on profitability rather than imagining what could go wrong.

This incident is not unusual and was not perpetrated by super villains. The group that attacked Colonial is made up of reasonably clever hackers who know how to extract funds, paid in crypto currency, in exchange for unlocking proprietary resources encrypted by ransomware. They are Russians, which means that they may moonlight for the intelligence agencies of their Motherland. They have carved out their piece in a criminal enterprise that is likely bigger than the international narcotics trade and growing rapidly. Ransomware attacks launched by groups like DarkSide hit everything from multinational corporations to neighborhood medical practices. Even when paid, there is no guarantee payment will unlock encrypted systems. DarkSide had been looking for bigger companies to hit, ones able to pay more. This is exactly what brought them to Colonial and likely precipitated what could become the biggest non-weather-related gas crisis since the Carter administration.

Why did this happen? First, I believe that Colonial's cybersecurity efforts were subpar for the pipeline industry. One security evaluator asserted, "Colonial pipeline likely did not have the awareness needed to protect themselves." As of Sunday, the chief information officer of the company, Marie Mouchet, stated in her corporate bio that she was, "Building [a] Security and Information Governance Team to address and manage cyber and physical security risks across critical infrastructure of the pipeline ensuring information and data security." Nearly a decade after Saudi Aramco was likely hacked by Iran and after many actors in the oil and gas sector had seen major disruptions and breaches, the

pipeline operator that moves 45% of refined fuels through the East Coast was in the building phase on cybersecurity.

They were getting around to it.

Why was Colonial slow off the mark in getting this done? The reason is simple. Cybersecurity is expensive. It is a cost on the balance sheet and corporate risk managers still view being hacked as “unlikely” or “manageable.” Doing the minimum on cybersecurity was a practical decision for the partners sharing ownership in the company. Leadership was willing to make investments in automating operations, replacing technicians with computing technology. After the infrastructure was automated, the attendant savings were pocketed. Still largely offline, Colonial does not appear able to operate in some form of “manual mode” as the operators of Ukraine’s electricity utilities did after Russian GRU hackers attempted to crash out its power grid in December 2015. Colonial abandoned the idea of manually delivering fuels and providing ticketing for them for an efficient automated solution that touches the computer networks of many suppliers.

Profitability trumped resiliency for Colonial’s owners: Koch Industries, KKR, the Quebec Deposit and Investment Fund (which manages public pensions), Shell Pipeline and Australia’s IFM, a private equity firm. Colonial was built by nine oil companies. Only two are involved in its operation today. The rest are investment firms. To borrow from a colleague in the financial business, those firms excel at three things: financial engineering, cutting costs and producing sales pitch slide decks to offload assets. It produces a steady rate of return on the 4.2 million barrels of refined fuels that flow every day from Houston, Texas, to Linden, New Jersey, and several interconnects in between. On Tuesday, the day industry experts expected a begin of return to normal operations, the company’s website, Ms. Mouchet’s bio along with it, went down, not once but twice. Colonial is yet another example of firms avoiding cybersecurity responsibilities and letting the costs be borne by society.

For all that we have heard about risk assessment in cybersecurity, on critical infrastructure we still are still groping in the dark. The 9/11 attacks gave us some indicators on what we might not want terrorists to blow up, but our nation has failed to address the

security costs of our computing present, while racing headlong into an artificial intelligence future. Since the 1980’s, American business has leveraged computing to automate all sorts of jobs previously done by people. What we are dealing with now is what happens when computer systems fail. Those who think we can continue to remove the human component from the operation of our critical infrastructure are wrong. Efficiency is not all that our society must value. Resilience matters too.



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# ***NEXT STEPS IN TEXAS SURFACE VS MINERAL RIGHTS? THE ANSWER, MY FRIEND, IS BLOWING IN THE WIND***

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Perhaps Bob Dylan would not have predicted this, but Texas generated nearly 22% of its electrical power from wind and solar energy in 2020, per the EIA, and also makes use of other natural resources, such as oil and gas and agriculture. The state allows minerals to be sold and owned separately from the surface. In the context of wind or solar companies contracting for using the surface, mineral and royalty owners of Texas often have their rights overlooked. In short, surface owners may find themselves unexpectedly restricted in their traditional activities.

The typical method of contracting for wind or solar is to enter a contractual lease. Initially, wind energy developers, and later solar farm developers, modified oil and gas leases. While somewhat akin to pounding the square peg into a round hole, modified oil and gas leases served well as a contractual model, but some problems stand to be addressed.

Clearly, wind or solar companies only need access to the surface. Some foundations penetrate a few feet into the ground at most, but there is no need to penetrate deep into the subsoil or beyond. Subsequently, the mineral or royalty owner – or the oil and gas operator – need not be a party to the wind lease contract. Texas law is clear and has been for well over a century: mineral owners, which include oil and gas operators, own the dominant estate. In translation: within certain spacing requirements, a well can be drilled anywhere the operator desires.

Wells can, and do, disrupt the wind currents when a rig is on location. Worse, when located too closely to a wind turbine,

wells can disrupt the turbine's operation. In the case of solar farms, shadows, vibrations and other activity also disrupt the use of carefully placed photovoltaic cells. Additionally, even when drilling has ended, oil and gas operators have access rights — along with the right to lay pipelines and place equipment on the surface. Generally, the surface owner, or the wind or solar company, can do little about this.

Texas has a long history of interpreting the rights of oil and gas operators. Generally, if summed up in a single thought: the operator wins, the surface owner loses. That was true until 1971, when the Texas Supreme Court reviewed the Getty Oil Company v. Jones case where the surface owner tried using an irrigation system but found it blocked by a pump jack. The surface owner sued and the Supreme Court announced a new doctrine: where the cost of accommodating the surface owner's needs is low and does not require the expenditure of large amounts of funds, then the operator must accommodate the surface owner's needs. Here, the Supreme Court required that the operator place its pump in a cellar and use a low-profile pump. Hence was born the accommodation doctrine.

Since then, the doctrine has been modified. The surface owner must have been using the surface before the well was drilled or the lease taken; the cost/benefit analysis must tilt toward low cost/large benefit.

An interesting problem arises when neither wind nor solar companies undertake a comprehensive review of mineral rights ownership and enter into a contract with the surface owner, only to discover that an oil company had leased the minerals from

an owner who may not be the surface owner. Problems can be circumvented by researching the mineral ownership before the lease is proposed, and an accommodation reached with the mineral owner and the oil and gas operator. In the terminology of the business, a title report or opinion detailing the chain of ownership and previous agreements for the property are necessary. More importantly, the contract should be reviewed by someone that understands the relative rights of the parties.

The accommodation reached, typically, designates specific locations for drilling, locations of easements for roads and pipelines and placing equipment, all to prevent disruption to surface operations. Fortunately, today's technology has evolved so that wells can be vertical, intentionally deviated from the vertical or drilled horizontally, all of which may accommodate the needs of all parties. This is a negotiation process, and there is no standard template.

Agricultural users, farmers, ranchers, and possibly recreational users frequently are unaware of what awaits them. The development of surface rights and the rights accorded to wind or solar developers may have an impact on grazing patterns. The placement of easements, solar cells, wind turbines, and related equipment can play havoc with plowing patterns and may permanently disrupt irrigation rights.

To those surface owners that lease their lands for hunting, no comfortable co-existence between hunters and construction crews exist yet, and so responsibility for damages to wind turbines or solar cells is an unexplored area of law. Insurance has not yet stepped into that breach. An increase in bird and bat collisions of the last 25 years has prompted efforts to document environmental impact and minimize risk to both wildlife and wind turbines.

Texas has not developed a body of law involving air rights, so we do not know if a surface owner has the right of winds across the property. Can a next-door neighbor build a silo, barn, or other structure or put in trees that may interfere with the wind or create shadows with no impediments? Do we need an air rights accommodation doctrine? Can the legislature provide an answer? As alternative energy becomes increasingly important, answering

these and other questions become critical for the rational growth of an important industry. It took nearly a century and a half to work out the issues of surface and mineral owner rights, and they still are not clearly delineated. Adding wind and solar to the body of law cannot wait a century.



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# CONSUMERS ATTRIBUTE FAILURE OF THE TEXAS POWER GRID TO FLAW IN TEXAS LAWS

## HOBBY SCHOOL

Hobby School of Public Affairs

Beginning February 13th, Winter Storm Uri brought the state of Texas to a standstill. At its peak, the storm left 4.5 million homes and businesses without power, killed at least 111 people and cost at least \$195 billion. In response, several bills were introduced this legislative session to address problems facing Texas' electric grid and reliable electricity service. But only one – SB3 which passed on May 23rd – seems likely to become law.

To understand Texans' preferences for reliable electricity and future power generation in the state, as well as their willingness to pay for both, the Hobby School of Public Affairs at the University of Houston together with UH Energy conducted an online survey between May 13-25, 2021. The survey is the second conducted in the aftermath of Winter Storm Uri; the first was fielded between March 9-19, 2021. Texas residents aged 18 years and older participated in the most recent survey for a total of 1,500, of whom 68% reported interrupted power service during the winter storm and 30% reported damages to their homes due to the outages.

Three months after the blackouts, Texans remain frustrated and ready to attribute blame to power generators and policymakers. When asked about which factors or entities were responsible for the electricity grid failure during the winter storm, 62% of respondents blamed the lack of weatherization or winterization of power generators. While respondents also attributed blame to severe weather (58%) and the lack of oversight over power-generation plants (51%), ultimately the lack of weatherization or winterization of natural gas industry equipment (50%) figured prominently in their responses.

Less than a quarter of respondents said that Texas' reliance on renewable energy was to blame. In fact, a majority of respondents agreed that solar and wind power – 56% and 53%, respectively – would make a substantial contribution to reliable and secure electricity supply in Texas in the future. While 45% of respondents agreed that onshore conventional natural gas would contribute to secure and reliable electricity in Texas, just over a third of respondents agreed that onshore unconventional natural gas typically produced via hydraulic fracturing (fracking) or onshore natural gas produced without flaring or venting would make substantial contributions.

It is clear that Texans want action. A majority of respondents agreed that current laws and regulations in Texas are insufficient to tackle issues related to electric failures as experienced this past February; only 17% disagreed. Texans were also split in their confidence as to whether the state government would adequately tackle issues related to electric failures, as experienced this past February, whereas a third said they were confident, 40% were not and 28% remained neutral.

A salient concern among Texans is reliable electricity, which means “the ability of a power system to provide service to customers while maintaining the quality and price of electricity at an acceptable level.” Thirty-six percent of respondents said that is it never acceptable for power outages to occur and another 27% said only once a year is acceptable. Further, the vast majority of respondents said that a power outage lasting more than two hours poses a significant problem.

Two-fifths of respondents also said that reliability of electricity

supplies was one of two important factors in deciding which methods of electricity production should be used in Texas in the future. The second most common factor was cost (26%), followed by helping to prevent climate change (20%) and efficiency in production (19%).

However, when it comes to paying for reliable energy supply respondents are unambiguous. Forty-five percent said energy producers should bear the cost to protect the Texas electric grid from effects of severe weather, another 18% want the government to collect extra sales or property taxes and 14% prefer consumers pay extra costs in their electricity bills. When asked if they were willing to pay an extra cost per month to keep power outages to 4=four hours or less, few respondents (11%) approved and 20% were uncertain.

Despite their frustrations, Texans are aware of the cost to mitigate the impact of severe weather events on the reliable supply of electricity. Although frustrated with regulators and electricity companies, Texans seem to understand that the cost of reliable electricity supply would eventually fall on them. Moreover, when offered a menu of policy options and power outages Texans entertained the possibility of paying a few extra cents per kilowatt hour of electricity consumed.

The survey provides important lessons for the future of the electricity system in Texas: recurring severe weather events will continue to pose threats to the reliable supply of energy, creating disruptions and human and material losses. Addressing these problems is costly and will require regulatory changes and massive investments. Consumers value access to cheap electricity but are ready to blame producers and policymakers for systematic failures in the supply of electricity.

In the short-run, consumers would prefer producers pay the bill for reliable electricity, but in the long-run the cost of needed investments must be recovered. Smart public policy solutions should aim at aligning the incentives of all actors involved by encouraging electricity producers and distributors to prepare the grid to withstand the impact of severe weather, incentivizing the development and adoption of new technologies to mitigate climate change and reducing the costs to a tolerable level for consumers.





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# AT STAKE IN MEXICAN MID-TERM ELECTIONS IS FOREIGN ENERGY INVESTMENT

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In less than two weeks, Mexico will hold its mid-term elections.

While on paper voters will select their new representatives in Congress, this will also gauge support of the current administration's efforts to reassert control over energy, especially the oil sector.

President Andres Manuel Lopez Obrador, both populist and left-leaning in practice, made clear early on that a central goal of his and that of his Morena party is to reassert state control over the oil and gas and power sectors. His justification is that Mexico needs to be energy self-sufficient for reliability and economic success.

"The President's aim is to turn Pemex into a national entity in charge of supplying Mexico's domestic needs," said Derek Woodhouse, an energy partner at global law firm CMS, who started his career at the Mexican Energy Ministry. "Instead of having Pemex as a way of getting income for the country, as it did in the past, his vision is for Pemex to stop losing money and self-produce for Mexican consumption."

It's a sharp reversal of the 2013 opening of Mexico's energy sector by the previous Pena Nieto administration.

The Energy Reform, as it is known in Mexico, changed the country's constitution to remove barriers to international investment in every area of the sector, from oil to natural gas pipelines to gas station chains. The changes led to several offshore and onshore bidding rounds, and billions of dollars of

investment commitments.

This constitutional change allowed international and integrated and non-integrated energy companies, among them ExxonMobil, BP, Royal Dutch Shell to invest billions of dollars into Mexico. The desire to invest in Mexico by energy majors and minors was always there, but constitutional restrictions kept outside investors out of the playing field.

By contrast, over the last three years Lopez Obrador has focused on national pride and a long-standing suspicion of a global economy to argue that investment in the country's energy sector is a problem, rather than an opportunity for Mexico.

"For him, this is all part of the fourth revolution of the transformation of Mexico's institutions to eliminate, to reduce what he calls the mafia of power, the institutional economic political establishment and to empower poorer sectors of society," said Vanda Felbab-Brown, a senior fellow at the Brookings Institution, in a May 24 webinar on the Mexican elections.

His plan included building a new \$14 billion refinery to reduce gasoline imports and increasing Pemex's domestic production rates.

Yet his message overlooks reasons for falling rates of oil production in Mexico – that is, Pemex's struggling financial state, which creates a roadblock for further production investment. It also sidesteps Mexico's need for competitive power rates to

support industry and the economy.

In the 2018 election, his populist message resonated with a public frustrated with corruption and low economic growth. Subsequently, Lopez Obrador and his party were elected with an unprecedented majority.

“This is something that the President has been very shrewd about making a political issue – this idea that ‘they lied to you,’” said Lourdes Melgar, the former undersecretary for oil and gas in the Energy Ministry in the Pena Nieto administration. “He keeps telling the public that ‘the only ones who benefitted are these corrupt companies, you have not seen any benefit from it’. Most people don’t see what the benefits from the reform are.”

Now it’s time to see how much support he can get, and if it will be enough to re-steer Mexico back to a state-controlled energy sector – and if so, how permanent he could make this change. For this goal, changing the constitution would be key.

On June 6, Mexico will hold a national election for its entire House of Deputies (the lower chamber of Congress) and 15 of its 32 state governorships. The election will determine whether Lopez Obrador and his Morena party will be able to retain an absolute majority in the House.

An absolute majority is important when thinking about oil and gas in Mexico because in order to change the Constitution, a two-thirds (or absolute authority in the Mexican system) vote of support is required. Yet both the Senate and the House would have to give this support for Lopez Obrador to change the Mexican constitution, and these changes would in turn need to be supported by a majority of state houses.

The June 2021 election will not be the door that makes this possible, as no seats in the Mexican Senate are up for election – and gaining some Senate seats is still required to push through a constitutional law change.

Still, the scenario is fostering apprehension in the international energy community. This stands as a test of how much domestic political support Lopez Obrador has obtained on his quest to

reassert more and more control.

His strategy so far has been to push for legislation that can be passed in Congress, combined with reasserting state-owned Pemex and CFE, Mexico’s main power company, where possible. He has pushed hard to install regulators supportive of his changes, and those committed to the current energy reform laws and to competition in the market said they felt pressured to leave.

In 2020, his Energy Ministry began creating regulations that gave priority to CFE for power dispatch, which flies in the face of the competitive market established in 2013. Companies immediately complained, saying it undermined the ability of private renewable power companies to compete.

They turned to the courts in response, calling for – and receiving – temporary injunctions that make these laws invalid until a final court decision is made, which in Mexico can take years.

Texas’ winter storm and power outage, left Mexico cut off from its natural gas supply from Texas for several days. Lopez Obrador successfully used the crisis to push through laws that prioritize state-owned natural gas, fuel oil and diesel generation. This effectively robbed private sector renewable energy companies of the clients and income they could have competitively earned. In April of this year, he went further, pushing through a law that allows pulling permits for those already invested in oil and gas in Mexico. The justification given was national security concerns.

“We are suffering from a perverse energy reform, which was approved for looting, for theft, for the benefit of a minority at the expense of the suffering of Mexicans who must now pay more for energy,” Lopez Obrador said in a March 22 press conference, explaining the need for the change. “We have to repair the damage in whatever way possible.”

These law changes were blocked successfully for now by a temporary injunction.

The question for Mexico – and for energy investors – is whether Lopez Obrador’s administration will challenge these injunctions

that have frozen his proposed changes, potentially kicking this to the Supreme Court, which would render a decision final and could not be further challenged by companies.

A wide debate within Mexico as to whether Lopez Obrador's end game is actually changing the constitution, or simply asserting power over Mexico's energy production to gain further political control has surfaced. Again, upcoming elections gauge how his moves play with the public to date.

Should he be looking for a constitution change, the next question is whether Mexico's Supreme Court will take up the cases and possibly overturn laws created in the spirit of the 2013 energy reform legislation. A critical seat will be open on the court in November, and some observers believe that Lopez Obrador will have the opportunity to turn the court to one favorable to him with his next appointment.

All of this leaves the spirit of those dramatic law changes designed to encourage foreign investment, and its technology and investment potential, in a precarious situation.

"The energy reform is not dead, but it is heavily damaged," said Miriam Grunstein, an energy lawyer in Mexico City who has provided legal counsel to Mexico's Senate and to Pemex.

In practice, energy companies can still carry out much of their day-to-day business in Mexico, but simultaneously must invest in expensive legal battles to stave off these new laws.

Even if constitutional laws created by the 2013 energy reform remain after Lopez Obrador leaves office in 2024, energy investors are not likely to forget this chapter.

"When the sector first opened and we were talking to companies about investment in Mexico, one of the key elements was that they were looking for legal certainty, for the right laws and the right regulators and the right contracts," Melgar said. "They really needed the security of the long-term certainty – and this is something that the government has really undermined."



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# *IS BIDEN TRYING TO SELL NORD STREAM 2 APPROVAL AS A GREEN ENERGY INITIATIVE?*

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Western powers often characterize Russia as a rogue state with nuclear weapons and a military disproportionate to its frail economy. Russia is the largest supplier of raw materials to the world economy. Its president, Vladimir Putin, does not let a trouble-making opportunity go to waste.

The new Biden administration has the responsibility of dealing with Russia that has forcibly changed Europe's boundaries (Crimea), initiated a "separatist" war in East Ukraine, quasi-annexed parts of Georgia, shot down a passenger plane (MH17), intervened in Syria on behalf of Bashar Assad, interfered with foreign elections, assassinated regime opponents at home and abroad, kidnapped sailors in international waters and denied freedom of navigation on the Black and Azov Seas.

But Ukraine remains at the heart of Washington's Putin Problem.

After Ukraine unseated its pro-Russian president in 2014 to pursue a policy of integration into the West, Putin has sought to unravel a democratic Ukraine through his proxy war in "separatist" Donetsk (DNR) and Luhansk (LNR) "peoples' republics," both governed by Moscow viceroys. The Kremlin's propaganda campaign claims that Ukraine never has and never will be a nation, that it is run by crooks, neo-Nazis, and extremists who victimize Russian speakers.

In a word, the Kremlin hopes to convince the West that Ukraine is not worthy of support. Putin is now directing this message at President Joe Biden and his inner circle, perhaps with some

success.

The West has had almost a decade to learn how to deal with Russia. Its preferred instrument has been sanctions to punish Russia for specific criminal acts, such as the shooting down of MH17 in July of 2014 or the poisoning and imprisonment on sham charges of Putin opponent Aleksei Navalny. The Trump administration, joined by the European Union, also levied stiff sanctions on companies associated with the new undersea pipeline (Nord Stream 2) from Russia to Germany. Nord Stream 2 would replace the Ukrainian pipeline network that has transported Russian gas to Europe through Central Europe for decades.

The West imposes sanctions on Russia as an incentive to improve behavior. If Russia were to, for example, admit guilt for shooting down MH17 and compensate relatives or release Navalny, the associated sanctions would be lifted.

So far, this strategy has not worked.

The Western world had every reason to expect that the new Biden administration would impose tough new sanctions on Nord Stream 2. After all, Biden publicly declared Nord Stream 2 "a bad deal for Europe" after declaring that Putin is a "killer." Moreover, Biden let it be known that new sanctions for the Navalny affair were in the works.

To nearly everyone's surprise the Biden administration

announced on May 19 that it was waiving Nord Stream 2 sanctions, despite the fact that a strong bipartisan Senate majority supports new sanctions.

Biden's stated rationale for clearing the way for the completion of Nord Stream 2: Trump, as President, damaged Washington-Berlin relations by criticizing Germany harshly for not meeting its commitments to NATO. Hence, the US should repair relations with their most important ally by supporting Angela Merkel through the Nord Stream 2 deal before she leaves office in September. Already gas production in European Union is declining, with Germany alone expected to increase consumption of natural gas by 20 Bcm by 2034 to 110 Bcm. The Nord Stream 2 pipeline under the Baltic would effectively bring more supply from reserves in Russia to Germany as well as to other countries in the EU. German officials project the pipeline to lower gas prices by 13% and allow Germany to decommission all nuclear power plants and coal plants by 2038 – as called for by Germany's Energiewende.

By contrast, much of the EU, despite the opportunity to reap economic and environmental benefits of the Nord Stream 2 gas pipeline fear it as an instrument of Russian domination. As well, following Merkel's departure in September, elections may usher in a change in Germany's position on Nord Stream 2.

Without a doubt the big winner from Biden's decision is Moscow. The big loser is Ukraine and the Kyiv-Washington relationship.

Vladimir Socor of the Jamestown Foundation regrets the loss of western credibility in Ukraine, and a perceived "downgrading of Ukraine on the scale of Western policy priorities" taken in deference to Russia, in particular the exemption of Nord Stream 2.

Ukraine understands that timing was not a coincidence. The waiver announcement was made on the day of the Blinken-Lavrov meeting to prepare for the Biden-Putin summit scheduled for June 19 in Geneva. Nord Stream 2, Ukraine believes, is Biden's gift to Putin to entice him to the Geneva summit.

Ukraine reacted in a burst of diplomatic fury to what it perceived

as the Biden betrayal. Washington did not even extend the courtesy of advance notice of the upcoming Nord Stream 2 waiver. Ukraine President Volodymyr Zelenskiy characterized the lifting of sanctions on Nord Stream 2 as a "defeat of the United States, a personal defeat of President Biden in terms of standing up to Russia [...] a major Russian geopolitical victory, and a redistribution of power and influence [in Europe]." Zelenskiy went on to declare to be "personally worried about possible tradeoffs" at the Biden-Putin summit adversely affecting Ukraine.

The former Ukrainian foreign minister, Pavlo Klimkin, declaring that the US decision came as "a blow to the gut" to Ukraine and that "any signs of a crisis of confidence between Ukraine and the United States would be the worst thing that could happen at this time."

The backlash to President Biden's Nord Stream 2 decision required the White House Press Secretary, Jen Psaki, to declare that Washington "doesn't regard the meeting with the Russian President as a reward; we regard it as a vital part of defending America's interests." That the White House had to deny on record that Nord Stream 2 was a "bribe" to lure Putin to a summit is telling commentary.

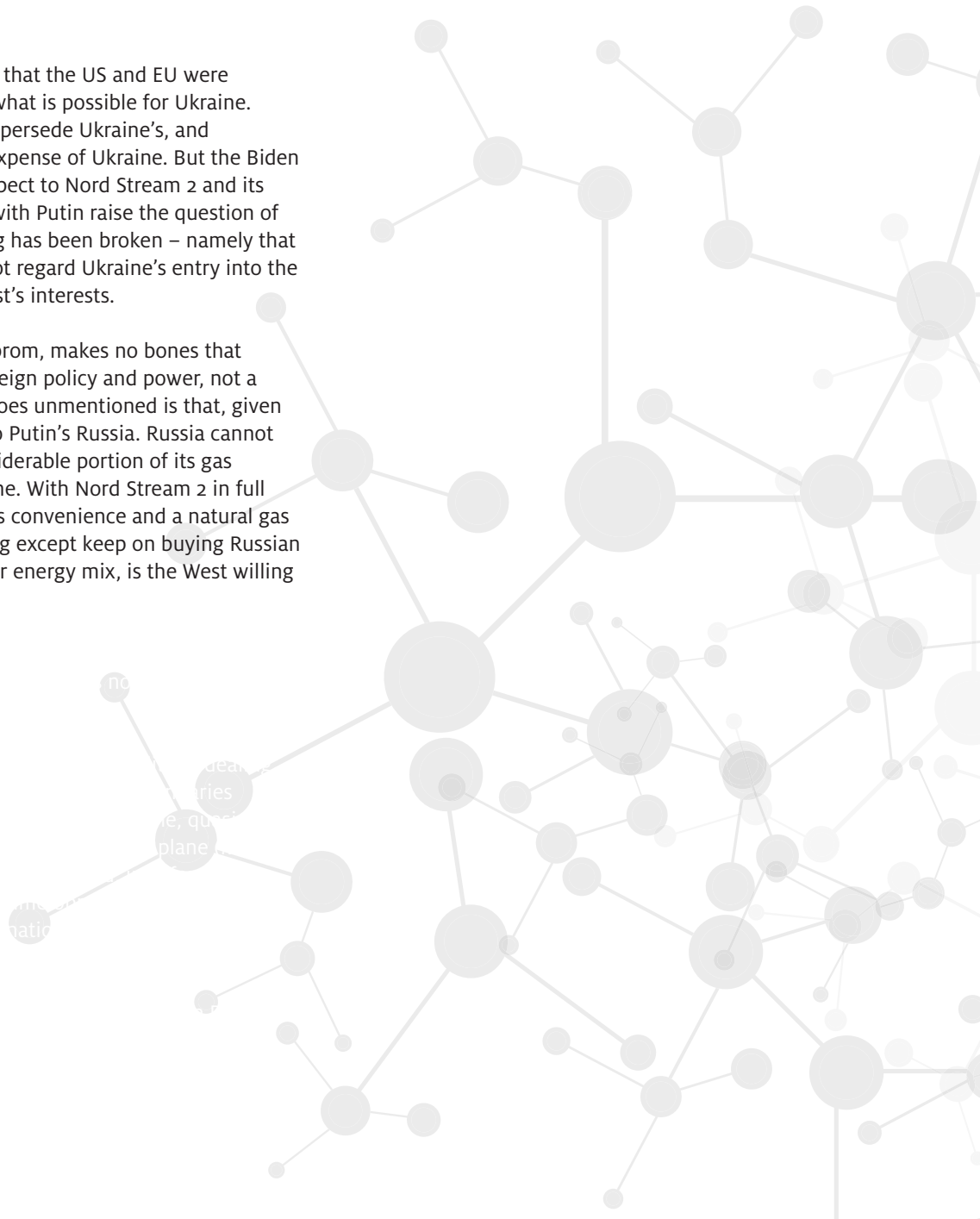
Moreover, two fellows of the influential Council on Foreign Relations published in The Hill a "Green" apologia for Biden's actions on May 20. The story, entitled "How to Turn Nord Stream 2 Into a Win for Ukraine," contends that Ukraine's loss of the gas transit business is a blessing in disguise. It frees the Ukrainian budget from reliance on carbon energy, and it allows Ukraine to focus on green energy. After all, in the long run, the world will be carbon free, so Ukraine can be at the forefront of the green energy revolution. As to Europe, the authors contend that Nord Stream 2 just replaces the capacity of the Ukrainian pipeline system. Overall gas volumes will be unaffected, so the gas price will be unaffected. Not to worry, Nord Stream 2 will have to obey German competition rules.

However, control of gas pipelines bestows considerable power over price and quantity. Given the substantial clout of the Russian lobby and its cyber warfare capacity to take out rivals, the Gazprom supplied Nord Stream 2 will not be a paragon of the

competitive model.

The rules of the game have been that the US and EU were on Ukraine's side and would do what is possible for Ukraine. Germany's interests appear to supersede Ukraine's, and incidentally favor Russia at the expense of Ukraine. But the Biden administration's actions with respect to Nord Stream 2 and its rush into a one-on-one summit with Putin raise the question of whether this basic understanding has been broken – namely that the Biden administration does not regard Ukraine's entry into the Western world as vital to the West's interests.

Russia's state gas company, Gazprom, makes no bones that it is an instrument of Russian foreign policy and power, not a commercial undertaking. What goes unmentioned is that, given the importance of gas revenue to Putin's Russia. Russia cannot invade Ukraine so long as a considerable portion of its gas pipeline traverses through Ukraine. With Nord Stream 2 in full operation, Putin can invade at his convenience and a natural gas dependent Europe will do nothing except keep on buying Russian gas. If this is the cost of a greener energy mix, is the West willing to pay it?



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# *EV BATTERY RESEARCH POWERS AHEAD TOWARD NEXT BIG BREAKTHROUGH*

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Any serious discussion of the future of electric cars ends up with a review of where battery technology, specifically battery range and recharge speeds, will be in the coming years.

Well, it's complicated – much more complicated than the science that led to semiconductor improvements, which is what made our current computer and smart phones possible.

It's also a good example of technology problems that need to be solved to move towards the carbon-free future described everywhere from the Department of Energy to Greenpeace to ExxonMobil.

A big leap is needed to increase the distances these batteries can power cars. To do so, battery technology researchers are focusing on immediate improvements, with an eye on a longer-term move to solid state batteries, which would replace the liquid part of a battery.

It's what happens in this now-liquid part of the battery, the electrolyte, that makes this swap so incredibly complicated.

To see why, it is helpful to review how a battery works: to charge it, electricity flows from its negative electrode, called an anode, to its positive electrode, the cathode. The material that makes this flow possible is the electrolyte. In the use of a battery, the flow goes back from the anode to the cathode.

In the lithium-ion batteries now used in electric vehicles, or EVs, this back-and-forth flow between the anode and cathode is made by positively charged lithium ions. These batteries typically have

graphite or silicon anodes, lithium metal oxide cathodes and a liquid electrolyte.

One challenge of lithium-ion batteries is that a relatively low amount of energy can be stored. In concrete terms, this has limited how far EV cars can drive before they need to be recharged.

The obvious solution is to increase the energy density of the battery. An immediate option for doing so is to make the anode itself from lithium. It's attractive because of lithium's energy density and low weight, both of which would give EVs additional range.

But there are several challenges in working with lithium as an anode material. Its repeated expansion and shrinkage of the anode volume during the charging and discharging process causes it to shed some lithium ions. This build-up, known as lithium dendrite, can short-circuit the battery and shorten its life.

"Lithium plating does not like to behave in a uniform way – that means it is easy to short-circuit," said Yan Yao, a professor of engineering specializing in battery technology at the University of Houston.

Another way to solve these problems with lithium is to jump ahead to a solid-state lithium battery. Solid-state lithium batteries use a solid electrolyte, which removes the problem of the liquid electrolyte. It also makes them smaller.

Researchers like Yao say that recent developments in solid-state

battery research has been encouraging – exciting, even – but there are still fundamental knowledge gaps that stand between these batteries’ potential and their entrance into a future market. These gaps are not small; they involve the science behind the materials and processing of them, as well as design engineering.

One fundamental challenge is finding a suitable material from which to make the electrolyte. Solid electrolytes conduct lithium ions at room temperature and can potentially replace the liquid electrolytes currently used.

Yet possible solutions, like the sulfide-based solid electrolytes that specialty materials company NEI favors, create other problems.

“Every known solid electrolyte has one or more drawbacks that must be overcome to enable the development of viable solid-state batteries for EVs,” wrote a group of battery researchers in the ACS Energy Letter, following a May 2020 workshop on solid-state batteries held by the Oak Ridge National Laboratory.

At this point, solid-state lithium batteries being proposed also use the lithium anode, yet relatively little research in how the lithium anode would perform with a solid electrolyte has been conducted. Alternative materials that are more widely available – making it cheaper - for the cathode are also being studied.

And then there is the tremendous challenge of being able to economically manufacture solid-state batteries at scale.

Making the high-quality thin film required for the solid electrolyte is proving to be a devilish task. Many battery labs are using much thicker solid-state separators in laboratory experiments, but it will be critical to produce much thinner ones (much less than the width of a human hair) in commercial production, and to do so consistently and flawlessly, before these batteries can be scaled for commercial use.

Yao, who leads the research on how to improve quality control for these batteries, said that “a small pinhole in the separator could allow the lithium anode to penetrate the separator and lead to a battery failure.”

The challenges in manufacturing these batteries on a commercial scale is formidable. It means huge investments as well, given the significant – and expensive - changes to the manufacturing process that would be required.

This makes it huge news that a company like QuantumScape, an ambitious Silicon Valley start-up (with investors like Bill Gates and Volkswagen), says that it aims to offer solid-state batteries for commercial use by 2024.

Solid Power, a company recently invested in by BMW and Ford, has also announced that it can manufacture all solid-state batteries using existing lithium-ion battery manufacturing infrastructure. It is talking about beginning pilot production of EV batteries in early 2022. But it has not yet announced commercial production – which is the huge advancement that companies are vying for. Furthermore, the company is vague on its technical details and how it has solved the challenges facing manufacturers.

Others are even more modest in their timeline: Toyota is talking about using its first solid-state battery for an EV by 2030, and other car manufacturers globally are following rapidly, creating partnerships with battery manufacturers around the world.

One of the big challenges for the U.S. is that it only started to seriously produce EV batteries recently, nearly a decade after Asia. As a result, a robust U.S. supply chain for building battery technology simply does not exist.

Demand for technical talents in the industry is starting to emerge and is clearly a reflection of the growing EV industry and the importance of battery technology to lead the transformation. As Yao notes, “this is the first year that graduate students could easily find jobs in battery industry.”

And yet if our country is going to get serious about soaring aspirations of being carbon-free in the coming decades, the complex challenges of vehicle electrification require rapid charging of batteries, enhancing battery range, developing equitable charging infrastructure and addressing battery end-of-life options are crucial next steps.



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# FORD'S NEW ELECTRIC PICKUP COULD SPARK CHANGING ATTITUDE IN OIL INDUSTRY

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The Houston Auto Show perhaps seemed an odd place for Ford Motor Co. to unveil its all-electric Ford F-150 pickup last month. On the one hand, a lot of Texans drive pickups. On the other, many of those pickup-driving Texans work in the oil business and view electric vehicles as an existential threat to their jobs.

But perceptions are changing rapidly, and Ford seems intent to use the electric F-150, dubbed "Lightning," to bring a whole new type of customer to the EV market, even in the oil business.

The F-150 is Ford's best-selling vehicle, and the automaker clearly hopes the pickup's popularity will lure customers who snicker at the bubble-like sedans from Elon Musk. The Lightning looks like a truck, and it has all the hauling power of a traditional F-150. It also has an optional onboard generator that can power a typical home for several days, which could come in particularly handy in Texas where we struggle to keep the lights on.

Both the auto and energy industries are in early stages of a transformational shift toward more dependence on electricity generated by renewables and natural gas-power plants and away from traditional fossil fuels like oil and coal.

Mike Ramsey, an analyst who follows the EV market for Gartner, an independent research firm, points out that Ford learned a decade ago, when it switched to aluminum body panels on the F-150, that these sorts of largescale shifts are not a time to be timid.

"That was probably an even bigger deal than electrifying their F-150," he said. "It was a huge decision, and incredibly risky. And

they took the risks with their biggest, most important product. Ford learned the lesson that sometimes if you're going to make a transformational change, it's better to do it with your biggest bet rather than with some experiment. By doing it with the F-150, there's no backing out."

At face value, the Lightning stands as an attempt to vault ahead in the race for EVs. Ford previously fell behind Musk's Tesla and even General Motors, which pledged an all-electric fleet by 2035. GM has focused on the smaller Bolt, electric vans and an all-electric Hummer, a 9,000 pound behemoth that may cost more than \$100,000 and targets not just the eco-conscious but also the "ego-conscious," Ramsey said.

Overall, automakers are pumping some \$200 billion into the EV transition — more than NASA spent to put a man on the moon, according to estimates from the consulting firm KPMG. But not all automakers will be able to navigate the transition. One or two may miss the mark badly enough that they go under in the next decade, a recent KPMG study found.

Ford said it received 100,000 pre-orders for the Lightning in the three weeks after the rollout, compared with about 750,000 F-series trucks it sells annually. Clearly, it's still counting on traditional pickups for most of its truck sales, but the Lightning's share could continue grow rapidly, especially as more companies look to reduce their carbon footprints.

Which is why, at least initially, Ford may not be targeting its traditional truck-buying consumer. Instead, it has its eye on corporate customers — including oil companies — looking to



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# JOHN HOFMEISTER: A VISIONARY WHO CALLED FOR A MORE INCLUSIVE, LESS INSULAR ENERGY INDUSTRY

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I was talking with John Hofmeister in late January about the fledgling Biden administration's decision to rejoin the Paris Climate Accord, which Hofmeister applauded as a powerful symbol that put 194 nations on the path toward a shared goal.

OK, I said, but let's be honest. That powerful symbol could cost a lot of jobs in the oil business. Is it worth it?

"If the alternative is extinction, yeah," he said, before launching into a five-minute discourse of the history of pollution. Pre-COVID, we had seven and a half billion people on the planet burning 100 million barrels of oil a day, he added, and that would likely rise to 9 billion people burning as much as 125 million barrels per day of oil by 2040. "And then you say, my God, that's not counting coal," he said. "How does the Earth catch its breath?"

Hofmeister used to run U.S. operations for Royal Dutch/Shell, one of the world's largest producers of fossil fuels. But he wasn't a typical oil executive, and his unconventional views often rankled those inside the industry as much as those outside it. His book, *Why We Hate the Oil Companies*, published in 2010, began with the line: "Americans have long had a love-hate relationship with the oil industry, myself included."

Hofmeister died in late May after a short illness. He was 73.

During and after his time at Shell, Hofmeister was an outspoken leader in Houston's energy and business

communities. He served on the United States Energy Security Council, a bipartisan group that includes several former Cabinet members, as well as other advisory boards including UH's Energy Advisory Board, and he chaired the National Urban League.

A former human resources director, he was brought in as CEO of Shell Oil in 2005 to clean up an accounting scandal. Inside Shell, grumblings surfaced that he wasn't a real oil guy.

But Hofmeister understood, before many of his counterparts, that the energy business was changing, and oil companies needed to become more diverse and less insular.

The first time I met him in 2006, he told me that the debate over climate change was irrelevant. "Most of the world's policy makers believe it's real," he said. "And they're making policies based on that belief." The industry, he argued, could either get on board with those programs or get run over by them.

More oil company CEOs talk that way now, but 15 years ago, Hofmeister was one of the few.

He was also a pragmatist who believed that energy should be reliable and abundant — and affordable. "Green" shouldn't be an excuse for higher cost. Too many environmentalists lacked an understanding of energy economics, he felt. After he left Shell, he formed a nonprofit — Citizen for Affordable Energy, to further promote public understanding and practical solutions for energy issues. He wanted people to understand where energy came from, what it cost, how difficult it was to fuel a planet and the

tradeoffs inevitably made.

Most of his rancor was reserved for politicians, whom he believed fanned misunderstanding about energy and nurtured the divide between energy producers and consumers.

“We now have the view that some energy is good energy and some energy is bad energy,” he told the Washington Post in 2010. “Energy is energy. The creation of energy causes harm. It has implications, no matter what type of energy it is. If it’s wind or solar, it has consequences or implications. We shouldn’t be looking at this ideologically through Democratic or Republican eyes.”

He favored a realistic understanding of energy options, and he tried to cut through industry myths every chance he got. During an appearance on CNBC shortly before he retired from Shell, he declared, correctly, that oil isn’t a free market. When the show went to a commercial break, an assistant handed him a note. It was from someone at Shell’s parent company in The Hague telling him he could not say that on national TV. He crumbled the note up, tossed it aside, went back on the air and made the statement again.

“The myth of the free market still resonates as if it’s a reality,” he told me later. But oil markets, he argued, are regulated at every step from the well to the gas pump. Global prices are controlled by a cartel of producing nations that attempt to collude by setting production quotas.

At the same time, he frequently cautioned about the seduction of “green dreams.” When the Obama administration’s 2010 budget proposed cutting subsidies and tax credits for oil and gas production to push renewables, he warned the move would cut funding for what we knew worked and plow it into what did not. Wind and solar simply were not affordable and eliminating oil subsidies back then would leave many small producers destitute, driving up consumer prices at the pump. “They’re chasing votes on the back of clean and green,” he told me.

Hofmeister disliked the term “clean energy” because he thought it was politically divisive. Sustainable energy, he argued, was

more accurate.

As part of his efforts to expand public understanding of energy, he sought to open a dialog between the industry and the community, especially those parts of the community that oil companies rarely spoke with directly.

I first met Hofmeister in 2006 on one such meeting — a trip to Philadelphia. He was touring the U.S. to talk with various public groups about energy. One of Shell’s public relations folks asked me if I’d like to tag along on one, so I picked Philadelphia because I wanted to see how Hofmeister’s message was perceived in a non-oil town.

His sessions were candid and sincere. He listened to complaints and tried to explain the complexity of energy markets and supply. He did this in city after city, happy to endure the barbs of criticism in hopes of increasing understanding.

But he was never an apologist for Big Oil, and he firmly believed that technology was the greatest tool we had to meet the energy demands of the future.

In our January conversation, he told me the shift to electric cars was not just about reducing consumption of fossil fuels, it was part of a centuries-long drive for greater energy efficiency. Sure, gasoline as a fuel, is efficient, but about 80% of its energy is lost to heat, he argued. “Only 20% of what you’re paying gives you the go,” he said. Electric motors, by comparison, are 75% or more efficient—three times more so than an internal combustion engine.

“The science behind energy has always been changing,” he said. “It’s always evolving. The shift to electrification is simply embracing technological change for the better.”

I enjoyed every conversation with Hofmeister. He had a unique way of looking at the world, and his insights came with a candor and a pragmatism that will be sorely missed.

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# ***GREENING AIR TRAVEL THROUGH SUSTAINABLE FUELS WILL BE A TOUGH CLIMB***

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As concerns about Covid-19 slowly fade, the skies are becoming friendlier again, with domestic flight traffic creeping up toward pre-pandemic levels.

But it's not there yet.

By March 2021, passenger traffic increased by 30% from last month, and airlines say it may take a couple of years to fully recover, as remote workplaces continue to disrupt business travel and more folks travel locally.

Yet the full recovery of the airline industry is still within sight. Still, airlines must plan to meet their target goals of net zero carbon emissions by 2050.

Until recently, the industry mostly relied on increases in fuel efficiency for carbon reduction improvements.

Fuel is a large operational cost for airlines, and so economics play a powerful motivational role in optimizing fuel, even without the carbon implications.

Yet there are limits to what fuel efficiency can achieve in reducing the carbon emissions, given that jet fuel is typically made of fossil fuels.

Both domestically and internationally, politicians and customers alike are asking airlines to further reduce their carbon footprint. This comes from a growing awareness of the need for carbon reductions and = the aviation sector's outsized carbon footprint.

Air travel comprises 2% of carbon emissions worldwide – a seemingly small number, but one that could grow rapidly without changes in the industry. Domestic flights are responsible for 9% of carbon emissions in domestic travel, making it one of the dirtiest forms of transportation.

Worse, most aviation emissions are in the upper atmosphere, so the impact is on climate change is greater.

To achieve net zero carbon emissions, the industry has started to adopt non-carbon emitting fuels – known as sustainable alternative fuels.

Sustainable alternative fuel can be made from a surprisingly wide range of materials. Crops and tree residues like switchgrass or wood waste can be processed through gasification, for example, with that gas then converted to synthetic liquid fuels, according to a U.S. Government Accountability Office report. Vegetable oils, animal fats and even algae oils have shown potential, as has separated municipal solid waste.

The challenge is getting enough of the fuel for an industry that in 2019 consumed 12 billion gallons of jet fuel for U.S. travel. Worldwide, U.S. jet setters burned through more than 18 billion gallons of jet fuel, about 20% of total global consumption.

At these consumption rates, sustainable fuels could eventually meet about 80% of the global carbon reduction target, according to the International Air Transport Association. It currently is targeting a carbon emissions reduction by 50 percent relative to

2005 levels by 2050.

It's a strategy that U.S. airlines have shown a growing interest in as they make their own carbon neutral commitments.

As part of this, an industry group that represents most U.S. domestic carriers, Airlines for America, has been working to supply these sustainable fuels since 2006. They partner with the U.S. Federal Aviation Administration to develop industry standards for the fuel.

Airlines for America set a target of 2 billion gallons of sustainable fuel by 2030. It's a steep upward climb from 2020 production levels at 4.5 million gallons.

A unique challenge is meeting rigorous safety criteria – much stricter than what ethanol or biodiesel fuel faced in their development and deployment. The reason lies in the extreme range of conditions under which airplane engines are required to operate.

“At ground level you are going to have a certain heat, you are going to go up in the air, you are going to be at 36,000 feet and it's going to be pretty darn cold up there,” said Nancy Young, the vice president for Environmental Affairs at Airlines for America. “And at the same time, there has to be energy density to fuel the aircraft in the same way that petroleum-based fuel does.”

One decision made on alternative jet fuel standards is the need to be usable on existing jet engine technology. The alternative would have been to try to persuade the airlines to invest billions of dollars in rebuilding its technology to adapt to new fuel standards – a tough ask for the cost-conscious aviation industry.

As a result, standards were established to ensure = the sustainable fuel would act as a parallel fuel, known in the industry as a drop-in fuel, which operates on a chemical level as a functional equivalent to jet fuel.

A big advantage of using sustainable drop-in fuels is that they can be integrated into the already existing airport and fueling infrastructure.

“Our plan is to drive alternative fuel producers to produce sustainable fuel that will work with the system that we have,” Young said. “At the same time, we work with the aircraft manufacturers, the researchers with NASA and others and a research portfolio that will advance opportunities for electric and hybrid electric aircraft and future non drop-in fuel sources, like hydrogen.”

Relatively high costs for the fuels = need to come down, airlines say, in order to make them more feasible. Sustainable fuels on average cost about three to five times more than petroleum-based jet fuel.

Increasing = alternative fuel producers is another challenge – many likely candidates are already producing renewable fuels for automobiles but may not be equipped to make drop-in alternative jet fuel.

“Ground-based alternative fuel has a tremendous incumbency,” Young said. “If you're a fuel producer, you're already doing those other types. It takes you an investment to then do sustainable aviation fuel. And you care about what the federal and state incentives are that might help support that process.”

One idea for jump-starting production increases is a tax credit of \$1.50 per gallon for alternative fuel producers, an idea that President Biden has included in his recently released budget proposal. It's an increase from the \$1.00 offered in previous tax legislation and is similar to tax boosts once given to the wind, solar and biodiesel sectors in order to encourage further investment.

“The aviation industry is saying we are in the early days of sustainable aviation fuel production – we have not yet been able to do the optimization on the supply chains and the production process itself,” said Steve Csonka, executive director of the Commercial Aviation Alternative Fuels Association. “We hope to come down the learning curve, but assistance with financing of some kind is needed to allow that to occur.”

The Biden proposal would make the credit available from 2022 to

2027 and would only apply to alternative fuels that can achieve at least a 50% reduction in emissions.

Yet while a presidential acknowledgement is a big step forward, much remains to ensure that these sustainable fuels – which are currently at less than .01% of global aviation fuel supply - can actually fuel an entire industry.

Sourcing feedstocks on a commercial scale need to be identified and established, facilities built and financed. Supply chain planning for feedstock is no small issue, especially if it involves growing crops, which means both intensive land and water resources. It will be a challenge to scale up while still ensuring the aviation fuel industry does not attempt to take over already committed water sources or land used to grow food.

Daunting? Yes. Impossible – no, based on how both ethanol and biodiesel production blossomed under similar tax credit benefits to meet a changing demand.

Sustainable aviation fuels is at a crossroads, and a healthy leg-up could be just the boost it needs to ramp up and provide an important environmental benefit for all of us at a much-needed time.



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# ***TEXAS GRID FAILURES HAVE REPERCUSSIONS FAR BEYOND THE LONE STAR STATE***

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As a child living in the Mediterranean island nation of Cyprus in the early 1970's, I had a nightly routine. After dinner, I would get ready for bed and then climb onto the sofa next to my father. Inevitably, the lights would go out, and as we sat in the dark he would tell me stories about the history of the region before putting me to bed.

The country didn't have enough generating capacity to maintain its grid, so it operated what we would now call rolling blackouts. It was a good preparation for my life as an adult in 21st century Texas.

The consequences of Texas' inability to manage its energy network has implications far beyond the Lone Star State. It creates a vulnerability to the nation's food and energy supplies, not to mention to the lives and livelihoods of millions of Texans.

Much has been written about the impact of the February grid failure on Texans — hundreds dead, property losses of as much as \$20 billion, and an overall economic impact of as much as \$130 billion.

But it could have been far worse. The Texas grid came within minutes of total collapse. If that had happened, the second-most populous state — ironically, also the biggest energy producer in North America — would have found itself back in the Wild West, technologically speaking. Twenty-four million people might have gone without electricity for months.

That's just the beginning. Texas produces almost one-third of the nation's gasoline supply. It's the largest cotton producer, and

the Wintergarden is a major provider of spinach and other vegetables for much of the country. Food and fuel supplies nationwide might have been crippled, along with air, sea, and land transportation. The results would have been a national calamity.

"Texas would have become a ward of the nation," said Ed Hirs, a University of Houston Energy Fellow. "It would have been worse than Puerto Rico after [Hurricane] Maria."

The February crisis, though, also underscored regulatory failures in managing the natural gas system. That failure not only made the outages in Texas worse, they affected states across the Midwest. Minnesota, Kansas, Arkansas, Oklahoma and Missouri are decrying Texas' mismanagement of its natural gas production, and some are accusing the state and its producers of market manipulation. Meanwhile, disruptions in the flow of natural gas also caused some \$2.7 billion in lost production from factories in northern Mexico — many of which supply products to U.S. retailers and manufacturers.

Wellheads and pipelines froze, curtailing supplies just as consumers needed more fuel for heat. Prices jumped from as little as \$2 per million British thermal units to as much as \$1,200 in some regions, and consumers in those states now face billions of dollars in excess bills.

In other words, people across the country are now, quite literally, paying for Texas officials' willful disregard of the public good.



So far, state leaders passed only a few Band-Aid bills. One would require generators to winterize plants, although the fines for disregarding the law are negligible. The second addressed the cost of the February outages. Not surprisingly, consumers got stuck with the bill, and which they'll be paying for the next 30 years.

None of this, however, ensures the state won't face another crisis. In fact, in June — well before the hottest part of the summer — the Texas grid was again on the brink of crisis. The Electric Reliability Council of Texas, the grid operator for most of the state, enacted emergency measures imploring consumers to conserve electricity by raising their thermostats and shutting off large appliances.

Elected officials could have prevented all this, but they turned a blind eye to the problem in every legislative session since 2011. That year, when the state also faced a winter freeze out — albeit one with a lower death toll — the federal government recommended changes, including mandatory winterization of power plants, to prevent another crisis. While some lawmakers took it seriously, most elected officials and the regulators they appoint chose to ignore it, and nothing was done.

Grids in crisis aren't unique to Texas. The heatwave baking the western United States is prompting a run on air conditioner purchases, raising concerns about new demands on the grid at the worst possible time. The North American Electric Reliability Corp., has warned that a hotter-than-normal summer poses high risks for a national grid that is already vulnerable. Long-term, the prospects of increasing electrification means without significant improvements, grid conditions could deteriorate further.

But in other regions, the response is dramatically different. Utilities face penalties and legal liability for grid failures. In Texas, generators bear no liability. That responsibility falls to ERCOT, which claims it's a quasi-government entity immune to lawsuits.

Meanwhile, other states are experimenting with new ways to stabilize the grid, such as battery storage, and some companies

are distributing smart thermostats to encourage conservation during times of peak demand. In Texas, our supposedly free market has encouraged no such innovation.

Nor can Texas ship in power from other states that might have some to spare because our grid is isolated. While grid independence has advantages, the issue is moot. Who would want to plug into the impending disaster that is the Texas grid?

Until Texas gets its grid in order, it's on its own. Fixing the problem is going to take a more drastic overhaul than anything that's been proposed so far, starting with the regulators.

ERCOT and the Public Utility Commissioner, the three-member panel appointed by the governor and charged with overseeing it, didn't follow their own rules in February. The market failed to keep the power flowing, and regulators intervened, setting prices at their maximum and keeping them there for days. Then, lawmakers stepped in to socialize the cost of that failure — some \$16 billion — among all ratepayers, orchestrating a bailout that we will still be paying for 30 years from now.

"The PUC and ERCOT have proved they're incapable of acting in the public interest," Hirs said. Most Texans agree. A recent UH study found that most of those surveyed believed current laws and regulations are insufficient to address the grid failure. They also don't believe state government will adequately tackle the issues.

Currently, ERCOT serves a dual role as a both a regulator and a broker between buyers and sellers in the electricity market. While it monitors grid reliability, it also serves as a clearing house for contracts traded in the wholesale market. Hirs believes those two functions should be split.

In addition, the grid operator needs better incentives for building of more generation. How would those incentives be paid for? Rather than asking consumers to bailout the government for its bad decisions, lawmakers could dip into the state's Rainy Day Fund to cover the cost of the February failures, then levy a small fee on consumers and other market participants to fund new generation. Most Texans would rather pay for reliability than

failed leadership.

In addition, lawmakers should draw clear lines for the behavior of ERCOT and PUC officials. None should have a financial stake in any company that produces, transmits or trades electricity, Hirs contends. I'd also prohibit them from conducting private calls or meetings with investors groups and offering market insights to those looking to profit from the volatility of the Texas market.

Finally, we need to recognize that our natural gas and electricity markets are inextricably linked. That's been the case for 20 years, but we still regulate them separately. That caused big problems in February, and it likely will again. We need to form a Texas Energy Commission that combines the PUC and the Railroad Commission, and we need to ensure those regulators are working for the people of Texas rather than the industries they regulate.

There are no easy answers, but these steps would set Texas on a path for bringing its power grid into the 21st century.



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# DEMOCRATS AND REPUBLICANS WILL AGREE ON CLIMATE CHANGE

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Climate change is among the most polarizing issues of modern American politics. Discussions about it frequently take on religious rhetoric of beliefs, punishments and moral imperatives. Despite the apparently unbridgeable gap of the left and the right, the 2020's will likely bring forth the convergence of their viewpoints and hopefully a united front against climate change.

Many issues in American politics are divisive because they do not affect all Americans equally: police brutality or female reproductive health are critical issues to some voters and background noise for others. Climate change is not one such issue: it affects everyone. Texas and California both suffer from droughts. Democrat-run Western states are prone to forest fires; the Republican-run Southern ones bear the brunt of hurricanes and flooding. True, adaptation to the effects of climate change is easier for wealthier white communities than for those of color, but no one is exempt from these effects.

For all their chest-thumping, Republicans and Democrats already have considerable similarities in their attitudes to climate. Both the left- and the right-leaning media generally relegate it to "other news," ensuring that it does not become a political priority. On an individual level, white Democrats are almost as likely as Republicans to buy carbon dioxide-spewing SUVs or live in large houses — and governments of Democrat-run states are very sheepish when it comes to taxing such climate-hostile behaviors. And both sides are blissfully uninterested in the parts of the world where people are already dying because of climate change: think Yemen, Maldives, or

Bangladesh.

On some issues, Republicans should be more interested in climate change than Democrats. Save for the urban elites, Republicans are more likely to live in a rural setting and thus be more affected by natural calamities. Republicans are also more likely to live in Southern states, both hotter and more prone to flooding.

The Republican argument against investing in climate change prevention is largely an economic one, anchored in the present. Replacing current technologies with less polluting variants will be expensive. It will put the U.S. economy at a disadvantage relative to the European countries with more forgiving climates, or China, which does not equally care about the environment. Republicans treat the climate like a car that "runs just fine" and therefore needs no investments in worn-out parts. The Democrats' counterargument often takes on a moral tone of responsibility toward our children or the planet but is, in essence, also an economic one. In their view, our "climate car" needs preventive maintenance: whatever costs we pay for now will help us avoid much larger future spending, as well as other problems.

Climate arguments are close to two decades old. Deferred maintenance of our climate car shows its effects — the climate-associated costs and inconveniences of running our society are greater every year, as insuring and repairing homes, businesses and infrastructure damaged by forest fires and other natural calamities add up in price. The National Oceanic and Atmospheric Administration (NOAA) is tracking the largest of these disasters.

Since 1980, the U.S. has sustained close to 300 major weather-related events with a total cost close to \$2 trillion. In 2020, 22 such events occurred, and the cost of dealing with them was \$95 billion. In 2017, Hurricane Harvey alone caused more than \$120 billion in damage. This is the cost of deferred maintenance, and it is clearly rising very quickly. What would be the cost of prevention? A 2020 report by International Renewable Energy Agency (IRENA) projected that a global investment of \$110 trillion in decarbonization by 2050 would set the world on a sustainable growth path (and allow the recouping of many of these initial costs). The U.S. share of this total would probably come out to about \$30 trillion. A daunting but no longer incomprehensibly large figure: 1 trillion dollars annually. If current trends hold, it will not be long before the annual costs of Californian wildfires and Gulf Coast floods start approaching this number. At that point, the Republican and Democratic arguments will become the same: future costs will become present costs.

Unfortunately, as negligent car owners know, once deferred maintenance can no longer be deferred, its expenses greatly exceed those of prevention. Similarly, our choice between climate change avoidance and adaptation is disappearing, and we will soon have to invest in both. If we don't, our climate car may very well become — driverless.

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# ***MEXICAN MID-TERM ELECTION FENDS OFF NATIONALIZATION FEARS FOR ENERGY SECTOR***

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Constitution Early predictions that Mexico's June mid-term election could open the door to its energy assets being renationalized seem not to have proven true.

These concerns can largely be put to rest, thanks to results that modestly favored the leading Morena party but stopped short of facilitating changes President Andres Manuel Lopez Obrador had been campaigning for – changing the Mexican to permit the renationalization of the energy sector.

Lopez Obrador long argued that the 2014 opening of the energy sector to international investment was bad for Mexicans and used the campaign season to reiterate this message.

“We are suffering from a perverse energy reform, which was approved for looting, for theft, for the benefit of a minority at the cost of the suffering of Mexicans who have to pay more for energy,” Lopez Obrador said in March, explaining his reasons for trying to change the 2014 laws. “We have to repair the damage in whatever way possible.”

Results from the June 6 vote show that President Andres Manuel Lopez Obrador and his Morena party lost the two-thirds supermajority in Congress needed to make a lasting change to the Constitution, moving the president's often-stated goal more out of reach.

“The president is in a weaker situation than before the election,” said Leo Zuckermann, a political commentator in Mexico, at a Woodrow Wilson Center webinar. “We are far away from some of the things that had been said during

the campaigns, that Mexico is going to be a dictatorship or a hegemonic party, like we had in the 1970's with the PRI.”

Yet the Morena Party still retained a majority, as well as picked up several governorships. It shows the president still has strong but not impenetrable support, especially considering the negative drag provided by a pandemic and continued problems with organized crime.

While the populist president, Andres Manuel Lopez Obrador, was not up for election, this mid-term election was widely characterized as the country's opportunity to weigh in on the president's efforts to reshape Mexico's direction, especially with regards to energy policy.

The entire lower chamber of Congress was up for election as were the majority of governorships and many state races. President Lopez Obrador campaigned on behalf of Morena candidates in these races, reiterating his plans to make Mexico more self-sufficient in its energy supply.

The election results are better news for oil and gas than for electricity in Mexico, where the administration has shown particular interest in discouraging the many relatively recent private renewable power companies.

The immediate concern about Lopez Obrador renationalizing the energy sector by changing the constitution appears to be off the table, and many of the companies that have invested in oil and gas are sufficiently powerful, that the administration has shown little interest in taking the sector on directly.

Lopez Obrador still has room to push for constitutional change if he chooses, but it will require allying with the opposition or trying to use the courts, both of which are unlikely scenarios.

Even so, the last three years – in which Lopez Obrador has removed many energy regulators, cancelled auctions and pushed for legislation that undermines private energy investment – have left investors leery of Mexico.

Simultaneously, the current administration will need to address how best to deal with Mexico's state-owned Petroleos Mexicanos (Pemex), which has a staggering \$120-billion and growing debt, crippling its ability to make the needed investments in the sector. "Pemex is losing lots of money and cannot pay its debt," said Rosanety Barrios, a former senior official at the Energy Minister in the previous Pena Nieto administration. "At a certain moment, they will have to do something to recover financial confidence for Pemex."

One possible solution tentatively growing more attractive would be new partnerships between Pemex and private companies to develop its already secured offshore and onshore leases, known in Mexico as farm-outs. In these arrangements, the private company usually provides investment dollars and operational know-how in exchange for the access to the leasing rights that Pemex has. Pemex has entered into a handful of these arrangements, including one with BHP at the Trion ultra-deepwater block in the Gulf of Mexico.

The administration is also expected to remain focused on increasing Mexico's refining capacity, which Lopez Obrador prioritized for the country's energy security. Work is expected to continue on a new refinery in Dos Bocas, Tabasco, despite its bloated \$12-15 billion price tag. A promise of more domestic refining led to the May 26, 2021 purchase of Shell's share of Deer Park Refinery in Houston, with whom Pemex previously had a 50/50 joint venture.

"Deer Park represents a political victory for Lopez Obrador," Barrios said. "In his quest for energy security, he is explaining to his supporters that imports don't count if Pemex is the owner of the refinery."

For the power sector, the outlook is darker.

The administration has focused on trying to help its state-owned power company, the Federal Electricity Commission, or CFE, regain its former dominance at the expense of private investment. And because the sector first cracked open to private investment nearly 20 years ago, this could hurt companies with an established footprint as well as the more recent renewable energy arrivals.

While Lopez Obrador may not push for constitutional law changes, lawsuits over earlier laws that effectively gave CFE most of the generation business are still moving through courts. These laws were challenged successfully in lower courts but may be heard by the Supreme Court at some time in the next year. The Mexican courts have granted temporary injunctions on these lawsuits, preventing these laws from going into effect. These judicial decisions have effectively kept the 2013 energy reform going for those already investing in Mexico's energy sector, at least for the time being, until a permanent decision by the Supreme Court is made. The independence of the courts in making these decisions also shows that the system of checks and balances is still working in Mexico, said Julian Cardenas, a research professor at the University of Houston Law Center.

"There are sectors that are very aware of how important the stability of legal framework is to keep the investments needed by the energy industry," Cardenas said. "This is fundamental for Mexico's integration in global energy markets, the attraction of investments and the country's access to international funding." But while current investors have received some assurances, these legal battles – and the overall approach of the administration to private electricity investment – have effectively stopped any new electricity investment from moving forward. Generation developers like Mannti Cummins, who has been working on a wind generation project in Baja California Sur for the past six years, say that investment in new projects or the transmission to make them viable has essentially frozen until the Supreme Court makes a final decision.

The result could devastate the electricity sector, given that the country's generation and transmission infrastructure are in desperate need of investment, with demand for power growing

at a quick clip. The situation has also been made worse for the fact that to date the CFE has not invested in new generation or transmission line improvements.

“They are going to be short on transmission, short on generation – there are going to be blackouts,” Cummins said. “They are going to have to pay private people to come in and help them on all aspects – generation, transmission, distribution. If not this summer, then next summer.”



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# ***TIME TO CLEAN THE SKIES, ELECTRIC PLANES HAVE ARRIVED***

**EMILY PICKRELL**

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When the airline industry talks about reducing its carbon footprint, the future of electric planes is always on the horizon.

It should be – airline flights globally are expected to double in the next 20 years, yet the industry is far behind other forms of transportation in making the transition to a carbon free future.

“If that trend continues, then aviation is going to become one of the top polluters in all industry sectors,” said Susan Ying, senior manager at electric aircraft company Ampaire, in a NOVA documentary. “Aviation will become the final dinosaur, that does not clean up, if we don’t act right now.”

For jumbo jets, the future of fully electric flight is a few decades away. If a jumbo jet were to use today’s batteries, 1.2 million pounds of batteries would be required just to generate the power of the jet engine it would be replacing. This weight would effectively need an additional eight jet planes just to carry that weight!

Understandably, overcoming these limitations of battery technology is a big focus for electric plane development right now. Both private companies and governments around the world are starting with what has worked so far.

Swiss company Solar Impulse, threw down the gauntlet in 2010 by successfully building an electric plane that could run on solar power and by demonstrating its prowess with a 26-hour flight.

Advancements keep continuing, as a wide range of companies have shown interest in electric planes.

In 2017, Slovenian aircraft manufacturer Pipistrel introduced one of the first all-electric airplanes – including an electric propulsion system – that has been certified for use in flying schools.

In 2019, seaplane airline company Harbour Air announced completion of the world’s first successful all-electric commercial aircraft flight. Its ePlane, a six-passenger DHC-2 de Havilland Beaver, which uses a 750-horsepower magni500 propulsion system, flew for about a half hour over the Canadian Fraser River.

NASA has also been focusing on trying to develop an all-electric plane. It has spent the last decade working on the battery and design for a two-seater plane, the X-57, as a way to help develop the needed technology. The X-57 is designed to have a range of about 100 miles and a cruising speed of 172mph. The plane is currently in a high-voltage ground testing phase.

Achieving liftoff will require about 200 kilowatts of battery power, enough to power more than 100 average American homes, according to Brent Cobleigh, project manager for Flight Demonstrations and Capabilities at Armstrong.

The 850-pound lithium-ion battery pack needed to power the plane required ensuring safety while minimizing weight. This inspired new welding techniques, lightweight packaging and an alternative method of extracting heat from the battery’s surface.



For bigger planes, the challenge grows – airline manufacturer Boeing has already estimated that they are still several decades away from getting a 777-sized plane up in the air with just electricity.

The innovative engineering that spurred the efficiency of the modern jet engine makes it difficult to replace with a battery-operated version, according to Dr. Kaushik Rajashekara, electric engineering professor at the University of Houston, who specializes in air transportation.

“The modern jet engine has the highest power density of any machine - this is why jet engines are used in any aircraft,” said Rajashekara.

In order to still maximize the benefit of these jet engines, a two-pronged approach to introducing electricity to aviation has emerged.

Short haul, commuter flights for small numbers of passengers are much closer to going electric, especially if battery technologies become somewhat lighter. Smaller all-electric or hybrid regional planes might be available sometime in the 2030’s, according to Boeing. Boeing has also released an electric passenger air vehicle that can be fully autonomous, with a range of up to 50 miles. It was designed for Uber Air, as flying taxi service that Uber says could be ready by 2023.

For jet planes, the industry is now looking for ways to integrate more electricity into certain functions of the plane while retaining the design of the jet-fueled engines.

One of the design advantages is that even small electric motors are still powerful, meaning that several motors could be placed on the wing of a plane. Electric flight control systems, for example, have already replaced mechanical flight control systems in some planes, which are the components beneath an aircraft’s surface allowing it to fly.

Companies are also researching ways to introduce more electricity into the engine itself, replacing the gear box that drives the hydraulic pump, fuel pump and oil pump with electrical systems.

Eventually, jet planes could evolve into hybrid vehicles, much like cars – with both a jet engine and an electric motor. Both would provide propulsion for the aircraft.

“It is like a Toyota Prius - you have a jet engine and an electric motor,” said Rajashekara. “Both will provide the propulsion for the aircraft.”

Hybrid-electric airline manufacturers like Ampaire say that hybrid planes cut down on operational costs – another benefit given the reduced need for fuel. Maintenance costs are also lower.

“Starting with hybrid as well, versus fully electric, provided a great mix of fully performance, cost savings and our ability to get it done technically in a timely manner,” said Brice Nzeuko, senior executive at Ampaire, speaking to NOVA about the company’s Electric Eel.

The Electric Eel is a hybrid plane in which the forward piston engine of a Cessna is replaced by an electric motor powered by a battery, making it a parallel hybrid configuration. It flew first in 2019.

The limitations on longer flights, however, would depend on big breakthroughs in battery technology, including necessary battery weight reductions to improve its practical use.

The U.S. Department of Energy is currently funding a number of related projects to improve the technology for hybrid airplanes, such as lightweight fuel cells power systems and high-power density motors and drives.

Private companies like Tesla are also investing heavily in electric flight, hoping to become a big player, with Elon Musk claiming that the company’s batteries could achieve the needed power density for electric planes by 2023.

It can’t come too soon – the airlines say they need to meet their goal of 50% reduced net emissions by 2050, compared with 2005 levels. To achieve this while meeting expected demand growth, electric planes will need to be in the mix.

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# ***WHERE 'BIG OIL' STANDS IN ITS LOW-CARBON TRANSITION***

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Less than a month ago, oil-and-gas titan ExxonMobil had a rude shake up, as an activist investor group won an unprecedented three seats its board of directors. The win had been fueled by a campaign message that the company needs to get much more serious about shrinking its carbon footprint.

The specter of ExxonMobil, one of the world's largest oil and gas companies, being pushed around by activist investors feels like a new chapter in the transition to a lower carbon future.

'Big Oil' long has been a term to paint the world's largest oil and gas companies as a monolith. Yet in the last decade, its biggest players – ExxonMobil, Chevron, Total, BP and Shell - are actually falling into different camps when it comes to the energy transition, largely on geographical lines.

The U.S.-dominated camp has been led by heavyweights ExxonMobil and Chevron, which have acknowledged the need for a transition but have been slow to commit to net zero carbon emissions by 2050, an overarching goal established by the Paris Agreement.

Exxon, for example, openly acknowledges plans for its continued role in producing fossil fuel for decades to come. The oil-and-gas titan has continued to make fossil fuel investments, while putting some investment dollars in carbon reduction technology, such as carbon capture projects.

Exxon has also invested extensively in biofuels, with a target of 10,000 barrels a day by 2025.

What they have not done is map out a plan to move their business towards other forms of sustainable energy, explaining that their core business is 'oil and gas'.

Chevron, too, has been hesitant to make longer term emissions reduction commitments, recommending in March 2021 that its shareholders vote against proposals that called for emissions reductions.

"In Chevron and ExxonMobil, you don't see anything significant," said Praveen Kumar, director of the Gutierrez Energy Management Institute at the University of Houston. "It is not just that you don't see the lower emissions commitments. You don't see any significant investments with respect to the transition, such as moving into sustainable electric power."

In Europe, however, the biggest companies are taking a more aggressive approach towards asserting their conversion to green. In 2019, Spanish Repsol became the first oil and gas company to make a net zero carbon emissions commitment by 2050. It did so, citing the Paris Agreement commitments as its roadmap.

British BP soon followed suit, unveiling in February 2020 concrete steps to reduce its methane footprint in the short term.

Royal Dutch Shell, in its 2021 announcement of net carbon zero plans by 2050, offered plans to further reduce oil production by moving aggressively into sustainable energy and carbon capture. French Total listed plans for 25 GW of renewable generation by 2025.

Yet the European model is not strictly voluntary – it is being pushed along by societal, regulatory and legal pressure. In December 2019, the European Council endorsed the EU target of climate-neutral by 2050. It has proposed laws to back up the message.

And its courts are following suit.

In May, Shell was ordered by a European Union court to cut its global carbon emissions by 45% by the end of 2030, in a lawsuit brought by environmental groups. The court ruled that the company's plans were still insufficiently vague to meet its goals.

Meanwhile, efforts to pressure U.S. companies has come through the private sector rather than the government. The lithe and often speculative hedge funds have led the charge.

“Institutional investors, like the big pension funds – Calpers, Vanguard – there were a lot of expectations that these big institutional funds would push the same way as the EU,” Kumar said. “We were hoping that the same pressure would be afoot, but this did not happen. We only started to see shareholder pressure once the hedge funds became aggressive.”

So what has caused the change?

To some extent, the reduced ability of companies like Exxon and Chevron to fight off activist behavior is the result of their reduced power in the market.

“What changed was the shale revolution – it made the supply of oil much more democratic, where most of the supply in the U.S. was no longer under the control of the big oil companies,” Kumar said.

Analysts once thought that when shale oil production slowed down, the larger companies would be able to consolidate their positions through mergers. Instead in 2020, demand dropped dramatically because of the pandemic. Worse yet for these companies, the OPEC producers leveraged their power to further reduce prices, in a struggle for control of the market.

The activist momentum has also been helped in part by the Biden administration. His administration's climate transition plans include rejoining the Paris Agreement, and emission reductions by at least 50 percent by 2030.

Where does this leave U.S. companies?

Both ExxonMobil and Chevron are recovering from disastrous losses in 2020: ExxonMobil posted a \$22 billion loss, while Chevron's hit was \$5.5 billion.

In March 2021, Chevron made a first-time commitment to a net zero carbon path by 2050, though it states that policy and technology continue to be major challenges in reaching these goals.

In May 2021, Exxon also launched a new low carbon business unit.

Its newly reconfigured board is also taking up a study to investigate the impact to its own business of developing a net zero carbon commitment.

Their outlook for 2021 looks brighter however, as gas prices climb, driven by a demand that is moving closer to its pre-Covid level.

At the same time, Exxon and Chevron are looking at what comes next. They have floated the idea of improving their carbon-cutting profile by merging, a possibility that has been discussed behind the scenes with no clear outcome to date.

In April, Chevron announced its first investments in offshore wind, becoming the first U.S. oil major to do so.

Meanwhile, a team approach could also benefit the European model, which still permits companies to improve their profile by playing hot potato with their carbon-intensive assets, rather than investing in making them more environmentally responsible.

The sale of Royal Dutch Shell's 50% ownership of the Deer Park Refinery this spring is a perfect example of the plan. The

refinery's purchase by Mexico's state oil company, Petroleos Mexicanos, effectively reduced Shell's carbon footprint, while increasing that of Mexico's.

"This allows the board of directors and the CEOs to report back that they have reducing their carbon footprint as a result of these sales," said Ed Hirs, an energy economics lecturer and energy fellow at the University of Houston.

Yet as the companies jockey for position around the transition table, it is important to remember that as oil prices rise, this enthusiasm may well die down. The next step globally may well be a more unified plan with incentives provided, such as a carbon tax, to make it financially meaningful for companies to do their part.



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# *AS ATTITUDES TOWARD EVS CHANGE, AUTOMAKERS LEARN TO THINK BEYOND THE CHASSIS*

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A few years ago, many experts believed consumer's biggest concern in adopting electric vehicles was "range anxiety" — the fear that a car couldn't hold a charge long enough to get you where you wanted to go and back home.

Car buyers, accustomed to gasoline engines and readily available filling stations, worried about being stranded by their EVs.

A few weeks ago, talking with Greg Bolino, CEO of DG Reimagined, a Michigan-based consultancy that specializes in EVs, I mentioned the term "range anxiety." He told me it's no longer accurate. As more charging stations have popped up across the country, range anxiety has given way to a different concern: "charge anxiety." EV drivers are less worried about finding a charging station and more worried about how long a charge will take.

Of course, this is less of a concern for drivers who use EVs for commuting. Most can charge either at home, at work, or both, so — assuming their commute is within their car's battery range — they don't have to worry about running out of juice.

But what if they want to take their EV on a long trip? Sure, these days it's easier to find charging stations along the way — there are even apps for that. But how long will they have to wait to charge en route? If it takes several hours, it can put a significant dent in travel time.

"Now, the predominant fear is that you're going to wait a long

time when you hit the road, i.e. that 5 or 10 percent of the time that you're not going to work or traveling locally," Bolino said.

Bolino noted new batteries coming out in the next year will charge to as much as 80 percent in 30 minutes, and some will charge to 50 percent in seven minutes.

"That's like a stop at the gas station," he added.

But automakers are beginning to think beyond the traditional motor-and-drivetrain arrangement to unlock more possibilities for EVs. For example, Bolino believes EVs of the future will have small motors — perhaps gasoline powered — that can recharge the battery if there's no charging station nearby. The motor wouldn't need to be strong enough to power the entire vehicle, but it could run while, say, the driver is eating at a restaurant. That would generate enough charge to replenish the battery by the time the driver returns.

These recharging motors wouldn't have traditional cylinders and pistons but use rods to create a vibrating motion that would generate electricity. They would be quieter than leaving a full-size gasoline engine idling, and they would produce fewer emissions.

Such a system could even cut down on the need for additional batteries and reduce vehicle weight, Bolino said.

He believes the adoption of EVs will accelerate because of what he calls the three Ps: purpose, performance and practicality. People say they would choose an EV because they believe it's

good for the environment, and many realize that transportation contributes one-third of the carbon we produce nationally. As for performance, most EV motors are quicker and have more torque than their corresponding internal combustion engines.

“My Tesla Model 3 is faster than any car under \$100,000 except the Corvette,” Bolino said. “People are surprised by the incredible torque and performance of electric motors.”

EVs also typically are quieter and have a smoother ride than vehicles powered by internal-combustion engines.

As people learn that EVs have many superior features, including better acceleration, handling and torque, and prices come in line with conventional automobiles, EV appeal will continue to grow.

Operating cost will become a significant factor once purchase prices are no longer a barrier for many consumers. EVs are far cheaper to own, require less maintenance, and obviously need no gasoline.

“It takes about 11.5 to 12 cents a mile to run a Cadillac,” Bolino said. “It takes about 4.5 cents a mile to run a Tesla.”

The longer people own EVs, the more those savings will become apparent, as the benefits of lower maintenance kick in.

“If you have a 10-year-old vehicle, so many things can go wrong,” said Mike Ramsey, an analyst who follows the EV market for Gartner, an independent research firm. “There’s so many moving parts, and there’s random sensors and seals and fluids and lines. All that stuff is not in an electric car — none of it. That’s where people are going to really see a big difference.”

Neither Bolino nor Ramsey, by the way, are EV evangelists. In fact, Ramsey had been skeptical about the widespread of EVs, noting that last year they accounted for just 1.8 percent of the total U.S. automobile market. Range anxiety, high prices, and general unfamiliarity kept many consumers away.

But now that range is less of a worry and carmakers are starting to think more like software companies when it comes to added

features, he believes EV ownership will rise to about 4 percent this year and 8 percent next year.

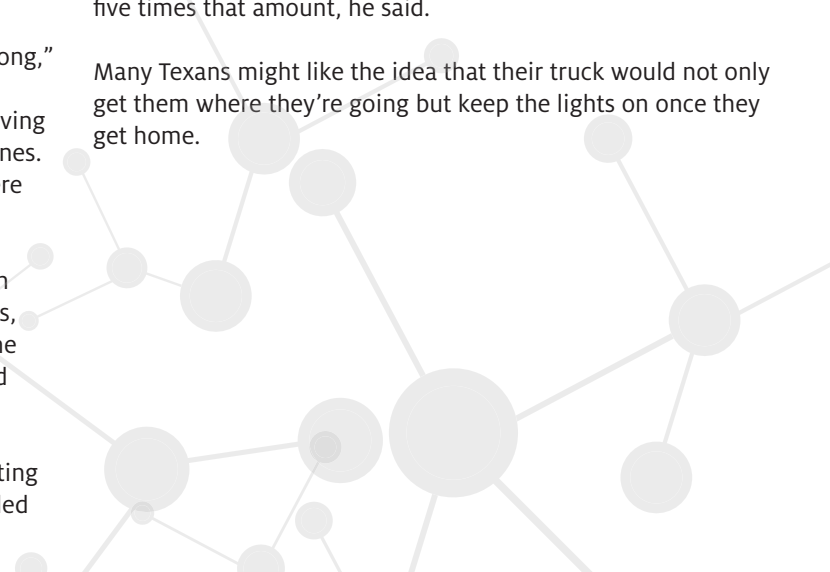
EVs also have the potential to provide power for more than just transportation. He sees a race between traditional automakers and tech-oriented startups like Tesla. EVs have fewer mechanical parts, and they’re more standardized across models. That sets up an interesting race. Companies like Tesla understand the technology and need to get better at making cars, while automakers need to get better at building software.

As I wrote last month, Ford is introducing an all-electric version of its F-150 pickup that has the capability to power an entire home for days. In the future, power grids may be improved to incorporate distributed generation from EVs, Bolino said.

It’s still years away, and it will require improvements in battery technology and cooperation from electric utilities and transmission companies, but Bolino believes the value could be significant.

“The value of a vehicle on the grid is a real thing,” he added. In Michigan, for example, he estimates that an EV could add about \$186 a year in power to the grid. In places like Texas, where the value of energy spikes during peak demand, the value could be five times that amount, he said.

Many Texans might like the idea that their truck would not only get them where they’re going but keep the lights on once they get home.



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# ***FIXING THE TEXAS POWER GRID REQUIRES NEW OVERSIGHT – DON'T HOLD YOUR BREATH***

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In the vast expanse of West Texas' Permian Basin, hundreds of miles from the nearest power plant, lies a clue to why the February power outage was so catastrophic.

You see them at wellsite after wellsite — electric motors. A decade ago, the drilling equipment powering Texas' most prolific oil and gas field ran on diesel fuel. Today, most are powered by electricity.

But as the February freeze settled in, power plants froze and electricity slowed to a trickle at many natural gas well sites. Then, as one industry insider explained it to me, a vicious cycle began. Without electricity to run the wells, gas production slowed. Without gas, power plants couldn't generate enough electricity to power the wells. And even when more electricity did become available, it was selling at the maximum price of \$9,000 per megawatt hour, which meant gas producers simply couldn't justify the cost. Even if they could have kept pumping, they would have lost money on every molecule of gas they produced.

No one planned for this. The state's natural gas and electrical systems are more intertwined than ever, yet we have a regulatory system — and industry mindsets — that still view them as separate markets.

The Texas Railroad Commission, a three-member panel elected by the public, oversees natural gas production. By putting a priority on gas used for heating, it actually curtailed the flow of gas to power plants.

The electric system is overseen by the Public Utility Commission, a three-member panel appointed by the governor. In February, the PUC stuck its finger in the allegedly free market for electricity and mandated maximum prices. It kept those prices artificially high for days, despite signs market conditions were returning to normal.

The agencies, housed in the same building in Austin, didn't coordinate the response to the crisis. So the Railroad Commission starved power plants for gas, while the PUC jacked up prices, making the cost of producing gas unaffordable.

And since our state has no backup system to ensure reliability — no state program to offset gas producers' high electricity costs so they could keep producing while the PUC meddles in the market, for example — no one bothered to look at how these actions, in total, affected the overall supply of electricity.

This week, the PUC and the state's grid operator, the Electric Reliability Council of Texas, are talking about ways to tweak the emergency pricing formula. But neither the PUC nor state lawmakers have paid serious consideration to how to better manage the overall system.

That may be because the best way to improve the management is to get rid of the managers.

"I think we should erase the Railroad Commission and erase the PUC and have a new commission that not only does what they do,

but also does more,” says Chrysta Castañeda, a Dallas oil and gas attorney who ran an unsuccessful bid for Railroad Commission last year. (Full disclosure: we also wrote a book together.) “We don’t have supply chain planning from beginning to end. We’ve got these siloed agencies that don’t talk to each other.”

Castañeda argues that the state needs a single agency that oversees everything — sourcing, demand, distribution — and does it with an eye toward the state’s needs not just today but over the next three to five decades. The new agency would also take over the PUC’s oversight of ERCOT.

Forming a new commission — and eliminating the old ones — would probably take a constitutional amendment or legislative action, which probably won’t happen.

“It’s unlikely you’d see a merger between these two agencies,” said Brandon Rottinghaus, a University of Houston political science professor. “It’s a challenge to change the structure of Texas government. The voters usually don’t care enough to make widescale changes, and politicians are generally happy with the status quo.”

Voters simply have too many offices to keep track of, and as a result, even more prominent positions such as attorney general rarely get the full attention from the electorate, he said.

That’s even more true when it comes to the Railroad Commission. After all, its name doesn’t reflect its responsibility of regulating oil and gas production, and no one has gotten elected to it in recent years by proposing major reforms. (Castañeda did, and lost.) Besides, the industries regulated by the two commissions prefer things as they are.

“There’s a lot of inertia in Texas government, and part of the reason for that inertia is cemented by industries that are happy with the devil they know,” Rottinghaus said. “Change means uncertainty, and that something that most government folks as well as industries that work with these agencies don’t want to see.”

But such aversion to change could leave Texas even further behind when it comes to creating a reliable electric grid for the future. Castañeda believes a combined agency would protect consumers and businesses as the energy landscape becomes more complex. How will evolving battery technology will affect supply and availability? What might it mean for costs? How will we account for the vagaries of distributed generation — home solar panels, private wind turbines and the like?

What’s more, we could miss opportunities that fall outside conventional thinking. For example, she has proposed capturing the gas flared at the wellhead and using it to generate electricity onsite to power wells, basically micro-generation that would reduce harmful methane emissions at the same time. Some companies are already pursuing this technology. And changing the regulatory structure could drive other changes as well. We currently produce most of our generation fuel — wind, solar, natural gas — in remote areas, then spend billions transporting it via pipelines or transmission lines to populated areas. In the future, companies could be incentivized to build manufacturing plants in remote areas, taking advantage of cheap and abundant power without high transmission costs.

“What if we didn’t have to spend so much money on moving power? What if we were able to access more power that’s generated locally?” Castañeda asks. “It’s a little bit like farm to table — sustainable farming happens closer to where people eat their meals. The same thing could be true for power generation.”

But for now, Texas leadership is more concerned with adhering to its ideological strictures — its stubborn belief that electricity is a free market, and that if we just keep tinkering, we’ll find a way to fix a system that hasn’t lived up to its promises for the past 20 years.

“For us to freeze our conception of how we generate electricity to the equivalent of 2008, which is where I think our minds are stuck, is just not practical,” Castañeda said. “We’ve got to think for the future.”



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# ***COMMUNITIES AND GOVERNMENTS WANT FAIR PLAYING FIELD IN EV CHARGING***

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If you build the charging stations, the EV purchasers will come.

That is the premise on which the Biden administration is banking, that its promise to build 500,000 new charging stations to help move forward the tipping point towards the climate-friendly technology.

Where you build them – and accordingly, which EV purchasers you are encouraging - is the next question.

Those looking at the history of transportation say that making charging stations accessible to lower income communities is one way to ease the disproportionate pollution burden that they carried in U.S. highway development.

“For the last 70 years, the impact of fossil fuel burning cars has disproportionately hurt communities of color and neighborhoods that have the lowest mobility,” said Andrea Marpillero-Colomina, an urban studies professor at The New School. “They own less cars than other people, and yet their healthcare costs and comorbidity rates related to air pollution are higher. If you are spending a lot of time in the emergency room because you are breathing polluted air – that is a huge impact on your life, every single day.”

This higher burden that lower income communities has continued to this day. A recent University of Houston study showed a direct relationship nationwide between lower life expectancies and low income communities that are hard hit by contamination.

Air pollution is a big part of this. In California, for example, cars and trucks are a chief cause of poor air quality, contributing nearly 80 percent of the nitrogen oxide – i.e. smog - and 95 percent of the toxic diesel particulates in the air.

At the same time, in the early days of the EV mobility transformation, most EV cars don't rely on publicly-accessible charging stations. The vast majority are charged at home, with owners living in single-family homes.

Currently, EV ownership is skewed towards the affluent. Tesla Model X owners, for example, earn an average of \$143,000. More than 70% of this group is male, with a median age of 54. There are more than 1,000 Tesla super charging stations in the U.S., providing a private sector solution for this demographic.

The Biden administration is trying to address these energy justice issues in its ambitious \$1.2 trillion infrastructure plan. The program, which is still being debated in Congress with no clear resolution in sight, would ensure that 40% of the overall benefits from clean energy would be for communities that have not historically been invested in.

Biden's budget includes \$4 million for programs that encourage workplace charging as a way to make EVs possible for communities that won't have access to home charging. Electrify America, a program started by Volkswagen as part of its diesel emissions settlement, has also helped push public charging forward: to date, it has established a network of more than 500 charging locations and over 2,200 individual charging units.

Electrify America stations have been located in public access areas, such as parking lots and big-box store parking garages.

States and cities are following suit, making sure that minority communities are part of the planning.

Oregon's Dept. of Transportation, for example, has already estimated a need for 600 charging stations by 2025 for disadvantaged communities and 6,000 by 2035. These estimates take into account that a significant proportion of the population live in apartments or other multi-unit homes that do not provide convenient overnight on-site charging.

New York City recently announced its plans to add 100 charging ports in the city, trying to remove barriers to EV adoption. The new ports will be level-2 chargers, which provide an 80% charge in four to eight hours and will be distributed across the city.

"The current limited charging capacity in the city has been a challenge to expanding EV access for New Yorkers, with most of the existing chargers today located in expensive or private Manhattan parking garages," city officials explained in their announcement of the new sites.

The first charging station was installed in the Norwood section of the Bronx, which has a median income of about \$38,000, far below Manhattan's \$93,000 median income. Plans are underway to fund more than 21,000 level-2 chargers by 2025 throughout New York City and the surrounding counties. The cost is not insignificant: Each level 2 charge takes between \$5,000 and \$10,000 per installation. New York City currently has roughly 15,000 registered EVs.

The State of California has developed strategies to ensure that disadvantaged and rural communities are included in the planning. Priorities include ensuring that charging solutions are equitably distributed, and involving communities in this process.

The economic and environmental case for access for all is compelling: fewer repairs are needed for these costs and the price of electricity is a lot less than gasoline.

And would-be EV purchasers, regardless of economic status or background, are becoming increasingly interested in doing so.

In a recent consumer survey, more than 70% of drivers expressed interested in owning an EV. But more than half of them said they were held back by lack of access to public charging stations.

Yet how and why communities are consulted about EV infrastructure planned for their neighborhood could be critical in whether the new gadgetry is embraced or viewed as an unwanted solution to a problem they are still left to struggle with.

Done wrong, it can appear a top-down decision that leaves a community feeling patronized at best, with equipment they don't understand or view as a sign of impending gentrification, said Michael Breish, an energy policy specialist for the Washington State Dept. of Commerce, who has worked with communities across Washington discussing the state's electrification plans.

Moving several chargers to a neighborhood will eventually require a major upgrade to the electric infrastructure, and this expansion, if done without a community's consent or participation, could further generate misunderstandings.

Including community participation early in the process helps ensure transportation solutions that the community thinks are most important, Breish said. Locals will be the best positioned to identify the key bottlenecks and find uniquely local solutions.

EVolve Houston, an organization working with the City of Houston to encourage electric vehicle adoption, has recognized that working with communities upfront will be critical to their mission. They are currently developing an equity plan in their deployment strategy that will be "a blueprint to engage the community", according to Stephanie Coates, secretary of the board for EVolve Houston.

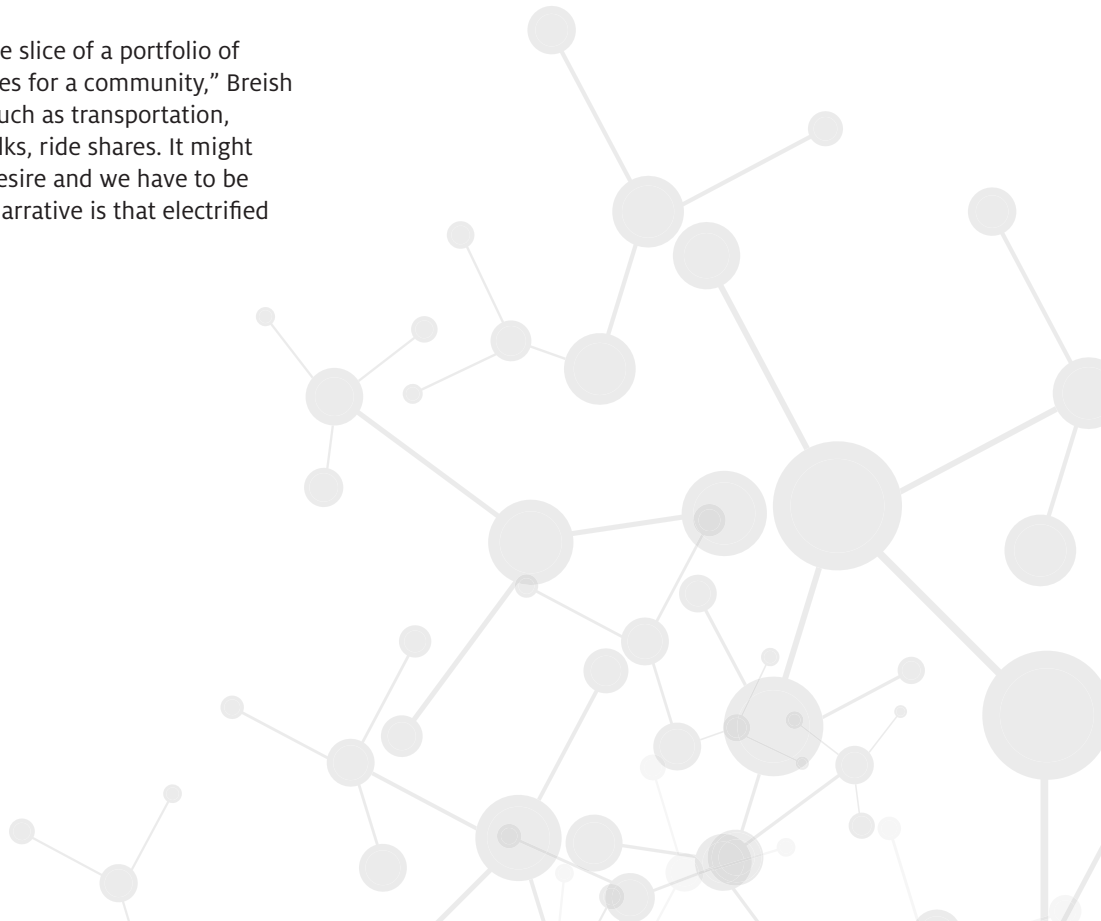
"That is the kind of feedback we want - and our goal is to get it before we rollout pilots", Coates explained. The plan will also

draw on community meetings that have already been held by the City of Houston – a benefit of private and public groups working together.

Having this kind of information upfront could mean that highest priority might be the electrification of school buses or diesel trucks that drive through their neighborhoods, with charging stations to make this possible. And additional measures - increasing the affordability of EVs and addressing the last-mile challenges these communities often face with ride share EVs - might be crucial for these communities to expand their use of mass transit.

But it may mean having to rethink charging stations for local residents as being the top of the list.

“Charging stations and EVs are one slice of a portfolio of solutions for clean mobility services for a community,” Breish said. “There are other priorities, such as transportation, electrified garbage trucks, sidewalks, ride shares. It might not be the immediate goal they desire and we have to be okay with that, even though the narrative is that electrified transportation are a savior.”



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# ***OIL PRICE PREDICTIONS BANK ON HOW QUICKLY SHALE PRODUCTION RESUMES***

**EMILY PICKRELL**

Energy Scholar, UH Energy

The success of the vaccines against COVID-19 did a lot to assuage fears, grow the economy globally and increase oil use this spring, sending prices sharply up. Yet, just how long this economy recovery and rising oil prices will continue is anybody's guess.

Oil prices have certainly responded to a more normal economy: After West Texas Intermediate prices (a good gauge for US oil) bottomed out at \$21 per barrel in March 2020, prices hit \$74 in July 2021, and are now roughly \$70.

These price fluctuations are largely a result of the pandemic and resulting demand drop.

The massive cuts that OPEC and associated countries (called OPEC+) took helped the markets recover some. However, the sub \$40 price per barrel immediately crippled cash flow for many US shale producers, who operate on very slim margins.

“The most crucial thing to me is that the pandemic basically put a clamp on shale production,” Kumar said. “Many smaller shale producers had to shut down production and did not have the financial ability to ride out financial collapse, and went bankrupt. U.S. shale production is still significantly below pre-Covid levels.”

The challenges for shale producers in coming back up to speed is what led to these higher prices this spring.

“The shale financiers got badly burnt last year and are not likely going to be rushing back to shale investments,” Kumar said.

The loss of an experienced workforce in the shale patch has added a further constraint in resuming production, and this is what has been keeping upward price pressure – but it won't last forever.

The challenge in determining how much and how long this shale production impact will last is because the price of oil is driven by the marginal barrel of oil, where the markets get cleared.

This contraction in U.S. supply has given OPEC+ some additional power again in being able to influence prices through controlling how much of the U.S. supply contraction it will make up for. It makes a difference, as events in April 2020 illustrated.

At that time, OPEC+ had made a huge production cut of 10 million barrels per day (bpd), responding to the pandemic-related demand plunge. The cut – about 10 percent of world output – has since been relaxed to its current 5.8 million bpd.

Since then, OPEC+ agreed to add back 2 million bpd from April to July of this year. As demand increases, Saudi Arabia and Russia have teamed up to propose adding back 400,000 bpd from August to December 2021 and to extend the current OPEC+ agreement until the end of 2022.

The United Arab Emirates has refused to accept the proposal, upset that it would be limited to its original baseline commitments in the extension.

The OPEC response to the conflict has sent a garbled message for oil prices, as the group cancelled their planning meeting in early July, giving no roadmap for output after August.

Without an agreement, OPEC+ is obligated to leave its production commitments at their current levels until the end of the year, which could push prices up.

The bigger danger, however, is that many member countries will simply ignore the quotas altogether, motivated more by the need to keep their citizens (and thus their budgets) happy than by working in tandem with Saudi Arabia's discipline.

Worries that shale producers will do so could in turn motivate for the OPEC+ members to avoid keeping supply so short that it encourages price spikes.

"Seventy dollar oil is right at the full-cycle breakeven price for the US shale plays," Hirs said. "If the Saudis let the price go above \$70/bbl for too long, the US will expand oil production."

Several global political factors could further push the price of oil up or down. Successful U.S.-Iran nuclear negotiations, for example, could add Iran's 1 million bpd of crude back to the global market.

Meanwhile, China's previous oil demand growth throughout the early 2000's -- the biggest driver of higher prices up until the shale boom increased supply -- is not expected to return to its former levels.

Raymond James, a Houston-based energy research group, is more optimistic about long-term prices, predicting that overall demand growth is enough to support the higher rates.

"Yes, spot pricing of WRI and Brent is off its recent highs, but it remains close to the highest levels since 2018," analyst Pavel Molchanov wrote in an Aug. 2 Raymond James analyst report. "In the grand scheme of things, the oil market is doing just fine, thank you."

Molchanov focuses on growing demand, the relative success of vaccination and economic openings and the need for prices to rise to incentivize more production. Raymond James has raised its price forecasts for not only the second half of 2021, but for all of 2022 and the long-term, in response.

Kumar is more pessimistic, looking at the continued impact of the Covid-19 virus, and inability of OPEC+ to rein in its members' production levels.

"Now that the Delta variant is playing havoc the world over, OPEC will not hold back on production," Kumar said. "They will start producing and the demand will not grow as much as people were thinking. It is going to be a downward trend, rather than up."

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# ***BEGGING OPEC IS SO 2008. WE NEED ENERGY POLICY THAT REFLECTS THAT PAST DECADE***

**LOREN STEFFY**

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President Biden, 2008 called. It wants its energy policy back. Earlier this month, the White House urged OPEC to boost oil output because the production increases the cartel already promised aren't enough.

The Biden administration is in a tough spot. Inflation is accelerating at its fastest in 13 years, and people are paying more for everything from lumber to chicken wings. Energy prices are among the more volatile inflation indicators. Average pump prices for gasoline have surged by almost \$1 a gallon nationally compared with a year ago.

So the president resorted tried-and-true tactic from the Era of Energy Scarcity: beg OPEC. It was a favored strategy of presidents from Obama back to Nixon, but one that we were supposed to have left in the dust thanks to the energy abundance ushered in by the fracking boom.

Biden could have asked U.S. producers to open the taps. We have the capacity now, thanks to hydraulic fracturing, to keep a ceiling on oil prices. The silence was deafening.

"Asking for more U.S. production goes against the green climate initiative that the administration is pushing," said Dan Pickering, founder and chief investment officer of Pickering Energy Partners. "So they ask OPEC, which pushes the hydrocarbon production somewhere else. The Saudis are easy relief for everyone except the oil and gas industry in the U.S." After years of investing in moving the country toward energy independence, we are now mired in a retreat, a political game

of hide the pickle in which we prattle on about phasing out fossil fuels when in fact, we're just parking our problems elsewhere. Obviously, the Biden administration is looking for a quick fix, hoping inflation will settle down as supply chains recover from COVID interruptions. But that, too, is an anachronism, a policy of the past. If we are serious about transitioning away from fossil fuels, we need a long-term vision, and we need to understand that such a large migration takes time.

"We're going to need hydrocarbons — gasoline, chemicals, plastics — for much longer than most people would like or realize," Pickering said. "The time to net zero is measured in decades."

For some 40 years, the U.S. was dependent on foreign oil. Then the fracking boom came along, and by 2014, OPEC took notice. U.S. oil production more than doubled in less than a decade, surging from 5 million barrels a day to almost 13 million barrels by early 2020. We suddenly found ourselves as one of the world's biggest oil and gas producers, in addition to our long history as its biggest consumer.

That production increase changed the nature of petro-politics and gave us far more foreign policy flexibility than we had before. In recent years, domestic production has slipped back to between 10 million and 11 million barrels, the result of weak demand during the pandemic and greater calls from investors for more financial discipline from producers.

The Biden administration has made it clear that it would like that

decline to continue. It champions policies designed to hasten the end of fossil fuels, such as its proposed fracking ban on federal lands, for example. While that has little immediate impact, it causes energy producers to hesitate in committing large amounts of capital to new projects.

“It’s a shot across the bow,” Pickering said. “It’s a signal that it’s just going to get tougher in the U.S.”

Of course, it already has, in part because of the industry’s own behavior. At the height of the fracking boom, most U.S. shale producers were overspending their cash flow. Production soared and companies gobbled up properties and expanded drilling programs. But profitability lagged, and investors got tired of funding a boom that paid them little return. These days producers talk about free cash flow and dividends and seek low-risk acquisitions, rather than boasting about land grabs and production gains. Consider Pioneer Natural Resources, one of the biggest players in the Permian Basin, which pledged 75 percent of its second-quarter free cash flow to shareholders.

This newfound financial discipline is part of the reason that producers have stood by as the price of West Texas Intermediate crude has surged almost 30 percent this year.

“Even if the Biden administration asked U.S. oil companies to increase production, it’s questionable whether they would listen or respond,” Pickering said. “The stock market would punish any actions that are likely to lead to lower commodity prices or lower dividends.”

The White House doesn’t seem to understand the magnitude of what was accomplished by U.S. energy producers in the past decade. Not only did our production of oil and gas rise to levels unseen since the early 1970’s, our deployment of renewables rose at the same time.

Certainly, it’s not willing to do anything to encourage domestic drilling at this point, even if that means outsourcing our energy production once again.

But the shift in the domestic energy landscape have been

dramatic. In 2007, we imported an average of more than 12 million barrels a day. By 2019, before the pandemic’s influence on the markets, we imported just 670,000. Between 2005 and 2019, the U.S. cut in half its use of coal for generating electricity. Natural gas, a far cleaner fuel source, sopped up much of that generation, and renewables absorbed the rest. Renewables, which despite the hoopla were little more than a science experiment a decade ago, are now firmly ensconced in our energy mix.

In other words, increased oil and gas production was a major step in controlling our own energy destiny and navigating our own way toward a cleaner energy future. Asking OPEC to pump more oil isn’t just an indictment of American achievement in energy production, it also undermines the very goals of energy transition that the administration purports to desire.

Our energy landscape in 2008 was marked by desperation and few options. When things got tough, we had little choice but to beg the Saudis for help. But in the ensuing years, American ingenuity and determination did something that most of the world thought was impossible: we rewrote our energy future. We now have far more flexibility in navigating our transition to cleaner, more sustainable energy. Returning to our old habits for the sake of political expediency puts that future, and everything we’ve worked for, in jeopardy.

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# ***ENERGY OPPORTUNITIES IN VENEZUELA WILL ABOUND IF LEADERSHIP EVER CHANGES***

**EMILY PICKRELL**

Energy Scholar, UH Energy

As the energy world adjusts to the idea – theoretically, at least – of becoming less oil dependent, one of many unknown pieces is how it will impact an oil-rich country like Venezuela.

The distressed South American country plays no small role in the global energy saga: It owns one of the world's largest oil reserves, and until the last two years, was a main supplier of oil for U.S. refineries.

This ability to sell its oil to a top market once made it one of the richest South American countries, all centered on an oil production of more than 3.4 million barrels per day (bpd). This history could enable Venezuela to re-open its energy sector to the investment world, potentially attracting billions of dollars, if its leadership changes.

“Venezuela’s oil sector opening could represent for U.S. companies major investment opportunities, even bigger than the most recent energy reforms in the region, if democracy and rule of law returns to the country,” said Julian Cardenas, an energy law professor at the University of Houston. (Cardenas is also a board director at Venezuelan energy company PDVSA Ad Hoc, overseeing the protection of PDVSA’s assets abroad.)

Opposition leaders in Venezuela have openly identified the oil industry as its best chance for repairing the county, should they gain power. It is a seemingly natural choice to fund the massive infrastructure that will be needed after decades of neglect.

Indeed, Venezuela’s previous failure to distribute the oil wealth is what opened the doors of power to socialist leader Hugo Chavez. Chavez made a public show of driving out many of its

experienced petroleum engineers and reasserting state control of the sector.

His successor, President Nicolas Maduro, continues to assert control. He is seemingly more in control of the country than ever, having recently managed to pack the Venezuelan Congress with handpicked supporters. Meanwhile, the economic situation is deteriorating.

“While Maduro might seem to be in control, in the last eight years, all his plans to create economic growth have failed - creating not only the exodus of Venezuelans but also corporations that have decided to leave the country,” said Cardenas.

Oil production has been falling for the last two decades, the result of inexperienced and often corrupt leadership and a shortage of investment dollars. The country that once earned \$90 billion a year from oil exports now only brings in about \$2.3 billion.

A 2019 decision by the U.S. to levy sanctions on Venezuela’s exports has made a bad situation worse.

Oil makes up about 99 percent of the value of its exports. And until recently most of it has been going to the U.S., which was buying about 800,000 barrels per day (bpd). By 2021, the amount has dropped to less than 400,000 bpd. Instead, U.S. frenemies Russia, China, Iran, and Cuba have taken the U.S.’s place as the major consumers of the reduced Venezuelan oil production.

At this point, Venezuela currently has a lower standard of living than Haiti, and according to United Nations Human Rights Commission, 5.4 million Venezuelans have fled to neighboring



than Haiti, and according to United Nations Human Rights Commission, 5.4 million Venezuelans have fled to neighboring countries since 2015. Venezuelans are currently the largest group of asylum seekers in the U.S.

One of the big questions for the Biden administration is how to move forward with Venezuela, as it balances its own energy and immigration policy goals. Experts like Cardenas say the sanctions are having an impact but are not necessarily enough for regime change.

The Venezuelan leadership has agreed to participate in negotiations now being held in Mexico City, looking to end its economic crisis but vague about how much it is willing to give up in exchange. The Biden administration has made clear that without concessions from Maduro's regime for free elections, sanctions will remain the same. To date, Biden's approach has been to continue the Trump administration's approach of exemptions for some energy companies already operating in Venezuela.

This bending of the rules is designed to keep the U.S. footprint – albeit bare bones at this point - in the Venezuelan energy sector, undoubtedly waiting for change to come.

“In this case, letting US companies keep minimum operations in Venezuela has been part of the U.S. foreign policy strategy – after all these efforts the U.S. is not willing to leave the country to the Chinese or Russians,” Cardenas said.

It's a strategy that has an eye to the future, trying to run the clock until a new administration is in charge of Venezuela. One of the big questions for the U.S. is whether the current sanctions are actually pushing the Maduro administration towards change. Maduro's government has already made some small concessions in efforts to stave off economic collapse, hoping to attract much-needed international investment.

“Venezuela is going to become the land of opportunities,” Maduro said in a June 2021 interview with Bloomberg Television. “I'm inviting U.S. investors so they don't get left behind.”

Yet the oil markets are not likely to immediately be receptive to reinvesting in Venezuela, and the last two years have shown that even the Gulf Coast refineries can get along quite well without the heavy Venezuelan crude for which they were designed.

And while Maduro is talking about reforms that allow him to still run the country, others involved in the talks are pushing for real elections that could bring in new leadership.

Should this happen, the country could change its economic direction quickly. It has already had to do both the early 1900's, and again in the late 1990's. For example, if given the needed investment, Venezuela could ramp up production to 2.6 million bpd in the next ten years, according to an estimate by IPD Latin America, a consulting firm.

Yet even if Venezuela gets new leadership, it still has many roadblocks ahead in persuading energy investment to jump back in. Some Venezuelan oil is heavy and expensive to process, and big companies are becoming held to account for their carbon footprint. And while energy demand is again growing, there is a shift away from fossil fuels that will make importing them less attractive.

Companies, in turn, have said what they will need to return to Venezuela: the end of US sanctions, political stability, predictable and enforceable rules. None of that seems possible without Maduro's accepting to hold free democratic elections. Venezuela is also facing the competition of other opportunities, even under a new regime. The costs and risks of extracting oil in Venezuela means it will have to offer lower prices to make such an investment attractive.

And this strategy for rescuing Venezuela through its oil would come when the rest of the world is talking about how to burn less. Indeed, both French-owned Total and Norwegian-owned Equinor recently announced they will be selling their stakes in a Venezuelan project in order to lower their carbon footprint.

As the current Venezuelan administration faces growing pressure to decarbonize, it might just help tip the balance to usher in a new way of doing business in Venezuela.

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# *UNTIL PRODUCTION SETTLES, NATURAL GAS PRICES WILL CONTINUE THEIR UPTICK*

**EMILY PICKRELL**

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When it comes to energy, a geography rich with natural resources has its perks.

While Japan is currently paying close to \$10 per million British thermal units (MMBtu) for the natural gas it imports, one luxury of our country's shale boom is the way it has created really low natural gas prices. Prices were once up to \$13 per MMBtu as recently as the last decade, but since 2014, they have mostly stayed in the two-to-three dollar range.

Yet this year, domestic natural gas prices have again been climbing up, even though predictions remain that we have enough natural gas resources to last us decades.

Last month, the Henry Hub natural gas spot price hit \$3.84 per MMBtu, the highest summertime rate since 2014.

And even that's not the highest rate at the Henry Hub this year - it reached \$5.35 per MMBtu in February, driven by the cold spell that month in several central states. In Texas, Houston Ship Channel spot prices shot up to \$400 per MMBtu on February 16, raising financial chaos in the Texas power markets.

Yet, the persistence of these higher prices, long after the cold spell, indicates that more than just a freak storm is at play.

"During this hot summer across the U.S., natural gas supplies - including stored natural gas - have been drawn down more than usual," said Ed Hirs, an energy economist at the University of Houston. "These relatively higher prices are likely to persist

through to the spring as natural gas storage facilities replenish their supplies."

Domestic natural gas comes from two types of sources. The first category consists of hydrocarbon reservoirs that are predominantly natural gas such as Haynesville shale, the Marcellus shale, and the Utica shale. But it is also an associated product of crude oil in places like the Permian Basin, meaning that a significant portion of natural gas supply is tied to the production of oil and drilling in the oilfields.

The shale revolution drove the drilling of many such wells with the associated gas produced, creating a glut of natural gas.

During the pandemic, the contraction of oil production in places like the Permian shale last year also reduced the supply of accompanying natural gas.

Despite this contraction, prices quickly fell to \$1.63 per MMBtu in June 2020. It was triggered by the drop in manufacturing that had been caused by the pandemic-related disruption to supply chains.

Yet this where the reasons behind natural gas pricing gets a little more complicated. For while the pandemic had an immediate downward impact, the overall U.S. demand for natural gas has been growing. The U.S. currently produces and consumes about 31.5 quadrillion British thermal units (Btus) of natural gas, up from 24.5 quadrillion Btus in 2010.

This raises the question of how domestic supply is responding

to this expected demand increase. If the Permian does not recover to prior levels of activity, and it is not expected to do so, those companies that are primarily natural gas producers in the Haynesville, Marcellus, and Utica will increase their drilling activity. Even George Mitchell's original gas shale play in the Barnett shale will see new activity.

If oil prices remain in the \$70 per barrel level, growth in oil production may resume and may increase the supply of natural gas.

What other factors are driving the recent natural gas price increases?

In the short term, the polar vortex of 2021 followed by the hottest summer on record in the U.S. have driven down gas supplies in storage. The recovery from the pandemic recession is also driving domestic gas demand. Continued domestic economic growth is on the horizon as the EIA predicts that the industrial sector will increase gas demand by 35 percent by 2050, and make up more than 75 percent of its overall expected 4.6 quadrillion Btu demand growth.

Regionally, insufficient pipeline infrastructure also impacts natural gas prices. Boston, for example, pays the same price as those in Japan, because of a lack of pipelines to the Northeast, leaving it to import natural gas via LNG tankers.

The Permian Basin in Texas has the opposite problem. The low natural gas prices combined with a lack of infrastructure in place has led to the flaring of much of its gas: 900 billion Btu over a year in 2019. At current prices, the value of this flared natural gas would be well over \$1 billion.

At some point, throwing gas away because the cost of pipelines don't justify themselves will no longer make economic sense (if it currently does). The push for more electrification as a solution to climate change will also increase demand, but in the immediate future is not considered to be significant enough to drive price increases.

This is also the case with natural gas exports: The U.S. now

exports an average of 6.6 trillion Btu per day of LNG, according to the EIA. That's a big number, but still relatively small compared to the 82.5 trillion Btu per day in 2021 that the U.S. consumes domestically.

Mexico is also buying a lot more U.S. natural gas than it did a decade ago.

It has made a big shift in the last decade towards U.S. (mostly from Texas) natural gas for its power and manufacturing needs. Mexico now imports about 65% of its natural gas from Texas - 7.6 trillion Btu per day - through the multi-billion-dollar pipelines built up. These exports to Mexico are expected to reach 9.1 trillion Btu per day by 2025.

A global growth in demand for liquified natural gas, or LNG, is also tapping U.S. reserves. The U.S. is now exporting more LNG than the gas it transports to Mexico and Canada via pipelines, according to the U.S. Energy Information Administration. LNG exports are expected to reach 8.5 Btu/d in 2021 and 9.2 Btu/d in 2022, the EIA said.

This global LNG market is a fairly recent phenomenon, driven by a rapidly increasing demand from China, Korea and India, all of which have transformed their economies in the last generation.

Other mature economies, including Japan and Europe, are increasing their use of LNG as a bridge fuel as they try to reduce their carbon footprint.

Yet while prices are up this year, most energy analysts expect that the huge U.S. reserves of natural gas and the technology to access it will eventually even out, keeping prices relatively stable below five dollars for a MMBTU in the years to come.

"As natural gas prices firm up, some northeast guys will increase production, and that will offset the exports sent out of the country," Jamison Cocklin, a senior editor at Natural Gas Intelligence, said. "Natural gas prices are more balanced in that sense."

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# ***NOT COOKING WITH GAS: PHASE-OUT MANDATES IGNORE ECONOMICS OF ENERGY TRANSITION***

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My gas water heater recently started leaking, and I replaced it with an electric one. It wasn't an obvious choice.

On the one hand, the price of propane, which powers most of my home appliances, has surged 42 percent since last October. On the other hand, I was among the more than 4 million Texans who lost power during record freezing temperatures in February. The state's stubborn and willful embrace of an unreliable electric system means that during the next winter freeze or other grid-rattling weather event, I may lose hot water.

My choice is playing out, albeit under different circumstances, in other parts of the country. Homeowners and local government officials are reassessing the use of natural gas appliances, and in places far removed from Texas — places like the northeast where they prefer to leave the production of fossil fuels to others — municipalities are actively encouraging the switch to all-electric homes.

Communities around Boston, for example, are debating whether to block or limit the use of natural gas for cooking and heating in new houses. Similar efforts to phase out natural gas are underway in San Francisco, Seattle, Denver and New York. The first phase-out ordinance was passed by city leaders in Berkeley, Calif., in 2019. The measures, these city leaders believe, will reduce demand for fossil fuel and help meet climate change goals.

Of course, oil-producing states such as Oklahoma, Texas and Louisiana have adopted laws prohibiting gas phase-out

measures. All of this law-making and goal-setting misses the point. No matter what goals or limits we set, energy transition is driven by economics — we need abundant and reliable supplies that can be produced affordably. Banning the use of natural gas is just as bad as banning a ban on its use. Both policies ignore the underlying economics of energy transition.

During the past 15 years, we've made steady progress toward cleaner fuels, but we haven't done it by legislating demand. We've done it by innovation that has improved the economics of alternatives. Hydraulic fracturing, for all its negative consequences, has allowed the U.S. to shift more power production away from coal — a far greater environmental scourge.

In 2005, the U.S. generated half its electricity with coal. By 2019, that share had been cut in half. Natural gas, meanwhile, rose from 19 percent to 38 percent of all generation. The reason: fracking made gas cheap and abundant.

Those trends, by the way, may reverse in the short-term as skyrocketing demand for post-pandemic electricity collide with lower natural gas production, which is driving up gas prices. In July, average spot prices for gas were more than double a year earlier, and 62 percent above 2019.

The rise of electric vehicles and other alternative transportation fuels — natural gas among them — likely represents the next big shift. And that shift can't occur without natural gas. If we're using electricity for transportation, that means we need more natural gas, not less, in the short-term, to generate that additional

electricity.

“I think we could migrate away from crude oil, but I’m not sure it makes sense to migrate away from all fossil fuel,” said Christine Ehlig-Economides, a University of Houston petroleum engineering professor.

The phase-out argument seems to say that by switching away from gas appliances, demand for natural gas — and, of course, that great green bogeyman, fracking — will diminish. But that, if you’ll pardon the pun, is a pipe dream.

Renewables simply can’t meet the demand. They account for only 20 percent of U.S. generation, and it’s intermittent and weather-dependent. Even the Biden administration’s overly optimistic plan, released in early September, to decarbonize the grid by 2050 will be possible only with hefty federal investment of about \$210 billion.

But even so, achieving that will take another three decades. At the moment, renewables have neither the capacity nor the consistency to meet, on their own, the rising demand for electricity. What’s more, most large-scale wind and solar farms are built in remote areas, and we lack adequate transmission capacity to get that power to cities.

Combined-cycle natural gas plants are the best option we have for supporting renewables. The more renewables we build, the more we need natural gas plants to support them.

This is particularly true in Texas, where we became the biggest wind power producer in North America with the help of abundant — and cheap — natural gas supplies.

The drive to phase out natural gas is premature — a case of climate change fears getting ahead of rational policy. Cooking with electricity instead of gas isn’t going to save the planet. In fact, homes and businesses account for just 13 percent of the greenhouse gases the U.S. produces annually, according to the Environmental Protection Agency.

The move to cleaner fuels needs to focus on the dirtiest fuels

first — coal, then oil, then natural gas. The chemicals industry, for example, is shifting away from oil and turning natural gas as feedstock for plastics, pesticides, paints and other household items. Chemical companies use of petroleum accounts for more than 14 percent of all greenhouse gas emissions.

At the same time, natural gas producers need to understand that providing the foundation for our energy future comes with a responsibility to the public that the industry has largely ignored.

In the wake of the February freeze in Texas, which left some 200 people dead and cost billions of dollars in property damage the natural gas industry has taken little responsibility.

In fact, some players made billions and turned around and funneled that money to state politicians in for the form campaign contributions. State leaders can try to legislate against gas phase outs, but the industry now faces a consequence of its own inaction: consumers throughout the Midwest face higher gas bills. In Texas, consumers are facing billions in charges that could add to their bills over the next 30 years.

That could undermine public trust in natural gas as a heating fuel and cause more homebuyers to demand electric appliances.

The past 15 years has taught us that we can combat climate change and embrace energy choices that are cleaner and more affordable. Rather than mandating phase outs or banning them, elected officials need to focus on encouraging the most reliable and affordable options. Then let consumers choose.

In my case, I chose to phase out my gas water heater because of rising propane costs, but I still want the option of having gas appliances. If the February freeze taught us anything, it’s that we don’t have reliable energy infrastructure in Texas. So I’m hedging my bets: the new water heater is electric, an older one is gas.

The reason is simple: reliability matters too. We won’t be ready to phase out gas until we have an electric grid that can support growing demand for electricity. Even by the most optimistic assessments, that will take decades.

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# *SPOTLIGHT HITS SOLAR POWER, BUT EQUAL ACCESS QUESTIONS PERSIST*

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The Biden administration has its eyes unflinchingly set on the sun, this week announcing plans to shift the U.S. to 40% solar power by 2050.

The announcement is motivated by concerns about climate change, but solar investment has a healthy economic benefit for its owners – solar panels raise a home’s value on average by more than four percent.

Yet the benefits of rooftop solar, which is encouraged through government programs and tax policies, are disproportionately accruing in richer neighborhoods.

Early photovoltaic – or PV – adopters are four times more likely to be earning \$200,000 a year or more than those earning less than \$50,000, according to a 2021 study on income equity in solar adoption.

Solar policy currently also seems to encourage adoption on racial lines.

Neighborhoods with more than 50 percent black or Hispanic populations had significantly less rooftop solar installations than those with a majority white population, according to a 2019 study by Tufts University and the University of California, Berkeley.

The study compared households with comparable median household incomes, and found that majority black communities had 69 percent less rooftop solar installations than no majority communities.

One of the big problems for lower income and more ethnically diverse neighborhoods is a lack of knowledge on how to secure solar power, as well as its benefits.

There are a whole host of reasons for this.

The first issue is that of a broader question of infrastructure needs, and who should allocate them – and how. Community activists struggle with balancing the benefits of solar power, for example, with that of other needs.

“How do you say we are going to give people solar when they cannot even put a new roof on their house?” said Catherine Flowers, one of the founders of Energy Well Texas, which provides consulting services on energy options for communities. “When we talk about equity, that means giving people exactly what they need, not just what we want to give them.”

Making the decision about whether solar is the best solution for an individual’s financial needs and environmental priorities requires education on the options.

In places where solar power has become popular, there has typically been a first adopter who becomes familiar with the technology and essentially educates the local community. This solar first adopter then becomes that reliable voice of encouragement, paving the way for others to do so as well.

Research has shown that these solar experts tend to come directly from the solar workforce – which is also predominantly

white. Nearly two-thirds of the solar workforce self identifies as such - which could explain the lower levels of exposure to the benefits of solar in non-white majority communities.

The disparity in the solar industry is even more stark at the top: the U.S. Solar Industry Diversity Study 2019 found that 88% of all senior executives at solar firms are white, and 80% are men.

The NAACP is one group that acknowledges the link between solar jobs in communities of color and its potential to increase solar installations in these neighborhoods. In July, The NAACP published its own Equitable Solar Policy Principles, to ensure that the benefits of solar flow fairly to minority and poorer communities.

“We envision a solar-powered future that invests in under-resourced communities, creates local, sustainable wealth, and adds to community resilience and a healthier future for all,” said Denise Abdul-Rahman, the national field organizer for the NAACP Environmental and Climate Justice Program, in a written statement.

Putting more emphasis on training for jobs in fields like solar energy could also help open up opportunities for minority communities, according to said Reeves Clippard, the CEO and co-founder of A&R Solar, a Northwest-based solar installation company.

“Washington State has a great community college system,” Clippard said. “They are giving all kinds of skills to kids and retraining professionals – not just about how to get into solar, but how to understand it, and understanding the building science. There is a lot of training that needs to happen.”

For those ready to move forward on solar, the investments can also come in a variety of packages. One option is the installation of solar panels on a free-standing building, such as a house, or a multi-household dwelling.

There are many benefits in making this investment – the federal government provides a 26% tax credit for systems installed in 2020-2022, and 22% for systems installed in 2023.

Yet the way solar installation loans and tax incentives have traditionally been structured also makes them difficult for lower income households to benefit from.

“The fact is that the pathways to adopting renewables have largely been built on consumer debt,” said Tamara Jones, managing director at Clean Energy Works, a nonprofit that provides advisory services on clean energy solutions. “In the marketplace, there are two big assumptions – that you are rich enough to pay for it yourself, or that you will take out a loan to do so.”

Clean Energy Works is one of several organizations that are developing financial strategies for those who may not own their own building or whose credit and income profiles may not meet this standard.

For others, joining a solar co-operative is an option that could open the door for more citizens to the benefits of sun power.

It allows neighbors who are not ready to make a huge up-front commitment to instead share the expense of installing solar – and its benefits.

These co-ops organize 50 to 100 neighbors in a group that can then take on the process of purchasing a joint solar contract with an electricity provider. The solar co-ops essentially give these members a bulk-purchasing power while still maintaining an individual contract agreement. The benefits of these arrangements include discounted pricing and the assurance of a quality solar installation.

All of these strategies feel like a partial solution in weaning the country off fossil fuel power, but they are an example of the thousand little steps that will be needed to make an energy transition successful.

“We are not going to be able to address the climate change peril unless we get 100 percent of the people participating in this new clean energy economy,” Jones said. “We all need to be in the lifeboat or everyone drowns.”







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