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ENERGY INVESTMENT BANKING

MUSINGS FROM THE OIL PATCH

October 8, 2019

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Note: *Musings from the Oil Patch reflects an eclectic collection of stories and analyses dealing with issues and developments within the energy industry that I feel have potentially significant implications for executives operating and planning for the future. The newsletter is published every two weeks, but periodically events and travel may alter that schedule. As always, I welcome your comments and observations.* Allen Brooks

Summary:

The Rhyme Of Oil History Should Be Heard And Studied – Part 1

Nearing the 5th anniversary of OPEC's oil price drop, people wonder how this downturn compares to the one experienced in the 1980s. It was worse than now. Understanding what happened, and how the industry adjusted to enjoy the boom years of the early 2000s, will offer insights about how to navigate the current downturn.

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China EV Utopia Shows Subsidies Are Critical For Success

For the first time ever, China's EV sales have declined, surprisingly for two months and likely the 3rd quarter. This comes after the government cut subsidies. The Chinese EV industry is struggling, raising the possibility of a repeat of the China solar panel fiasco, which should be a warning for auto manufacturers globally.

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Should The LNG Market Worry About "Lower For Longer"?

The outlook for LNG is bright, but global prices are converging on the current low Henry Hub gas price, squeezing profits for global gas producers. The Age of Natural Gas is here, but shifting demand trends may be signaling that gas prices will remain low for a long time. Energy execs will be challenged to adjust strategies.

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Peak Climate Change Euphoria Has Passed; Now What?

Greta Thunberg lectured UN world leaders over ruining her future by not acting on climate change. This spectacle highlighted climate change hysteria, but the *Economist* wrote about how difficult it is to make climate models work, since no one knows how to deal with clouds. Unfortunately, our future is being planned and plotted based on these faulty models.

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The Rhyme Of Oil History Should Be Heard And Studied – Part 1

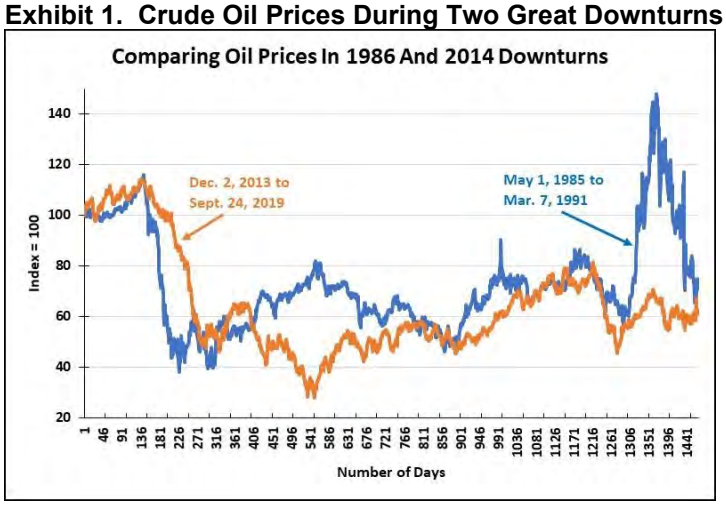
OPEC's usual way for managing the oil market was to adjust the organization's output

We are approaching the 5th anniversary of the infamous 2014 Thanksgiving Day OPEC meeting whose outcome disrupted the functioning of the global oil market. Up until then, OPEC's usual way for managing the oil market was to adjust the organization's output, ensuring a reasonable balance between global oil supply and demand. The cushion for balancing the market is global oil inventories, some of which belong to the organization's largest supplier, Saudi Arabia, and are held in the kingdom as well as in several strategic locations around the world. The balance of global oil inventories is scattered in or near large oil consuming markets around the world, under a structure established by the International Energy Agency (IEA), an autonomous organization established in November 1974 by the Organization for Economic Co-operation and Development.

Companies struggle to demonstrate they can operate while, at the same time, not destroying their balance sheets with too much debt and negative cash flows

As today's oil industry struggles with oil prices seemingly locked in a $45-$65 per barrel range, participants must adjust their expectations for oil prices not returning to $100 a barrel anytime soon. It also means accepting the inability for the industry to tap capital markets, as investors are shunning energy stocks due to fears their future is dimmed by the push for a "green" economy. Additionally, companies struggle to demonstrate they can operate while, at the same time, not destroying their balance sheets with too much debt and negative cash flows. This industry environment is unlike any time in its past, or so conventional wisdom tells us.

Exhibit 1. Crude Oil Prices During Two Great Downturns



Source: EIA, PPHB

Today's environment and challenges are similar to those the industry faced in the 1980s. Two years into the current downturn, people were asking whether this time was worse than the earlier era? In our view, the 1980s were worse, as that oil price collapse

had a greater impact on companies, cities, employees, and the financial sector than we have experienced this time.

To address the relative damage between the two periods, we began by examining how oil prices moved in each. The oil price in current dollars was indexed to starting dates approximately a year before the respective oil price declines. For the first 300 days, the pattern of oil prices in each period was remarkably similar. The recent price drop fell less rapidly than in the 1980s. In both cycles, after initially hitting bottom, prices traded sideways briefly before rising. After brief recoveries, the two cycles diverged, as oil prices sank lower in the current downturn, but continued recovering in the 1980s.

The 1985 fall saw oil prices drop to $11.44 from $27.33, a 58% fall, in only 10 months

To appreciate the speed of the respective drops, the 1985 fall saw oil prices drop to $11.44 from $27.33, a 58% fall, in only 10 months. By contrast, this cycle's initial fall was by only 50%, as prices went from $93.82 to $46.23 over 13½ months, or 3½ months longer than in the earlier cycle. The current price track rallied from its January 27, 2015 low, prior to declining to the lower-low of $27.45 on February 20, 2016.

The interesting visual from the chart is that by the time this cycle's low price was established, the earlier period's oil price had recovered roughly half its initial decline. That provided little solace, however, as prices subsequently began sliding, a decline that extended for 17 months from July 17, 1987 until Nov. 21, 1988, at which point the oil price had fallen to $12.98 from $22.39 per barrel.

The U.S. stepped up to supply Israel with military aid, earning the wrath of Arab countries in the Middle East

To understand the history of the 25 years following 1985, and its similarities and differences from the period since 2014, one should understand the role of the IEA. Global oil demand had mushroomed during the 1960s, and the United States found its oil wells starting to run dry. After having provided oil to the allies during World War II, which enabled them to defeat Germany and Japan, the United States enjoyed a unique role as the primary oil supplier to the world. By 1970, declining oil production changed the U.S. from an oil exporter into an importer, a condition that mushroomed as oil consumption increased sharply over the next few years. In October 1973, war broke out between Egypt and Syria and Israel (Yom Kippur War). The war was an attempt to drive the Israelis from the territory they had seized during the Six Day War in 1967. The U.S. stepped up to supply Israel with military aid, earning the wrath of Arab countries in the Middle East. The U.S. move was to counter the Soviet Union move to supply arms to Egypt and Syria.

In retaliation for U.S. involvement, the Organization of Arab Petroleum Exporting Countries (OAPEC) announced a 5% production cut, along with an embargo on oil flowing to countries supporting Israel. Those countries included: The Netherlands, Rhodesia, South Africa, Portugal and the United States.

The embargo caused oil prices to leap fourfold from $3 per barrel to $12

Saudi Arabia only agreed to join the embargo after President Nixon promised Israel $2.2 billion in military aid. Saudi Arabia was reluctant to use its oil as a weapon, fearing lasting fallout from its supporters and customers, a concern it has expressed in recent years. The OAPEC embargo included monthly production cuts, such that by December 1973, output was 25% below September's level. This prompted gasoline lines in the U.S., as drivers lined up to fill up. Moreover, the embargo caused oil prices to leap fourfold from $3 per barrel to $12. The price spike spawned a global recession and increased tension between the U.S. and its European allies, who blamed the U.S. for provoking the embargo with its assistance to Israel. The embargo ended in March 1974.

Governments discovered how little they knew about energy and how each country fit into the global picture

Governments discovered how little they knew about energy and how each country fit into the global picture. In the U.S., we created an 'Energy Czar' to oversee and coordinate all government departments dealing with energy. His power was virtually unlimited to deal with supply and demand issues. We attended a hearing in Hartford, Connecticut in which Energy Czar Bill Simon was taught that neighborhood gas street lights had a single valve controlling the flow - all or nothing. Utilities were soon installing multiple valves.

Better energy data was one mandate

To better understand the global energy market, as well as develop plans for handling future embargos or other supply disruptions, the IEA was created. Better energy data was one mandate, while other mandates included reducing oil dependency through conservation, developing alternative energy sources, promoting energy research and development, consulting the oil companies and oil producing and consuming countries to develop a stable international energy trade and rational management of the world's energy resources, and to prepare a plan for dealing with a major disruption of oil supplies.

The original founding members of the IEA were Austria, Belgium, Canada, Denmark, Germany, Ireland, Italy, Japan, Luxembourg, The Netherlands, Norway (under a special Agreement), Spain, Sweden, Switzerland, Turkey, United Kingdom, and the United States. Over the years, the IEA grew with the addition of Greece, New Zealand, Australia, Portugal, Finland, France, Hungary, Czech Republic, Republic of Korea, Slovak Republic, Poland, Estonia, and most recently Mexico.

Eleven years later, drilling had increased four and a half fold

The 400% increase in oil prices between October 1973 and March 1974 is referred to as the "first oil shock" for what it did to economies, financial markets and the energy industry. As the U.S. oil business stagnated during the 1960s, the drilling rig count fell from 2,000 to 1,000 in 1970. As oil prices began rising faster in the early 1970s than in the 1960s (from 1.7%/year to 8%/year growth), drilling took off. Eleven years later, drilling had increased four and a half fold, partly helped by the "second oil shock" when the Iranian government was overthrown and its oil was taken off the market in 1979.

Natural gas had fallen under the purview of the Federal Power Commission

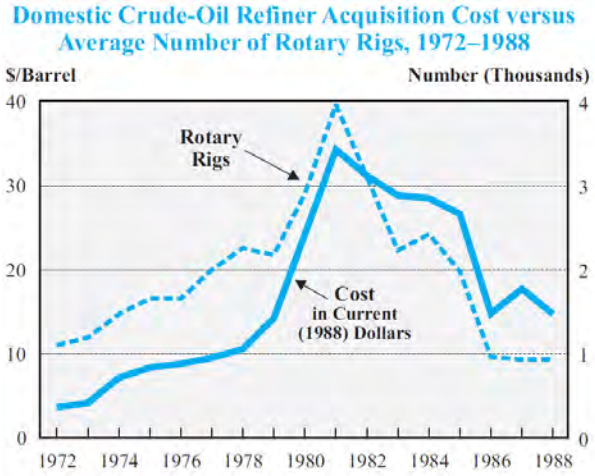
Another market event receiving little attention in oil industry history involved natural gas, which played a significant role in the oilfield service industry's growth. Natural gas had fallen under the purview of the Federal Power Commission (FPC), which regulated gas utilities, due to a Supreme Court decision in 1954 (Phillips Petroleum Co. vs. Wisconsin, 347 U.S. 672). The court determined that the sale of natural gas at the wellhead was subject to regulation under the Natural Gas Act of 1938. That required companies obtain a "certificate of public convenience and necessity" before selling gas in interstate commerce.

In 1974, the FPC set the national ceiling price at $0.42/Mcf, more than twice the 1959 price

Under the rules of the FPC, prices were determined by a return-on-cost analysis, but the agency was buried under an avalanche of requests for rate cases by the thousands of gas producers. To deal with the backlog, the FPC moved to set a maximum price for gas sold in five regions. Until the rate analyses were completed, prices were based on the average contract price for 1959-1960. By 1970, prices were only set for two regions. The FPC then moved to a national pricing arrangement and abandoned its return-on-cost calculation. In 1974, the FPC set its national ceiling price at $0.42/Mcf, more than twice the 1959 price, but still below market.

Due to the unwieldy price-setting mechanism, FPC gas ceiling prices always lagged market conditions, impacting drilling activity. Drillers focused on states with robust intrastate gas markets such as Texas and Louisiana. If gas was discovered, produced and sold to customers within the state's borders, its price was unregulated. This price freedom created an explosion in construction of petrochemical plants along the Gulf Coast given the assurance of gas supply, even though prices were multiples of the regulated interstate gas price. We remember intrastate gas contracts in the $6-$8/Mcf range, while interstate gas prices were set at 50-cents and 75-cents/Mcf. Guess where gas drilling was centered?

Exhibit 2. Drilling Rigs Follow Crude Oil Prices



Source: "An Examination of Banking Crises…"

Few analysts today can imagine a U.S. oil patch with over 4,000 active drilling rigs

The oil price explosion and the emergence of an active intrastate gas market, plus some help from higher interstate gas prices, drove drilling activity. Exhibit 2 (prior page) shows the relationship between the real price of oil ($1988) and the rig count. Few analysts today can imagine a U.S. oil patch with over 4,000 active drilling rigs. That we now have only 1,200 rigs working with huge production speaks to the impact of drilling technology improvements.

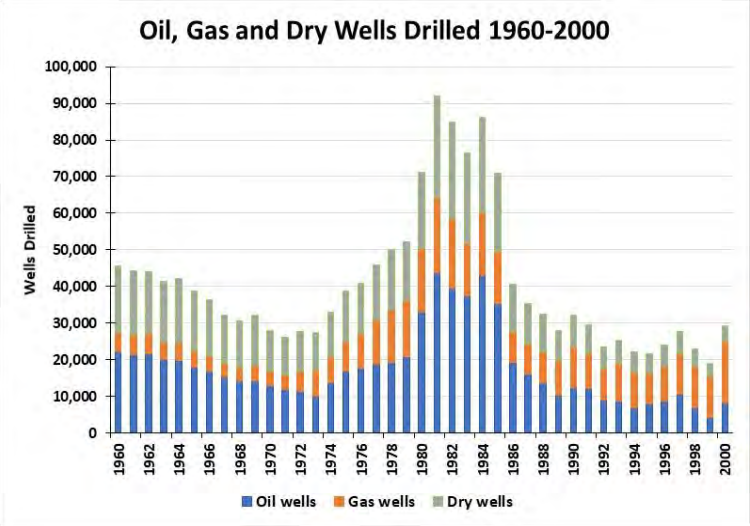
Due to the pricing problem in the interstate gas market, by 1978, 41% of annual gas sales were in intrastate markets, meaning that 46 states were sharing less than 60% of the nation's gas supplies. This market distortion prompted the passage of the Natural Gas Policy Act of 1978. The act provided for a phased deregulation of gas prices through 1985, except for "old" gas from wells drilled prior to April 1977, which remained controlled, and "deep" gas from wells drilled below 15,000 feet, which immediately became free of all price controls.

The deep gas price decontrol set off a drilling frenzy, especially in the Anadarko basin in Oklahoma

The deep gas price decontrol set off a drilling frenzy, especially in the Anadarko basin in Oklahoma. Deep gas prices soared to $10/Mcf and higher, multiples of regulated shallow gas prices. New gas plays in the Rocky Mountains were kicked off by price decontrol.

As expected, the sharp rise in oil and gas prices during the 1970s and early 1980s delivered economic blows to businesses and residents in the Midwest and Northeast. The first oil shock produced a recession, but as oil prices stabilized following the fourfold increase, they declined slightly during the next few years until the 1979 Iranian revolution sent prices skyrocketing. That revolution precipitated a global recession in 1980. With natural gas prices, especially deep gas prices, rising sharply, gas demand declined.

Exhibit 3. How Drilling Changed Between 1960 and 2000



Source: EIA, PPHB

By 1982, gas pipeline companies had cut in half the prices they were willing to pay for deep gas, creating a financial disaster for drillers

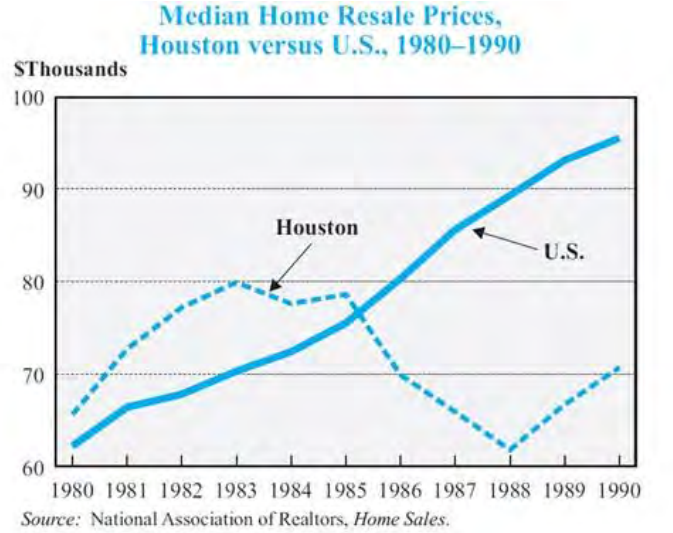
By 1982, gas pipeline companies had cut in half the prices they were willing to pay for deep gas, creating a financial disaster for drillers. Their incomes were falling at the same time deep drilling costs had escalated more than anticipated. This marked a tipping point for the domestic oil and gas industry, but also for the banking sector and oil patch communities dependent on the energy business.

One way of seeing the dramatic changes that happened to the oil and gas industry, and its oilfield service suppliers, is by examining the history of wells drilled. Exhibit 3 (prior page) shows that flat oil prices and declining production contributed to a steady decline in drilling during the 1960s. That all changed in 1974 after the Arab oil embargo of 1973. Drilling climbed throughout the 1970s and then exploded in the early 1980s, helped by the Iranian situation. High oil and gas prices compared to five years earlier drove drilling, albeit at a slowing rate, until the 1985/86 oil price collapse. At that point, as Warren Buffet is famous for saying, we quickly found out who was swimming without a swimsuit when the water went out.

Not only did companies fail, but the banks that lent them money were also destroyed, although the downturn in local economies and the housing sector added to the banking industry's woes

Recording exactly how bad the 1980s downturn was for oil and gas and oilfield service companies requires significant digging into historical records. We've already begun assembling a list of names of prominent companies that failed to survive the carnage, just as lawyers Haynes and Boone track E&P bankruptcies now. Not only did companies fail, but the banks that lent them money were also destroyed, although the downturn's impact on local economies and the housing sector added to the banking industry's woes. This period also witnessed the collapse of the savings & loan industry (S&L), which had boomed with the oil price explosion, but was decimated by falling home prices and lost jobs.

Exhibit 4. Houston Home Sale Prices Fell In 1983-1988



Source: "An Examination of Banking Crises…"

Houston's median home resale prices fell by slightly more than 20% during 1983-1988

Exhibit 4 (prior page) shows that Houston's median home resale prices fell by slightly more than 20% during 1983-1988. This coincided with national home resale prices climbing. To some degree, the national price improvement (note how the national price slope increased after 1985) may have benefitted from economic improvement helped by lower oil prices.

Houston lost more than 225,000 jobs, about one in eight, and the unemployment rate climbed above 9%

However, it wasn't a good time for homeowners in Houston. The picture of an abandoned home with grass overgrowing the yard in the Forestwood subdivision in Houston, was endemic of oil patch conditions. We had abandoned homes with unkept yards in our neighborhood on the west side of Houston, populated by energy workers, many of whom lost their jobs. Houston lost more than 225,000 jobs, about one in eight, and the unemployment rate climbed above 9%. Depending on their ability to find other jobs, or change careers, unemployed workers often had to make difficult decisions. Lack of jobs, or taking lower-paying jobs necessitated tough decisions over moving and "walking" on mortgage obligations, which reverberated throughout the S&L and banking industries in the Southwest. Over 200,000 homes stood vacant in the depths of the oil-recession of the 1980s in Houston.

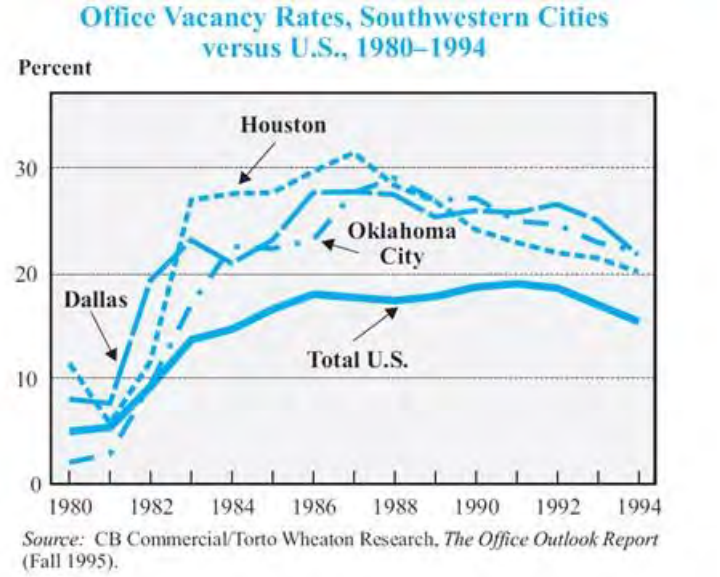
Exhibit 5. Abandoned Houston Home In 1980s

Source: ***Houston Chronicle***

Problems in the residential market were also seen in the office and commercial real estate markets

Problems in the residential market were also seen in the office and commercial real estate markets. We remember watching from our office window in downtown Houston the dismantling of a 10-year old, 15-story office tower owned by a bank. It was to be replaced by a new, taller office tower to house the Bank of the Southwest. The oil downturn erased that decision, and eventually the bank. The downtown block remains a parking lot, 35-plus years later!

Exhibit 6. Office Markets In Oil Patch Hurt By Downturn



Source: "An Examination of Banking Crises…"

Some laid off Midland geologists moved into tents after losing their homes

The experience in Houston was mirrored throughout the Southwest, as shown in other office vacancy rates. Midland was caught rebuilding its dingy and inefficiently configured Petroleum Club, only to open a modern, fashionable new club building in the depths of the oil price decline. The city had lived through numerous boom-bust cycles, but this one proved devastating. Some laid off Midland geologists moved into tents after losing their homes.

Our perspective on this era was shaped by our work. After the oil price collapse, the deteriorating industry overwhelmed companies that had relied on debt to grow. In the late 1980s, we were retained by the U.S. Maritime Administration (MARAD), who guaranteed loans for offshore drillers and support vessel owners, to help assess strategies for dealing with its distressed loan portfolio. Ultimately, we spent significant time testifying in bankruptcy court proceedings involving these distressed companies. While not a badge of honor, we testified in bankruptcy court hearings in virtually every federal court along the Gulf Coast stretching from Alabama to South Texas. That probably represented about a dozen bankruptcies.

One step in resolving the bankruptcy involved dealing with Global Marine's MARAD-backed debt

We were also appointed as the court expert on offshore markets and rig values in what, at the time, was the largest federal bankruptcy in Houston history. It involved Global Marine, one of the world's largest offshore drilling companies. One step in resolving the bankruptcy involved dealing with Global Marine's MARAD-backed debt. Due to our role in the federal bankruptcy court, for which Global Marine was obligated to pay us for the work, we were considered a consultant to the driller. That meant we could not advise MARAD, as we had been doing in all their other bankruptcy

cases. When the time came to negotiate a settlement, MARAD required Global Marine to involve us in the negotiations, and both agreed that I was to be the impartial facilitator.

From a peak of 4,500 active drilling rigs at the end of 1981, the count fell to 686 in July 1986

This was a very interesting period in our career, and provided insight into the destructive nature of the 1985 oil price collapse. From a peak of 4,500 active drilling rigs at the end of 1981, the count fell to 686 in July 1986. According to the Federal Reserve Bank of Dallas, sales of oilfield equipment plunged from $40 billion in 1981 to only $9 billion in 1986. The premier Offshore Technology Conference trade show that drew 100,000 visitors in 1982, could only muster 25,000 attendees five years later. Drilling rigs were no longer valued by their economic contribution, but rather on how much they weighed, as most were heading to scrap iron dealers. Companies such as Hughes Drilling in Oklahoma and Storm Drilling in South Texas were among industry casualties.

To appreciate the 1980s' devastation, one only needs to consider the history of Delta Drilling Company, a land driller headquartered in Tyler, Texas. The company was founded in 1931 by four immigrants and a Texan. It grew, while expanding into oil and gas production, and offshore drilling, a business it operated for 20 years from 1957 to 1975. At the company's peak in 1981, it operated 59 domestic drilling rigs and six foreign onshore rigs. The company went public that year, making many long-time employees millionaires overnight. In 1985, while operating under its new name, DeltaUS, it sold its oil and gas production and interests in two gas plants to Kerr McGhee for $140 million to pay down its debt. In 1988, DeltaUS sold 75% of its stock to P.A.J.W. Corporation, wholly-owned by Gordon Getty, for $7 million, plus a $2.5 million working capital loan. The following year the company entered Chapter 11 bankruptcy, emerging in 1990 as 100% owned by Mr. Getty. The company was ultimately sold to Nabors Industries (NBR-NYSE). One sad aspect of the Delta Drilling story was that its millionaire employees, by the time they could sell their stock, found its value was only a fraction of the initial price. These employees were assessed taxes based on that peak share price, creating huge capital gain taxes at a time when the stock was virtually worthless and bankrupting most of them. Bankruptcy was paired with lost jobs.

Many of the companies that had survived previous downturns failed to make it through this one

For those in the energy industry, and analysts who researched the industry, many of the companies that had survived previous downturns failed to make it through this one. Here are names of just a few of the companies that disappeared in this era: Texas Oil & Gas, Superior Oil, Damson Oil, National Oilwell, Houston Oil & Minerals, McMoran, Oryx, Pennzoil, Hughes Tool Company, Dixilyn-Field Drilling and Sedco. It is only a fraction of the universe of well-known companies that disappeared. The financial impact was both devastating and long-lived.

(Part two of this article will focus on quantifying the devastation wrought on the oil patch in the aftermath of 1980s oil price collapse and how it compares to today's downturn.)

China EV Utopia Shows Subsidies Are Critical For Success

EVs would allow it to create a new global business, which China would dominate

The electric vehicle (EV) future has largely been built on the embrace of this technology by China, the world's largest car market. As the country leapfrogged wired telephones directly into the smart phone era, the government viewed EVs as their opportunity to leap into a green economy. Moreover, EVs would allow it to create a new global business, which China would dominate. There was obviously a huge domestic automobile market in China, and with large cities facing environmental challenges as car and truck traffic choked their roads, the idea of "clean" vehicles was enticing. It wasn't lost on the government that China possessed a dominant position with respect to lithium and other rare mineral supplies critical for the development of a global battery business necessary to power EVs.

In 2008, when Beijing hosted the Summer Olympics, the government shut down local coal-fired power plants and suspended operations of steel foundries and other metal processing plants that emitted carbon and other particulates in an effort to clean up the city's famous dirty air. Faced with growing pollution in other major cities, the Chinese government told them to restrict the growth of internal combustion engine (ICE) vehicles in their urban areas. The government encouraged the cities to promote EVs, both through official licensing policies as well as via cash subsidies. This strategy now appears to be showing cracks.

The China market is suddenly stumbling, causing more cautious views about near-term EV growth projections from even its strongest proponents

The rapid growth of the Chinese EV market was perceived as the key driver behind the global EV industry. The China market is suddenly stumbling, causing more cautious views about near-term EV growth projections from even its strongest proponents. A proponent we follow has suddenly acknowledged the global slowdown in EV sales across all traditional markets he monitors, but he blames the EV slowdown on global economic weakness, which he sees reflected in lower total auto sales.

U.S. auto sales for the month of August increased 10.9% over a year-ago sales. Seasonally adjusted, annualized sales for August were 17.07 million units, well above forecasts of 16.5 million to 16.8 million, and up from 17.01 million last year. The August rate was also up from 16.82 million in July. August marked the fourth month this year for a sales pace of 17 million units or more, including three out of the last four months.

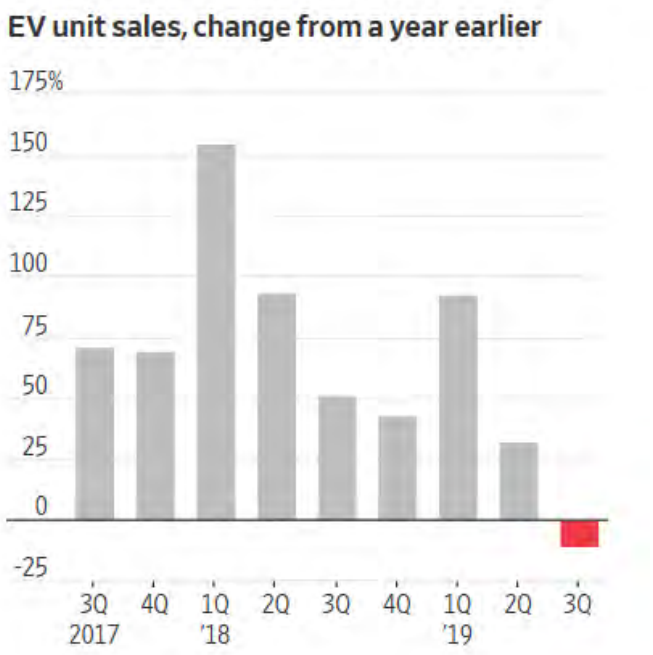
According to *Automotive News Data Center* estimates, U.S. auto sales were down 1.9% through July. The data shows that retail demand was lower, but fleet deliveries were stronger. Including the

August data, total sales are now only 0.3% lower year-to-date. The U.S. auto market is much stronger than other auto markets around the world, but people who believe a recession is just around the corner will caution that U.S. sales could deteriorate rapidly.

For the first time ever, EV sales fell in July and August by 5% and 11%, respectively

In China, auto sales fell 3% last year, but EV sales continued to increase. EV sales in 2018 were 1.26 million units, accounting for 60% of global sales. Year-to-date through August, total Chinese auto sales are down 11%, consistent with the much weaker overall economic figures coming from the country. For the first time ever, EV sales fell in July and August by 5% and 11%, respectively. A possible explanation was that given weak ICE sales and growing vehicle inventory, dealerships drove sales with steep discounts that undercut EV prices even with subsidies. If these conditions continue, the official target of 2.0 million EV sales in 2020 looks questionable.

Exhibit 7. EV Sales In China Falls For First Time



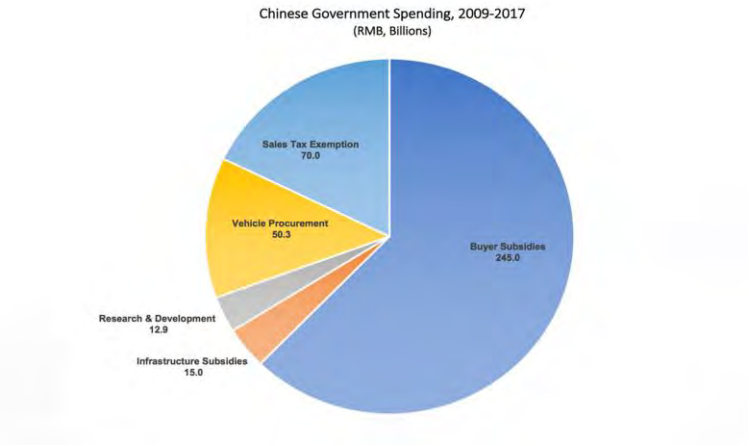
Source: ***WSJ***

The supposed all-in commitment to EVs by China may be wavering, at least until its auto sales recession ends

Another problem for the Chinese EV market, which has contributed to lower sales in recent months, was the government's decision to cutback subsidies. They are programmed to end next year. The supposed all-in commitment to EVs by China may be wavering, at least until its auto sales recession ends. Earlier this year, the government told cities they should loosen their restrictions on ICE car sales to help boost overall vehicle demand. Ultimately, the government needs to deal with its subsidy program, which has

become critical to the health of the EV market. Through 2018, China has spent $58 billion on direct and indirect EV subsidies according to the Center for Strategic and International Studies (CSIS).

Exhibit 8. EV Subsidy Spending In China



Source: CSIS

Has China built an EV bubble that is about to burst?

The bulk ($36.6 billion) of subsidies have gone to EV buyers, although the government has also cut sales taxes. Government EV purchases, as well as research and development spending, have also been important for the industry. In the end, however, the country has created a large number of EV manufacturers with so much capacity that it is difficult to see how these companies will become profitable in the foreseeable future. This scenario raises the question: Has China built an EV bubble that is about to burst?

The government has introduced new performance-based subsidies, such as rewarding battery manufacturers that achieve certain thresholds in capacity

After rolling back the blanket subsidy support for Chinese EV manufacturers, the government has introduced new performance-based subsidies, such as rewarding battery manufacturers that achieve certain thresholds in capacity, allowing EVs to travel further. During a roundtable on the future of mobility held during *Fortune Magazine's* Global Sustainability Forum, Andy Zheng, founder of Aspiring Citizens Cleantech, a big data company, said that using distance as a metric for rewarding EVs is misguided.

Mr. Zheng said, "There's a great anxiety about batteries and range but without data, we're all just guessing." To illustrate this point, he used Shenzhen taxis as an example. They were all converted to EVs in 2017. Mr. Zheng invited guesses about what percentage of those 22,000 electric taxis regularly travelled more than 50 kilometers (31 miles) in any single trip. Guesses ranged from 2% to 5%. According to Mr. Zheng, the actual answer is 0.3%. "So how do we define excessive production?" he asked? "Maybe excess is manufacturing that isn't innovative. We need subsidies that support innovation."

The company announced the recall of 4,803 cars, equal to about 25% of all the cars it has ever delivered

Recent news reports highlighted troubles for EV manufacturer NIO Inc. (NIO-NYSE) due to both excess manufacturing capacity but also quality issues. The company announced the recall of 4,803 cars, equal to about 25% of all the cars it has ever delivered, for battery problems. Batteries reportedly burst into flames and emitted smoke, which certainly raises quality concerns in the minds of buyers.

NIO was portrayed this past March by the CBS network's "60 Minutes" television news show as a "Tesla killer." Since then, NIO's share price is down 80%, including a 20% drop the day it announced the recall and cancelled its earnings conference call. During its June quarter, NIO burned through $600 million of the $1.1 billion of cash on its March 31st balance sheet. The company's top two investors have pledged to invest $200 million, which will last six weeks at the current cash burn rate. The problem is that NIO has a negative 10.9% profit margin, losing roughly $2,500 per vehicle sold, with little prospect of costs being cut soon. This condition is not unique to NIO, as it exists throughout the global EV industry.

The hope is that EVs will enable China to go from being a technological follower to a leader in the automobile sector

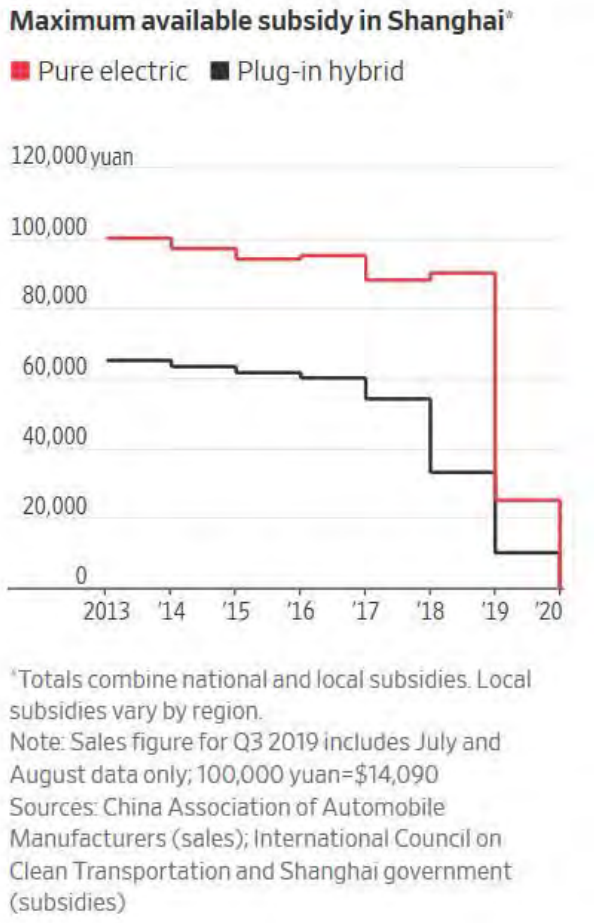
In the late 2000s, China identified EVs powered by lithium-ion batteries as a "strategic emerging industry." It is a key sector within the "Made in China 2025" high-tech development program the government conceived for its economy. The hope is that EVs will enable China to go from being a technological follower to a leader in the automobile sector, reduce the country's dependence on imported oil and improve its air quality.

As a study by CSIS points out, "government intervention has not jump-started the EV market so much as substituted for it." The study contends that much of the industry activity would not exist without government support and involvement. According to CSIS, government support has been equal to over 42% of all EV sales. That is an unbelievably high figure for any industry, even in China. Relating this spending on EVs to any return measure is impossible, since the industry has never been profitable. This investment may be viewed as a measure to create jobs in China, but the government's decision to cut back subsidies suggests that is not how the spending is viewed in official circles.

The Chinese government cut EV subsidies by 65% in June and will end them in 2020

The Chinese government cut EV subsidies by 65% in June and will end them in 2020. The fall in EV sales in July and August cannot be considered unrelated, even given the steps dealers took to sell ICE vehicles. Cutting or eliminating subsidies has been followed with lower EV sales in virtually every instance, no matter where in the world it has happened.

Exhibit 9. EV Subsidies In China Are Falling



Source: CSIS

The biggest, and maybe more critical question is whether EVs are set to repeat China's solar panel experience

The biggest, and maybe more critical question is whether EVs are set to repeat China's solar panel experience of a few years ago. If so, there could be serious ramifications for the global auto industry, as companies are gearing up with huge investments in new EV manufacturing capacity around the world.

Consolidation within the industry is a likely outcome, but who will drive it?

Much like solar panels, there are hundreds of EV manufacturers with substantial capacity in China, meaning industry profitability is nowhere on the horizon. Chinese consumers still see EVs as "ethical" purchases, but they worry about car quality, range, maintenance and the cost of battery replacements, just as do American and European customers. When the day of reckoning arrives for these Chinese EV manufacturers as they run out of cash, they will turn to their investors or governments for lifelines. How investors and governments respond will be interesting to watch. Consolidation within the industry is a likely outcome, but who will drive it?

CSIS suggested that the "result could be millions of Chinese cars dumped on global markets, which could threaten the livelihoods of producers up and down the supply chain

With EVs as a key ingredient for China's future economic success, the lagging economy might cause the government to decide, sooner than later, to push its companies into the global market. Turning to the global market for sales could also happen without the government's push, as companies see this strategy as how to reach profitability sooner. In its report, CSIS suggested that the "result could be millions of Chinese cars dumped on global markets, which could threaten the livelihoods of producers up and down the supply chain that are not the beneficiaries of the Chinese state's deep pockets. It is not hard to imagine a counter wave of antidumping and countervailing duties adopted to stop this flood."

The scenario sounds familiar because it mirrors the experience of China's solar industry, as it went through its boom-bust cycle and sought a solution. The fallout went far beyond China's shores, as solar panel producers elsewhere were driven out of business. A negative result, according to experts, is that the most prevalent kind of solar panels on the market today is less than optimal but dominates because China scaled up the technology prematurely. This could also be a risk for China should the world one day find that hydrogen fuel cells are more efficient and safer for powering transportation than lithium-ion batteries. China would be locked into an inferior technology.

According to BP Statistics, China generated 85.4% of its electricity in 2018 with fossil fuels, with coal accounting for 58%

China's backing for EVs is not only predicated on its desire to dominate a "new technology" industry, but also because it believes it will deliver cleaner air. This is a social issue, but also a global image problem, something that haunts China's leaders. The problem is that for all the recent emphasis on investments in new wind and solar capacity and slowing new coal power plants, the country still depends on fossil fuels for its electricity to charge EVs. According to BP Statistics, China generated 85.4% of its electricity in 2018 with fossil fuels, with coal accounting for 58%. In contrast, wind (2.5%) and solar (1.2%) provide only a minor share of power. Hydropower and nuclear provide over twice the amount of clean energy that China's renewables deliver.

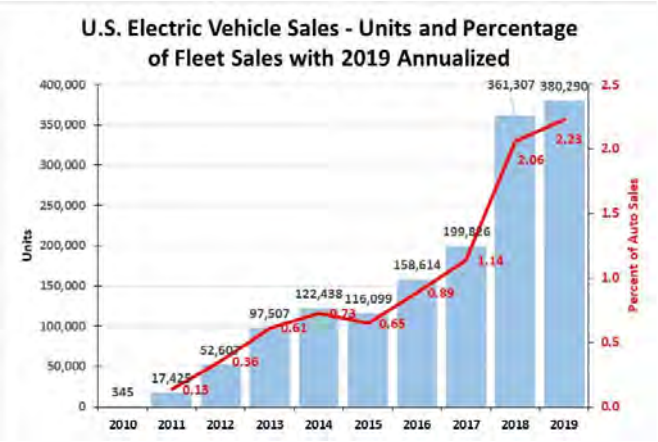
All these problems—lack of profits and threatened supply chains—might be justified should the move to EVs lead to cleaner air. But given China's dependence on fossil fuels, especially coal, EV adoption is not reducing air pollution but relocating it.

Although auto sales in the United States have not fallen as much as other markets around the world, EV sales in the past two months have declined

Although auto sales in the United States have not fallen as much as other markets around the world, EV sales in the past two months have declined. Through the first half of 2019, monthly EV sales averaged a 20% increase over the prior months, although the monthly gains ranged between 0.3% and 51.1%. It was not surprising that EV sales in May and June increased year-over-year by 16.8% and 51.1%, respectively. Those were the months leading up to the next cut in subsidies for EVs sold by Tesla (TSLA-Nasdaq) and General Motors (GM-NYSE). Subsequently, July and August

EV sales fell by an average of 20.6%. The net impact was a reduction of 52,000 EV sales in our estimate of annualized sales based on the first six months compared to the year-to-date data. That means there would be 12% fewer EV sales in 2019.

Exhibit 10. How The EV Market Has Grown



Source: ***Insideevs.com*****, PPHB**

How much longer auto manufacturers will be willing to sell EVs at a loss remains a huge unknown?

Since global auto sales data lags one month behind domestic sales reporting, our revised annualized EV sales projections for the additional month of data shows only a 40,000-unit reduction. Since we know that China EV sales fell significantly in August, when the complete data is available, we expect our global EV sales projection will fall by more than 52,000 units. How much longer auto manufacturers will be willing to sell EVs at a loss remains a huge unknown, but given government mandates and continued subsidies, EVs will not disappear from manufacturers' vehicle line-ups. The projections of hyperbolic growth curves for EVs, however, may be revised, which may tame the enthusiasm for them.

Will the government throw money at the EV sector while further loosening ICE restrictions to pump up its economic growth rate, or will it resort to the solar panel approach and push EV exports?

Given the first ever decline in EV sales in China, and the extremely rough auto sales market (down for 17 months in a row), one wonders what will happen in the future? Already, projections show economic growth in China in 2020 may fall below 6%; a rate that has not happened in decades. Will the government throw money at the EV sector while further loosening ICE restrictions to pump up its economic growth rate, or will it resort to the solar panel approach and push EV exports? Either path will send shock waves throughout the automotive world. China's actions are something to be watched.

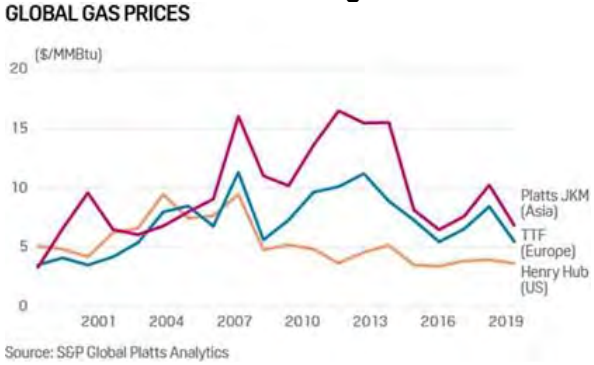
Should The LNG Market Worry About "Lower For Longer"?

Since 2013, LNG prices in Asia and Europe have been trending lower toward a convergence with the U.S.'s low Henry Hub natural gas price. This is largely due to a surplus of global LNG liquefication capacity, but also shifting regional demand trends. Lower LNG

The real battle ground for LNG contracts is being waged in Asia, as Japan, the world's leading importer, experiences demand shifts

prices have opened numerous trade opportunities, especially in Europe, for U.S. shippers capitalizing on our country's low-cost domestic gas supply. The real battle ground for LNG contracts is being waged in Asia, as Japan, the world's leading importer, experiences demand shifts. At the same time, Japan is being surpassed by China, as the leading LNG importer due to its apparent insatiable natural gas demand. These changes are creating new market dynamics with interesting potential ramifications for the global LNG industry.

Exhibit 11. LNG Is Trending Toward HH Low Prices

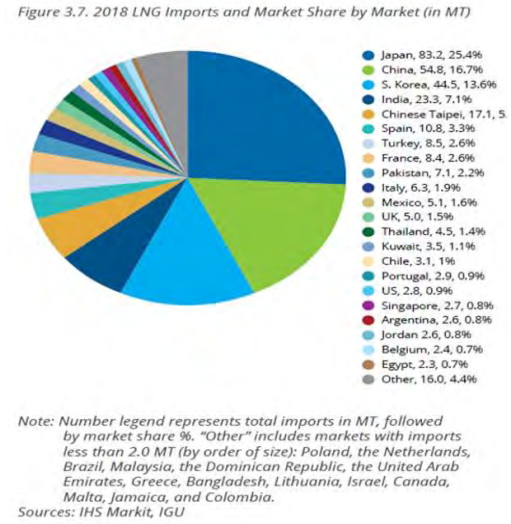


Source: Platts Analytics

The Asian LNG market is the world's largest

The Asian LNG market is the world's largest. The top five LNG importers for 2018 were all from the Asia/Southeast Asia region and accounted for 222.9 million tons per annum (mtpa) of consumption, representing 67.8% of total LNG trade. The top three importers were Japan, China and South Korea. The second tier of importers included India and Chinese Taipei, which used only about half the volumes of South Korea.

Exhibit 12. Asia/Southeast Asia Dominates Market

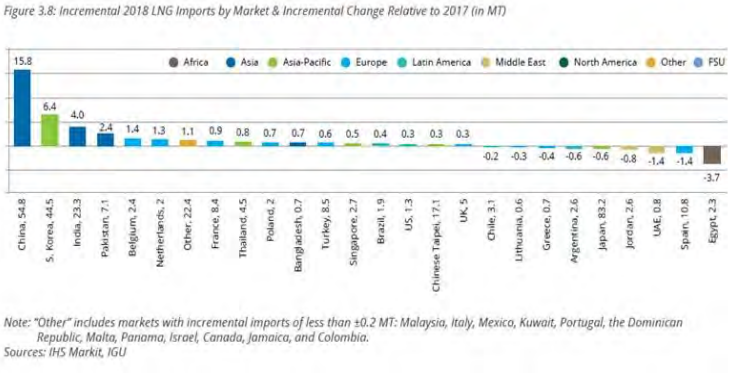


Source: IGU

The greatest growth was recorded by China, whose consumption rose by 15.8 million tons (MT), two and half times the growth rate of South Korea (6.4 MT) and nearly four times India's consumption increase of 4.0 MT

To appreciate the LNG market's evolving dynamics, consider the annual consumption growth by country for 2018. (Exhibit 13.) The greatest growth was recorded by China, whose consumption rose by 15.8 million tons (MT), two and half times the growth rate of South Korea (6.4 MT) and nearly four times India's consumption increase of 4.0 MT. At the other end of the scale, of the nine countries who experienced LNG consumption declines in 2018, Japan was in the middle with a 0.6 MT decline, after having experienced increases for years.

Exhibit 13. Japan's LNG Consumption Fell In 2018



Source: IGU

Japan is reducing its LNG use for power generation, as the nation begins restarting its nuclear power plants that were shutdown following the 2011 Tōhoku earthquake and resulting tsunami that crippled the Fukushima Dai-ichi nuclear power plant with its three generating units. Given concern over the safety of the country's other nuclear plants, Japan's regulators had ordered the idling of all 54 of the nation's nuclear plants, rapidly changing the Asian energy market and sharply escalating the country's LNG consumption.

In 2010, Japan's nuclear operations were producing 288 tera-watthours (TWh) of electricity, approximately 25% of the country's output. Oil and gas were primarily utilized to offset the immediate shortfall from the nuclear plant shutdowns. Oil demand for power generation doubled between 2010 and 2012. Oil-generated-electricity went from 99TWh in 2010 to 197 TWh in 2012, replacing 36% of the 272 TWh of electricity lost due to the nuclear plant shutdowns.

Natural gas for electricity generation in Japan increased by 100 TWh to 461 TWh, accounting for 37% of the lost nuclear power

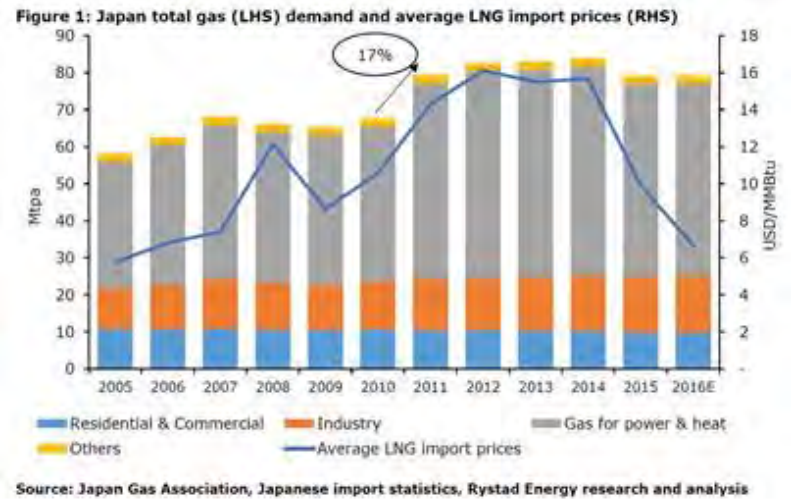
Natural gas for electricity generation in Japan increased by 100 TWh to 461 TWh, accounting for 37% of the lost nuclear power. Japan's coal business did not benefit to any degree, as coal-fired power plants had already been running in a base-load mode with high utilization. The remaining lost nuclear electricity output was offset by power conservation policies and efficiency gains, which helped to reduce the country's overall use of electricity. This is an important

market dynamic, as Japan has one of the oldest populations, which leads to less power use. Japan also has a highly restrictive immigration policy, which contributes to a declining population.

Over the same period, Japan's average LNG import prices rose from $10.50 per million British thermal units (MMBtu) in 2010 to $16.10 in 2012

The net result of the nuclear outage was a surge in LNG imports. Between 2010 and 2012, LNG imports increased 27%, from 70 to 87 mtpa. Over the same period, Japan's average LNG import prices rose from $10.50 per million British thermal units (MMBtu) in 2010 to $16.10 in 2012. This rise occurred at the same time U.S. natural gas prices were falling from $4.40 per thousand cubic feet (Mcf) to $2.77. Japan's LNG imports peaked in 2014 at 89 mtpa and began declining in 2015 when the first of the country's nuclear power plants returned to operation. This history is seen in Exhibit 14.

Exhibit 14. Recent History Of Japan's Gas Use



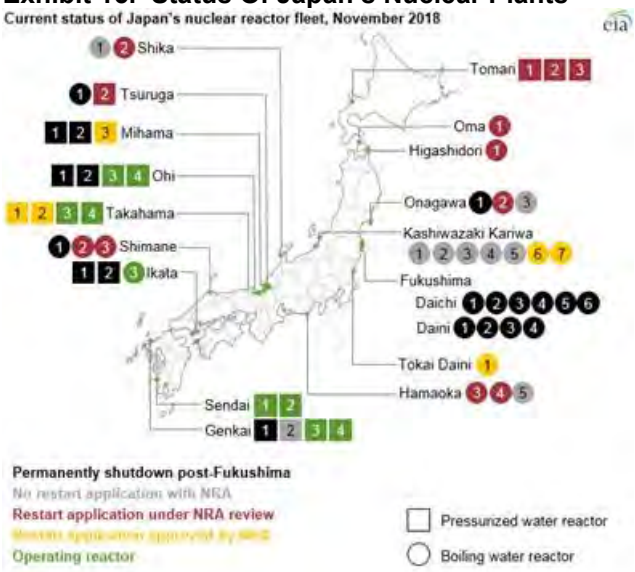
Source: IGU

Japan's regulators have allowed a handful of nuclear power plants to come back on line once safety steps were taken, including arrangements allowing a plant to operate from a remote control-room in the event of a terrorist attack. Two plants came back into service in 2015, with an additional one in each of 2016 and 2017. Five nuclear plants restarted in 2018, bringing the industry up nine operating plants as 2019 began. Several others came back into service but were soon shut down due to local opposition.

No new nuclear plants will be started up in 2019 due to lengthy start-up issues, along with local opposition

No new nuclear plants will be started up in 2019 due to lengthy start-up issues, along with local opposition. The pace of the nuclear industry recovery is slowing and has become more complex since the regulators have declined to grant delays of the terrorist safety regulation compliance deadlines. In fact, several of the nine plants currently operating will be shut down in 2020 due to them not meeting the terrorist operating requirement deadlines.

Exhibit 15. Status Of Japan's Nuclear Plants

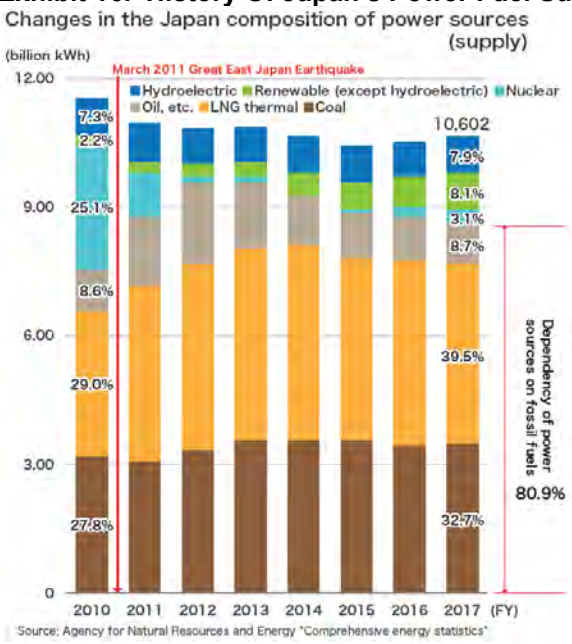


Source: METI

That represents 10% Japan's gas consumption by the power sector

The U.S. Energy Information Administration (EIA) estimated that the nine restarted nuclear reactors will displace some 5 MT of LNG imports per year, equal to an average of 700 million cubic feet per day of natural gas. That represents 10% Japan's gas consumption by the power sector. However, with several operating plants forced to shut down in 2020, that estimated displacement will be reduced.

Exhibit 16. History Of Japan's Power Fuel Supplies



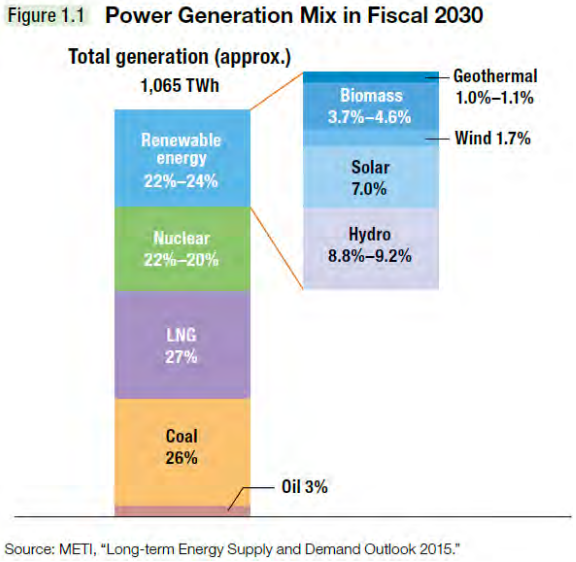
Source: METI

At the same time, the delay in the nuclear plant recovery is a setback for the nation's future electricity generating plan. The nine operating plants have only 8.7 gigawatts (GW) of generating capacity. While the figures aren't available, the addition of five nuclear power plants in 2018 has probably contributed to a doubling, or possibly slightly more, of the share of power coming from the nuclear sector depicted in Exhibit 16 (prior page). The chart shows how dramatically Japan's power sector was impacted by the 2011 nuclear accident.

The nation's long-term energy plan, as part of its greenhouse gas emissions reduction commitment, anticipates nuclear power providing 20%-22% of the nation's power in 2030

The challenge for Japan is to get its nuclear industry, the fourth largest in the world, back on stream. The nation's long-term energy plan, as part of its greenhouse gas emissions reduction commitment, anticipates nuclear power providing 20%-22% of the nation's power in 2030. That would represent 3½ times the share of electricity share coming from nuclear now. Today's share will fall when plants are shut down until they can comply with the terrorist operations requirement. Achieving the 2030 targeted nuclear electricity generating share means operating approximately 30 nuclear plants. The problem is that of the 25 nuclear plants that have applied for restart, Japan's regulators have only approved 15 requests. Six of the approved plants have yet to resume operations, as local opposition exists and safety upgrades need more time.

Exhibit 17. Japan's Plan For Energy In 2030



Source: METI

Japanese utilities and trading companies are committing $10 billion over 2017-2027 to LNG projects worldwide

As more nuclear power capacity is restarted, the need for LNG will decline. Japanese utilities and trading companies are committing $10 billion over 2017-2027 to LNG projects worldwide. These projects include LNG Canada and Mozambique LNG. This utility spending is part of a growing LNG investment phase, despite the current low gas prices.

Over $50 billion of LNG investments have been approved this year, a record

According to the International Energy Agency (IEA), over $50 billion of LNG investments have been approved this year, a record. Dr. Fatih Birol, IEA executive director, told the LNG Producer-Consumer conference: "This year, 2019, already broke the highest amount of (final investment decisions) for the first time ever, $50 billion." This translates into more than 170 billion cubic meters (bcm) of natural gas liquefaction capacity taking a final investment decision (FID) this year, surpassing the prior record in 2005 of 70 bcm. The FIDs are being led by Canada and the United States.

Argentina may also be in position to supply LNG in the mid-2020s

There will also be more LNG coming from Qatar, the world's LNG superpower, which has committed to increase its output by up to a third in the next five years. Russia and Australia are also targeting more gas supply. A new study from energy consultant Wood Mackenzie projects that Argentina may also be in position to supply LNG in the mid-2020s. That country is positioned to supply gas during the seasonally strong winter demand period, as Argentina's summer, when domestic gas use is low, coincides with winter in the Northern Hemisphere. Many of these new LNG projects being proposed benefit from their production of condensates that enhance the economics.

Dr. Birol told the audience that the increase in new LNG liquefaction capacity is due to demand growth from Asia, where China is projected to surpass Japan as the world's largest LNG consumer within five years, and in Europe where local gas supplies in the Netherlands and the North Sea are in decline. European natural gas production has fallen by half over the past decade, and with the prospect that the giant Dutch Groningen gas field will be shut in a few years, the need for more imported gas, either from Russia by pipeline or as LNG, will be needed. LNG demand may also be helped by the desire of European countries to reduce dependency on Russia for their gas supply, something that has created geopolitical issues in the past.

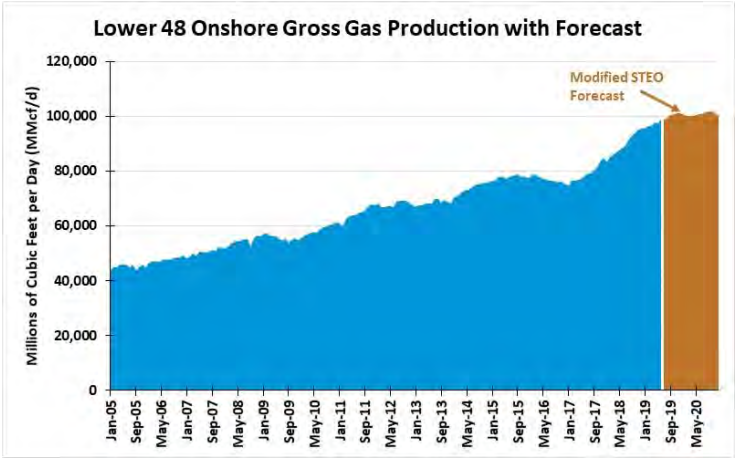
The IEA's optimistic view of LNG's future is shared by other forecasters, including Platts' Analytics who forecasts a 40% increase over the next decade due to Asian demand growth. The Age of Natural Gas has arrived, despite the attacks on the fuel from environmentalists because its low price is creating competitive headwinds for wind and solar power.

Given the growth of U.S. natural gas production, and projections for growth to continue, LNG shippers are aggressively adding to their liquefaction capacity

Given the growth of U.S. natural gas production, and projections for growth to continue, LNG shippers are aggressively adding to their liquefaction capacity. There are more than two dozen LNG export projects moving through the regulatory process, which requires approval from the Department of Energy for where the gas can be shipped, and then from the Federal Energy Regulatory Commission (FERC) for construction and environmental compliance. The problem is that weather, construction and regulatory bottlenecks have slowed actual capacity development. At the start of 2019,

forecasts expected LNG feed-gas supplies to top 9 billion cubic feet per day (Bcf/d). Because of problems, it is more likely capacity will barely surpass 7 Bcf/d.

Exhibit 18. U.S. Onshore Gas Production Growth



Source: EIA, PPHB

FERC has now established a new regulatory office in Houston to handle LNG approvals that may help speed the approval process

At the start of June, there were seven LNG projects with 81.5 Mtpa of export capacity awaiting final FERC approvals. Only two have been approved – one on the final day of its 90-day approval window and the other more than a month beyond its window. FERC has now established a new regulatory office in Houston to handle LNG approvals that may help speed the approval process. Given the current LNG oversupply, the delays may not prove as disruptive as it appears on the surface.

Another LNG market dynamic undergoing change is the use of oil-linked pricing in long-term contracts. Approximately 70% of these contracts are oil-linked, but the IEA's Dr. Birol believes it will fall to 50%, with the balance of contracts being gas-price linked. The expectation is that the United States will account for two-thirds of global growth in LNG exports and it possesses the cheapest natural gas available, which will drive the pricing shift.

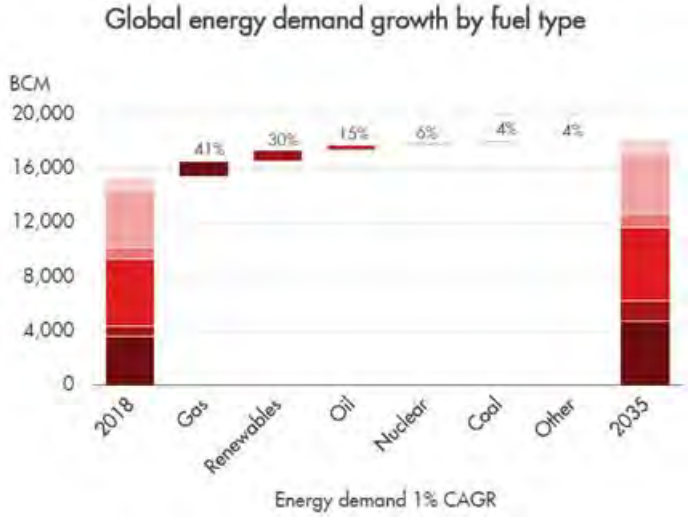
Japan expects to have surplus LNG supplies in the future and desires to have the flexibility to ship any surpluses to other markets

Another change being pushed by Japanese utilities is to free up contract destination restrictions. Whenever these long-term contracts come up for price renegotiations (usually every 3-5 years), the utilities are seeking complete freedom to redirect volumes to other markets, which is not permitted currently. These changes signal Japan expects to have surplus LNG supplies in the future and desires to have the flexibility to ship any surpluses to other markets, reducing fuel costs for the utilities.

According to the report from consultant McKinsey and Company about the LNG market to 2035, natural gas is the only fossil fuel that will experience growth over the entire forecast period. LNG plays a

significant role in the growth, as does pipeline supplies and local gas use. Royal Dutch Shell's (RDS.A-NYSE) 2019 LNG Outlook report has a more bullish outlook for fossil fuels, which is shown in Exhibit 19. The report shows increases for all fossil fuels, but natural gas shows the greatest growth potential, followed closely by renewable energy.

Exhibit 19. All Fuels Grow, But Natural Gas Grows The Most

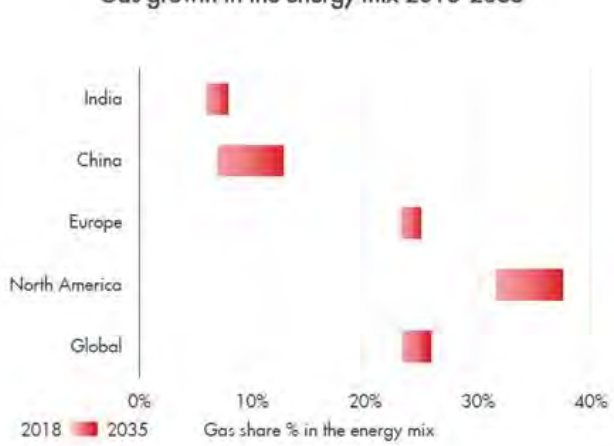


Source: Shell

Shell sees natural gas use in the energy mix of major countries and regions increasing meaningfully out to 2035

Shell sees natural gas use in the energy mix of major countries and regions increasing meaningfully out to 2035. China's increase is not surprising, but North America's is probably somewhat surprising, but that demand growth reflects the continuing switch from coal to natural gas for generating electricity, and the use of natural gas to fulfill the interruptible periods of renewable energy.

Exhibit 20. More Gas Will Be Used Everywhere

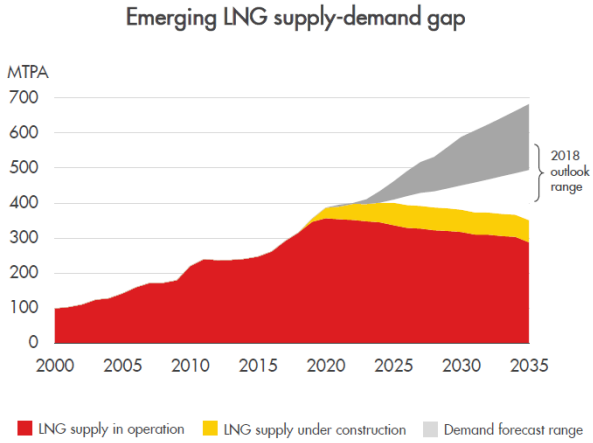


Source: Shell

Virtually every long-term forecast suggests periods when supply and demand will be out of sync

While LNG is projected to have a bright future, virtually every long-term forecast suggests periods when supply and demand will be out of sync. That is due to the stair-step pattern of LNG supply additions that come from bringing into service discrete chunks of supply that often do not exactly match demand increases. Today's LNG market, with its low LNG prices, reflects significant new LNG supplies arriving ahead of demand growth. That growth, based on estimates for how natural gas demand will increase, will be matched in the foreseeable future. However, long-term, we cannot identify all the liquefaction projects needed to meet projected demand growth in the forecast out-years. This is shown in Exhibit 21.

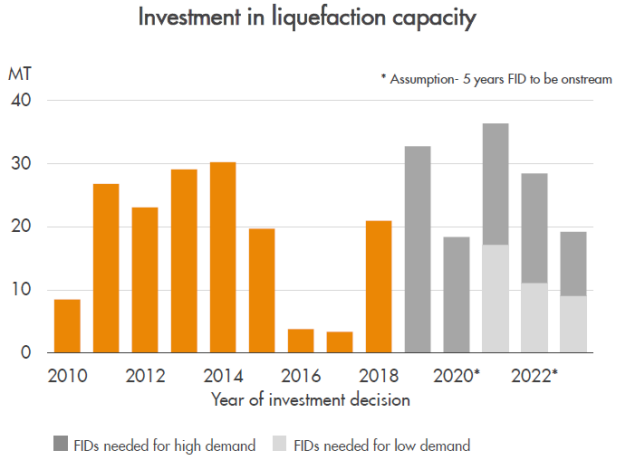
Exhibit 21. Where Will Future LNG Supply Come From?



Source: Shell

As Exhibit 22 demonstrates, beyond 2020, the ability to project liquefaction capacity additions becomes less certain. In this case, Shell shows what FIDs will be needed to meet both high and low LNG demand scenarios.

Exhibit 22. World Will Need More LNG Supply



Source: Shell

Each LNG project requires significant time from FID to output

Given these long-term forecasts showing periods of LNG market tightness and weakness, LNG companies will be careful about the timing of their FIDs. Each LNG project requires significant time from FID to output. As we have seen in the U.S. this year, these delays can throw the capacity addition timetables off meaningfully, and with more cargoes likely to be moving under spot contracts, pricing can become more volatile. That volatility may cause shippers to become more conservative in future FIDs, reinforcing pricing volatility.

This price projection suggests McKinsey doesn't foresee pressures to drive LNG prices substantially higher to levels as in 2012-2014

The long-term LNG price forecast offered by McKinsey is for a $7/bcm price. That price is about where Asian and European prices are currently, and above Henry Hub prices. This price projection suggests McKinsey doesn't foresee pressures to drive LNG prices substantially higher to levels as in 2012-2014. What prices have been factored into new LNG FIDs is unknown, but they are likely higher than now. Such a modest price outlook would be in keeping with forecasts for crude oil, suggesting that producers must deal with a world of "lower for longer." Controlling costs and capital spending will become key in business strategies. Welcome to the reality of the new energy world.

Peak Climate Change Euphoria Has Passed; Now What?

We were amused to watch Swedish climate change star teenager Greta Thunberg lecturing the leaders at the United Nations, but we wondered how many of them have teenagers?

Much was made of the estimated four million students and their parents protesting in the streets around the world against the failure of politicians to act against climate change the Friday before the start of the United Nations annual session. Of course, there are seven billion people on the planet, and major cities can turn out a quarter of that number for parades honoring professional team championships. We were amused to watch Swedish climate change star teenager Greta Thunberg lecturing the leaders at the United Nations, but we wondered how many of them have teenagers?

As we watch the clock count down to the planet's Armageddon in a decade if nothing is done about climate change, we are inundated with articles and op-ed pieces about how and why we should tear up current lifestyles and prohibit those living in poverty around the world from enjoying higher living standards to effect some climate change actions. Will they work? Who knows? Will they matter? Who knows? What we do know is that everyone's life will be changed.

A recent *Wall Street Journal* op-ed proposed a carbon tax scheme that includes a dividend from the revenues raised to people paying the tax

A recent *Wall Street Journal* op-ed proposed a carbon tax scheme that includes a dividend from the revenues raised to people paying the tax. Upon reading the article and letters in response a few days later, we were reminded of what we wrote when we explored an article written in *Foreign Policy* by Ted Nordhaus, an environmental policy expert and co-founder of the Breakthrough Institute, on that very idea. Mr. Nordhaus is the nephew of Noble Prize-winning economist William Nordhaus, an economic modeling and climate expert. The younger Mr. Nordhaus demonstrates that dramatic

Economists love carbon taxes because they fit well into their computer models, but the real world doesn't work the way the models tell us

climate change projects won't save the world, but rather slow, quiet, incremental changes will prove more successful. He argued that economists love carbon taxes because they fit well into their computer models, but the real world doesn't work the way the models tell us. He actually argues that tax subsidies have been more successful in reducing carbon emissions, and nuclear power is one of the best ways to reduce greenhouse gases. His arguments are counter to the conventional view.

His solution is to go "technology by technology and sector by sector" to negotiate solutions

As he wrote about federal carbon tax proposals and the Green New Deal: "…they share a common assumption: Concern about climate change is significant enough to support an explicit, far-reaching, economywide approach to the problem." He went on to write: "Unfortunately, there is little evidence to back that idea." His solution is to go "technology by technology and sector by sector" to negotiate solutions. He cited the recent legislative efforts to support commercialization of advanced nuclear and carbon capture technologies as successful results from his approach. We found his arguments to be very persuasive.

More importantly, most people fail to understand that all the projections about climate change and global warming are based on the assumption that more CO_2 in the atmosphere will create more heat. This is based on physics, but there is much more to the interaction between CO_2 and the climate's sensitivity – its feedback system – that can impact that relationship than can be captured in computer models. Simple isn't always best.

One difficulty that climate models have yet to solve is modeling the impact of clouds

As the climate change hysteria was reigning in Turtle Bay, the *Economist* published "The climate issue." It contained a wide array of articles about aspects of climate change and how different parts of the world were dealing with them. One article, however, was called "Throwing the dice." It was about the uncertainties of climate change and the computer models that are predicting the climate future upon which the current hysteria is based. One difficulty that climate models have yet to solve is modeling the impact of clouds. As the *Economist* wrote: "Clouds, for instance, present a particular challenge to modelers. Depending on how they form and where, they can either warm or cool the climate." Better get this assumption correct if you want to believe the model's prediction.

Carbon is moved through the climate by living organisms – plants and humans

Another problem for climate models is the carbon cycle. Note that carbon is moved through the climate by living organisms – plants and humans. Their actions are not easily modeled, further contributing to climate model uncertainty. Uncertainty is seldom mentioned when scientists, let alone politicians who have no clue about sensitivities, discuss the models' predictions.

We have written two articles in recent years discussing a climate model maintained by the Steklov Mathematical Institute of Russian Academy of Sciences in Moscow that was the most successful in

The biggest news about this model is that it predicts global temperatures rising less than the threshold of concern, an increase of +1.5oC

modeling past climate. This model successfully captured the temperature cooling, warming and pausing periods in the history of temperature data, something other models have failed to achieve. This Russian model, surprisingly, does not rely on CO_2 as its driving mechanism. The biggest news about this model is that it predicts global temperatures rising less than the threshold of concern, an increase of +1.5°C. Nobody pays attention to its prediction because it doesn't fit the narrative climate scientists need in order to keep government funding flowing for their research efforts. While the *Economist* wrote pages of text trying to put a positive spin on the challenge of climate models, the magazine had to admit to the reality that they are not particularly accurate. We wonder whether climate change protagonists will pay attention?

Despite the global euphoria over climate change that dominated the news a few weeks ago, the next big political event isn't until the first two weeks of December. Enjoy the respite, but rest assured there will continue to be articles and protests in the interim to keep the fires burning, but climate change isn't likely to dominate the news cycle as intensely as in September. Maybe we will have time to focus on the real science and realistic solutions.

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