PPHB

Energy Musings

Insights into the Energy Industry

Allen Brooks, Managing Director

Energy Musings *contains articles and analyses dealing with important issues and developments within the energy industry, including historical perspective, with potentially significant implications for executives planning their companies' future. While published every two weeks, events and travel may alter that schedule. I welcome your comments and observations.* Allen Brooks

January 24, 2023

This will be the final issue of *Energy Musings* published under the PPHB banner. The next issue will be available at www.energy-musings.com in two weeks.

Winter Storm Elliott Shakes Up Electrify Everything Narrative

As demand escalates in areas with high electric heating share, how will the grid handle more demand? Last December's storm shows serious problems with our grid and power supply.

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Renewables As Our Energy Future Confront Pushback

Flyover country is the locus of much of our renewable energy. Communities increasingly are pushing back. We examine the data and its impact on renewable energy growth.

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Battle Over Methane Ignores Where It Comes From

The oil and gas industry is under attack over methane emissions. The largest source of methane emissions is wetlands. A revision to land use carbon emissions changes the equation.

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Winter Storm Elliott Shakes Up Electrify Everything Narrative

In the days leading up to Christmas, North America was assaulted by a record winter storm and polar-cold temperatures that swept down across Canadian plains and deep into the United States mid-section before moving steadily eastward. The storm brought record-cold temperatures across the majority of the United States from Colorado to the eastern seaboard and as far south as Miami, Florida, as well as parts of Eastern Canada. Some U.S. locations experienced blizzard conditions marked by high winds and record snowfalls. Modern life was disrupted as weather conditions forced the implementation of a complete driving ban in Buffalo, New York, for five-and-a-half days, canceled more than 18,000 flights, saw rail service disrupted for extended periods, and left about 6.3 million households in the U.S. and 1.1 million in Canada without power for some part of the storm. Merry Christmas.

Winter Storm Elliott, as it was named unofficially by the *Weather Channel*, was described by The National Weather Service in Buffalo as a "once-in-a-generation storm." The National Oceanic and Atmospheric Administration's Weather Prediction Center said it was a "historic arctic outbreak," and politicians in New York referred to the Buffalo situation as the "Blizzard of the Century." That name is funny in a way since Buffalo's snowfall total was just two inches more than what fell across upstate New York during the Blizzard of '88. That is 1888.

That storm dumped record snowfalls in many locations across the Northeast that in many cases have yet to be exceeded. We are familiar with the Blizzard of '88 because we were told about it by our great-grandparents whose home in Connecticut was buried by snow up to the second-floor windows forcing them to tunnel to get out. This picture of a sidewalk tunnel in Farmington, Connecticut reflects what many people in the region were forced to resort to after the Blizzard of '88.

Exhibit 1. Tunnels To Allow Walking After Blizzard Of '88 Record Snowfall

Source: *wunderground.com*, New York Historical Society

In a 2020 article by weather historian Christopher Burt, he wrote:

> Few storms are as iconic as the "Blizzard of '88". It was the deadliest, snowiest, and most unusual winter storm in American annals. No storm of similar magnitude has occurred anywhere in the contiguous United States since. Over 400 perished, including 200 in New York City alone, many literally buried in drifts in downtown Manhattan. On March 13, 1888, the temperature in New York fell to 6°F during the storm—still the coldest temperature ever measured there so late in the season.

Burt also pointed to several other facts about the storm that are noteworthy. The blizzard was the first widely photographed natural disaster in the United States. Therefore, we have added several additional photos we found fascinating.

Exhibit 2. Street Scene In New York City During Blizzard Of '88

Source: *wunderground.com*, C.H. Jordan/Library of Congress

Exhibit 3. Clearing Up Record Snowfall In Saratoga Springs, New York

Source: *wunderground.com*, Saratoga Springs History Museum

Burt noted several changes to American life that came from the Blizzard of ’88. In New York City, the storm led to a high-line rail disaster that prompted city officials to embrace creating a subway system and dismantling the elevated rail lines. Additionally, the loss of all communications from Washington, D.C., northward resulted in the burying of telegraph, and later, electric lines in many parts of the Mid-Atlantic and Northeast regions. One wonders what changes may emerge from Winter Storm Elliott.

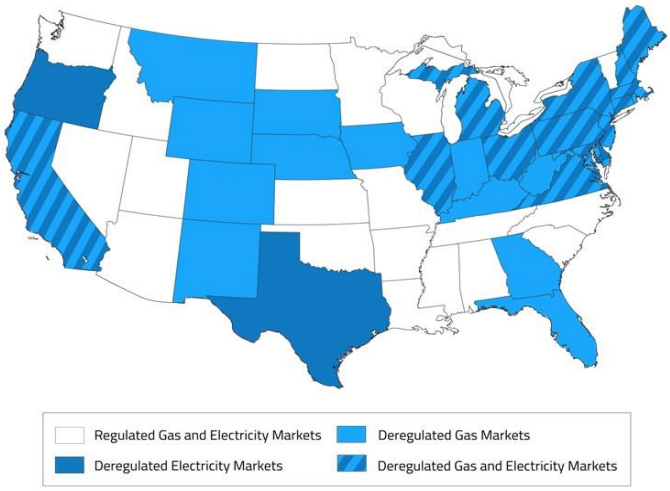
The storm led to power disruptions in many regions of the country, given Elliott’s extensive range. We cannot remember a time when as many regional electricity grids issued rolling blackout warnings to their customers in anticipation of the storm’s arrival and during its presence. From Texas to Michigan, from Tennessee to Atlanta, and from the Carolinas north to the Mid-Atlantic and Northeast regions, people were asked to reduce their electricity usage to help local utilities manage the grid’s supply/demand balance. In many locations, grids experienced record power demands. The cold in the Southeast created a major problem because of a preponderance of homes heated with electricity. Given the strong winds, homes with minimal insulation struggled during the coldest part of the day – at night – when power supplies were constrained by the loss of solar power’s contribution to supply. As New England has found in recent years, the greatest demand for power often comes at night during the winter because of record-low temperatures and electric heating demand when solar power is absent.

While millions of people suffered power outages, a national disaster was avoided. That has not stopped official inquiries from beginning into what went wrong within regional grid operations. The public is beginning to realize the fragility of the nation’s power grid and the need to upgrade it. The challenge is that many systems have experienced significant increases in intermittent clean energy sources that make sustaining grid operations more difficult. Remember, electricity must be generated and delivered at the time it is demanded by consumers, and the stability of the current must be maintained constantly, or the system risks collapsing.

As people begin questioning why our grid is experiencing such problems, fingers are being pointed at how electricity suppliers are regulated, and the role intermittent power sources are playing in potential rolling blackout scenarios. Several recent articles have examined whether the promises of lower-cost electricity in a deregulated industry are true. We decided to examine the issue.

The following map shows the regulatory status of utilities in the various states. Seventeen states have deregulated their electricity industries, with 15 of them also freeing up their natural gas utilities.

Exhibit 4. States With Deregulated Electricity And Natural Gas Markets



Source: ***electricchoice.com***

To examine the question of whether electricity deregulation has been good for local ratepayers, we examined the power price history of each of the 17 deregulated states since each became deregulated. We compared those histories against the average electricity rates paid by the nation's ratepayers living in the remaining regulated states. The following chart shows the deregulated states, the year in which their electricity systems were deregulated, their average electricity price in cents per kilowatt-hour in the year of deregulation, and the rate for October 2022, the most recent data available. We are then able to calculate the compounded annual increase in the state's electricity rates as well as the rate of increase for the comparable period for the regulated states.

Exhibit 5. Deregulated State's Electricity Prices Rise Faster

State	Year of Deregulation	Years	First Year	October 2022	CAG Rate	USA
CA	1995	27	11.61	25.49	3.0%	2.2%
CT	1996	26	12.05	25.04	2.9%	2.3%
DE	1999	23	9.17	16.16	2.5%	2.7%
IL	2002	20	8.39	17.25	3.7%	3.0%
ME	1998	24	13.02	23.06	2.4%	2.6%
MD	1995	27	8.43	15.86	2.4%	2.2%
MA	1998	24	10.60	26.28	3.9%	2.6%
MI	2008	13	10.75	18.18	4.1%	2.3%
NH	1998	24	13.92	30.44	3.3%	2.6%
NJ	1999	23	11.40	16.42	1.6%	2.7%
NY	1999	23	13.23	23.29	2.5%	2.7%
OH	1997	25	8.63	16.16	2.5%	2.4%
OR	1997	25	5.56	11.91	3.1%	2.4%
PA	1999	23	8.86	17.63	3.0%	2.7%
RI	1996	26	11.81	24.64	2.9%	2.3%
TX	2002	20	8.05	14.77	3.1%	3.0%
VA	2001	21	7.79	14.61	3.0%	2.7%

Source: EIA, PPHB

What we found was that 13 of the 17 deregulated states have experienced rate increases faster than the regulated states. There is no pattern in the rate of increases in the deregulated states' rates, but that likely reflects the power supply mix and how it is changing within the individual states. For example, Oregon has access to substantial amounts of hydropower that historically has been low-cost. However, as the state's economy has grown and power demand has increased, utilities in Oregon have had to rely on new power sources that are more costly than traditional hydropower.

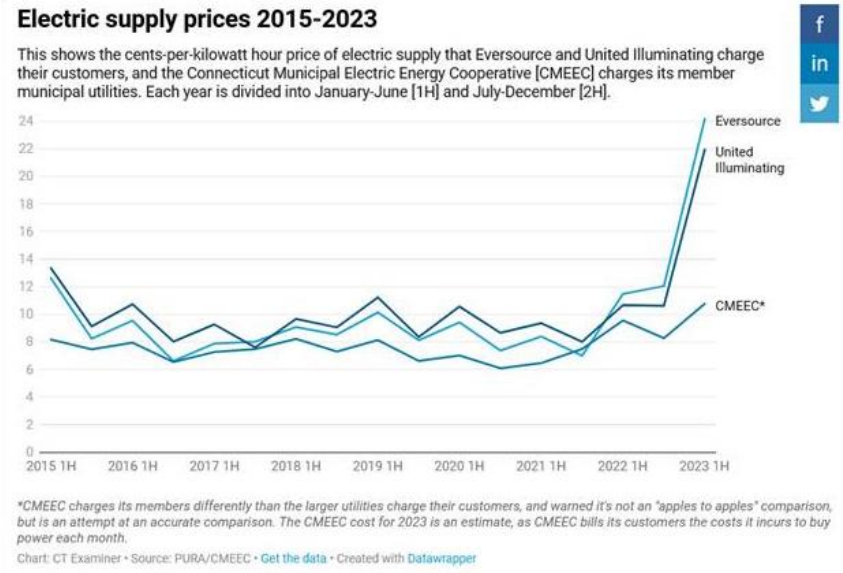
There are other operational characteristics of deregulated states, just as there are for regulated states, which can influence electricity prices. A recent article in *The Connecticut Examiner* discussed the political investigations into the sharp increase in utility rate increases that went into effect on January 1st. Customers of Eversource and United Illuminating, Connecticut's largest electric utilities and publicly owned, are paying at least 43% more for electricity, a steep cost increase that the state's smaller municipal utilities have so far managed to avoid. Customers of Norwich Public Utilities will see just a 12.5% increase in electricity prices this half year, while Groton Utilities customers will see about a nine percent increase. How can utilities in the same state post such dramatically different rate hikes that are tied to their natural gas purchases? Aren't all the utilities buying gas from the same market? It appears the difference is in the gas purchasing policies that are regulated by the state's Public Utility Regulatory Authority (PURA) versus those for municipal utility buyers.

As *The Connecticut Examiner* wrote:

> Both Eversource and United Illuminating follow a relatively rigid process set by PURA, the state's energy regulator, to buy their supply of electricity for customers, compared to the Connecticut Municipal Electric Energy Cooperative which has more flexibility to seek cost savings in the market.

They went on to note that Eversource held four procurements in 2022 - April, July, September, and October – to buy power for its customers from January through June 2023. These procurements resulted in a 24.17 cents per kilowatt-hour price, twice what customers had been paying since July. On the other hand, the Connecticut Municipal Electric Energy Cooperative (CMEEC) buys the power for six municipal electric utilities in the state, including Groton and Norwich. CMEEC can purchase power for its members on any day and for any duration – the next hour or for five years ahead. The CEMEEC policy of opportunistic buying has consistently led to a lower cost of power supply. CEMEEC operators acknowledged the success of their policy last year, but they also have experiences where their purchase timing was poor.

Exhibit 6. Differences In Gas Buying Policies Led To Lower Cost



Source: ***CT Examiner***

Given the uniqueness of each state's power system, we need to do a deeper investigation before rendering a verdict about whether deregulation has caused the higher rate of electricity price increases or has only been a contributor. This will involve examining changes in the generating sources of power over time. Additionally, we need to examine the generating capacity of each power source and how those have changed over the interim.

However, we read another article attempting to demonstrate that those states with the highest penetration of wind energy in their power supply have experienced a much faster increase in their electricity rates than electricity prices rose nationwide over the same time. That appears to be true.

The following chart shows the biggest source of electrical power for each Canadian territory and U.S. state. Note that wind power is the number one source of electricity in Oklahoma, Kansas, Iowa, and South Dakota. The buildout of wind generation capacity took off in 2010 and has continued until now. Through 2021, retail power prices in those four states have risen by an average of 27% compared to an 18% increase for U.S. average electricity prices. The smallest rate increase was experienced by Oklahoma (+20%), while the largest was in South Dakota (+36%).

Exhibit 7. States With The Most Wind Power Have Higher Cost Electricity

Source: ***Elements***

The reason those states with the largest source of power coming from wind have experienced higher rates of price hikes lies with the nature of the power. Intermittent wind power necessitates that electric utilities provide backup power supplies for when the wind does not blow. That cost is

not assigned to the price of wind power. In addition, wind-generating sources are usually located far away from where the power is used, so new transmission lines must be built. This expense adds to the utility's cost structure that must be recouped through higher electricity rates for all ratepayers.

On the other hand, wind and solar power are being and have been showered with healthy subsidies to encourage their development. These subsidies provide intermittent power suppliers with incentives to operate their facilities at as high a rate as possible while being willing to accept negative power prices at times just to keep the turbines turning. The pricing distortions in power markets are allowed in deregulated markets, while in regulated markets the utility controls the power supply and is only able to earn its regulated rate of return on investment. This structural difference in electricity markets likely goes a long way to explaining the divergence in electricity prices.

There will be other examinations of the operational and cost structure of electricity systems because of the large number of rolling blackout notices issued during Winter Storm Elliott, and the numerous blackouts experienced. These examinations need to be conducted soon and in-depth because our politicians are potentially setting the nation on a path for our power structure that will make it less stable and more expensive. Besides the higher cost of electricity, there are the costs associated with disruptions. In many cases, these disruptions are causing individuals, families, and businesses to act and make investments to sustain their normal living standards. It is quite possible, and maybe probable, that the "electrify everything" strategy for dealing with climate change is moving too fast. Staying on such a course may prove much more disruptive, costly, and life-threatening than anyone imagines.

Interestingly, in Connecticut, one electric utility company CEO has suggested that deregulation has not produced the consumer benefits that were expected. He believes it is time for Connecticut to revise the regulations and allow utility companies to get back into owning the electricity-generating assets. That would make them subject to a rate of return regulations.

Frank Reynolds, the president and CEO of United Illuminating (UI), said in commentary for *CT News Junkie* that the system is not working. "There is considerable misinformation regarding who ultimately bears responsibility for these rising costs, so let me be clear," Reynolds said. "Electric generator supply costs have risen over 150% over the last three years, enriching out-of-state generators at the expense of Connecticut families. The realization of lower electric supply costs for residents has clearly not materialized: the energy market structure in the state and New England is irrevocably broken." He went on to say, "In the long term, we at UI would welcome the opportunity to discuss empowering utilities to have further control over the price of generation to help mitigate these cost increases,"

In a counter to Reynolds, Dan Dolan, the president of the New England Power Generators Association, responded in his own commentary for *CT News Junkie*, entitled "Beware the Desperate Utility Company." Dolan defended the companies he represents, saying competition in the power generation market has increased efficiency, lowered wholesale electricity prices, and reduced carbon emissions.

A long-standing argument by consultants and renewable power developers for generation market decontrol has been that these moves will lower wholesale electricity prices. As we have demonstrated above, that has not been the case, especially in New England where every state that decontrolled its electricity market has experienced higher rate increases than regulated states.

Dolan suggested that UI is trying to get back into the power generation business via a "side door." UI is owned by Avangrid, the renewable power subsidiary of the Spanish global utility company, Iberdrola. Avangrid is developing the 1,200-megawatt offshore wind farm Commonwealth Wind, among others. Commonwealth Wind has contracts to supply power to both Massachusetts and Connecticut utilities. In had asked the Massachusetts Public Utility Commission (PUC) to stop its review of Avangrid's Power Purchase Agreements (PPA) with three local utilities because the price was too low to support the financing of the wind farm. As we wrote in our last issue, the PUC rejected the request and approved the PPAs forcing Avangrid to decide if it wants to build a highly unprofitable and very expensive offshore wind project.

According to Dolan, Avangrid has made clear that the Connecticut PPAs are equally problematic. So far, Avangrid has not made any formal move to cancel the contracts, but Dolan thinks it is only a matter of time. Dolan asks: "Is the Massachusetts experience the ghost of Christmas future for Connecticut?"

New England was particularly hard-hit by the Winter Storm Elliott as the super cold temperatures, which peak at night when renewables are limited or not available. The region is highly dependent on natural gas to generate power, but in winter, because of the pipeline capacity shortage, local utilities resort to expensive liquefied natural gas (LNG) imported from abroad or restarting coal and oil-fired power plants. During the four-day storm, New England power companies burned 31.5 million gallons of fuel oil to generate electricity.

At the peak of electricity demand on December 24th, oil generated 34% of the region's electricity, with nuclear contributing 19%, natural gas at 16%, imported power at 11%, and renewables (including burning wood and trash, besides wind, solar, and hydropower) at 6%. A reason for oil having a larger than normal winter fuel share was the spike in natural gas and LNG prices partially caused by Europe's gas crisis. At the same time oil was providing the lion's share of power, Massachusetts Governor-elect Maura Healey was calling for the state to generate 100% of its power from fossil-free fuels by 2030.

At a recent hearing with Connecticut and Massachusetts officials examining the electricity price hikes, some Connecticut elected officials suggested adding more fossil fuels, at least for a while. Connecticut Senator Norm Needleman (D) of Essex, after acknowledging the need to be sensitive about adding fossil fuel capacity, commented, "I'm not comfortable putting my residents at risk, and they are definitely at risk. I think we need to understand that and do everything we can to mitigate that."

Economics clashed with energy security risks. Healey wants Massachusetts to have 100% clean electricity within seven years. However, utility officials told the officials it could be 10-20 years before New England is no longer reliant on natural gas to fuel its power plants. Massachusetts' outgoing governor's administration recently published a report saying the region may be still dependent on natural gas in 2050.

Winter Storm Elliott may have brought the conundrum facing electricity utilities, power generators, consumers, and grid operators to the forefront. A deeper examination of our current electricity systems and grid vulnerabilities is needed. The idea of electrifying everything and only using clean electricity may not be realistic for decades. Popular political policies driving such a rapid transition may be a ticket to disaster. Who will be held accountable?

Renewables As Our Energy Future Confront Pushback

Climate change activists, including leading global organizations such as the United Nations and the International Energy Agency, are pushing for world economies to transition to renewables from fossil fuels quickly and fully for their power supply. These voices hail the emission reduction benefits of "clean energy" supplies while ignoring the problems of their intermittency and the land mass they require. The following from the Executive Summary of a 2020 report titled "Renewables, Land Use, And Local Opposition In The United States" from the Brookings Institute summarizes the challenge facing wind energy.

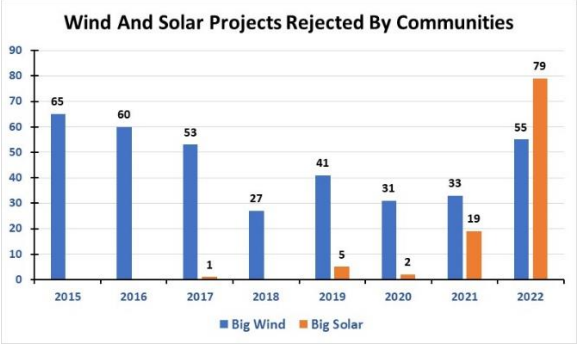
> Wind and solar generation require at least 10 times as much land per unit of power produced than coal- or natural gas-fired power plants, including land disturbed to produce and transport the fossil fuels. Additionally, wind and solar generation are located where the resource availability is best instead of where is most convenient for people and infrastructure, since their "fuel" can't be transported like fossil fuels. Siting of wind facilities is especially challenging. Modern wind turbines are huge; most new turbines being installed in the United States today are the height of a 35-story building. Wind resources are best in open plains and on ridgetops, locations where the turbines can be seen for long distances.

As the report discusses, communities across the country are pushing back on the siting of wind and solar renewable energy projects. Residents are often reluctant to have towering wind turbines or acres of solar panels sitting next to their homes. Wind turbines are known to have constant light flickering and noise issues, besides red lights on top of them blinking all night.

While the Brookings report mentioned the remote siting of renewable energy projects and the need to build transmission lines, this is becoming a major challenge as power must often be transported hundreds and maybe even a thousand miles from the generation site to consumers. It is possible to install solar panels on rooftops in metropolitan areas while it is impossible to put up wind turbines.

Our friend and energy writer Robert Bryce has been documenting the pushback to renewable energy projects by communities for years. He maintains a Renewable Rejection Database on his website where he documents decisions by local governments to restrict or reject renewable energy projects from being built in their communities. The database documents wind project rejections starting in 2011. As of January 11, 2023, there are 368 wind and 106 solar projects that have been rejected or restricted.

Exhibit 8. Rejected Renewable Projects



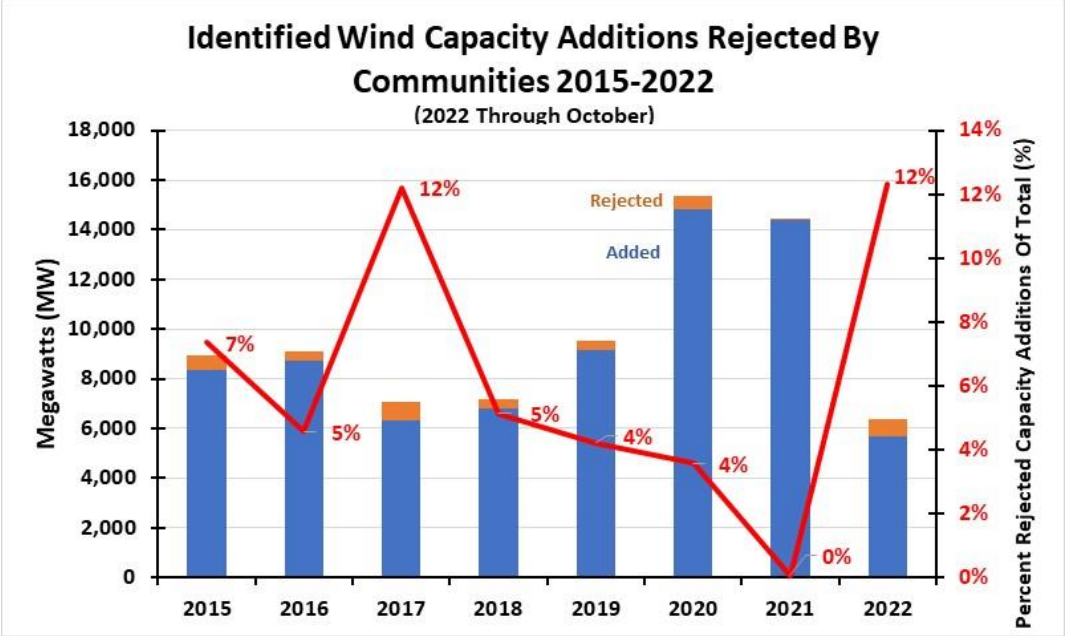
Source: Robert Bryce, PPHB

The chart above plots the annual number of wind and solar projects that have been restricted or rejected. One reason for the declining trend for wind projects is that many of the restrictions put into place in earlier years are preventing the construction of wind projects over growing areas of the country. The increase in rejections in 2022 reflects the actions of several county governments in Ohio that covered the multiple townships they oversee. For example, the decision of the Logan County government covered the 17 townships within its boundaries.

We decided to see what impact these renewable project rejections have had on the growth of the industry. Because there is a longer time series of wind project rejections, we read the commentary associated with each item in the database. This allowed us to identify specific wind projects that were rejected. These projects listed either the number of wind turbines involved, or, in a few cases, the amount of wind-generating capacity planned to be installed. Because most of these projects were early in their planning, the amount of information available was limited. However, we were able to accumulate a listing of rejected projects for each year. To determine the generating capacity of the projects, we used 2.3 megawatts (MW) as the capacity of individual onshore wind turbines. This allowed us to estimate the total wind-generating capacity that was rejected each year.

Using the Energy Information Administration's database of annual installed wind generating capacity each year, we were able to calculate the amount of new capacity installed each year. We were able to compare the amount of wind generating capacity that was rejected against the amount of new capacity installed, which then allowed us to calculate the percentage represented by rejected projects. One issue we faced in this analysis was recognizing that projects rejected may not have been ready to be built. Additionally, when 50- and 90-turbine projects were proposed, it was likely they would need more than one year to be installed and begin operating. Therefore, we tested our calculation by sliding the rejected capacity forward a year. That did little to change the percentage figures, so we resorted to our initial calculations, which are shown in the following chart.

Exhibit 9. Notable Amount Of Potential Wind Capacity Has Been Rejected



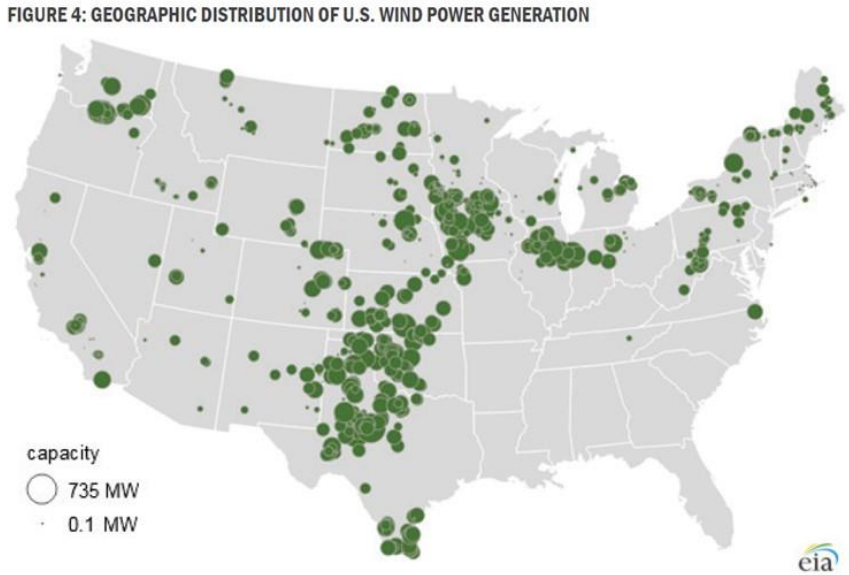
Source: Robert Bryce, EIA, PPHB

What we found interesting in the analysis was that the two years when the rejected percentage reached 12% were low installation years. If we ignore those two years and 2021 when rejections represented less than 1%, the annual rejection rate was in the 4%-5% range. In any single year, a 4%-5% capacity loss does not seem outrageous. However, given the cries by climate activists and others that the transition to clean energy is not happening fast enough, the rejections quickly amount to a meaningful amount of lost generating capacity.

NIMBYism (not in my backyard) and BANANA-ism (build absolutely nothing anywhere near anyone) continue to bedevil energy infrastructure construction efforts. With renewable energy requiring that projects be constructed where the weather conditions are optimal, building them in rural areas makes them subject to greater pushback by fewer people. Yes, these are people whose lives are disrupted by the operation of renewable energy projects near their homes and places of business that allow power users living elsewhere to avoid similar disruptions. Our monitoring of renewable energy and utility news confirms the project pushback continues. What may be new is the growing pushback in some of the most liberal and environmentally active states such as New York, California, and Vermont. With electricity bills soaring and rolling blackouts becoming more frequent across the country, the renewable pushback will continue growing. There are fundamental reasons for the pushback.

If we examine where wind generation is already operating, it is where the wind is strongest. The Brookings report showed wind generation concentration. If you are a community located near the existing wind generation concentration, you might be concerned about becoming completely covered with green as some areas already are. One reason for the heavy concentration is the land mass needed for wind farms. In addition, because of wind's intermittency, substantially greater capacity must be built to reach the output capacity of fossil fuel plants with their much higher utilization rates. For wind, this can mean building upwards of 2.5-3.0 times the target capacity needed on a sustained output basis. The chart shows the geographical distribution of wind generation. This map is three years old, so a more up-to-date map would show much higher concentrations of wind-generating assets.

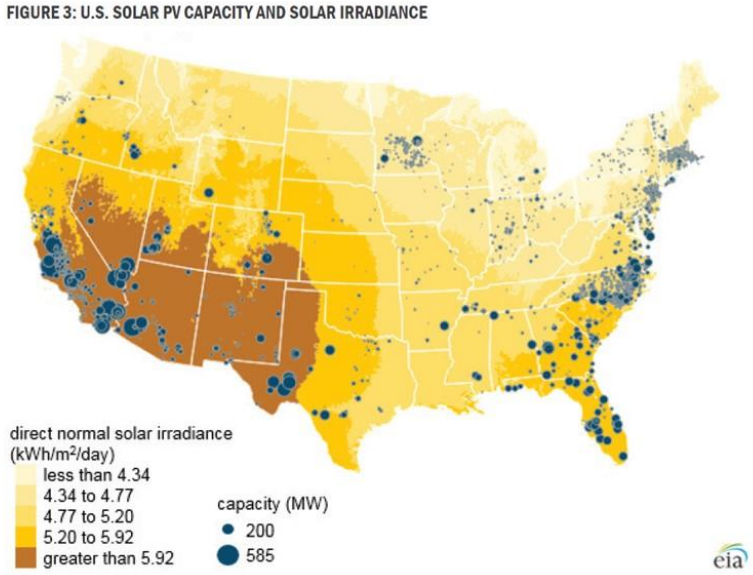
Exhibit 10. Where Wind Generation Is Concentrated In The United States



Source: EIA

To add to the fear of rural communities of a takeover of their land by renewable energy developers, we show the map below designating those regions of the country offering the optimal locations for solar power generation projects. Notice how much of this map showing areas by their ranking for solar irradiance overlaps the areas of wind energy concentration. For residents in these rural locations, the assault on their communities by renewable energy developers will increasingly be met with resistance.

Exhibit 11. Where The Sunshine Lands The Most In The U.S.



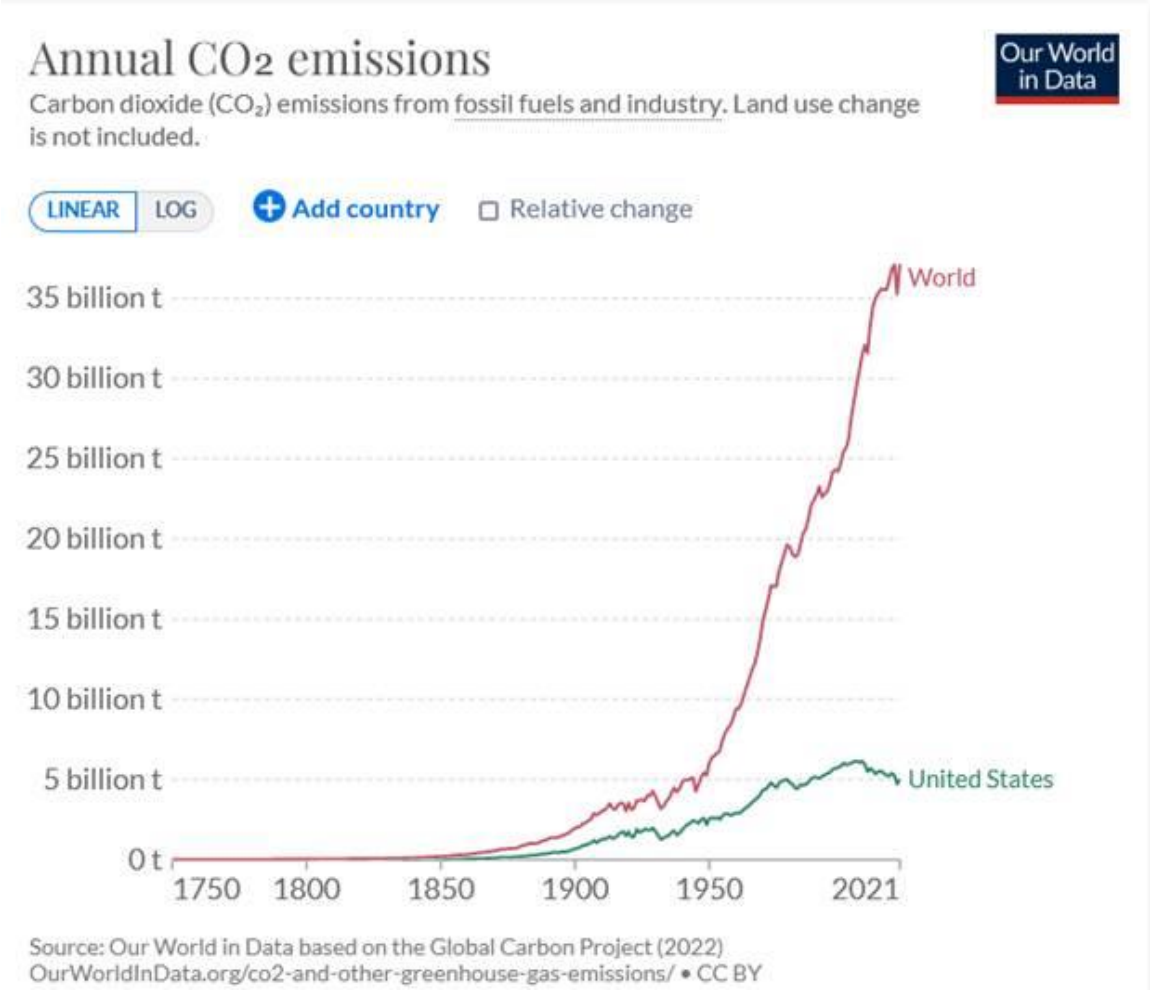
Source: EIA

When one considers how much land must be devoted to renewable energy, plus the need to construct transmission lines, many people are becoming less enamored with wind and solar power. Yes, they are sources of power that do not generate carbon emissions, but they produce significant emissions during their manufacturing. Moreover, renewables alter the landscapes that rural residents love. Yet, the rural disruption is spared for those who most benefit from it. Balancing the pros and cons will be an ongoing struggle.

Battle Over Methane Ignores Where It Comes From

The various iterations of the climate emergency narrative over the decades have been influenced by the level of concern over the amount of carbon injected into the atmosphere. A solution to the growing carbon dioxide (CO_2), especially those emitted by burning coal, is to substitute carbonless energy. This substitution, unfortunately, makes electricity grids less stable due to the intermittency of carbonless (wind and solar) power. What has proven successful in cutting CO_2 emissions over the last several decades has been substituting less-carbon-intensive natural gas for coal. That substitution explains the success of the United States in cutting its emissions meaningfully in recent years. Exactly how much becomes debatable due to the various datasets, but for sake of this article, we will use the data from Our World in Data. The chart below shows annual CO_2 emissions from 1750 to 2021 for the world and the United States. Their data comes from the Carbon Tracker Project (CTP). Later we will explore the revision to CTP's data back in late 2021.

Exhibit 12. World Carbon Emissions Have Soared While U.S. Emissions Are Down

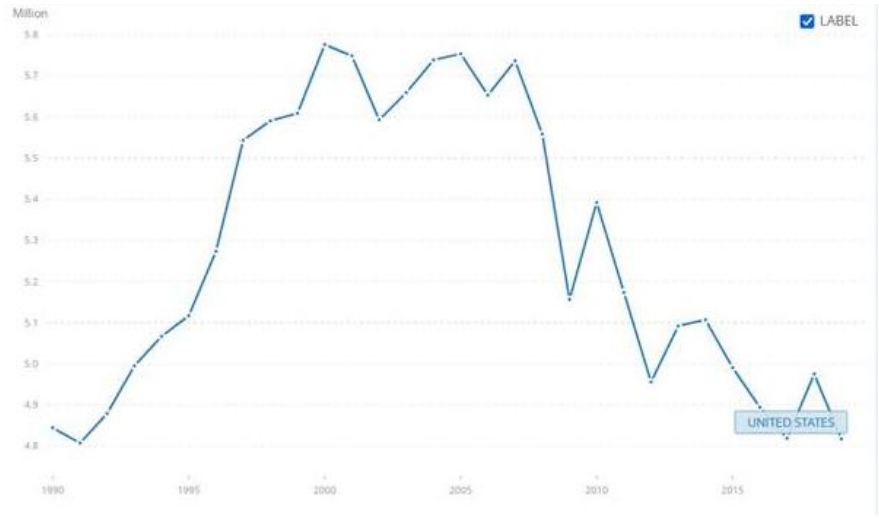


Source: Our World in Data

As the chart shows, world CO_2 emissions began rising after 1850 with the emergence of the industrial age, and then accelerated their climb after 1950. Carbon emissions continued to climb, except for the pandemic year of 2020, while U.S. emissions flattened their pace of increase and entered a downtrend after 2007, bringing them back to the level they were at in 2000. U.S. emissions also declined during 2020's pandemic year.

The following carbon emissions chart shows the carbon data collected by the World Bank. Because of its methodology, the reported data lags several years behind other carbon data collectors who often use estimates and reports from multiple sources to derive their more recent emissions totals. The World Bank does not rely on estimates but rather collects official data from governments. As the chart below shows, U.S. carbon emissions through 2019 have been in a sharp decline since peaking in 2000. Interestingly, the World Bank's data shows U.S. emissions in 2007 being below those of 2000, in contrast to the CTP data showing them increasing. This may be a function of the CTP data relying on various estimates.

Exhibit 13. How U.S. Carbon Emissions Have Decline Since 2007



Source: World Bank

The difference in emissions datasets is notable, something that is difficult to rectify. For example, in 1990 the World Bank's estimate of U.S. emissions is slightly more than 5% below that of the CTP. By 2019, the difference has widened to 8.4%. This makes comparing the progress in reducing emissions a challenge. In fact, according to the CTP, U.S. emissions had increased by 2.7% between 1990 and 2019, while the World Bank says they fell by 16.6%. Who is right? We will come back to this question after we address the methane issue and the CTP revision.

It is generally acknowledged that the U.S. has done a good job in cutting its carbon emissions in recent years. Most countries like to use 1990 as the basis for comparing their emissions achievements, but the U.S. prefers 2000 or 2007 to acknowledge that between 1990 and those later years it did a poor job in limiting emissions.

For the U.S., the 2000s ushered in the petroleum shale revolution that initially cut its teeth by boosting natural gas production. The success in lifting gas output proved so prolific that the U.S. suddenly went from being short of natural gas supplies and having to import growing volumes from Canada to become not only self-sufficient but also an exporter of domestic natural gas output to the world market. The surge in gas production in the U.S. during this period sent domestic natural gas prices crashing from the $8-$12 per thousand cubic foot level to below $2 where they remained until recently.

The cheap domestic gas found a growing market in the power generation sector, where utilities, seeking the least costly fuel supply, found gas to be cheaper than coal. Suddenly, natural gas was displacing coal in plants that could burn multiple fossil fuels or gas was firing newly constructed combined-cycle power plants. Not only were electricity costs coming down, or at least not escalating, utilities were able to cut their carbon emissions by switching to natural gas.

The dramatic increase in gas use in the power market became the death knell for many older coal plants. Lower electricity costs and reduced emissions were good for U.S. consumers. This trend was sustained until the Covid pandemic upset the demand for power relative to our available baseload generating capacity. Due to age and activist pressure, U.S. nuclear plants were being closed, along with older coal plants. Electricity generating capacity was being replaced with renewable power sources – wind and solar – spurred on by healthy government subsidies. However, the intermittent output of wind and solar power required that backup power supplies be

available to make up supply shortfalls. Natural gas plants were the preferred backup because they could start and ramp up output quickly, which was necessary when they were operating in a backup power supply mode.

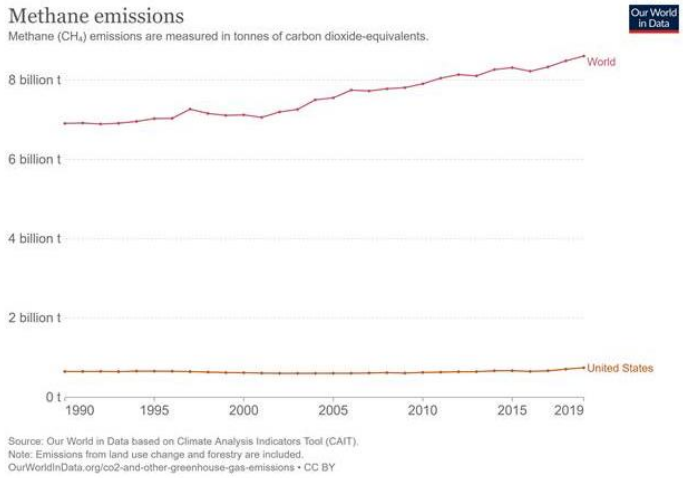
For climate activists, the victory of coal being displaced by natural gas turned out to be less than satisfactory. While cutting carbon emissions had been achieved, the volume eliminated was not as much as would have happened had coal been replaced exclusively by carbon-free energy such as wind and solar. While a cogent and emotional argument, it ignored the reality of intermittent renewable power. As a result, it appears that most renewable power capacity added to the nation's energy mix was merely offsetting electricity demand growth rather than displacing fossil fuel-powered baseload power.

As natural gas consumption rose, climate data showed an increase in methane emissions in the atmosphere. What we know about greenhouse gas emissions is that two characteristics determine their impact on the atmosphere. Those characteristics include the length of time they remain in the atmosphere and their ability to absorb energy. Methane has a much shorter atmospheric lifetime than CO_2 (around 12 years compared with centuries for CO_2). However, methane is a more potent greenhouse gas in absorbing energy while in the atmosphere.

How to measure the potency? It can be estimated by using the global warming potential (GWP) metric. This metric expresses a ton of any greenhouse gas emitted in CO_2-equivalent terms to create a single measure of total greenhouse-gas emissions. The GWP for methane is between 84-87 when considered over a 20-year timeframe. Its impact is only 28-36 when considered over the 100-year time used for most discussions of CO_2 emissions. In other words, one ton of methane is equivalent to 28 to 36 tons of CO_2 when judged over 100 years, but two and a half to three times that amount (84-87 tons) over 20 years.

When we examine Our World in Data for methane emissions data, we find the U.S. represents a small proportion of the world's total methane emissions. In the chart below, we see that U.S. methane emissions were flat for essentially all of 1990-2019, albeit having ticked up slightly in the latter years. In contrast, world methane emissions, after dipping slightly in 2015, have risen sharply in the most recent years.

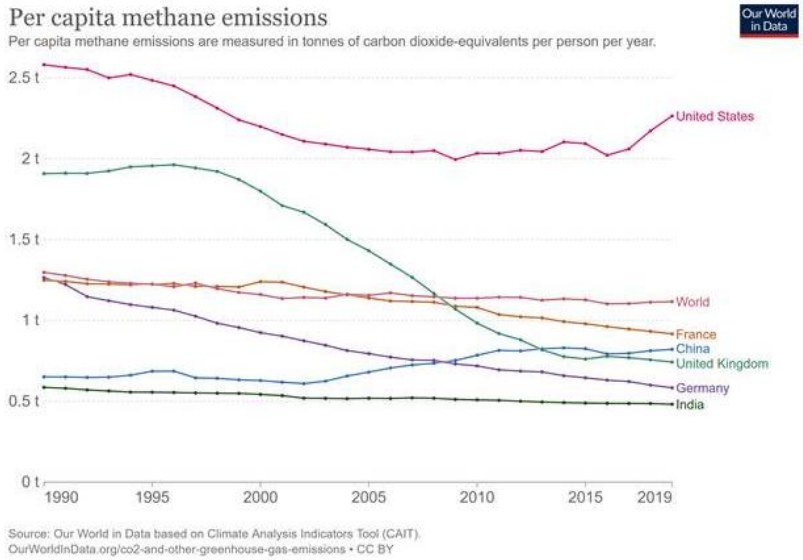
Exhibit 14. Only Recently Have U.S. Methane Emissions Risen



Source: Our World in Data

One gains a different perspective when methane emissions are presented in CO_2 terms on a per capita basis. The recent uptick in methane emissions in the U.S. is more evident in the chart below. It is also interesting that the U.S. has the highest per capita methane emissions of leading countries and the world. We are not sure why the U.K. displayed such a remarkable decline in emissions, although the country exited its use of coal for power generation and began importing significant amounts of electricity from the European continent. We added Germany and France to this chart. For both countries, we see steady declines in their per-capita methane emissions. Both countries reduced their use of coal, and in France's case increased their use of nuclear power. Germany, on the contrary, has invested significantly in renewable energy in recent years, while shutting down many of its nuclear power plants.

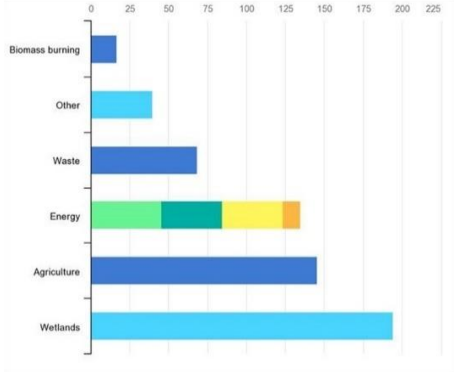
Exhibit 15. U.S. Methane Emissions Are Still Below Level In The 1990s



Source: Our World in Data

As part of the recent climate activist campaign to end the use of fossil fuels worldwide and especially in the U.S., targeting methane emissions became a key element. That raises an interesting question of where methane emissions arise. The International Energy Agency (IEA) has compiled data about the sources of methane emissions, which is displayed in the chart below. This chart was updated as of October 2022, but a footnote about the data attributes the energy data to the IEA as of 2019 and the other non-energy emissions data to earlier years. The energy emissions data is segmented into that coming from natural gas (light green), coal (dark green), oil (yellow), and bioenergy (orange).

Exhibit 16. Wetlands Are The Largest Source Of Methane Emissions



Source: IEA

The total amount of methane shown in the chart is 596 million metric tons (Mt) with the following distribution:

- Wetlands 194
- Agriculture 145
- Energy 134
- Waste 68
- Other 39
- Biomass burning 16

A variation of this chart was displayed on the *EARTH.org* website that accompanied a discussion about the significance of methane emissions and the fact that the concentration of methane in the atmosphere now is 2.5 times greater than in pre-industrial levels. Both this website and the IEA have noted that annual global emissions are subject to a high number of uncertainties. Both organizations made the point that emissions from natural sources represent about 39% of the total with anthropogenic emissions accounting for the remaining 61%. Of the anthropogenic emissions, agriculture accounts for about a quarter of the total, closely followed by the energy sector (22.5%). Within the energy sector, natural gas is the largest component at 7.6%, followed by coal and oil, each at 6.5%, and bioenergy at 1.8%.

The IEA made the case that natural gas "can play an important supporting role in energy transitions by replacing more polluting fuels; it may also deliver services that are difficult to provide cost-effectively with low-carbon alternatives, such as peak winter heating, seasonal storage, or high-temperature heat for industry. However, fulfilling this role requires that adverse social and environmental impacts be minimized: immediate and major reductions in methane emissions are central to this." The IEA estimates that it is technically possible to avoid 75% of methane emissions from oil and gas operations. Importantly, the IEA also believes a substantial portion of global emissions (40%) can be eliminated at no net cost.

What we found interesting is that natural methane's Other category is almost equal in volume to the emissions from natural gas (39-45 Mt), while methane emissions from Waste at 68 Mt are one and a half times the volume of natural gas methane emissions. Waste methane emissions are coming from landfills, and some of that gas is being captured and used to fire electricity-generating plants.

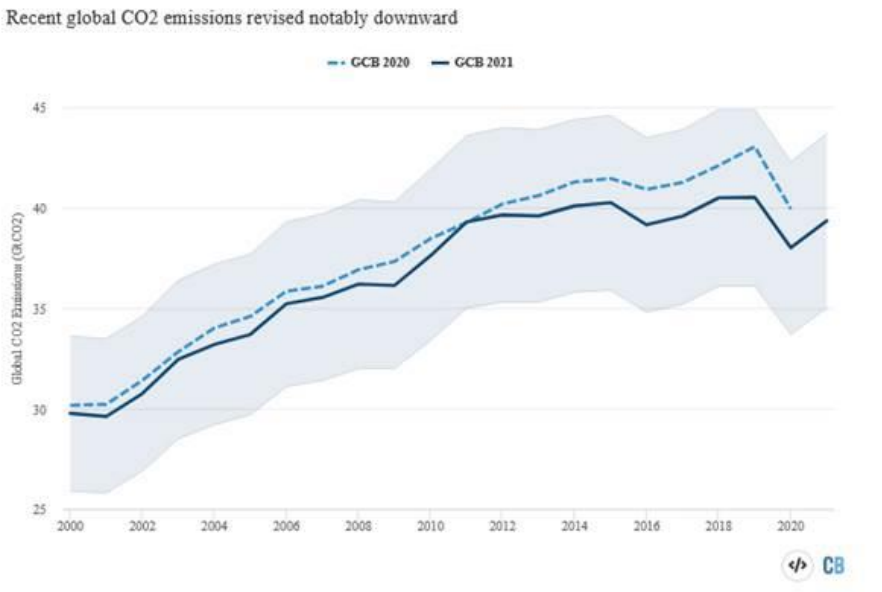
Targeting oil and gas transmission hubs, gas processing plants, producing well sites, and other petroleum processing facilities is an easy target. By flying helicopters and airplanes, and now

satellites over these various facilities, sensors can detect methane emission leaks. Fixing them requires manpower and capital expenditures to replace faulty valves and other leaky connections. This is an effort the petroleum industry is undertaking and will continue to undertake to become better stewards of the climate. Flaring natural gas at wells is often necessary because of the lack of infrastructure, again something the industry is working to reduce. While not all gas flaring can be avoided, it can be kept to a minimum with planning.

While the petroleum industry is a favorite target of climate activists over methane leaks and carbon emissions, we are now beginning to see attacks on the agricultural sector, the second largest methane emitter. Reducing meat consumption is a favorite target because it would eliminate animals from human diets and animal methane emissions (burps and farts) from the atmosphere. Such a move would be welcomed by those health experts recommending the elimination of meat from diets to improve people's health. One problem with this effort is that plant-based meats that were the rage a short while ago are losing popularity and momentum. People considering these meat alternatives are suddenly reading the labels and finding many chemicals in their diets that have alarmed them. Sales of plant-based meats have experienced a slowdown, and in some cases outright declines, while some fast-food chains are abandoning plans to offer these alternatives on their menus.

What we were surprised to learn was that last year the CTP revised downward their CO_2 emissions notably. An article by *Carbon Brief* in late November 2021 discussed the revisions. It began by posting the chart below that shows the carbon emissions for both fossil fuels and land-use changes. What is notable is that rather than steadily increasing until 2019, the revised CO_2 data shows emissions were essentially flat between 2010 and 2019 before falling in 2020 and only returning to 2010's level in 2021.

Exhibit 17. A Major Revision Down For Carbon Emissions

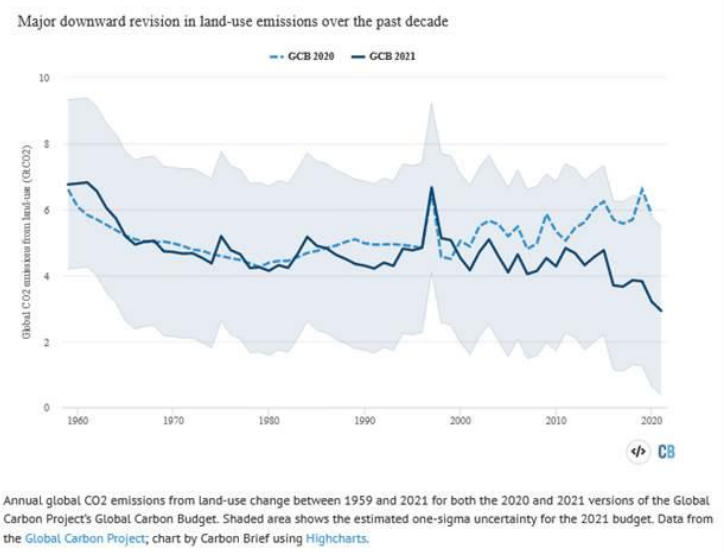


Annual total global CO2 emissions – from fossil and land-use change – between 2000 and 2021 for both the 2020 and 2021 versions of the Global Carbon Project's Global Carbon Budget. Shaded area shows the estimated one-sigma uncertainty for the 2021 budget. Data from the Global Carbon Project; chart by Carbon Brief using Highcharts.

Source: ***Carbon Brief***

The primary reason for the decline was a sharply reduced volume of emissions from land-use change. That revision is evident in the chart below which shows how the revised data depicts a steady decline in land-use change emissions since 2017 rather than a steady increase from the late 1970s.

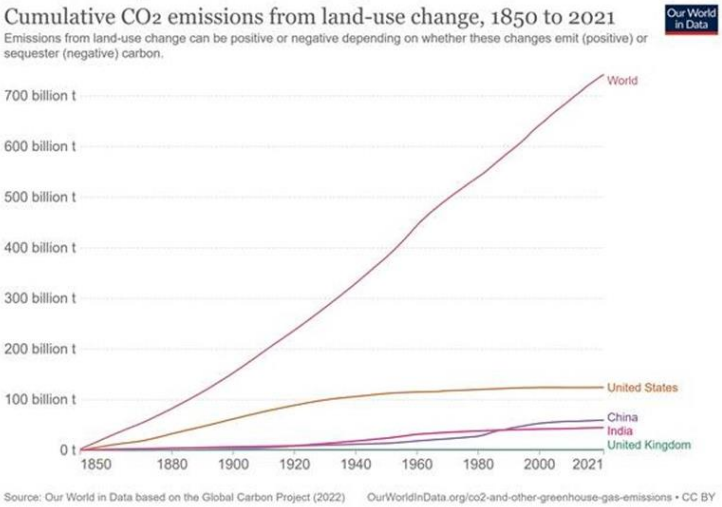
Exhibit 18. Sharply Lower Land-Use Change Emissions



Source: ***Carbon Brief***

How important is land use change emissions? The following chart shows cumulative land use change emissions for the world and select countries starting in 1850. Note that while the U.S. leads the increase from the 1850s to about 1940, since then the land use change emissions have been flat. The emissions growth has come from China and India, as well as many other developing economies. We suspect that this Our World in Data chart does not reflect the revised land use change data from the CTP.

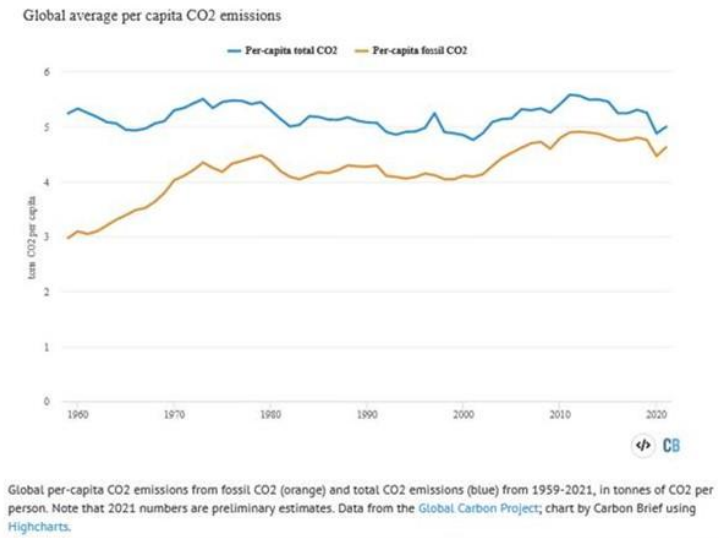
Exhibit 19. Cumulative Land-Use Change Emissions Are Falling In U.S.



Source: Our World in Data

To promote the "shutting down fossil fuel" argument, *Carbon Brief* showed the following chart on total per capita CO_2 emissions and those per capita emissions from fossil fuel use. Two points stand out. First, total per capita CO_2 emissions have been essentially flat since 1960, a span of 80 years! This was also a period when the world welcomed several billions of additional people. Secondly, there were two periods during this history when fossil fuel emissions accelerated: the 1960s and the 2000s. Both periods marked rapid economic development and improvements in the well-being of the human population as fossil fuels delivered longer human lifespans and global poverty was reduced.

Exhibit 20. Fossil Fuel Emissions Have Accelerated In Recent Years

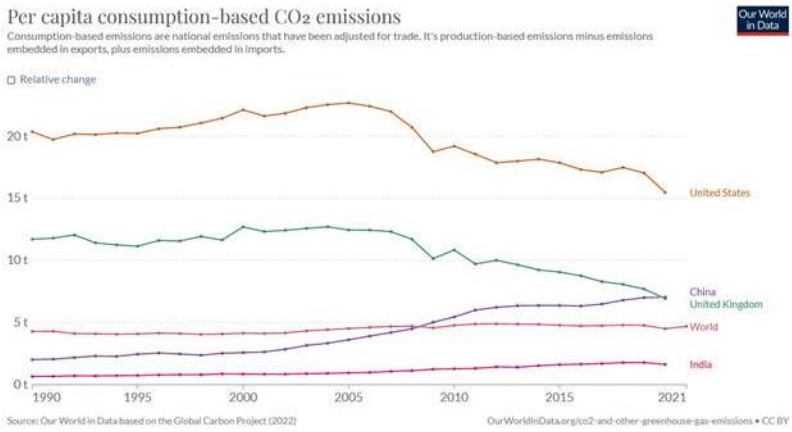


Global per-capita CO2 emissions from fossil CO2 (orange) and total CO2 emissions (blue) from 1959-2021, in tonnes of CO2 per person. Note that 2021 numbers are preliminary estimates. Data from the Global Carbon Project; chart by Carbon Brief using Highcharts.

Source: ***Carbon Brief***

A chart from Our World in Data of per capita consumption-based CO_2 emissions for the world and select countries shows U.S. emissions peaking in 2005 and steadily and sharply falling until 2020. The world emissions are essentially flat for the entire 1990-2020, with a slight uptick in 2021. While the U.S. has the highest per capita CO_2 emissions, it also represents 25% of global economic activity.

Exhibit 21. Note Improved U.S. Per Capita Carbon Emissions

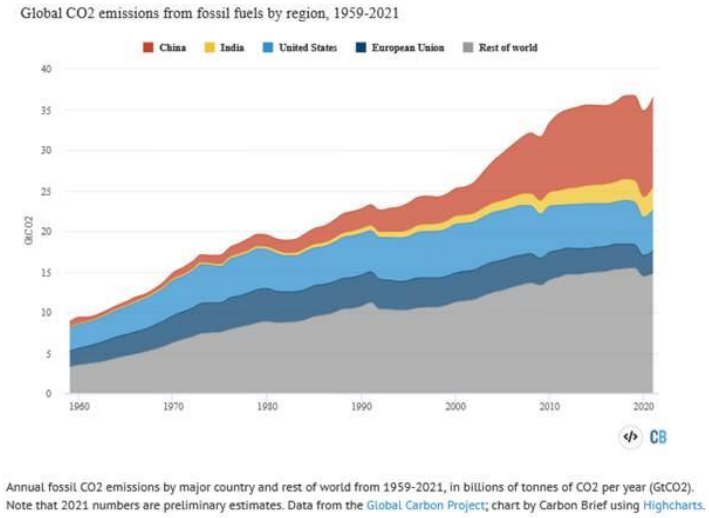


Source: Our World in Data

Two final charts from *Carbon Brief* show the annual global CO_2 emissions by region of the world and by fuel source. In the regional emissions data history, it becomes clear how much China and India have played in global carbon emissions. China is certainly the more important source that needs to be constrained, which is easier to acknowledge than to achieve.

The chart does show progress being made by the U.S., Europe, and the Rest of the World in reducing carbon emissions.

Exhibit 22. Emissions History Shows The Role Of China

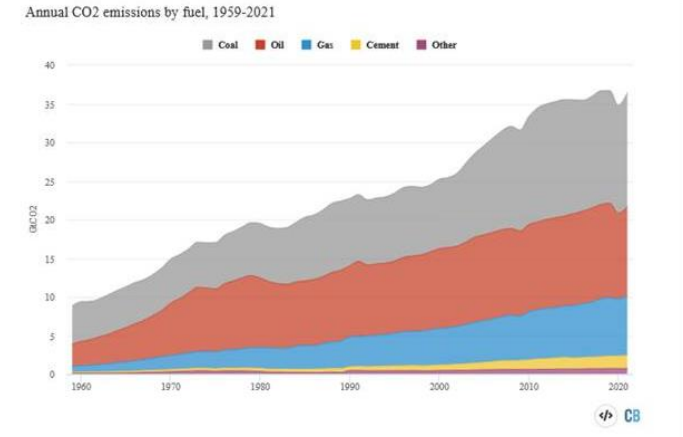


Annual fossil CO2 emissions by major country and rest of world from 1959-2021, in billions of tonnes of CO2 per year (GtCO2). Note that 2021 numbers are preliminary estimates. Data from the Global Carbon Project; chart by Carbon Brief using Highcharts.

Source: ***Carbon Brief***

The following chart shows the carbon emissions of fossil fuels, cement, and others. While cement has become a more significant emitter in recent years, it is clear coal's emissions have become the largest source of incremental carbon emissions. Using more natural gas would be a major step forward in the battle to control carbon emissions.

Exhibit 23. Coal's Comeback Is Highlighted By Emissions



Annual CO2 emissions by fossil fuel from 1959-2021, in billions of tonnes of CO2 per year (GtCO2). Note that 2021 numbers are preliminary estimates. Data from the Global Carbon Project; chart by Carbon Brief using Highcharts.

Source: ***Carbon Brief***

The battle over the role of CO_2 emissions in climate change will continue. Methane's increased prominence will continue growing, but the oil and gas industry is working to reduce its methane emissions. What is not surprising but disappointing is how little attention, or even acknowledgment, is given to natural emissions from land use and wetlands. By failing to acknowledge their role in global carbon emissions the full scope of the climate change challenge cannot be appreciated. The recent massive revision of the history of carbon emissions as done by the CTP confirms how difficult measuring emissions is and impacts determining the appropriate plans to restrict further emissions. A significant change in the narrative from a massive revision of climate data should be a wake-up call that we need to be careful in developing emission plans that will disrupt society and the economy and may prove ineffective but extremely costly.

Random Energy Topics And Our Thoughts

Coming Clean About The Cancellation Of Keystone XL Pipeline

In what must have been a late Friday night data dump, the U.S. Department of Energy (DOE) fulfilled a mandate nearly 11 months late when it delivered its report on the jobs lost and economic impact from the cancellation of the Keystone XL pipeline permit by President Joe Biden on his first day in office, January 20, 2021. The cancellation of the permit was a campaign issue and pledge by then-candidate Biden. He fulfilled that pledge with Executive Order 13990 revoking the pipeline permit, declaring the pipeline's construction to be a "disservice" to the U.S. because of the climate impact from hauling 830,000 barrels a day of oil to Gulf Coast refineries.

We found the saga of this report's publication fascinating, as it reflects a statement by federal bureaucrats showing their disdain for their ultimate bosses. While the permit cancellation was no surprise, Republican senators from three states who would have hosted the pipeline pointed out, as did several welders at work on the pipeline, the lost jobs and economic gains the region suffered. They immediately moved to force the bureaucracy to quantify the economic impact, even though there were numerous studies and Congressional testimony of the economic benefits that would accrue to the states and the nation.

Given the Democrat's control of the Senate, the legislative efforts in June 2021 by Senators Kevin Cramer (R-ND), Steve Daines (R-MT), and Jim Risch (R-ID) to order a report, Defending Keystone Jobs Act, came up short. That changed in November when the government was passing the Infrastructure Investment and Jobs Act. Section 20034 of that law mandated that the DOE prepare a report "to estimate the job losses and consumer impacts associated with the revocation of the Keystone XL pipeline permit." The DOE was given 90 days to produce the report. That meant the DOE was to deliver its report by February 13, 2022.

The publication of the report was announced on January 5, 2023, by the offices of Senators Daines and Risch. The report is 18 pages in total. There is a title page, a blank page, two pages with a message from Energy Secretary Jennifer Granholm fulfilling the mandate and a list of senators to whom the report was delivered, a two-page executive summary, and a Table of Contents page, so the actual report is 11 pages in length. Almost as many months as the report was late.

The report was not an analysis but rather a literature search of public reports forecasting the jobs and economic impact of building the pipeline. Table 2 at the end of the report showed what the bureaucrats found in their research efforts.

Exhibit 24. What Studies Showed About Keystone XL's Economic Impact

Table 2 – Economic Impact of the KXL Construction Based on Inputs from Different Studies and Models [42]

U.S. average (2013-2014)	Units	Perryman Group	REMI	GLI/REMI	Final SEIS (2014)
Employment	Jobs per year	59,468 [43]	36,860	16,149	21,050
Business Sales	2011 $ (billions)	$20.93	$9.22	$6.01	-
Gross Domestic Product (GDP)	2011 $ (billions)	$9.61	$5.14	$3.12	$3.4
Personal Income	Current $ (billions)	$6.50	$3.19	$1.36	$2.05
Personal Income per Job	Annual $	$54,651	$43,327	$42,047	-

Source: DOE

The following text is the conclusion of the report, which is framed for emphasizing the least impactful outcome from the pipeline's construction. The report states:

> The studies and assessments conducted during the 2010-2014 time about the potential impact of the construction of the KXL pipeline found that:
>
> - The SEIS and other estimates indicate there would be around 50 permanent jobs once the pipeline was operational. Additionally, estimates for the jobs created during the construction phase of the KXL pipeline ranged from 16,149 to 59,468 annually for a two-year period. However, the high-end figure overstates jobs, and the study it was based on included project input from other countries and included portions of the Keystone pipeline project outside the XL segment in question. The SEIS included an estimate that U.S. jobs would be 21,050 annually for two years, with a subset of the jobs, 3,900, as direct construction jobs.
>
> - The literature review for this report showed that the effect on consumer prices was inconclusive, particularly in light of the changes that have occurred in Canadian and U.S. crude oil markets since the KXL pipeline was proposed.

Notice that the table above never shows just the "permanent jobs," a figure the DOE continues to focus on when questioned about the report. The pipeline permit was canceled at a time when the U.S. economy was beginning to recover from the pandemic and the nation's unemployment rate was 6.7% (December 2020). At the time the project was restarted following the granting of the permit by the Trump administration, the project was actively supported by labor unions - the Laborers International Union of North America, the International Brotherhood of Teamsters (IBT), the International Union of Operating Engineers, and the United Association of Union Plumbers and Pipefitters (UA). These four unions reached an agreement in August 2020 with TC Energy, the pipeline's operator, to represent the thousands of project workers. That agreement promised the pipeline would create 42,000 "family-sustaining" jobs and provide $2 billion in total wages.

At the time of the TC Energy agreement, Jim Hoffa, the former general president of the IBT said "The Keystone XL pipeline project will put thousands of Americans, including Teamsters, to work in good union jobs that will support working families." He went on to say, "We believe in supporting projects which prioritize the creation of good jobs through much-needed infrastructure development." His comments were seconded by UA President Mark McManus who stated: "This project will bring good paying jobs to our members, all while keeping energy costs low and delivering a boost to local communities and their economies. We're ready to get to work."

All four unions endorsed Biden ahead of the 2020 presidential election. In August 2020, McManus said Biden would be a "fierce ally" to the union and Hoffa stated the Teamsters "have a friend in Joe Biden." You will not find any comments from these gentlemen following the release of the report, which, incidentally, you will not find on the DOE's website.

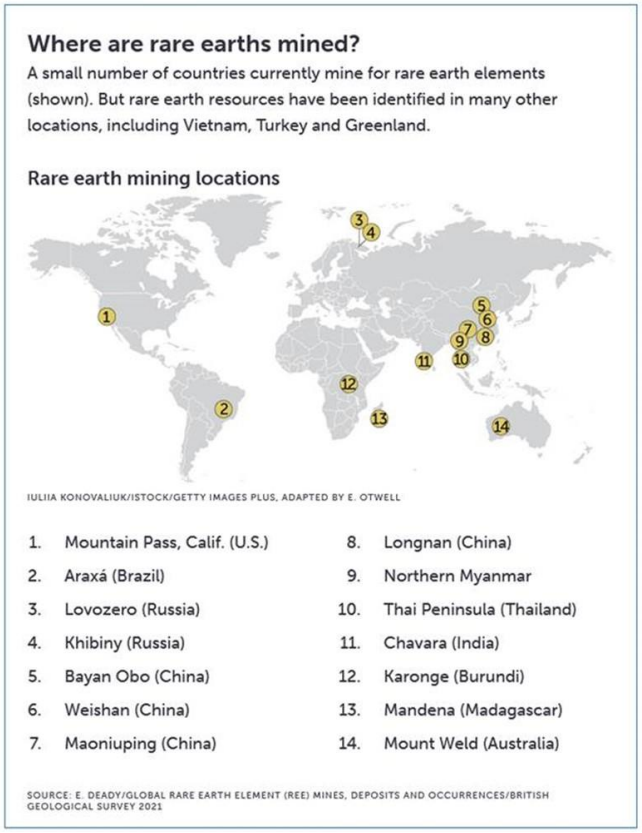
Will Sweden's Rare Earth Discovery Make Any Difference?

Recently, a Swedish mining company announced it had found Europe's largest known deposit of rare earth minerals (REMs). LKAB, a state-owned company that made the discovery, is hoping to use this deposit to develop a continental REM supply chain for Europe, helping to reduce its dependence, and that of most of the world, on China for these minerals that are critical for the future of the renewable energy sector.

The deposit was discovered near Kiruna, Sweden's northernmost city. The economy of Kiruna has been based on mining for more than a century. New mining activity, however, will need to be balanced against other interests including the preservation of areas of natural beauty and the safeguarding reindeer herding in the region by the Sami people.

REMs is a group of 17 metals which include scandium, yttrium, and 15 elements from the lanthanide group. The 15 lanthanides are lanthanum, cerium, praseodymium, terbium, samarium, europium, neodymium, promethium, gadolinium, holmium, erbium, dysprosium, thulium, lutetium, and ytterbium. Despite the name – rare –, these minerals are not as rare as suggested. They are found in abundance across the world with most concentrations found in China which is the leading producer, as shown in the chart below.

Exhibit 25. Locations Where REMs Are Mined



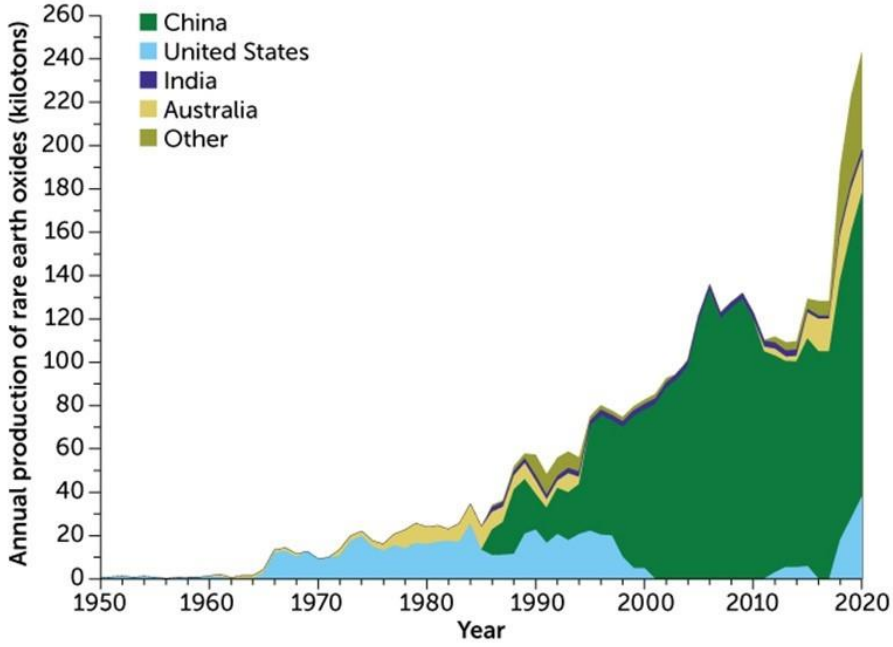
Source: ***sciencenews.org***

Although they can be found in concentrations higher than other metals, their disperse locations make it uneconomical to mine and extract. Additionally, some countries restrict REMs mining because of environmental issues. REMs are mostly found together as they chemically bond to each other and non-metal elements. This makes for a costly and chemically challenging process to separate individual REMs.

A high-concentration source of REMs is needed for a commercially viable project. The first step is to create concentrated clumps in raw form by using standard mining procedures such as crushing and scrubbing. When a concentrate has been formed, chemicals are introduced to attempt to separate individual REMs. This process can include leaching, precipitation, dissolving, and other purification methods specifically designed for individual earth elements. Depending on the rare earth element, acids and radioactive chemicals can be incorporated into the extraction process, which often must be repeated hundreds of times. These processes produce toxic waste and partly explain why mining and extracting REMs is limited as many countries are unwilling to accept the environmental risks and damages.

The chart below shows the production of rare earth oxides by country for 1950-2020. For many years, the United States was the predominant source of this rare earth material, but in the mid-1980s, China emerged as a new supplier and has grown to be the largest world supplier. If governments want to shift their economies to 100% clean energy, the chart below will need to change dramatically.

Exhibit 26. REMs Output Past Must Change For Renewables To Advance



Source: ***sciencenews.org***

An analysis of the mineral content in clean energy versus traditional energy sources is enlightening. The International Energy Agency's (IEA) 2021 report, The Role of Critical Minerals in Clean Energy Transitions, produced the chart below that shows the mineral content in an electric vehicle is five times the amount used in a conventional fossil-fuel-powered vehicle. Likewise, an offshore wind turbine needs 12 times the amount of minerals, including REMs.

Exhibit 27. Few Realize Magnitude Of Mineral Content In Renewable Energy

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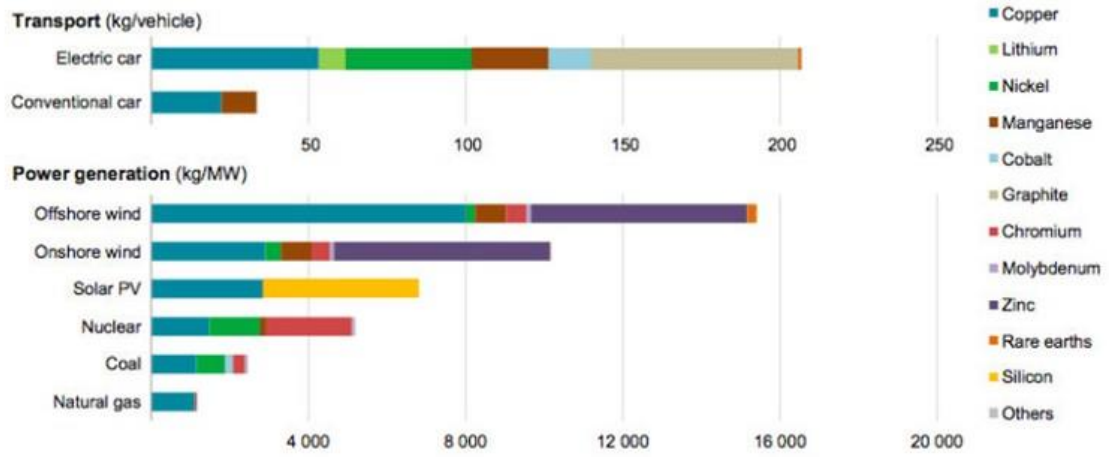


Source: IEA

In the year-plus since the IEA report was issued that stated mineral output needed for electric vehicles must expand 30-fold by 2040. They also stated that the time for new mines from discovery to production averages 16 years. These two dynamics unscored the IEA's pleading for

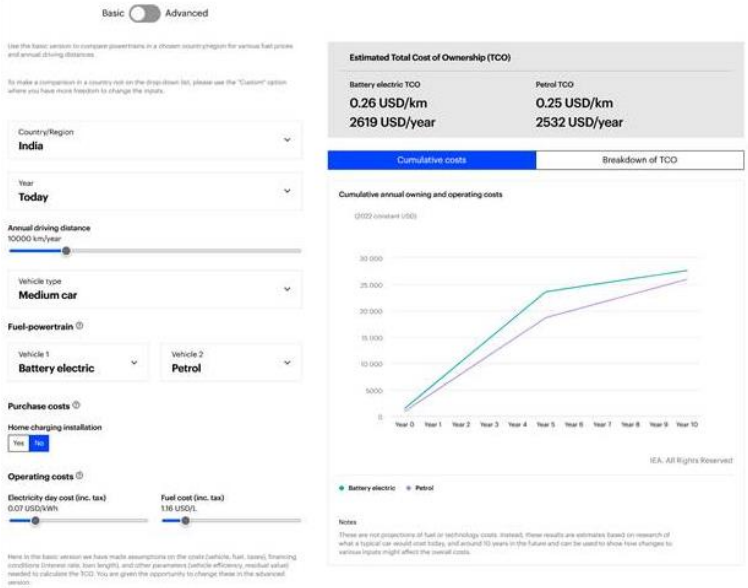
the renewable and mining industries to get moving or the climate crisis would only worsen. The IEA seemed not to recognize or acknowledge the environmental challenges a widespread mining and mineral processing expansion would entail and whether countries around the world were willing to accept such an expansion.

Hoping to shortcut the time and challenges of establishing a REMs supply chain, LKAB recently became the largest shareholder in a Norwegian company, REEtec, that specializes in separating rare earth minerals from concentrates with technology that is said to be more environmentally friendly. The plan is to eventually construct such a plant in Sweden. However, LKAB must further assess its recent discovery. To do that the company is planning to construct a several-mile-long tunnel from its existing iron ore mine to the discovery to facilitate assessing the resources present. Given the work ahead, LKAB said it could take 10-15 years or more before metals were delivered to the market. LKAB's CEO Jan Mostrom said he was hopeful that the growing demand for REMs and the need to develop continental sources will help clear the way for the new mine. "Without mines, there can be no electric vehicles," said Mostrom. And that would be a setback for the climate activists.

IEA Vehicle Cost Tracker Not Positive For EVs

We discovered the following vehicle cost tracker on the website of the International Energy Agency, a loud proponent of renewable energy and electric vehicles (EV). The default was to the analysis of the total cost to operate an EV versus a petrol vehicle in India, which is presented below. The settings called for 10,000 kilometers of driving a year, charging the EV at home at a cost of 7 cents per kilowatt-hour, and fueling the petrol vehicle for $1 per liter, or the equivalent of $3.785 per gallon. What the analysis and graph show are that the EV is more expensive to operate in the initial year ($1,449 vs. $885). The cumulative difference reaches a peak in year five ($23,526 vs. $18,654) and then narrows by year 10 ($27,515 vs. $25,924). This means that during the years five to 10, the EV was less costly to operate.

Exhibit 28. Total Cost Of Operating An EV Versus A Petrol Vehicle By Country



Source: IEA

We input data for the cost of U.S. electricity (16 cents), and we left the other variables the same. The analysis also showed the EV as more costly over the 10-year forecast span. Again, the EV was more costly in year one and much more costly in year five. The cumulative difference had EVs 40% more costly than the petrol car. That gap narrowed by the 10th year to only a 24% difference. This cost tracker is not presenting a strong case for buying EVs.

We Warned About China's Demographics; Suddenly It Is Topical

This headline from the January 18th print edition of *The Wall Street Journal* encapsulated concerns and fears among the corporate and economic world over the just-released population figures from China. The figures showed China's population shrank in 2022 by 850,000 people to a total of 1.412 billion, for the first annual decline since 1961. Birth rates have been falling for a while, reaching 6.77 per 1,000 people compared to 7.52 in 2021, the equivalent of a million fewer births. India is now projected by the United Nations' population forecasters to surpass China next year to become the world's largest population.

Exhibit 29. We Warned About China's Challenges With Shrinking Population

China's Shrinking Population Compounds Growth Concerns

Economists said China's shrinking population poses a major future challenge for the world's second-largest economy, while President Xi Jinping's top economic adviser sought Tuesday to restore investors' confidence.

By Stella Yifan Xie, Jason Douglas and Lingling Wei

strained growth for much of 2022, setting the stage for a recovery this year. The U-turn, in the wake of public protests, was part of a broad policy reset aimed at boosting the economy, including an easing of regulations on the property sector and signals that the clampdown on the tech sector has ended.

Beijing is now betting on a robust rebound in economic

likely will announce a growth target of between 5% and 5.5% for 2023 at the coming legislative sessions in March. China on Tuesday posted 3% growth for 2022, its second-worst growth rate since 1976.

Speaking to the World Economic Forum in Davos, Switzerland, Vice Premier Liu He sought to send a message to investors and executives that

ers also projected optimism. China's reopening and exit from its zero-Covid policy is the "most positive catalyst" for global markets this year, said Hong Kong Exchanges & Clearing Ltd.'s chief executive, Nicolas Aguzin.

"If China produces a solid growth number for 2023, 5% or 5% plus, that will actually underpin much global growth

Source: ***The Wall Street Journal***

The opening of *The Wall Street Journal* article stated: "Economists said China's shrinking population poses a major future challenge for the world's second-largest economy…" The article pointed to issues such as how a shrinking population means fewer consumers as China strives to redirect its economy to a consumer-driven one from an investment- and exports-driven one. One aspect of a declining population is a shrinking workforce that limits China's economic growth. Economies only grow by adding more workers or boosting existing workers' productivity. China's productivity growth has been slowing. It averaged 1.3% on average for the decade ending in 2019 compared to a 2.7% average rate for the previous decade.

In our lead article in the last issue of *Energy Musings,* we discussed how demographics would contribute to the creation of a new world order. We specifically discussed how China's aging population would impact the country. We wrote:

> Because the population shortfall is appearing in the younger age group, it means the workforce is smaller than previously thought. Without replacement workers, China's labor force will begin shrinking rapidly, and as a result, China's cheap labor dynamic is being eradicated in favor of India, and various Southeast Asian, and Latin American countries that can produce goods cheaper than China. Such a development will have

> profound impacts on China's economic and social policies, and potentially on the country's international policies.

On the same day as *The Wall Street Journal* article was published, *The New York Times* Nobel-prize-winning economist and now opinion columnist Paul Krugman wrote a column about the Chinese population issue titled "The Problem(s) With China's Population Drop." He brought up China's population concerning climate change when he wrote:

> But why consider this a problem? After all, in the 1960s and 1970s, many people worried that the world was facing a crisis of overpopulation, with China one of the biggest sources of that pressure.

If you have been paying attention, recent media stories have targeted the world's overpopulation issue and why it needs to be controlled. The articles are based on research and opinions of climate activists. Krugman ignores the recent attention and only brings up the 1960s and 1970s.

Krugman went on to discuss the points we mentioned above. The conclusion of Krugman's column made a telling geopolitical statement about China's aging problem. Krugman wrote:

> Oh, and China is a superpower, with an authoritarian and seemingly erratic leader. I don't think it's alarmist to worry about how it will react if its economy performs poorly.

We will continue to monitor global demographics and how they will reshape the world order.

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