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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

August 17, 2021

Dealing With The Climate Change Narrative

We outline our plans for a series of articles discussing the issues surrounding climate change. We lay out the planned schedule and topics to be discussed, while also spelling out our biases.

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Disaster Scenarios Are Not New In Our History

We write a brief history of climate and environmental disasters, while discussing some of the most famous disaster predictions in history. It sets the stage for a discussion of climate science.

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Block Island Wind Farm Stops For Technical Reasons

The offshore wind farm's blades are stopped for "routine maintenance," but they are also dealing with "stress lines." It has become a problem elsewhere, raising questions about the implications.

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Dealing With The Climate Change Narrative

We are now 76 days away from the start of the 26th United Nations Climate Change Conference of the Parties (COP26) to address the final rules for implementing the Paris Agreement approved by 197 members in 2015. A week ago, we received the latest epistle Assessment Report (AR6) from the Intergovernmental Panel for Climate Change (IPCC). The Summary Report for Policymakers highlighted the worsening state of the planet's climate. While the language was ramped up to dramatize our precarious position, the actual forecast is less dire. A popular word is "unequivocal" that the warming is driven by humans.

Climate scientists, politicians and the media are happy to suggest we are barely years away from going over the climate cliff, as that is how they can pressure the COP26 delegates to act. Note how the report and its commentary is laid out: the world is on fire; humans are the cause; we are heading for a climate catastrophe; BUT there is time to head off this disaster if policies are adopted. The problem with this roadmap is that recent climate negotiations heading into the Glasgow conference suggest there are significant hurdles to overcome (China and India positions) to reach an agreement.

Climate disaster scenarios are not new. In fact, they likely first appeared in the Bible, but usually they involved God looking out for the good in people as he unleashed disasters. Just as in religion, fear of the unknown can be a strong motivator for people to act. The question is are they taking the appropriate actions?

With this issue, we start a series to dig into the details of what we know and what we do not know about climate change. Our first issue will delve into the climate disaster scenarios we have been bombarded with over the years if we fail to end carbon emissions. In the next issue, we will explore the science of climate change, focusing on what we are sure of and what we are speculating about. This will be the most challenging article, as we strive to keep the issues understandable, while explaining the science and the controversies.

Our third issue will consider the disaster predictions from this issue and their outcomes or likely occurrence. Lastly, we will explore the plans and suggested remedies for limiting carbon emissions to address climate change. We will encompass the economic and social costs and benefits of the solutions, whenever possible.

First, our biases. We acknowledge the planet's warming, as well as the human contribution. We take issue with the "climate alarmism" driving the narrative, rather than thoughtful assessments of the issues and searches for solutions that can be readily achieved at the least cost and social disruption. As we have learned over the past 18 months in dealing with Covid-19, the science of viruses is not settled. Why should we believe the science of our climate, as equally complex as the human body, is settled? Therefore, we are open to having our opinions changed by facts, science, and economics.

Disaster Scenarios Are Not New In Our History

At the root of all disaster scenarios throughout history is population. The most prominent disaster prophecies came from Thomas Malthus, a prominent late 1700s English economist and demographer. Malthus is best known for his theory that population growth will tend to outrun food supply and that the betterment of humankind is impossible without strict limits on reproduction. This theory is known as Malthusianism. It was explained in An Essay on the Principle of

Population as It Affects the Future Improvement of Society, with Remarks on the Speculations of Mr. Godwin, M. Condorcet, and Other Writers published in 1798.

While Malthusianism occasionally became popular during the next 150 years, it was embraced by the late 1960s environmental movement, which followed a turbulent social era highlighted by opposition to the draft and Vietnam War. Biologist Paul Ehrlich and his wife, Anne Ehrlich published The Population Bomb in 1968, which predicted worldwide famine in the 1970s and 1980s due to overpopulation, as well as other major societal upheavals, and advocated immediate action to limit population. That fear was supplemented by dramatic scenes of environmental damage, due to meeting the needs of the rapidly growing population. The most famous environmental damage scene was the June 22, 1969, fire on the Cuyahoga River in Cleveland, Ohio. The fire, while lasting only 20 minutes, was not the first-time industrial waste and debris on the river had caught fire. This fire and its associated publicity spurred enactment of the Clean Water Act of 1972, which created the Environmental Protection Agency (EPA).

Exhibit 1. 1969 - Cleveland's Cuyahoga River Fire Spurred EPA Formation

Source: ***patrickmurfin.blogspot.com***

The year before the Cuyahoga River fire, the Club of Rome was founded by an Italian industrialist and a Scottish scientist and named for the location where the idea was born. The Club consists of 100 full members selected from current and former heads of state and government, UN administrators, high-level politicians and government officials, diplomats, scientists, economists, and business leaders from around the globe. At the group's first major gathering in 1970, Jay Forrester, a professor at Massachusetts Institute of Technology (MIT), offered to use computer models he had recently developed to study more rigorously the complex problems that concerned

the group. A team of MIT researchers studied the implications of unbridled population and economic growth. They examined the five basic factors that determine and, potentially in their interactions, may limit growth. These factors were: population, agricultural production, non-renewable resource depletion, industrial output, and pollution. Their research and modeling work led to the Club's first major report, The Limits to Growth, published in 1972.

Today, on its web site, the Club of Rome writes:

> While *Limits* had many messages, it fundamentally confronted the unchallenged paradigm of continuous material growth and the pursuit of endless economic expansion. Fifty years later, there is no doubt that the ecological footprint of humanity substantially exceeds its natural limits every year. The concerns of the Club of Rome have not lost their relevance.

Their "ecological footprint of humanity" underscores the views that drive much of the climate change debate today. These claims are coming, however, at the same time population growth projections are being reduced by the U.N. and other forecasters due to falling birthrates across the world. This reflects the historical pattern of rising incomes and living standards producing lower birth rates. Less human labor is needed to survive. With fewer people in the future, our "ecological footprint" should be smaller.

The Limits to Growth report ignored the impact of technology that has boosted global food production well beyond what was envisioned, with fewer people needing to be involved. This technological improvement has freed workers who would have been tied to the drudgery of farming to go on to contribute to the economy in other, more productive ways. The report also ignored the potential of technology enabling us to shift to more efficient and cleaner energy, as well as to improve medicine and education, contributing to higher living standards and longer lifespans.

Weather always produces dramatic events that awe us. This is because the events are outside of our recent experience, so they appear unusual. As humans, we look for an explanation. Today, we turn to meteorologists for explanations rather than shamans. We believe in the technology, which we call science. That is what the meteorologist relies on – the history of weather data that can be studied and used to help predict whether it will rain or be sunny tomorrow. Have you ever noticed that the local TV weatherperson almost always lists the record high and low temperatures, and the dates when they occurred, when they pronounce their forecast? They never tell you about the weather at the time those historical highs and lows were recorded, because we only want to know if we need the umbrella, a snow shovel, or AC tomorrow.

Technology has allowed us to learn much more about our planet and its environment, all of which has enabled meteorologists to forecast more accurately and for longer time periods. Technology has also enabled us to learn more about our past weather, too. Learning about water temperatures in the South Pacific that create La Niña, or El Niño weather events, or the warm desert temperatures of North Africa that spawn Atlantic hurricanes can help us better understand our future weather. Understanding water temperatures and jet streams can help us predict where storms may go.

Studying the sediments that make up the surface of the earth, or the composition of ice cores and the magnitude of tree rings from hundreds of thousands of years ago furthers our knowledge of historical weather and temperature phases the planet has experienced. With this historical knowledge we can begin to look for patterns and possible cause and effect relationships that may

impact our current weather. Remember, climate relates to decades, usually three, of weather patterns, while weather is the current meteorological trends.

In 1859, the Irish physicist John Tyndall conducted an experiment at the Royal Institution in London that confirmed the existence of the greenhouse gas effect of our atmosphere. He demonstrated the absorption and radiation by certain gases in what we now call long-wave infrared radiation. Tyndall wrote: "Thus the atmosphere admits of the entrance of solar heat; but checks its exit, and the result is a tendency to accumulate heat at the surface of the planet." While Tyndall acknowledged the work of Joseph Fourier in 1824 and Claude Pouillet in 1836 who had identified the rudimentary principles underlying the greenhouse gas effect on our atmosphere, what he had done was to detect and explain the physical basis of the greenhouse process and identify the gases responsible.

More recently, it is thought that American scientist Eunice Foote made a similar discovery in 1856, three years before Tyndall. Her experiment was crude, and it is possible she did not comprehend what exactly she had measured or whether she understood its significance. She did not differentiate between heat from the whole solar spectrum and what we now call long-wave infrared, which is responsible for the greenhouse effect. Nevertheless, her experiments did provide evidence of the absorption of heat by CO_2 and moist air.

While the scientists above laid the foundation for understanding the greenhouse effect, other scientists added to the knowledge. In 1896, Svante Arrhenius calculated the temperature rise in the atmosphere that would be caused by a doubling of CO_2 levels. Guy Callendar in 1938 showed that human activity was responsible for increasing CO_2 levels, and thus potential climate change.

In 1988, the World Meteorological Organization and the United Nations Environment Program established a committee of climatologists, meteorologists, geographers, and other scientists from around the world to study global warming, i.e., the greenhouse gas effect. The IPCC includes hundreds of scientists who review the most up-to-date research available related to global warming and climate change, from which it evaluates the risk of climate change caused by human activities, as it produces its periodical climate assessments.

How did humans get involved? *National Geographic* explains:

> Past changes in Earth's temperature happened very slowly, over hundreds of thousands of years. However, the recent warming trend is happening much faster than it ever has. Natural cycles of warming and cooling are not enough to explain the amount of warming we have experienced in such a short time—only human activities can account for it. Scientists worry that the climate is changing faster than some living things can adapt to it.

The final sentence in the paragraph above explains the motivation behind the push for aggressive action to curb carbon emissions, almost regardless of the financial cost and personal freedoms sacrificed.

In 1992, four years after the creation of the IPCC, the U.N. held its first Earth Summit in Rio de Janeiro. U.S. President George H.W. Bush, along with other world leaders, attended the meeting, at which the U.N. Framework Convention on Climate Change (UNFCCC) was adopted. The treaty was ratified by the U.S. Senate and drives U.S. climate actions.

An impetus for Congressional approval of the UNFCCC was the famous testimony of James Hansen of NASA's Goddard Space Institute before the U.S. Senate Committee on Energy and

Natural Resources on June 23, 1988. The hearing was organized by its chairman Senator Tim Wirth (D, Col), who revealed in a 2007 interview that he timed the meeting based on the D.C. weather forecast for a hot day, as well as having the windows left open all night and the heat turned up. The room's heat was further impacted by a full audience and banks of television cameras generating additional heat. As a result, the air conditioning was overpowered, and Hansen was mopping his brow during his testimony, further reinforcing his message.

In his testimony, Hansen presented the following charts. The first shows temperature differences from the mean for 1951-1980. It shows the average temperature for the first five months of 1988 setting a record going back to 1880. That was not a surprise as 1988 turned out to be one of the warmest years in modern history.

Exhibit 2. Long-Term Temperature Chart Shows Global Warming

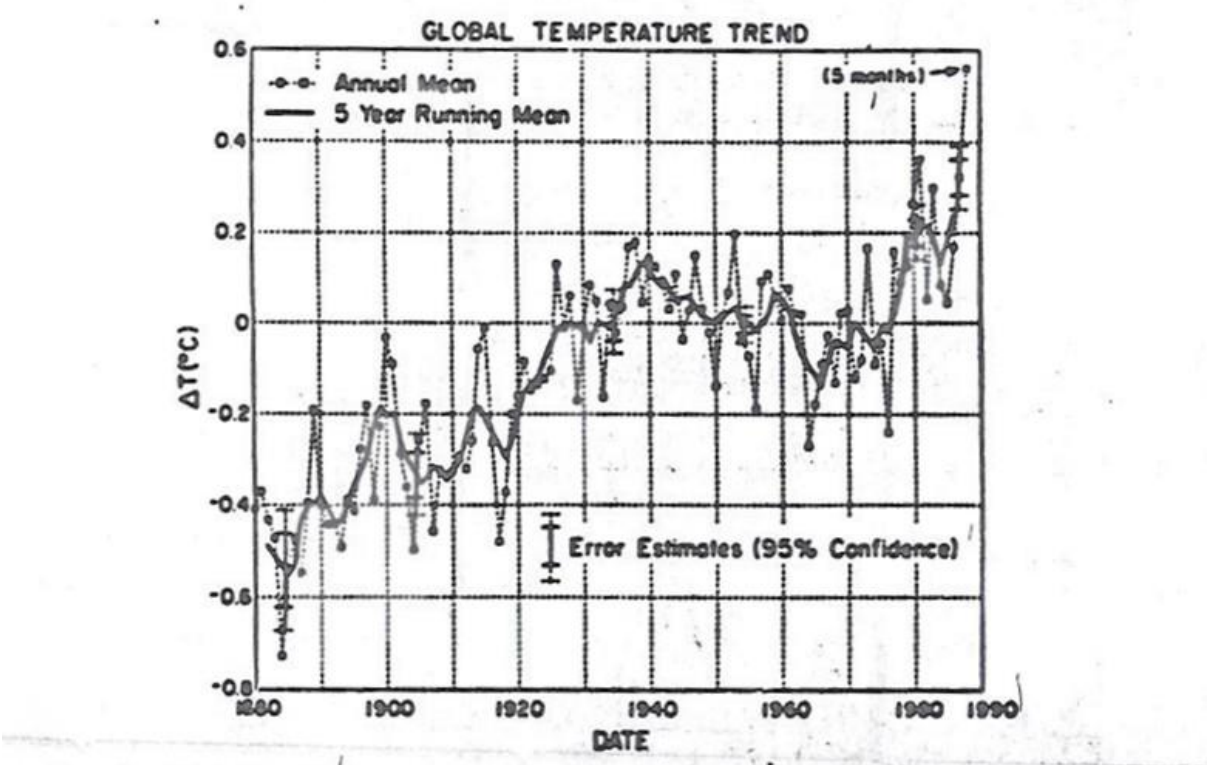


Fig. 1. Global surface air temperature change for the past century, with the zero point defined as the 1951-1980 mean. Uncertainty bars (95% confidence limits) are based on an error analysis as described in reference 6; inner bars refer to the 5-year mean and outer bars to the annual mean. The analyzed uncertainty is a result of incomplete spatial coverage by measurement stations, primarily in ocean areas. The 1988 point compares the January-May 1988 temperature to the mean for the same 5 months in 1951-1980.

Source: Hansen Congressional Testimony 1988

The second chart shows the change in global temperatures for the prior 30 years, which is when we first had accurate measurements of atmospheric composition. When compared to the 30-year mean, 1950-1980, the warming is more than 0.4º C in 1988. Hansen told the committee; "The probability of a chance warming of that magnitude is about 1 percent. So, with 99 percent confidence we can state that the warming during this time period is a real warming trend." By that

he meant the warming was greater than what natural warming would suggest, so this indicates that humans have contributed.

Exhibit 3. Near-Term Temperature Chart Confirms Global Warming

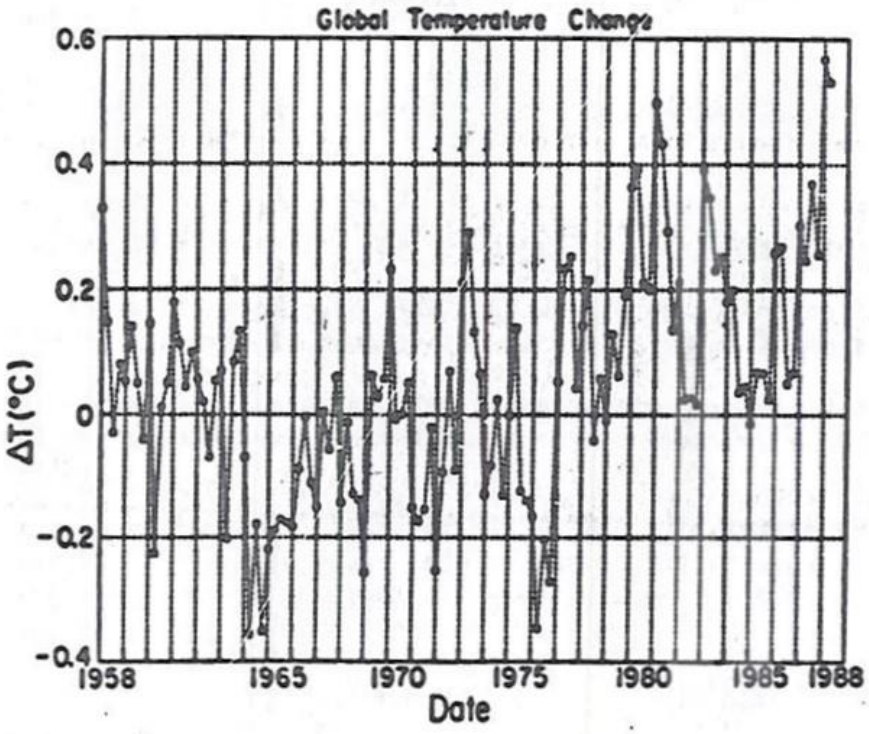


Fig. 2. Global surface air temperature change at seasonal resolution for the past 30 years. Figures 1 and 2 are updates of results in reference 6.

Source: Hansen Congressional Testimony 1988

Hansen's third chart was his forecast for global temperatures for the next 30 years using climate models developed by his NASA group. There are three scenarios presented: A – business as usual, meaning trace gas emissions grow at the rate of the previous 20 years; B – trace gas emissions are fixed at their current level; and C – draconian emission cuts over the next 10 years that completely eliminate trace gas growth by 2000. We could not find a definition of what "draconian emission cuts" meant.

Exhibit 4. Hansen's Long-Term Temperature Forecasts

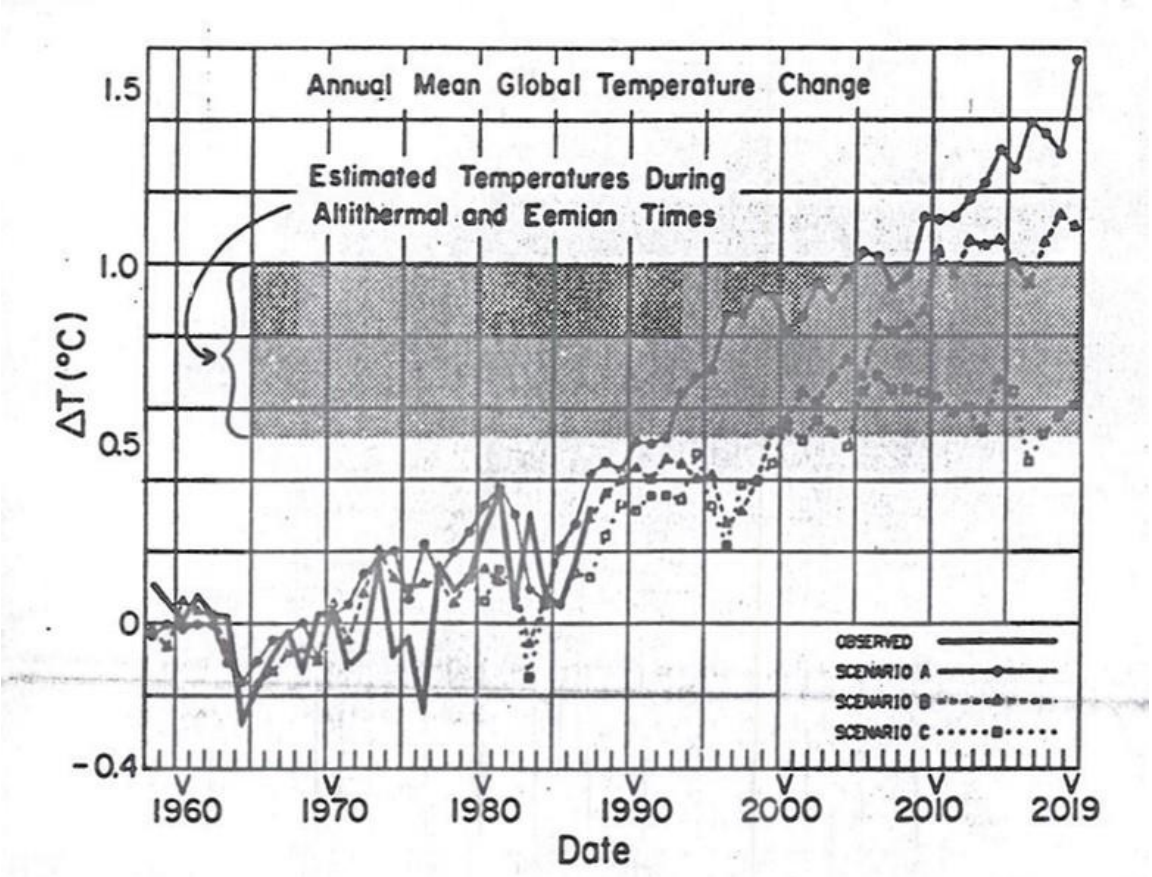


Fig. 3. Annual mean global surface air temperature computed for trace gas scenarios A, B and C described in reference 1. [Scenario A assumes continued growth rates of trace gas emissions typical of the past 20 years, i.e., about 1.5% yr^{-1} emission growth; scenario B has emission rates approximately fixed at current rates; scenario C drastically reduces trace gas emissions between 1990 and 2000.] Observed temperatures are from reference 6. The shaded range is an estimate of global temperature during the peak of the current and previous interglacial periods, about 6,000 and 120,000 years before present, respectively. The zero point for observations is the 1951-1980 mean (reference 6); the zero point for the model is the control run mean.

Source: Hansen Congressional Testimony 1988

In his concluding comments, Hansen stated the following:

> Altogether the evidence that the earth is warming by an amount which is too large to be a chance fluctuation and the similarity of the warming to that expected from the greenhouse effect represents a very strong case. In my opinion, that the greenhouse effect has been detected, and it is changing our climate now.

He went on to discuss issues such as the frequency of drought conditions in the future, as well as heat waves, which were keyed by commentary about the number of hot days in Washington, D.C.

and Omaha, Nebraska. In both cases, he, his NASA team, and their global climate models predicted more of both over the next 40 years.

Given this predicate, the door was opened for global warming studies to pour forth. Those came despite the IPCC concluding in 1990 that the observed warming at that point was consistent with global warming evidence, but also with natural variability, meaning they could not attribute the warming more to humans than nature. Disaster de jour became a tool to keep the focus on the climate change message and need for action. The pressure to get something done resulted in the evolution of climate change language. Whenever it seemed that the momentum for action waned, the language was ramped up. It went from global warming to climate change to climate emergency to climate crisis, and now to climate catastrophe. Environmental activists will say the shift from global warming to climate change was necessitated by the realization that unique weather events were driven by warming temperatures, so the language needed to be expanded to encompass both factors. In other words, all weather events could be attributed to climate change.

The terminology shift was also driven because the public, when polled, put climate at the bottom of their primary concerns. Climate ranks high in polls when the topic is climate, or climate is listed among the available responses. This disconnect between warming temperatures and unusual weather events and the public's concern is frustrating to climate change activists, who have no doubt about the problem and its solution.

Proclaiming an impending disaster, which is often forthcoming after an extreme weather event, is needed to gain media and public attention in a world of dispersed communications. It is also important for scientists in their efforts to secure research funding. No one will fund research showing that extreme weather events are rare. Therefore, we have been subjected to many outlandish predictions that never came true, but their failure is ignored, based on the mantra attributed to Niels Bohr or Yogi Berra or maybe Nostradamus that it is difficult to make predictions, especially about the future. Nevertheless, John Nolte compiled a list of 44 poor forecasts. Not all of them are about climate, but most are. Each forecast was published in a reputable newspaper or magazine or reported by mainstream media. (We will deal with their reality in another issue.)

Exhibit 5. List Of 44 Environmental Disasters

1. 1967: Dire Famine Forecast By 1975
2. 1969: Everyone Will Disappear In a Cloud Of Blue Steam By 1989 (1969)
3. 1970: Ice Age By 2000
4. 1970: America Subject to Water Rationing By 1974 and Food Rationing By 1980
5. 1971: New Ice Age Coming By 2020 or 2030
6. 1972: New Ice Age By 2070
7. 1974: Space Satellites Show New Ice Age Coming Fast
8. 1974: Another Ice Age?
9. 1974: Ozone Depletion a 'Great Peril to Life
10. 1976: Scientific Consensus Planet Cooling, Famines imminent

11. 1980: Acid Rain Kills Life In Lakes
12. 1978: No End in Sight to 30-Year Cooling Trend
13. 1988: Regional Droughts (that never happened) in 1990s
14. 1988: Temperatures in DC Will Hit Record Highs
15. 1988: Maldives Islands will Be Underwater by 2018 (they're not)
16. 1989: Rising Sea Levels will Obliterate Nations if Nothing Done by 2000
17. 1989: New York City's West Side Highway Underwater by 2019 (it's not)
18. 2000: Children Won't Know what Snow Is
19. 2002: Famine In 10 Years If We Don't Give Up Eating Fish, Meat, and Dairy
20. 2004: Britain will Be Siberia by 2024
21. 2008: Arctic will Be Ice Free by 2018
22. 2008: Climate Genius Al Gore Predicts Ice-Free Arctic by 2013
23. 2009: Climate Genius Prince Charles Says We Have 96 Months to Save World
24. 2009: UK Prime Minister Says 50 Days to 'Save The Planet From Catastrophe'
25. 2009: Climate Genius Al Gore Moves 2013 Prediction of Ice-Free Arctic to 2014
26. 2013: Arctic Ice-Free by 2015
27. 2014: Only 500 Days Before 'Climate Chaos'
28. 1968: Overpopulation Will Spread Worldwide
29. 1970: World Will Use Up All its Natural Resources
30. 1966: Oil Gone in Ten Years
31. 1972: Oil Depleted in 20 Years
32. 1977: Department of Energy Says Oil will Peak in 90s
33. 1980: Peak Oil In 2000
34. 1996: Peak Oil in 2020
35. 2002: Peak Oil in 2010
36. 2006: Super Hurricanes!
37. 2005: Manhattan Underwater by 2015
38. 1970: Urban Citizens Will Require Gas Masks by 1985
39. 1970: Nitrogen buildup Will Make All Land Unusable
40. 1970: Decaying Pollution Will Kill all the Fish

41. 1970s: Killer Bees!
42. 2004: Department of Defense Predicted Climate Change Would Destroy Us by 2020
43. 2019: Glacier National Park Removes 'Glaciers Gone by 2020' Signs
44. 1995: Most East Coast Beaches 'Gone in 25 years'

Source: John Nolte on Twitter

Some years ago, we came across the following report about problems in the Arctic, a centerpiece of the devastation a warming planet will produce. According to the report from the *Associated Press* and published in *The Washington Post*:

> The Arctic ocean is warming up, icebergs are growing scarcer and in some places the seals are finding the water too hot, according to a report to the Commerce Department yesterday from consul staff in Bergen, Norway.
>
> Reports from fishermen, seal hunters and explorers all point to a radical change in climate conditions and hitherto unheard-of temperatures in the Arctic zone. Exploration expeditions report that scarcely any ice has been met as far north as 81 degrees 29 minutes. Soundings to a depth of 3,100 meters showed the gulf stream still very warm. Great masses of ice have been replaced by moraines of earth and stones, the report continued, while at many points well known glaciers have entirely disappeared.
>
> Very few seals and no white fish are found in the eastern Arctic, while vast shoals of herring and smelts which have never before ventured so far north, are being encountered in the old seal fishing grounds.

Amazingly, this report was published on November 2, 1922!

Conditions in the Arctic and Antarctica are reported on frequently, as the disappearing ice and glaciers is a sure sign of the impending doom associated with rising temperatures due to increasing amounts of carbon in the atmosphere. Melting glaciers also make for powerful visual images. The most identified image of the Arctic is the polar bear. In 2017, a *National Geographic* photojournalist published a video of an emaciated polar bear (photo below) that went viral. The bear was photographed on Baffin Island, and the video's caption said the bear's situation was not isolated. The implication was that with the melting ice limiting their ability to hunt, polar bears were struggling to find enough to eat. Polar bear experts were outraged. Later it was shown this polar bear was ill, likely with cancer. In fact, the latest data shows the Arctic's polar bear population, which spreads from Canada to Russia is growing, despite shrinking ice cover. *National Geographic* was forced to remove the photo and publish a correction – embarrassing for a top scientific magazine. The rush to publish the photo, which went viral, was an example of the media being swept up in the need to promote the climate change narrative.

Exhibit 6. The Emaciated Polar Bear Photo Error Of National Geographic

Source: Paul Nicklen/*The Globe and Mail*

A little over two years ago, *Time* magazine featured United Nations' Secretary-General António Guterres standing in water off the island nation of Tuvalu in the South Pacific. The issue titled "Our Sinking Planet," highlighted the plight of island nations and coastal regions at risk of being overwhelmed from rising seas driven by global warming. The photo used on the cover of the magazine was taken when Guterres was on a four-nation tour in the region.

After discussing how leaders of island nations are fearful of the impact of climate change on their citizens, including their homes and food supply, *Time* made the following claim:

> And so, five years ago, Vunidogoloa was abandoned. The Fijian government built a new town about a mile up the hill at a cost of half a million dollars. Vunidogoloa is the first place in Fiji to relocate because of the effects of climate change, but it won't be the last. Prime Minister Frank Bainimarama tells me he plans to move 40 Fijian villages in the coming years to cope with rising sea levels, which **globally climbed about 7.5 in. in the 20th century and could rise 3 ft. more by the end of the 21st,** according to the U.N.'s climate-science arm. "Every day I think about climate change," he says. (emphasis added)

Notice that sea-levels rose by 7.5 inches over 100 years but are projected to climb at a rate nearly 5-times faster over the next 80 years. The key to that rise will be the melting glaciers and ice in the Arctic. Interestingly, this rationale was used numerous times to predict the demise of the Maldives in the Indian Ocean.

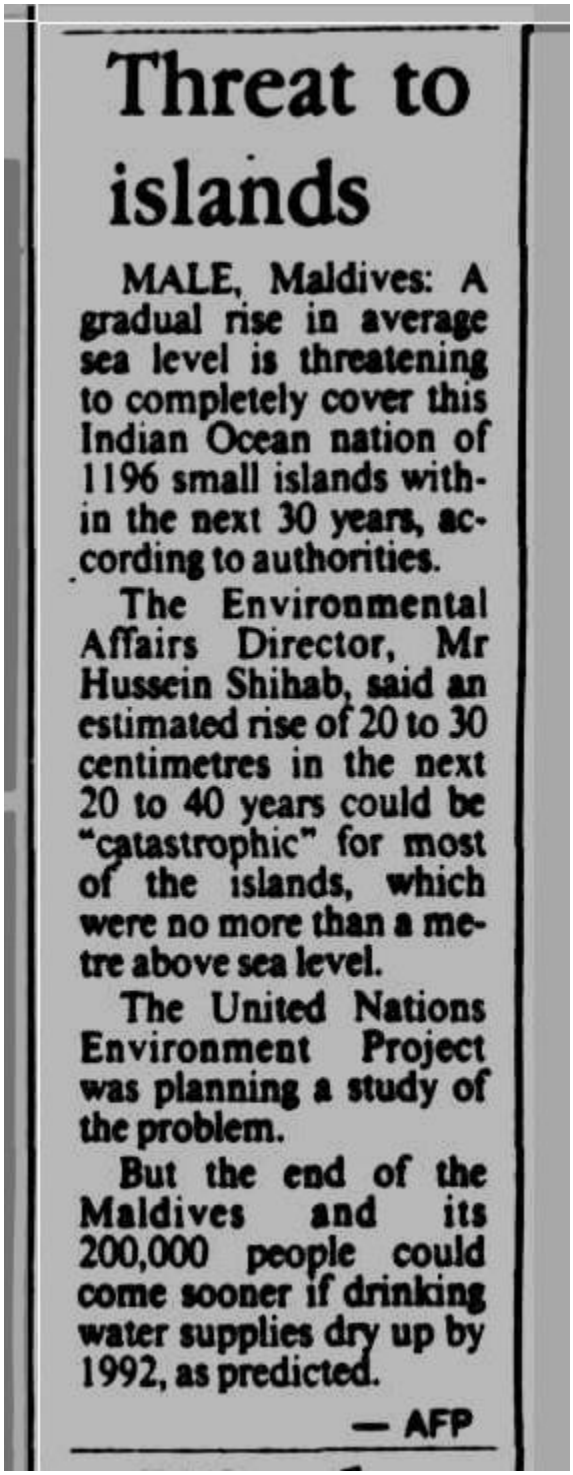
Exhibit 7. Drowning Pacific Ocean Islands

Source: ***Time***

In 2012, the former president of the Maldives, Mohamed Nasheed, sounded climate alarm bells saying, "If carbon emissions continue at the rate they are climbing today, my country will be underwater in seven years." That would have coincided with Guterres' visit in 2019. However, the island was and still is above water. More telling was the September 1988 report by the *Agence France-Presse (AFP)* that a "gradual rise in average sea level is threatening to completely cover this [Maldives] Indian Ocean nation of 1,196 small islands within the next 30 years," according to government officials. At the time, Environmental Affairs Director Hussein Shihab told *AFP* "an estimated rise of 20 to 30 centimeters [8-12 inches] in the next 20 to 40 years could be 'catastrophic' for most of the islands, which were no more than a meter [39 inches] above sea level."

It was also pointed out that the nation's demise might come sooner if drinking water was contaminated by invasion from rising ocean salt waters, as predicted to happen by 1992. These forecasts suggested dire outcomes for the residents, but neither has come true. In fact, the population of the Maldives has more than doubled since that 1988 forecast.

Exhibit 8. Death Of Maldives



Threat to islands

MALE, Maldives: A gradual rise in average sea level is threatening to completely cover this Indian Ocean nation of 1196 small islands within the next 30 years, according to authorities.

The Environmental Affairs Director, Mr Hussein Shihab, said an estimated rise of 20 to 30 centimetres in the next 20 to 40 years could be "catastrophic" for most of the islands, which were no more than a metre above sea level.

The United Nations Environment Project was planning a study of the problem.

But the end of the Maldives and its 200,000 people could come sooner if drinking water supplies dry up by 1992, as predicted.

— AFP

Source: ***trove.nla.gov.au***

One of the more recent climate change disaster scenarios involves the world's largest coral reef system. The Great Barrier Reef consists of over 2,900 individual reefs and 900 islands stretching

over 1,600 miles, greater than the distance from Boston to Miami, and covering an area of approximately 133,000 square miles. It is located in the Coral Sea, off the coast of Queensland, Australia. It is the largest structure in the world created by living organisms, visible from space, and home to thousands of species of marine life.

Formation of the Great Barrier Reef dates back 500,000 years, but the current reef structure did not begin forming until 15,000 years ago. Unlike most barrier reefs, which are formed by volcanic eruptions, the Great Barrier Reef began forming during the Ice Age. At that time, sea levels were 200-400 feet lower than today. Along the coast of Australia, a coastal plain developed from the remnants of the erosion of the Great Dividing Range. As the glaciers melted at the end of the Ice Age, sea levels began rising and this landmass was submerged. New coral began growing on the old, dead coral, as well as on the formerly exposed landmass. As water levels rose, the coral continued growing toward the surface of the water in search of sunlight, which the algae living within the coral need to survive. Once sea levels stabilized, wind and water began to erode the coral, which caused them to begin growing outward, creating the modern structure of the reef.

Coral is made up of tiny animals that build hard external skeletons, which form the structures we recognize. Inside these structures are algae, living in a symbiotic relationship. The coral produces fluorescent chemicals that protect the algae from bright sun. The algae use photosynthesis to harness solar energy to make sugars that provides food and oxygen for the coral, which is protecting and providing nutrients for the algae. It is the algae that give coral its many colors.

The science of reefs is that coral and algae evolve together to survive within a particular temperature range. If temperatures go outside of this comfort range, the coral will expel the algae, which is called bleaching because the coral becomes colorless. A 2017 UNESCO draft report expressed concern about the impact of coral bleaching on the Great Barrier Reef. The report warned about Australia's ability to meet the targets of the Reef 2050 report without considerable work to improve water quality. The concern was based on rising sea temperatures due to climate change, but also the runoff of fertilizers and sediments from adjacent farming. A 2018 report showed that about one-third of the Great Barrier Reef had experienced substantial damage from bleaching. The researchers also found that large amounts of coral had died in the warming waters before they could expel their algae partners.

Exhibit 9. Concerns Raised About Health Of Great Barrier Reef Coral

Great Barrier Reef is damaged beyond repair and can no longer be saved, say scientists

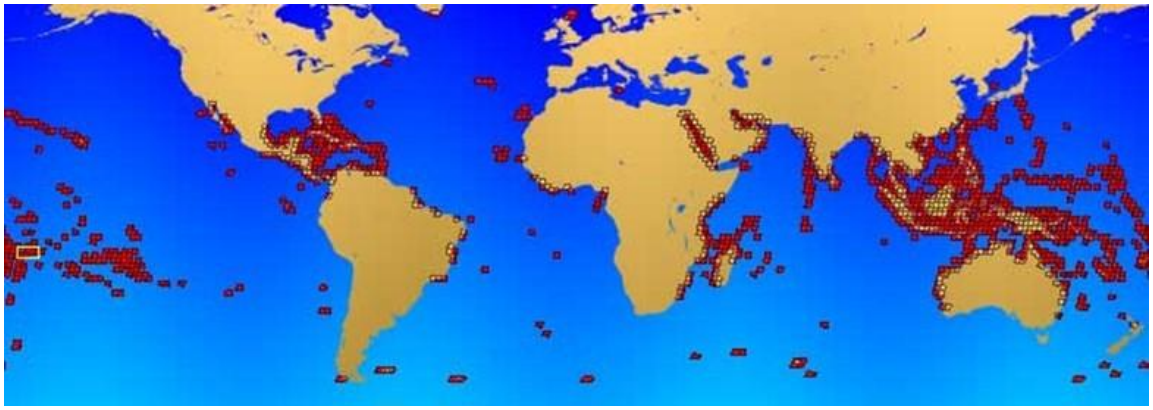
By Helena Horton
29 May 2017 • 1:17pm

Source: ***BBC***

In 2020, a study found that the Great Barrier Reef has lost more than half of its corals since 1995 due to warming waters. Without stopping global warming, the corals will be unable to keep up with rising ocean temperatures. However, we know there have been many coral bleaching events due to marine heatwaves in the summers of 1998, 2002, 2006, 2016, 2017 and 2020. The 2016-2017 period was marked by a strong El Niño that warmed the Pacific Ocean waters.

Concern about the Great Barrier Reef's health goes back to the 1970s. At that time, it was due to an influx of starfish that were attacking the coral. At that time, research of coral reefs was in its infancy. As reef expert Peter Ridd points out, coral areas the size of Belgium can be wiped out by cyclones, massive starfish invasions and bleaching. In every case, the coral reef recovers. Data about the Great Barrier Reef has only been maintained since 1985, and it shows frequent fluctuations in the coral coverage.

Exhibit 10. Worldwide Locations Of Coral And Coral Reefs



Source: english-online.at

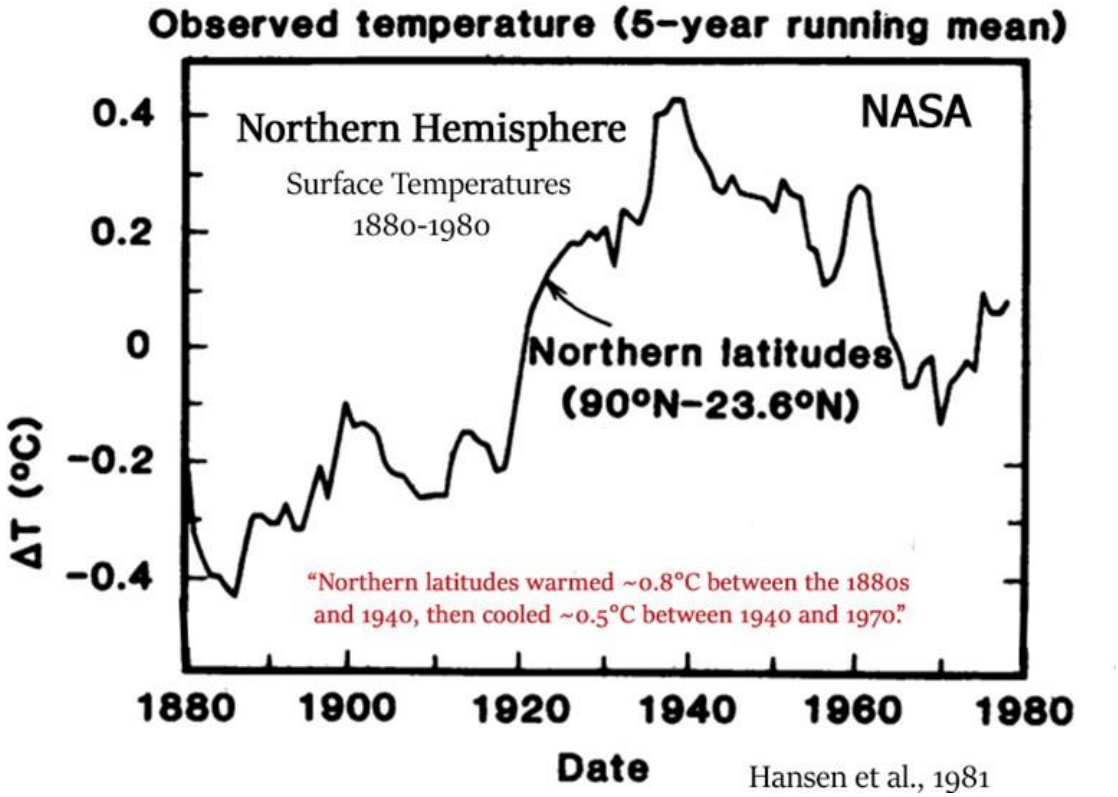
Ridd points out that coral thrives in warmer waters than off Australia, such as found in Southeast Asia and the Red Sea. He says the coral colors in these warmer waters tend to be more brilliant due to the warmer water. He also noted that coral reefs even exist off Scotland, which has cold water. He suggests that coral and its algae partners adapt to different water temperatures. He admits, however, that coral has a problem dealing with sudden significant increases in water temperatures. However, they do recover over time, something that has been going on forever.

A favorite disaster scenario emerged 20 years ago. It involved the future of snow. At that time, according to Dr David Viner, a senior research scientist at the climatic research unit (CRU) of the University of East Anglia, within a few years winter snowfall would become "a very rare and exciting event". He went on to say, "Children just aren't going to know what snow is." Another climate scientist, David Parker, at the Hadley Centre for Climate Prediction and Research in Berkshire, England said British children would have only virtual experiences of snow and cold. Using the internet, they might see polar scenes, or even "feel" virtual cold. Hard to imagine children not being able to catch falling snowflakes on their tongues.

These projections were made in 2000 in response to the U.K. experiencing a winter without snow. These scientists also suggested the U.K.'s climate would eventually resemble that of the Mediterranean. Would that be a return to the U.K. climate that existed during the Roman occupation when farmers raised grapes and made wine?

While a world without snow was a scary thought, the prospect of another Ice Age was scarier. People forget that in the 1960s, the consensus of climate scientists was the world was heading into a cooling phase. The data was overwhelming, and the realization was stark given much of the world's population had lived through a rapid warming phase during 1910-1935. Then things changed. Temperatures began dropping and didn't stop until 1970. The temperature record was recorded in a chart by NASA's Hansen that appeared in a 1981 article in which he and his co-authors had discovered an emerging warming trend.

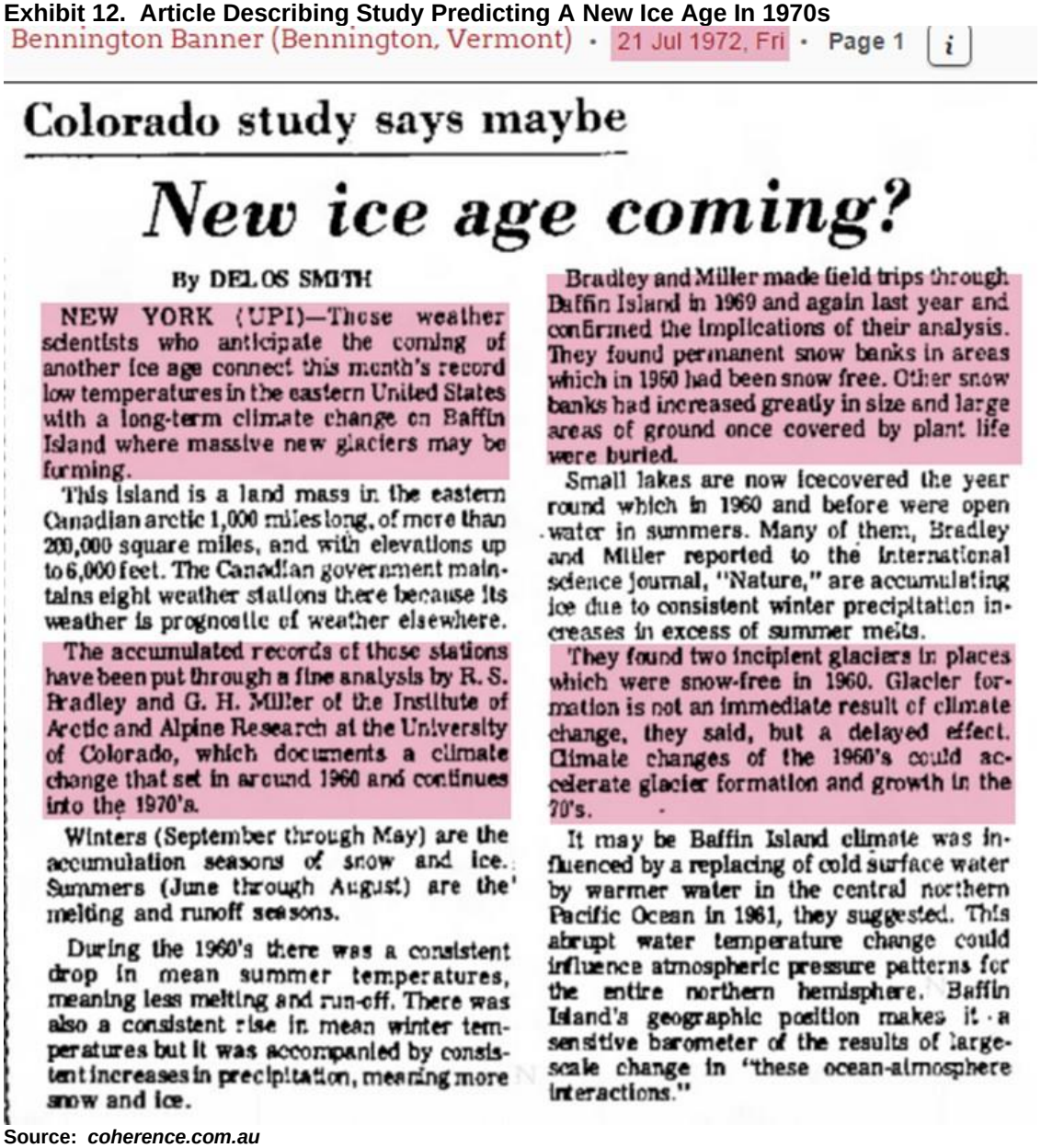
Exhibit 11. 100 Years Of Observed Temperatures Showing Hot And Cold Phases



Source: co2coalition.org

The chart above was published by co2coalition.org and annotated to show how temperatures in the Northern Hemisphere had warmed before they cooled. Scientific studies were produced during the latter 1960s and early 1970s showing how ice coverage and glaciers were growing. These studies suggested the world would continue to cool, and the risk was that people would die from cold temperatures and starvation from shortened growing seasons for foodstuffs.

Exhibit 12. Article Describing Study Predicting A New Ice Age In 1970s



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Colorado study says maybe

New ice age coming?

By DELOS SMITH

NEW YORK (UPI)—Those weather scientists who anticipate the coming of another ice age connect this month's record low temperatures in the eastern United States with a long-term climate change on Baffin Island where massive new glaciers may be forming.

This island is a land mass in the eastern Canadian arctic 1,000 miles long, of more than 200,000 square miles, and with elevations up to 6,000 feet. The Canadian government maintains eight weather stations there because its weather is prognostic of weather elsewhere.

The accumulated records of those stations have been put through a fine analysis by R. S. Bradley and G. H. Miller of the Institute of Arctic and Alpine Research at the University of Colorado, which documents a climate change that set in around 1960 and continues into the 1970's.

Winters (September through May) are the accumulation seasons of snow and ice. Summers (June through August) are the melting and runoff seasons.

During the 1960's there was a consistent drop in mean summer temperatures, meaning less melting and run-off. There was also a consistent rise in mean winter temperatures but it was accompanied by consistent increases in precipitation, meaning more snow and ice.

Bradley and Miller made field trips through Baffin Island in 1969 and again last year and confirmed the implications of their analysis. They found permanent snow banks in areas which in 1960 had been snow free. Other snow banks had increased greatly in size and large areas of ground once covered by plant life were buried.

Small lakes are now icecovered the year round which in 1960 and before were open water in summers. Many of them, Bradley and Miller reported to the international science journal, "Nature," are accumulating ice due to consistent winter precipitation increases in excess of summer melts.

They found two incipient glaciers in places which were snow-free in 1960. Glacier formation is not an immediate result of climate change, they said, but a delayed effect. Climate changes of the 1960's could accelerate glacier formation and growth in the 70's.

It may be Baffin Island climate was influenced by a replacing of cold surface water by warmer water in the central northern Pacific Ocean in 1961, they suggested. This abrupt water temperature change could influence atmospheric pressure patterns for the entire northern hemisphere. Baffin Island's geographic position makes it a sensitive barometer of the results of large-scale change in "these ocean-atmosphere interactions."

Source: ***coherence.com.au***

In the 1970s, *Time* and *Newsweek* produced magazine covers highlighting the coming ice age, as well as detailed articles quoting various climate scientists, including well-known global warming scientists today. Government agencies such as NASA and the CIA authored papers highlighting the emerging cold era and its implications for the world's population. *The New York Times* and the *Washington Times* authored many articles about the weather, climate, scientific studies, and interviews with the scientists producing them. Books were written about the cold future that was coming.

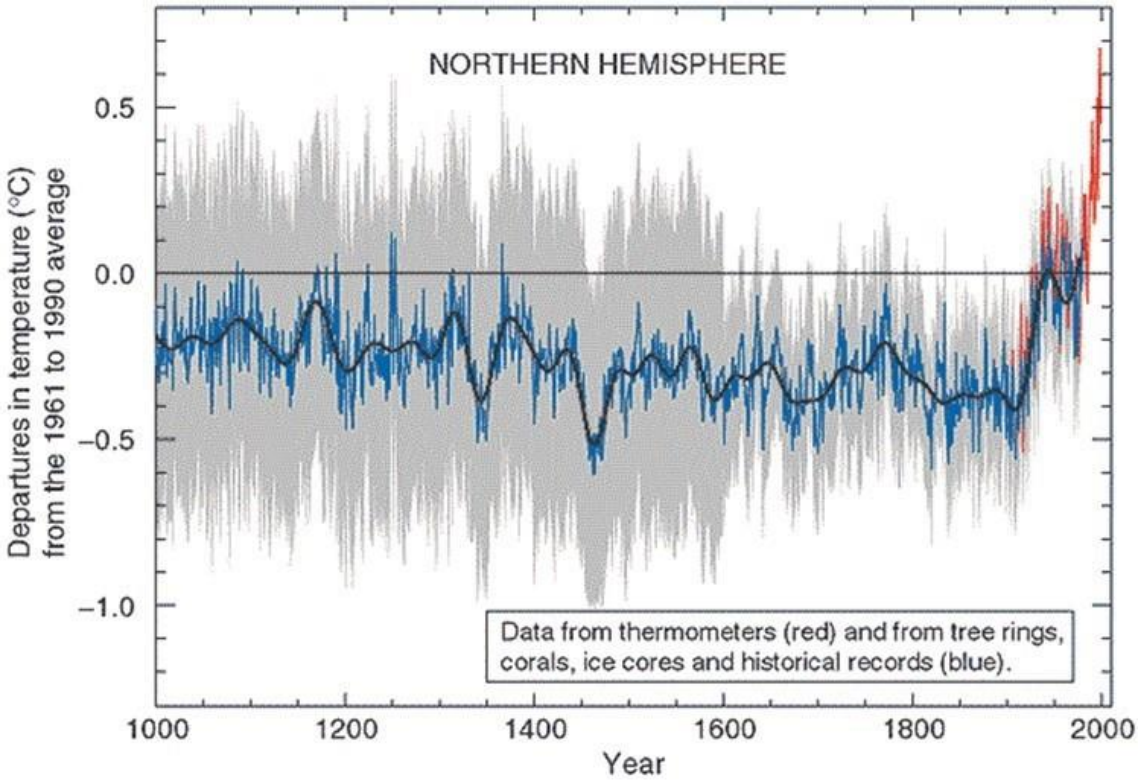
A *New York Times* article authored by John Tierney summed up the issue, its potential causes and possible outcome. An excerpt stated:

> In the 1971 essay, "Overpopulation and the Potential for Ecocide," Dr. Holdren and his co-author, the ecologist Paul Ehrlich, warned of a coming ice age. They certainly weren't the only scientists in the 1970s to warn of a coming ice age, but I can't think of any others who were so creative in their catastrophizing. Although they noted that the greenhouse effect from rising emissions of carbon dioxide emissions could cause future warming of the planet, they concluded from the mid-century cooling trend that the consequences of human activities (like industrial soot, dust from farms, jet exhaust, urbanization, and deforestation) were more likely to first cause an ice age.

Many readers may identify Paul Ehrlich, the biologist and author, with his wife, of the 1968 book, The Population Bomb, who predicted how over-population of the planet would result in starvation and deprivation. Co-author John Holdren eventually became President Barack Obama's chief science advisor and the man who influenced the administration's policies for fighting global warming, leading to Obama's heavy hand in forging the 2015 Paris Agreement on climate.

How the scientific community shifted from studying and fearing a new Ice Age to raising warnings about global warming and climate change is an interesting development. Surprisingly, the first Earth Day in 1970 discussed the cooling before focusing on global warming. The Earth Day movement was motivated to attack pollution, which as noted above, was reportedly the driving force behind global cooling and environmental damage.

Exhibit 13. The 'Infamous' Hockey Stick Temperature Chart



Source: IPCC AR3

The last disaster scenario is related to climate research utilized by the IPCC. It was spurred by the infamous "hockey stick" graph of global temperatures that drove climate change research and policymaking around 2000. The graph (above) was created by Michael Mann, a climatologist and

geophysicist professor at Penn State University. Because there is no accurate historical temperature database, he employed data from tree rings, but also coral reefs and other sources, which he linked to the recent temperature data. The chart was hailed for its breakthrough contribution to proving the acceleration in global warming. A continuation of the trend the chart showed would certainly create a climate crisis. It was so monumental that the IPCC embraced it in its 2001 report.

The graph was challenged by other climate scientists and statisticians who noted it eliminated historical periods such as the Medieval Warm Period and the Little Ice Age, well recognized and acknowledged eras. The mathematics of how the graph was created and its impact in the global warming debate, it only reflected temperature data for the Northern Hemisphere, became a significant issue. Criticism exploded within the scientific community when emails from climate scientists at the University of East Anglia, who were involved in promoting the hockey stick graph, revealed that devious mathematical techniques (Mike's trick to hide the decline) were employed to create it. Moreover, the emails revealed a concerted effort by these scientists and their associates to block critics from having their critical research on the topic published or presented at scientific conferences. We also learned these scientists avoided complying with freedom of information requests, in violation of the law. This scandal prompted several investigations, but all were conducted by people involved in supporting the intent of the graph and the scientists involved. The graph was ultimately determined to be false, and the IPCC withdrew its support. In response to criticism, Mann sued several critics, losing a high-profile Canadian case by failing to comply with the court's demand he produce the data behind the graph. The court banned the use of the graph and ordered Mann's research to be ignored. He continues his legal cases, which seems to be his response to questioning of his research.

While the hockey stick temperature graph was discredited, it has been resurrected in the latest AR6 report. It plays a role in the new IPCC climate scenarios. In its AR reports. The IPCC sets forth various scenarios for the future climate based on various climate assumptions. In initially, it used socio-economic considerations to set the assumptions. More recently, the IPCC began employing assumptions about fuel use and the impact on climate forcing. Forcing refers to the laws of thermodynamics that determines that the incoming energy from the sun and the reflected outgoing energy equals radiative forcing. When incoming energy is greater than outgoing energy, the planet warms, and vice versa. The scenarios are designed to help guide future climate change research and policymakers considering actions to slow the rise of global temperatures. (In the AR6 report, the IPCC reverts to socio-economic factors.)

In the IPCC's AR5 report (2014), four scenarios were presented. They were designed to indicate possible warming pathways in "business as usual" scenarios assuming various fuel uses and climate policies. One scenario, RCP8.5 (Representative Concentration Pathways), is considered a "high emissions" case. The results of this scenario have become the "business as usual" scenario embraced by the media and politicians, which leads to the worst-case outcomes.

Exhibit 14. Most Extreme Warming Scenario Versus Other Less Warming Scenarios

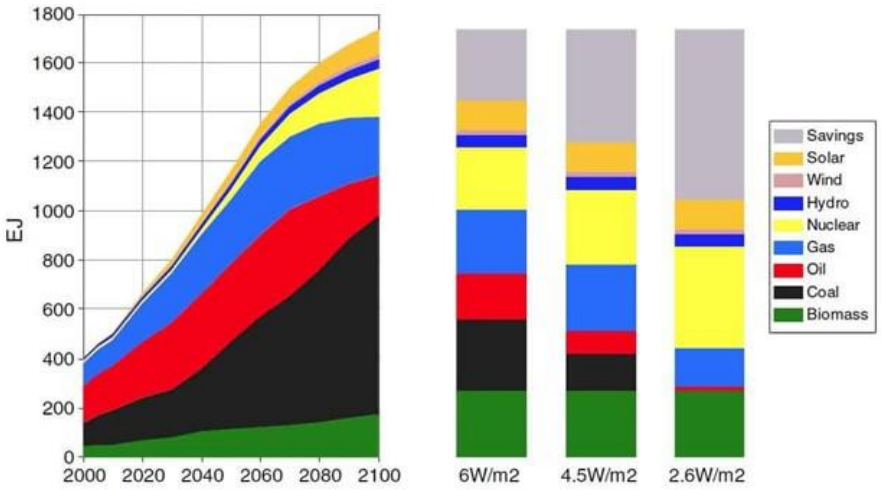


Fig. 5 Development of global primary energy supply in RCP8.5 (*left-hand panel*) and global primary energy supply in 2100 in the associated mitigation cases stabilizing radiative forcing at levels of 6, 4.5, and 2.6 W/m^2 (*right-hand bars*). Note that primary energy is accounted using the direct equivalent method

Source: IPCC AR5

As the chart shows, RCP8.5 foresees an unbridled use of coal, something not likely to occur. It also foresees global economic growth well beyond any forecast. The chart (above) for RCP8.5 shows the mix of energy used in 2100 as compared to the other three scenarios shown in the columns to the right. Importantly, the IPCC gave RCP8.5 only a 3% possibility of occurring. However, the way the scenario was presented in the summary report for policymakers made it appear this was a likely outcome if politicians failed to act, and act aggressively. It helps explain why the description of climate change became a crisis.

We have just been presented with IPCC AR6 to help guide the upcoming discussions at the climate conference in November at COP26. We will deal with AR6 in future issues when we discuss the science of climate change, disaster scenarios, and remedies, but a couple of key points are worthy of comment. In AR6 the IPCC has reverted to socio-economic forecasting scenarios and away from the definitive RCP scenarios. It also is not giving weight to any one scenario, although the emphasis in the report suggests a continued focus on RCP8.5. Importantly, the IPCC has reduced its energy forcing projection, which results in a narrowing of the potential 2100 temperature forecast range. Critically, the top end of prior forecasts from as far back as 1990 has been lowered in the new assessment, while the lowest cases have also been eliminated. The tightening of the range of future temperature projections is important, but so too is the fact that average warming target measure has not changed. Thus, despite the hyped catastrophic language used by UN officials and the media, which is designed to influence COP26 delegates, the actual outlook is less scary. It is not the apocalypse forecast.

Block Island Wind Farm Stops For Technical Reasons

The nation's first commercial offshore wind farm has been in operation since late 2016. It consists of five 6-megawatt (MW) GE wind turbines. Originally conceived as a 100-wind turbine project that extended from Rhode Island waters into Massachusetts waters, the $1.5 billion wind farm was to provide 1.3 terawatt-hours of electricity per year, equal to 15% of the state's total

electricity consumption. In 2009, Rhode Island designated Deepwater Wind to begin a pilot project, which resulted in it signing an agreement to sell the power to National Grid, the state's primary electricity company. The power produced by the turbines is collected and moved to Block Island and then to the mainland via underwater cables. The primary consumer is Block Island Power Company, which uses the wind power to displace diesel-generated power, with excess electricity being shipped to the Rhode Island mainland. The electricity was initially to be purchased at 24.4-cents per kilowatt-hour (kWh) with a guaranteed 3.5% annual increase.

The contracted price was deemed too expensive for Rhode Island electricity ratepayers by the Public Utilities Commission. Following that rejection, the state legislature revised PUC rules for evaluating wind power contracts, insuring the contract's approval, despite negative commentary from the PUC commissioners. Following further legal actions, including an appeal to the Federal Energy Regulatory Commission (FERC), the project began construction of components in 2014. They were delivered from France the following year and installed during 2016. The wind farm became operational in December 2016, with an electricity price starting at 27.5-cents/kWh.

A recent column in New London, Connecticut's *The Day* newspaper reported that on a recent visit to Block Island, the reporter noted that four of the five turbines were not rotating. He began to investigate why, which produced an interesting saga. One thing known before the turbines had stopped spinning was that the underwater cables associated with the wind farm needed to be reburied, as they had been exposed by erosion from wave action.

The plan was to rebury the gathering and transmission cables earlier this year, but due to operational issues, the work could not be performed, so it was postponed to the fall to avoid interrupting activity on the island and its power supply during the summer. The transmission cable to the mainland originally was estimated to cost $50 million, but reports are its final cost was closer to $100 million. The estimated reburying cost is estimated at $30 million, but speculation is it will likely cost more. It was a separate project from the wind farm and paid for by Rhode Island electricity ratepayers, just as they are paying the cost to rebury the cable. The cost of reburying the power gathering lines will be paid for by the wind farm's owner, Ørsted, so the expense is unknown.

The frustrating point for Rhode Islanders is that the original design plan for burying the mainland cable where it comes ashore on Block Island was changed when it was initially installed. The reburying plan will resort to the original plan. The cable has also been reburied on the mainland because it was exposed by wave action. Rhode Island ratepayers are now paying for National Grid management mistakes, for which they apparently are getting a pass.

Exhibit 15. Block Island Wind Farm Off Coast Of The Island

Source: University of Rhode Island

The reporter said he learned that the four wind turbines suddenly stopped working several weeks ago, even on windy days. He spent most of the following week trying to learn why the blades were not spinning. He reached out to wind farm owner Ørsted by phone and email. He was frustrated that the only phone numbers listed on the company's web site were in Denmark where it is based. He said he thought Ørsted had promised to open an office in New London.

He couldn't get anyone from the Rhode Island Office of Energy Resources to respond despite multiple days of messages left. A spokesman for National Grid told him that the wind turbine shutdown isn't impacting the power supply and referred all questions to Ørsted. He also spoke with the president of Block Island Power Company, who said he doesn't know why the turbines were not working and suggested that Ørsted may not answer the question because the information is proprietary.

Eventually, the reporter received an email from a representative from a Rhode Island public relations firm who identified herself as an Ørsted spokesperson saying the shutdown was "ongoing routine summer maintenance" and is expected to continue for "the next few weeks." In the email, part of the "routine" maintenance" is to repair "stress lines" identified by GE. She also indicated that an assessment of the wind farm showed "the turbines are structurally sound, and the repairs should be finished in coming weeks." She did not provide any additional information about the repairs, nor how much the maintenance will cost. Of course, that expense is on Ørsted's tab, not paid for by Rhode Island ratepayers.

In the newspaper article, the reporter discussed Ørsted's issue in Europe where it is liable for about $500 million for reburying cable connections in up to ten offshore wind farms it owns and operates. That is a significant cost issue, which we have covered in a previous *Energy Musings*

article. The significance of the issue is that Ørsted altered its previous cable burying technique when these ten wind farms were constructed, likely to save money. Later wind farms built by Ørsted reverted to the earlier technique for buying cables. The liability is to cover the cost of rebuying the cables at these ten offshore wind farms.

More troubling, and with potentially greater significance, is the "stress" issue. In June, operations at the 396 MW Merkur wind farm in the German North Sea were partially stopped after the discovery of "signs of stress fatigue" on parts of the project's turbines. According to The Renewable Infrastructure Group (TRIG), which owns 25% of the project, in "routine inspections" the stress issue "on certain areas of the support structure of the Helihoist on some" of the 66 GE Haliade 6 MW turbines was discovered. The company reported that the turbines were still under warranty and a service agreement with GE provides for reimbursement for the lost wind power but up to a cap, which the company said will not be exceeded. We cannot find updated information on the issue, although TRIG said some of the initial wind turbines shut down have been returned to service. We do not know how many turbines were impacted, or whether some are still off-line. These turbines were constructed after those used in the Block Island Wind Farm. The "root cause" of the stress issue has not been identified. In its statement announcing the wind turbine shutdowns, TRIG stated:

> The project's dedicated asset management team, with support from the Company's Managers, is working closely with the manufacturer to identify and put in place a solution that will allow the wind farm to resume operating safely and effectively for the long term.

Although the turbines shut down and now back in service may not have had serious issues, why the stress lines developed and what repairs have or needed to be done, have not been reported. Is this a potentially serious issue that effects the lifespan of this GE model offshore wind turbine? These turbines with stress lines are relatively young – 3-6 years old. We know from analytical work on U.K. offshore wind farms that initial construction costs have not declined over time as promised, and maintenance costs have been higher than projected. Moreover, offshore wind turbine lives, in some cases, have been well short of their advertised length. These issues partially explain why most wind farms close once their government subsidies end.

We will follow this issue, but given that it effects Østed's profitability, unless it rises to a material threshold, it will not be disclosed or discussed by the company. It is possible GE will release information, since the issue involves their turbines, but maybe only to customers. As *The Day's* reporter pointed out when he discussed the lack of response to his inquires, no one wants the Block Island Wind Farm to get additional "black eyes" beyond the cable problems alluded to above. Black eyes are not good for this nascent industry that many people are counting on.

The Future Of Mobility Is EVs According To Biden

President Joe Biden and his administration have been focusing on electrifying the nation's transportation sector. Electric vehicles (EV) have been assigned an outsized role. He presented an aggressive EV plan in his "American Jobs Plan" last spring to encourage domestic automakers to rapidly switch output from gasoline-powered vehicles to EVs. EVs are touted not only as better for the environment but a huge job creator – at least for well-paying union jobs. Those plans faced push-back and were scaled back. In the bipartisan infrastructure bill just approved by the Senate, only $7.5 billion of the $1 trillion spending is dedicated to EVs for installing charging stations. Hope for more support for EVs shifts to the Democrat's $3.5 trillion budget bill. Last week, Rep. Debbie Dingell (D, MI) led 12 fellow members of the House of Representatives

hoping to boost EV spending to $85 billion in its bill that must dovetail with the Senate-passed bill before legislation can be finalized. We will be watching.

More recently, to hype the EV movement, the White House held an event with a handful of automaker CEOs in attendance, along with leaders if the AFL-CIO labor movement, where the President signed an executive order establishing a goal of 50% of all cars and light-duty vehicles sold in the U.S. in 2030 being battery electric vehicles (BEV), plug-in hybrids (PHEV), or fuel cell electrics (FCEV). This goal, however, is voluntary and was not embraced enthusiastically by all the automakers. The idea of the goal being voluntary prompted a disappointed Dan Becker, a longtime clean car advocate and director of the Arizona-based Center for Biological Diversity's Safe Climate Transport Campaign to say, "Voluntary pledges from auto companies make a New Year's resolution to lose weight look like a legally binding contract."

The administration has other tools to try to boost EV sales from their current roughly 3% market share to the 50% goal. Hitting the goal means approximately eight million EVs a year being sold by the late 2020s. Getting there will require substantial help from the government in the form of money and policy support. We're not talking about mandating the sales target, or banning gasoline-powered cars, we're talking about help for the nation's rare earth minerals industry, as well as expanding the EV charging network. One assist may come from the EPA's proposed increase in auto manufacturers' fleet fuel efficiency standard (CAFE) by 10% for the 2023 model year and then by 3-5% per year thereafter, reaching a 52-miles-per-gallon average by 2026. For a car manufacturer, meeting the CAFE standard can be achieved by boosting EVs as a percent of its total vehicle sales, as well as lifting the fuel efficiency of its gasoline models.

The most critical support for EVs will be an expansion of the federal tax credit for EVs (more money). Until substantial reductions in the cost of EV batteries are achieved, these clean vehicles will continue to sell for thousands of dollars above the price of comparable gasoline-powered vehicles, making the sale proposition a challenge. A recent *New York Times* article, "Missing Link in Electric Car Push: Money," showed how the high cost of EVs had distorted their market. It supported its thesis by showing the concentration of EVs in California's wealthy ZIP codes. (We've looked at similar data for Texas showing the same thing.) Buyers with high incomes can take advantage of the federal tax credit, as well as pay for their luxurious and expensive Teslas. In fact, when the article's reporters interviewed EV owners in these neighborhoods, they found it wasn't environmental concern that drove the purchase. As one Tesla buyer put it, the incentives are "subsiding my luxury." An elitist attitude like that will produce a limited number of EV buyers before economics becomes the prime determinant in the EV market's growth. Earlier this year, a Houston business reporter described his family's search for a new car. He concluded that his and his wife's combined incomes would not support the purchase of an EV.

Currently, SB 1298, the Clean Energy for America Act, is awaiting action in the Senate but with no Republican support. It would increase the present $7,500 EV tax credit to $10,000 for buyers of qualified BEVs and PHEVs made in the U.S., and to $12,500 for buyers of qualified vehicles made in U.S. factories with union workers. It would not change the $8,000 credit for FCEV buyers. It also would restore eligibility for these tax subsidies to GM and Tesla who have exceeded their sales limits at which point their access to the tax credits expired. In this regard, GM CEO Mary Barra is pressing for the ceiling on EV sales eligible for tax credits to be increased, or better yet, done away with, leading to permanent tax subsidies.

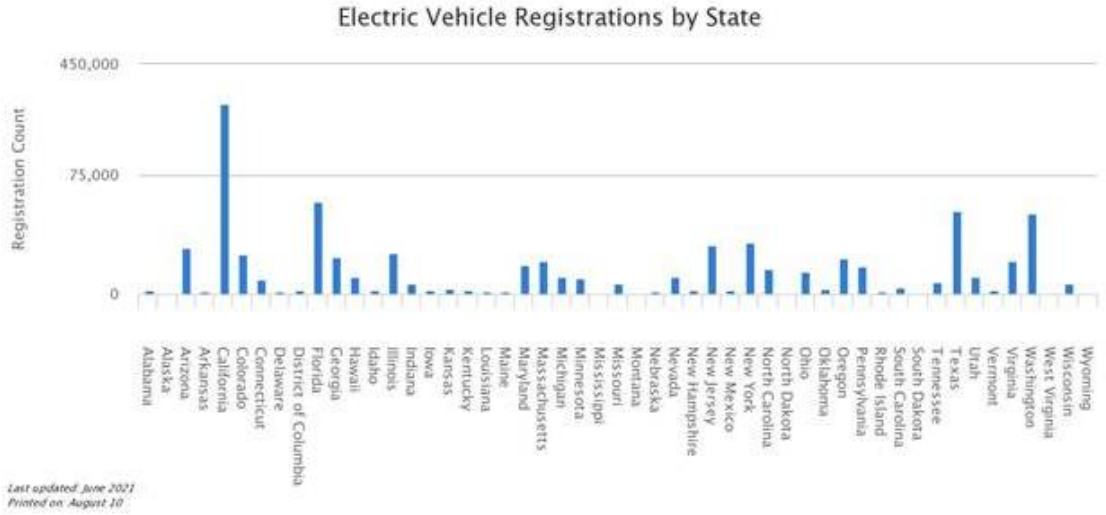
Note the $2,500 greater tax subsidy for union made EVs. As one article pointed out, Tesla, which manufactures vehicles in the U.S., would be eligible for the $10,000 credit but not the $12,500 credit because its labor force is non-union. Maybe Elon Musk, Tesla CEO, was not invited to the

White House bash for fear of sending mixed messages when the Biden administration is seeking union support for its EV efforts.

This description of how the federal EV tax credit is to be modify isn't what we were led to believe the Biden administration wants. Our understanding, based on research earlier this year, was that the Biden administration wants to shift the tax subsidy from its focus on car buyers to auto companies via transitioning the tax credit into a sales price reduction. Because most future buyers will have more moderate incomes, and thus do not generate large federal income tax liabilities that would utilize the tax subsidy in full, the final cost will not come down as much making EVs too expensive. Reducing the vehicle price should have a greater impact on future EV sales than increasing the tax credit. Making the subsidy permanent would be even better!

A chart on EV registrations by state prepared by the National Renewable Energy Laboratory based on data from Experian Information Solutions shows the top four states for EVs in mid-2021 to be California, Florida, Texas, and Washington. Most other states, except New Jersey, New York, Arizona, and Illinois, are minor players in the EV market. The top EV states have pockets of extreme wealth that can afford EVs.

Exhibit 16. U.S. States Ranked By Number Of EV Registrations



Source: NREL

Another analysis based on different data shows a different line-up of the top EV states. The data for the following charts comes from the Open Vehicle Registration Initiative of Atlas EV Hub. Atlas is working with states directly to make data on EV registrations publicly accessible. Sixteen states are currently members, representing most of the EV registrations in the nation. The data is updated on different time scales – annually, bi-annually, and monthly – and provides county or ZIP code detail.

Using this data, California is the leader by a wide margin, followed by Washington, Florida, and Texas. Washington and Florida are close in total EV registrations. Importantly, the data shows the split between BEVs and PHEVs, which is meaningful but given little airtime when EVs are discussed. The media and most people believe EV numbers refer only to BEVs, although PHEVs account for a significant share of the market.

Based on EVs per 1,000 population, California and Washington are well ahead of Florida and Texas. Washington's performance is helped by having only eight million people compared to California with over 39 million, Texas with 30 million, and Florida with 22 million.

It is also evident that the number of charging stations will be important for the speed with which the different states can grow their EV fleets. That is why the Biden administration's focus on installing 500,000 more charging stations, especially along the interstate highway system, will be important. The scary part is that the federal government will be picking the sites for their installation, reminiscent of the mess the government made of gasoline allocations in the past. Furthermore, more charging stations doesn't address the charging time hurdle bothering many EV buyers.

Exhibit 17. EV Market Dynamics In Leading States

Category	California	Washington	Florida	Texas
EVs on the Road	623,919	74,355	71,441	48,475
Battery Electric Vehicles	366,702	54,151	51,285	35,539
Plug-in Hybrid Electric Vehicles	257,217	20,204	20,156	12,936
BEVs per 1k People	9.34	7.31	2.45	1.26
PHEVs per 1k People	6.55	2.73	0.96	0.46
BEVs per DC Fast Charge Ports	61.35	78.25	48.11	45.62
EVs per Level 2 Port	19.46	23.24	14.20	11.29
Date	12/31/2020	7/20/2021	12/31/2020	8/3/2021

Source: EV Hub (www.atlasevhub.com)

Given Tesla's dominance in the EV market, we decided to look at how it ranked in the four states. We calculated Tesla's share of the states' total EVs and then of the BEV market, as the company's models are only 100% electric. Each of the four states showed Tesla the leader by a wide margin. The concern is whether Tesla may be running out of elite buyers – those desiring to be trendsetters, interested in the EV technology, or wealthy enough to afford a Tesla.

Exhibit 18. Tesla's Market Share In States With Large EV Registrations

	California	Washington	Florida	Texas
Tesla Share of EV Market	41.7%	41.7%	58.8%	55.7%
Tesla Share of BEV Market	70.9%	57.2%	81.9%	76.0%

Source: EV Hub (www.atlasevhub.com)

The issue of EV charging receives attention primarily as it relates to the challenge of finding a charging station and secondarily the charging time. For people living in apartments where access to charging stations is non-existent, EV owners must rely on public charging stations, meaning their electricity costs more. In Germany, this is becoming a significant issue given the country's newly announced net zero emissions strategy.

An article from *Zeit Online* focused on what awaits Germans once the ban on cars that emit CO_2 in the European Union begins in 2035. It means all Germans will be forced to buy BEVs. This means that anyone who cannot charge their EV at home or at their employer will be forced to rely on public stations. A recent survey showed that more than half of the current EV charging is done at home, a quarter at the employer, and less than 20% at public charging stations. Those ratios are likely to change significantly in the future.

Zeit Online discussed the economics of public charging stations, which will present a serious problem for those Germans without access to home or employer charging. According to Energie Baden-Württemberg AG (EnBW), a German electricity company, "A larger charging park with a solar roof costs a six- to seven-digit amount." This cost is increased by the need to maintain the charging station regularly and to operate a 24-hour hotline for customers. In the case of fast charging stations, a medium voltage connection is expensive, but indispensable. As EnBW pointed out, the national cost of electricity is 32 cents per kilowatt hour. At a normal public charging station, the cost will be 20-cents higher, and at a fast-charging station, it will be 45-cents more. This means a typical "fill-up" will cost €60 ($70) or more. Moreover, if someone uses an account with one electricity company at another company's charging station, the cost of the power will be 20% more than the posted price, much like the user charge for accessing an ATM outside of a bank's network.

Growth in charging stations in the U.S. is slow because of their cost and payback. The president of a subsidiary of RaceTrac Petroleum Inc., with over 750 locations, told a *Wall Street Journal* reporter that "We're perfectly OK putting capital at risk. The key is we've got to have a viable business case. We don't see an investable marketplace." The CEO of Pilot Co. with 900 retail and fueling locations in the U.S. and Canada said the most popular of the company's 58 chargers are in use 5% of the time. They need to be in use about 30% for the company to earn a return on its investment. In the article, he was quoted saying, "The economic case today for EV charging investment does not exist."

Further to the issue of chargers and investment, Andrew Clyde, CEO of Murphy USA, which has more than 1,650 locations, said its latest survey of customers showed that most drive a 12-year-old car or truck that cost less than $15,000. "Electric vehicles have to be affordable, which they aren't," he told the *WSJ*. He also noted that "I'm not a denier." But the most telling comment came from a vice president of the parent of Love's Travel Stops & Country Stores Inc., who said, "What really drives us to put locations in is when there's heavy subsidies available, where we can more or less build it for free." Welcome to the new infrastructure world embraced by the U.S. Senate.

The cost of EVs remains a hurdle for growing sales. Mandates and subsidies will work to a certain degree, but by pushing people into having to buy an expensive appliance that is critical to most people's everyday lives and incomes, and then inflating the cost of the power is not a strategy for getting the most buy-in by people. Without public support for EVs, which has numerous components, and more money, getting to Mr. Biden's 50% goal by 2030 looks highly questionable.

Thoughts On Recent Energy News

Biden's Oil Policy - LOL

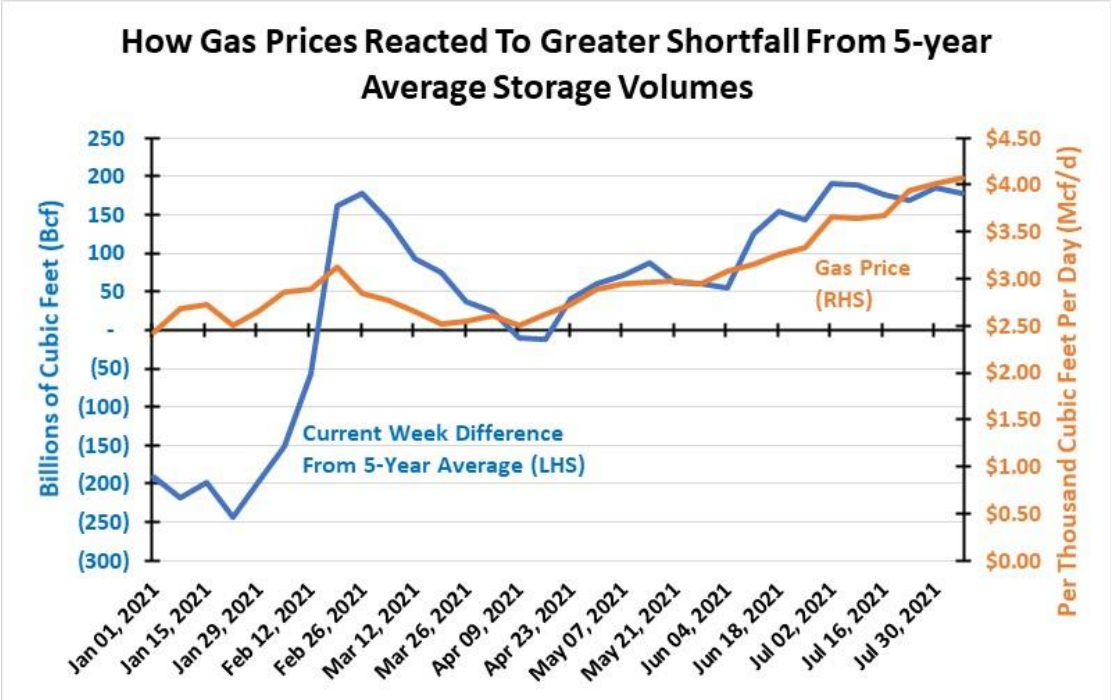
Pardon us while we laugh. Jake Sullivan, National Security Advisor, told the Washington press corps last Wednesday that the Biden administration was asking OPEC+ to increase its oil output to temper the rise in gasoline prices. The administration fears high gasoline prices may slow the economic recovery, and boost inflation that hurts lower income families. He also said they sent a letter to the Federal Trade Commission urging them to use whatever tools they had available to monitor potential anti-competitive pricing in the gasoline market. That move was typical of government response whenever gasoline prices rise. Go after those big oil companies for monopolizing the market, even though they comply with the myriad and often byzantine rules.

Maybe the administration should have sent a letter to Joe Biden. It has been his policies – killing the Keystone XL pipeline, pausing leasing activity on federal lands, slowing the approval of permits to drill on federal land, banning lease sales in Alaska, instituting environmental and wildlife restrictions on federal land – that have contributed to high prices. Nothing good for American oil and gas workers. Moreover, Biden had no problem approving the Nord Stream II gas pipeline from Russia to Germany, making Europe more dependent on Russian gas supplies. Moreover, with U.S. oil production down, we have become a net oil importer again. And guess what? Russia is now our second largest supplier of foreign oil supplies! Gee, is Biden beholden to Putin?

Want To Know Why Natural Gas Prices Are At $4/Mcf, But May Fall?

People continue to be surprised that natural gas prices are at $4 per thousand cubic feet (Mcf), the highest point since late 2018. The market has been worried that not enough gas was being put into storage for the upcoming winter. Therefore, traders moved up prices to help reduce demand and encourage more production. That would allow more supply to be injected into storage.

Exhibit 19. A Shortcut To See Where Natural Gas Prices Are Heading



Source: EIA, PPHB

The above chart plots the difference in 2021 weekly storage volumes from the 5-year average. As we began the injection season this spring, the difference was about zero. As the difference grew, gas prices began rising, eventually stopping around $3.65/Mcf. That was at the peak in the storage volume difference. Gas prices then remained stable while injections grew, closing the gap with the 5-year average. When the market sensed injections would start lagging the 5-year rate, gas prices began climbing, in this case above $4/Mcf to work its magic in the marketplace. Last week's injection of 49 billion cubic feet, the gap between current storage and the 5-year

average, gas prices sold off, falling under $4/Mcf. That suggests the market believes prices near this level will be sufficient to rebuild storage for the winter. It will be interesting to see how weekly storage volumes compare with the 5-year average, as that will likely tell us where gas prices are headed.

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