SHSS Simon Hunt Strategic Services

ECONOMIC & COPPER ADVISORY SERVICES

THOUGHT FOR THE DAY

CLIMATE CHANGE: ARE RENEWABLES & EVS SO GREEN?

"Global oil production would fall 30% by 2030 without significant investments." **Saudi Arabia's Oil Minister, Prince Abdulaziz bin Al-Saud**

"The 'New Energy Economy' rests on the belief – a centerpiece of the New green Deal and other similar proposals that the technologies of wind and solar power and battery storage are undergoing the kind of disruption experienced in computing and communications, dramatically lowering costs and increasing efficiency. But this core analogy glosses over profound differences, grounded in physics, between systems that produce energy and those that produce information." **Manhattan Institute**

"Solar cycle 24 was a feeble cycle peaking at 114 sunspots compared with the average of 179. Solar cycle 25 is now underway and is expected to peak at 115 sunspots in July 2025. According to our model the sun's quiet period will begin around the first half of 2027." **NASA & NOAA Scientists, September 2020**

"The pledges to reach net zero emissions made by many countries, including China and India, should have strong implications for coal – but these are not yet visible in our short-term forecast, reflecting the major gap between ambitions and actions." **Keisuke Sadamori, Director of Energy Markets & Security at IEA**

"Electrification of cars causes a shift of focus from the use phase to the materials production and refining phase." **Volvo Cars**

1. Background

Renewables and EVs are an intrinsic part of eliminating or at least reducing CO2 emissions. The consensus view is that the world has been warming because of the excessive rise in carbon dioxide or CO2 and that such an increase has been due to using fossil fuels to generate electricity and to use gasoline (petrol) to drive vehicles amongst other uses.

The global per capita data on CO2 emissions is interesting showing that it peaked in 1980 and is trending down and that the level is tied into economic activity.

Table 1:

Global Per Capita CO2 Emissions – Metric Tons per Capita

1960	1980	2000	2020
3.121	4.601	3.813	4.230

Source: IEA

Between 1960 and 1980, per capita CO2 emissions rose by rose by 47.4% but global GDP increased by 90.1%. Between 1980 and 2000 the respective changes were -17.1% and plus 59% and between 2000 and 2020 they were plus 10.9% and plus 61.8%. In this latter twenty-year period developing countries grew 3.3 times faster than the OECD (99.6% v 30.5%).

Anyone who traveled through China in the 1990s and even more recently will have encountered the horrific dark days in winter and even in summer when, as an example, we were driven through an industrial valley to visit a plant; the driver had to switch on his headlights even though it was 2 'O' Clock in the afternoon.

The CO2 emissions per capita for China should be seen against the country's rapid industrialization in the forty years since 1980 when GDP increased by a total of 380% compared with the OECD's 92%. Part of Xi Jinping's Common Prosperity drive is to clean up the atmosphere so making the country more livable. Even the building of new fossil fuel power plants will use the latest technology which eliminates over 99% of CO2 emissions. Why does not OECD governments go down this route?

Given that China and the OECD have similar populations it is likely that China's per capita CO2 emissions will continue to remain below the OECD average in the coming twenty years.

Table 2:

China & OECD Per Capita CO2 Emissions – Metric tons Per capita

	1980	2000	2020
China	1.495	2.648	8.200
OECD	10.949	10.728	8.500

Source: IEA, SHSS

In the 1980-2000 period China's GDP rose by 197% compared with per capita CO2 emissions increasing by 77% and over the last twenty years per capita CO2 emissions rose by 110% but GDP by 183%.

In the OECD in the first twenty-year period GDP rose by 61% but CO2 emissions declined by 2% and in the second twenty-year period GDP increased by 31% with CO2 emissions falling by 21%.

Developing nations will resist changing their growth habits to accommodate the demands from Washington, Berlin or London. Instead, they will adopt more pragmatic steps by fully

using technology such as Carbon Capture & Storage (CCS) which removes over 99% of CO2 emissions.

2. Climate Change

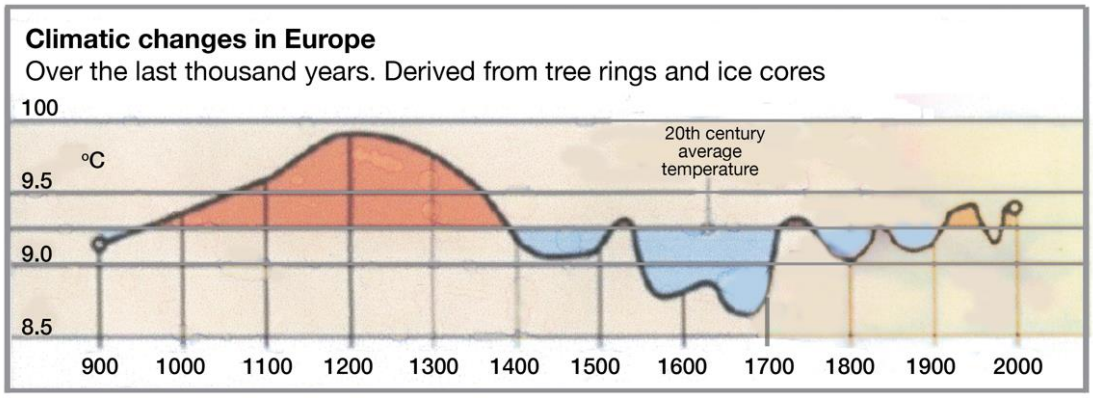
The consensus view is that mankind's focus on growth through industrialization by using fossil fuel power stations and driving gasoline cars so creating a global car pool of 1.578 billion vehicles at end 2020 has dramatically increased world CO2 emissions from 9.39 billion tons in 1960 to over 36 billion tons in 2020 causing global weather patterns to become warmer. Unless stopped if not reduced the consequences for our plant would be dire.

This is the thesis being driven by politicians and their corporate elites under the influence of Klaus Schwab and the World economic crowd. In contrast, we know that in at least two of the 5-Eye countries that their military establishments, who also undertake detailed long-run weather analyses do not hold to this consensus view. Their focus is on long-run weather patterns.

These views are led by years of intensive studies undertaken by the National Oceanic & Atmospheric Administration (NOAA) and by NASA and others who believe that it is not CO2 emissions that have caused warmer weather but by solar activity, volcanic activity and changes in oceanic temperatures. These weather patterns move in long-run cycles of around 70 years.

Chart 1:

Climatic Changes in Europe



Source: William Houston

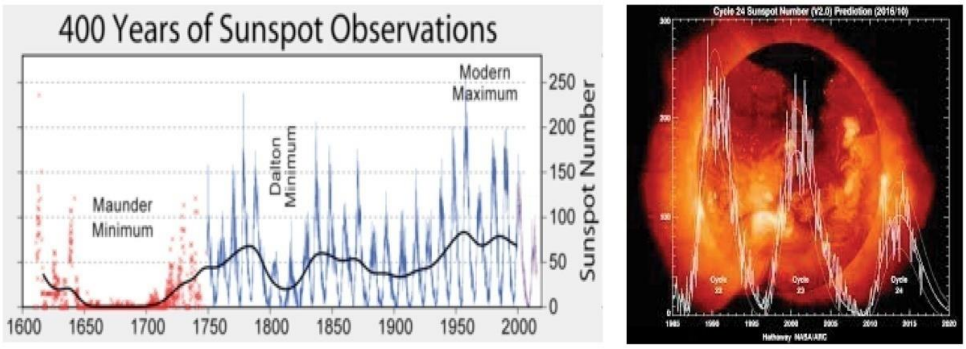
As Bill Houston writes, these temperature records were derived from a study of tree rings and ice cores that tell the story of how regular movements in the solar system directly affects life on earth. Measuring the width of tree rings provided a continuous climate and temperature record going back thousands of years from samples taken from inter alia the giant Redwoods of California.

Ice cores taken from Cape Century in Greenland provided an even longer record going back tens of thousands of years.

Sunspots are dark patches on the sun's surface that rise and fall over an eleven-year cycle; they also change their polarity so that over twenty-two years they complete a rhythm known as the Hale Cycle.

Chart 2:

400 Years of Sunspot Observations



Source: William Houston

This chart shows the sunspot record over the last 400 years with two Minima Cycles, the Maunder and Dalton cold cycles being highlighted. We are currently moving out of Maximum Weather Cycle into a new Minima which NOAA predicts will be a 'full-blown' Grand Solar Minimum (GSM) cycle starting in the late 2020s and lasting at least until the 2040s.

The significance of this shift to cooler weather is that the oceans are then able to absorb the excess CO2 emissions whereas in the warmer temperatures they are unable to do so. The shift from a warming climate to a cooling one will impact all of those policies that politicians have thrown at their electorates.

The question then is whether the general public realizes that these policies are raising their costs of living in a period when weather is not actually warming but getting colder and that CO2 emissions have started falling as the oceans are again able to absorb excess CO2 emissions.

If current government policies prevail in developed countries it will result in fossil fuels leaving us before we can leave them. For instance, Saudi Arabia's Energy Minister has just said that if the oil industry does not get significant investment soon oil production will fall by 30% by 2030.

Current electricity prices across Europe, the UK and probably later this winter in America should act as a wake-up call that the world cannot rely on the variables of sun and wind.

Even the IEA seems to be accepting this fact in their recent forecast. For instance, fossil fuels will still account for 58% in 2030 and 48% in 2040 of world electricity generation.

If NOAA is right and is supported by a number of independent scientists and climatologists then we could see the re-emergence of fossil fuels from 2030 onwards – of course using technologies like Carbon Capture & Storage.

Table 3:

Electricity Generation by Fuel Source – Thousands of TWh

	2020	**2030**	**2040**
Coal	10	10	10
Gas	6	8	9
Nuclear	3	3	3
Oil	1	1	0
Hydro	4	5	6
Wind	2	3	5
Solar	1	3	5
Other Renewals	1	1	2
Total	**28**	**34**	**40**
	Coal, Gas, Oil % Total		
	61%	58%	48%

Source: IEA, July 2021

3. Renewables & EVs: Are They as Green as They Are Supposed to Be?

First Batteries:

- Batteries are energy storage systems. They do not produce electricity which comes from state and national grids. Globally 61% of electricity generation came from coal, gas and oil, dropping to only 58% by 2030 and 48% by 2040. Renewables % of the total is 14%, 21% and 30% respectively.
- Thus, EVs are not a zero-emission vehicle; they are a derivative of the sources of electricity generation.
- An EV battery weighs around 1,000lbs, about the size of a travel trunk. It contains around 25lbs of lithium, 60lbs of nickel, 44lbs of manganese, 30lbs of cobalt, 200lbs of copper and 400lbs of aluminum, steel and plastics. Within each battery there are 6,831 individual lithium-ion cells.
- Translating the metals content per single battery into ore processing per battery we get the following: 25,000lbs of brine for the lithium; 30,000lbs for the cobalt; 5,000lbs for the nickel; and 25,000lbs for copper. In total, 500,000lbs of ore needs to be processed for each EV battery.
- As at end of 2020 there were 6.8 million EVS on the roads worldwide, 2 million higher than in 2019 but almost five times higher than in 2016. This

means that total ore processed for all 6.8 million EVs was 14.4 million metric tons of ore at the end of last year.

- By 2040, around 330 million EV cars are forecast to be on world roads. This means that some 72 million metric tons of ore will need to be processed alone for EVs.
- EV battery life is said to be around 10 years but an EV user in Sweden driving a 2013 Tesla had his battery deteriorate to such an extent that a replacement was needed at a cost of $22,000.
- Thus, battery life remains unknown with few manufacturers giving guarantees and that battery life is the equivalent of car life given the replacement cost of batteries.
- The recycling of spent EV batteries is still in the early stages of development.
- Operating costs are just one part of the total costs of a battery, wind turbine or solar panel. Total or embedded costs start from the mining of the metal used all the way through to being installed in a battery.
- It thus includes the energy component of each phase including energy used in transporting the material at every stage.
- The question then is: are EVs energy efficient and do they actually reduce CO2 emissions when accounting for all energy inputs.

Second, Solar Panels

- Solar panels are not exactly eco-friendly and they cannot be recycled. The main problem with solar arrays is the chemicals needed to process silicate into the silicon used in the panels. To make pure enough silicon requires processing it with hydrochloric acid, sulfuric acid, nitric acid, hydrogen fluoride, trichloroethane, and acetone. In addition, they also need gallium, arsenide, copper-indium-gallium-diselenide, and cadmium-telluride which are also highly toxic. Moreover, silicon dust is a hazard for workers.
- Solar technologies have improved greatly and will continue to become cheaper and more efficient. But the era of tenfold gains is over. The physics boundary for silicon photovoltaic (PV) cells, the Shockley-Queisser Limit, is a maximum conversion of 34% of photons into electrons; the best commercial PV technology exceeds 26%.
- Cost models for solar normally assume a capacity utilization of 29% (i.e. how often they produce electricity) but real-time data reveals a capacity utilization of only 19% according to the Manhattan Institute. Large batteries are needed to store the electricity when the sun shines but the scale needed is off the charts.

Third, Windmills

- Each windmill weighs an average of 1688 tons and contains 1300 tons of concrete, 295 tons of steel, 48 tons of iron, 24 tons of fiberglass plus neodymium, praseodymium and dysprosium.
- Each blade weighs 81,000lbs and will last 15-20 years at which time it must be replaced but they cannot be recycled. So, what do you do with used blades? There are over 99,000 in use now.

- Wind turbines have a global utilization rate of just 31% so hardly a reliable source of electricity according to the Manhattan Institute.
- Wind power technology has improved also but the era of 10-fold gains is over. The physics boundary for a wind turbine, the Betz Limit, is a maximum capture of 60% of kinetic energy in moving air; commercial turbines exceed jut 40%.

4. Conclusion

- Renewables may appear attractive alternatives to fossil fuels but they have failings. When there is little wind as in the UK this year, wind turbines fail; and when the sun is weak or when day descends into night, solar fails.
- To store energy in these off-peak periods would require massive battery banks. For instance, Tesla's Gigafactory could store three minutes-worth of annual US electricity demand. It would require 1,000 years of production to make enough batteries for two days' worth of US electricity demand.
- Both wind and solar have higher CO2 footprints than fossil fuels; they have just been switched from the front-end to the back-end. In contrast, fossil fuels are both efficient producers of electricity and by using CCS technology virtually all CO2 emissions are caught.
- The years of warming weather across the globe are nearly over to be replaced by at least twenty years of cooling/cold weather. What happens then when households experience rising energy costs during years of cooler weather?
- And what then when people start realizing that it is sunspot activity, changes in water temperatures and volcanic activity that changes weather patterns not CO2 emissions?
- And what about the 4 billion people living in low-middle income and low-income countries in the world? Over time they will aspire to have a better life which means electricity consumption. Look at what is happening to the approximate 664,000 villages in India – they are being connected to the electricity grids.
- If people in these countries raise their energy consumption to just one-third of Europe's per capita level, world demand for electricity will rise by an amount equal to twice America's total electricity consumption. Will renewables be able to meet this demand?
- By the way, America's electricity consumption in 2020 was 3.8 trillion KWh.
- Finally, sometime around 2030 politicians will be forced to throw in the towel on renewables. They will have a place in the energy mix but subordinated to fossil fuels.
- The world is not yet ready to support a fully electric auto fleet according to Toyota in August this year. Robert Rimmer, their head of Energy and Environmental Research said this:

> "*If we are to make dramatic progress in electrification, it will require overcoming tremendous challenges, including refueling infrastructure, battery availability, consumer acceptance and affordability".*

- Like renewables, the world will start switching back to gasoline powered cars in the 2030s with EVs retaining a place in the vehicle mix but not the share of the market now being forecast.