AN OBJECT EXAMPLE OF THE INFEASIBILITY OF "RENEWABLE" ENERGY SOLVING THE ENERGY NEEDS OF NEW SOUTH WALES(NSW)

By: Kevin Loughrey LtCol(Ret'd), BE Mech (hons), psc, jssc

Abstract

In order to provide a reliable pumped hydro system capable of delivery 8GW without interruption, it is estimated that it would require water storage facilities four times the size of Warragamba Dam perched at an average height of 800 metres.

The cost of electricity produced by a roof top solar installation is estimated to be around 10.4 cents/kWh. *This does not take into account the cost of having a storage facility* capable of providing power when the sun isn't shining and the wind isn't blowing.

When the storage facility, necessary for reliable power, 24/7, is taken into account, the cost of electricity produced by the proposed pumped hydro system using roof-top solar systems will be around 21 cents per kiloWatt hour(kWh). This compares poorly to electricity produced by brown coal which is around 2.5 cents/kWh. (See Figure 2.)

In summary, the proposed 8GW pumped hydro system proposed by the NSW Government is unlikely to provide reliable electrical energy to the citizens of NSW and, when it does provide electricity, it will likely cost around 8 times more than electricity that would be produced by, for example, brown coal.

Annex A is a paper that provides proof that Carbon Dioxide does not have an appreciable warming effect on the earth's atmosphere. There is absolutely no justification in science for this extraordinary expenditure to create systems that will not delivery inexpensive, reliable electrical energy but will, instead, ruin the economy of Australia. The only beneficiary of this action, in the long term, will be the Chinese Communist Party.

Dated: 11 June 2024 (see last revision in footer)

Background

This paper does not seek to analyse NSW's present and future energy needs. I may investigate that later. Today, we were told that NSW intends to create a pumped hydro system that will generate 8 Gigawatts on a continuous basis. The inference to be drawn from this, as a consequence of the previous conversation, is that the majority of the power for this pumped hydro system will come from solar panels on the roofs of businesses and domestic dwellings. It may also come from wind farms and mass solar panel installations closely located to the pumped hydro-electric system.

Purpose

The purpose of this paper is to use this example as a means of highlighting the practicality and economy, or otherwise, of such a scheme, ie, a Pumped Hydro electricity system that is capable of delivering 8 Gigawatts on a continuous basis.

Some Basic Physics to Assist the Reader

A watt is a Joule of energy per second. A Joule of energy is expended with a force of 1 kg moves through a distance of 1 metre. When a kilogram mass of water (which is 1 litre) falls through a distance of 1 metre in one second, at 100% efficiency, it is capable of generating 9.80665 watts of power.

Scoping the System

So a system that is creating 8 Gigawatts of power requires that $8/9.80665 \times 10^9$ litres of water flow every second = 0.8158×10^9 litres of water per second through a distance of 1 metre. (Note: This assumes 100% efficiency in the process. I will deal with the matter of system efficiency later in this discussion.) If this system ran for 24 hours it will require $0.8158 \times 10^9 \times 60 \times 60 \times 24$ litres of water = $70{,}485.12 \times 10^9$ litres = 70,485.12 Gigalitres/the elevation of the dam. The average height of the Great Dividing Range is around 600 metres so we will assume that all of the repositories in which the water is stored will be held at that elevation. The water would not run down to 0 metres so let's assume for the sake of this calculation that an average drop of 400 metres would be possible. The number of Gigalitres that would be required to flow through the system to produce 8 Gigawatts for 24 hours is thus, 70,485.12 Gigalitres/400 =176.2128 Gigalitres (if the system was 100% efficient...which it would not be).

Pumped hydro works by pumping the water up to an elevation and then letting it run down hill though pipes (called penstocks) at the bottom of the drop of which are turbines, usually Francis Turbines, connected to electricity generators. The efficiency of a Francis turbine and generators is typically around 90%.

The pumps that move the water up to the elevation usually work at an efficiency around 80%. There is around a 10% loss through friction in the pipes and turbulence, so that overall efficiency of the system is 0.9x0.8x0.9 = 0.64, that is, for every watt of power input, you get 0.64 watts out in the form of electricity.

In addition to this there are losses in voltage transformation and through transmission of the electricity over power lines but these losses are similar to that which one would encounter with a conventional coal-fired base load facility and so, for the purposes of comparing the wind/solar/pumped hydro system with a coal fired generator, we can ignore calculating what these losses are.

This being the case, the amount of water now needed to provide 8 Gigawatts of power for 24 hours continuously is thus 176.2128 /0.64 = 275.3325 Gigalitres. In order to provide reliable power, to cover rainy periods (at the time of writing, in the Northern Rivers area, it has rained for 12 weeks continuously) and periods when the wind does not blow, it is estimated it would be necessary to hold at least 30 days supply of water. This increases the total size of the repositories to 8259.975 Gigalitres. *This is approximately 4.07 times the size of Warragamba Dam's total capacity*[1].

The Cost of Largescale Rooftop Solar

Let's now look at the cost of the roof-top solar systems that will provide the 8 Gigawatts of power on a continuous basis to the system.

For the purposes of this example, we shall assume that all systems are 6 kW capability and cost $8,000 to acquire and install[2].

These systems typically produce 15kWh per day of power during the winter and 30kWh per day of power during the summer.

Unfortunately, bright sunny days are not common except in the driest of areas where there are no houses and therefore no roof-top solar. To set up solar PV systems in the dry, sunlit areas of Australia then requires considerable investment in infrastructure in the form of ultra-high-voltage DC power lines with attendant transformation, inversion and transmission losses. So we will, for the purposes of this paper deal only with urban roof top solar systems. From https://www.currentresults.com/Weather/Australia/Cities/sunshine-annual-average.php we get the following table.

1 2,027Gigalitre – See https://www.waternsw.com.au/supply/visit/warragamba-dam

2 Note that the Government presently pays around half the cost of a roof top solar system through subsidisation.

Average hours of bright sunshine a year

City	Day	Annual
Adelaide, South Australia	8	2774
Brisbane, Queensland	8	2884
Cairns, Queensland	8	2738
Canberra, Australian Capital Territory	8	2811
Darwin, Northern Territory	9	3103
Hobart, Tasmania	6	2263
Mackay, Queensland	8	2993
Perth, Western Australia	9	3212
Rockhampton, Queensland	7	2592
Sydney, New South Wales	7	2592
Townsville, Queensland	9	3139

Figure 1: Annual "Daylight" hours per location

There are approximately 8,766 hours in an average year of 365.25 days. Of this, 1/2 is nominally "daylight", ie, 4,383 hours. It can be seen from the above table that, because of clouds, one could conservatively reduce the power being typically generated from roof top solar on a cloudless day by around 40%, ie, (15+30)/2*.6 kWh/day = 13.5kWh/day average production.
Given the 8Gigawatt /0.64(the efficiency)= 12.5 GW is needed 24 hours per day, all year round. To produce 24hr x 12.5 GW = 300GWh of power requires $300x10^9/13.5x10^3 = 22.22x10^6$ roof-top solar systems, ie, approx 22 million solar systems. These will cost a total of $\$8,000x22.22x10^6$ = **$177.760 billion**.[3]

For this investment, it would be possible to construct around 88 coal fired power stations, each with a capacity of between 1 & 2 Gigawatts or 44 Nuclear largescale power stations.

The Likely Cost of a kWhr Generated by this Means
These roof-top solar systems have an average life of 25 years. In 25 years, each system will generate 365.25 days in a year x 13.5kWh/day x 25 years = 123,271.875 kWh of electricity. (This does not take into account PV cell degradation which naturally occurs due to ageing.) A system costs approximately 800,000 cents. This comes to 800,000cents / 123,271.875 kWh = approx 6.5 cents/kWh. This does not take into account the bank interest that is lost from this sunk investment. The actual marginal cost is thus (@ 2% interest) in the order of $12,867.50 over a 25 year period which brings the cost of electricity generated by this means to **10.44 cents/kWh**.

This is only the cost per kWhr of electricity generated during the day by PV solar panels. When the sun does not shine and the wind does not blow (in the case of windmills), hydro is necessary and so the cost of a pumped hydro-elect system has to be added to this project.

The Likely Cost of the Pumped Hydro System
The cost of the pumping system, which includes the establishment of significant dams, the pipes, turbines, maintenance, etc is considerable. That cost can be assessed from the experience of the hydro-electricity schemes that do not use pumped hydro. To gain some understanding of this, see:
https://www.irena.org/costs/Power-Generation-Costs/Hydropower

For large hydropower projects the weighted average Levellised Cost of Energy (LCOE) of new projects added over the past decade in China and Brazil was USD 0.040/kWh, around USD 0.084/kWh in North

3 This takes into account that, when the PV systems are operating, they must produce 8GW of power, plus they must provide the power to pump water up to reservoir so that, when the system are not producing power to the full extent or not at all, such as at night, power can still be provided to meet peak demand in the evening and the mornings.

America and USD 0.120/kWh in Europe. For small hydropower projects (1-10 MW) the weighted average LCOE for new projects ranged between USD 0.040/kWh in China, 0.060/kWh in India and Brazil and USD 0.130/kWh in Europe.

This figure is probably too optimistic in terms of its cost. The cost for the proposed New England project will require massive dams (as touched upon previously in this paper) at both top and bottom plus pumps as well as turbines at the bottom. It has been suggested that the intention is to have massive wind and solar farms fairly close by, thus reducing input transmission losses to the pumps (and the need for long periods of constant hydro), but Armadale is a long way from Sydney and transmission losses could exceed 20%. The total infrastructure and environmental costs would be without precedent in this country.

For this example, we will choose the modest figure of US0.084/kWh (taking the US example which would have similar labour costs.) This comes to 10.6 cents Australian per kWh at present exchange rates.

So the total cost of the proposed pumped hydro solar & wind system, if it is practical at all, is likely to be in excess of **21 cents/kWh** for roof top solar with backup for reliable power supply. Now we should compare this with the cost of power generation using nuclear, coal and gas-fired facilities.

Comparison with Nuclear, Coal and Gas Generation Systems

The following graph produced by Jo Nova uses actual data from the National Electricity Market (Australia) data

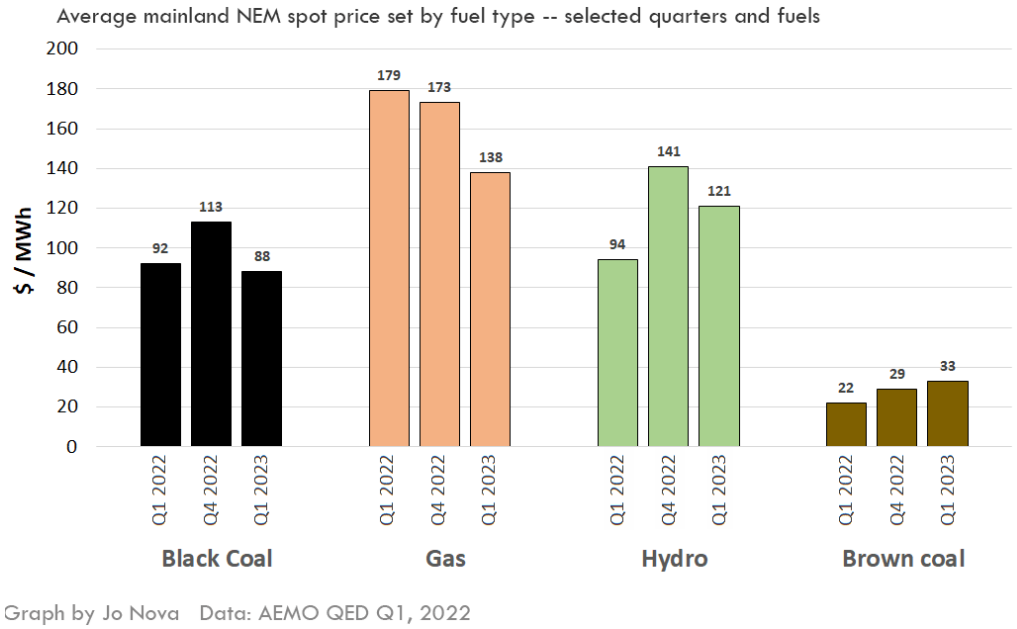


Figure 2: Cost per kWh of electricity produced by various means

This graph shows that brown coal is by far the cheapest way to produce electrical power. It should be noted that these cost are based on systems that have been in operation for a long time and so their cost of acquisition has been well and truly amortised.

It is very difficult to obtain factual pricing for (new-build) nuclear, coal and gas however, the order of economy appears to be coal, nuclear and then gas. I have included costs determined by the US Department of Energy as at 2019.

U.S. average levelized costs (2012 $/MWh) for plants entering service in 2019

Table 1: Indicative costs/kWh for various Electricity Generators in the US

Plant type	Capacity factor (%)	Levelized capital cost	Fixed O&M	Variable O&M (including fuel)	Transmission investment	Total system LCOE	Subsidy[1]	Total LCOE including Subsidy
Dispatchable Technologies								
Conventional Coal	85	60	4.2	30.3	1.2	95.6		
Integrated Coal-Gasification Combined Cycle (IGCC)	85	76.1	6.9	31.7	1.2	115.9		
IGCC with CCS	85	97.8	9.8	38.6	1.2	147.4		
Conventional Combined Cycle	87	14.3	1.7	49.1	1.2	66.3		
Advanced Combined Cycle	87	15.7	2	45.5	1.2	64.4		
Advanced CC with CCS	87	30.3	4.2	55.6	1.2	91.3		
Conventional Combustion Turbine	30	40.2	2.8	82	3.4	128.4		
Advanced Combustion Turbine	30	27.3	2.7	70.3	3.4	103.8		
Advanced Nuclear	90	71.4	11.8	11.8	1.1	96.1	-10	86.1
Geothermal	92	34.2	12.2	0	1.4	47.9	-3.4	44.5
Biomass	83	47.4	14.5	39.5	1.2	102.6		
Non-Dispatchable Technologies								
Wind	35	64.1	13	0	3.2	80.3		
Wind-Offshore	37	175.4	22.8	0	5.8	204.1		
Solar PV[2]	25	114.5	11.4	0	4.1	130	-11.5	118.6
Solar Thermal	20	195	42.1	0	6	243.1	-19.5	223.6
Hydro[3]	53	72	4.1	6.4	2	84.5		

According to this, the cost of a kWh of power generated from a newly built coal fired power station is 9.5 US cents. Advanced nuclear is 9.6 US cents. These are for new installations. The US fossil fuel installations face special taxes because of their "carbon" pollution so, without these, the costs would be significantly less and closer to the graph shown above. China retails its electrical power for around US 5 cents/kWh. The costs attributed to nuclear are also controversial and likely to be inflated here.

The US figures therefore are likely to be on the high side compared to what would be experienced in Australia. We shall therefore estimate that **the present day cost of generating electricity using coal or nuclear is around AU 10 cents/kWh**.

It is noteworthy that Australian coal-fired power generation was, before the introduction of intermittent power sources into the network, amongst the cheapest in the world. Here is what has happened to the cost of electrical power after the Labor Government started its drive towards "renewables"

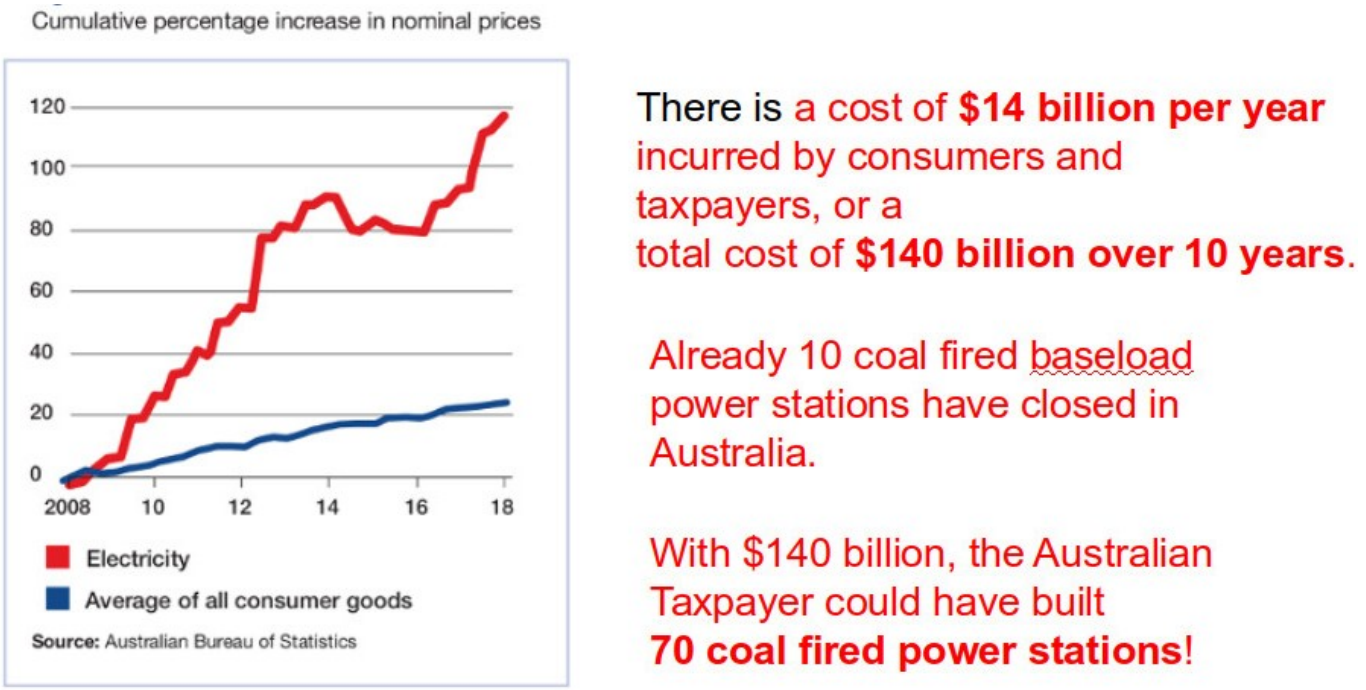
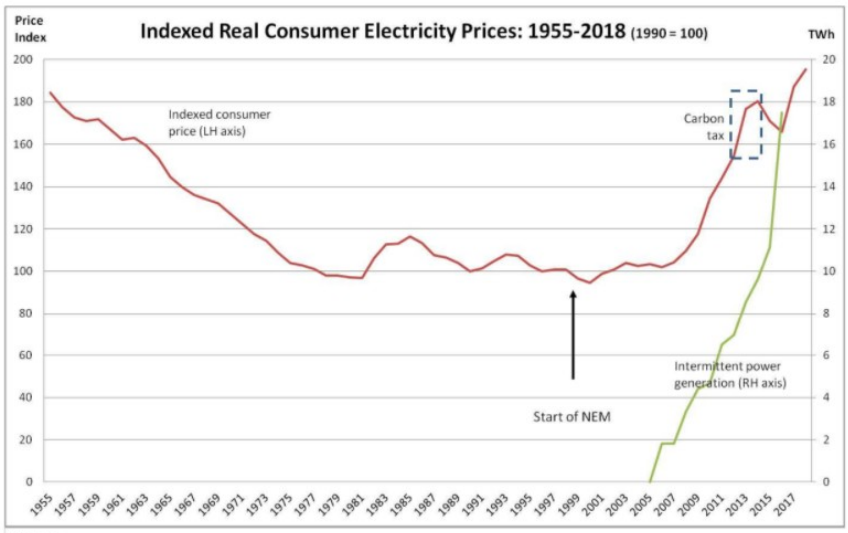


Figure 3: Cost of Electricity in Australia vrs Consumer Price Index

It can be seen that energy in Australia has risen by around 550% higher than the Consumer Price Index over the same period; starting in late 2007 through to 2018. The cost of electricity still rises on the same trajectory. Any suggestion, by advocates of this scheme, that they will achieve a 10% reduction in energy costs has to be viewed against this backdrop. There is a need to reduce energy costs by at least 550% to get back to the situation that existed in 2007-2008. Government could improve on that figure if it adopted coal and nuclear power generation and prevented the unreliable, intermittent inject of power from solar and wind into the network.

The following graph appears to show a correlation between the amount of power being injected intermittently into the grid and the resultant cost of electricity as a consequence.



If Australia is to have the cheapest and most reliable electricity possible, it is imperative that the injectiion of intermittent power into the grid be stopped. If unreliable solar and wind are to be used, they must be backed up by a storage system that ensure input will be reliable and variable according to demand.

Summation

The idea of having pumped hydro driven largely by roof-top solar systems that must be scrapped after 25 years, using components that are largely built in China, appears to carry a high level of risk and will not deliver the cheapest energy to Australian industry and society. This study suggests that:

1. The cost of electricity created by the proposed pumped-hydro, solar and wind scheme will be in the **order of at least AU 21 cents per kWh wholesale**.
2. The cost of producing electricity using coal or nuclear, without the disruption of intermittent injection of power by “renewables”, is likely to be significantly less than **AU 10 cents per kWh**.

Experience suggests it is likely that nuclear energy will be slightly cheaper than coal; especially if modular nuclear reactors are collocated at existing coal fired power generation facilities. Nuclear is also an interesting study because if Australia were to develop a nuclear processing and reprocessing industry, it has the potential to earn Australia many billions of dollars per year reprocessing the reactor rods of other countries. This would also aid in preventing nuclear weapons proliferation by tightly controlling the access to fissile material. Any country that did not return its rods for reprocessing would not receive any more enriched uranium.

Given the core justification for pursuing this method of power generation is to reduce emissions, the pumped-hydro project appears to be imprudent and a great waste of taxpayers' money.

- End -

Annex: A. LtCol(Ret’d) K.A. Loughrey, “THE NON-EFFECT OF CARBON DIOXIDE ON WARMING THE EARTH’S ATMOSPHERIC TEMPERATURE”, dated 11 June 2024

ANNEX A
TO AN OBJECT EXAMPLE OF THE INFEASIBILITY OF "RENEWABLE" ENERGY SOLVING THE ENERGY NEEDS OF NEW SOUTH WALES(NSW)
DATED 11 June 2024

THE NON-EFFECT OF CARBON DIOXIDE ON WARMING THE EARTH'S ATMOSPHERIC TEMPERATURE

By LtCol Kevin Loughrey(Ret'd), BE Mech(Hons), Grad Dip Strategic Studies(ANU)

The Alleged Cause of Global Warming

It is asserted by some scientists that Carbon Dioxide(CO_2), Nitrous Oxide(N_2O) and Methane(CH_4) are catastrophically warming the atmosphere. Based on this assertion, these scientists, and those politicians and people who are adherents to this belief, demand that mankind dramatically reduce the emissions of these gases. In the agreements reached so far, major emitters of these gases such as Communist China and India are exempt from these restrictions.

But what if the earth's atmosphere is not warming but instead cooling? Would this not put an end to this thesis given that the concentration of CO_2 has been rising steadily for around a century?

Data taken from Ice Cores show no Correlation between CO2 and Atmospheric Temperature

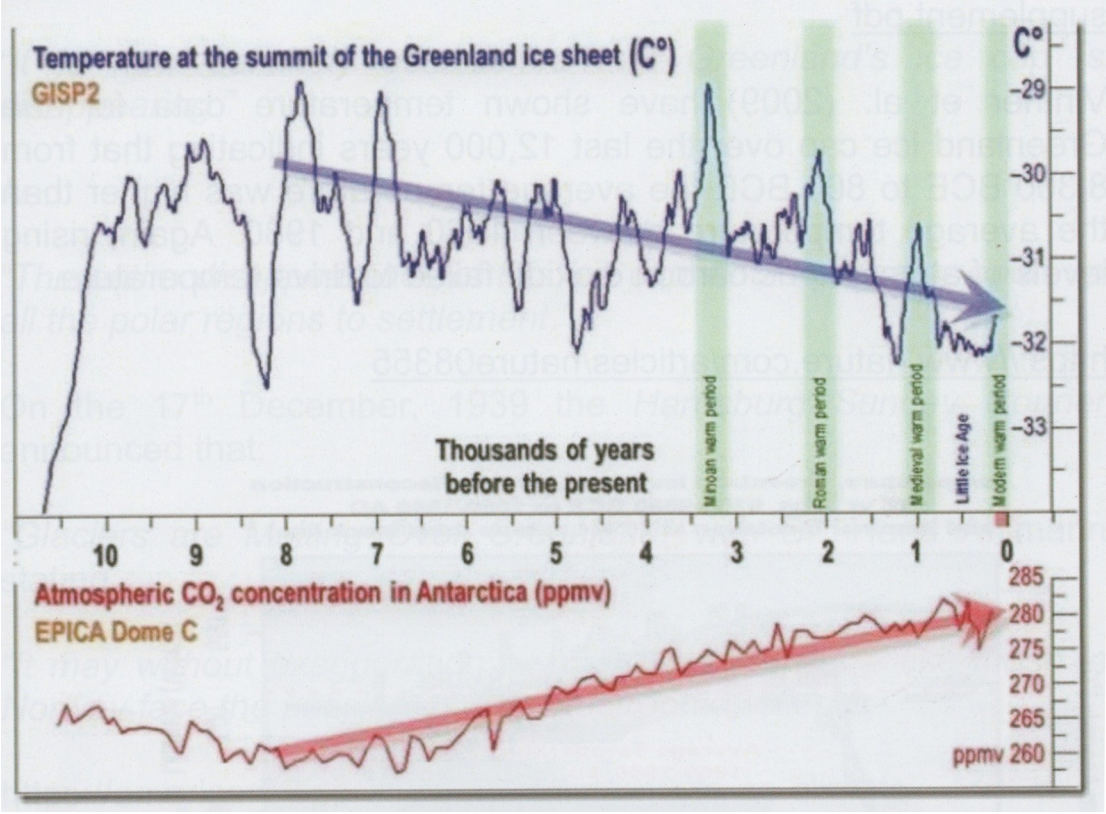


Figure 4: As CO2 Concentration increases, Atmospheric Temperature decreases

Figure 4 displays data, extracted from ice cores in Greenland, pertaining to atmospheric temperature and CO_2 concentration over a period of 10,000 years. The graph shows that, whilst CO_2 has been slowly increasing, the temperature of the atmosphere has been gradually, in fits and starts, decreasing. From

this, it can be seen that CO_2 has no appreciable warming effect on the earth's atmosphere. Given this fact, reducing human emissions of CO_2 is a case of solving a problem that doesn't exist. The above relates to a period of 10,000 years. What about closer to the present day? Let's now look at the temperature data from every major climatology network around the world.

Raw Data from Numerous Climatology Networks all show the same Trend – Downwards!
Here are plots of raw temperature data taken from weather stations of long standing around the world that have not been encroached upon by urbanisation; something that would artificially exaggerate the real situation with respect to the atmospheric temperature close to Earth's surface.

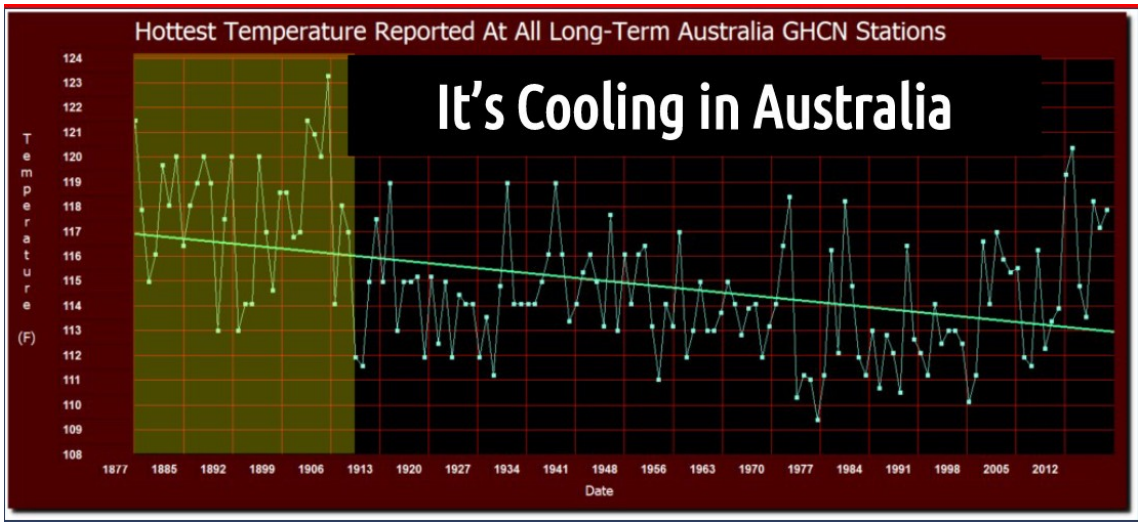


Figure 5: Australia - 1885-2019

According to Figure 5, from 1885 to around 1998, Australia's climate has been cooling. After 1998, the temperature record is broken because the Bureau of Meteorology:

- replaced the analogue measuring systems with digital technology,
- used digital equipment *<u>incapable</u>* of reading temperatures below -10C,
- did not reveal data showing that the results of the two systems when running in parallel produced differing readings and the new system has never been properly calibrated against the analogue system in order to ensure that temperature comparisons would be from the same reference base,
- put the new equipment in smaller housings (called Stevenson Screens) causing them to record a higher temperature, and
- painted the insides of the boxes black[4] so that they radiate onto the measuring equipment – once again causing higher temperatures to be registered.

Figure 6: A Stevenson Screen

Was this incompetence or was it a deliberate ploy to gain Government grants?
So what about the rest of the world? Figures 7 to 12 show the same trend. Temperatures have been on a gradual decline whilst the concentration of CO_2 in the atmosphere has been steadily rising.

4 I was told this by the Hon Craig Kelly MP but haven't been able to verify this. It may not have been a consistent practice or this may have been corrected in some or all of the latest Stevenson Screens.

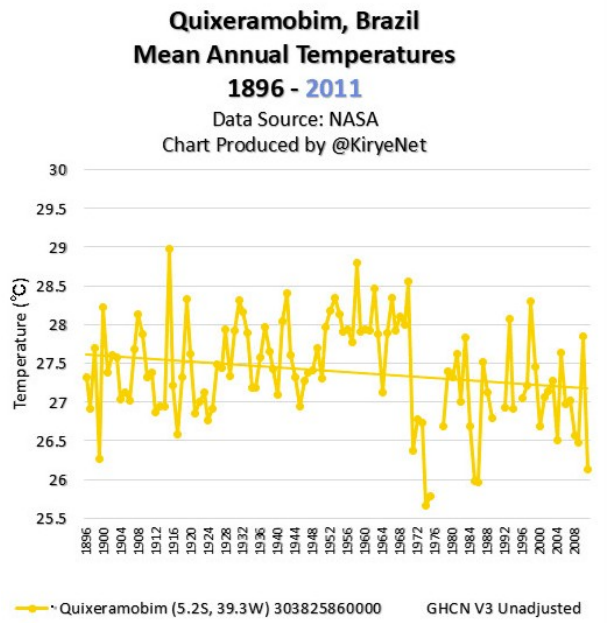


Figure 7: Brazil - 1896 -> 2011

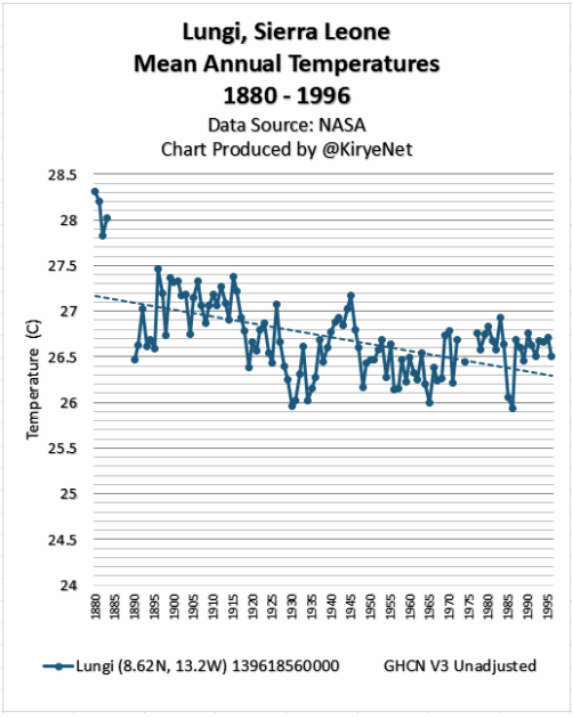


Figure 8: Sierra Leone Africa 1880-1996

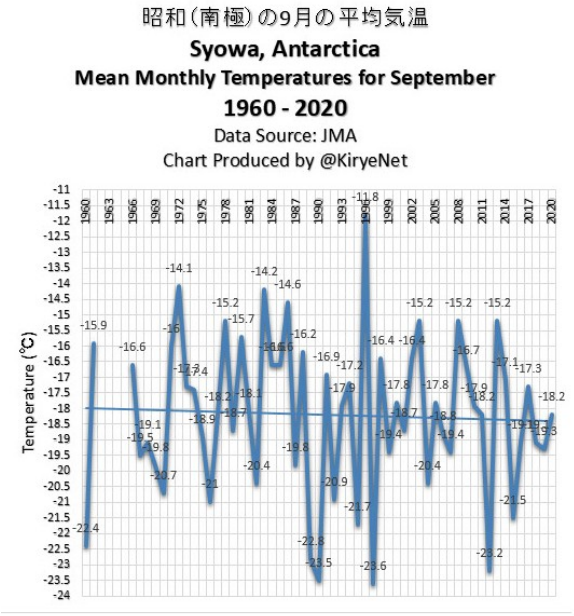


Figure 9: Antarctica 1960->2020

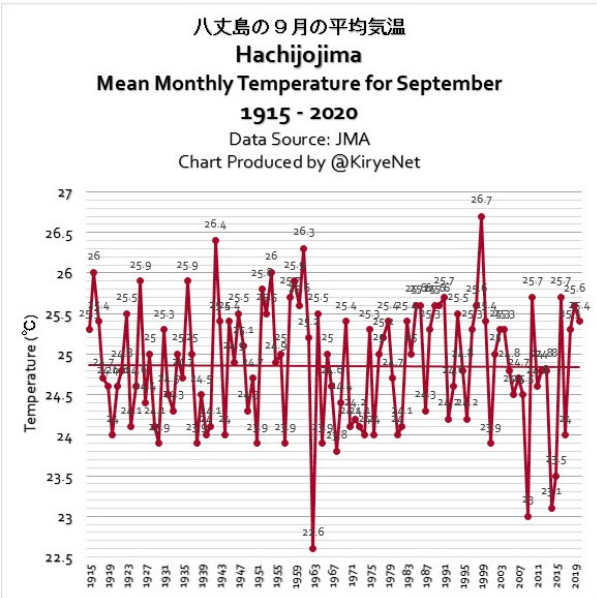


Figure 10: Japan 1915-2020

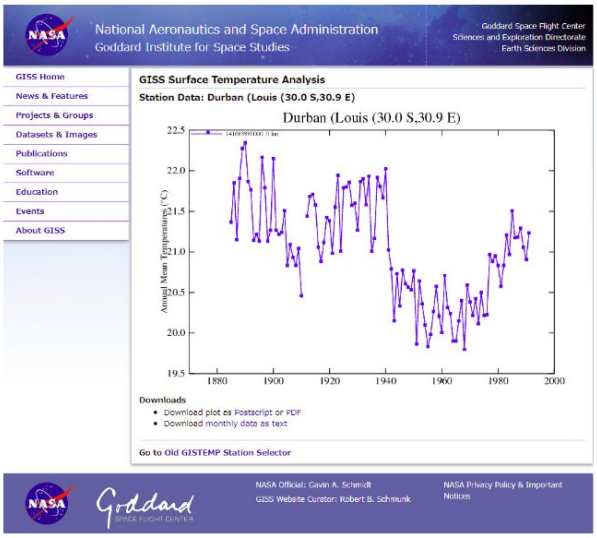


Figure 11: Durban Sth Africa 1885-1995

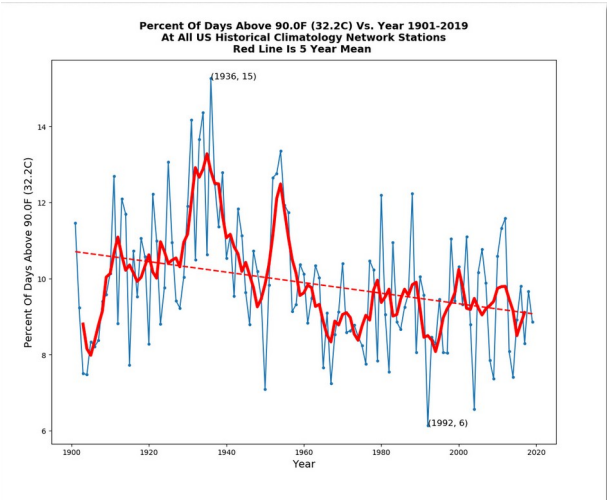


Figure 12: USA 1901-> 2019

The Chances of this being an error are Zero!

Given that these temperature measuring networks recorded their data in isolation of each other because of the lack of global communications in those days, it is an impossibility that they could all be wrong. How is it then, that we are constantly being told that the world will end in a fireball when all historical data show exactly the opposite?!

Carbon Dioxide Concentration during this Period

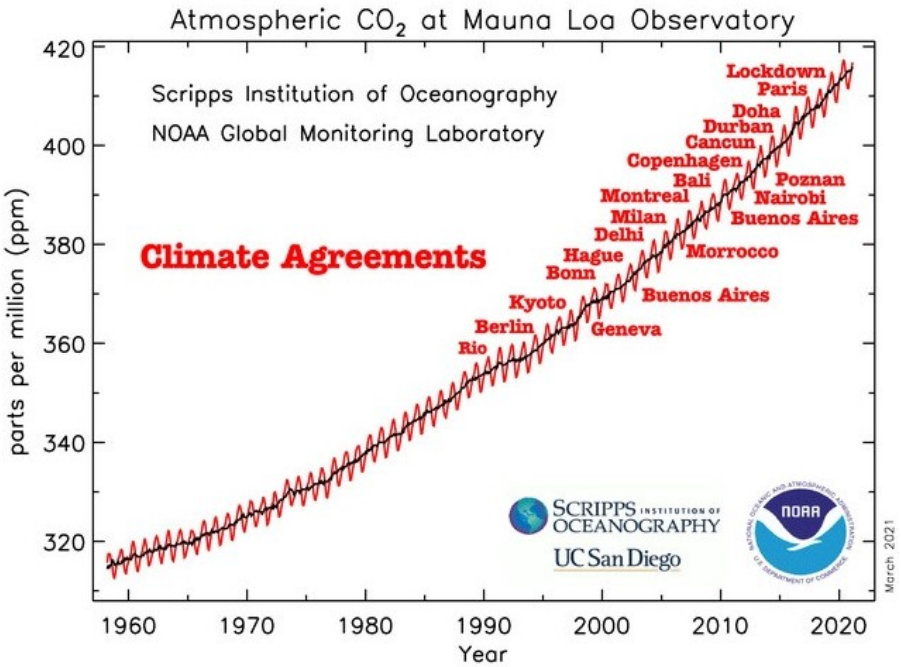


Figure 13: Rising CO2 Concentration for last 60+ years

Figure 13 shows the rise of concentration of CO2 in the earth's atmosphere from approximately 1957 to the 2022. During this time, as shown above, all raw data shows that the temperature of the atmosphere has been dropping or, at the very least, has remained relatively stagnant. Therefore, even with data from a very short time-frame in geological terms, it can be seen that there is no appreciable relationship between the concentration of CO2 in the earth's atmosphere and its average temperature. Certainly, in terms of maximum temperatures there appears to be no difference and even a decline.

A Congregation of the Evil and Wicked

If there is no connection between the concentration of CO_2 in the earth's atmosphere and its temperature, why then are there persons and organisations in this world trying to limit the emissions of CO_2. The reason is quite simple. It is about crippling energy production in Western economies and, by that means, destroying the prosperity of those affected because inexpensive, reliable energy is the foundation stone of any modern prosperous nation.

What you are seeing is very similar to what you saw with the lies promulgated about COVID-19. COVID-19 (alpha) was a disease that was no more dangerous than Influenza if people were given early treatment with a range of low cost medicines. But the use of these treatments was bizarrely banned by Western Governments worldwide! Doctors have been denied the opportunity to properly care for their patients and many have been deregistered for speaking out. Millions of people have died unnecessarily. The wealthy elite have greatly increased their fortunes, just as they are doing with "Climate Change", whilst the middle class and the poor have been further impoverished.

Interestingly, the same people involved in the Climate Change movement were behind COVID-19. These are:

- large financial institutions with massive investments in the Pharmaceutical Industry but also in "renewable" energy technology.
- The World Economic Forum, an organisation aiming to destroy Western economies so as to precipitate a "Great Reset".
- People who just generally hate humanity and believe the world's population should be culled.
- The Chinese Communist Party (CCP), a huge criminal cabal that wants to be the dominant power of the world by 2049, the 100th year of the reign of the CCP of China. The CCP has benefited hugely from "Climate Change". Nearly all renewables hardware is purchased from China and they have not had to reduce their emissions at all so their electricity is 5 times cheaper than most countries comprising the Western economies.

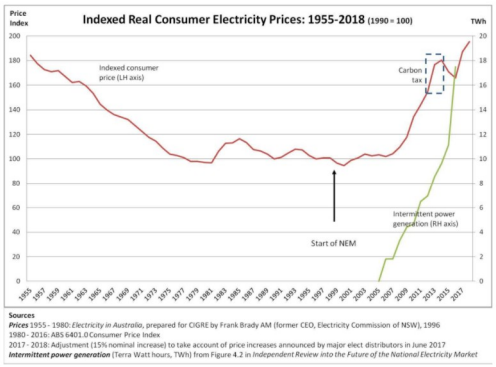


Figure 14: Electricity Cost and effect of Injection of Renewable Power

Figure 14 shows that there is a direct correlation between the cost of electricity in Australia and the injection of intermittent power from appliances like roof top solar and windmills.

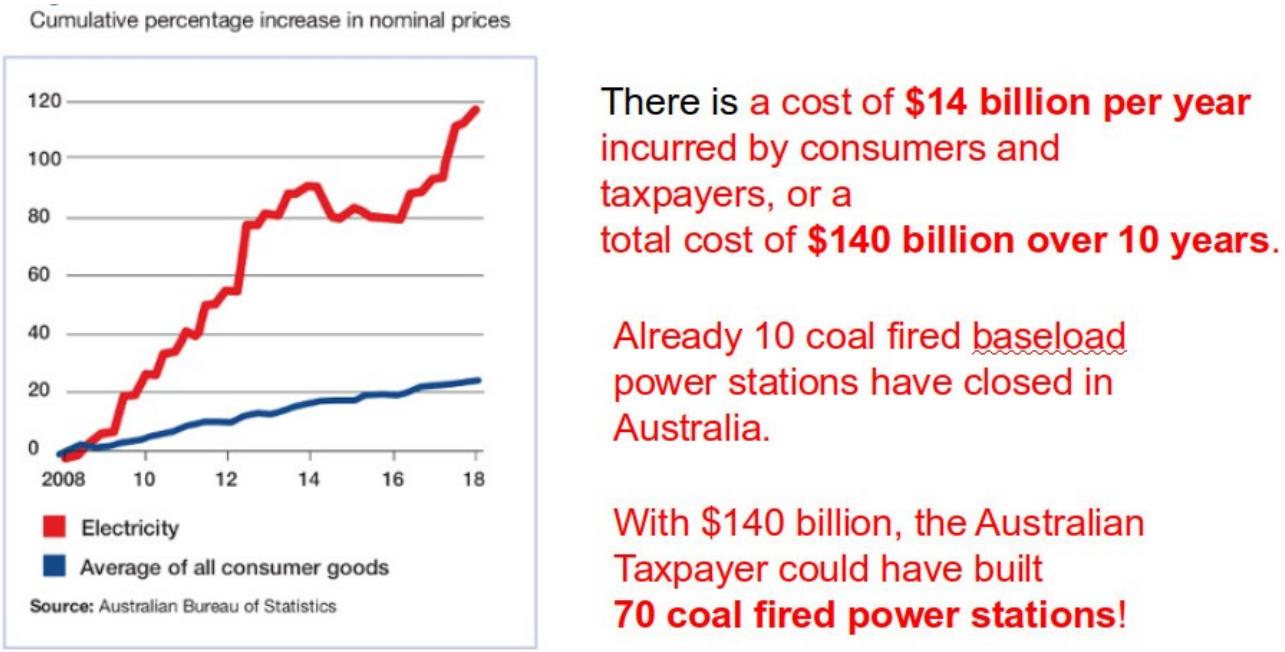


Figure 15: The rising cost of electricity compared to the Consumer Price Index

As per Figure 15, the cost of electricity has risen by more than 6 times the Consumer Price Index whilst, all the time, the Australian public has been assured that renewable energy would be cheaper. Clearly it is not!

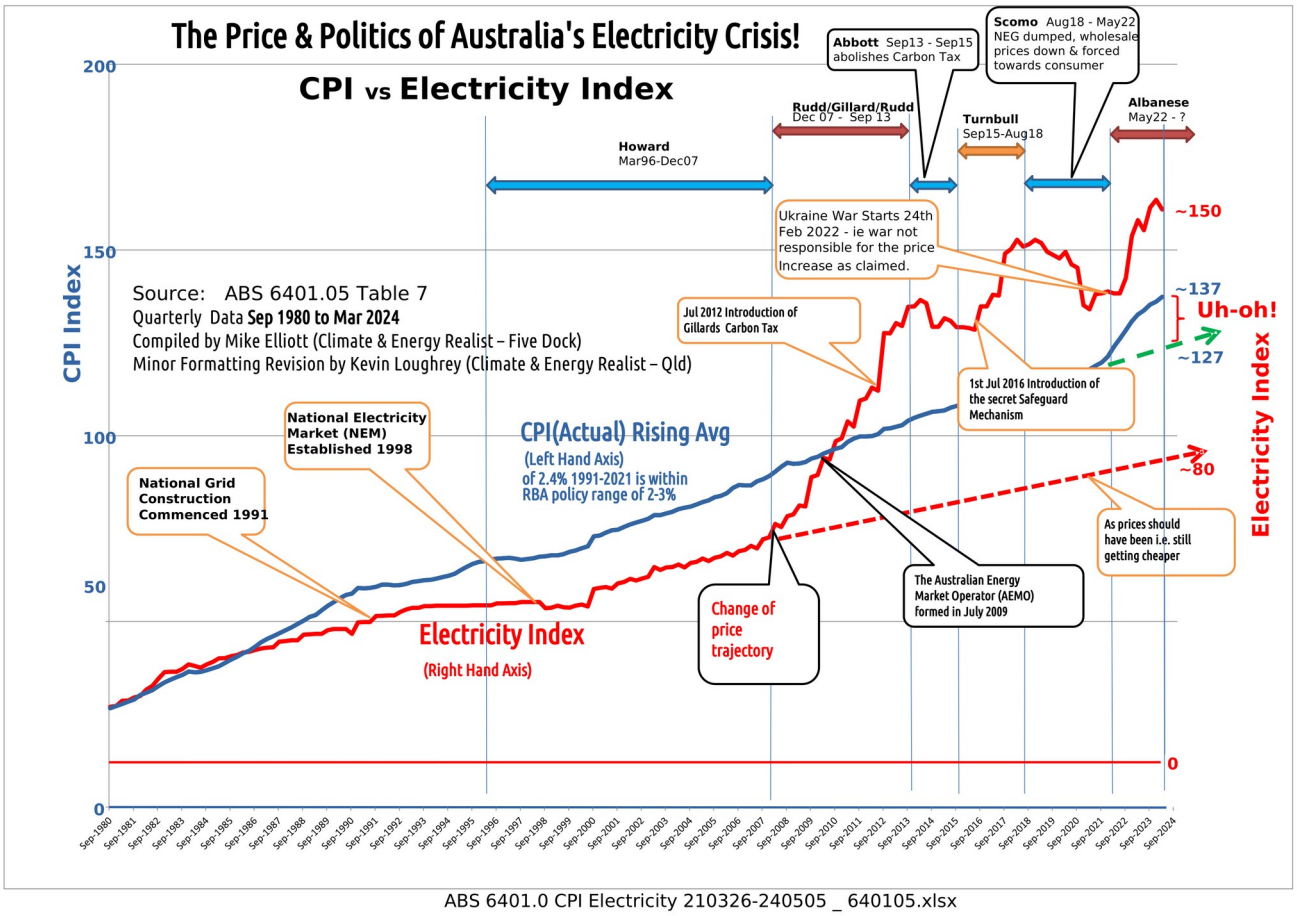


Figure 16: Comparison of the Cost of Electricity against Consumer Price Index with annotations

Figure 16 provides more detail regarding the rapidly increasing cost of electricity as a consequence of the introduction of intermittent power systems in the form of wind and solar generators.

Cheap reliable energy is the foundation stone of any modern society. With energy costs many times greater than that of Communist China, Australia is well on the way to being both impoverished and vulnerable to take-over by foreign interests.

The Path to Salvation

It would be comparatively simple to rectify what has happened:

1. Carry out a massive public relations campaign to prove to the public that they have been misled. CO_2 does not appreciably warm the earth's atmosphere and, in fact, the extra concentration of this gas is doing enormous good. This education of the public is critically important because without that, there will not be the political will to carry out other reforms that will be necessary if Western economies will once again have inexpensive, reliable energy to drive their industries and their economies.
2. Abolish all subsidies related to energy generation of any sort.
3. Abolish any regulations that mandate in any way the use of "renewables" and "renewable" energy.
4. Revert to the way that electricity was generated before 2007. It is madness to inject power intermittently into a power grid.
5. Explore the feasibility of placing modular nuclear reactors, based on the latest proven technology, at some existing power stations where that is cost effective. (If this were commercially viable, the cost and time needed to transition to nuclear technology would be far, far less than building new base-load power generating facilities, based upon nuclear technology, from scratch.)

If we fail to do this, the future for our children, grandchildren and their successors looks extremely bleak.

-End of Paper -