WE CAN STILL AVOID THE NET ZERO TRAP

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Colophon

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The Climate Intelligence foundation (Clintel) was founded in 2019 by emeritus professor of geophysics Guus Berkhout and science journalist Marcel Crok. Clintel's main objective is to generate knowledge and understanding of the causes and effects of climate change, as well as the effects of climate policy. Clintel published the World Climate Declaration, which has now been signed by more than 1900 scientists and experts. Its central message is "there is no climate emergency".
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Abstract

Radiative transport of energy in the atmosphere can be easily calculated using fundamental physics. These calculations confirm the observations that greenhouse gases play a modest role in climate warming. The important conclusion from theory and measurements is that there is no man-made climate crisis.

However, climate models – constructed by governmental organizations – predict a climate catastrophe and greenhouse gas CO_2 gets the blame, despite the fact that on water planet Earth H_2O is the most important greenhouse gas.

The model-based fear-inspiring narrative is that the human contribution to CO_2-emissions poses a fundamental threat to the survival of humanity. Therefore, all fossil fuels must be banned. Fortunately, this doom story is not consistent with the facts.

Establishing cause and effect is the most difficult subject in science (correlation is different from causation!). This certainly applies to the behavior of our climate. After all, the Earth's climate is an extremely complex system, in which complicated processes take place in a four-dimensional space: three spatial coordinates (x,y,z) and one time coordinate (t). We know little about that yet. That is why Earth's climate behavior is very difficult to capture in models. Experience shows that climate science should not start with complex models, but with reliable observations.

The limitations of current climate models, partly due to numerous assumptions and numerical limitations, are such that they do not yet form a serious basis for mitigating climate policy. In particular, the premise that the human contribution to CO_2 production would be the recipe for a future climate disaster is not supported by observations. Consciously ignoring the saturation effect in the warming caused by the greenhouse gas CO_2 plays an important role in this. In addition, the many assumptions on the very complex role of clouds is just as important. Clearly, clouds are the Achilles heel of climate science.

Historical awareness is indispensable in climate research. The results of geological science are a veritable treasure trove of data on the relationship, or lack thereof, between the CO_2 content of the atmosphere and temperature. The geological archive tells us that there is no correlation, and therefore no causal link, between CO_2 and temperature. Studies of ice cores show that warming precedes an increase in atmospheric CO_2 content. The recent past points out that the natural variability of temperature is considerably greater than human influence on it.

In the wake of the unreliable predictions of climate models, energy supply on a global scale has become a topic of much heated debate. Due to the dubious conclusions of climate models about the role of CO_2, fossil fuels have been condemned. The Net Zero approach has become, at least in the West, the political Holy Grail. The reliability of demand-driven fossil energy is sacrificed to supply-driven illusions. The West is apparently prepared to risk prosperity for this. The rest of the world watches in amazement.

In our contribution we argue for the further development of nuclear energy, with special attention given to the option based on the thorium cycle and its associated advantages. In the long term, this is the only rational way to adequately supply the world with energy. There is therefore no reason to swim further into the Net Zero trap. We can still go back.

In summary, there is climate warming, but there is no climate crisis. That is good news. Unfortunately, we are at the beginning of a self-made energy crisis. That is very bad news. A new cabinet must stop the model-based doom stories about climate disasters and make new choices in energy policy.

Part I: Climate and Science

Although weather has been a favorite topic of conversation since time immemorial, the fascination with climate is relatively recent. Both weather and climate are constantly subject to change. This is obvious for the weather; just look out your window every now and then. This is less obvious for the climate, defined as an average of the weather over a period of 30 years, and spatially over much larger areas than your own backyard. Nevertheless, it is an inescapable fact that over the past 4.5 billion years the climate has been influenced by the ever-changing external and internal forces to which our planet is subjected. The climate has no choice but to respond to all those impulses by constantly changing. But can a trend be discovered in these changes, and does man have a dominant or non-dominant influence on those trends? The latter is important, because if you have influence on it, you have an option to use that influence to deal with unwanted climate changes. If there is no human influence, there is no choice but to adapt to those changes. The answer to that question is therefore of great importance for many issues in our society.

Natural science is indispensable to understand something about climate and, if possible, to make predictions about conceivable trends. The science of physics is quite recent. Modern physics is usually thought to date from the time of Galileo Galilei, who lived from 1564 to 1642. Through Galileo we learned that understanding begins with making careful observations. We then try to place all the observations we have into a theoretical framework or scientific model. If the model can explain all observations, we are on the right track. If our model can only reproduce part of the observations, the theory is incorrect. The fact that observation is the starting point of all natural science is an achievement whose importance cannot be underestimated.

Modern physics actually has a history of only about 400 years. In that time, it has brought humanity enormous benefits in terms of technology, medical knowledge, healthcare, economic progress and a reliable, affordable and safe energy supply. On the other hand, 400 years in the history of humanity is but a short breath. It is obvious that physics is far from complete and will be the source of future innovations that we cannot possibly predict at this time. *The science is settled?* On the contrary, natural science has in fact only just begun. That's a wonderful prospect!

Back to the climate. The climate represents an extremely complex physical-chemical system that is subject to constant change. Only by making observations about phenomena that we can regard as indicators of climate can we hope to unravel some of that complexity. For example, it is obvious to measure the temperature at ground or sea level. Now that is more easily said than carefully done. At first sight, this makes temperature measurements seem simple. You stick some thermometers in the ground here and there and read them regularly. This has only been happening since about 1850, and certainly only on a very limited part of the planet. Measuring is nice, but it must be consistent over time, done with sufficient accuracy, and be representative. And that's where the problems start. Measuring stations that used to be located somewhere in open space far away from any kind of habitation are now located in the suburbs of ever-expanding cities, or next to a busy highway or at an airport. The *urban island effect* is then a guarantee for higher measuring temperatures than in the past, even if the climate has not changed significantly during that time. Fortunately, we have been monitoring temperatures in tropospheric layers in the atmosphere since 1979 with satellite measurements that are reliable and representative. Nevertheless, the period over which we can do this is only 45 years, hardly more than the time period that defines climate. We should therefore be careful with interpretations that may be based on measurement series that are too short. In general, measuring properly is more difficult than is usually thought. Competent measuring is an essential part of natural science.

The *Intergovernmental Panel on Climate Change (IPCC)* has claimed a leading role in the climate discussion. This intergovernmental organization is led by the WMO and UNEP, two agencies of the United Nations. The IPCC's task is to map man's influence on the climate, assuming in advance that it is important or even dominant, but does not conduct any research itself. It merely summarizes research done by others. The IPCC regularly publishes lengthy reports, but only the extract under the name *Summary for Policymakers* receives publicity. The text of this short summary (SPM) is agreed upon by government representatives by majority vote, so that it is *show* of *hands physics* by lay people. Truly a new way of conducting what a scientific discussion should be. It should therefore come as no surprise that the IPCC's working methods attract a great deal of criticism from critical scientists. That's not how you make scientific decisions. See Guus Berkhout's interview in Liberum [1].

Climate is an extremely complex system and climate change is the result of all kinds of influences exerted on the Earth's climate system. Given the complexity of the system, it is not obvious that there is one simple cause. Nevertheless, the IPCC continuously argues that there is only one culprit in the climate problem, and that is CO_2. That is, to say the least, a curious position that is open to skepticism and has been subject to much criticism from the start. This simplistic starting point has gradually proven to be untenable due to more and more scientific facts. CO_2 as a thermostat knob for the climate is a fiction without scientific basis. Remember, if there can be multiple causes (including CO_2) that also influence each other, then it is a miracle to be able to conclude that only CO_2 is the main cause. After all, a multidimensional cause-and-effect analysis is required with the relationship between these main causes as preconditions. We have never seen such an analysis from the IPCC.

Because CO_2 is a main product in all combustion processes, climate policy has become closely linked to the question of how we should shape our much-needed energy supply in the future. If the aim of policy is to keep CO_2 out of the atmosphere, alternatives must be found for the use of demand-driven fossil fuels such as gas, coal and oil. The choice fell on biomass and supply-driven energy based on sun and wind. Curiously enough, the only option that is even remotely promising, namely the use of nuclear energy, has proven to be an impassable path, at least in the Netherlands, although fortunately the tide is slowly turning on this point. The fact that society, by banning fossil fuels and using what is called renewable energy, is on the highway to the destruction of everything that has been built up in the past, will be substantiated in detail below on the basis of relevant physics.

The physics of greenhouse gases

All molecules that are not a diatomic homonuclear molecular gas are capable of absorbing and emitting infrared photons (diatomic means: *consisting of two atoms*; homonuclear means: *consisting of atoms of the same element and the same isotopes*). The vibrational and rotational levels of such every day molecules play a key role, and they come under the heading of greenhouse gases. Note that electrical dipole transitions are dominant here, so that only vibration modes that change the dipole moment are important. Because the linear molecule CO_2 is an important greenhouse gas, we find that the doubly degenerate bending vibration at 667 cm^{-1} and the asymmetric stretching vibration at 2349 cm^{-1} are infrared active, while the symmetric stretching vibration is not. Larger molecules such as methane (CH_4) generally have multiple infrared active vibrations. It is relevant to realize that the most important greenhouse gas is water vapor, H_2O. Depending on the temperature, water occurs in the atmosphere in various aggregation states (solid, liquid, gas), which means that the infrared spectrum extends over a wide wavelength range and is very complex [2]. This multistate property of H_2O gives the Earth's weather and climate its unique property.

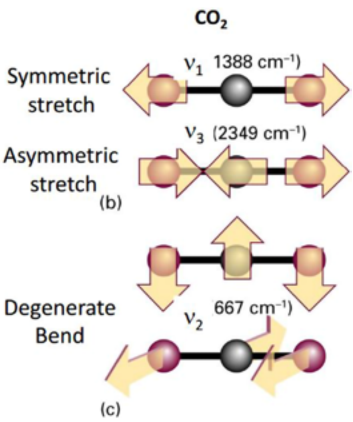


Figure 1: The three normal vibrations of the linear molecule CO_2 are shown here. For the greenhouse effect of CO_2, the doubly degenerate bending vibration at 667 cm^{-1} is by far the most important.

The Earth's temperature is determined by two factors: solar radiation in the visible wavelength range, which warms the planet, and energy loss due to infrared radiation at the top of the atmosphere, which causes cooling. The balance between the two contributions is subtle, because it is about the difference between two major effects. It is as if we want to determine the weight of the ship's captain by weighing the ship *with* and then *without the* captain. The difference then provides the weight of the captain. It goes without saying that we are dealing with great uncertainties. The subtle balance between both factors determines the resulting temperature. In the absence of greenhouse gases, the Earth would be significantly colder than with it. In that sense, greenhouse gases are a boon to life on Earth. The Earth's surface, warmed by the sun, emits infrared radiation as a black body, which does not immediately disappear into space, but is absorbed by greenhouse gases and partly re-emitted. It is therefore important to know how infrared radiation interacts with various greenhouse gases.

The theory of radiation transport in the atmosphere is based on quantum mechanics developed by Max Planck, among others, and is described by the Schwarzschild equation. This is very well-known physics that is beyond dispute. Nevertheless, solving the Schwarzschild equation is no easy task. An extremely important result of such studies is that the infrared absorption does not depend linearly, but logarithmically, on the CO_2 concentration in the atmosphere. The work of Van Wijngaarden and Happer (see Figure 2) provides guidance in this regard. It is interesting that the logarithmic dependence is also endorsed by the IPCC, but in their forecasting a linear relationship is used.

Max Planck
1858-1947

Karl Schwarzschild
1873-1916

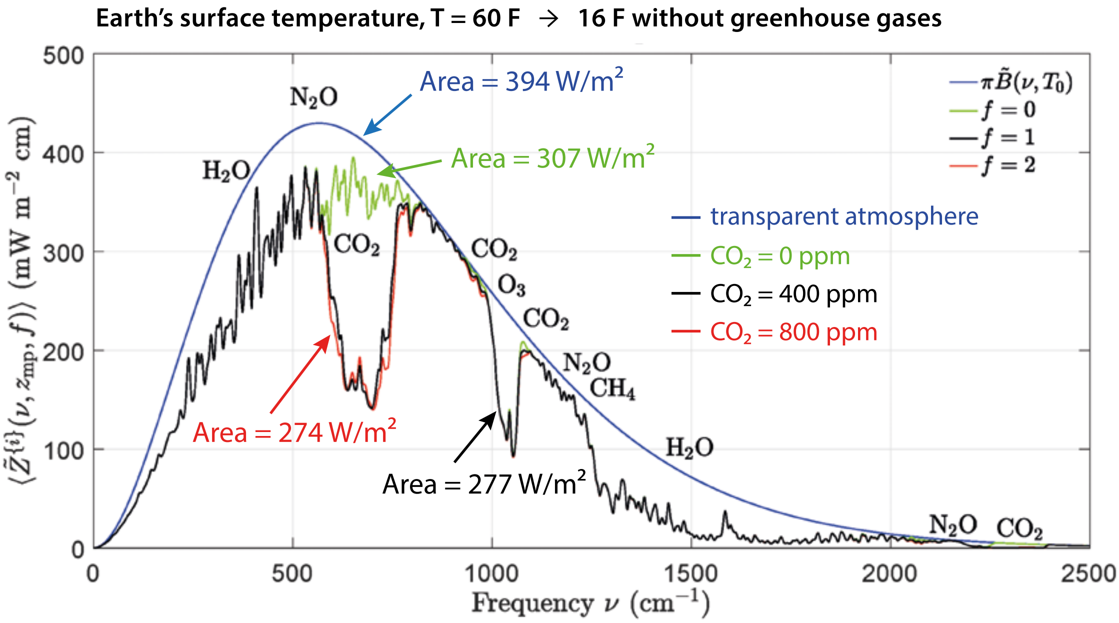


Figure 2: Frequency-dependent infrared radiation – measured by satellites with a resolution of 3 cm^{-1} – that leaves the Earth under the influence of various greenhouse gases (Van Wijngaarden and Happer [3]). The blue line is infrared radiation emitted by an Earth's surface with a temperature of 288.7 K for an atmosphere without clouds and without greenhouse gases. The green curve is the curve that would be measured with satellites for an atmosphere with all greenhouse gases present at their current (2020) concentrations, but without CO_2 and clouds. The black line represents the satellite measurement in the absence of clouds, and in the presence of all greenhouse gases at their current concentrations. The red line would then be the result after doubling the CO_2 concentration from 400 to 800 ppm. The difference between the black and red curves is remarkably small, a forcing of only 3 W/m^2, which is the result of the saturation effect (logarithmic smoothing). To clarify, this forcing is defined as the amount of infrared energy (in W/m^2) that fails to leave the Earth due to CO_2 doubling and that is considered responsible for a (small) part of the observed warming since 1850.

At the current concentration of CO_2 of 400 parts per million (ppm) we see the black curve where the significant absorption of infrared radiation at 667 cm^{-1} is striking. When the CO_2 concentration is doubled to 800 ppm, we get the red curve, which differs very little from the black one. Doubling the amount of CO_2 in the atmosphere therefore has little influence on the amount of infrared radiation that disappears into space. The situation is similar to someone wanting to paint a black barn door red. The first layer of red paint mainly colors the door red, the second layer serves to touch up some places where some of the original black color can still be seen, and after that further layers of red paint have little effect. Doubling the CO_2 concentration from 400 to 800 ppm increases the so-called forcing by about 3 W/m^2 and, assuming that greenhouse gases are the only source of warming, this additional forcing at the surface causes only a modest temperature increase, (much) less than 1 °C. The effect of a further doubling will be much smaller. The doom stories about catastrophically warming by increasing CO_2 are contradicted by theory and observations.

The blue curve in Figure 2 is the so-called Planck curve for a black radiator that describes the radiated energy (vertical axis) as a function of the radiation frequency (horizontal axis, in units of cm^{-1}). For the surface temperature 288.7 K was chosen. This Planck radiation law is a triumph of modern physics and was extremely important in making the quantization of photon energy and thus quantum mechanics an accepted part of physics. Figure 3 shows how the Sun has the maximum of its radiation curve in the visible region, while the Earth's surface emits thermal radiation in the infrared. The total energy emitted depends on the fourth power of temperature T.

$$B_\lambda(T) = \frac{2hc^2/\lambda^5}{e^{hc/\lambda kT} - 1}$$

Here h is Planck's constant, c is the speed of light, k is the Boltzmann constant, T is the temperature and λ wavelength. In Figure 3 an average surface temperature of T=288 K was chosen.

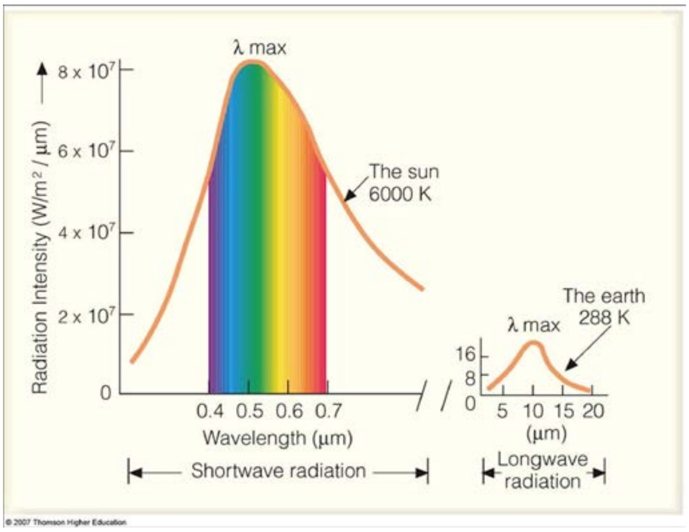


Figure 3: Planck's formula for a black radiator, with the emitted energy (in W/m^2) as a function of wavelength and temperature. For the horizontal axis, in addition to wavelength λ, the frequency v or the number of wave numbers in cm^{-1} is often used, as in Figure 2. In contrast to the wavelength scale, both the frequency scale and the wave number scale are proportional to the photon energy. The strong temperature dependence of the emission explains the intensity difference in shortwave- and longwave-radiation.

Figure 3 shows how the Sun has the maximum of its radiation curve in the visible region, while the Earth's surface emits thermal radiation in the infrared. The total emitted energy (area under the curve) depends on the fourth power of temperature T, the Stefan-Boltzmann Law:

$$W(T) = \sigma\, T^4$$

In this formula σ = 5.670374419 x 10^{-8} W m^{-2} K^{-4} represents the so-called Stefan-Boltzmann

It is good to realize that in addition to the vertical energy transfer via greenhouse gases, both vertical and horizontal heat flows in the atmosphere and in the oceans are of significant importance. In the troposphere there are the Hadley cells [4] that cause the so-called Hadley circulation. These important heat flows consist of rising warm air saturated with water vapor in the tropics that transports this warm air to latitudes of about 25 degrees. Please note that ocean currents play by far the largest role in horizontal heat transport on Earth. After all, the heat capacity of water is much greater than that of air. We see that many natural forces are active in determining the change of temperature on planet Earth.

To get an idea of how important the forcing of 3 W/m^2 is, the following should be considered. If we realize that since the Earth's orbit is elliptical, the difference in solar intensity between summer and winter is of the order of 91 W/m^2 [5], a change of 3 W/m^2 is far from worrying. The fact that the influence of CO_2 is logarithmic and not linear, and the fact of the low forcing (approximately 3 W/m^2), is widely shared, including by the IPCC. The fact that there is nevertheless little publicity about it is an indication that political alarmism has taken precedence over reliable science.

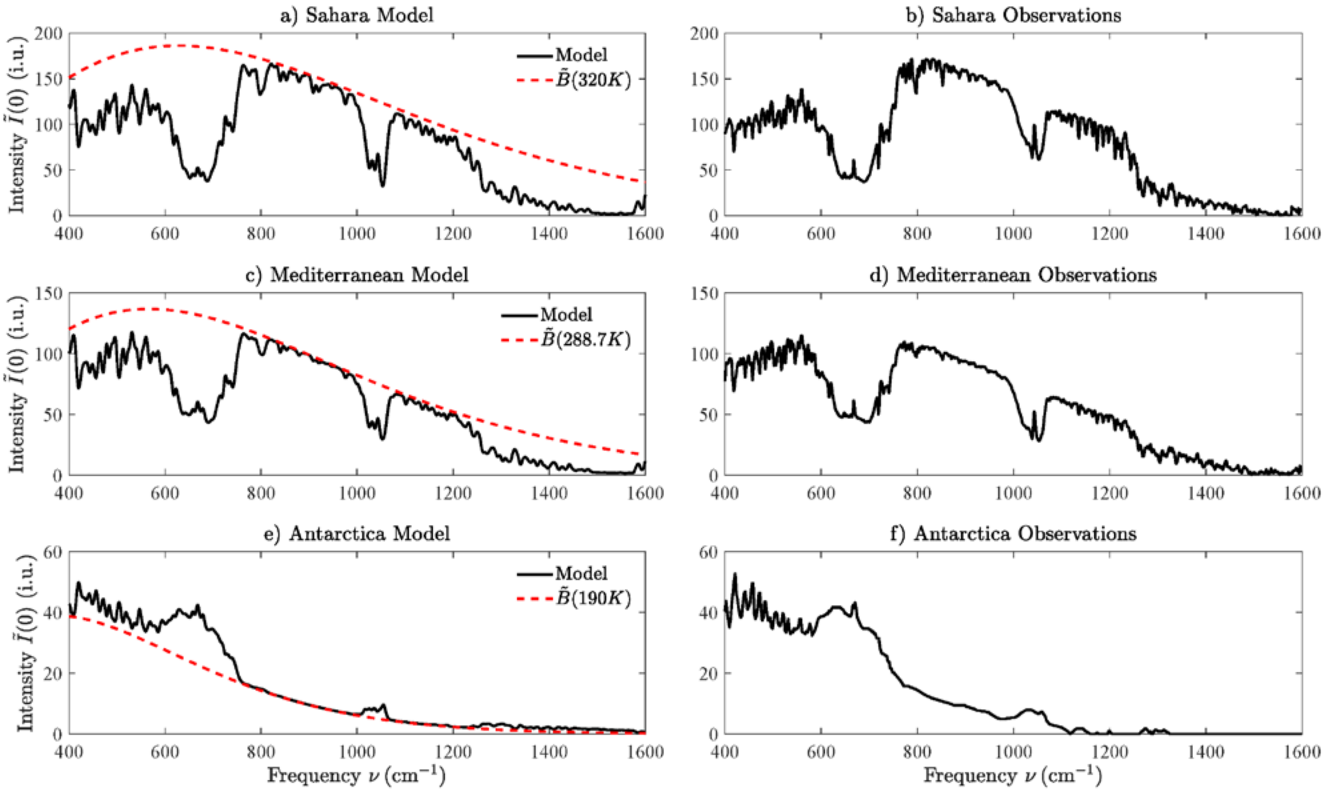


Figure 4: Simulations of infrared radiation leaving Earth by Van Wijngaarden and Happer in the absence of clouds for the Sahara, the Mediterranean and Antarctica, compared to satellite observations [3]. It is striking that the forcing for the winter Antarctic area is negative. This is because the relatively warm greenhouse gases in the atmosphere send more infrared radiation into the universe than the colder ice surface with a temperature of 190 K. The agreement between simulations and observations is extremely good.

Because the theory of radiative transport is extremely reliable and is in very good agreement with the measurements for the three areas in Figure 4, we can also calculate the relative contributions of the various greenhouse gases with good accuracy. However, it is important to note that this equation applies in the absence of clouds. Clouds pose a serious complication and are in fact the Achilles heel of current climate science. A reliable description of the role of clouds is lacking, and this is not due to a possible lack of attention to the problem.

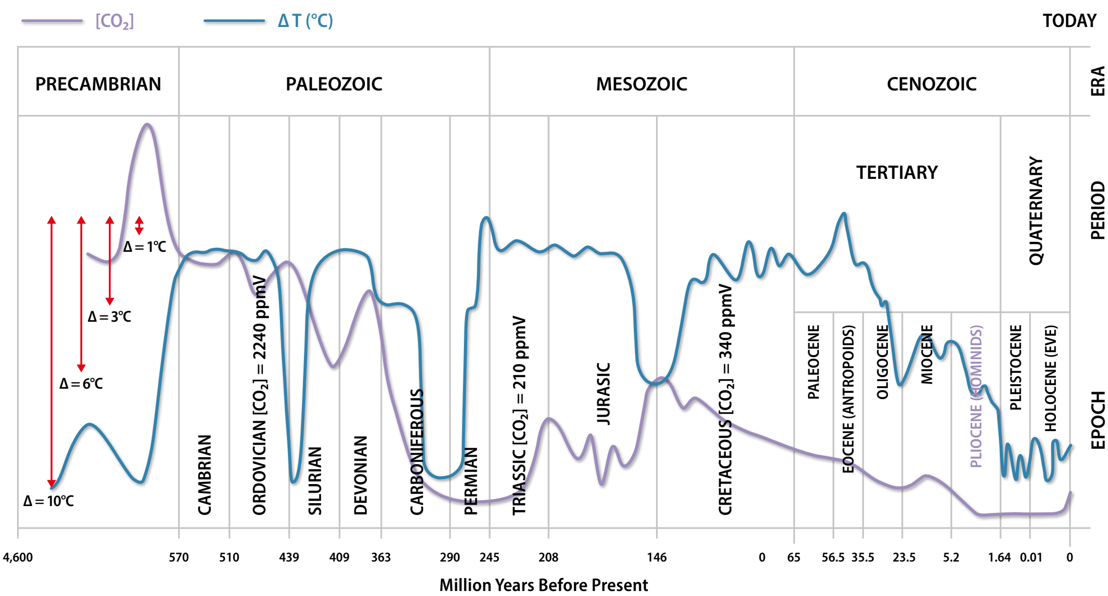
Nobel Prize winner in Physics John Clauser has contributed an interesting reflection on the role of clouds [6]. He suspects that more clouds across the Earth enhance the Earth's ability to immediately reflect incoming short-wave solar radiation back into space. The albedo of the planet would therefore increase, resulting in cooling. This gives rise to an interesting feedback mechanism, because any warming will lead to more evaporation of the oceans, which make up 70% of the Earth's surface, and therefore to more cloud cover. This in turn results in some cooling. In this way, clouds would represent a control system for the water planet Earth that keeps temperature fluctuations within limits, in accordance with Le Chatelier's Law. Alarmist views about catastrophic runaway temperature increases suggested by climate models are therefore very unlikely. The numerical substantiation of Clauser's conjecture is very worthwhile [6] and gives an indication that the role of CO_2 becomes even smaller with than without clouds. More research is obviously needed on this point.

Information from the geological past

The Earth has been around for 4.5 billion years and has had quite a bit of climate history behind it. By far the largest part of that history took place in the absence of humans. It is useful and enlightening to look at what geology has to tell us. Naturally, no one was present to take measurements, but geology is capable of determining, for example, from the fossil records or from deposits of all kinds of geological sediments with plant remains, to form a picture of how the climate has developed over millions of years. We call those *proxies*. The results from the geological archive are extremely educational, also for the current climate discussion.

The geological archive has provided a picture of the CO_2 concentrations in the geological past and the temperatures that prevailed on Earth at the time. If we look at what the archive is telling us about CO_2 concentrations and temperature, we see that in the history of our planet there are periods with very high CO_2 concentrations (up to 7000 ppm) and low temperatures, and periods with low CO_2 concentrations and high temperatures (10 degrees warmer than now). In short, the geological record shows no statistical correlation between the two quantities on this geological time scale, and certainly no indications of a causal relationship either. Other natural causes apparently

Geological Timescale: Concentration of CO_2 and Temperature fluctuations



1 - *Analysis of the temperature Oscillations in Geological Eras* by Dr. C. R. Scotese © 2002. 2 - Ruddiman, W.F. 2001. *Earth's Climate: past and future* W.H. Freeman & Sons. New York, NY. 3 - Mark Pegani et all. *Marked Decline in Atmospheric Carbon Dioxide Concentrations During the Paleocene*. Science; Vol. 309. No. 5734; pp. 600-603. 22 July 2005. *Conclusions and Interpretation* by Nasif Nahle © 2005, 2007.
Corrected on 07 July 2008 (CO2: Ordovician Period).

Figure 5: CO_2 concentrations (purple) versus temperature (blue) over the last 600 million years [7]. Note that on this geological time scale there is no correlation and there is certainly no evidence of a causal relationship. Regarding the CO_2 scale, the high peak in the Precambrian corresponds to about 7000 ppm. Note the low values in recent times. The disappeared CO_2 is now stored in the geological layers, especially limestone ($CaCO_3$).

played a much more important role in the geological past. This is consistent with our conclusions above. In Figure 5 we give an idea of what these proxy measurements tell us.

Naturally, the important question now arises to what extent the arrival of humans and the use of fossil fuels influences this picture. The fact is that humans have become a factor in the total CO_2-balance, but again we see that anthropogenic CO_2 is very unlikely to be the decisive factor that the IPCC would like us to believe! Figure 5 shows that the natural variability is much greater than the small warming (less than one degree) that the increase in greenhouse gases has caused at most so far according to the theory of radiation transport. And looking at the logarithmic absorption property, we should certainly not see more CO_2 in the future as a catastrophe.

In the Mesozoic Era, according to the archive, temperatures were approximately 10 degrees higher than now, and CO_2 concentrations were higher than now. That geological period was a boon for flora and fauna. In any case, those were the conditions when dinosaurs were hopping around in large numbers. If there is something that stands out in Figure 5, it is that CO_2 levels have steadily decreased over the last million years! If we realize that below 180 ppm plant life will seriously suffer from a shortage of CO_2 and ultimately lead to mass extinction of humans and animals, this sheds a different light on the current CO_2 narrative. In any case, some scientific doubt would be appropriate. Science should not only investigate and publish the disadvantages of CO_2 (warming), but certainly also the advantages (greening). The IPCC is very silent about the latter. There is a lot to be said about the benefits of CO_2, as recently described in detail by a number of experts of the CO_2 Coalition [8].

Ice ages

Geological science deserves compliments for its creative ways of uncovering information from the geological past, when humans did not yet exist. The proxy measurements used are often very different in nature, but if multiple proxy measurements lead to approximately the same conclusion (*consilience*), this creates confidence in the truthfulness. As we go further back in geological time, obtaining reliable information generally becomes more and more difficult. Going back less

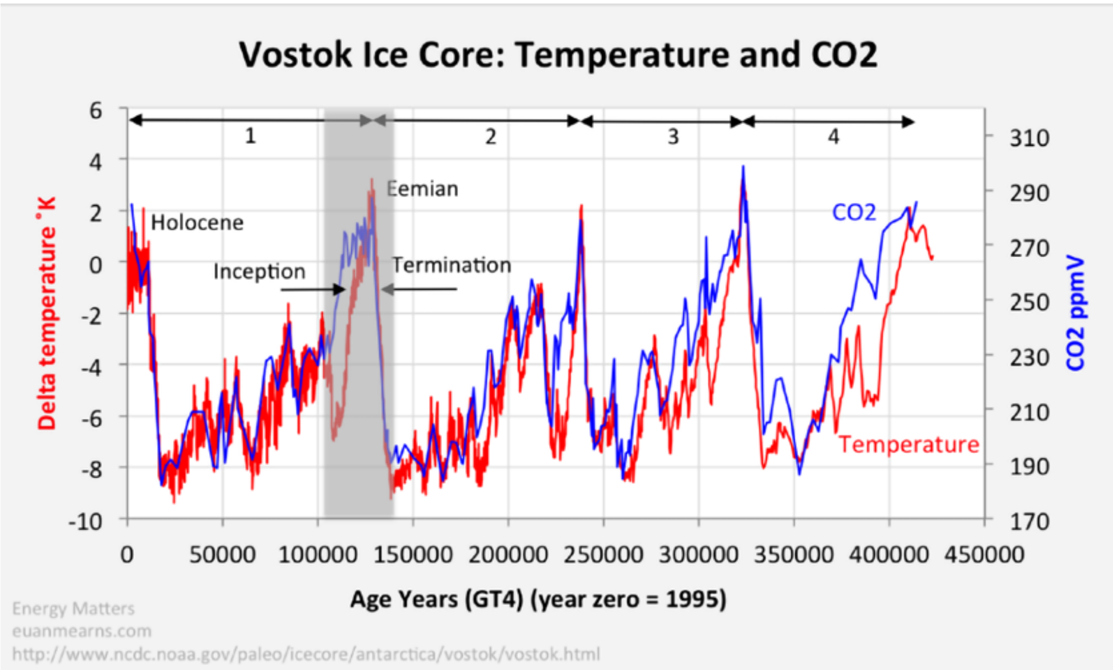


Figure 6: Results of a study of Vostok ice cores [9], showing both temperature and CO_2 concentrations. Note that the horizontal axis runs from more recent (left) to more distant in time (right). It is important to note that the increase in temperature precedes the increase in CO_2.

far in time makes it possible to obtain measurements with better time resolution. It is interesting to note that the geological and geophysical departments of the major oil and gas companies have made a major contribution to this historical climate information.

A good example of proxy measurements is studying ice cores obtained from glaciers. The deeper you drill, the older the ice layers that are reached. These ice layers contain air bubbles that bear the signature of the time in which they were created. That air could be hundreds of thousands of years old. The trapped air can be analyzed to monitor changes in CO_2 over time. From other values that can be calculated from the isotopic composition of the molecules trapped in the ice core bubbles, estimates of past temperatures are obtained.

The Vostok ice core data, one of the longest datasets available, recorded four ice ages and five *interglacials* including our current interglacial, the Holocene. Because several ice cores have been examined by different groups of scientists and the results of such studies agree well, they are considered reliable. Figure 6 above summarizes the Vostok results [9]. A few things are immediately noticeable in Figure 6. There is a strong correlation between CO_2 concentrations and temperatures over a period of 400,000 years. However, temperature increases and decreases *precede* increases and decreases in CO_2 concentrations! So if there is a causal relationship, it is the temperature change that changes the CO_2 concentrations (note, the time axis is negative)! So, if there were a causal relationship, it would be temperature that determines the CO_2 content of the atmosphere, rather than the other way around. This is consistent with Henry's law. People who claim that warming follows CO_2 do not have the science of ice cores on their side.

Recent history

As we go back less far in time and humans have entered the scene, the temperature information becomes increasingly accurate. Let's walk through the last few thousand years (see Figure 7).

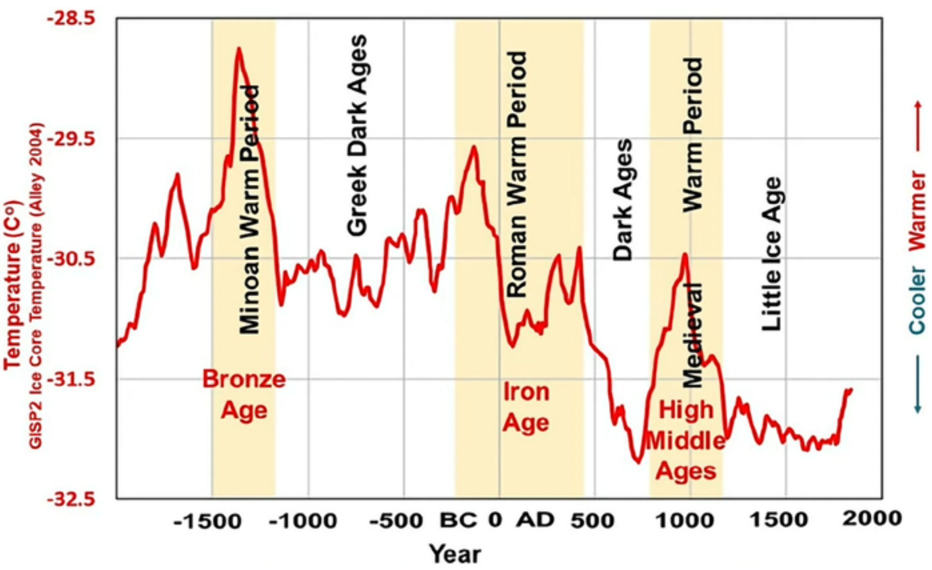


Figure 7: Temperature changes over the last 4000 years. The natural variability is more than 3 ^{0}C [10].

Over the past 2000 years, human CO_2 emissions have not played a significant role. Nevertheless, there was an alternation of warm and cold periods, caused by natural variability with temperature fluctuations of the order of more than 3 °C. It is striking that precisely during the periods when some warming took place, the economy and agriculture flourished and a there was a prosperous social environment. Warm periods, unlike cold periods, are generally a time of prosperity. Let's look at the recent past in a little more detail.

In the autumn of 218 BC, Hannibal crossed the Alps with his army, in which elephants played a prominent role. Although his army suffered very large losses, the winter conditions did not prove to be an insurmountable obstacle to transferring a strong-armed force to the Po Valley. It is extremely doubtful whether with the snow conditions in the Alps over the last few years such a trip would have been possible at all.

Figure 8: Illustration of Hannibal's crossing of the Alps with his elephants in the autumn of 218 BC. That would certainly not have been possible under barren snow and ice conditions.

Hannibal's crossing took place during the Roman Warm Period, which lasted from about 250 BC to 400 AD (Figure 8). It was precisely during this period that the expansion of the Roman Empire took place, which reached its peak during this period. As we see so often in the past, the warm and stable climate of that period, about 2 °C warmer than today, was an important factor in the development of agriculture, trade and culture. Climate warming during this period played a key role in the success of the Roman Empire.

From about 950 to 1250 the Medieval Warm Period (MWP) took place, which led to warmer temperatures, at least in the North Atlantic area. During that period, the Vikings colonized Greenland (part of the land was green at that time, hence the name), supporting their livelihood through livestock and agriculture. When the climate later cooled again, the settlements in Greenland were abandoned. Whether this conclusively observed warming occurred exclusively in Europe and the North Atlantic region, or whether it was a global phenomenon, is a subject of interesting scientific debate.

From the 14th century to the mid-19th century, large parts of the world experienced a period of significantly lower temperatures, known as the Little Ice Age (*LIA*). In the Netherlands, this period is well characterized by many paintings of those days. The painting by Hendrick Avercamp from around 1608 (Figure 9), which is now in the Rijksmuseum, is a well-known, but certainly not the only, illustration of the fact that it was considerably colder then than it is now. It was a popular subject in painting of that time.

Figure 9: Illustration of the cold period in the Netherlands (1450 – 1850) by the Dutch painter Hendrick Avercamp, on display in the Rijksmuseum in Amsterdam.

In summary, if we look at the geological past in which humans were completely absent, or if we turn our gaze to the more recent past in which humans were present but not responsible for significant CO_2 emissions, the Earth, or at least a large part of it will experience significant climate changes involving both significant warming and cooling. The periods of warming often appeared to coincide with positive social developments, with societies thriving in many ways. In any case, it can be concluded that the natural variability of the climate then and now was and is considerable.

Mainstream climatology now argues that recent human activity has made this natural variability secondary to the warming caused by humans with their greenhouse gases. This fixation on CO_2 as a life-threatening doom gas is mainly a result of climate models, but is hardly supported by observations. More about climate models in the next section.

Failing climate models

Theory development is indispensable in order to understand observations of climate behavior. That is why a lot of energy is invested in developing climate models. Now climate is a physically-chemically extremely complex system, described by coupled integro-differential equations, which is not easy to model. It is even questionable whether such a very complex system can be solved with sufficient reliability at all [11,12]. Even the KNMI and the IPCC endorse this statement, albeit reluctantly and not on the front pages of their publications. But they do try!

The KNMI has the following to say: *"The variability of the system poses limitations to the predictability of the climate state. Internal variations of the climate system beyond monthly time scales apart from the contribution from the positive multidecadal surface temperature trend that is currently eminent (Oldenborgh et al. 2012) and oceanic variability (Hazeleger et al. 2013), are difficult to predict and at time scales of 30 – 100 years useful predictions are basically impossible. Not only because of the large contribution of the natural variability, also because the external forcing related to human activity is considered to be unpredictable. Any attempt to make climate predictions at a relatively small spatial scale such as the Netherlands or even Western Europe for multiple decades ahead cannot be expected to lead to skillful results".*

The KNMI therefore concludes that prediction and expectations are not possible and that climate predictions do not lead to workable results.

The IPCC says about it: *"Scenarios are images of the future, or alternative futures. They are neither predictions nor forecasts. Rather, each scenario is one alternative image of how the future might unfold. A set of scenarios assists in the understanding of possible future developments of complex systems. Some systems, those that are well understood and for which complete information is available, can be modeled with some certainty, as is frequently the case in the physical sciences, and their future states predicted. However, many physical and social systems are poorly understood, and information on the relevant variables is so incomplete that they can be appreciated only through intuition and are best communicated by images and stories. Prediction is not possible in such cases".*

By the way, these passages have disappeared from their respective websites! That's strange for scientific organizations! Is it an indication that alarmism takes precedence over scientific correctness? Does politics determine which scientific message can be conveyed?

But let's do the ultimate test, and that is comparing the results of climate models with those of the best quality observations. To this end, we compare model results with satellite measurements of the temperature in tropospheric layers [13]:

Look at Figure 10 in some detail. First, the time scale starts in 1979, when satellite observations became available. Unfortunately, graphs are often manipulated by alarmists by choosing the scale and period in such a way that they visually work towards the conclusion they want to reach. Here that is impossible. Second, we see that at the starting point of the graph, models and observations all pass through the same point, and that as time goes on, the curves of the satellite and balloon

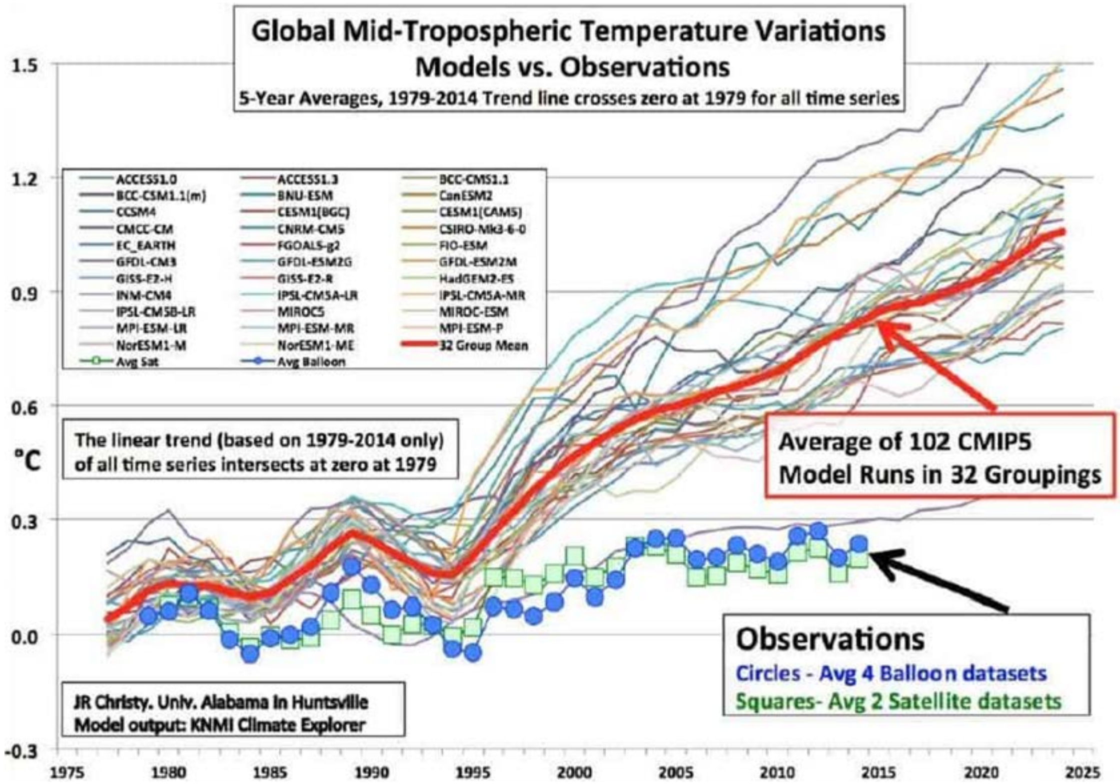


Figure 10: Results of satellite observations since 1979 versus the predictions of various climate models [13]. The red line is an average of the different models. What is striking is the fact that the models suggest much stronger global warming than is observed by satellites and weather balloons. Not the observations, but the alarmist models determine climate policy.

observations and those of the climate models become increasingly divergent. It is striking that there are more than 100 climate models, all with different properties. The latter is curious. In physics, non-relativistic quantum mechanics is based on the Schrödinger equation alone, and relativistic quantum mechanics on the Dirac equation alone. Why does climatology need 100 different models? Let's look at these types of questions in a little more detail.

Developing climate models is important to understand observations of climate indicators. Because climate is extremely complex, this is a demanding task. How do you handle that? First of all, you naturally use the relevant known and well-tested physics, such as the theory of radiation transport in the atmosphere. Then there is physics involved that is less well known, and for which there are no explicit formulas, but which is nevertheless important. You take these kinds of effects into account by parameterization and by tuning the parameters in the model.

You do not know the value of those parameters to start with, but by adjusting the parameters in such a way that the agreement of the model results with the observations at any point on the timeline is perfect, you fool yourself into thinking that you are on the right track. When choosing sufficient parameters in a model, you can always bring model results and observations more or less close together with the mathematical tuning process, but the scientific value of this tampering is at least dubious. Once the parameters have been determined, the model then follows its own course over time, and differences between model results and observations begin to develop. Finally, it should be noted that there may also be unknown physics at play that we cannot include in a climate model. After all, we don't know what we don't know!

Parameterization is part of validating models, but it is an exercise that is full of pitfalls. The brilliant Hungarian-American physicist John von Neumann (1903-1957) [14] had the following to say about this in a comment: *"With 4 parameters I can fit an elephant, and with 5 I can make it move its trunk"*, to indicate that an excess of parameters quickly leads to arbitrariness. The ever-growing differences between climate predictions and observations over time are therefore extremely worrying. Moreover, climate models are parameterized in very different ways, depending on which aspect of the climate problem is being studied. This leads to a cloud of curves, each following its own course in time. People often refer to an average of all these model results, see the red curve in Figure 10. Unfortunately, it is not clear that the average of inadequate models should lead to adequate predictions. In short, what is the scientific value of that red curve?

We can conclude that the currently available climate models are unsuitable to reproduce all reliable available observations, and therefore certainly unsuitable to base climate policy on. The series of predictions by climate models that never came true is long. This has meant that people no longer talk about predictions for which you can be held accountable, but about scenarios. Of course, these are also future expectations, but the story is that it is only about possible future perspectives that may or may not turn out to be correct. Due to the failure of models to perform, the jargon has clearly become more cautious, but the discrepancies between the results of climate models and observations have remained as large as ever. The climate models are certainly not suitable for policy making (*not fit for purpose*).

Normally you would expect that as time goes on, science advances and models become more accurate and realistic. This is not the case in the climate world. The CO_2 story is comparable to that of 30 years ago. The IPCC's most recent report, AR6, is unfortunately much more an outgrowth of alarmist climate politics than of serious science, to the extent that several early climate alarmists have expressed their concerns about it. When politics and science compete for priority, science is inevitably the loser. The scientific content of AR6 has now been scathingly criticized [15].

The physics of radiation transport in the atmosphere indicates that the warming caused by CO_2 and other greenhouse gases is in fact correct (see Figure 4) and not alarmingly large (see Figure 10). Moreover, it is very questionable whether the human contribution through the combustion of fossil fuels dominates over the natural variations that have been important for 4.5 billion years. To exaggerate the relatively minor influence of greenhouse gases, climate models postulate feedback between CO_2 and the most important greenhouse gas H_2O, water vapor. Since there is no physics that prescribes such a coupling, this postulated effect is taken into account via parameterization. Curiously enough, this parameterization leads to positive feedback, which means that the warming effects of CO_2 and H_2O reinforce each other by a factor of 3. Although this is an attractive result from the alarmist perspective, it does not follow from the history of the Earth's climate. It also does not fit with Le Chatelier's Law, which states that a physical system strives to return to equilibrium when disturbed. A positive coupling is at odds with this principle. There is therefore a fierce debate about how physically realistic this coupling is, and how great the climate sensitivity (*climate sensitivity* [16,17]) really is. In measurement and control technology, a lot of positive feedback quickly leads to oscillations [17], and that is the origin of all kinds of irreversible tipping points that are made public by climate alarmists with the help of their over-parameterized models, but which have not yet been revealed by observations. In short, an open debate is also desperately needed on this subject.

That CO_2 alone would be the thermostat knob with which the extremely complex climate system can be regulated, is scientifically highly unlikely. For convenience, with this assumption all other influences on the climate are denied or written off as unimportant. Nevertheless, there is an important trend in science that believes that changes in solar activity over time are indeed important. The work of the Serbian geophysicist and astronomer Milanković (1879-1958) is illustrative when we talk about the longer term. Milanković parameters are astronomical quantities that cause cyclic variations, such as the ellipticity of the Earth's orbit, the obliquity, which is the angle of inclination of the Earth's axis with respect to the plane of the ecliptic, and the precessional motion of the Earth's axis. They influence the Earth's climate changes over thousands of years, in the rhythm with which ice ages and interglacials alternate. This is because they determine the intensity and distribution of sunlight on Earth.

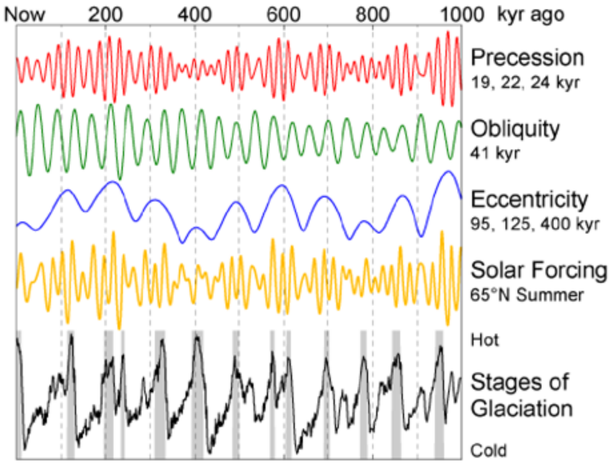


Figure 11: Overview of the behavior of Milanković parameters [18]

In the media, but also in climatology, a lot of attention is regularly paid to all kinds of measurements that would represent unique records and that would be a signature of disastrous global warming. These attribution attempts have a questionable statistical basis. If the influence of the Sun and the changes in the influence of the Sun on the Earth's climate are indeed significant, as argued by Milanković, and different cycles with very different and often long periods play a role, it is obvious that maxima and minima in these cycles lead to more climate records. Reliable satellite temperature measurements have only been available since 1979, and in terms of the Milanković cycles that is only a very short time span. It is therefore obvious that if we continue to measure long enough, new records will occur that are caused by effects totally different from those of greenhouse gases [19].

Part II: Energy

Energy is a basic necessity of life and the basis of any form of progress. It is of the utmost importance that energy is available when it is needed. Large-scale energy generation must also be reliable, safe and affordable. Man started generating energy from the moment he learned the importance of fire. Fire turned out to be important for heating, but also for preparing food from plant and animal sources. Fire played an important role in the transition from nomadic hunter-gatherers to communities that settled in a suitable place and sustained themselves through agriculture and livestock farming.

As populations grew, energy needs increased. Initially, the energy needed for farming was provided by the use of animals. By utilizing fire, metals could be obtained and converted into useful utensils. The need for wood as fuel increased noticeably. As science and technology advanced, energy needs only increased. The invention of the steam engine made corporate production possible, with another enormous increase in energy use. It is no coincidence that the industrial revolution was accompanied by large-scale deforestation, especially in Europe. Fortunately, energy generation through wood burning was eventually replaced by the use of fossil fuels (coal, oil and gas), with large-scale positive consequences for humanity. The fact that we would return to large-scale wood burning in the 21st century is a huge administrative blunder.

The benefits that humanity has derived from the large-scale availability of fossil fuels can hardly be overestimated. There is actually no element in a modern society that is not dependent on demand-driven energy. This includes mobility, science, technology, medical progress, healthcare, education, food supply, agriculture, construction technology, all developments that have contributed greatly to the enormously increased life expectancy of humanity and the ability to enjoy life with a certain degree of comfort. Fossil power stations have become a technological achievement

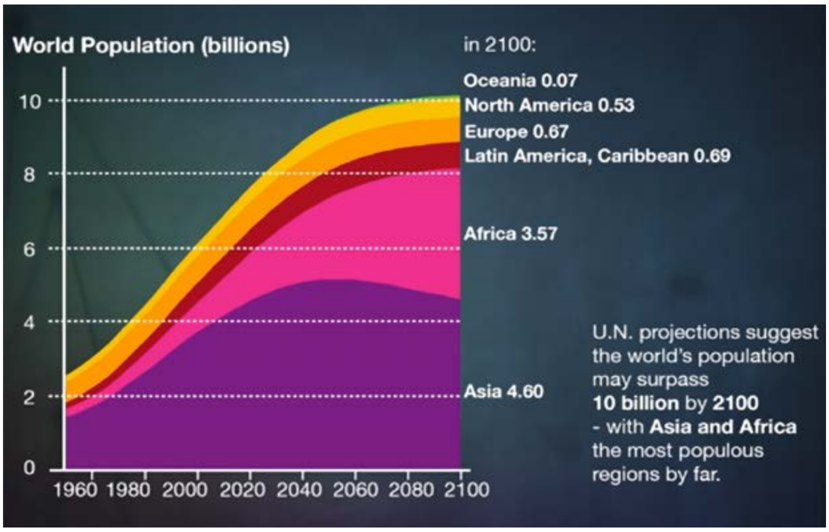
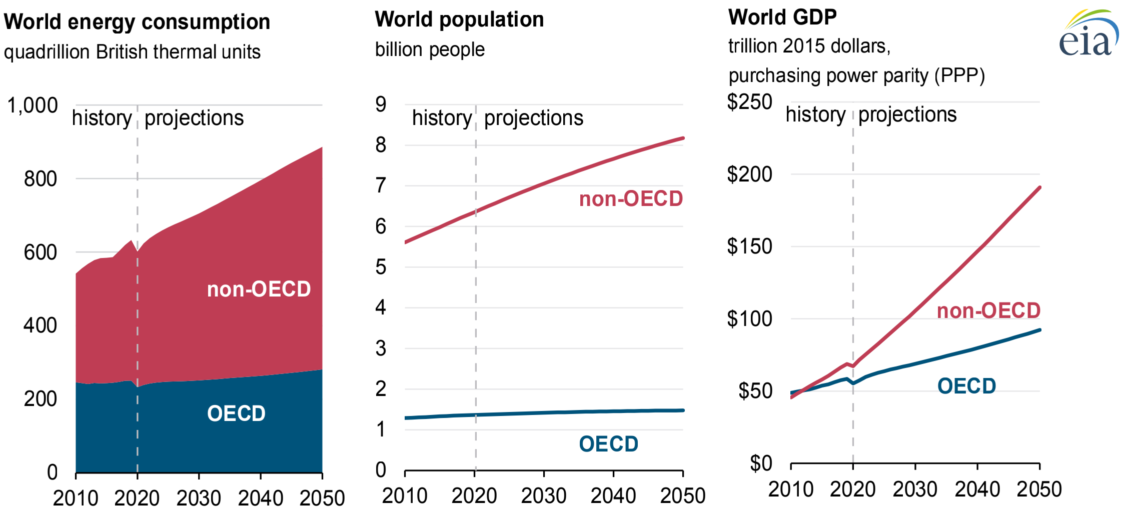


Figure 12: United Nations forecast of world population growth to 2100.

of the highest quality and their reliability is proverbial. And all that at very acceptable costs. But can the current level of safe, reliable and affordable energy supply also be maintained in the future? That certainly is not obvious.

Because a safe, reliable and affordable energy supply is crucial for prosperity and well-being for a world population that is (currently) growing at 1.1% per year, it is advisable to look ahead based on available forecasts. We then see that the world population will grow from approximately eight billion to ten billion earthlings between now and 2100. Most of that growth will take place in Asia and Africa. The European share of the world population will continue to decline. Figure 12 gives a good idea of what awaits us in a demographic sense.

The growth of the world population will immediately translate into a corresponding increase in energy consumption. The growing number of world inhabitants is of course relevant to this, but moreover, they will not be satisfied with the limited amount of energy per capita that previous generations had available. The energy requirement will therefore increase faster than linearly. Moreover, this growing need will mainly take place in non-OECD countries, see Figure 13. It goes without saying that meeting this enormously growing energy need is certainly no easy task.



Source: U.S. Energy Information Administration, *International Energy Outlook 2021* (IEO2021) Reference case

Figure 13: EIA forecast for world energy use until 2050. The expected increase between now and 2050 is in the order of 40%!

What are the options we have on a global scale to meet this gigantic energy need in the future? Currently, the need is mainly covered by the use of fossil fuels (approximately 80%). It appears that their supplies are not unlimited. Although there is coal for the next 1000 years, the estimated reserves of oil and gas are currently in the order of 50-200 years. This means that, although there is no dramatic rush, a lot has to be done in the long term. What realistic strategy can we develop for this?

Let's start by looking at how we generate our energy now, and what the expectations are until 2050 (see Figure 14). The picture is clear. Even in 2050, fossil fuels will still account for the lion's share of the world's energy supply and will therefore remain indispensable for the time being. Those who shout loudly that we must immediately stop using fossil fuels have no idea what they are talking about. Pension funds that have sold shares in the oil and gas industry for ideological reasons should be deeply ashamed. The supply-driven *renewables* (wind and solar) so promoted by the West are completely unsuitable for being connected to the power grid. Even more wind turbines and solar panels are a recipe for chaos in the energy supply. But what must be done in the field of energy supply to safeguard the future global economy and world food supply? The current refusal to think and debate this rationally is inexcusable.

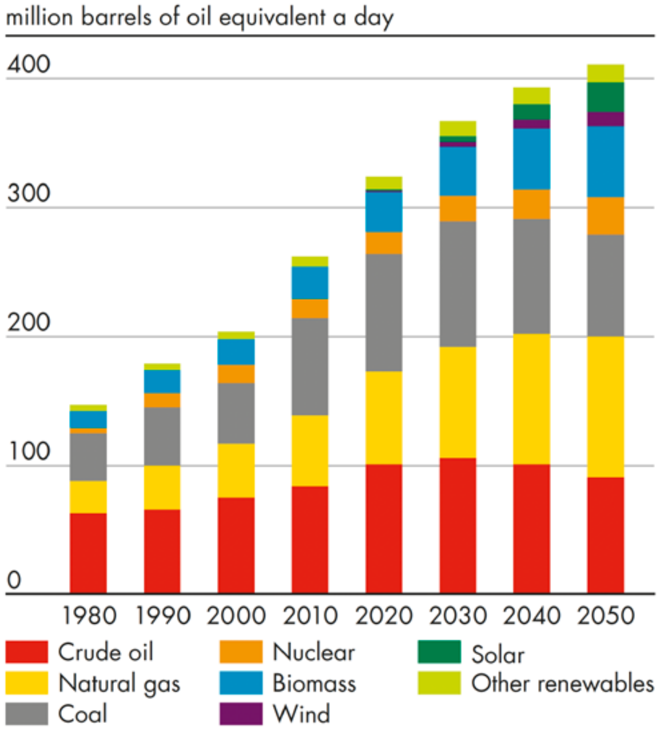


Figure 14: Estimation of future world energy consumption and which sources will be used to meet energy needs. Unsurprisingly, the contribution of fossil fuels remains dominant, existing and planned renewables will not be able to even keep up with the growth in our energy needs. Real energy experts have been warning about this for decades.

A rational approach is desperately needed to make a well-considered assessment of the problem of our future energy supply. To start, it is useful to see how this is handled in most of the world. For Asia, where most of the world's population lives, the case is clear. Their top priority is to provide their growing populations with reliable energy at an affordable cost. That is why people are investing in fossil fuels on a large scale and making no bones about it. Their main goal is to provide their people with a future of prosperity and well-being, not to mention adequate food production. Attempts by the West to force entire continents under the political yoke by denying them the use of fossil fuels and fossil-based fertilizers are a form of climate colonialism that most of the world's population does not want. They do understand that fossil fuels and fossil-based fertilizers [20,21] will be indispensable for many decades to come (see Figure 15):

With any method of energy generation, it is important to first ensure that the resources you have to invest to actually generate energy are not greater than the final yield. In this context the concept of Energy Return on Energy Investment (EROI) is leading [22]. It goes without saying that ultimately a method of energy generation that requires relatively little investment and yields relatively high returns in physical and economic terms puts the user in a better competitive position. The data on EROI leaves little room for doubt. Supply-driven energy (solar, wind) has a poor EROI, especially if there is no storage for backup. Demand-driven energy generation does not require backup and systematically performs many times better. This should not be surprising, because many activities that are crucial for a modern society depend on energy being available when you demand it. Waiting for the sun to peek out from behind a cloud and for the wind to blow sufficiently is not a pleasant prospect for a surgeon in the middle of a complicated operation, much less for the patient on the operating table. And if there is an excess of wind and/or sun, the power grid cannot cope with the supply and the energy supplied has a negative price.

Figure 16 provides an overview of the EROIs of the available energy generation methods. 'Green' energy sources are doing quite poorly, fossil fuels are doing very well and hydropower is even better. Unfortunately, due to the lack of Dutch Alps, hydropower is not a realistic option here. Nuclear

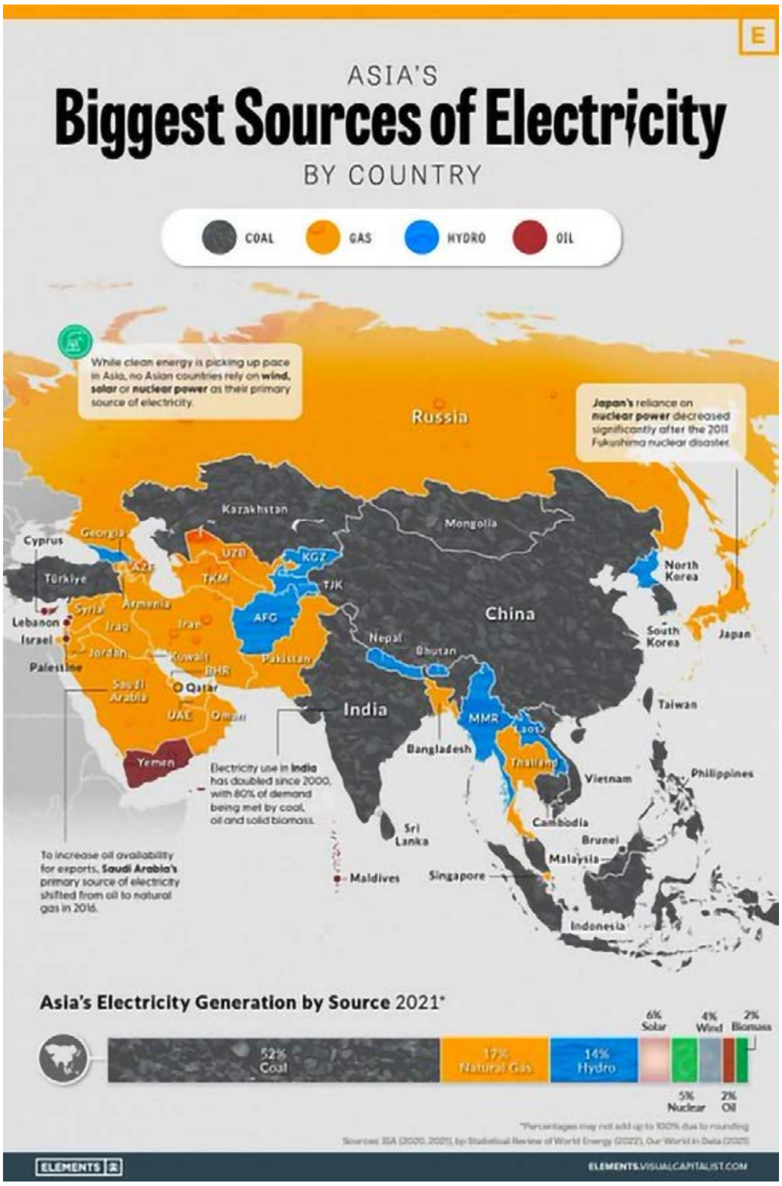


Figure 15: The way in which a large part of the Asian continent provides its current and future energy supply is mainly through the large-scale use of fossil fuels. That is the only rational choice if the goal is to eradicate poverty.

energy is head and shoulders above all other available generation methods! The question therefore arises why we do not invest in nuclear energy on a large scale.

In the Netherlands, nuclear energy has been a trauma and a taboo for years. Since the large-scale demonstrations of the Peace Movement against the stationing of nuclear weapons in the Netherlands around 1981, everything containing the word *nuclear* was suspect. When Nuclear Magnetic Imaging was introduced as an important imaging technique in medicine, the word *nuclear* was so daunting that it was decided to completely avoid the word *nuclear* and speak of Magnetic Resonance Imaging (MRI). The fear of anything in any way associated with *nuclear* was very deep. In fact, this senseless association with nuclear weapons is still prevalent in the Netherlands, although there is a gradual change. In countries such as China and India, without the history that we have experienced, people are able to appreciate the great benefits of nuclear energy, partly in view of the high EROI, and there is hardly the political resistance that we encounter in the Netherlands. Let us consider in a little more detail the importance of nuclear energy, which is inevitable for the large-scale world energy supply of the future.

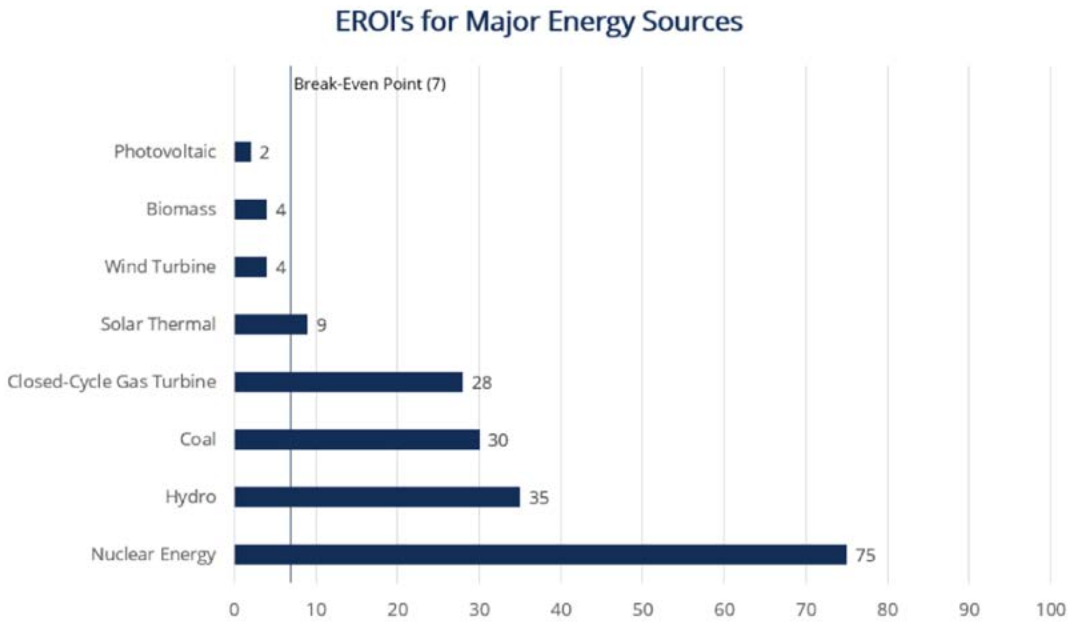


Figure 16: Energy Return On energy Investment (EROI) for different methods of energy generation [22]. The superior performance of nuclear energy is striking.

Nuclear energy can be obtained from the fission of heavy nuclei such as uranium and thorium, or from the fusion of light nuclei. Nuclear fission based on the uranium cycle was developed in the Manhattan Project, which ultimately led to the atomic bombs on Hiroshima and Nagasaki, and thus to the end of the Second World War. Nuclear fusion is extremely complicated from a technological point of view. There is a large international research project in Cadarache, southern France, but as yet there is no prospect of large-scale applications. Nuclear energy from the nuclear fission of uranium was developed for civilian applications and has more than proven its enormous value as a reliable energy source. We will briefly discuss the uranium cycle.

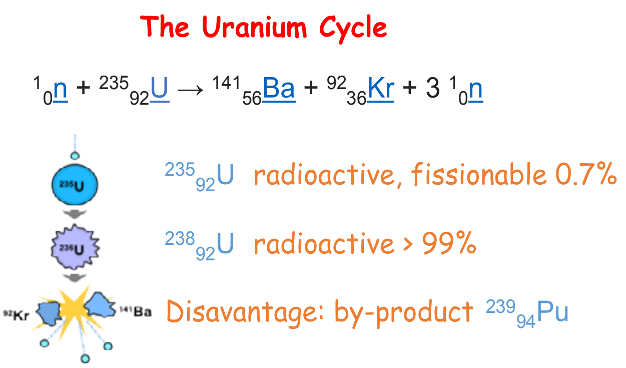


Figure 17: The Uranium Cycle. Looking at the notation, at $^{235}_{92}U$ the subscript 92 gives the number of protons in the nucleus that determines the position of uranium (U) in the periodic table, and the superscript 235 is the sum of the number of protons and neutrons in the nucleus. For example, $^{1}_{0}n$ represents a single neutron.

Uranium has several isotopes, of which $^{238}_{92}U$ is the most common (>99%). That isotope is radioactive, but not fissionable. The isotope $^{235}_{92}U$ is both radioactive and fissile, so it is suitable as an energy source and only 0.7% occurs naturally. To this end, natural uranium must be enriched, removing part of the $^{238}_{92}U$ and leaving a mixture with a high $^{235}_{92}U$ content. Through neutron bombardment, $^{235}_{92}U$ splits into two lighter nuclei plus several neutrons, which can maintain a chain reaction and release an enormous amount of energy. A drawback is that the remaining $^{238}_{92}U$ in the mixture can also absorb a neutron, forming plutonium, $^{239}_{94}Pu$. This isotope is radioactive with a long half-life of 24 thousand years. This creates a storage problem. This waste problem must be taken seriously. In the long term, the availability of uranium may also become a limitation.

To overcome the disadvantages of the uranium cycle, the thorium cycle came into the picture. This concerns the radioactive, non-fissionable thorium isotope $^{232}_{90}Th$, which occurs for almost 100% in natural thorium. Thorium is waste from the extraction of various rare metals and is therefore cheap. When $^{232}_{90}Th$ is subjected to a neutron bombardment, the short-lived proactinium is first produced. $^{233}_{91}Pa$ is formed, which quickly decays to the radioactive and fissionable $^{233}_{92}U$. This uranium isotope then provides nuclear energy through nuclear fission. Because many steps of neutron absorption are required to form $^{239}_{94}Pu$, the probability of producing this somewhat problematic isotope in the thorium cycle decreases by two orders of magnitude.

Because safety is always an important point of concern in all methods of large-scale energy generation, a lot of research has also been focused on this issue in the civil implementation of nuclear energy. Around 1970, prof. Alvin Weinberg [23] on Oak Ridge National Laboratory (Oak Ridge, Tennessee, USA) developed a reactor concept in which the nuclear fuel was dissolved in a reaction vessel filled with molten salts at a temperature of approximately 700 °C. If the temperature for whatever reason gets out of hand, a salt plug at the bottom of the reaction vessel, causing the reactor vessel to be emptied into a container located below it. This principle was experimentally tested in a year-long experiment in the 1970s and found to be successful.

In summary, the thorium cycle in combination with the MSR principle offers many advantages, see Figure 18.

The advantages of nuclear energy based on the thorium cycle

1. A Molten Salt Reactor (MSR) is inherently safe in principle
2. Thorium is a waste product of the extraction of raw materials, abundantly available and cheap
3. Almost 100% of all thorium is the thorium isotope that is needed and thus usable
4. Reactor operates at low pressure
5. Proof of principle is available (Oak Ridge National Laboratory, Oak Ridge, Tennessee, USA, 1970)
6. A thorium reactor can be build fast: China 2019-2023
7. Waste problem (plutonium) is two orders of magnitude smaller than with uranium
8. Waste from the uranium cycle can be used as a neutron source in the thorium cycle
9. Small MSR reactors are an excellent option for many applications
10. Costs in The Netherlands are, for 2/3, an invention by politicians and bureaucrats, without a rational basis

Figure 18: The advantages of nuclear energy based on the thorium cycle

Opponents of nuclear energy always talk insistently about the dangers of nuclear fission. Three Mile Island (Harrisburg, Pennsylvania, 1979), Chernobyl (Ukraine, 1986) and Fukushima (Japan, 2011) are always brought up. A meltdown was impending in Harrisburg, but the safety measures proved sufficient. There were no casualties at the Harrisburg reactor. Chernobyl involved a very outdated power plant with inadequate management. The resulting meltdown claimed approximately 40 direct radiation casualties. The radiation level has now fallen back to normal background radiation levels. An extremely powerful seaquake followed by a devastating tsunami occurred in Fukushima. A meltdown took place in a number of nuclear power stations on the coast. The devastation caused by the tsunami forced the evacuation of 100,000 people. No one died from radioactive radiation! Modern nuclear power plants, especially those of the Molten Salt Reactor (MSR) type, are inherently safe. For more details about thorium nuclear energy, we refer to the website of the Thorium MSR Foundation [24]. The large-scale use of nuclear fission to provide the world with safe, reliable and affordable energy in the future is inevitable, partly due to the lack of credible realistic alternatives.

The fact that nuclear energy is unavoidable in the long term for an adequate world energy supply and that we had better start doing so quickly, is a rational statement. In line with this, it is advisable to think about what is the best implementation in the Netherlands. In principle, we can choose between a small number of large reactors that will provide a significant part of the energy supply in our country, or opt for a larger number of modular reactors that will meet more local needs. A mix of both types of reactors is of course also an option. Naturally, a rational discussion about the possible options is urgently needed. There is no decisive reason not to first focus on a number of reactors based on the uranium cycle. Such reactors have been proven to be safe, immediately available and can be built and deployed at short notice. In addition, given the expected benefits, it is advisable to focus on the further development and implementation of thorium reactors. The development of artificial intelligence (AI) requires huge data centers with enormous energy requirements. The tech companies that build such data centers rightly have no confidence in the uncertainties of supply-driven wind and solar energy. Due to security of supply, they are increasingly opting to install smaller modular nuclear reactors. Small reactors must also be part of the energy policy for the Netherlands.

The message is clear. The future world energy needs will certainly not be met by supply-driven energy sources such as wind and sun. The low EROI (Figure 16) and the inability to store sufficient electrical energy pose insurmountable problems. Stop it! Wind and solar will only play a role in niche applications. We cannot survive without fossil fuels in the coming decades, but this should not lead to hasty panic. In the coming decades there will be plenty of time and opportunity to gradually transition to a future energy supply based on nuclear energy. It is therefore advisable to replace the illusory and unaffordable investments in supply-driven energy as quickly as possible by focusing on safe, sustainable and affordable nuclear energy. Apart from an outdated ideology and incompetent politics, there is in principle nothing that stands in our way.

Conclusion

In this article we indicate that there is climate change, but there is no climate crisis. Dubious scientific climate models have led to the prediction of a catastrophe, those predictions have led to climate fear among the population, that climate fear has led to a net zero CO_2 climate policy, and that climate policy has led to a nonsensical energy policy. That emotional chain must be eradicated root and branch.

The climate discussion is currently no longer about climate, but about CO_2 targets and the banning of fossil fuels. The result is that we spend billions on measures that only make matters worse. Getting rid of gas is an irresponsible policy. Filling the production wells in Groningen with cement and buying expensive LNG from the US…. the politicians responsible should be deeply ashamed. In the meantime, the burden on citizens continues to increase, but they get nothing in return. On the contrary, our country is going in completely the wrong direction. A scientific analysis, such as in this article, emphasizes the complete inadequacy of what current politics is doing in its ideological, anti-scientific climate and energy schemes. In the interest of the future of the Netherlands, it is urgent to thoroughly overhaul the current climate and energy policy, to abandon the illusion of *renewables* for our large-scale future energy supply, and to urgently invest in nuclear energy.

We recently published two contributions in Dutch [25,26] and English [27,28] on the non-existent climate crisis, and on what is urgently needed politically to reverse the decline of the Netherlands. These columns are mainly aimed at a readership of non-experts. In the current contribution we provide the necessary physical substantiation for the more initiated. We hope that this will stimulate a scientific discussion that will once again give natural science the place that is indispensable for a rational assessment of the current problem. Experience shows that this cannot be expected from inexpert politicians.

Postscript

The scientific arguments we put forward in the current article are largely known among experts, but an open discussion about them is made impossible [1]. In this context we mention *Climate: The Movie* by Tom Nelson [29], in which a lot of information is given that there is little evidence of a climate crisis. The scientific underpinnings of the considerations put forward in the film have been summarized by Andy May [30]. While images often say more than words, a recent video by David Siegel is also worth watching [31]. We also draw attention to four documentaries that were made by a professional Flemish team from the Belgian Tegenwind.tv in October 2022 by interviewer Alain Grootaers and director Mark Sanders with Kees de Lange in the pleasant ambiance of Andalusia in Spain [32, 33, 34, 35].

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[34] Kees de Lange, Premiere of "Will the sun catch enough wind?", 3rd episode of "The unraveling of dogmas" (tegenwind.tv)

[35] Kees de Lange, Last episode of "The unraveling of dogmas" with Prof. Dr. Kees de Lange premiere (tegenwind.tv)

Curriculum Vitae Prof. Dr. CA (Kees) de Lange

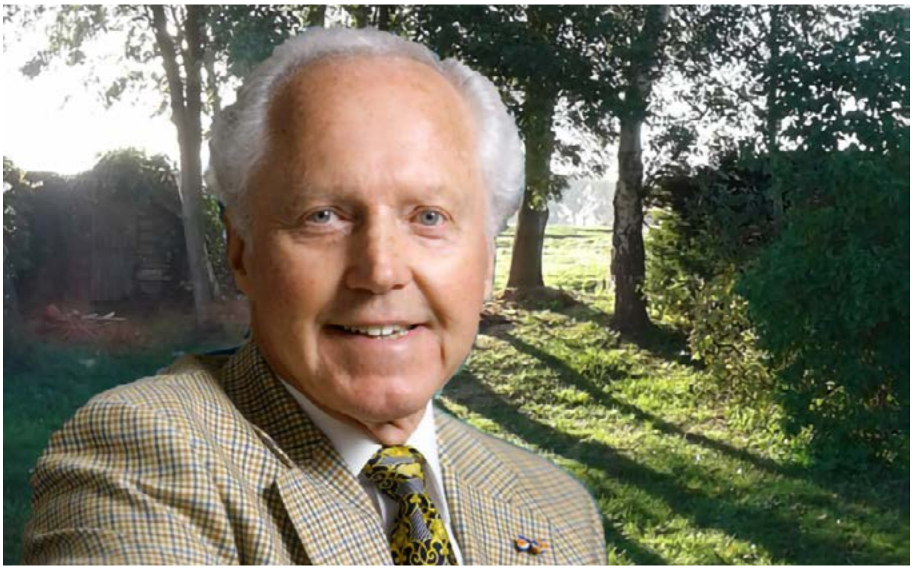
Kees de Lange (1943) studied mathematics, physics, astronomy and electronics (cum laude) at the University of Amsterdam and obtained his PhD in theoretical chemistry in Bristol, England. He is emeritus professor of atomic, molecular and laser physics, with specializations in atmospheric chemistry and physics, magnetic resonance and complex modeling, at both the Vrije Universiteit and the University of Amsterdam. He is currently a member of the American think tank ''The CO_2 Coalition'' and is currently working with North American colleagues on fundamental physics problems in the environment, climate and energy. He was a Member of Parliament in the Province of North Holland for 50Plus, and was a member of the Senate (2011-2015), initially for the OSF, but later as an independent Senator under the name Fractie De Lange. During his career, De Lange has been active in several areas. For example, he has been chairman of the Association for Academics in Scientific Education (VAWO) and of the Central Works Council (COR) of the University of Amsterdam. He was also chairman of the Dutch Association for Pension Interests (NBP) and of the Scientific Bureau of 50Plus.

My motto: *The selling out of democratic values and the giving away of control over our own future by Dutch politics must be reversed*

PUBLICATIONS:

- "Nuclear magnetic resonance in oriented molecules" (dissertation, 1969, University of Bristol, UK, supervisor Prof. dr. AD Buckingham)
- Various columns on Follow The Money, De Dagelijkse Standaard, Jalta, Climategate, Opiniez.com, Indepen, Tegenwind.tv
- More than 200 publications in the field of chemistry and physics.
- Website www.cadelange.nl

Curriculum Vitae Prof. Dr. ir. AJ (Guus) Berkhout



After a scientific career in the geoenergy sector, Professor Guus Berkhout held a chair in geophysical and acoustic imaging at TU Delft from 1976 to 2008. From 1998 to 2001 he was a member of the university board, responsible for scientific research and intellectual property. In recent decades he advised the Dutch government on noise problems around Schiphol Airport. In 2019, he founded the Climate Intelligence Foundation (Clintel) together with science journalist Marcel Crok.

Guus Berkhout has written hundreds of peer-reviewed scientific articles on geophysical imaging of the Earth's upper lithosphere. He is also the author of the trilogy "The Future of the Netherlands".

Dr. Berkhout received many scientific awards during his career. He is a member of the Royal Netherlands Academy of Arts and Sciences (KNAW), senior member of the Dutch Academy of Engineering (AcTI), honorary member of the American Society of Exploration Geophysicists (SEG) and honorary member of the European Association of Geoscientists and Engineers (EAEG).

He is an Officer in the Order of Oranje-Nassau.

Prof. Berkhout's motto: *"We can never achieve a big step forward if we stay within the same concept".*

For more information, see www.aj-berkhout.com clintel.org